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Natural factors as prophylactics of major dental diseases in children

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Abstract

Introduction. In Ukraine, the prevalence of dental caries in children 12 years old reaches 72.7% -91.4%, in children 15 years old - 81.3% -94.3%, while the intensity of caries in children of these age groups ranges from $2, 23 \pm 0.21$ to 3.71 ± 0.37 and from 3.91 ± 0.39 to 6.18 ± 1.01 , respectively. For the physiological formation of dental hard tissues in children, a sufficient level of calcium intake and assimilation with the participation of vitamin D is of great importance. Children for many reasons need to correct calcium metabolic disorders by using combined calcium and vitamin D preparations and a balanced diet, including foods and drinks, enriched with calcium. **Materials and methods.** Clinical studies were conducted involving 138 children 7-11 years old. To assess the extent of tooth decay, caries was determined by its prevalence, intensity, growth rate of caries, reduction of the growth rate of caries, a biochemical analysis of oral fluid was performed to determine the content of calcium, phosphorus, acid phosphatase, alkaline phosphatase. Children of the main treatment subgroup were offered the proposed Treatment and Preventive Complex, which included correction of eating behavior and drinking regimen (consumption of naturally-table low-mineralized waters without gas with Ca^{2+} content from 50 to 200 mg / l). **Results.** When using Treatment and Preventive Complex in children, a low increase in the intensity of decay of permanent teeth, an increase in the level of Ca, a decrease in the activity of acid phosphatase and alkaline phosphatase in the oral fluid were determined in comparison with the control group. **Conclusions.** Thus, the use of mineral water with a Ca^{2+} content of 50 to 200 mg / l, as a source of natural Ca intake, can be recommended as an aid to the comprehensive prevention of caries in schoolchildren.

Key words: school-age children, dental caries, oral fluid, treatment-and-prophylactic complex, mineral waters,

Introduction

Almost 100% of the adult population of the planet and 60% -90% of school-age children suffer from caries (1). In Ukraine, depending on the region of residence, the prevalence of dental caries in children 12 years old reaches 72.7% -91.4%, in children 15 years old - 81.3% -94.3%, while the intensity of caries in children of these age groups ranges from 2.23 ± 0.21 to 3.71 ± 0.37 and from 3.91 ± 0.39 to 6.18 ± 1.01 , respectively (2, 3, 4). An important factor in the pathogenesis of caries is the resistance of dental hard tissues to the effects of organic acids, which are the product of the vital activity of cariogenic microorganisms. The resistance of hard tissues is due to the structure of the enamel and dentin of the teeth, as well as their level of mineralization. The most intensive

processes of maturation and mineralization of hard tooth tissues occur in children (5, 6). For the physiological formation of dental hard tissue in children, a sufficient level of Ca intake and assimilation with the participation of vitamin D is of great importance. Unfortunately, most adolescents, for various reasons, are not provided with sufficient Ca - only 1 out of 10 girls and 1 out of 4 boys in the age of 11-15, they receive the necessary amount of Ca with food, that is, children are at high risk for Ca deficiency (7, 8, 9,10). Therefore, children in particular need to correct violations of calcium metabolism through the use of combined preparations of calcium and vitamin D and a balanced diet, including foods and drinks enriched with calcium (8).

However, the use of medications requires a balanced approach to determining the necessary doses, the duration of administration, taking into account the cumulation of vitamin D, the need for regular monitoring of Ca levels in urine and blood (8, 9,11). These provisions initiate the search for other sources of Ca, in particular, natural, providing the possibility of continuous safe use. Numerous studies have proven the role of drinking water as a source of minerals. With drinking water, a person can receive from 5 to 20% of the daily dose of Ca at a concentration of Ca in water at the level of 25-200 mg/l. (12). The revealed effect of the complex of macrocells (calcium, magnesium, strontium) and their ratio in drinking water on the prevalence of the pathology of the musculoskeletal system, the positive role of drinking water with high mineralization in the process of supporting bone mineral density and the concentration of calcium and magnesium in the blood, indicate the significance of this source of this element into the body (13, 14).

Interesting, from this point of view, it may be the use of natural table mineral waters (MW) with the high calcium content. Recently, in Ukraine, there has been a growing demand for the use of natural tableware MW, which has a certain chemical composition, which determines their effect on the organism. The biologically active components that make up the MW mutually reinforce (or suppress) each other, especially with prolonged intake, and cause a therapeutic effect, which manifests itself as the sum of many secondary indirect reactions (15). At the same time, the role of individual macronutrients of natural MW in their general use as prophylactic and therapeutic agents in dental diseases remains poorly understood, especially in conditions of their combined effect.

Our preliminary experimental studies showed that the daily use of natural canteen MW with a Ca^{2+} content of 50 to 200 mg / l (natural sources of which are located in Ukraine) when modeling experimental caries in monthly rats reduces the prevalence of caries by 20.0-30, 0%, and the intensity of the carious lesion is 1.5 times, and also normalizes calcium-phosphorus metabolism and activates the antioxidant defense system (16, 17).

The purpose of this study was to assess the possibility of using MW as an adjunct in the comprehensive prevention of dental caries in schoolchildren.

Material and methods. Clinical studies were conducted involving 138 children 7-11 years old. Depending on the activity of the carious process, the children were distributed as follows: group I - children with compensated caries - control group; group II - children with compensated caries - the main group; group III - children with subcompensated caries. Group I (n = 22) underwent oral hygiene (OH) and were given recommendations on food and drink regimen. In each of groups II (n = 60) and III (n = 56), control treatment subgroups (CTS) were created, which included 28 children, respectively, they underwent OH, caries treatment, provided food and drink recommendations, and the main treatment subgroups (MTS), in which there were 32 and 28 children, respectively, who underwent the proposed treatment and prophylactic complex (TPC). Patients were randomized using the blind method. TPC provided for the identification and correction of risk factors for dental caries; professional oral hygiene followed by hygienic training and individual selection of oral care products (Ca-based kinds of toothpaste or fluoride contents of 500-1000 ppm), treatment of dental caries and its complications (if necessary); preventive minimally invasive therapy of caries: professional activities (sealing fissures, deep fluoridation, the use of professional gels and varnishes with fluoride) and the appointment of drugs for home use - topical gels based on calcium and fluorine for a month; the use of a local probiotic containing *L. keuteri* (DSM 17938 and ATCC PTA 5289) correction of eating behavior (by recommending daily use of foods with the highest calcium content and avoiding tooth decay products); drinking regime (the use of natural table water of weakly mineralized water without gas with a Ca^{2+} content of 50 to 200 mg/l - "Berezovskaya" non-carbonated, "Aqua-vita", "Morshinskaya" non-carbonated, "Karpatskaya" spring non-carbonated, "Mirgorod" non-carbonated).

Clinical examination of children was carried out according to a standard scheme using generally accepted methods at the beginning of the study and after 12 months. Following the age of children and WHO recommendations, prevalence, intensity (the index of the intensity of carious lesions of permanent teeth + the index of the intensity of carious lesions of temporary teeth, ILPT+ ILTT), and an increase in the intensity of caries were determined to assess the degree of dental caries lesion (18,19). The reduction in caries growth was

determined by Sakharov E. B. (1984) (18). Children underwent biochemical analysis of oral fluid (OF) to determine the content of Ca, phosphorus (P), acid phosphatase (ACPH), alkaline phosphatase (ALPH). OF in children was collected for 7-10 minutes in the morning at rest in sterile disposable containers with a volume of 5-10 ml, which were transported to the laboratory in a thermal container with cooling elements for 3 hours. A biochemical study of OF was performed on a Labline-100 automated biochemical and enzyme immunoassay analyzer, WestMedika (Austria). The study of the concentration of total Ca in OF was carried out using a set of ready-made reagents Calcium-arsenazo, BioSystems (Spain), concentrations P were performed using the UV photometric method using a set of ready-made reagents Phosphorus liquirapid, Human (Germany), and ALPH activity was performed using a set of ready-made reagents Alkaline Phosphatase, Human (Germany), ACPH activity - by a set of ready-made reagents Acid Phosphatase, BioSystems (Spain) (20).

The studies were carried out in compliance with the principles of bioethics and the rights of the patient in accordance with the Helsinki Declaration (2000.) and the Fundamentals of Ukrainian legislation on health care (1992). The materials were examined by the bioethics commission of the NMAPE named after P.L. Shupik (Minutes of the meeting of the commission on ethics No. 11 of 11/19/2018).

Statistical analysis of the data included the calculation of mean values, standard deviation, and mean error. To assess the significance of differences between samples subjected to the normal distribution law, Student t-test (p) was used. Statistical calculations were performed in the SPSS 17.0 software environment (IBM SPSS Statistics 17 Free PC Software FullVersion, USA) and MS Excel 2010 (license number K9366093I 2016).

Results

At the beginning of the study, the prevalence of dental caries in children of group I was 59.1% with an intensity (ILPT+ ILTT) of 1.84 ± 0.19 . In children from CTS of the II group, the prevalence of caries was determined at the level of 96.4% according to its intensity of 3.14 ± 0.24 ; in children from MMS in this group the corresponding indicators were 93.8% and 2.93 ± 0.26 . The indicators of tooth caries intensity in children from CTS and MMS of group II significantly ($p < 0.05$) differ from such children of group I, while there is

no significant ($p > 0.05$) difference between the indicators of children from CTS and MMS. A more detailed analysis showed that the intensity of caries in the first permanent molars in children of these groups was at the same level: group I - 0.45 ± 0.18 ; II CTS group - 0.54 ± 0.16 , II MMS - 0.62 ± 0.19 . The intensity of damage to temporary teeth (ILTT) - 1.38 ± 0.29 , 2.57 ± 0.34 and 2.24 ± 0.34 , respectively, indicates a more specific weight in these children is the intensity of caries of temporary teeth. At 100% prevalence of dental caries in children of group III, the index of intensity of dental caries (ILPT+ ILTT) in children with CTS and MMS was 6.79 ± 0.26 and 6.64 ± 0.39 , respectively. With such a high degree of tooth damage in children of both subgroups of the III group, in contrast to children of the II group, the intensity of caries of temporary teeth (ILTT) is more than 2 times, the intensity of damage to the first permanent molars is almost 3 times (Table 1).

Table 1. Caries intensity in children 7-11 years before treatment

Indexes Groups	ILPT± ILTT	ILTT	ILPT	ILPTthe first permanent molars
I, n=22	1.84 ± 0.19	1.38 ± 0.29	0.46 ± 0.18	0.45 ± 0.18
II CTS, n=28	3.14 ± 0.24	2.57 ± 0.31	0.57 ± 0.17	0.54 ± 0.16
II MMS, n=32	2.93 ± 0.26	2.24 ± 0.34	0.68 ± 0.20	0.62 ± 0.19
III CTS, n=28	6.79 ± 0.26	5.00 ± 0.39	1.79 ± 0.35	1.57 ± 0.21
III MMS, n=28	6.64 ± 0.39	5.18 ± 0.48	1.46 ± 0.34	1.32 ± 0.30

After 12 months, the intensity of decay of permanent teeth (ILPT) in children of the MMS group II, where the proposed TPC was applied, increased only from 0.68 ± 0.20 to 0.86 ± 0.27 , in children of group I this indicator increased from 0.46 ± 0.18 to almost the same level - 0.81 ± 0.24 . In contrast, children with CTS of group II - from 0.57 ± 0.17 to 1.12 ± 0.24 , that is, 2 times ($p < 0.05$). Thus, in children of MMS of the group II, a low increase in the intensity of caries of permanent teeth was determined - 0.18, in contrast to children of Group I and CTS of the group II, in which they found an average level of increase in the intensity of caries, the indices of which were 0.35 and 0, respectively, 55. The reduction of caries in the MMS of the group II in relation to the CTS was 67.3%, to I control group - 48.6%. A positive effect of the proposed TPC was observed in children with acute respiratory infections of the III group, in which dental caries were determined at a high level. The intensity of caries of permanent teeth in children from CTS after 12 months was 2.36 ± 0.22 ,

which was significantly ($p < 0.05$) more than in children of MMS, 1.65 ± 0.23 . The increase in caries of permanent teeth in children with CTS was 0.57, while at the same time as in children with MMS it was three times less - 0.19. The reduction of caries in MMS to CTS was 66.7%, to AI - 45.7% (Table 2).

Table 2. The intensity of caries in children 7-11 years after 12 months after treatment

Indexes Groups	ILPT± ILTT	ILTT	ILPT	ILPTthe first permanent molars	Caries increase
I, n=22	2,38±0,36	1,56±0,43	0,81±0,24	0,81±0,24	0,35
II CTS, n=28	3,54±0,39*	2,42±0,36	1,12±0,24	1,12±0,24	0,55
II MMS, n=32	2,64±0,26	1,78±0,37	0,86±0,27	0,78±0,27	0,18
III CTS, n=28	6,00±0,31*	3,64±0,54	2,36±0,22*	2,08±0,19*	0,57
III MMS, n=28	4,94±0,42	3,29±0,51	1,65±0,23	1,39±0,27	0,19

Note. 1. * - $p < 0,05$ - significance of differences between children CTS and MMS after 12 months.

The occurrence and development of dental caries in children are accompanied by certain changes in the composition and biochemical properties of the oral fluid. Oral fluid can serve as an alternative diagnostic fluid compared to blood. In turn, by determining changes in the biochemical parameters of the oral fluid, it is possible to assess the condition of the organs and tissues of the oral cavity, as well as assess the impact of the developed treatment and prophylactic methods and approaches. Researchers pay special attention to determining the content of Ca and P, which provides the mineralizing properties of the oral fluid, namely, the formation and maintenance of the mineral composition of tooth tissues, and, above all, enamel (21, 22, 23, 24). The calcium content in the oral fluid in a certain way is affected by the state of phosphorus-calcium metabolism in the child's body, which is due to a sufficient level of Ca intake and assimilation (7).

A biochemical study showed a low initial Ca content in the PP of children of all groups, the P content was fixed within the normal range, which indicates an insufficient mineralizing potential of the oral fluid. 12 months after the use of TPC, we determined an increase in the Ca content in the OF of children of all subgroups and an unreliable ($p > 0.05$) decrease in the content of P. But, unlike group I and CTS of groups II and III, a significant ($p < 0.05$) an increase in the Ca content in OF (0.98

± 0.03 mmol/l and 1.11 ± 0.15 mmol/l, respectively) after application of the TPC, and these indicators are also significant ($p < 0.05$) differed from the CTS indices (0.69 ± 0.08 mmol/l and 0.76 ± 0.06 mmol/l) (Table 3).

Table 3. The content of calcium and phosphorus in the oral fluid of children 7-11 years before treatment and after 12 months

Groups Indicators	I	II		III	
		CTS	MMS	CTS	MMS
Ca, mmol / l before TPS	0,68±0,04	0,59±0,03	0,66±0,10	0,64±0,17	0,36±0,07
Ca, mmol / l after TPS	0,73±0,15	0,69±0,08*	0,98±0,03	0,76±0,06*	1,11±0,15
P	$p > 0,05$	$p > 0,05$	$p < 0,05$	$p > 0,05$	$p < 0,05$
P, mmol / l before TPS	4,67±0,48	4,77±0,23	5,04±0,35	4,81±0,55	5,01±0,52
P, mmol / l after TPS	4,58±0,44	4,19±0,39	4,47±0,22	4,19±0,32	4,26±0,28
p	$p > 0,05$	$p > 0,05$	$p > 0,05$	$p > 0,05$	$p > 0,05$

Note. 1. p – the reliability of the difference in scores in children of each subgroup before and after the TPC;
2. * – $p < 0,05$ – the reliability of the differences between children CTS and MMS after the TPC.

It is known that acid phosphatase and alkaline phosphatase participate in calcium-phosphorus metabolism; they separate phosphate from phosphoric acid compounds, thereby providing mineralization of bones and teeth (22). In the presence of inflammatory diseases, the activity of these enzymes increases sharply (21, 25).

At the beginning of the study, an increased activity of ACPH in OF was established in children of CTS and MMS of groups II and III compared with children of group I.

Regarding alkaline phosphatase, compared with the indicator of children of group I, an increase in the activity of this enzyme was observed in children from MMS of group II and from CTS and MMS of group III. 12 months after the use of TPS in children from MMS of groups II and III determined a significant ($p < 0.05$) decrease in the activity of ACPH (0.11 ± 0.02 mmcat/l and 0.10 ± 0.02 mmcat/l) and ALPH (0.35 ± 0.03 mmcat/l and 0.35 ± 0.04 mmcat/l, respectively) in OF compared with the results in children with CTS of these groups (ACPH - 0.28 ± 0.02 mmcat/l and 0.26 ± 0.01 mmcat/l, ALPH - 0.32 ± 0.01 mmcat / l and 0.59 ± 0.09 mmcat/l, respectively) (Table 4).

Table 4. Biochemical parameters of oral fluid in children aged 7-11 years before treatment and after 12 months

Groups Indicators	I		II		III	
	CTS		MMS		CTS	
ACPH, mmcat / l, before TPS mmcat / l	0,17±0,02	0,39±0,11	0,39±0,05	0,42±0,13	0,49±0,11	
ACPH, mmcat / l after TPS	0,12±0,02	0,28±0,02*	0,11±0,02	0,26±0,01*	0,10±0,02	
p	p<0,05	p>0,05	p<0,05	p>0,05	p<0,05	
ALPH, mmcat / l, before TPS	0,29±0,02	0,23±0,06	0,58±0,07	0,54±0,09	0,53±0,07	
ALPH, mmcat / l, after TPS	0,32±0,04	0,32±0,01	0,35±0,03	0,59±0,09*	0,35±0,04	
p	p>0,05	p>0,05	p<0,05	p>0,05	p<0,05	

Note. 1. p – the significance of the difference in children of each subgroup before and after TPS;

2. * – p<0,05 – the significance of the difference between the CTS and MMS groups after TPS

The diagnostic significance of the biochemical parameters of oral fluid for assessing the state of organs and tissues of the oral cavity is confirmed by the results obtained by us when examining children of different ages with imperfect osteogenesis, which is genetically caused by a disease from the group of collagenopathies, characterized by a violation of the formation and development of bone tissue and changes in its structurally functional state. Among dental pathologies, the most studied manifestation of imperfect osteogenesis, which occurs in more than 50% of cases in such patients, is imperfect dentinogenesis (26). Biochemical studies of the oral fluid of 18 children with imperfect osteogenesis showed a decrease in the content of Ca (0.62 ± 0.06 mmol/l), P (4.40 ± 0.39 mmol/l) and ACPH (0.07 ± 0.01 mmcat / l), at the same time, a significant increase in the level of ALPH (0.52 ± 0.06 mmcat / l) in the oral fluid of these children was determined. An increase in the level of alkaline phosphatase is probably because to the fact that, in the case of imperfect osteogenesis in children, an increase in bone remodeling rates in blood serum is observed (27) and, as a result, in the oral fluid.

The obtained results of indicators of tooth decay rate indicate a positive effect and effectiveness of the developed treatment and prophylactic complex. The dynamics of the main biochemical parameters of oral fluid in school-age children (Ca, ACPH, ALPH) coincides with the data of other authors (21, 23, 24, 28, 29) and indicates an increase in the mineralizing potential of oral fluid due to the influence of local means of prevention and by regulation of food and drinking regimes using natural-table weakly mineralized water without gas with a Ca^{2+} content of 50 to 200 mg/l.

The relationship between the micro- and macroelement composition of MW in certain regions of Ukraine and the main dental diseases in children living in these territories indicates the importance of this factor in the development of caries (15, 30, 31).

In recent years, 285 publications have devoted the problem of the relationship between endemic caries and the salt composition of drinking water, but most of them are devoted to the influence of fluorine in the water on the development of dental caries (32). Children living in regions with an optimal or excessive concentration of this halogen in water have significantly lower caries compared to children living in regions with insufficient fluoride (6, 33, 34). The prophylactic effect of physiological concentrations of fluoride in drinking water on the prevalence of caries in children has been proven (35, 36). On the other hand, an excessive concentration of fluoride in drinking water leads to the occurrence of fluorosis (34). Significantly less scientific work is devoted to other macro- and microelements of drinking water. Despite the low intake of Ca and other trace elements with drinking water, which hypothetically can affect the mineralization processes, most researchers are skeptical about the possible role of the mineral composition of drinking water in the prevalence of caries (32).

However, a survey of 440 children 7, 12 and 15 years old in different settlements of Transcarpathia (v. Kvasy., G. Svalyava., G. Rakhov), with climatic and geographical differences in the macro- and microelemental composition of drinking MW, indicates that the prevalence and caries intensity to a certain extent depends on the composition of drinking water (37).

The largest number of studies is devoted to the possibility of local application of MW of Transcarpathian region in the comprehensive prevention of caries, due to the presence of a significant amount of fluorine and Ca in them (especially in carbonic and iodine-bromine waters). According to AM.Potapchuk (1991), the use of highly mineralized “Paseka” MW as a local prophylactic together with controlled hygiene of PR significantly reduces the solubility of the surface layers of enamel, the yield of Ca and P ions, increases the enamel resistance and the ability to remineralize (38).

The analysis shows that when using Transcarpathian mineral waters in the form of hydro

procedures, the buffer capacity of OF increases, and the permeability of tooth enamel and the molar ratio decrease and stabilize. The bactericidal effect on plaque microflora deserves special attention (39).

Conclusions. Thus, the use of MW with a Ca^{2+} content of 50 to 200 mg/l as a source of natural Ca intake can be recommended as an aid to the comprehensive prevention of caries in schoolchildren. Given the importance of endogenous prevention of dental caries in children, the use of natural table MW with a Ca content of 50 to 200 mg/l as a safe prophylactic is relevant and requires additional study since it will significantly reduce the need for drug therapy and significantly increase the effectiveness of treatment without contraindications.

Authors declare no conflict of interest

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Rehabilitation of unstable knee in osteoarthritis

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Abstract

Knee instability is a common condition found in degenerative knee osteoarthritis. The evolution of the disease is a chronic one, with acute exacerbations that accentuate the static and dynamic deterioration of the knee joint. Women are more susceptible in 70% - 80% of cases, with an increased frequency after menopause, between 40 to 70 years, being often associated with obesity and varicose veins. Starting from these data and then extrapolating with the increased number of people coming to treatment with this condition, we considered that a more in-depth study theoretically, but especially practical, in terms of the effectiveness of physiotherapy treatment is slowing down the evolution of the disease. Based on the objectives we presented earlier, we are determined to focus our efforts on this category of patients, and through our study we try to find new ways to reduce the suffering of the patients and to ensure the sustainability of the obtained results.

Key words: *knee osteoarthritis, physiotherapy, rehabilitation, instability, muscle toning.*

Introduction

Knee Osteoarthritis (KOA) is a degenerative condition that consists in the destruction of the hyaline cartilage, find on the articular bone extremities (1,2,3). Recent studies have shown that osteoarthritis is not limited to the destruction of hyaline cartilage, but affects the entire joint, including the subchondral bone (4,5). There is a progressive wear of the articular cartilage, which loses an amount of flexibility, the pain will appear and the mobility of the knee will be limited (6,7). The knee joint is not only the largest, but also the most complex joint of the human body (8,9). Knee joint is able to withstand stress and injury risks in all daily activities, as well as in various grades or sports activities (10,11). However, people with anatomical problems such as curved legs may experience pain. Normal processes related to aging and overweight, as well as post-traumatic conditions, can lead to joint wear (12,13,14).

Frequency of axial deviations in the frontal plane, the degree of physical disability, especially in the advanced stages, the diminished autonomy of the

affected persons, as well as the risk to which the person is subjected, in the case of the improper treatment of KOA and in the case of not practicing physiotherapy programs, determined us to organize the research in this conditions (15,16). Functional physiotherapy recovery is the main means of medical recovery assistance (17). Its primary objective is to restore the function (lost or deficient) or to obtain a major improvement (or finding compensatory mechanisms) (18)

Research objectives: Highlighting the deficiencies that accompany KOA on all levels on the sample subjects, trying to confirm and add to the ones provided from the medical surces. Identification and selection of the most appropriate methods, procedures and techniques, witch can optimize the recovery of patients, according to the particularities of each subject.

Structuring and restructuring the recovery program determined by the behavior of the subjects and the results of the periodic evaluation it is an another objective.

Research tasks: formulation of working hypotheses; establishing the working modalities; selection of the group subjects, and choosing the most efficient techniques, methods and procedures according to the particularities of each subject.

Hypotheses

Physical medicine possesses the necessary means to reduce the pain and inflammation and prevents disabling deformities (19). The methodological principles of physiotherapy, positively influence the degree of mobility in KOA, and patients which are following a functional recovery scheme can be socially and / or professionally recovered (20). Medical recovery through physiotherapy is based on modern therapeutic concepts, its efficiency being directly proportional to the shortening of the healing time (21). In the case of definitive morphological or functional lesions, physiotherapy ensures the formation of compensatory mechanisms (22). Physiotherapy objectives are strictly related to the symptoms that are frequently repeated in the KOA, even if they are not present at the time of treatment (23). Physiotherapy in KOA is performed individually or in small groups of patients with the same symptoms (24).

Methods and materials:

- a) Theoretical documentation;
- b) Method of investigation;
- c) Observation;
- d) Method of measurement (exploration and evaluation);
- e) Data recording, processing and graphical representation.

All the techniques used in the treatment scheme must start from a positive diagnosis, accompanied by a clinical picture and objective investigations. The functional balance, the current state and the presumptive prognosis of the evolution of the deficit must be established, then the immediate and long-term goals will follow (26). The examination includes: anamnestic data, clinical and paraclinical examination of the patient and specific tests to establish the positive diagnosis of KOA (17,18). This assessment will be initial and periodic in order to follow the evolution of recovery. The collected data are quantified and noted in the treatment records. The examination includes: anamnesis; somatoscopic examination; palpation; joint balance; muscle testing; examination of static and dynamics; global (appreciation of locomotion) (19,20). The

study was carried out in the Center for Physical Therapy within the Faculty of Physical Education and Sports of the "Dunărea de Jos" University in Galați, with the support of the physiotherapy and orthopedics department of the Micromedica Clinic from Piatra Neamt. The equipment of the physiotherapy room is as follows: wall bracket, physiotherapy table, gym bench, mattresses, sand bags, electrotherapy equipment, stepper, ergometric bicycle, dumbbells, rollers, elastic bands, Rocker cage, ultrasound, mechanical elongation, table shockwave apparatus, etc. For the exploration and evaluation of patients we use goniometers, metric tape, scales, special records methods for recording the collected data.

For the research I selected twelve subjects that entered the treatment between October 2018 - March 2019. In the first stage of research an theoretical documentary was made, by studying the specialized literature and I got in touch with specialists in the field of recovery (medical doctor and physiotherapist). In the second stage I selected the subjects and I formed the group for the study and I prepared the materials for testing and treatment. In the third stage we developed and applied the physiotherapy programs in order to recover the patients after an individual evaluation. On the final stage I appreciated the dynamic evolution of the parameters, and I collected and interpreted the obtained data, using an graphically processed method. After that I carried out this study on a group of 12 patients, with age between 40 and 74 years old, who had unilateral or bilateral KOA. Left KOA was found on 4 subjects, right KOA on 3 of them, and 5 patients showed bilateral involvement.

The physiotherapy program was personalized and aimed at achieving the proposed goals of the recovery. The physiotherapeutic treatment plan includes: regaining *quadriceps muscle strength*, as extensor and "locker" of the knee; the recovery of the quadriceps as a stabilizer in the critical stability zone between 60° - 90°; increasing the tone of the hamstrings is done at the 15° - 20° end of extension; train the *tensor fasciae latae* and the sural triceps. Restoring knee joint mobility to gain normal function is another important goal, in addition to stability and strength, and is always done in parallel (11,13,14).

The physiotherapy techniques used in program was mobilizations of the patella in transverse and

longitudinal plane (21); posture for the reduction of knee flexion: the patient in the ventral decubitus, with the leg outside the table, with a sandbag below the knee. Sitting on one chair with one leg extended to another chair, weights are applied to the knees (22); autopassive and active exercises with their own body weight and with different weights (23); facilitation techniques (24).

Physiotherapy is assisted by other procedures with the role of increasing soft tissue elasticity, reducing muscular contractions and retractions, such as: local ice massage; short waves with pulses in athermic dosage; low frequency currents, medium frequency interference currents or using excitomotor forms; LASER; aimed procedures for improving the vascularization and the local tissue trophicity, diathermy, low frequency electromagnetic fields; the massage plays a major role right from the beginning of the recovery program thanks to its favorable effect on stimulating proprioception (maintaining muscle tone) and by mobilizing the patella on the femoral condyles. In addition, the local tissue circulatory and biotrophic effect cannot be neglected. To these physical procedures was added our physiotherapy program, which contained a total of 22 exercises, using personalized dosing and breaks between exercises; with these we reached the goals set initially and presented previously (22-25).

Results

After the recovery programs were applied proceed to the next step: the collection, processing and interpretation of the data obtained in order to confirm or disprove the working hypothesis. We used several parameters specific to the research methodology, namely: amplitude, arithmetic mean, standard deviation and coefficient of variation. The standard deviation is a measure of the dispersion of values around a value considered medium. The coefficient of variation is an indicator of the dispersion of the values in the series that are expressed as a percentage (27).

Following the calculations we have come to the conclusion that the values we have obtained support the hypothesis that physiotherapy positively influences the mobility of patients with KOA.

This can be found in the graphical representations from the following graphics.

Discutions

Following the study and analyzing the obtained results, we reached the following discutions. The recovery program applied to patients with KOA gave favorable results in terms of knee mobility, flexion and extension. Following the application of the physiotherapy program, a considerable improvement was observed in the muscles of the lower limbs. The program is more effective when the patient participates actively and consciously and respects the indications and contraindications received from the physical therapist. In order to maintain the results obtained, patients with KOA must continue the recovery program for the rest of their lives, at home or in special centers, depending on the stage of the disease. By observing the fundamental principles of physiotherapy: the principle of grading the effort, the principle of effective dosing, the principle of individualizing the treatment, the principle of the precociousness of the treatment, favorable results were obtained. Overweight influences the appearance of KOA. The reintegration of people with KOA into socio-daily activities was achieved by applying the appropriate recovery program

Conclusions

From the statistical analysis of the data obtained from the initial and final parameters measurements obtained, the knee angles of the patients included in the study showed significant changes. The physiotherapeutic treatment had positive effects on the knee range of motion, both in flexion and in extension, fact demonstrated by the parameters obtained at the final evaluation. The initial flexion and extension parameters, were changed after the recovery treatment by physiotherapy, so that the final parameters approached the reference ones. The normalization of the biomechanical function of the knee was the result of this study, thus contributing to the generation of a protocol that aims to make the recovery programs effective by physiotherapy. We consider that the results obtained make a qualitative contribution of the physiotherapeutic program, by reducing the working time, and costs of the treatment sessions. The rehabilitation of the osteoarthritic knee instability should be carried out in an efficient manner, targeted and adapted to each patient, in order to obtain the reduction of functional and algic symptoms, based on clear and easy to apply programs and protocols.

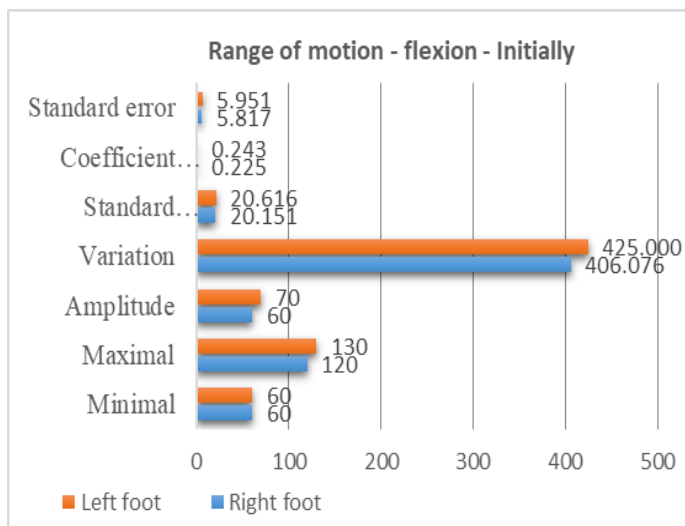


Fig.1 Dispersion parameters calculation for the range of motion flexion initially

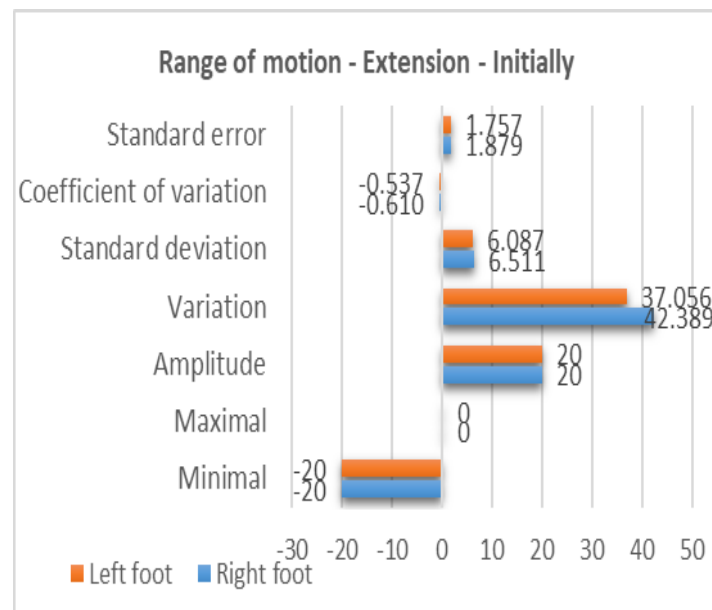


Fig.4 Dispersion parameters calculation for the range of motion extension finally

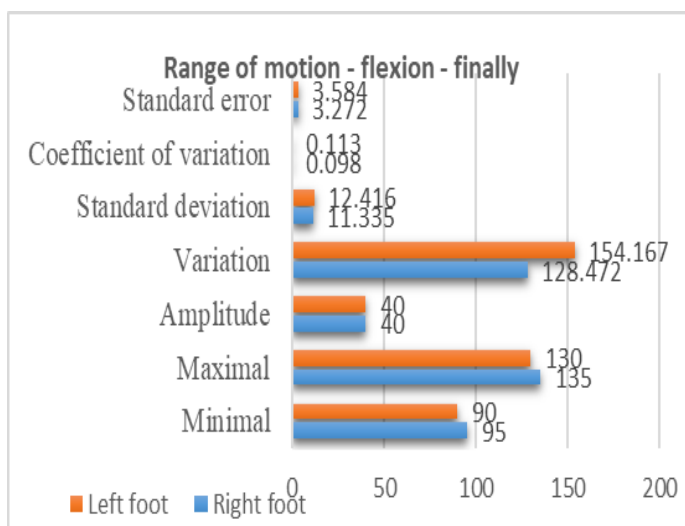


Fig.2 Dispersion parameters calculation for the range of motion flexion finally

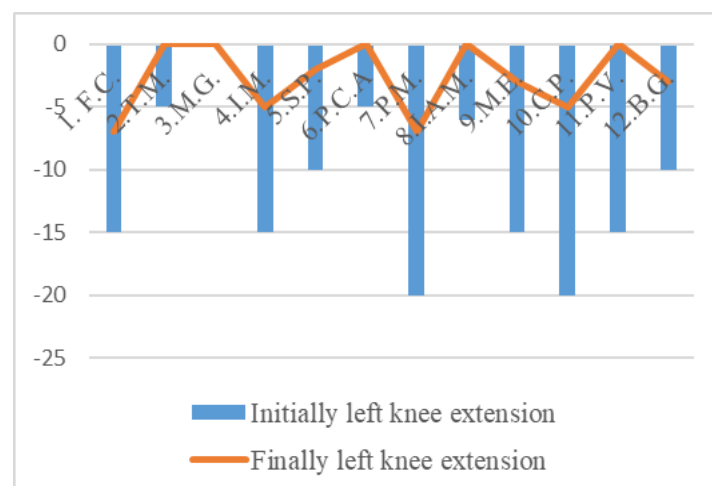


Fig.5 Increased extension to the left knee

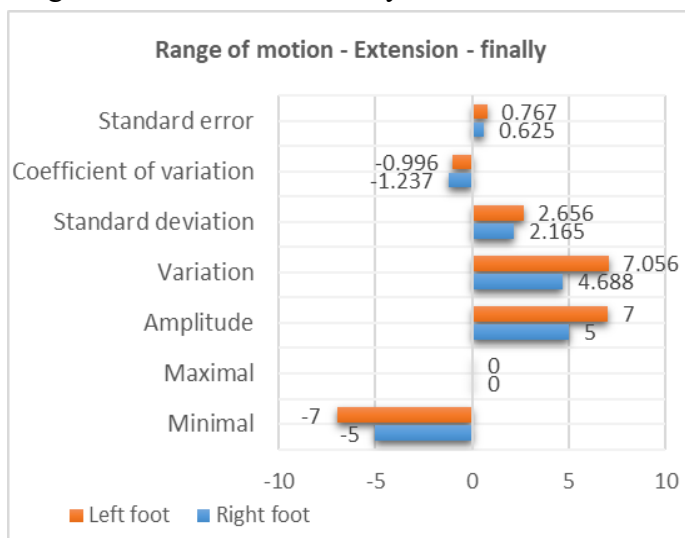


Fig.3 Dispersion parameters calculation for the range of motion extension initially

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Possibilities of using natural mineral waters in the treatment of patients with non-alcoholic fatty liver disease

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Abstract

Non-alcoholic fatty liver disease (NAFLD) is a chronic pathology that is increasingly diagnosed in different countries. The pathogenesis of NAFLD associated with insulin resistance, abdominal obesity, atherogenic dyslipidemia, arterial hypertension, endothelial dysfunction, impaired adipokine secretion, that is, components of metabolic syndrome. Treatment of NAFLD should be comprehensive and lengthy, although there are no standardized approaches to the treatment of NAFLD. Meanwhile, drug therapy carries certain risks: the development of serious adverse reactions with prolonged use. The work highlights modern views on the etiology, epidemiology, pathogenesis, drug and non-drug treatment of non-alcoholic fatty liver disease (NAFLD). Experimental and clinical studies on the mechanism of biological action, the effects of using different in composition and mineralization of mineral waters on the course of NAFLD had presented. Based on experimental and clinical studies, ideas about the specificity of the action of mineral waters of various balneological types and mineralization on the clinical course of NAFLD at different stages of the disease, the effect on the functional state of the liver, and the dynamics of lipid and carbohydrate metabolism had detailed. It is concluded that mineral waters could be successfully used in the complex treatment of NAFLD patients.

Key words: *non-alcoholic fatty liver disease, insulin resistance, dyslipidemia, mineral waters,*

Introduction

Non-alcoholic fatty liver disease (NAFLD) is a chronic pathology that is increasingly diagnosed in different countries (1). Depending on the diagnostic method, age, gender, and ethnicity of patients, the frequency of NAFLD in the adult population are from 17 to 46% (2, 3, 4, 5). Moreover, NAFLD is found not only in patients with obesity and metabolic syndrome, where its frequency reaches 60-80% (6) but also in 7% of individuals with normal body weight, mainly in young women with normal levels of liver enzymes (1, 7). According to the latest meta-analysis of 86 clinical studies in 22 countries, the frequency of NAFLD in the general population is 25%, reaching maximum values among the population of the Middle East and South America. It is assumed that by 2030, NAFLD will become the main cause of liver transplantation in developed countries (8). Studies in the Asia-Pacific region have identified a growing prevalence of the European diet, the popularization of fast food, a decrease in the diet of plant foods, an increase in the consumption of meat products and fats by 7 times,

which, according to the authors, would lead to an increase in the prevalence of NAFLD. It is noted that increasingly this pathology acts as a cause of mortality (9).

As part of a study conducted by American scientists [8], a model was developed to assess the progression of NAFLD, when the predicted changes in the development of liver cirrhosis associated with NAFLD, progressive liver diseases, and associated mortality had estimated until 2030. According to the results of the analysis, we can expect that the prevalence of NAFLD cases will increase by 21% from 83,300,000 (30% among people over 15 years old and 25.8% among all age groups) in 2015 to 100,900,000 (33.5 and 28.4 %, respectively) in 2030. At the same time, the number of cases of non-alcoholic stenotic hepatitis (NASH) will increase by 63% - from 16.5 to 27 million people. The number of patients with advanced liver disease will increase by 160%, from about 3,300,000 to 7,900,000 by 2030. The incidence of decompensated cirrhosis will increase by 168%, while the incidence of

hepatobiliary carcinoma - by 137%. It is noted that the growth in mortality from liver diseases in 2030 will be 178% compared to (8). The same authors came to the conclusion that in order to reduce the burden of the disease, strategies are needed to slow down the growth of cases of diseases, as well as to improve therapeutic options, because while maintaining high rates of prevalence of obesity and type II diabetes in adults, as well as taking into account the aging population, morbidity and mortality from NAFLD in the US will increase (8).

In general, at the beginning of the XXI century the concentration of "improper lifestyle" factors contributing to the development of NAFLD in the urban population (overeating and unbalanced diet, inadequate physical activity, chronic stress and arterial hypertension, environmental pollution, drug toxicity) was extremely high. This happened against the background of a simultaneous active restructuring of traditional food technologies - a process that accelerated at the beginning of the XXI century and had led to the fact that in the standard diet of the urban population of industrialized countries the content of foods containing vegetable fiber, irreplaceable polyunsaturated fats and antioxidants was sharply reduced and fast food was popularized. Indeed, for countries whose economies are only developing, the common is:

- low incomes of the population;
- the process of active urbanization has recently begun and the need for more recently the rural population to adapt to the high nervousness of life in the metropolis during the life of 1-2 generations;
- urban lithogenic and atherogenic diet;
- high levels of toxic pollution of the environment and food. All this, along with the high steatogenicity of the modern urban diet (typical for the USA, for example) leads to the rapid development of liver steatosis, as the base of NAFLD and its subsequent stages (10 -14).

Further growth of NAFLD and non-alcoholic NASH is found in all racial and ethnic groups of the countries of the world, increasing hepatic and cardiovascular morbidity and mortality. Analysis of mortality of NAFLD patients identified three main causes: cardiovascular events (13–38%), malignant neoplasms (6–28%) and liver pathology (2.8–19.0%) (1, 2, 14,15).

The traditional risk factors for developing NAFLD include: eating high-calorie foods, a sedentary lifestyle, obesity with a visceral type of fat

distribution, type 2 diabetes mellitus, atherogenic dyslipidemia.

There is growing evidence that NAFLD is a multi-systemic disease that increases the risk of developing not only type 2 diabetes mellitus (DM) and cardiovascular disease, but also osteoporosis, hypogonadism, hypothyroidism, polycystic ovary syndrome, kidney pathology, etc. (3 6, 8).

The pathogenesis of NAFLD associated with insulin resistance, abdominal obesity, atherogenic dyslipidemia, arterial hypertension, endothelial dysfunction, impaired adipokine secretion, that is, components of metabolic syndrome .

NAFLD is partially associated with the pathology of the biliary tract, peptic ulcer, pancreatitis, gastroesophageal reflux disease, irritable bowel syndrome (6, 7). Today, despite the complexity of the etiopathogenesis of NAFLD, many of its mechanisms have already been studied. But the question of the treatment of this disease is still open (14).

Treatment of NAFLD should be comprehensive and lengthy, although there are no standardized approaches to the treatment of NAFLD. First of all, therapeutic tactics provide for a modification of lifestyle and drug exposure. Lifestyle modification is aimed at correcting body weight using a hypocaloric diet and adequate physical activity (8, 9, 14).

The success of drug therapy is associated with the appointment of insulin resistance and statins, ursodeoxycholic acid, essential phospholipids, drugs with antioxidant effects (vitamin E), etc. (7, 11, 14). Meanwhile, drug therapy carries certain risks: the development of serious adverse reactions with prolonged use (for example, aggressive statin therapy with concomitant dyslipidemia), allergic manifestations, polypharmacy, and some of them (for example, vitamin E) can increase mortality from various causes, in particular, from hemorrhagic stroke and prostate cancer. Also, the results of drug therapy are not always satisfactory. All this reduces compliance and adherence to treatment (4,11, 14, 15).

Summing up the cited material, we can conclude that, despite the current progress in the treatment of NAFLD patients, there are still many open questions. This stimulates the search for new non-drug treatment technologies for NAFLD aimed at developing differentiated methods of rehabilitation treatment of patients of this nosological form using natural and preformed physical factors because now

there is no single conceptual approach to such treatment of NAFLD patients.

Recent years have proved the fundamental possibility of drinking mineral water (MW) to influence the course of metabolic processes in lipid and carbohydrate metabolism disorders in patients of different nosological groups, including those with metabolic syndrome, which is often associated with NAFLD (16)]

According to modern concepts, the name "mineral water" refers to groundwater that has a therapeutic effect on the human body, due to the increased content of useful biologically active components, their ionic and gas composition, and the general ion-salt composition of water. MW are not only complex multicomponent anionic cationic solutions, but they also have a diverse composition and different mineralization, which makes it possible to vary the drinking treatment depending on the phase of the disease, the severity of the pathological process and associated pathology.

Numerous experimental and clinical studies have proven the ability of MW of various composition and mineralization to stimulate the production of intestinal and pancreatic hormones (17, 18). These studies allow us to consider the role of gastrin as a pacemaker, which triggers all the sequential regulatory processes of the gastrointestinal tract, and glucagon - is a hormone that enhances the level of metabolic processes. Besides, together with other hormones, they perform adaptive functions. Already a single intake of MW causes a whole cascade of hormonal reactions due to a certain sequence and relationship. The beginning of the multi-chain reaction is the entero-insular axis: enteric signals to islet cells are ahead of signals from the internal environment of the body (19).

Mineral waters act on the digestive organs and the body directly (contact, directly, quickly), mobilize homeostatic systems from molecular to a higher level of biological integration and affect the pathological process. MW act "indirectly" from the gastroenteropancreatic endocrine system, acting on the endocrine, paracrine and neuroendocrine channels of regulation.

So, the mechanism of action of drinking mineral waters is associated not only with the accumulation of ions, but with their effect on the endocrinocytes of the intestinal hormonal system, which forms urgent and long-term adaptive reactions that mediate the functioning reserves of both regulatory units and various organs and the whole organism (20).

The course intake of MW due to the general training effect causes a long-term restructuring of the pituitary-adrenal and other systems, as well as mineral metabolism, which leads to an increase and improvement of the regulatory abilities of the body (5).

Studies of the regulatory effects of MW on the activity of the gastrointestinal tract have established the presence of important phenomena: the first is an increase in the sensitivity of pancreatic beta cells to the stimulating effects of MW. The second - the maximum rise in insulin after a course of taking MW occurs not at the 15th minute, as in the initial state, but already on the 5th. The biological significance of this phenomenon can be figuratively compared with the "early warning device," since it is the usefulness of the early phase of insulin secretion that creates the conditions for the optimal course of postprandial metabolic reactions.

The third phenomenon is directly related to increasing the duration and quality of human life. Of all the hormones in this regard, most researchers note the special role of serotonin. Analysis of the obtained experimental data showed that after a course of taking MW, along with other hormones, the basal level of serotonin rises by almost 75%. In this case, similarly to insulin, the early phase of serotonin secretion is stimulated. In general, an increase in the general nonspecific resistance of the organism as a result of the course of exposure to mineral water is achieved not only by activating hormones of the intestinal hormonal system, but also by adaptive restructuring of the activity of hormonal systems of higher levels of biological integration, where activation of the early phase of insulin and serotonin secretion is decisive (17, 21).

In experimental studies of Reps V.F., dedicated to the justification of the therapeutic and prophylactic use of drinking mineral waters for impaired liver function, it was convincingly proved that the pathogenic effects of aggressive and toxic factors have a powerful effect on energy metabolism in the liver with subsequent systemic metabolic disorders, which are the disintegration of the insulin mechanism of regulation of carbohydrate metabolism due to changes in the activity of transport membrane enzymes in hepatocytes, enhancement of lipid peroxidation (LPO) and the further development of dyslipidemia and formation of fatty liver (22).

In experimental modeling of pathological conditions, the course intake of drinking mineral

water has a stimulating effect on insulin secretion, inhibits lipid peroxidation processes, increasing AOS power, and normalizes the activity of transport ATPases in the liver cells. The dependence of the influence of mineral waters of various salinity on the course of the pathological process depending on its severity was demonstrated (22).

A concept has been formed on the mechanism of the optimizing effect of mineral waters on hormonal-enzymatic regulation of metabolism, which consists in activating a certain sequence of reactions: in the first minutes, lipid peroxidation in hepatocyte membranes is enhanced with the simultaneous mobilization of glucose, then (up to the 30th minute) against the background of increase in peak. In the early phase of insulin increment, processes of active glucose transport through the cell membrane and its utilization in the cell along the pentose phosphate pathway are enhanced. The cycle of these reactions ends with an increase in the level of free fatty acids, which indicates an increased use of lipids as energy substrates (17, 19).

It has been shown that an increase in the efficiency of metabolic processes during the intake of mineral waters occurs due to the activation of cortisol-insulin interaction, phase changes in the activity of the free radical oxidation system and transmembrane transfer of metabolites.

In the mechanisms of therapeutic and prophylactic action of mineral waters, one of the central places belongs to an increase in the power of antioxidant protection due to the optimization of metabolic reactions. It has been established that the insulin stimulating effect of mineral waters is directly related to their ability to inhibit lipid peroxidation (5, 20).

In studies conducted by N.D. Polushin and Topuria D.I. it was found that in experimental animals that received a course of mineral waters in the resort of Essentuki, the effect of various poisons on the liver is noticeably (2-3 times) (18). These primary preventive effects occur against the background of optimization of the insulin regulation of metabolic reactions and are directly related to them. The ability of the mineral waters of the Essentuki resort to optimize metabolic reactions by activating the early phase of insulin secretion during the early phase of the digestive cycle can and should be widely used to prevent the metabolic syndrome, in the pathogenesis of which the central place belongs to the disruption of the interaction of insulin with receptors on the cell membrane, which provokes the gradual development

of dyslipidemia and related diseases of the cardiovascular system.

According to the data (23), the use of chloride-bicarbonate sodium low-mineralized mineral water with different humic acids for 21 days in animals with experimental hepatitis was accompanied by a significant improvement in the detoxification function of the liver, an increase in basal metabolism, a decrease in inflammatory changes, normalization of liver enzymes, and an increase in protein-synthesizing function, which occurred parallel to the positive dynamics of the morphological changes of the organ.

Numerous experimental and clinical studies have proven the versatility of the therapeutic effect of MW (5, 20). MW can influence the regulation of the central brain structures, tissue respiration, stimulate the enteroinsular axis and release gastrointestinal hormones, enhance the function of the gastric glands, the regeneration of the gastric mucosa, normalize its motor and evacuation functions, restore the metabolism of hepatocytes, provide an immunoregulatory effect, stimulate processes bile formation, bile secretion and pancreatic secretion, harmonize relationships in the peroxidation system of lipids and antioxidant system. These general mechanisms underlie the therapeutic effects of a drinking cure.

In recent years, a small number of works have appeared that prove the effectiveness of the course drinking intake of MW in patients with NAFLD and associated diseases and conditions. At the same time, mineral waters of different composition (mineral waters of the "Essentuki", "Morshin" type, with a high content of organic substances - such as "Naftusya") provide unidirectionality, a similar effect of varying degrees of expression. Stabilization of carbohydrate metabolism through normalization of the physiological profile of insulin secretion, a decrease in insulin resistance, a decrease in dyslipidemia, a significant improvement in the basic functions of the liver and its hemodynamics were noted (24, 25). Studies conducted by Yu. Gerasimenko et al. Confirm the positive effect of various MW on metabolic processes in patients with type 2 diabetes mellitus (26). Low-mineralized MW with a high content of organic substances "Timan", low-mineralized sulfate-calcium-magnesium MW "Zvenigorodskaya" and medium-mineralized sulfate-bicarbonate-magnesium MW "Donat Mg" had a unidirectional effect to reduce the level of glycemia, and the higher the glycemia, the more a

pronounced effect was exerted by MW, elimination of glucosuria and acetonuria. A similar trend was observed in lipid metabolism when there was a significant decrease in total cholesterol and triglycerides. However, in terms of lipid metabolism, "Timan" MW had a more pronounced therapeutic effect, and a more pronounced decrease in body weight occurred with the course application of "Zvenigorodskaya" MW.

A study of the effectiveness of the average mineralized sulfuric magnesium-sodium MW of the Morshin resort (source No. 6) in patients with type 2 diabetes mellitus while taking metformin and dietary support indicate a decrease in glycemia by 1.4 times (in the control - 1.2 times), possible a decrease in the level of glycosylated hemoglobin (after 3 months there was no decrease in the control), a decrease in insulin resistance ($p < 0.05$). The above changes were accompanied by normalization of ALT and AST levels ($p < 0.05$), which did not occur in the comparison group (27).

A study of the effects of weakly carbonic, weakly mineralized hydro carbonate-magnesium-calcium MW of the Tibskoye field in the complex treatment of patients with NAFLD at the stationary stage showed an improvement in the clinical course of the disease, restoration of the functional state of the digestive system and, especially, a decrease in the levels of interleukin-6 and interleukin-8, peroxidation products lipids compared with the control. At the same time, the long-term results of this study (after 1 year) are noteworthy, when in patients who additionally took MW in the treatment complex, the number of days of temporary disability decreased by 2.5 times, the number of exacerbations decreased by 1.7 times, and the longer (8-12 months) a stable period of remission was observed in 90% of patients (28).

The use of a low-mineralized hydro carbonate calcium-sodium MW "Zapovedniy source" in combination with physical activity for 21-24 days in people with metabolic syndrome led to a significant, 42% decrease in insulin resistance according to the NOMA index, along with a possible decrease in the concentration of triglycerides and atherogenic coefficient ($p < 0.05$) (29).

The study of the effect of low-mineralized sulfate-bicarbonate magnesium-calcium MW "Narzan" in the complex of treatment of patients with coronary heart disease (CHD) showed a clear effect on reducing dyslipidemia, in particular, a decrease in

the concentration of total cholesterol, LDL and the atherogenic coefficient ($p < 0.05$) (30).

The effectiveness of the internal course application of mineral waters of the "Essentuki" type in the treatment of NAFLD, including with simultaneous type 2 diabetes mellitus, has been convincingly demonstrated (31, 32). The improvement of the functional state of the liver, indicators of hepatic hemodynamics, normalization of the lipid spectrum of the blood, peroxide homeostasis, weight loss was established. The normalization of the secretion of adiponectin, leptin and a decrease in insulin resistance under the influence of these mineral waters have been proven (19). At the same time, MW "Essentuki" No. 4 (medium-mineralized carbonic acid, hydro carbonate-chloride sodium MW) had a more pronounced insulinotropic effect, and "Essentuki New" (low-mineralized carbonic acid-hydro carbonate-sulphate-sodium chloride-calcium) contributed to greater weight loss (3.5 ± 0.4 kg) taking "Essentuki New" versus 2.3 ± 0.4 kg when taking "Essentuki No. 4").

Conclusions. Therefore, it can be argued that the mineral waters in the complex treatment of NAFLD can have a significant effect on the metabolism of lipids and carbohydrates, the restoration of the functional state of the liver. Meanwhile, the above studies are scattered and do not form a general idea of the differentiated purpose of mineral waters, depending on the stage of the underlying disease, metabolic disorders, and concomitant diseases of the digestive system. Existing data also do not answer the question about the specificity of the influence of mineral water of different composition and mineralization on the course of NAFLD.

All of the above proves the importance of studying the effect of mineral water of different chemical composition and mineralization on the course of NAFLD in the experiment and, further, in clinical studies, to prevent the progression of the underlying disease and reduce cardiometabolic risk.

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Challenges in multidisciplinary medical rehabilitation - Swyer-James-MacLeod Syndrome: case presentation and short literature review

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Abstract

Introduction. Swyer-James-MacLeod syndrome (SJMS) or unilateral hyperlucent lung syndrome is a rare disorder caused by infectious bronchiolitis obliterans and pneumonitis occurring in childhood. It is characterized by hypoplasia and/or agenesis of the pulmonary arteries resulting in pulmonary parenchyma hypoperfusion. **Materials and methods.** We report the case of a 27 years-old female patient who presented with progressive dyspnea, productive cough, fever and chills. **Results and discussion.** Chest radiography showed unilateral loss of left lung volume with hyperlucency. Unilateral reduction in vascularity with reduced caliber of the left pulmonary artery was revealed on CT scan of the chest, final diagnosis of SJMS being confirmed by angiography. **Conclusions.** This case strongly supports the recommendation of considering SJMS within the differential diagnosis workup of bronchiectasis, the syndrome being usually underdiagnosed.

Key words: *pulmonary, rehabilitation, multidisciplinary,*

Introduction

Swyer-James-MacLeod syndrome is a rare entity characterized by hypoplasia and/or agenesis of the pulmonary arteries resulting in pulmonary parenchyma hypoperfusion. It is considered an acquired disease secondary to viral bronchiolitis and pneumonitis during childhood and is etiologically associated with viruses, atypical germs or Mycobacterium tuberculosis (1-4). Its incidence was 0.01% in an X-ray study conducted on 17450 patients (5,6). SJMS was firstly described in 1953 by Swyer and James, by documenting the case of a child with unilateral hypertransparent lung without atelectasis (7). One year later, MacLeod published nine similar cases (8). The aim of the paper is to describe the clinical and paraclinical features of one patient with Swyer-James-MacLeod syndrome and to do a short literature review on the topic.

Material and methods

A twenty-seven year old female patient, Caucasian, nonsmoker, presented to the Emergency Department of our hospital for a ten-day history of progressive dyspnea, productive cough, fever (39°C) and chills. Empiric antibiotic therapy was prescribed with

progressive worsening of her symptoms. For a comprehensive examination, the patient was hospitalized in the Internal Medicine Department, stating no significant family medical history. She disclosed recurrent episodes of pulmonary infections during childhood and adolescence, which were treated with antibiotics and bronchodilators.

Results

The physical examination was unremarkable, except lung auscultation, which revealed crackles on the left side. The complete blood count showed leukocytosis (14720 cells/ μ l). The patient tested negative for alpha1-antitrypsin deficiency and sweat chloride test, whereas serum immunoglobulins levels were within normal limits. Sputum cultures were positive for Citrobacter spp. Pulmonary function tests suggested relevant irreversible moderate obstructive disease: post-bronchodilator values of forced expiratory volume in one second (FEV₁) forced vital capacity (FVC) and FEV₁/FVC ratio were: 44%, 63% and 60% respectively. The chest radiography showed small left lung and apical lucency area in the left lung. Thoracic computed

tomography (CT) scans revealed a small, hyperlucent left lung with cystic bronchiectasis, compensatory hyperinflation of the right lung and reduced caliber of the left pulmonary artery (figure 1). The CT angiography confirmed diffuse hypoplasia of the left pulmonary artery (figure 2). Patient management included bronchodilators, targeted antibiotics and expectorants. Seven days later, due to symptomatic improvement under current treatment, the patient was discharged with recommendations of regular follow-ups and influenza and pneumococcal vaccinations.

Discussions

Swyer-James-MacLeod syndrome is a rare lung disease, also known as “unilateral translucent lung” or “unilateral emphysema”. The hallmark of the syndrome is pulmonary arteries’ hypoplasia and/or agenesis, resulting in pulmonary parenchyma hypoperfusion, with characteristic radiological pattern - translucent or hyperlucent unilateral lung (6).

SJMS is an acquired illness secondary to childhood infectious bronchiolitis and pneumonitis, which are important clues, when found during anamnesis. Possible etiology may include viruses (Paramyxovirus, Morbillivirus, Influenza A, Adenovirus types 3, 7 and 21), atypical germs (*Bordetella pertussis*, *Mycoplasma pneumoniae*) and *Mycobacterium tuberculosis* (MTB) (5, 9). Infection with MTB is still very common in our country, overlapping with other rare conditions (10) and resulting in tuberculosis active disease in immunosuppressive conditions (11-14). Repeated infection causes an inflammatory reaction with consecutive obliteration of the peripheral airways and of the vessels, affecting the development of the organ. The affected lung becomes smaller than the healthy one, destruction of the alveolar walls leading to bronchiectasis and emphysema (5, 9). Unlike the majority of respiratory diseases, in which tobacco use or environmental exposures represent the most important risk factors (15-19), SJMS is not usually associated with smoking. Only the clinical assessment of smokers is not enough, but adding a biological evaluation will give the great picture of the problem (20).

Patients with SJMS are either asymptomatic, or, more frequently, they present non-specific respiratory symptoms (hemoptysis, dyspnea, chest pain, chronic cough, wheezing) which are commonly present in many other respiratory conditions (18). SJMS may also associate recurrent respiratory infections. Physical examination is

nonspecific: decreased chest expansion, wheezing, bronchial rales, crackles, hyper resonance (9, 21).

Respiratory function tests (RFTs) usually reveal a mild to moderate obstructive pattern: decreased FEV₁/FVC ratio, decreased FEV₁, bronchial hyperresponsiveness, decreased DLCO, severe air-trapping, increased RV/TLC ratio (residual volume/total lung capacity), and normal/slightly decreased lung volume. Frequently, these patients are misdiagnosed with chronic obstructive diseases such as asthma or chronic obstructive pulmonary disease (COPD) (21).

Diagnosis is mostly based on imaging studies. Radiographic changes may appear in a few months to a few years after the etiological infection and include: unilateral, unique hypertransparent lung, decreased pulmonary markings, small hilum, and mediastinum shift to the affected side. Furthermore, the involved lung fails in growing and exhibits minimal volume changes during breathing (9). CT-scans are mandatory for a complete positive diagnosis, revealing characteristic findings in the involved lung: small size, decreased lung attenuation, hyperlucency, bronchiectasis (in 30% of patients) and a mosaic pattern of air trapping (9, 21). The presence of bronchiectasis reveals severe exacerbations with poorer prognosis. Characteristic changes can also be found during nuclear medicine imaging procedures, such as decreased perfusion and decreased gas exchange during ventilation in the affected lung as compared to the healthy one (6, 9). Angiography is a helpful tool, showing small and/or hypoplastic pulmonary artery and branches in the involved lung (9).

Bronchoscopy is mainly recommended for differential diagnosis purposes, the endoscopic appearance being similar to chronic bronchitis. Bronchoalveolar lavage (BAL) shows inflammatory alveolitis, with increased cellularity (increased number of neutrophils) sometimes lymphocytes), increased number of CD8⁺ lymphocytes and decreased CD4⁺/CD8⁺ ratio. The considerable presence of B-cells (CD19⁺ cells) in the BAL fluid collected from our patient is an interesting finding, the given subpopulation having a normal concentration when examined by flow cytometry in the peripheral blood. This aspect suggests a hyperimmune reaction occurring in the lung, which might play a role in the subsequent development of the pulmonary impairment following the initial lung infection. A significant increase in the polyclonal B-cell lymphocytes’ number can be related to

bronchus-associated lymphoid tissue hyperplasia. Cases of follicular bronchiolitis sustained by latent adenoviral infection have been reported, suggesting that the lungs of these patients respond to persistent (unknown) antigenic stimulation by activating local immunological mechanisms (22).

A positive diagnosis requires positive history of respiratory infection and one of the following imaging requests: unilateral loss of lung volume with associated hyperlucency (chest X-ray), unilateral reduction in vascular density (chest CT) and unilateral diminished arterial perfusion (Tc 99m lung scan) (23).

Differential diagnosis needs exclusion of pulmonary thromboembolism, asthma, and COPD, lung imaging, PFTs, and absence of therapeutic response being important helpful tools. A hyperlucent lung is an alarming radiographic finding, case in which congenital lobar emphysema, bullous emphysema, pneumothorax, bronchiectasis with air trapping, bronchial stenosis and obliterative bronchiolitis must all be taken into consideration. It is also mandatory to exclude other vascular pathologies, such as congenital pulmonary agenesis or hypoplasia and acquired stenosis or compression of the main pulmonary vessels. None of these abnormalities would both produce diffuse, peripheral ventilatory defects on the single breath image and unilateral lung hypoplasia. Furthermore, air trapping and perfusion modifications are both missing in primary arterial defect and pulmonary thromboembolism (9). The course of the disease includes recurrent pulmonary infections, bronchiectasis and eventually, respiratory failure (24-27). The prognosis is worse in the presence of bronchiectasis (21, 22).

Treatment of SJMS is usually conservative and consists in preventive respiratory infection therapy and/or curative treatment with antibiotics, bronchodilators associated or not with low-dose inhaled corticoids and pulmonary rehabilitation with complex methods, using even natural therapeutic factors (28-31). In selected cases, such as chronic infection with lung parenchyma destruction, surgical treatment might be useful, including pulmonary lobectomy or pneumectomy (21), multidisciplinary rehabilitation programs after surgery being also necessary (32, 33). Before drastic measures are initiated, multimodal should be assessed to guide both short- and long-term treatment options, including pulmonary rehabilitation, trying to find a marker for monitoring the effect of the therapeutic measures for

these patients including radiological parameters (34, 35, 36).

Conclusions

We hereby report the case of a patient with positive medical history and characteristic radiological findings. Although he described recurrent respiratory infections during childhood and adolescence each time when admitted to the hospital, the indolent course of the disease and the non-characteristic chest scans led to late diagnosis. We strongly recommend considering SJMS within the differential diagnosis workup of bronchiectasis, the syndrome being underdiagnosed when having in mind the epidemiological data.

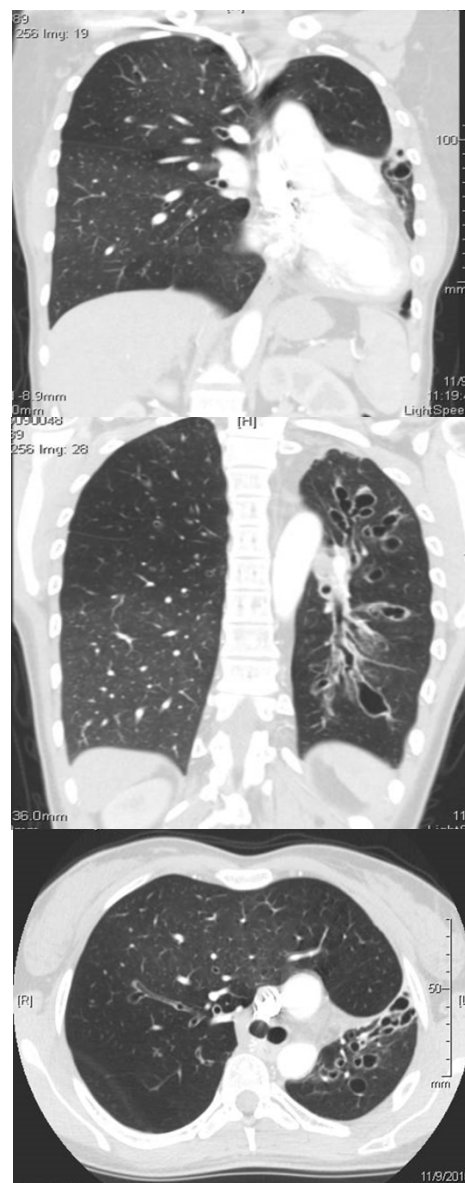


Fig. 1. Thoracic CT scan: small hyperlucent left lung with diminished vascularity and large cystic bronchiectasis, compensatory hyperinflated right lung



Fig. 2. CT angiography reconstruction: reduced caliber of the left pulmonary artery

Author contributions.

The authors contributed equally to the work.

Declaration of conflict of interests. There is no conflict of interest for any of the authors regarding this paper.

Informed consent. An informed consent was obtained from the patient included in this study.

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The effect of stretching exercises as part of the rehabilitation program for patients with spinal cord injury

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Abstract

Introduction & objectives: Spinal cord injury is a neurological condition with a devastating impact on all aspects of patients' life. Spasticity, a symptom of the resulting pyramidal syndrome, can be both beneficial and non-beneficial, and requires treatment when it causes significant limitations and complications. The therapeutic approach comprises a wide variety of therapies ranging from non-invasive to invasive procedures. One of the non-invasive procedures is physiotherapy including stretching exercises. There are several studies investigating the effects of stretching on spasticity but with inconclusive results, slightly favoring a positive effect. The aim of this case-control study was to evaluate the effect of a stretching module added to the specific physiotherapy program for patients with SCI.

Material and method: An observational case-control study was conducted which included 20 patients with SCI attending a motor neurorehabilitation program for 10 consecutive days at the Rehabilitation Hospital Cluj-Napoca and "Dorina Palace" Center, Cluj-Napoca, during the years 2016-2017. The patients were divided into 2 groups of 10 patients each: the control group, which received specific physiotherapy and occupational therapy, and the study group, in which a stretching exercise module was added to the rehabilitation program (attended by the control group). The patients were assessed using the Modified Ashworth Scale, the Range of Motion (ROM) test for the lower limb joints, and the Ten Meter Walk Test, both at the beginning and at the end of the 10-days rehabilitation program.

Results & discussions: The patients in the study group had statistically significant improvements in all the assessed scores compared to the control group, in which improvements were also present, but at the limit of statistical significance.

Conclusion: The inclusion of stretching exercises in the specific physiotherapy program for patients with spastic paraparesis after spinal cord injury seems to have a short-term favorable impact, by reducing spasticity and improving ambulation.

Key words: *spinal cord injury, spasticity, stretching.*

Introduction

Spinal cord injury (SCI) is a neurological condition with a major impact on all aspects of patients' life (familial, professional, socio-economic), and also on the health care system. According to the National Spinal Cord Injury Statistical Center, there are 12,500 new cases of SCI every year in the United States of America, 90% being traumatic, caused by road traffic accidents, violence, sports or falls. About 78% of the new SCI cases are male (1-5).

As a neurological syndrome, SCI is followed by tetraplegia/tetraparesis or paraplegia/paraparesis, and clinical severity is evaluated using the ASIA score. Post-traumatic SCI paraparesis occurs when the traumatic injury involves the spinal cord below the T1 level. Spasticity occurs in 80% of patients with SCI and is a main characteristic of the upper motor neuron syndrome (along with motor deficit,

increased tendon jerks, clonus, Babinski sign), and a major cause of disability. Spasticity is defined as a velocity-dependent increase in the tonic stretch reflex resulting in hypertonia of the deficient muscles. Spasticity develops progressively over the months following an injury, after a period of spinal shock, characterized by loss of tendon reflexes below the level of the lesion, motor deficit (paralysis) and hypotonia (2, 5-9).

Spasticity can be both beneficial and non-beneficial, and requires treatment when it causes significant impairments and complications. Although spasticity has a neural cause, there are also consecutive structural adaptations in the soft tissue. Spasticity increases motor deficit and induces pain and fatigue, tendon retraction and ankyloses (which can lead to joint deformation like in equinus contracture),

consequences that interfere with the efficacy of the rehabilitation program and increase the degree of disability (2, 10-12).

The pathogenesis of spasticity following SCI is not completely understood. Several mechanisms seem to be involved: enhancement of the excitability of motoneurons and interneurons, axonal sprouting, reduction of presynaptic inhibition, reciprocal Ia inhibition, post-activation depression, flexor withdrawal reflexes (6, 7).

The therapeutic approach comprises a wide variety of therapies ranging from non-invasive (antispastic drugs, physiotherapy) to invasive procedures (surgical rhizotomy). Antispastic drugs (baclofen, benzodiazepine, tizanidine, clonidine, botulinum toxin, dantrolene sodium) modulate the neuronal component of spasticity, and physiotherapy reduces its biomechanical side effects.

Electrotherapy comprises physiotherapy with exercises used to strengthen the deficient muscles, muscle stretching which helps in reducing muscle tone and in preserving joint mobility and range of motion, orthoses used to hold the limb in correct position, electrical stimulation which blocks the exaggerated motor activity (6, 8, 12-14).

Stretching, the process of elongation, is used by physiotherapists in the approach of spasticity. During stretching, tension is applied to soft tissue structures (muscles, tendons, connective, vascular, dermal, and neural tissues). There are several studies investigating the effects of stretching on spasticity, but with inconclusive results (11, 12, 15). Starting from empirical findings in neurorehabilitation practice, the aim of this case-control study was to evaluate the effect of a stretching module added to the specific physiotherapy program in patients with SCI.

Material and method

An observational case-control study was conducted, which included 20 patients with SCI attending a motor neurorehabilitation program for 10 consecutive days at the Rehabilitation Hospital Cluj-Napoca and "Dorina Palace" Center Cluj Napoca, between 1.01.2016-31.12.2017. The patients were divided into 2 groups of 10 patients each: the **control group**, with traumatic and non-traumatic (disc herniation, spine vascular malformation, spinal demyelinating lesion, hereditary spastic paraparesis) SCI, which received specific physiotherapy and occupational therapy, and the **study group**, with traumatic SCI, in which a stretching exercise module was added to the rehabilitation program. Post-

traumatic etiology of spastic paraparesis, ASIA score B, C and D, age over 18 years, imaging documentation, location of the lesion below T10, a length of time of maximum 1.5 years after SCI occurrence, the informed consent to participate in the study were the inclusion criteria.

The rehabilitation program attended by all patients was focused on specific physiotherapy which consisted of exercises aimed at an increase in joint mobility, particularly in the lower limbs, muscle relaxation and reduction of spasticity, an increase in muscle strength and resistance in both the lower and upper body (indispensable for transfers as well as other activities of daily living).

For the study group, passive stretching and neuroproprioceptive facilitation exercises were added, with emphasis on the most affected muscles by spastic paraparesis: coxofemoral flexors, knee flexors, plantar flexors. The principle of these exercises consists of placing the concerned muscles in the most elongated position tolerated by the patient. At this point, the contraction-relaxation technique is performed, after which elongation is continued, this succession being repeated until the patient's physiological limit or tolerance threshold is reached; at this point, this position is maintained for 10-15 seconds, followed by 15 seconds of relaxation while the initial position is regained. Three sets of 5 repetitions for each studied muscle were performed.

The patients of both groups were assessed at the beginning and at the end of the rehabilitation program in terms of spasticity and ambulation capacity. The evolution of spasticity was evaluated using the Modified Ashworth Scale (from 0 – normal tone to 4 – spastic limb on flexors and extensors) and the Range of Motion (ROM) test concerning flexion and extension of the coxofemoral joint, flexion and extension of the knee joint and foot dorsiflexion. The Ten Meter Walk Test evaluates the walking speed over 10 meters on a flat surface, at the patient's comfortable pace, being a method to classify patients from the point of view of ambulation.

Statistical analysis was performed using Microsoft Excel, categorical data being presented as diagrams, absolute and relative frequencies, and continuous variables being summarized using synthetic centrality or frequency histograms. The paired t test was also used. A p value lower than 0.05 allows rejection of the null hypothesis (absence of any effect of stretching exercises associated with physiotherapy in patients with spastic paraparesis

post-SCI) and acceptance of the alternative hypothesis.

Results

The distribution by gender and age is presented in Table 1 and Figure 1.

Table 1: Distribution by gender

Gender	Study group	Control group
Female	30%	40%
Male	70%	60%

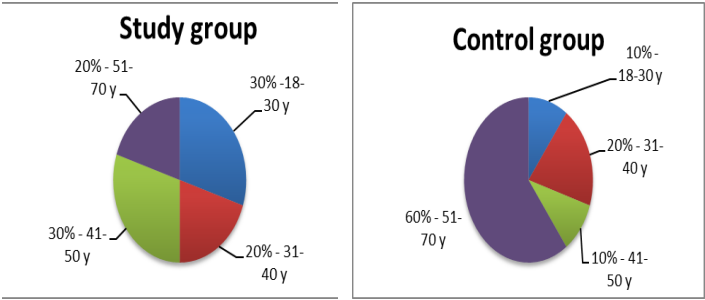


Fig. 1: Distribution by age in the study and the control group.

Patients in the control group were assigned based on ASIA scores to classes C and D. The study group also included 2 patients with a more severe clinical picture (class B) (Fig. 2).

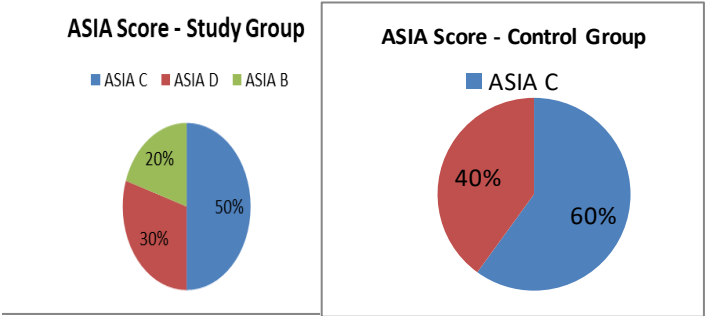


Fig. 2: Distribution by ASIA score in the study and the control group

Concerning the coxofemoral and knee range of flexion and extension and also the foot dorsiflexion range, a statistically significant improvement was found in the study group (with stretching exercises added to the rehabilitation program) compared to the control group, in which the improvement was at the limit of statistical significance (Figs. 3-5).

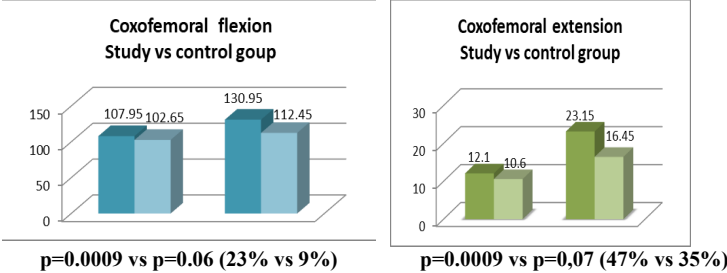


Fig. 3: Evolution of coxofemoral flexion and extension during 10 days (study vs control group)

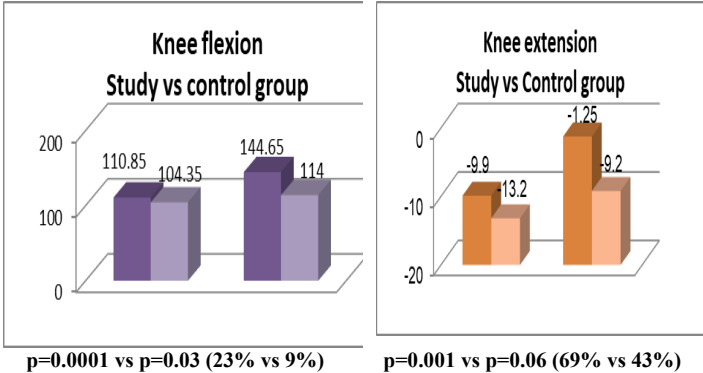


Fig. 4: Evolution of knee flexion and extension during 10 days (study vs control group)

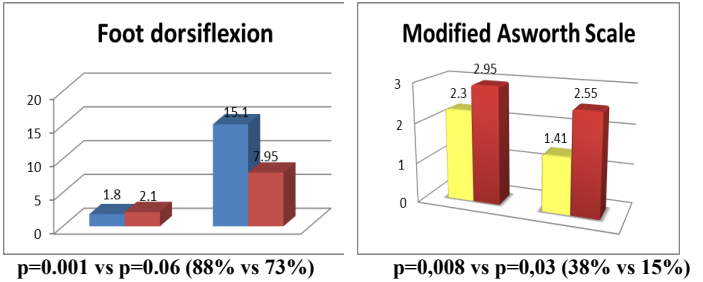


Fig. 5: Evolution of foot dorsiflexion and modified Ashworth scale during 10 days (study vs control group)

Spasticity reflected by the values of the modified Ashworth scale also improved statistically significantly in patients with stretching exercises added to the rehabilitation program, while the improvement was at the limit of statistical significance in the control group (Fig. 5).

The time measured by the Ten Meter Walk Test decreased statistically significantly in the study group, while the control group showed no notable changes (Fig. 6).

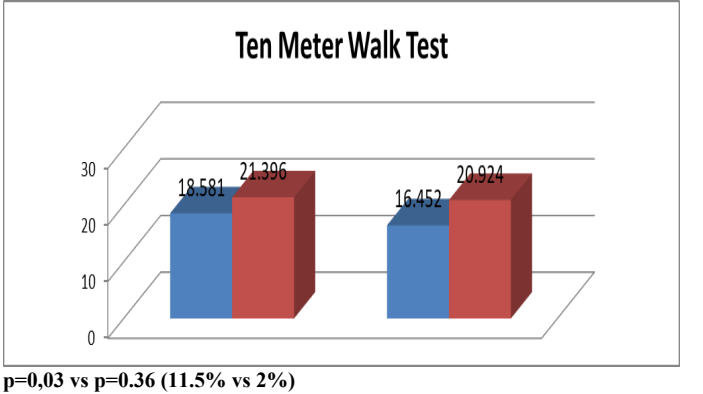


Fig. 6: Evolution of the Ten Meter Walk Test during 10 days (study vs control group)

Discussions

Although the study group included patients with a more severe neurological picture after SCI than those in the control group (ASIA score), these had

highly statistically significant improvements in spasticity reflected by the modified Ashworth scale and ROM in the coxofemoral, knee and ankle joints, as well as in the walking speed on the Ten Meter Walk Test, suggesting an improvement of ambulation.

The study has some limitations. The groups were not homogeneous, the patients in the control group also had other etiologies of SCI with a less severe neurological picture compared to the study group, in which all patients had traumatic SCI. Also, in the control group, the majority of the patients were aged over 50 years (reflecting in fact SCI etiology in this group), while patients in the study group were considerably younger. The patients came from two rehabilitation centers. Only the short-term effects were assessed, which were beneficial, but the long-term effects, which require a long time period during which stretching exercises added to physiotherapy should be performed constantly and their effects should be monitored, are not yet known. Also, consensus regarding a stretching protocol applied to patients with paraparesis after traumatic SCI, as well as consensus regarding the assessment methods would be necessary.

Conclusion

The inclusion of stretching exercises in the specific physiotherapy program for patients with spastic paraparesis after spinal cord injury seems to have a positive short-term impact on motor deficit, reflected by an improvement in walking, most probably by a reduction of spasticity. The study should be extended to larger groups of patients, and stretching deserves increased attention as part of physiotherapy programs intended for this category of patients.

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Does Respiratory Rehabilitation improve the outcome of pleural effusion in pulmonology department? Case report series and short literature review.

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Abstract

Introduction. Pulmonary rehabilitation is recognized as a complementary, non-pharmacological therapy for patients with COPD and pulmonary fibrosis. For pleural effusion, however there are not current recommendations in the existing literature. The aim of this study was to evaluate the beneficial role of respiratory rehabilitation (RR) in patients with pleural effusion and to review the main physiotherapy (kinetic therapeutic) techniques, as part of RR programs. **Material and method.** The article exemplifies three cases of acute pleural effusion or pachypleuritis, describing the diagnostic and treatment procedures as well as the pulmonary rehabilitation technique used. **Results and discussions.** Treatment goals, intervention, types of exercises were explained for each type of pleural disease. The diaphragmatic breathing, relaxation and/or antalgic postures, early mobilization, and a daily walking are recommended. **Conclusions.** Pulmonary rehabilitation should be applied in every patient with acute pleural effusion or pachypleuritis considering the potential benefits of physical therapy in the management of the patient's illness.

Key words: *pleural effusion, respiratory rehabilitation, pachypleuritis,*

Introduction

Pleural effusions (PE), defined as an accumulation of fluid in the pleural space due to the broad range of etiology, are a common pathology of any Pulmonology Department; most cases requiring further hospitalization. Although the clinical diagnostic of pleural syndrome is easily done, the etiology is quite difficult to determine (1). The most common respiratory causes of PE are lung cancer, pneumonia and tuberculosis (TB), in various proportion in different parts of the world. In Romania, for example, the main infectious etiology is tuberculosis as TB in Romania is higher compared to other developed countries. In many situations TB needs to be taken into consideration, especially in immunocompromised patient (2,3,4,5,6).

Some pleural involvement, such as TB pleural effusion, hemothorax, empyema, is healing with large pleural sequelae consisting in pachypleuritis, which can limit the expansion of the lung during expiration. For these reasons, patients presenting chronic impaired breathing, thoracic pain, changes in breathing mechanism, gain vicious posture. In time, patients may develop restrictive ventilatory defects, respiratory failure, which leads to impaired quality of life. In recent decades, pulmonary rehabilitation (PR) gained popularity as a non-

pharmacological treatment of chronic obstructive pulmonary disease (COPD) as well as of interstitial fibrosis and as a useful procedure before surgical resection of lung cancer (7,8,9,10). COPD, interstitial pneumonias, lung cancer and many other respiratory diseases share common risk factors, such as smoking and environmental exposures (11, 12, 13,14,15). PR include also education and smoking cessation advise besides supervised exercise training programs (7,16,17). Diagnosing tobacco dependence involves both clinical and biological evaluation of the tobacco consumption disorder, together with a psycho-behavioral evaluation (18). We have to emphasize the fact that anxiety and depression are not contraindication for referral the patients to PR; on the contrary, positive results can be obtained on the mental status as a result of an rehabilitation program (7,8,17). There are studies that have shown that PR can also improve the dyspnea and quality of life in patients with acute pleural effusion and extensive pachypleuritis (19). Chest physiotherapy intervention in PE aims to alleviate symptoms and assure minimal damage to lung function. The cases of patients that followed a respiratory physiotherapy program, associated with conventional therapy, support the use of this non-pharmacological

intervention in PE management (20-23). As pleural effusion is a common cause of hospitalisation all over the world, and pachypleuritis as a sequelae of pleural tuberculosis, unfortunately is still prevalent in our country with important impairment in respiratory function we sought to evaluate the importance of pulmonary rehabilitation on these patients. Therefore this article aims to describe the effects of respiratory rehabilitation (RR) on a series of patients with PE and to summarize the main effective physiotherapy (kinetic therapeutic) techniques, as part of RR programs, that improve the prognostic of disease.

Material and method

This paper presents 3 cases of patients with pleural disease consecutively admitted in the pneumology department that received pulmonary rehabilitation procedures as part of their therapy. All patients signed an informed consent that their data could be used for research purpose. The Hospital Ethics Committee approved the study. The assessment included: demographic, clinical, laboratory data, chest X-Ray, chest scans, pleural ultrasound, types of physiotherapy intervention and evolution under treatment.

Case 1: An infectious parapneumonic effusion (PPE) in a Caucasian, female, 21-year-old student, admitted to the hospital for high fever, bilateral chest pain, polypnea, dry cough, and severe asthenia. Symptoms had an acute onset, with progressive worsening despite Clarithromycin administered before hospitalization. The clinical exam revealed a general impaired status with tachycardia, pharyngeal congestion, dullness, inability to maintain orthostatism, and abolished breath sounds in the inferior part of the left hemithorax, heart rate (HR) of 102 beats per minute, low oxygen saturation (SpO₂) of 93%. The laboratory investigation revealed anemia (10,5 g/dl hemoglobin), severe systemic inflammatory syndrome with an elevated erythrocyte sedimentation rate (ESR) of 75 mm/1 hour, fibrinogen (646 mg/dl), C-reactive protein (PCR) level (225 mg/L), white blood cell (WBC) count (18,000/mm³), negative Mycoplasma pneumoniae and Chlamydia pneumoniae immunoglobulin M, negative Gram staining smears, negative sputum and blood cultures for Streptococcus pneumoniae, Staphylococcus aureus, Enterobacteriaceae, Pseudomonas aeruginosa and negative tests for A and B influenza virus. Initial thoracentesis revealed an exudative pleural effusion, with 90% of neutrophils and a very elevated value of

adenosine deaminase (ADA) of 80 IU. All molecular and bacteriological tests for Mycobacterium tuberculosis detecting in sputum and pleural liquid were negative. Because of the severe onset of illness, the empiric antibiotic treatment was started with Meropenem 3 g/day, Moxifloxacin 400 mg/day, Vancomycin 2 g/day, and non-steroidal anti-inflammatory drugs. Initially there was positive clinical evolution with improvement of general condition, decreased intensity of chest pain and releasing of dyspnea, but with persistent high fever after ten days of mentioned treatment. The thoracic ultrasound exam showed a large left pleural collection, mainly in the anterior part of the left thorax, with multiple fibrin filaments (Fig. 1).



Fig. 1. The pleural effusion with fibrin filaments at Thoracic ultrasound.

Chest computed tomography (CT) scan showed lateral and anterior loculated pleural fluid (Fig. 2). The intercostal tube drainage of the left pleural cavity revealed the purulent tendency of pleural fluid, suggestive for empyema stage of PPE.



Fig. 2. The loculated pleural effusion revealed on CT scan

A prolonged large spectrum antibiotic treatment was administered for another 10 days, associated with intra-pleural washing with antiseptic solutions by chest tube. After 10 days, chest drain tube was removed and patient started a 14 - days RR program with control breathing exercise, active expiration, pursed lips breathing, abdominal breathing with mobilization of diaphragm, and passive and active limb exercises. The patient was discharged in good

condition, asymptomatic, with no pleural fluid revealed by transthoracic ultrasound. The follow-up 6-month reevaluation revealed normal lung function and normal chest X-Ray (Fig. 3).



Fig. 3. The normal chest X-Ray after 6 month

Case 2 was an 26-year-old Caucasian male, active smoker (8 pack-years), with chest pain, dyspnea, profuse night sweating, productive cough, and mild weight loss. He declared no previous disease or other disorders in his medical history, and occasional consuming of ethanol. Clinical exam revealed an influenced general condition, SpO₂=93%, normal blood pressure (BP)=121/67 mmHg, mildly decreased chest movement, stone dullness to percussion, and abolished breath sound on the lower 2/3 parts of the left chest indicating a pleural effusion. Biological investigations showed systemic inflammatory syndrome (ESR=54mm/1h), hepatic cytolysis (ALT=87mg/dl; AST=63 mg/dl) and negative HIV status. ECG revealed sinus tachycardia.



Fig. 4. The large left pleural effusion on chest X-Ray

The chest X-Ray (Fig. 4) showed unilateral medium homogeneous density opacity, localized in the left lower 2/3 zone of the chest, and pleural effusion was confirmed by chest ultrasound. Sputum bacteriological screening for *Mycobacterium tuberculosis* (MTB) was negative in both microscopy and cultures. Thoracentesis was performed and 1,500 ml of sero-citrine pleural fluid was extracted. The TB etiology was sustained on the results of biochemical, cytological, and bacteriological pleural effusion examination. Rapid liquid of culture BACTEC MGIT revealed a positive presence of mycobacterium tuberculosis in the

pleural fluid. The new case of extrapulmonary tuberculosis (EPTB) was declared and first regimen of directly observed anti-TB treatment (DOT) started. Respiratory physiotherapy program was associated, consisting of breathing technique, in the first days with an incentive spirometer 10 minutes every 2 hours, folowed by limb exercises, and treadmill walking. After one month of clinical, functional and radiological therapy, the patient showed a decreased level of PE but with obvious extensive fibrotic lesions of pleura (Fig. 5). So, respiratory rehabilitation was continued as outpatient for one month (breathing exercises, lower and upper limb training) with positive results on dyspnea.



Fig. 5. Chest X Ray: the lateral and basal pachypleuritis

Case 3 was defined by post-TB syndrome complications with bilateral traction bronchiectasis, calcified left pachypleuritis after collapse-therapy, and severe chest kyphoscoliosis in an 84- year-old male, nonsmoker, with pulmonary secondary cavitary tuberculosis at the age of 20, treated only by collapse-therapy. At present, the patient was hospitalized for a persistent purulent cough, aggravated dyspnea (3rd degree on mMRC scale), diffuse chest pain, weight loss, and loss of appetite. The clinical examination at hospital admission revealed a poor general condition, cachexia (body mass index under 20 kg/m²), sensitivity to palpation of paravertebral zones, the spasticity of the paravertebral muscles, diminished breath sounds on left hemithorax, SpO₂=94%, BP=102/64 mmHg, HR=82 bpm, and chest deformation with a retracted and flattened left hemithorax, and a sub-scapular, post-surgical linear scar (Fig. 6).



Fig. 6. Posterior chest deformity

The chest X-Ray showed chest deformation secondary to ancient collapse-therapy, a calcified left pachypleuritis, and accentuated pulmonary draw with a tram line aspect suggesting bronchiectasis (Fig. 7).

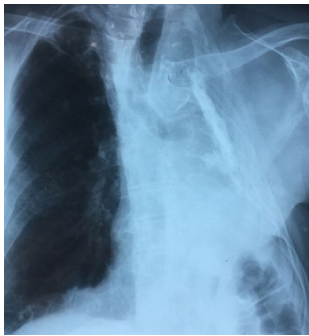


Fig. 7. Chest X-ray: thoracic distortion due to large calcificated pachypleuritis

All bacteriological examinations in sputum were negative for MTB or other bacteria. The spirometry showed severe restrictive ventilatory dysfunction with 65% decreased forced vital capacity (FVC). During a six-minute walking test (6MWT), the patient walked 300 m (60%) from 498 m predicted distance, with a significant desaturation (decrease of SpO₂ from 94% to 90%). During hospitalization, the patient received antibiotics, mucolytics, analgesic, bronchodilators, and a gastric protector associated with RR. The patient followed the technique of relaxation and posture, breathing exercises, diaphragmatic breathing, exercise training. After six weeks of treatment, the patient was discharged in good clinical condition, with a ten percent improvement FVC and a gain of 72 meters walked at the 6MWT. The difference between chest circumference at the end of maximum inspiration and maximum expiration, before and after rehabilitation program, measured the chest mobility and also demonstrated the positive effects results of the intervention.

Discussions

During pleurisy, there are some changes in thoracic mechanics, when the accumulated pleural fluid poses the diaphragm in a position that does not allow it to expand completely. Consequently, the respiratory frequency will increase to compensate the ventilation leading to dyspnea. The main objective of physiotherapy in pleurisy is to break this cycle. In active phase of pleurisy, the exercises must aid pleural fluid resorption, prevent the occurrence of pachypleuritis and relieve the pain.

In the sequelae phase with restrictive syndrome, other symptoms may occur, as dyspnea, decrease exercise tolerance, chronic cough. In this chronic

phase of disease, the goal of RR is to reduce the symptoms mentioned above.

The physiotherapy in pleurisy can be divided into different interventions depending on the PE phase (liquid phase, PE drainage, and pachypleuritis).

In the **liquid phase of PE**, physiotherapy has a preventive role to avoid pain and pleural sequelae by re-expanding the lung and increase the diaphragm mobility. The patient must be advised to stay in lateral position, with the pleurisy up, alternating position every 10 minutes with the decubitus dorsal and ventral. Dynamic expiration increases pleural pressure, which makes residual fluid drain through pleural tissue.

Another example of exercise is with patient placed in decubitus on the opposite side of pleurisy, to facilitate ventilation. Physical therapist must stand on the side of pleurisy with a hand under the abdomen of the patient to stimulate the diaphragm and a hand under the chest to stimulate the accessory respiratory muscles, forcing the inspiration. The physical therapist will induce a ventilation cycle based on apnea during inspiratory times. Apneas increase intrathoracic pressure to maximize the mobilization of the pleura. Other recommended types of exercises are diaphragmatic breathing, relaxation breathing exercises, and trunk rotations (5-10 minutes, three times per day), cough control exercises.

In the active phase of pleural disease, incentive spirometry (fig. 8), daily used, it is an useful tool with positive results on liquid resorption and thoracic expansion (19,20).



Fig. 8. Incentive spirometry devices

Patients with PE must, also, be advised to have an active lifestyle. Early mobilization and daily walking are recommended, as soon as possible from the first day of diagnosis and continue for at least 3 weeks.

When there is associated pain, physical therapist should do massage of the paravertebral muscle and shoulder muscle (21). Also, the patients could be educated for superior or inferior costal type of breathing (19, 20).

After the acute liquid phase, the exercises are focused on diaphragm training. The exercises consist

of abdominal-diaphragmatic breathing, full cycles of inspiration/expiration, massage to stop painful parietal contractions, posture correction, and bronchial drainage. After one month, the exercise for coastal expansion must be started, to re-expand the lung by lateral inclinations, rotations, upper arm lifting from lateral decubitus on a pillow, asymmetrical suspension with espalier, swimming (crawl style), slow nasal inspiration against resistance, diaphragmatic expansion (forced inspiration with patient half-seated and then supine), or, in ipsilateral decubitus, where the patient is performing maximal expiration followed by Valsalva maneuver (21).

For facilitating **pleural drainage**, RR includes active expiration with passive inspiration to favor the circulation of pleural fluid. Inspiration should be initially passive then active to favor pulmonary re-expansion, and bronchial drainage. After the thoracic drain is removed, the exercise for coastal expansion must be started.

In **pachypleuritis stage**, the pleural adhesions are installed, coastal spaces are narrow, and the diaphragm is elevated in the thoracic cage. The consequences are impaired breathing with dyspnea and diminished exercise tolerance. In these cases, chest exercises may be used, in order to do diaphragmatic mobilization and coastal expansion, but an important support may be represented by exercise training.

Firstly, the individual level of effort tolerance must be evaluated. The tests used are simple, as 6 minutes walking test 6 MWT or complex, as Cardiopulmonary exercise testing CPET (8). The goal is to determine the intensity of lower limb exercise training (7,17). Aerobic lower limb exercise training may be performed on a velo or treadmill, with the same program design as in COPD. The intensity of training is set up in order to reach 60-80% of the maximal power obtained at CPET or walking tests. The exercise training session work schedule may vary between 30 minutes and one hour, one session per day, 5-7 days per week. Every session must combine lower and upper limb training (cycle, velo, weights).

Walking, climbing stairs or running also have a beneficial role (22-25).

Literature studies support the role of physical therapy in improving the quality of life and promoting healing in pleural effusion. The study of G. Valenza-Demet showed a significant improvement of the forced vital capacity and forced

expiratory volume in the first second (FEV1) in patients who follow the physiotherapy program. Also, patients with RR had a better clinical and radiological progression, with a shorter length of hospitalization compared with those who followed only the pharmacological treatment (26.7 ± 8.8 vs. 38.6 ± 10.7 days) (19).

Conclusions

The case reports series revealed the main benefits of physical therapy in patients with different types of pleural involvement. An individualized respiratory rehabilitation program may be useful in the treatment of patients with pleural effusions because it contributes to a considerable reabsorption of pleural fluids with prevention of large pleural sequelae, optimization of lung expansion, diminished symptoms. The PR program may be also successful used in pachypleuritis with functional impact, leading to improved effort tolerance and quality of life.

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Ethics: An informed consent was obtained from all the patients presented in the article.

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Impact of pulmonary rehabilitation programs in improving health status in COPD patients

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Abstract

Pulmonary rehabilitation programme (PRP) have a positive impact on multiple outcomes of COPD, such as decreasing symptoms, increasing exercise tolerance and improving general health status. The aim of this study is to evaluate exercise tolerance impairment and to assess the impact of PRP in improving health status in patients diagnosed with COPD. It was conducted a prospective parallel group study in the Pulmonary Rehabilitation Department of the Clinical Hospital "V. Babes", Timisoara, from 2007 to 2010. The subjects included in the study were patients diagnosed with COPD stages I-IV GOLD, initially evaluated and started a PRP, then re-evaluated after 3 weeks and 6 months. The study group included 168 patients, 158 men, mean age 61.73 years. The initial evaluation revealed higher values of dyspnea scores using mMRC scale in advanced COPD stages (3.69 ± 0.77 in patients with COPD stage IV, vs 0.88 ± 0.5 in patients with COPD stage, $p < 0.05$), decreased Forced expiratory volume in 1 second (FEV1), P_{lmax} and P_Emax, and 6 minutes walking distance values corresponding with COPD severity stages. Re-evaluation at 3 weeks and 6 months after the pulmonary rehabilitation programme was applied showed significant improved dyspnea scores and exercise tolerance. The results of this study reconfirmed the positive and persistent impact of pulmonary rehabilitation programme on muscle dysfunction, dyspnea, and quality of life in COPD patients, regardless of severity.

Key words: COPD, pulmonary rehabilitation programme, 6 minutes walking test, pedometry.

Introduction

In Romania, in the last 10 years, the tuberculosis endemia has decreased progressively (1,2), but the neoplastic and bronchial obstructive pathology mainly determined by risk behaviours such as smoking, and prolonged exposure to occupational or environmental respiratory pollution has gradually increased (3-6). Chronic obstructive pulmonary disease (COPD) remained one of the most common causes of hospitalization in the pulmonology departments, despite the general concern in health education, especially related to the strategies smoking cessation (7-12). COPD is an important cause of decreased quality of life due to chronic disabling symptoms and exercise intolerance, which worsens over time. Airflow limitation and muscle deconditioning lead to the gradual decrease of physical activity from the early stages of the disease (13). Physical activity level is a predictor of the risk of exacerbation and increased mortality in COPD (14,15). Randomised and observational studies, supported by common clinical practice have confirmed the positive impact of pulmonary rehabilitation programme (PRP) on multiple

outcomes of COPD (16-18), and also in other chronic respiratory diseases, such as pulmonary fibrosis, sleep apnea syndrome, asthma (19-23). Often, patients with these disabling diseases are young (24-26) and require different types of interventions, including smoking cessation strategies, pharmacological therapy and PRP (27-30). The training of the peripheral musculature was established as an essential component of the PRP that aimed to prevent sedentary lifestyle, to improve the symptoms (especially the dyspnea), and to increase exercise tolerance (17). This study aims to identify the presence of skeletal muscular dysfunction and exercise tolerance impairment in patients diagnosed with COPD, and to assess the benefits of PRP when it is associated with specific pharmacological therapy.

Materials and methods

A prospective parallel group study was conducted in order to evaluate the muscular dysfunction in COPD patients and the impact of pulmonary rehabilitation programs on symptoms, respiratory function and exercise tolerance.

The study was conducted in the Pulmonary Rehabilitation Department of the Clinical Hospital "V. Babes", Timisoara, from 2007 to 2010, according to Good Clinical Practice criteria. All patients were initially evaluated and started a PRP, then re-evaluated after 3 weeks and 6 months. The subjects included in the study were patients diagnosed with COPD stages I-IV GOLD, without signs of acute exacerbation or clinically manifested respiratory failure and without significant associated pathology.

The inclusion criteria were: patients diagnosed with chronic obstructive respiratory disease who presented dyspnea, and/or limitation of effort capacity, with mild to severe functional limitation (Forced Expiratory Volume in 1 second less than 80%), with stable clinical condition on optimum bronchodilator therapy, non-smokers, former smokers or smokers included in a smoking cessation programme. The patients were also motivated and made able to understand and cooperate in the investigations and rehabilitation programme. Patients with neuromuscular or major locomotives deficits, alcoholics, patients with severe hypercapnic respiratory failure and those with acute, incontrollable cardiovascular disease or decompensated heart failure were excluded.

Pre and post rehabilitation program patient assessment included: measurement of respiratory functional capacity by spirometry using a Jaeger-type spirometer (Viasys, Germany), P_{Imax} and P_E_{max} assessment, the 6-minute walking test (6MWT) exercise tolerance evaluation, comprehension force testing (in kg-force) at the level of the dominant upper limb using a Dynatest type dynamometer (Riester brand - Germany).

Pulmonary rehabilitation programs (PRP) included:

a. Training of the lower limbs muscles performed by walking on a rolling mat or on an ergometric bicycle, pedometer monitored lower extremities light aerobic gymnastics or walking-at-will. There was a gradual increase in the intensity and duration of the sessions, from 5 minutes initially with repeated breaks of 3-4 minutes, to an effective minimum of 20 minutes.

b. Training of upper limb muscles using ergometric levers, weights of different sizes, dynamometers, tubes / elastic bands.

c. Exercises to increase joint flexibility in order to increase the degree of suppleness of movements, especially in elderly patients who frequently have joint changes (arthrosis / arthritis). The exercises

consisted of flexion movements - repetitive extensions, with extensive and complete muscular trips. The length of the program ranged from 3-12 weeks (minimum 3 weeks), 3-5 sessions per week, with a minimum duration of 20-30 minutes per day. The initial increase in the effort volume was achieved by increasing the frequency or duration of the trainings. When we reached 45 minutes of training / day, at a frequency of 5 days / week, the intensity of their training progressively increased.

Each training session consisted of the muscle heating period (10 minutes), the training session itself (fast walking, pedaling, rowing) and the relaxation session (10 minutes). In order to achieve a proper control of the intensity of the training, we used the pulse-oximeter, the blood-pressure monitor and the effort self-perception scale (Borg scale).

Results The study group included 168 patients, 158 men and 10 women, with COPD stages I-IV GOLD, who were proposed to follow the pulmonary rehabilitation programme. There were no deaths during the 6 months of monitoring. The initial comparative evaluation of patients is shown in table 1. The majority of patients were male (93%), in all GOLD stages groups. The average age increased gradually from COPD II to COPD IV, the average growth per stage being 3.22 years of age. Body mass index decreased as COPD severity was higher. As the waist did not change significantly between groups, body weight decreased steadily as the severity of the disease and age increased. Only 95 patients had BMI within normal limits, 28 were underweight, with an average value of 18.1kg/m² (BMI minimum value = 14.2kg/m²), and 45 of them were overweight, with an average value of 32.3kg/m² (maximum BMI = 35.5kg/m²).

Forced expiratory volume in 1 second varied with COPD severity stages, between 80.55±10.6% in stage I, respectively 64.21±9.5% in stage II, 39.50±5.86% in stage III, and 24.49±7.54% in stage IV. The P_{Imax} and P_E_{max} measurement detected decreased values from the healthy control group to the COPD group IV: P_{Imax} from 7.20kPa to 4.18kPa (with an average decrease of 1.06kPa per stage), respectively P_E_{max} from 8.56 to 7.37kPa (with an average decrease of 0.40kPa per stage). It was noted that the ratio between the average values of P_{Imax} and P_E_{max} increased steadily in favor of P_E_{max} from COPD II group to COPD IV group (respectively values of 1.18 in COPD II group, 1.40 in COPD III group and 1.76 in COPD group IV). In dynamics, the subsequent evaluations at 21 days and

at 6 months did not detect significant changes in the average values obtained within the study groups. Dyspnea assessment using mMRC and Borg scales revealed higher values in advanced COPD stages. Thus, the mean values obtained for the mMRC scale started from 0.03 in the healthy control group and reached 3.69 in the COPD IV group, and on Borg scale reached 4.85 units from 2.18. After the completion of the PRP, statistically significant improvements ($p < 0.05$) of dyspnea scores were detected on both scales, both after 21 days and after 6 months. Thus, the average decrease in the degree of dyspnea on mMRC scale was -0.39 units, and the average difference was -0.76 units on Borg scale. The 6-minute effort test (6MTW) initially showed a decrease in effort tolerance as lung function decreased, but PRP had a significant impact on exercise capacity, the distance travelled after 21 days and after 6 months was significantly greater than the initial one (table 2). The average distance travelled by patients according to the stage of COPD, before and after the PRP is shown in figure 1.

Table 2. Comparative statistical analysis of the distance travelled at 6MTW between the COPD groups II-IV, pre and post rehabilitation (Two-way ANOVA test and Bonferroni post-tests)

COPD II vs COPD III				
Time	COPD II	COPD III	Difference	95% CI of diff.
Initial	472.5	415.0	-57.47	-145.5 to 30.54
21 days	540.6	482.4	-58.20	-146.2 to 29.81
6 months	524.6	456.3	-68.27	-156.3 to 19.74
Time	Difference	t	P value	Summary
Initial	-57.47	1.829	$P > 0.05$	ns
21 days	-58.20	1.853	$P > 0.05$	ns
6 months	-68.27	2.173	$P > 0.05$	ns

COPD II vs COPD IV				
Time	BPOC II	BPOC IV	Difference	95% CI of diff.
Initial	472.5	350.2	-122.3	-208.7 to -35.87
21 days	540.6	400.6	-140.0	-226.4 to -53.55
6 months	524.6	387.9	-136.7	-223.1 to -50.25
Time	Difference	t	P value	Summary
Initial	-122.3	3.964	$P < 0.001$	***
21 days	-140.0	4.537	$P < 0.001$	***
6 months	-136.7	4.430	$P < 0.001$	***

COPD III vs COPD IV				
Time	BPOC III	BPOC IV	Difference	95% CI of diff.
Initial	415.0	350.2	-64.83	-130.1 to 0.4298
21 days	482.4	400.6	-81.78	-147.0 to -16.52
6 months	456.3	387.9	-68.41	-133.7 to -3.150
Time	Difference	t	P value	Summary
Initial	-64.83	2.783	$P < 0.05$	*
21 days	-81.78	3.511	$P < 0.01$	**
6 months	-68.41	2.937	$P < 0.05$	*

For patients taking outdoor walks, there was a progressive improvement in the walking distance per day highlighted on the pedometer, with a daily average values shown in table 3. The minimum average value was registered in the COPD group IV (2476 steps / 24 hours), but with the highest increase at 6 months after PRP (+636 steps / 24 hours). In COPD group III, the daily activity increase was + 597 steps / 24 hours after 6 months, and COPD group II registered the lowest increase of +540 steps / 24 hours (probably because the patients in this group performed the best preserved physical activity).

The evaluation of the muscular force by dynamometry (the force of comprehension at the level of the dominant arm) revealed the decrease of the average values from the healthy control group to COPD stage IV, respectively from 0.865kg-force to 0.675kg-force.

Table 3. The values obtained at pre and post rehabilitation pedometry

BPOC stage	Initial Pedometry	Pedometry after 6 months	Difference in metres	P
BPOC II	8724	9264	+540	< 0.05
BPOC III	5528	6125	+ 597	< 0.05
BPOC IV	2476	3112	+ 636	< 0.01

Discussion

In the present study, the results of the initial evaluation of COPD patients demonstrated the presence of muscle deconditioning and decreased exercise tolerance, decreased motivation, with negative repercussions on patients' lives in most cases. This study confirms the importance of introducing pulmonary rehabilitation programs in the treatment of symptomatic COPD patients. The PRP main goals are to decrease the level of dyspnea, increase effort tolerance and improve the quality of life (18,31).

Our results were also confirmed by a large study involving 647 patients from 9 rehabilitation centres in California, who registered significant improvements in symptoms and quality of life after rehabilitation, at 3-, 6-, 12-, and 18-month. The study confirmed also significant reductions in all measures of healthcare utilization. Over 18 months, benefits gradually declined, but levels remained above baseline values (32). In another cohort that included 76 patients with COPD, Mahler et al. described the TDI decline with - 0.7 (SD \pm 2.9) at 2 years (33). Also, dyspnoea has been shown to be a predictor of survival in COPD patients. In a prospective, multicenter trial conducted by Nishimura and his colleagues on 227 patients with

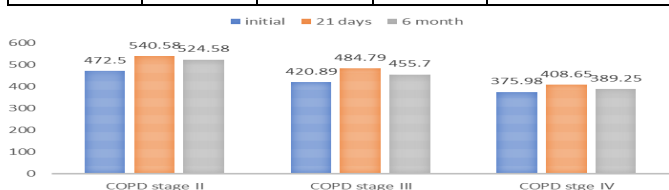


Fig 1. 6MWD (m) in stage II to IV COPD patients

COPD, survival was not significantly associated with COPD GOLD staging, and dyspnoea assessed by the MRC questionnaire was a better predictor of survival ($p < 0.05$) (34). Exercise capacity assessed by 6MWT showed a gradual decrease in physical performance as COPD severity increased. The recorded values gradually decreased compared to the normal values predicted from the healthy control group to the COPD stage IV group.

Patients with COPD have an annual decrease in distance walked in 6 minutes (6MWD) of approximately 25 meters, which is 5 times greater than in the healthy subject (35,36). Pinto-Plata and colleagues evaluated patients with COPD for 2 years, and they observed that the decline of 6MWD was 26 (SD \pm 37) meters / year, while for healthy persons of similar age the distance decreased by 12 (SD \pm 25) meters / year. In our study, after the implementation of PRP, the reassessment of patients at both 21 days and 6 months showed statistically significant increases (with high significance, $p < 0.001$) of the average values of 6MWD in all COPD stages groups (36). The highest increase was recorded on all groups at 21 days, with the average value of + 61.94 m (respectively + 68.8m in the COPD II group, + 67.34m in the COPD III group and + 50.40m in the COPD group IV). The 6MWD was maintained after 6 months compared to the initial test, but smaller than at 21 days. Thus, at 6 months the average growth on all groups was + 42.25m (respectively + 52.08m in the group COPD II, + 41.28m in the group COPD III and + 33.4m in the group COPD IV). This study reconfirmed the clinical relevance of 6MWT, as 6MWT is known as a predictor of survival. It has been shown that the absolute value of 6MWT is a better predictor of mortality in COPD patients compared with FEV1 and BMI. The value of 6MWD lower than 350 meters is has been demonstrated to be associated with an unfavourable prognosis of the disease (35-39). In this study, the improvement obtained in average values was over 40 meters (respectively 61.94m at 21 days and + 42.25m at 6 months), which corresponds to the proven favourable clinical response threshold. Clinical studies reported that pulmonary rehabilitation increases the 6MWS by 15-20% (36,37), situation in which the current results were also included.

Pedometry has shown an increase in the daily activity of COPD patients (39,40). The use of pedometers proved to be a very good motivation for patients to increase their daily physical activity, but

the values recorded were very varied within each subject, depending on the clinical status, the weather, the days of the week and certain current problems of the patients, the duration and the type of physical training sessions, aso. It is possible that the simple wearing of the pedometer, with the patients' awareness that they were being "watched" caused them an increasing in their physical activity on the days when they were evaluated. However, we noticed the attractiveness of these pedometers for patients, regarded as motivating, cheap and easy-to-handle "personal toys", which made some patients buy them.

Multiple evidences indicate that COPD is a systemic disease that may severely affect muscle function in patients diagnosed with this condition (13,41). Decreased muscle strength is independently associated with poorer exercise capacity and lower extremity functioning in COPD patients, and this is the main reason for targeting improved exercise capacity through pulmonary rehabilitation (39). In our study, after the completion of the PRP, the values recorded by dynamometry retesting were improved compared to the initial testing both at 21 days and at 6 months. In the COPD stage II group, an increase with 0.031kg-force at 21 days and 0.021kg-force at 6 months was calculated, in the COPD stage III group the improvement was 0.030kg-force, respectively 0.018kg-force. The highest improvement was obtained in COPD stage IV group, namely 0.037kg-force at 21 days and 0.024kg-force at 6 months. All patients received also pharmacological treatment respecting the GOLD guideline (42,43).

For maximum benefit, peripheral muscle training should combine several types of exercises: strength, endurance, flexibility, both in the lower and upper limbs muscles. Our findings supports the fact that earlier attention to skeletal muscle strength and/or endurance training of skeletal muscles could represent important components of disability prevention.

Conclusion

The results of this study demonstrated a favourable impact of pulmonary rehabilitation programme on muscle dysfunction, dyspnea, and quality of life in COPD patients, regardless of severity, with statistically significant and persistent improvements (6 months after PRP completion).

Declaration of conflict of interests

There is no conflict of interest for any of the authors regarding this paper.

Informed consent

An informed consent was obtained from the patients included in this study.

Table 1. Initial comparative assessment of patients according to GOLD stage

Parameter	Control group (healthy) n=32	COPD stage I n=27	COPD stage II n=43	COPD stage III n=45	COPD stage IV n=53
Gender Male/female	29/3	26/1	41/2	42/3	49/4
Urban/rural	17/15	14/13	22/21	24/21	27/26
Age, years mean-DS	55.65±15.58	56.66±10.35	62.93±1.2	63.15±1.09	64.20±8.31
Smokers/non-smokers	14/18	15/12	28/15	33/12	40/13
FVC%	96.54±11.0	89.12±11.2	72.63±1.37	57.04±1.037	37.50±11.77
FEV1%	96.2±9.8	80.55±10.6	64.21±9.5	39.50±5.86	24.49±7.54
FEV1/FVC	101.65±11.1	69.38±11.8	65.92±1.23	63.21±1.565	59.57±19.43
PI predicted, l	10.57±3.6	10.53±0.14	10.50±0.07	10.49±0.17	10.45±0.17
PI test, l	7.86±1.5	7.92±2.4	6.49±2.4	5.32±2.5	4.43±2.02
PI max%	71.67±25.0	75.2±1.9	59.36±3.13	49.67±2.315	40.83±18.39
PE predicted, l	13.30±2.9	12.74±2.3	13.51±0.17	12.72±2.12	13.04±1.46
PE test, l	9.59±0.26	9.70±2.03	8.480±3.28	8.39±2.98	7.76±3.32
Weight, kg	79.40±18.4	74.33±17.9	74.23±1.46	72.57±1.623	71.05±18.72
Waist, m	169.18±8.7	168.33±5.4	169.60±8.8	168.4±7.69	168±8.94
BMI, kg/m ²	27.55±4.7	26.1±5.7	25.96±5.6	25.58±5.4	25.10±6.34
6 MWT, m	561.81±110.2	515.5±78.05	467.14±123.78	421.84±117.36	394.57±104.31
Dynamometry, kgf	0.865±0.07	0.846±0.06	0.823±0.03	0.82±0.16	0.67±0.03
Dyspnea BORG scale	2.18±0.9	2.44±0.97	3.64±2.13	3.77±1.39	4.85±2.11
Dyspnea MRC scale	0.03±0.01	0.88±0.5	1.21±0.47	2.86±0.79	3.69±0.77

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Pulsed short waves in the remineralization of alveolar bone structures of the jaw in patients with diabetes mellitus – a series of cases

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Abstract

This clinical study included three patients aged between 50 and 78 years who had chronic marginal periodontitis and type 2 diabetes mellitus, diseases that are frequently associated due to changes occurring in polymorphonuclear cells, as well as to alterations of microcirculation. No bone augmentation therapies were performed. Bone regeneration was strictly influenced by conventional periodontal therapy, supplemented with ten pulsed short wave sessions applied to the lower face shortly after closed periodontal curettage. The allocated time was ten minutes for the first two sessions, and 15 minutes for the following 8 sessions. Clinical and radiological evaluations were performed at the time of presentation, as well as after initiation of pulsed short wave therapy: in the first case, three weeks after initiation of therapy and three years after the end of complex oral rehabilitation; in the second case, eight weeks after the onset of pulsed short wave therapy and in the third case, five weeks after the onset of pulsed short wave therapy. The results were significant in all three cases, demonstrated radiologically by the same type of radiological examination at identical scales. Bone remineralization was obvious in the alveolar processes of the jaw. Although further studies in this direction are necessary, the results are both clinically and radiologically significant.

Key words: *pulsed short waves, alveolar bone resorption, periodontal disease, diabetes,*

Introduction

Resorption and demineralization of the alveolar bone structures of the jaw in the presence of teeth are frequently found in outpatient dental services and are associated with periodontal diseases, which may occur in aggressive, chronic, necrotic and periodontal abscess forms (1).

The following factors are involved in the etiology of periodontal diseases:

Intrinsic factors

Systemic diseases are frequently involved: diabetes, osteoporosis, autoimmune diseases, cardiovascular diseases, endocrine diseases, renal diseases, dermatological diseases, digestive diseases, blood diseases and immune deficiencies, psychosomatic dysfunctions, vitamin deficiencies, the hereditary factor (1,2), etc.

Extrinsic factors

The local predisposing factors of alveolar bone destruction are represented by:

Irritating mechanical factors, lifestyle (deficient oral hygiene, smoking, trauma, stress), functional factors (1,2,3).

The determining factor of periodontal disease is bacterial plaque, which forms under poor oral hygiene conditions (1,2,3).

As regards the treatment of periodontal diseases, this includes extremely complex individualized stages and the therapeutic approach varies depending on the degree of tooth mobility, the response to local therapy, the number and position of residual teeth, the general health status, systemic therapy, patient compliance with treatment (1).

For good bone remineralization results, the following are required: educating and motivating the patient to achieve individualized oral hygiene, as well as eliminating bad habits (e.g. smoking, interposing objects between the dental arches), removing local irritating factors (supra- and subgingival scaling, root surface planing, adaptation or replacement of oversized fillings and prosthetic restorations, treatment of caries with radicular evolution, extraction of root rests that represent local irritating factors), required endodontic (re)treatments, curettage of periodontal pockets, determination of bacterial spectra in the periodontal

pockets, antibiotic therapy targeted on existing periodontal germs, evaluation of tooth mobility and dento-dental immobilization (when needed), elimination of static and dynamic occlusal interferences, fabrication of trays for bruxomanic patients (1,2).

Characteristics relevant to alveolar bone regeneration using pulsed short waves

Using pulsed short waves is beneficial for cells, stimulating the release of increased amounts of energy, required for repair processes. The biological and therapeutic effects of pulsed short waves are explained by an activation of cellular enzymatic reactions and the connective vascular system. The important biotrophic effect is represented by an improvement of intra/extra and transmembrane ion mobility, leading to a rebalancing of the Na⁺ and K⁺ pump, of the associated ATP-ase activity and implicitly, of all active transport systems, which results in the prevention or elimination of residual depolarized states, with the restoration of the physiological resting membrane polarity (4).

Pulsed short waves are perceived to have a non-thermal effect on human tissues; research demonstrates that these may have caloric effects in certain stages of treatment. The long duration of the pause in relation to the duration of impulses allows the caloric effects of this high energy to disperse or even disappear, so that the biological effects have a longer duration and decrease more slowly. The frequency of the impulses was calculated so that each impulse overlaps a persistent biological effect produced by the preceding impulse. Thus, the biological effects cumulate over a certain time period (5). Research confirms the fact that pulsed short waves can also be used safely at higher intensities, even in the presence of metals inside tissues [Seiger and Draper (2006)] (6,7). The effects of pulsed short waves are the cellular biotrophic effect, stimulation of local cellular activities, reduction of inflammatory processes, reduction of edema, stimulation of collagen and fibrin deposits, tissue regeneration (8). Some studies also provide solid evidence of the “non-thermal” effects on the cell membrane (Luben 1997, Cleary 1997).

The main effects of the pulsed magnetic field seem to occur in the cell membrane and involve ion transport along the membrane. As regards the influence on alveolar bone processes, the following main effects were taken into consideration: the increase in white blood cells, histocytes and fibroblasts in a wound, and the improved rate of

edema dispersion. Induction of hematoma absorption and reduction of the inflammatory process contribute to the rapid orientation of fibrin, stimulating collagen deposition. At the same time, they contribute to collagen stratification in an early stage, stimulating osteogenesis (4).

Objectives

To report the cases of three patients aged between 50 and 78 years who had chronic marginal periodontitis and type 2 diabetes mellitus, and who underwent pulsed short wave procedures as an adjuvant therapy to periodontal treatments, for alveolar bone regeneration and remineralization.

Hypothesis

The research aims to evidence alveolar bone remineralization and regeneration in the absence of associated bone augmentation treatment.

Material and method

The study was conducted based on the approval of the Ethics Committee of the Iuliu Hațieganu University of Medicine and Pharmacy Cluj-Napoca, as well as on the subjects' informed consent.

Research protocol

In the period 2015-2017, the patients presented to the dental office, requiring complex oral rehabilitation. Among other dental diseases, they had chronic marginal periodontitis in the context of the presence of type 2 diabetes mellitus, with which this is frequently associated due to polymorphonuclear (PMN) defects and alterations occurring in microcirculation (1,9). Diabetic pathology was followed up by a specialist in diabetes and nutritional diseases, being within normal limits in the period of dental treatments. Following local therapy, the patients were referred to the rehabilitation service of the Medical Clinic II in Cluj-Napoca for pulsed short wave procedures targeted on the lower face, on the areas where teeth affected by periodontitis were present.

Medical history data

a. Subject no. 1. Patient C.F. aged 50 presented to the dental office on 10.11.2014 for gingival bleeding and persistent pain in the maxillary front teeth, as well as difficult mastication.

The patient was multiparous, a non-smoker, she worked in pastry, she did not perform physical exercise and did not strictly follow the diets indicated by her treating doctor.

General disorders – type 2 diabetes mellitus diagnosed at the age of 45 years, followed up by the treating diabetologist.

Tests applied

1. Examination of the mucosae

The mobile and passive-mobile mucosae were supple, elastic, pink, without clinically detectable pathological masses. The marginal gingiva was hyperplastic, bleeding on minimal contact (e.g. during mastication, tooth brushing, etc.).

2. Examination of the salivary glands

The salivary glands were permeable, and saliva was in sufficient amounts; no present or previous hyposialia, xerostomia or hypersialia episodes were found.

3. Prosthetic diagnosis

Maxilla – termino-latero-lateral T-L,L edentation (Costa's classification), treated prosthetically by a semi-physiognomic metal acrylic bridge from 1.3 to 2.7 with distal extension to two teeth, i.e. 1.4;15 (P.P.F X-X-1.3-1.2-1.1-2.1-2.2-2.3-X-2.5-X-2.7). Treatment was performed ten years before; at the time of presentation, the prosthetic restoration no longer corresponded to the tooth neck adaptations (Fig. 1).

Mandible – total edentation – a resorbed bone ridge with a sharp margin, which is specific to edentation due to periodontal disease. A removable denture was placed about ten years before; during this period, the prosthetic restoration became inadequate because of bone resorption (Fig. 1.).

4. Dental, endodontic and periodontal diagnosis established after removal of FPD

Crown destruction was of carious etiology in teeth: 1.3;1.2;2.1; 2.2;2.3;2.5. No tooth migration was found considering that the teeth were immobilized using the bridge body.

Gingival retraction was calculated from the level of the gingival margin to the FPD, evidenced circularly in 2.5 and 2.7, with a 3 mm degree of retraction.

The bacterial plaque index was 2 (Silness and Loe), with a plaque retention index of 2 (Loe), the calculus index was 1 according to Marthaler (2), the periodontal inflammation index according to Russel was 6, the Mühlemann papillary bleeding index was 3 (2).

The presence of periodontal pockets and tooth mobility was in close correlation with bone demineralization (which is also obvious in Fig. 1).

Evaluation of the probing depth and tooth mobility: 1.3 periodontal pocket 8.5 mm on the mesial surface assessed by periodontometry at a constant pressure, tooth mobility grade 1; 1.2 chronic apical periodontitis with constant acute episodes, tooth mobility grade 3 accompanied by axial mobility

greater than 3 mm (1,2); 1.1 crown destruction, chronic apical periodontitis, distal periodontal pocket 11.5 mm, mobility grade 2; 2.1 mobility grade 0; 2.2 chronic apical periodontitis, mesial periodontal pocket 8 mm, mobility grade 1; 2.3 chronic apical periodontitis, mesial periodontal pocket 3 mm, mobility grade 1; 2.5 mesial periodontal pocket 5 mm, mobility grade 0; 2.7 periodontal pocket 3.5 mm on the mesio-vestibulo-distal surfaces, mobility grade 1, furcation involvement grade 0 (1).



Fig. 1. Initial OPT X-ray, which indicates T-L,L maxillary edentation and total mandibular edentation, respectively, demineralization of alveolar bone septa, especially in 1.3, 1.1, 2.1, 2.2, 2.5, 2.7, and the presence of apical reaction in 1.2.

Complex oral rehabilitation was required, for which the following were performed:

Supra- and subgingival scaling, as well as oral hygiene instruction, provided before removal of the prosthetic restoration, which was followed by extraction of tooth 1.2.

Dental and endodontic treatments

Softened dentin removal, as well as endodontic retreatment in teeth 1.1, 2.1, 2.2, 2.3 was performed. Corono-radicular reconstruction was carried out in teeth: 1.3, 1.1, 2.1, 2.2, 2.3, 2.5.

Surgical and periodontal treatments

Given the long duration of chronic marginal periodontitis, initiation of periodontal therapy immediately after endodontic therapy was chosen (3); antibiotic therapy with clindamycin 600 mg 3x1/day for five days was also administered.

Periodontal therapy consisted of irrigation of periodontal pockets with antiseptic chlorhexidine gluconate solution (10). An open periodontal approach was used, which consisted of scaling and root planing using both ultrasound loops and manual Gracey curettes; with the same curettes, the inner

epithelium of periodontal pockets was also curetted (11).

Considering tooth mobility, throughout the duration of treatment, the teeth were stabilized in order to favor tissue healing. Immobilization was performed using a provisional acrylic FPD, which could be removed whenever needed.

After 7 days, apical resection of the teeth with chronic apical periodontitis: 1.1; 2.2; 2.3 was performed.

Pulsed short wave treatment

Pulsed short wave therapy in this case was initiated 7 days after periodontal curettage and started on the day of apical resection, four hours before the intervention. A therapeutic course of 10 daily pulsed short wave sessions was conducted. An impulse frequency of 80/s during the first 2 sessions and 160/s for the rest of the sessions was used, with penetration steps ranging between 1 and 2 (4).

The locating emitter was placed at a minimum distance of 1 cm from the left anterolateral region of the lower face.

Advanced remineralization of the maxillary bone structure was observed three weeks after initiation of pulsed short wave therapy and apical resection, four weeks after completion of closed periodontal curettage, respectively.

Radiological aspects at three weeks: the marginal alveolar bone defects were visibly remineralized, the bone defects resulting from apical resections were minimally visible in the apex of tooth 2.3. The bone defect resulting after extraction of tooth 1.2 was minimally remineralized considering local as well as general pathology.

A total physiognomic metal-ceramic FPD was placed in the patient's maxilla, accompanied by an acrylic removable partial denture. In the mandible, an acrylic removable complete denture was placed.

Tooth mobility clinically improved up to physiological limits (1) (mobility grade 0) (given that FPD was made of three components in order to stabilize the removable partial denture), without the presence of depth on periodontal probing.

b) Subject no. 2. Patient C.R., female, aged 78, presented to the dental office on 18. 03.2015, complaining of tension in the jaw bones and teeth, gingival bleeding during tooth brushing, perceptible tooth mobility, mastication difficulties, hesitation in cutting and grinding food.

General disorders – type 2 diabetes mellitus diagnosed at the age of 70 years, followed up by the treating diabetologist, trigeminal neuralgia

diagnosed at the age of 40, Biermer anemia diagnosed at the age of 77 years.

The patient was nulliparous, a non-smoker, retired (a former civil engineer), she performed physical exercise regularly considering her age and systemic diseases, she constantly followed the indicated diets and the prescribed medication.

Tests applied

1. Examination of the mucosae

The mobile mucosa was atrophic and glossitis was present (12), both the tongue and the mucosa showed linear lesions secondary to vitamin B12 deficiency (13,14,15), the burning sensation, candidosis and xerostomia occurred quite rarely given the periodic treatments administered and strictly followed, symptoms were transient with a tendency to periodic recurrence (15). The marginal gingiva showed no hyperplastic appearance, but tended to bleed during tooth brushing.

2. Examination of the salivary glands

The salivary glands were permeable; however, the amount of saliva was reduced.

3. Prosthetic diagnosis – Maxilla - termino-terminal edentation (Costa's classification), treated by a total physiognomic metal-ceramic FPD from 1.1-1.2-1.3-(1.4) 1.4-distal extension, and FPD in 2.1 and 2.2, as well as by an acrylic removable partial denture.

Mandible – left uniterminal edentation (Costa's classification) without a prosthetic restoration, single tooth metal-ceramic FPD in 3.5; 3.4; 4.4; 4.5; 4.6; 4.7 (Fig. 2).

The prosthetic treatments had been performed seven years before as part of complex oral rehabilitation.

4. Periodontal, dental and endodontic diagnosis

The degree of gingival retraction in the teeth covered with FPD was calculated from the margin of the prosthetic restoration, and for the teeth without prosthetic restorations the distance from the enamel-cement junction to the gingival margin was measured (1).

Periodontal pocket depth was measured using periodontometry at a constant pressure, with conventional periodontal probes having a 0.5 mm blunt tip and an 11.5 mm long active part (2).

In the maxillary frontal area, gingival retraction of 3 mm was found in 1.3, 1.2, 1.1, 2.1, and of 1 mm in 2.2.

In the mandible, gingival retraction was present in the frontal area in 3.3, 3.2, 3.1, 4.1, 4.2, 4.3 vestibular 3.5 mm, lingual 3.3, 3.2, 4.2, 4.3 1 mm, 3.1, 4.1 3.5 mm. In the lower premolars 3.4, 3.5, 4.4, 4.5, gingival retraction was 2 mm circular, and in the

molars, retraction was 1 mm circular, identical in the molars covered with FPD 4.6, 4.7 and in 3.6, uncovered with FPD.

The degree of tooth mobility was also determined after removal of FPD.

Tooth migration was strictly found in the lower frontal area, where a flaring of the entire group of teeth of 1 mm for lateral incisors and canines and 1.5 mm for central incisors was also found.

The bacterial plaque index was 2 (Silness and Loe), the plaque retention index was 2 (Loe), the calculus index was 2 – according to Marthaler (1), the periodontal inflammation index was 2 according to Russel, the Mühlemann papillary bleeding index was 2 (2).

The crown destruction found both after FPD removal and in teeth without FPD was of carious etiology, as well as attrition at occlusal and incisal level, observed for all teeth without FPD.

Teeth 1.3, 1.1, 2.1, 3.6, 3.4, 3.3, 3.2, 4.3, 4.4, 4.5 showed carious processes.

Evaluation of probing depth and tooth mobility: 1.3 – periodontal pocket 5.5 mm on the disto-palatal surface, tooth mobility grade 1; 1.2 – mesio-vestibular periodontal pocket 3.5 mm, tooth mobility grade 1; 1.1 – distal periodontal pocket 3.3 mm, tooth mobility grade 0; 2.1 – vestibulo-disto-palatal periodontal pocket 5 mm, mobility grade 1; 2.2 – vestibulo-mesial periodontal pocket 3.5 mm, crown reconstruction with a corono-radicular device, mobility grade 2; 3.6 – vestibular periodontal pocket 5 mm, with furcation involvement grade 1 (1), mobility grade 1; 3.5 – vestibular periodontal pocket 5 mm, treated endodontically, corono-radicular reconstruction CRD, tooth mobility grade 0; 3.4 – vestibular periodontal pocket 5 mm, tooth mobility grade 1; 3.3 – vestibulo-mesial periodontal pocket 5 mm, treated endodontically, tooth mobility grade 1; 3.2 – vestibulo-mesial periodontal pocket 5.5 mm, treated endodontically, tooth mobility grade 2; 3.1 – periodontal pocket 6.5 mm, mobility grade 2 with axial mobility 2 mm; 4.1 – periodontal pocket 6.5 mm, mobility grade 3 with axial mobility 2 mm; 4.2 – vestibulo-mesial periodontal pocket 6 mm, disto-lingual physiognomic filling; 4.3 – vestibulo-mesial periodontal pocket 5 mm, treated endodontically, tooth mobility grade 0; 4.4 – vestibular periodontal pocket 3 mm, treated endodontically and incompletely filled, tooth mobility grade 0; 4.5 – mesial periodontal pocket 5 mm, treated endodontically and incompletely filled, tooth mobility grade 2; 4.6 - mesio-vestibulo-disto-lingual

periodontal pocket 6.5 mm, with furcation involvement grade 2, treated endodontically and incompletely filled, apical osteolysis of the distal root (without symptoms specific to apical periodontitis), tooth mobility grade 2; 4.7 - mesio-vestibulo-disto-lingual periodontal pocket 6.5 mm, with furcation involvement grade 1, treated endodontically and incompletely filled, apical and interraderic osteolysis (extending to the entire interraderic bone septum), tooth mobility grade 3 (with axial mobility higher than 3 mm).

Observation

The preexisting endodontic treatments could not be restored given the biomaterial used for endodontic fillings and the root canal calcifications due to the age factor, as well as the dental treatments performed over time. The periapical osteolyses present in the teeth that were not extracted did not pose any risk, some of them being due to pathological mobility.



Fig. 2. Initial OPT X-ray performed after ultrasonic scaling and individualized oral hygiene instruction. T-T maxillary edentation and terminal mandibular edentation, resorption of alveolar bone structures and interraderic bone septa are evidenced.

Treatment

Ultrasonic scaling and patient's instruction to use auxiliary oral hygiene methods, an oral irrigator in this case, followed by extraction of the unrecoverable teeth 3.1; 4.1; 4.7, and removal of the existing FPD seven days after the date of the last extraction.

Dental and endodontic treatments

The carious processes were treated in teeth 1.3, 1.2, 1.1, 2.1, 3.6, 3.4, 3.3, 3.2, 4.3, 4.4, 4.5.; endodontic treatments were performed in teeth 1.3, 1.2, 2.1.

Corono-radicular reconstruction was carried out in teeth 1.3, 1.2, 2.1, 3.3, 3.2, 4.2, 4.3, 4.4, 4.5, 4.6. In 2.2, the preexisting CRD was removed and the corono-radicular reconstruction was restored.

Periodontal treatments

Periodontal therapy was initiated after completion of dental and endodontic treatments (3); antibiotic therapy with amoxicillin 500 mg 4x1/day for five days was also administered.

Periodontal therapy consisted of irrigation of periodontal pockets with antiseptic chlorhexidine gluconate solution (10). A closed periodontal approach was used, which comprised dental scaling and root planing using both ultrasound loops and manual Gracey curettes (11); with the same curettes, the inner epithelium of periodontal pockets was also curetted.

Considering tooth mobility, throughout the duration of treatments, the teeth were stabilized in order to favor tissue healing; immobilization was performed with provisional maxillary and mandibular acrylic FPDs.

Pulsed short wave treatment

Pulsed short wave therapy in this case was initiated three days after completion of periodontal curettage. A therapeutic course of 10 daily pulsed short wave sessions was administered. The duration of the first two sessions was 10 minutes, the following eight sessions lasting 15 minutes. An impulse frequency of 80/s during the first 2 sessions and 160/s for the rest of the sessions was used, with penetration steps ranging between 1 and 2 (4).

The locating emitter was placed at a minimum distance of 1 cm from the left and right (alternatively from one session to another) anterolateral region of the lower face.

Clinically, tooth mobility returned to grade 0, which shows mobility within physiological limits (1), depths on periodontal probing being no longer present.

Prosthetic treatments

The patient had a total physiognomic maxillary metal-ceramic FPD placed in 1.3-1.2-1.1-2.1-2.2, accompanied by a Flexite base removable partial denture; in the mandible, total physiognomic single-tooth metal-ceramic FPDs were placed in 3.5; 3.4; 4.4; 4.5; 4.6 (on the patient's written request), and a total physiognomic metal-ceramic FPD was placed in 3.3-3.2-3.1-4.1-4.2-4.3.

c) Subject no. 3. Patient P.O., female, multiparous, aged 59, presented to the dental office on 04.07.2016, complaining of dental pain located in the upper jaw, abundant gingival bleeding during tooth brushing which had started about 12 months

before. The patient was a non-smoker, retired, sedentary, strictly complying with the recommended medication, but not completely following the recommended diets.

General disorders – type 2 diabetes mellitus diagnosed at the age of 52 years, followed up by the treating diabetologist.

Tests applied

1. Examination of the mucosae

The mobile and passive-mobile mucosae were supple, elastic, pink, without clinically detectable pathological masses. The marginal gingiva was hyperplastic, bleeding on minimal contact (e.g. during mastication, tooth brushing, etc.).

2. Examination of the salivary glands

The salivary glands were permeable, and saliva was in sufficient amounts; no present or previous hyposialia, xerostomia or hypersialia episodes were found.

3. Prosthetic diagnosis

Maxilla - L,A-L,L edentation (Costa's classification) treated by a semi-physiognomic metal-acrylic fixed complete denture placed about 16 years before in teeth 1.8-X-X-1.3-X-1.1-2.1-2.2-2.2-X-2.5-X-2.8 (Fig. 3).

Mandible – lateral edentation treated by a total physiognomic metal-composite fixed denture placed five years before. 3.8-X-3.5 (Fig. 3).

4. Periodontal, dental and endodontic diagnosis

The degree of gingival retraction in the teeth covered with FPD was calculated from the margin of the prosthetic restoration, and in the teeth without prosthetic restorations the distance from the enamel-cement junction to the gingival margin was measured (1).

Periodontal pocket depth was measured by periodontometry at a constant pressure, using a conventional periodontal probe with a 0.5 mm blunt tip and an 11.5 mm long active part (2).

In the maxilla, gingival retraction was found in 1.8, 1.3, 1.1, 2.3 5 mm circular (at the level of the four surfaces), in 2.1 3.5 mm vestibulo-mesial, in 2.2 5 mm vestibulo-disto-palatal, in 2.5 3 mm mesial, in 2.8 3.5 mm circular.

In the mandible, gingival retraction was found in 3.8, 4.8 5 mm circular, in 3.2, 3.1, 4.1, 4.2, 4.4, 4.5 4 mm circular, in 3.3, 4.3 3 mm circular, in 3.5 6 mm circular.

Tooth migration occurred considering that the patient lost her six-year-old maxillary molars before

the age of ten years, while the twelve-year-old molars were lost in early adulthood; thus, the wisdom molars were mesialized, remaining the last support in the molar group. Over the past months, the mandibular front teeth were displaced vestibularly in the form of a fan, the central and lateral incisors losing their points of contact by about 0.5 mm (Fig. 3).

The degree of tooth mobility was determined after FPD removal.

The bacterial plaque index was 3 (Silness and Loe), the plaque retention index was 2 (Loe), the calculus index was 3 according to Marthaler (1), the periodontal inflammation index was 8 according to Russel, the Mühlemann papillary bleeding index was 4 (2).

The crown destruction found both after FPD removal and in teeth without FPD was of carious etiology, as well as attrition at occlusal and incisal level observed for all lower front teeth without FPD.

Periodontal treatments

Observation

Considering the extensive destruction of the alveolar bone structure, dental scaling was carried out, after which antibiotic therapy with clindamycin 600 mg 3x1/day for five days was initiated, followed by endodontic treatment through prosthetic restoration of tooth 1.3; subsequently, the bridge body distal to tooth 1.3 was removed. Tooth 1.8 was detached as soon as the bridge body was transected.

In another session, closed periodontal curettage was initiated, both manual, using Gracey curettes, and ultrasonic, which was carried out during four sessions. In the same period, long-term intracoronal immobilization of mandibular front teeth with metal reinforcement, as well as provisional composite immobilization of teeth 4.8, 4.5, 4.4 was performed (2).

On the day of the last periodontal curettage session, pulsed short wave therapy was introduced and administered according to the adopted protocol. A therapeutic course of 10 daily pulsed short wave sessions was conducted. The duration of the first two sessions was 10 minutes, the following eight sessions lasting 15 minutes. An impulse frequency of 80/s during the first 2 sessions and 160/s for the rest of the sessions was used, with penetration steps ranging between 1 and 2 (4).

The locating emitter was placed at a minimum distance of 1 cm from the left and right (alternatively from one session to another) anterolateral region of the lower face.

Seven days after completion of periodontal curettage, the prosthetic restoration was removed and a provisional acrylic FPD also playing a restraining role was fabricated.

The patient did not wish to have the mandibular FPD removed, tooth 3.5 being vital and without any symptoms.

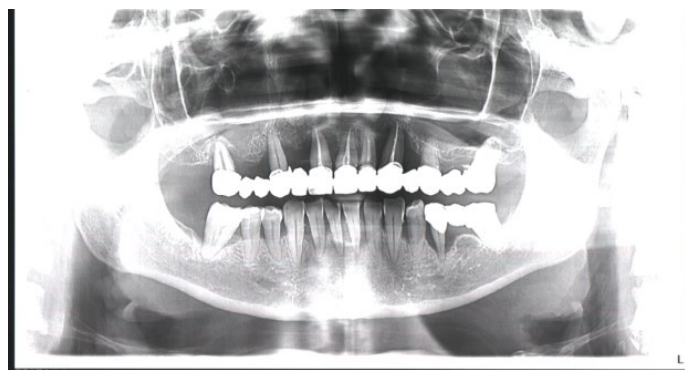


Fig. 3. Initial OPT X-ray performed after ultrasonic scaling and individualized oral hygiene instruction. Severe resorption of both maxillary and mandibular alveolar processes is observed, the supporting bone around certain teeth taking a concave shape.

Tooth mobility and crown pathology in the maxilla could not be assessed initially because the FPD was maintained for a period of seven days after pulsed short wave therapy due to the massive resorption of the maxillary alveolar bone structure. This situation was also found in teeth 3.8, 3.5, where there was a bridge body that the patient did not wish to renounce.

Evaluation of probing depth in the teeth covered with FPD: 1.8 - mesio-disto-palatal 10 mm, centro-vestibular 8.5 mm; 1.3 - disto-palatal 8.5 mm, vestibular and mesial 10 mm; 1.1 - vestibulo-distal 8.5 mm, mesial 3.5 mm; 2.1 - mesial 5 mm; 2.2 - distal 8.5 mm; 2.3 - circular 11 mm; 2.5 - vestibulo-mesial 5.5 mm; 2.8 - mesial 8.5 mm, vestibular 5.5 mm, distal 8.5 mm, palatal 3.5 mm; 3.8 - vestibulo-distal 7 mm, mesial 10 mm; 3.5 - circular 11 mm.

Evaluation of probing depth and tooth mobility in the teeth uncovered with FPD: 3.4 - circular periodontal pocket 5.5 mm, tooth mobility grade 1; 3.3 - vestibulo-disto-lingual periodontal pocket 4.5 mm, attrition grade 2, mobility grade 2; 3.2 - vestibulo-mesio-lingual periodontal pocket 4 mm, attrition grade 2, mobility grade 2; 3.1 - vestibulo-disto-lingual periodontal pocket 4 mm, attrition grade 2, mobility grade 2; 4.1 - vestibulo-disto-lingual periodontal pocket 4.5 mm, attrition grade 2, mobility grade 2; 4.2 - vestibulo-disto-lingual

periodontal pocket 5 mm, attrition grade 2, mobility grade 2; 4.3 – periodontal pocket mesial 5 mm, distal 3.5 mm, attrition grade 2, mobility grade 1; 4.4 – circular periodontal pocket 4 mm, mobility grade 1; 4.5 – circular periodontal pocket 2.5 mm, mobility grade 1; 4.8 – circular periodontal pocket 7 mm, mobility grade 2.

Reevaluation of tooth mobility five weeks after initiation of pulsed short wave therapy and complete removal of the maxillary FPD indicated mobility grade 1 in 2.3, the rest of the teeth having mobility grade 0 (1).

In the mandible, except for the front teeth and the teeth included in FPD, tooth mobility was also grade 0.

Dental and endodontic treatments

1.3 - was treated endodontically by prosthetic restoration; five weeks after initiation of pulsed short wave procedures, corono-radicular reinforcement with a glass fiber post was performed.

All endodontically pre-treated teeth underwent corono-radicular reconstruction using fiber glass posts.

2.5 - mesio-occluso-distal caries treated and filled with glass ionomer cement

2.8 – occlusal caries treated and filled with glass ionomer cement

Prosthetic treatments

These were carried out four weeks after completion of pulsed short wave procedures, a period during which the patient had a provisional acrylic bridge placed in order to avoid additional tooth mobilization.

Two total physiognomic metal-composite bridge bodies were placed in the maxilla, in 1.3-X-1.1-2.1-2.2-2.3 and 2.5-X-X-2.8, respectively, to allow balancing of a conventional Flexite base removable partial denture, which comprised the edentulous ridge for hemiarch 1 and the edentulous gap between teeth 2.3-2.5, respectively.

Results

Remineralization of the alveolar bone structure after initiation of pulsed short wave therapy was obvious in all three cases included in the study, over a short time period, the results exceeding the expectations. Bone regeneration around the teeth subjected to closed periodontal curettage was radiologically visible. The contour of the bone defects surrounding the teeth had a tendency to reorientation of bone trabeculae towards the tooth roots after completion of pulsed short wave treatments (Figs. 4, 5, 6, 7). In other dental areas with vertical bone defects, a

higher bone density around the roots and a greater bone volume even in vertical direction were found.

Regarding the first case, patient C.F. had much more intense remineralization of the alveolar bone structure compared to bone remineralization in edentulous areas (Figs. 4, 5).

Case a., patient C.F.

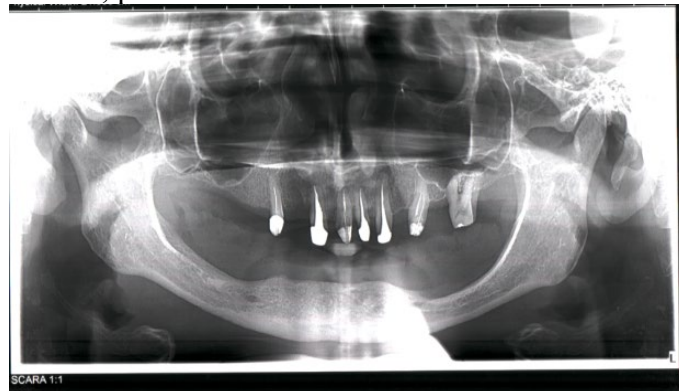


Fig. 4. OPT X-ray performed three weeks after initiation of pulsed short wave therapy. Remineralization of the maxillary alveolar bone structure three weeks after onset of pulsed short wave therapy and apical resection, and four weeks after completion of closed periodontal curettage is seen.



Fig. 5. OPT X-ray performed three years after completion of treatments; completely mineralized alveolar bone can be seen marginally (interdental bone septa) and apically. An exception was the extraction area, which remained hypomineralized.

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Case b., patient C.R.

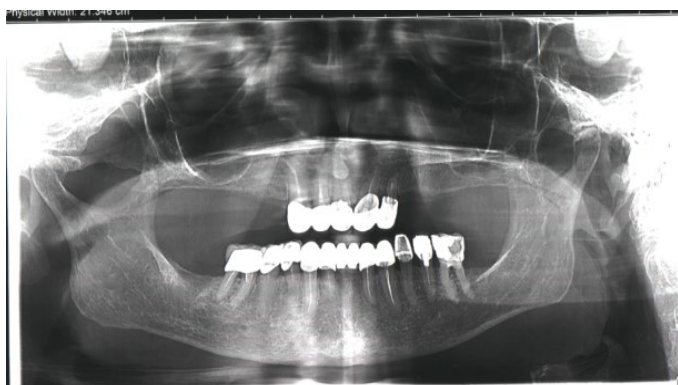


Fig. 6. OPT X-ray. T-T maxillary edentation, T-T mandibular edentation. Radiological image details: the marginal and interradicular alveolar bone defects are visibly remineralized; apically, it is still minimally visible in tooth 4.6 as well as tooth 3.3, where it is slightly more pronounced, which indicates in this case an asymptomatic apical reaction of endodontic etiology. X-ray taken eight weeks after initiation of pulsed short wave therapy.

The X-ray in Fig. 6 shows advanced remineralization of maxillary and mandibular alveolar bone structures eight weeks after the onset of pulsed short wave therapy and closed periodontal curettage.

Case c., patient P.O.

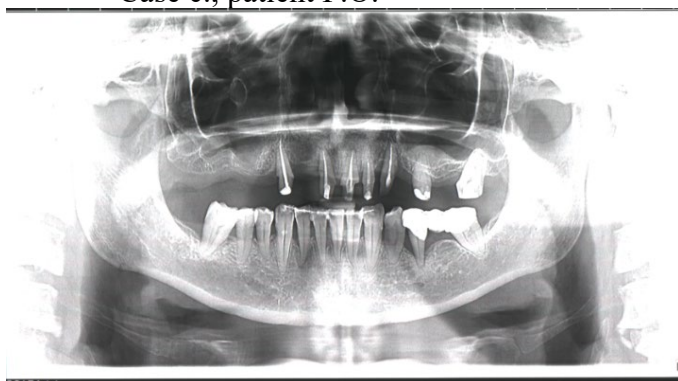
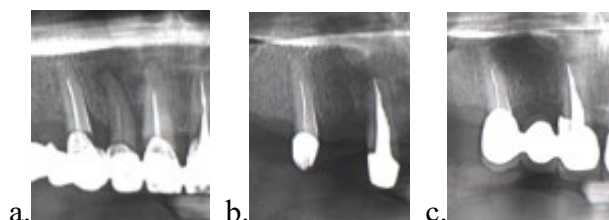


Fig. 7. OPT X-ray performed five weeks after initiation of pulsed short wave therapy. Intense remineralization of alveolar bone structures around the teeth and interdental bone septa can be observed.

Discussions

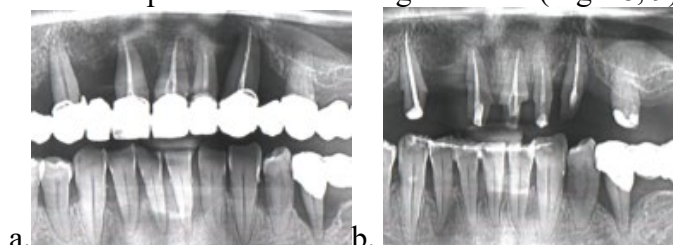
Regarding the first case, a control panoramic X-ray was also performed after three years (Fig. 5). Although there are studies showing the fact that in diabetic patients positive results persist for a short time period (16,17), here bone remineralization was equally visible radiologically after three years. A major contribution is represented by the patient's motivation to maintain individualized oral hygiene, as well as by visits to the dental office every six months for professional dental cleaning.



A stronger independent association between chronic marginal periodontitis and diabetes mellitus is demonstrated; it has been proven that periodontal therapy has a significant systemic effect on endothelial function as well as on glycemic control (18,19). Periodontal treatment reduces glycated hemoglobin (HbA1C) (20), peripheral insulin resistance (21), bacterial exposure and inflammatory markers (22).

The action of pulsed short waves on the bone is represented by the production of microshocks on crystalline bone structures (particularly on collagen), with the production of negative electrical charges that will lead to an increase in osteoblast activity and the deposition of calcium salts in the bone. The effect on osteoblast energy metabolism is not excluded either (4). It considerably accelerates fracture callus formation due to the bone composition, which maintains electrical charges negative for 7-8 days (4). This situation suggests the presence of correlations between the introduction of pulsed short wave therapy shortly after completion of periodontal curettage, considering the more pronounced mineralization of alveolar bone processes, compared to the rest of the jaw bone structures.

Another theory is that according to which teeth are bone growth and development centers (23); in this sense, activation of cellular enzymatic reactions and of the periodontal connective-vascular system stimulates periodontal bone regeneration (Figs. 8, 9).



Another aspect evidenced is represented by the importance of dento-dental immobilization in order to maximize the effects of pulsed short waves, a situation recommended including in the case of large joints, particularly in diabetic patients (24,11); there

are also publications that mention the efficacy of low intensities for a longer time period (17).

Comparison with other procedures

Regarding ultrasounds, experimental periodontal studies in which bone defects were created report similar results by using low intensity ultrasounds after alveolar bone augmentation (25), compared to the current study, in which pulsed short waves were used in the absence of bone augmentation.

The efficiency of shock waves in improving tooth mobility did not prove to be significant, considering the fact that tooth mobility was identical to the mobility of the control group after treatment, its reduction over time being more rapid compared to the placebo group, which indicates extremely modest effects on alveolar bone regeneration. Experimental shock wave studies report similar results (26,27,28).

In comparison, laser therapy also offers very good results, including in diabetic patients, with respect to alveolar bone regeneration, providing a radiological appearance similar to the use of pulsed short waves assessed at one year (29,30).

Conclusions

Provided that oro-dental hygiene is maintained, results can persist for long time periods.

This protocol that uses pulsed short waves for the treatment of alveolar bone loss in diabetic patients can be a less invasive alternative compared to periodontal flap surgery, even in cases with aggressive bone losses.

Although further studies in this direction are required, pulsed short waves represent a valid therapeutic method, which allowed obtaining alveolar bone regeneration in the case of these patients.

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Non-surgical correction of diplopia after stroke- a strong impact factor on quality of life-minireview

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Abstract

One of the most frequent disorders accompanied by diplopia is represented by stroke. Beyond different symptoms of stroke, diplopia constitutes an important clinical factor in influencing the quality of life in surviving patients. In this paper we discuss the visual impairment associated with stroke location, types of diplopia, the clinical examination, and the nonsurgical treatment of diplopia. The purpose of diplopia treatment is to restore binocular vision and eliminate the double vision. The most used nonsurgical treatment for diplopia is the optical correction by the prisms. Another therapeutic option is the botulinum toxin injections.

Key words: *diplopia, stroke, visual rehabilitation, prism correction,*

Introduction

Stroke represents the second leading cause of death (1). Commonly defined, there are two types of stroke, either ischemic (in 85% of cases) or hemorrhagic (in 15%) (1). According with the implied territory stroke is accompanied by specific clinical symptoms, which interfere with patient's quality of life (2,3). Common symptoms of stroke in the left hemisphere include aphasia, right hemiparesis and right hemianopia, and in the right hemisphere, left hemispatial neglect, left hemiparesis and left hemianopia (4). Posterior circulation or infratentorial stroke comprise a lot of additional symptoms, including diplopia, bulbar palsies, dysphagia, unilateral dysmetria and incoordination, as well as reduced levels of consciousness. Diplopia appears either in right or left-sided strokes (5).

Diplopia or double vision is one of the most unpleasant symptoms for the patient with stroke. Double vision represents the perception of two images of a single object seen adjacent to each other (horizontally, vertically, or obliquely) or overlapping. Sometimes the patients use the term of “ghost image”(6)revealed that 92% of patients who had a stroke have visual problems even though only 42% of multidisciplinary stroke team reported objective findings of ocular disorders.

Types of diplopia

Diplopia can be monocular (when the double image is recognized only by the tested eye) or binocular (when the double image is present when both eyes are open). The vertical diplopia means that one image is higher than the other and in orizontal diplopia the two images are separated horizontally.

Causes of binocular diplopia

Binocular diplopia is the most frequent form (89%) due to different pathologies including the central nervous system such as: stroke (ischemic and haemorrhagic), multiple sclerosis, myasthenia gravis, cerebral tumors, neuromuscular junction dysfunction, palsies of the third, fourth or sixth cranial nerves or other diseases like thyroid ophthalmopathy and diabetes mellitus (7). When one eye is closed double vision disappears (8,9,10).

Diplopia can appear as a result of different cranial nerve palsy (III,IV and VI-th)or from skew deviation (11,12) Rowe et al. (13) in a prospective multicenter observational case cohort study revealed that 16.5% of patients with stroke developed ocular misalignment associated with diplopia.

Diplopia from a recent stroke is confusing to the patient because adaptation in order to improve visual acuity by a head turn (rotational of the head to the

right/left- early stage) or suppression (capacity of the brain to ignore the information of one eye by the brain- late stage) has not yet occurred. Images may appear to overlap each other or may appear adjacent to each other. Diplopia also causes symptoms of blurred vision, dizziness, poor balance, alexia, psychological stress, asthenopia, and headaches. Sometimes patients cannot recognize double vision unless they are asked.

Double vision can be constant or variable. Binocular diplopia may vary depending on the direction of gaze or with tilting or turning of the head. Fatigue may also contribute to variable double vision.

Most stroke survivors with a known cerebral stroke-related diplopia have an overwhelming impulse to close one eye or have been instructed to patch the deviating eye in order to eliminate the second image. This makes the patient happy for the moment because the patch resolves the diplopia. Unfortunately, patching the deviating eye for too many weeks can facilitate the binocular dysfunction and reduce peripheral vision. Stroke-related binocular dysfunctions with mild-to-moderate paretic angles of strabismus are often capable of a wider range of motion of the effected eye. This can be achieved by having the patient monocularly track a moving target (pursuits) in the direction of the restrictions several times per day for a few weeks.

Severity of diplopia (mild, moderate, severe) in different gaze position may be established by the patients by completing the Diplopia Questionnaire ([freelyavailableat:www.pedig.net](http://www.pedig.net)) on a 5-pointscale (always, often, sometimes, rarely, never) (14).

Squint associated with diplopia significantly affects the patient's quality of life. Rowe et al in his multicentre observational cohort study revealed that 16.5% of patients with stroke had squint with diplopia (13).

Diplopia can be associated with vertical gaze in palsies of the third and fourth cranial nerves (midbrain and thalamic infarcts) and with saccades of the eye mediated by the frontal lobes. The saccadic defects may appear after both cortical and brainstem infarcts (13). Another possible association of diplopia may be the bidirectional horizontal nystagmus due to a posteroinferior cerebellar strokes (15). Unfortunately visual problems after stroke are under estimated in patients with stroke (16) Hanna et al. (17) developed a screening tool for visual impairment post stroke. The authors concluded that the existing tools gave incomplete evaluation of visual troubles after stroke (17). Retinal ischemia can

accompany diplopia and may act like a prelude for stroke as it stipulates the American Stroke Association guidelines, that is why neuroimaging is recommended immediately to identify a possible concomitant cerebral ischemia (18). There are studies (19) which demonstrates that 18.2% of patients with retinal ischemia developed a recurrent stroke after 1 month follow-up. A characteristic sign for thromboembolic predisposition is the Hollenhorst plaque (cholesterol plaque) in the retina (20). Papilloedema may be present due to the brain oedema secondary to stroke. (21). Posterior pole hemorrhages (Terson syndrome) as a result of intracranial hemorrhages may be present (22).

There are also risk factors which should be explored such as: diabetes mellitus, hypertension, hyperlipidemia, coronary artery disease and tobacco use which can act as a trigger for recurrences of stroke (12,23). The stroke may be associated with visual field deficits. Some authors (24,25) consider that visual field defects indicates a poor clinical outcome, risk of falls and mortality in patients with stroke.

Clinical examination

It is mandatory to follow a complete ocular exam, including the exam of visual acuity with the best correction, ocular fundus assessment, intraocular pressure measurement and refraction examination.

The presence and evaluation of diplopia starts with the ocular motility exam by testing ductions in all directions of the gaze. The motility is reduced or absent in the direction of the paretic muscle in a incomitant squint and mostly indicates a neurogenic palsy (26).

The presence or absence of eye deviation is assessed by cover/uncover, alternate cover, and/or Maddox rod testing. The amplitude of deviation can be recorded with prisms, using prism cover test and Maddox rod testing when necessary, in primary position at distance (5 m) and near (30 cm) and in all cardinal gazes.

The **prism and alternate cover test** alternates the cover over both eyes while a prism is placed in front of one eye. This helps measure the difference between the two eyes and determine what prism is needed to fix the double vision.

Fusion amplitudes is measured for patients with long-standing deviation, and presence of excyclotorsion is identified by using double Maddox rod test.

Nonsurgical treatment in diplopia

Nonsurgical treatment in diplopia includes prism prescription and botulin toxin injection.

Prism is a transparent, solid, triangular refracting medium with a base and apex. Its apical angle determines the power of prism. A prism of one prism diopter power (Δ) produces an apparent displacement of one centimeter to an object situated one meter away. Light entering the prism will deviate toward its base. However, image appears shifted to the apex, and the eye examined or treated tend to deviate toward its apex. This is how prisms function and manipulate the special location of image clinically (27).

Indications for prism correction are management of: long-lasting diplopia consecutive to cerebral stroke associated with small angles eye deviation (under 10 Δ) and transitory diplopia with or without strabismus.

When a prism is placed in front of one eye, with its base directed outward, the light rays from object will be deflected outward (to the base) and fall on the retina outer to fovea. Since the light still falls on the macula of the other eye, double vision would be produced. Consequently, the eye with prism base directed outward will deviate inward so that the deflected light falls on the macula once again and binocular vision is made possible. The maximum effort which can be put in this way (the capacity to maintain fusion) is measured by the strongest prism with which diplopia is not produced. Prismatic power of even 30–60 Δ can be overcome normally by convergence and 10–15 Δ divergence, and 2–4 Δ by circumvergence. The measurements of this artificially produced diplopia (vergence power) are important in diagnosis and treatment.

There are few studies (28,29) evaluating the effects of non-surgical treatments for strabismus on the patient's life quality. Prism correction is a commonly used non-surgical treatment for binocular diplopia in the context of a variety of different strabismus types (30). Successful correction of diplopia using prism would be expected to result in significant improvements in visual function which may then translate into improved questionnaire of quality of life.

Prisms are generally recommended for optical correction of symptomatic binocular diplopia of different etiologies (30,31,32,33,34). They eliminate diplopia by altering the path of light rays and aligning the image on the fovea of the deviating

eye. Studies reporting data on success of prisms in treating diplopia are limited to a few case series that lack details of ocular misalignment and prism prescriptions (35,36,37,38,39). It is generally believed that prism glasses are most successful in eliminating diplopia in patients with comitant deviations of less than 10–12 prism diopters (PD), although the success of prisms for deviations greater than 10 PD and for incomitant deviations has not been systematically studied (35).

Types of prisms

If prism correction is needed for a longer period, it can be ground into the lens of eyeglasses. Eyeglasses with a prism look like any other glasses without a prism, although the lens on one side may be thicker and more noticeable.

Sometimes when we assume that the diplopia will be temporary, or patients require larger prism strength (>10 D) and in those with greater than 5 PD of lateral incomitance, or as an initial trial to assess the effectiveness of prisms prior to prescribing permanent prisms the Fresnel prism (a thin press-on vinyl sticker) is fitted over the front of eyeglasses. With a Fresnel prism lens, the prism is slightly visible.

The advantages of Fresnel prisms are represented by the oblique application in patients with combined horizontal and vertical deviation, larger deviations (up to 30 PD) and are lightweight and thin. Moreover, they can be easily mounted to the back of the spectacle lens. The disadvantages of these prisms are the loss of contrast, loss of acuity, scattering of light, and visibility.

This is not ideal for long-term use, but it does allow the patient to test drive a prism and see how it works. Fresnel prisms are also used when the prism prescription is not stable [35].

Prescription of prisms

Like normal eyeglasses, a prism is measured and prescribed with a unit of measurement called **prism diopters** (from 0.5PD, 1.0PD, 1.5PD, and so on). Depending on the double vision, the prism is placed vertically, horizontally or diagonally in one or both lenses of the eyeglasses.

Sometimes when we assume that the diplopia will be temporary, a Fresnel prism (a thin press-on vinyl sticker) is fitted over the front of eyeglasses. With a Fresnel prism lens, the prism is slightly visible. This is not ideal for long-term use, but it does allow the patient to test drive a prism and see how it works.

Fresnel prisms are also used when the prism prescription is not stable and may change rapidly.

Prescriptions of prism cover the following steps. In general, the minimum amount of prism that would make the patient diplopia free in the primary gaze is prescribed. This is measured by moving a Barren's prism bar with increasing strength of prisms in front of one eye with the patient fixating on the distance Snellen chart until the patient reports resolution of diplopia. As a general rule, half of the prism dioptic size as measured by the prism cover test in primary position is tried and increase or decrease based on patient's responses. Usually, the prism strength is divided equally between the 2 eyes with the base on the opposite part of deviation.

It is important to establish the prism correction for distance and near. Sometimes there are differences between the two corrections. So, the glasses for distance may correct diplopia, but they are not suitable for near (the patient may need another prismatic strength) (26).

Apers and Bierlaagh (38) described the effectiveness of prisms in 75 patients with paralytic squint. Hatt et al (28) in their study of adults with a different range of strabismus types and moderately severe diplopia, demonstrated a prism success rate of 68%.

Tamhankar et al reported success rates in adult strabismus patients.[thamkar,thamkar] For both Tamhankar et al studies success with prism was defined as complete or partial resolution of diplopia based on patient report. In the first study, of 94 patients with a range of motility disorders, 88% were considered successfully treated (12) and in the other study, of 64 patients with large angle, incomitant, or combined horizontal and vertical strabismus, 72% were successfully treated (30). There are conditions where optic corrections fail due to other ophthalmological disorders (40,41), due to associated neurological symptoms, or due to cognitive severe impairments (42).

Another treatment for diplopia is the injection of botulinum toxin which blocks local synaptic transmission at cholinergic terminals. Botulinum neurotoxin prevents the release of acetylcholine at the presynaptic neuromuscular junction thereby inducing flaccid paralysis. This toxin-mediated paralysis includes three principal steps: binding, internalization, and inhibition of the release of neurotransmitter (43).

It has become a useful therapeutic armamentarium in the treatment of post stroke spasticity. Its principal advantage is that it has a focal, selective, and

reversible effect in the injected muscles without having very many adverse effects[44] Botulinum neurotoxin is significantly associated with reduced spasticity, increased range of motion, and improved upper extremity function. In the treatment of strabismus associated with stroke, it is considered that botulinum toxin causes lengthening of the injected muscle and a correlate shortening of the antagonist muscle.

Conclusions

Visual impairment is frequently under-reported in patients with stroke. Binocular diplopia with ocular deviation is a common sign in the stroke influencing the quality of life. It may be associated with other ocular sign including visual field defects. Correction of diplopia is mandatory in order to eliminate double vision. Nonsurgical treatment of diplopia includes the use of prism and botulinum toxin.

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Cristina Nicula has written the majority of manuscript, performed the proofing, researched the topics and approved the final manuscript. Dorin Nicula has also written part of the manuscript as well as researching the topics .Adriana Elena Bulboaca provided a literature review and approved the final manuscript.

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Perspectives of inpatient neurological rehabilitation in elderly patients

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Abstract

Demographic data record an increasing number of people aged over 65 years, with specific health conditions and a high probability to suffer from chronic diseases, cognitive impairment or loss of autonomy, and with limited functional reserve. The prevalence of disability increases with age, affecting 33% of men and 42% of women aged over 85 years. Many neurodegenerative disorders increase in prevalence with age. Thus, the need for rehabilitation treatment in this segment of population is very high, loss of functioning being the most prominent condition for admitting elderly persons in rehabilitation facilities. Rehabilitation in the elderly is an important tool in regaining autonomy, associated with substantial reduction in the burden of health and social costs. Patients aged over 80 years need a comprehensive geriatric assessment (CGA) to establish the global capabilities of the person for inclusion in a coordinated therapy plan and a long term follow-up. CGA will identify patients with severe or complicated medical conditions and important disability who require a multidisciplinary team and a coordinated rehabilitation program, accessible only in rehabilitation hospitals. Rehabilitation treatment should start from the intensive care unit, and continues until the patient reaches a plateau of maximal functional improvement. The most useful therapeutic interventions in old people are physical and occupational therapy, and, for selected and stable patients, therapy in a balnear resort is an option to improve their quality of life.

Key words: *geriatric population, rehabilitation, loss of autonomy, old patients,*

Introduction

Worldwide, life expectancy of population is rising, with an increasing number of people aged more than 65 years: more than 800 million (about 12% of world population) are older than 60 years (1). According to World Health Organization (WHO), octogenarians are currently about 15% of the elderly population over 65 years, the "oldest old" (aged over 85) representing 12% of this population in highly developed countries and 6% in countries under development. There is a prediction for increase in population aged 85-and-over with 351% between 2010 and 2050, compared with an increase of 22% in population younger than 65 years. Furthermore, the number of centenarians is predicted to increase 10 times until 2050 (2) and by 2047 the number of old people is projected to exceed the number of children (1).

Aged persons frequently suffer from chronic illness: 17,4% have four or more chronic conditions, 50% have at least two and 80% have at least one (3). Elderly people have a high probability to suffer from severe health conditions; most common causes of

years lived with disability (YLDs) are mental and behavioral disorders and musculoskeletal pathology (4). Moreover, the functional reserve of old persons is limited, and mild events such as falls, infections or hospitalizations may decrease the ability of patients to return home. Loss of autonomy could also appear without a precipitating event, due to limited functional reserve of geriatric population (5).

Neurologic disability in the elderly and importance of rehabilitation

The prevalence of disability increases with advancing age; some authors report that 33% of men and 42% of women over 85 years had severe disability (6). Multiple chronic conditions in the elderly, including neurologic diseases, are associated with increased levels of disability. Other factors involved in disability are high vulnerability of older population, with potential rapid deterioration after acute injuries, combined with physical deconditioning, poor diet or smoking (6).

According to epidemiological studies, 10-20% of people aged between 60 and 80 years are estimated to have one of the three most frequent neurological diseases: stroke, Alzheimer's disease or Parkinson's disease (7). Many neurodegenerative disorders increase in prevalence with age. The prevalence of Parkinson's disease is 1,902.98 per 100,000 in persons over 80 years (8). Stroke and vascular dementia, highly prevalent conditions in elderly population, are preventable. According to Bejot, total number of strokes will increase with 55% by 2030, related to increased incidence of strokes in people over 75 years old (65% versus 25% stroke incidence in < 75 years old) (9-10). The prevalence of dementia increases with age, affecting almost 50% of octogenarians (11).

Fortunately, disability episodes in the elderly could be brief and reversible in one to two months, making rehabilitation treatment an important tool in regaining autonomy. Moreover, patient's needs and abilities could fluctuate over time, requiring readjustments of treatment goals and methods (5).

Thus, improvement of disability in the elderly through rehabilitation treatment, will lead to an increase in self-care and autonomy, with a substantial reduction in the burden of health and social costs for this category. The primary goal of rehabilitation is to enable functioning at highest level possible, with the presence of an impairment. The need for rehabilitation treatment in this segment of population is very high, explained by the growing number of persons older than 80 years and by the severe health conditions specific to this category (12). WHO defines rehabilitation as an active process by which those affected by injury or disease achieve a full recovery or, if a full recovery is not possible, realize their optimal physical, mental and social potential and are integrated into their most appropriate environment (13).

Assessment of elderly persons before admission in a rehabilitation facility.

Loss of functioning is the most prominent feature related to rehabilitation requests in older adults. Worldwide, accurate identification of older patients which are at risk for poor health outcomes and require geriatric management, is a necessity. Implementation of screening tools for such patients is a health priority in many countries. Proposed scores were Barthel Index (BI) (14) and the Identification of Seniors at Risk (ISAR) score (15).

The ISAR score is one of the most commonly used screening tools with high sensitivity for the prediction of poor health outcomes in older persons (16). This score consists on six yes/no answers regarding need of help and hospitalizations prior to the actual medical visit, and questions about drug treatment, visual problems and memory complaints (17). An ISAR score ≥ 2 indicates risk of poor outcome, and states the necessity of a specialized geriatric evaluation before admission in hospital or in rehabilitation facility.

People over 80 years are frail because they usually have multiple and complex medical problems. During hospital admission, a decline in patient's independence is expected, possibly induced by acute illnesses, decline in physical and cognitive functioning, increased risk for falls and delirium. Each patient over 80 years with ISAR score ≥ 2 needs a comprehensive geriatric assessment (CGA) before inclusion in a rehabilitation program. CGA consists in assessing patient's medical, functional and psychological capability to undergo a rehabilitation program. The key domains evaluated during CGA are: presence of specific medical conditions, cognition, language and psychological status, vision and hearing, swallowing and nutrition, sphincterian continence, physical function and activities of daily living (ADL). Also, risk evaluation (for falls, or pressure sores) and social environment (home, caregiver or family support) are included (6). CGA is in fact an interdisciplinary diagnostic process used to determine the global capabilities of a frail elderly person to be included in a coordinated plan for treatment and long term follow-up (18). A Cochrane systematic review which evaluated CGA utility on 10,000 inpatients, has demonstrated that patients which had CGA assessment had a longer life expectancy and were less likely to be institutionalized at 12 months than patients with general medical care (19).

CGA should usually be performed by a specialized geriatric team, either on a geriatric ward, or on a rehabilitation facility (20). With CGA, old patient's needs of care are appropriately identified, leading to a better management of medical and rehabilitation treatment to maximize recovery and return to previous levels of functioning. Abnormal geriatric risk assessment by CGA is associated with longer hospitalization and higher amount of nursing and physiotherapy during hospital stay, greater risk of falling, and a lower percentage of successfully terminated treatment in older in-patients (21).

Settings of rehabilitation services for elderly people

Patients with single or uncomplicated health conditions require usually access to outpatient rehabilitation services, therapy being delivered by a single specialist (e.g. physiotherapist, speech-language therapist, etc.). Patients with severe or complicated medical conditions and with important disability require a multidisciplinary team and a coordinated rehabilitation program to address their complex needs, accessed only in rehabilitation hospitals (12).

Rehabilitation therapy in acute hospitals. In medical, surgical or Intensive Care Units (ICU), rehabilitation starts with assessment of patient's physical and mental capacity to participate in the therapy. Close collaboration of therapists with medical staff is needed to evaluate the appropriate time for rehabilitation therapy: patient with hemodynamic stability, appropriate mental status and optimal pain management. Patients in ICU, even on ventilator, and patients with respiratory failure (after pneumonia, for example) can benefit from early mobilization (22). Mobilization could be started, if possible, on postoperative day, even after knee or hip replacement surgery (23). In acute stroke, timing and intensity of very early mobilization are under debate. In AVERT study it has been demonstrated that higher dose and very early mobilization in the first 24 hours post-stroke, was associated with a reduction in the chance of favorable outcome at 3 months (24). Better results were obtained if physical therapy sessions were shorter and more frequent; early occupational therapy could also be beneficial for selected old patients in Stroke Units (25-26). Rehabilitation therapists are also involved in discharge planning of acutely ill patients.

Efficiency of inpatient rehabilitation has been demonstrated in a systematic review of 89 randomized controlled trials including 97,000 old people. Patients which undergone multifactorial care and rehabilitation had reduced nursing home admissions compared with those who did not. Falls and acute hospital readmissions were also reduced, but there was no reduction in deaths (27).

Rehabilitation therapy in post-acute period. Post-acute settings for geriatric patients includes rehabilitation hospitals, geriatric services, long-term care hospitals, outpatient facilities or home-based. In determining the appropriate location for discharge and continuation of rehabilitation treatment, multiple factors need to be considered in patients over 80

years old. Admission in a rehabilitation hospital is recommended for patients with:

- Specific neurologic conditions – such as stroke, spinal cord injury, traumatic brain injury, multiple sclerosis, Parkinson disease or muscular diseases, which implied intensive rehabilitation treatment at highest levels.
- Medical stability : patients with complex medical problems (like spasticity, sphincterian dysfunctions) which require regular physician assessment and close medical and nursing care, are better discharged in inpatient rehabilitation facility.
- Preserved cognitive function: patients which are able to participate in rehabilitation therapy, could achieve their therapeutic goals in a rehabilitation facility. Patient's motivation and therapy tolerance are other important factors in choosing inpatient or outpatient rehabilitation program.
- Complex rehabilitation programs: conditions which required more than one type of rehabilitative intervention, offered only by a multidisciplinary team (e.g. physical therapy, visual rehabilitation, occupational therapy and speech-language therapy) are admitted in rehabilitation hospitals (12, 28).
- Low degree of pre-existent disability: patient which was previously independent; patients which required permanent assistance from another person previous to acute neurologic event, are unlikely to become independent again, and they will be discharged in a nursing home.

All other category of aged persons: patients with orthopedic impairments or amputations, which usually require single therapeutic interventions, patients with uncomplicated health problems which could be followed by specialized nurses under medical supervision, patients with impaired cognitive functions or without tolerance at intensive rehabilitative treatment – should be admitted in long-term hospitals or nursing homes. For this category of patients, implementation during hospitalization of a nursing program centered on basic self-care, will improve functional outcomes (29).

Hospitalization in geriatric units offers important functional benefit in patients aged over 80 years, with improvements in home discharge rates (27).

Rehabilitation therapy for aged persons in balnear facilities - uses natural therapeutic factors with recognized healing properties, based on their chemical, mechanical and thermal body effects (30). Aged patients with medical or neurological disorders could be admitted for balnear treatment if their

medical condition is stable. Effect of combined therapies (mineral water baths, mofettes, crenotherapy, aerotherapy, along with kinesitherapy, massages and electrotherapy) lasts at least 2 months for persons over 80 years old (31). Beneficial effect of natural therapeutic factors, combined with kinesitherapy and specific local techniques (mofettes, mineral waters, carbonated baths) has been demonstrated by many studies in old stable patients, suffering of stroke, cardiovascular diseases (32-33). Also, in older patients suffering of multiple medical conditions, balnear treatments in specific resorts, potentiate the regenerative capacity of the body and neutralize the toxic effect of external substances (e.g. alcohol) (34-35).

Rehabilitation interventions for neurologic elderly patients

- **Physical therapy:** Physical activity is beneficial for reducing overall morbidity and mortality in older adults (36). Exercise tended to decrease mortality risk in clinical populations (mostly people with cognitive decline or cardiac disease), which reinforces the role of exercise as a core therapeutic element for treating prevalent diseases in older people (37). Tolerance of cardiac muscle to effort-induced ischemia could be increased by using antioxidant and cardio-protective agents (38). Physical exercises reduces also the risk of falls, a physical activity program have been demonstrated to be more effective in men than in women, in reducing the rate of all serious fall injuries, including fractures and admissions to hospital (39).

The physical activity recommendations intended for all older adults need to be modified for specific medical disorders, such as decompensated cardiac diseases, chronic pulmonary conditions, acute/subacute stroke, or neurosurgical procedures. Physical therapists will adapt exercises to patient's specific condition and needs (12).

Progressive resistance exercise (ie, weightlifting) can significantly improve muscle strength and, to a lesser extent, functional activities (12). Resistance exercises can improve strength and gait velocity, especially in frail patients with slowed gait. Knee extension machines are effective to strengthen quadriceps; chair rises with weight vests or weights attached to the waist (waist belts) are an alternative to leg press machines (40). Vibration therapy provides a non-invasive, cyclic mechanical stimulation that has been shown to improve

quadriceps muscle strength, balancing, and movement velocity (41).

A recent study demonstrated that specific perturbation-based training program may be more efficient in preventing falls in seniors (75 years old) compared to traditional approaches (muscle strength exercises for lower extremity). It has been demonstrated on experimental studies that execution of different motor tasks on unstable surfaces increases the activation of the muscles and the perception of sensory signals used in sensory-motor integration. Unpredictable fluctuations and disturbances in the neural information, which could be simulated by certain exercises, processing facilitates the ability of the nervous system to respond with appropriate motor commands to the changing environment (42).

Dynamic postural training using static and dynamic Biodex balance system had a positive effect on mobility and balance in the elderly (43). Balance training is also an important component of fall prevention for patients with fragility fractures during rehabilitation (41). Pilates exercises improved static and dynamic balance, and increase stability, mobility, flexibility and muscle strength, and decrease the fear of falling and in the number of falls in the elderly (44). Dynamic balance training can involve slow movements in single stance, simple tai chi movements, tandem walking, turns while walking, walking backwards, walking over a virtual object (eg, a 15-cm stripe on the floor), slow forward lunges, and slow dance movements. Multicomponent balance training is probably most effective in improving balance (40).

The best exercise regimen in older people would be moderate-intensity, multicomponent training comprising balance exercises (eg, balance, strength training for the lower limbs, and aerobic exercise - walking), performed 2 to 3 times per week, with 30 to 60 minutes (37).

- **Occupational therapy (OT):** address impairments in dexterity, that that commonly affect patient's ability to complete activities of daily living. It is focused on maintaining or optimizing the meaningful occupational performance of the patient within his living and working environment. OT role is to adapt certain activities, to introduce assistive devices and to modify the environment (45). OT include the use of assistive technology and adaptive methods. Assistive technology includes mobility aids (canes, walkers,

wheelchairs), home safety devices and self-care devices, but also sophisticated computerized and electronic technology. Adaptive methods includes training patients to perform usual tasks safer or easier (12).

Conclusions

In recent years, the demographic distribution is under change, and the population is ageing. Old people, especially octogenarians, are usually frail persons, suffering from chronic medical problems, and being at risk to lose their autonomy after every acute event. Regaining lost functions is a long and complex process, requiring material and human resources and a strong family support. There is a tendency to include such patients for inpatient intensive rehabilitation in hospitals. Admission in a rehabilitation hospital requires a complete evaluation from a geriatric team, which will determine the capabilities of a elderly person to be included in a coordinated and intensive plan for treatment and in a long term follow-up. There is a need for development of specific geriatric inpatient and outpatient units, which will complete the frame of neurorehabilitation and functional improvement in geriatric patients.

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Abstract

The hand is considered to be one of the most important structures of the human body, with the help of which we can do different kinds of activities. A lesion of the hand can destabilise the patient from a physical point of view but also from a psycho-social one. The distal radius fractures are the cause of morbidity for patients and determine the decrease of the workforce, despite the restoration of the bone alignment and even if the fracture is cured from an anatomical point of view. The hand traumatism, especially the fractures, may have as causes osteoporosis, age, medication by corticoids, repeated traumatism and physical deficiencies. The objective of this trial is the evaluation of parameters (the movement amplitude, the muscular force, the prehension, the functional coefficient, the quality of life) which enable the clinical - functional recovery of patients who had hand traumatism and their social- professional reinsertion. The study was conducted for a period of 6 months in the ambulatory and included 20 patients diagnosed with post-fracture sequelae at the distal radius level. The evaluation of the patients was made at the beginning and at the end of the treatment, as well as at the examination 6 weeks after the end of the treatment. For this purpose, electrotherapy, lymphatic drainage massage and the kinesiotherapy program were applied. After making the joint balance sheet, it is found the favorable evolution in the recovery on all the mobilisation directions, but also the functional coefficient, in all the evaluation moments: initial, final and control. By applying the evaluation methods and scales to the 3 moments of assessing the patients, the efficiency of the complex recovery program can be seen.

Key words: *clinical - functional recovery, hand traumatism, the distal radius fractures,*

Introduction

The hand is considered to be one of the most important structures of the human body, with the help of which we can do different kinds of activities. The hand is also the organ of sensitivity, of the elaborated expressivity and also the organ of speech for the deaf and dumb. A lesion of the hand can destabilise the patient from a physical point of view but also from a psycho-social one. The distal epiphysis radius fractures represent approximately 74.50% of the fractures of the upper limb, 14% of the total fractures at the extremities of the limbs (1) and about 18.7% of the total number of fractures of the locomotion system whereas the fractures of the metacarpal bones and of the phalanx represent 10% of the total number of fractures, but 70% are encountered in patients aged 11-45 (2). The distal radius fractures are the cause of morbidity for patients and determine the decrease of the workforce, despite the restoration of the bone alignment and even if the fracture is cured from an anatomical point of view. Therefore, it is important to take into account the rehabilitation of the soft tissue lesions that are considered to be responsible

for the reduction of the mobility, of the muscular force and of the functional ability. (3).

The statistical analysis of the conservatory treatment results shows that in approximately 23.8% – 42% of the cases, the radius fractures at the distal extremity may be complicated by secondary movements under the cast. These secondary movements are the consequence of the reduced oedema and may occur in the 5th and 10th day since the traumatism (4).

A trial on 11 patients reveals that the average angulation value was 19° before the reduction of the fracture, it was 5° after the reduction and it was 4° after the bone repair. The fractures with the angulation over 15° had normal functionality due to a complete process of bone remodelling.

The distal radius fractures are the most frequent orthopaedic lesions, representing 1/6 of the total number of fractures and can be associated to the styloid ulnar fractures (5,6) There are trials which show some complications of the distal radioulnar fractures (7,8): pain, instability, disability, even without serious consequences (9,10,11,12). The stability of the distal radioulnar joint and of the

ulnar-carpal one is determined by the presence of the triangular fibrocartilage and of ligaments (5,13,14). The lesions of the triangular fibrocartilage and of the ligaments are frequently encountered at the fist, being detected by radiography, arthroscopy (15) and magnetic resonance (16).

In a trial of 2019 (3) the researchers discovered that arthroscopy was useful and valuable in determining the prevalence and gravity of the soft tissue lesions in case of lesions that could not be detected on the standard radiographies.

In another trial of 2016 (17) for the patients with a distal radius fracture and in some cases with an ulnar styloid fracture, the fist and the forearm were immobilised in the cast for 6 weeks, in the flexion position of the fist at 30° and its ulnar inclination of 15-20°. The patients were encouraged to start moving both their joints, respectively the elbow and the metacarpal-phalanges. Then the sick limb and the healthy one were tested from a functional point of view by means of the Quik Dash scale; the muscular force was measured by means of the dynamometer and of the imagery elements (radiography and magnetic resonance) that could show the presence of possible signs of instability and osteoarthritis after the traumatism and immobilization. Among the 38 cases taken into account there were 10 cases where the triangular fibrocartilage was sick, a case of instability at the level of the radioulnar distal joint and one case that had modifications at the level of the ulnar styloid whereas the decrease of the muscular force of the sick limb was obvious. It is the first trial that evaluates the mobility of the joints at the level of the fist, correlated to the muscular force and to the functional ability (18). The trial also points out the importance of the supination, which is affected in the ulnar styloid fracture, and the fact that the pain and the limitation of the mobility are the consequence of the instability in the radioulnar distal joint. The muscular force decreased in the supination in the persons with instability of the radioulnar distal joint after the fracture at this level.

The frequency of the fist fractures, according to some research, increases 10 times, for 15 years, after the menopause occurs, but continues to be stable. Osteoporosis is one reason why the distal radius fractures occur, that is why the early diagnosis of this health condition enables the prevention of the

fracture by evaluating the fracture risk and it also enables to establish the appropriate therapeutic strategy (19).

It is very important the calcium intake from food and medication (20,21) but also the D vitamin that has its role in the bone metabolism, which reduces the risk to have a fracture (22). As for the fractures of the children, it is important to mention the role of calcium, of magnesium and of D vitamin in the recovery after the fracture and in the presence of the vasomotor tonus. In this context, the calcium reference intervals can provide with the necessary information about adding or not adding these elements essential to the normal bone development. The serum levels of the magnesium ion represent only 1% of its contents in the body because most of it is stored in bones, muscles and soft tissues (20, 22).

As for the post-traumatic recovery of the fist and of the hand, it is important to find the affected soft parts, respectively the hand tendons that have a special structure and on which depends the stability at this level. In this context, it is recommended to apply kinetic techniques apart from electrical therapy procedures in order to enable the recovery and reintegration of patients in the professional activities (23). A trial conducted from 2003 to 2004 in six European countries monitored the incidence of the household traumatism in a group of over 88,000 children aged 0-18 years. Thus, it was noted that the age group 5-18 years revealed a maximum risk of sprains followed by contusions, wounds and fractures. According to the location, on the first place were identified the traumatisms at the level of the upper limbs (55.79%), which represents more than half of the total number (24). According to a trial conducted in 2015 in the Emergency Cases Department in Italy, the most frequent hand traumatisms were the phalanx contusions 20.8%, the phalanx fractures 7.9% and the closed radius fractures 5.8%. The occurring tendency of the traumatisms recorded 2 peaks: at the age of 12 and in the elderly (25). According to the data received from the Emergency Department of the County Hospital Suceava, from 1 to 17 January 2018, 41 persons aged 5 and 88 needed medical healthcare after having had traumatisms because they fell from the same level whereas 19 of them had fractures and contusions in the upper limb.

From the anatomical point of view, the hand has 27 bones distributed in 3 regions: 8 carpal, 5 metacarpal and 14 phalanges. The muscles of the hand are complex and are distributed in 3 regions: the muscles of the thenar eminence, of the hypothenar eminence and of the palmar middle region (26). Chronic dysfunction of the musculoskeletal system or compression of the nerve is a other major cause of disability. Diagnosis of these conditions is a vibrant subject of research, which aims to increase the quality of life, while reducing the costs for healthcare (27,28). The most frequent hand traumatism are sprains, luxations and fractures, tendon ruptures or lesions of the radial and cubital nerves.

The hand traumatism, especially the fractures, may have as causes osteoporosis, age, medication by corticoids, repeated traumatism and physical deficiencies. The sequelae after fractures are: the capsule- ligament adherence, muscular -ligament adherence, the muscular atrophy, the redness in the joints, the decrease of the functional ability.

The treatment of the sequelae after the fracture is complex and involves:

[1] the antalgic and antiinflammatory medication to reduce the algic /inflammatory symptomatology,

[2] the electric therapy (29) has different roles: antialgic/ antiinflammatory, vasodilating, myorelaxing/ relaxing

- the currents of low frequency: TENS, with electrodes applied on the painful spot, the frequency 50-100 Hz, the intensity 10-40mA, the duration of 10 minutes

- The ultrasounds in pulsatile application, with a frequency of 1 MHz, the intensity of 0.4- 0.6W/cm² by using the antiinflammatory gel (30,31).

The application of ultrasound is useful in the pathology of the soft tissues but also in the joint one whereas the mechanical and thermal effects are deeply felt and provide with the blood flow necessary to the recovery process (21,32).

The ultrasound have their role in reducing the pain, the joint stiffness and the muscular contraction. After the application of the ultrasound, the number of red blood cells is reduced, the coagulation process is influenced, and variations of the serum calcium are recorded (32). For an adequate treatment, it is important to establish correctly the values of these blood elements. (33).

The ultrasound are applied in order to increase the permeability of the cellular membrane, to stimulate the blood circulation, the fibrolysis and the vasodilation, which determine the antalgic, antiinflammatory action. Furthermore, the ultrasound have the role of influencing the periosteal reconstruction (32).

[3] the massage in order to improve the properties of the muscles and to increase the local metabolism by enabling a faster recovery

[4] the hydro-thermo-therapy: the use of the partial bath with warm water of 36-37⁰ C for 15-20 minutes or use cryotherapy in case of local inflammation

[5] Kinetic therapy- with its role of increasing the joint mobility, the muscular force, the prehension and the functional coefficient. It is for this purpose that the posturation is used (the antideclive to reduce the oedema and to enable the circulation), manipulations, passive mobilisation, passive-active, active at first and then active with resistance, which is applied for each joint separately on all the physiological movement directions (34, 35).

The objective of this trial is the evaluation of parameters (the movement amplitude, the muscular force, the prehension, the functional coefficient, the quality of life) which enable the clinical - functional recovery of patients who had hand traumatism and their social- professional reinsertion.

Material and method

The objectives pursued in the recovery program were:

- to reduce the pain and inflammatory syndrome
- to fight edema
- to increase the joint amplitude
- to keep / increase the muscle strength
- to increase the muscle tone
- to increase the quality of life

The study was conducted for a period of 6 months in the ambulatory and included 20 patients diagnosed with post-fracture sequelae at the distal radius level.

The evaluation of the patients was made at the beginning and at the end of the treatment, as well as at the examination 6 weeks after the end of the treatment. The data processing involved the use of quantitative variables (age, sex, living environment) but also qualitative (pain, joint amplitude, functional coefficient of mobility, muscle strength, quality of

life). For this purpose, the VAS scale (Visual Analogue Scale) was used to assess the pain (value 0 means lack of pain, value 10 represents maximum pain), joint balance sheet to assess the joint mobility (it was performed on all the hand joints, on the physiological directions of movement and the goniometer was used), the functional coefficient Rocher to establish the functionality degree, the dynamometry to quantify the useful muscular force for the prehension, the LEE functional index (the general functional assessment where the rating is 0 if the activity is normal, 1 if the activity is done with difficulty and 2 if the activity is impossible to be done), the QOL scale (Quality of life) to assess the patients' quality of life (psycho-socio-family). During the recovery treatment, pulsatile ultrasonotherapy was applied, also by using anti-inflammatory gel, with a frequency of 1 MHz and a working intensity of 0.6W / cm².

The lymphatic drainage massage was applied to reduce the edema, but also sedative massage for the fingers, fist and forearm area. The massage lasted for 15 minutes and was made from the distal joints to the proximal ones.

The kinesiotherapy program lasted for 15 days and was strictly individualized. The following were performed:

- the passive and active mobilizations of the fingers and fist joints
- active exercises to recover the prehension
- active exercises with resistance
- exercises at the Canadian table - occupational therapy
- emphasis on the recovery of supination

The criteria for including the patients in the study were:

1. diagnosis of the radius / ulna post distal fracture sequelae
2. no chronic decompensated diseases
3. patients who agreed to participate in the study

Exclusion criteria:

- ✓ trauma at another level of the upper limb
- ✓ surgically treated intra-articular fractures
- ✓ bilateral fractures
- ✓ open fractures
- ✓ presence of osteosynthesis elements at the level of the hand or forearm
- ✓ patients with neuro-psycho disorders

✓ patients who did not agree to participate in the study

All the patients received information about the recovery treatment that is to be applied, the methods applied were non-invasive, and the obtained data were used only for this study. The following devices were used: Chattanooga device and equipments from the kinesiotherapy room (balls, elastic bands, Canadian plate, 0.5 kg weights).

Statistical analysis

The obtained data were recorded and processed by using Microsoft Excel version 2010, by using the median, the standard deviation, the t-student test, in order to compare the obtained results and to verify the work hypothesis. The t-student test helped to evaluate the value of the p-index that can indicate the occurrence of an error related to the work hypothesis whereas the statistically significant value was for p<0.05.

Results and discussions

The trial group was made of 20 patients, and the distribution according to the age group, sex and life style is found in Table 1.

Table 1. Distribution of patients

age group(years)	women	men	urban	rural
20-35	2	1	1	2
36-50	1	3	2	2
51-70	4	3	5	2
>70	3	3	4	2

It is noticed in the chosen group that the patients are equally represented according to sex, and that there are more patients from the urban places (60%). The greatest occurrence of fractures was recorded in the age group 51-70 years (35%) followed by the age group over 70 years (30 %), the age group 36-50 years (20%) and the age group 20-35 years (15%).

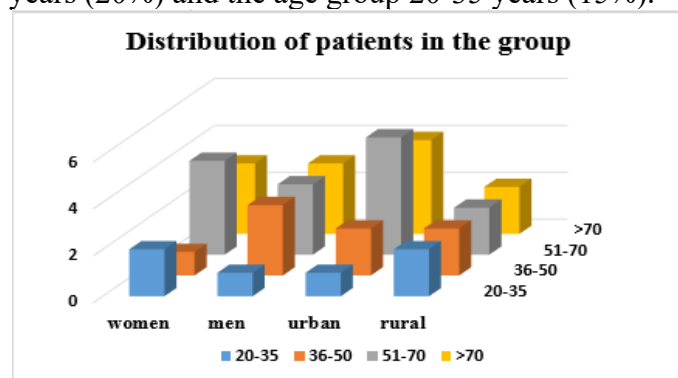


Fig. 1. Distribution of patients in the group

After making the joint balance sheet, it is found the favorable evolution in the recovery on all the mobilisation directions, but also the functional coefficient, in all the evaluation moments: initial, final and control.

Table 2. Evolution of the joint mobility

joint balance sheet	initial	final	control
flexion	12±1.85	22±2.63	36±3.53
extension	10±1.59	18±2.56	28.5±2.87
radial inclination	9±1.79	16±1.94	18.5±0.81
ulnar inclination	13±1.61	22±1.44	25±1.22
functional coefficient	21±4.69	39±2.69	57±3.12

The graphic representation of the mobility of the patients' fists is presented in Figure 2

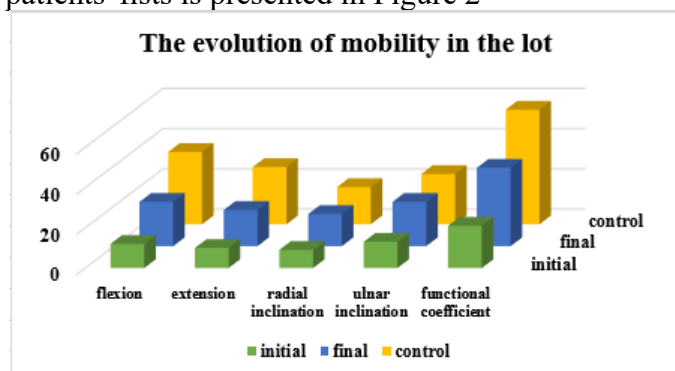


Fig. 2. Evolution of mobility of the fist

When evaluating the muscular force by means of the dynamometer, it was found a favourable evolution, presented in Table 3 and in Figure 3.

Table 3. Evolution of the parameter muscular force

moment	initial	final	control
Dynamometry	15±12.51	25±12.38	34±12.39

The muscular force of the flexor muscles of the hand was evaluated by making 3 repeated measurements and by calculating their average.

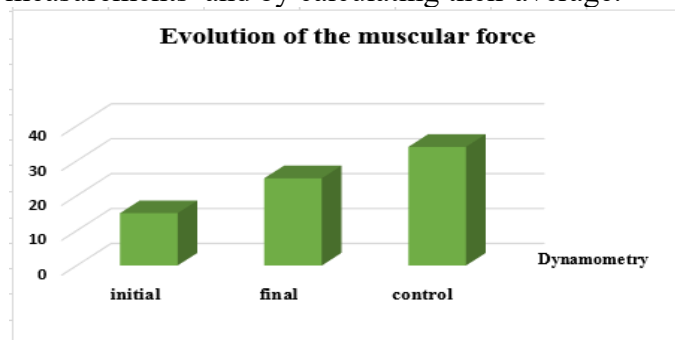


Fig. 3. Evolution of the muscular force

After the completion of the VAS scale for the evaluation of the pain, it resulted that the pain was reduced in the group, and matched the other parameter to evaluate the patients' health condition, respectively the quality of life that was improved.

Table 4. Evolution of VAS scale and QOL scale

Scale	initial	final	control
VAS	8±0.94	6±1.05	3±0.76
QOL	83±6.34	90±5.54	100±4.75

At first the patients had moderate to severe pains that prevented them from doing their daily activities, but, after the recovery program, the pain was decreased and enabled them to do their normal daily activities.

S2

Conclusions

By applying the evaluation methods and scales to the 3 moments of assessing the patients, the efficiency of the complex recovery program can be seen. So:

- The pain decreased from the initial to the final moment, the result being statistically significant, with $p < 0.0138$
- The joint mobility increased on all the movement directions, with statistically significant values, namely:
 1. Flexion $p < 0.0207$
 2. Extension $p < 0.0186$
 3. Radial inclination $p < 0.0052$
 4. Ulnar inclination $p < 0.0034$
- The functional mobility coefficient registered an increase, with $p < 0.0134$
- The increase of the muscle strength, assessed in the flexors of the hand, was statistically significant with $p < 0.0481$
- The increase of the mobility parameters values enable the patients to do their daily activities close to normal, which implies the social independence of the patients
- The applied individualized recovery treatment enabled the increase of the patients' quality of life materialized in the statistically significant value of the index of quality of life with $p < 0.0379$

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Informed consent: *An informed consent was obtained from the patients included in this study.*

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Abstract

Introductions. Lymphedema is an interstitial accumulation of protein-rich lymph fluid, due to the post-therapeutic alteration of lymphatic circulation in the upper limb. The appearance of lymphedema is favoured by a number of risk factors. All of these factors ultimately lead to a process of tissue fibrosis. **Materials and methods.** This study was carried out in an outpatient regimen, for a period of 12 months, in the kinetotherapy room, using massage elements for lymphatic drainage and kinetotherapy technique. The study group included 15 patients aged 27-65 years. **Results and discussions.** Patients evaluated the quality of life after surgery based on the physical and mental symptoms, which is why anxiety, pain reduction through massage and kinetotherapy give patients self-confidence as well as confidence in the recovery process. **Conclusions.** This complex programme that includes lymphatic drainage massage methods and kinetotherapy techniques should be applied individually, progressively, under the control of the kinetotherapist.

Key words: *lymphedema, kinetotherapy technique, lymphatic drainage massage,*

Introduction

Lymphedema is an interstitial accumulation of protein-rich lymph fluid, due to the post-therapeutic alteration of lymphatic circulation in the upper limb. Surgery (lymphadenectomy) and radiation therapy for breast neoplasm can lead to secondary lymphedema of the arm. The increase in volume is not immediate. It can be developed in months or years after the end of treatment.

The appearance of lymphedema is favoured by a number of risk factors: obesity, upper limb infections, surgery on the limb at-risk, level of use of the limb (degree of repetitive effort (1,2), number of lymph nodes removed from the axilla (axillary dissection versus sentinel lymph node), radiotherapy, airplane travel, tamoxifen treatment by promoting thrombosis and coagulation disorders, history of upper limb lymphangitis (3,4).

All of these factors ultimately lead to a process of tissue fibrosis. Fibrosis compromises lymphatic vascular endothelium regeneration by altering endothelial cell proliferation. The microstructure of the altered lymphatic vessels will lead to a reverse circulation of the lymph, from the collecting vessels to the lymphatic capillaries, materialized by the accumulation of lymph in the interstitial space. Pathophysiologically, over time there is an interaction between the processes of

lymphangiogenesis, inflammation, fibrosis and lipid metabolism which will lead to fibrosis and the deposition of adipose tissue with the increase in volume of the upper limb (5).

In 2001, it was shown that 80% of patients may have lymphedema symptoms in the first 3 years after breast cancer surgery and 20% may develop lymphedema at a rate of 1% per year (6). Later, a larger study showed that the incidence of lymphedema varies between 8% and 56% at 2 years postoperatively, depending on the extent of lymphadenectomy and whether radiation therapy was applied or not (7). These situations cannot be generalized, considering that there have been reported cases of lymphedema of the arm at several days post-surgery, but also 30 years after surgery (8).

Studies have shown that unilateral breast cancer is more common in the left breast than in the right breast. Increased incidence in the left versus right breast gland was discovered nearly 40 years ago by Fellenbergs who studied 986 breast cancer cases between 1933-1935, diagnosed and treated at the Swiss Cancer Center (9).

Breast lymphatics drain into the first station represented by the homolateral axilla. In the axilla, there are about 30-50 lymph nodes. The axillary

architecture is systematized into six ganglion groups divided on 3 levels according to their position in relation to the pectoralis major. Neoplastic invasion is usually performed from level I to II and III, respectively (10). This stratification is used by specialists in order to characterise the malignant axillary microscopic invasion.

- Level I, lower, is drawn along the outer edge of the pectoralis minor
- Level II, the middle axilla, is under pectoralis minor
- Level III, the upper axilla is located along the inner edge of the pectoralis minor

The apical lymph nodes drain into the subclavicular lymphatic trunk. The differences between the lymphatic drainage systems between the left and right sides consist of: on the left side, the subclavicular lymphatic trunk drains into the thoracic canal, while on the right side, it drains into the right lymphatic canal. Alternatively, the lymphatic trunks can drain directly into one of the large cervical veins. The mammary tegument drains to the inferior axillary group, the latero-cervical and infraclavicular ganglia. The nipple and the breast areola drain into the subareolar lymphatic plexus.

Lymphedema is a complication recognized by surgeons and oncologists, but benefits from reduced attention compared to other complications of mammary antineoplastic therapy. Homolateral axillary lymphadenectomy, an integral part of breast cancer surgery, can lead to edema with increased frequency for axillary lymph node dissection compared to the sentinel lymph node technique (11,12).

A study from 2012 presents 3 mathematical models in order to help clinicians in their attempt to determine the possibility of lymphedema occurrence in the arm 5 years after surgery, for each patient, and the possibility of establishing preventive measures and the appropriate treatment (13). Thus, for patients with low or no risk factor, the probability of lymphedema occurrence is 3%, in patients with 2 risk factors it is 19%, and in those with 3 risk factors it is 38% (14).

The quality of life of patients after surgery and oncotherapy is altered, patients accusing physical symptoms that involve pain and limiting mobility but also psychological issues such as nervousness, anxiety, depression which are difficult to resolve. (15).

There are situations when the patient who has lymphedema is affected by the chronic dysfunction

of the musculoskeletal system that affects the surrounding joint and tissues. The pathogenesis, diagnosis and treatment of these conditions is a vibrant subject of research, which aims to increase the quality of life, while reducing the costs for healthcare (16).

Recovery methods in the case of occurrence of lymphedema are most of the times limited to the application of methods to reduce the volume of lymphedema. Some studies have shown that procedures for the progressive recovery of force gradually increase the physiological capacity of the arm. This increased capacity should reduce the risk that the daily activities put stress on the lymphatic system of the affected side (17). In addition to these procedures, the patient must be aware of the need to maintain her health in order to reduce the risk of developing lymphedema (2).

Aim. The present study aims at presenting the importance of complex decongestant therapy in patients with lymphedema and methods of improving the quality of life.

Materials and methods

The general objectives were to reduce the volume of lymphedema and to raise the awareness of the patients about maintaining the health status, to reduce the risk of developing lymphedema, to recognize the clinical symptoms of lymphedema, to assess the patients' compliance with the recovery programme.

Recovery occurs through the use of kinetic techniques, avoiding the use of other more invasive methods for which the results of their use in this pathology are not known (18,19).

The study was carried out in an outpatient regimen, for a period of 12 months, in the kinetotherapy room, using massage elements for lymphatic drainage and kinetotherapy techniques, using for this purpose the stick and the Bobath ball (20).

The daily recovery programme had 2 stages: in the first stage, lymphatic drainage massage, and in the second stage, medical gymnastics exercises and application of elastic bandages (lymph taping).

The criteria for inclusion in the study were:

- positive diagnosis of secondary lymphedema
- patients who had lymphedema symptoms
- patients' consent for the application of the recovery treatment

Exclusion criteria from the study:

1. diagnosis of lymphangitis, angioma, angiosarcoma, dermal papillomatosis, lymphatic cyst

2. decompensated chronic diseases
3. inflammatory processes
4. patients who did not consent to participate in the study.

Recovery sessions lasted 60 minutes, with a frequency of 3 times / week.

For 30 minutes the manual lymphatic drainage massage is applied (20).

For another 30 minutes the patients continue with gymnastic exercises to operate the muscular pump and to help the proper functioning of the lymphatic and venous vessels. The program included limb mobilizations, exercises for the thoracic and abdominal muscles, respiratory gymnastics (thoracic, diaphragmatic and abdominal) to provide the oxygen needed for gas exchange in the lungs. At the end of the kinetotherapy programme, elastic bandages were applied to maintain the effects obtained.

Regarding the lymphatic drainage, the “appeal method” and the “resorption method” were applied:

[1] pressure on the lymph nodes from the throat-Terminus, then on the subclavicular lymph nodes

- ✓ on the healthy side of the breast: circular movements were performed on the axillary lymph nodes, pumping-pushing movements over the breast, then intercostal circular movements, drainage of the parasternal lymph nodes
- ✓ on the operated side of the breast: circular movements are made towards the healthy axilla, above the operative scar and below the clavicle
- ✓ for the arm: circular movements from the axilla to the back of the arm, applying the resorption method from the elbow crease to the Terminus point
- ✓ for the forearm: the “bracelet pressure” technique is applied, distally to the proximally
- ✓ for the hand: circular movements on the fingers, palm

The psychological impact of the surgery on the patients was also taken into account.

The following parameters were appreciated at the beginning (M1) and at the end of the treatment (M2): pain and quality of life. For pain, the VAS (Analogue Visual Pain Scale) scale was used, in which the value 0 = no pain, the value 10 =

maximum pain and the QOL (Quality of life) scale was used to assess the quality of life.

Somatometry elements were also assessed, respectively the perimeter of the arm (in 3 points), the forearm and the fist, using the measuring tape. The treatment lasted for 5 weeks.

Statistical analysis

To record the data obtained from patients, the Microsoft Excel program was used, namely, the mean, median, standard deviation, Student’s t test, in order to compare the obtained results and to verify the working hypothesis. The Student’s t test allowed us to determine the value of the p index, which may indicate an error regarding the working hypothesis.

Results and discussions

The study group included 15 patients aged 27-65 years, 10 (60.6%) from urban areas and 5 (39.4%) from rural areas.

Table no. 1. Distribution of patients per age groups

	Age group (years)	Number
1	27-35	6(40%)
2	36-45	3(20%)
3	46-55	2(13.33%)
4	56-65	4(26.67%)

The duration of treatment was 5 weeks, with a frequency of 3 sessions per week. The techniques of drainage massage and the complete programme of kinetotherapy were applied. The decrease of the pain parameter and the increase of the quality of life, assessed on the VAS and QOL scale, were noted.

Table no. 2. Evolution of pain and quality of life of the patients in the group

Scale	Statistics	Moment M1	Moment M2
VAS	Mean/STD deviation	8±0.71	6±0.91
QOL	Mean/STD deviation	76±4.56	88±4.19

After measuring the perimeter of the arm in 3 points (P1, P2, P3) and at the 2 evaluation moments, a reduction of the values for all measurement points compared to the initial values was noted.

Table no. 3. Evolution of the arm perimeter in the patients in the group

Arm perimeter	P1		P2		P3	
Moments	M1	M2	M1	M2	M1	M2
Statistics	33±2.74	31.5±2.21	30±2.42	28±2.29	27±3.33	26±3.39

Regarding the forearm and fist measurement, a reduction of the final values compared with the initial ones was noted, as well.

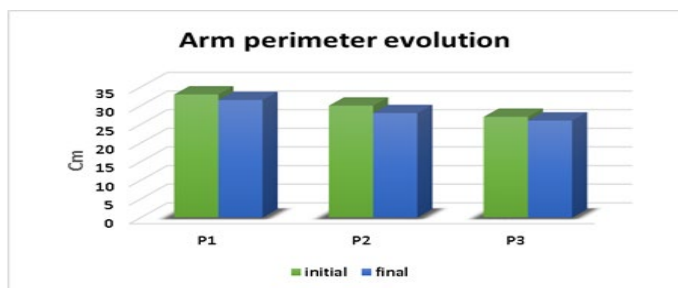


Fig. 1. Arm perimeter evolution in the study patients

Table no 3. Evolution of forearm and fist perimeter in the study patients

Perimeter	Moment M1	Moment M2
Forearm	22±1.81	21±1.79
Fist	17±1.41	16±1.06

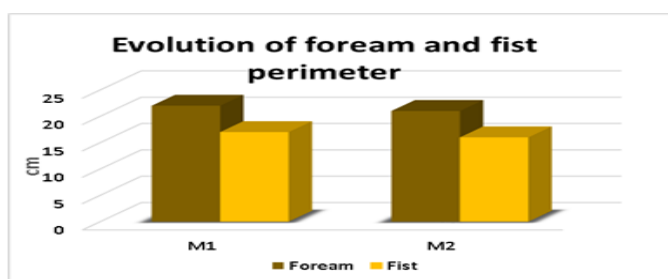


Fig. 2. Evolution of the perimeter of forearm and fist in the study patients

The obtained results allow us to affirm that the application of lymphatic drainage massage and the kinetotherapy programme as early as possible, as well as maintaining the effects obtained by using the elastic bandages ensures pain reduction, decreasing the perimeter of the arm, forearm and fist, allowing these patients to carry out daily activities with average functional capacity.

For the pain and quality of life assessment scales, the results obtained were statistically significant, the p value being less than 0.05

Table no. 4. The value of the Student's t-test for VAS and QOL scales

Scale	VAS	QOL
T test	0.0127	0.0029

By measuring the perimeters at the level of the upper limb segments (arm, forearm and hand) it was found that the Student's t test had statistically significant values in the arm at the 3 measurement points, $p < 0.05$. The same statistically significant results were obtained when measuring the perimeter for the forearm and fist.

Table no. 5. The value of the Student's t test for the perimeter of the upper limb

Perimeter	P1	P2	P3	Forearm	Fist
T test	0.0003	0.0007	0.0002	0.0003	0.0006

Patients evaluated the quality of life after surgery based on the physical (pain, limiting mobility, physical appearance) and mental (nervousness, anxiety, depression, irritability) symptoms, which is why anxiety, pain reduction through massage and kinetotherapy give patients self-confidence as well as confidence in the recovery process, which facilitates the faster reintegration of patients, in family and socio-professional life (21,22).

Further studies are needed to establish a broader protocol that combines different modalities of physical activity, frequencies, intensities and durations needed to improve specific outcomes among women who have undergone adjuvant therapy (23,24).

Conclusions:

Given that between 20% and 30% of patients develop lymphedema, an early recovery programme after surgery, can prevent lymphedema occurrence and reduce the complications associated with it. This complex programme that includes lymphatic drainage massage methods and kinetotherapy techniques should be applied individually, progressively, under the control of the kinetotherapist and allows enhancing the quality of life by improving the algal, functional, vasomotor symptoms.

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Informed consent: *An informed consent was obtained from the patients included in this study.*

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Clinical, paraclinical aspects and complex therapeutical approaches in a patient with incomplete paraplegia, post thoracic meningioma surgically treated, in neurofibromatosis context

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Abstract

Introduction: Neurofibromatosis - type 1 (NF1) and type 2 (NF2) - are genetic disorders of the nervous system that can affect the growth and development of nerve cell tissue and so can determine severe or rather permanent sequels. NF2 implies usually multiple tumors on the cranial and spinal nerves and it is less common than NF1. The most frequent symptom of NF2 is hearing progressive loss, as a consequence of auditory nerves affection and appears at early ages or at twenties. The evolution of a patient with NF2 depends on the number and location of tumors and some of them might develop a life-threatening or disabling condition. With a prompt diagnosis and an appropriate therapy it can be improved the patient prognosis and QOL.

Materials and Methods: This paper presents the case of a 43-year-old patient, with personal antecedents of hearing dysfunction, diagnosed in 2013 with neurofibromatosis that was hospitalized at the IV Neurosurgery Clinic of TEHBA in January 2019 and suffered a re-intervention for removal of the spinal cord tumor (psammomatous meningioma) and with spinal cord decompression. In our clinic, the patient was admitted for incomplete AIS/Frankel C paraplegia, he had initially followed a complex nursing program and subsequently a rehabilitation adequate program. The patient was assessed functionally using the following scales: AIS / Frankel, modified Ashworth, Functional Independence Measure (FIM), Life Quality Assessment (QOL), FAC International Scale, Independence Assessment Scale in Daily Activities (ADL / IADL), Walking Scale for Spinal Cord Injury (WISCI).

Results: The paraclinical assessments (cerebral and spinal cord MRI) detect multiple cerebral tumors and micro-nodules adjacent to the lumbar spinal roots, which, associated with the bilateral acoustic neurinoma (diagnosed in 2013), contributed to the suspicion of the NF2 diagnosis. The patient had two admissions in our clinic division, benefited from a complex neuro-muscular rehabilitation program, having a favourable evolution, with an increase in the evaluated scales scores, now performing walking with a support from another person in walking frame, as well as sphincter re-education, with the neurogenic bladder remission.

Conclusions: Even if there is no cure for neurofibromatosis and no standard treatment, it is important to promptly diagnose such a rare disease and to give an adequate treatment (AINS or other analgesic drugs, surgery, chemotherapy or radiation –when it’s needed, or psychotherapy) for controlling symptoms and also a personalized rehabilitation program (including nursing measures) enhancing including patient's quality of life.

Key words: *paraplegia, neurofibromatosis, neuro-muscular rehabilitation,*

Introduction

Neurofibromatosis - type 1 (NF-1) and type 2 (NF-2) - are genetic disorders of the nervous system that can affect the growth and development of nerve cell tissue and so can determine severe or rather permanent sequels.

Neurofibromatosis type1, also called von Recklinghausen’s disease, is the most common one (90% of all cases) (1) has an incidence by 1 in 3000 people (2) and it is an autosomal dominant disease affecting the skin, nervous system and bones. NF-1 it is caused by the mutation of a gene (that regulates production of neurofibromin protein – a tumor

suppressor) on the chromosome 17 and in 50% of cases this mutation it is done spontaneously. (2)

Diagnosis of NF-1 is made by matching at least 2 of the following 7 diagnostic criteria:

- six or more café au- lait spots
- two or more neurofibromas
- axillary and/or inguinal freckles
- optic glioma
- two or more Lisch nodules
- specific long bones abnormalities or sphenoid dysplasia
- first degree relatives with NF1(3)

Neurofibromatosis type II is also known as MISME syndrome – multiple inherited schwannomas, meningiomas, and ependymomas. (4) Being a genetic condition, it may be inherited or may arise spontaneously.

NF-2 implies usually multiple tumours on the nervous system and it is less common than NF-1 (incidence of 1 in 60,000). (4)

NF-2 is caused by mutations of the "Merlin" (Moesin-ezrin-radixin-like protein) gene (5) which is a tumour suppressor protein, located on chromosome 22q. At the beginning, Merlin was described to be a structural protein with the function of an actin cytoskeleton regulator and later on, its tumor suppressant role was discovered.

Pathogenesis

In people with NF-2 and ependymomas, the tumor suppressant function of Merlin may be compromised. Tumorigenesis are determined by the loss of function mutations in chromosome 22q, the place Merlin proteins are coded. (6)

Clinical manifestations of this disease, includes symptoms generated by the potential tumors that can appear, such as: brain or spinal cord tumors, peripheral nerve tumors.

Symptoms of Brain Tumors:

- Loss of hearing
- Facial drop
- Dizziness, headaches
 - Poor balance - uncoordinated walking/ vertigo, unsteady gait
 - Speech difficulties
 - Dysphagia (Swallowing Issues – choking, coughing while eating or drinking)

Vision Issues:

- Intracranial and Intraorbital Tumors
- Cataracts (cloudy areas on the lens of the eye) that develop at an unusually early age
- Diplopia (Double Vision)
- Dry Eye (Inability to produce tears)
- Oscillopsia (Fuzzy Vision)
- Papilledema (Swelling of Optic Nerve)

Symptoms of spinal cord tumors (schwannomas; meningiomas; ependymomas; astrocytomas):

- Drop Foot
- Scoliosis
- Tingling/Numbness of Limbs
- Back pain from the enlarging of the spine tumors,
- Weakness in the fingers and toes

Symptoms of Peripheral Nerve Tumors (brachial plexus tumors - upper arm/neck); sciatica nerve tumors - lower back/hip/upper leg; tibia nerve tumors - lower leg; median nerve tumors –arm):

- Hand / drop foot
- Peripheral neuropathy
- Muscle weakness
- Tingling/ numbness of limbs
- Pain

Individuals with NF-2 usually develop symptoms during early adulthood. Affected people generally have fewer brown macules on the skin than those having NF1 type (8). The most frequent symptom of NF-2 is hearing progressive loss, as a consequence of auditory nerves affection (7) (the hallmark lesions of NF-2 are bilateral acoustic Schwannomas, which affect almost all patients) and appears at early ages or at twenties. Besides, about a half of patients will develop tumours in other cranial nerves or the meninges, and also spinal tumours occur (7). The evolution of a individual depends on the number and location of tumours and it is to be mentioned that some of them might develop a life-threatening potential. It is important a prompt diagnosis in order to apply an appropriate therapy. (7)

Current and revised Manchester criteria for NF-2 (9)

1. Bilateral vestibular schwannomas (VS) <70^a or
 2. First degree relative (FDR) family history of NF2 and unilateral vestibular schwannoma (UVS) < 70^a or
 3. FDR family history of NF-2 or UVS and 2 of ^b meningioma, cataract, glioma, neurofibroma, schwannoma, cerebral calcification or
 4. Multiple meningiomas (2 or more) and 2 of unilateral VS, cataract, glioma, neurofibroma schwannoma, cerebral calcification or
 5. Constitutional or mosaic pathogenic NF-2 gene mutation in blood or identical mutations in 2 distinct tumors ^a
- a: 2016 suggested revisions.
- b: any 2 includes 2 of any tumor type such as schwannoma.

Diagnosis (10)

Neurofibromatosis is diagnosed using following tests:

- Physical examination
- Medical history
- Family history

- X-rays
- Computerized tomography (CT) scans
- Magnetic resonance imaging (MRI)
- Biopsy of neurofibromas
- Eye tests
- Audiometry
- Genetic testing (can demonstrate the presence of a mutation on the NF-1 or NF-2 gene)

Treatment

Neurofibromatosis cannot be cured but treatments are focused on controlling symptoms. Many symptoms, such as café au lait spots, do not need treatment. Though, we have to underline some options of treatment:

- Surgery in case of growing tumors
- Chemotherapy or radiation if a tumor has turned malignant
- Orthopedic surgery for postural spine problems, like scoliosis
- Physical therapy
- Cataract removal surgery
- AIS/AINS treatment of associated pain/symptoms

Surgical treatment

There are several different surgical techniques for the removal of acoustic neuroma (retro-sigmoid approach, trans-labyrinthine approach, middle fossa approach).(11) The choice of the operation depends on the size of the tumor, the hearing impairment and general health. Unfortunately, the chance of hearing preservation is small in large tumors, no matter the procedure chosen. When hearing is impaired, the trans-labyrinthine approach may be used for small tumors. In case of small, lateralized tumors with good hearing it is recommended the middle fossa approach. When the location of the tumor is more medial, a retro-sigmoid approach may be better.

Radiosurgery - types include also a lot of technics: SRS (stereotactic radiosurgery), Gamma Knife, CyberKnife, Proton Therapy which is a conservative alternative focused on the tumour sparing exposure to surrounding normal tissues. The goal of radiation therapy is to prevent the tumor growth. Although radiation is less immediately damaging than conventional surgery, it incurs a higher risk of subsequent malignant change in the irradiated tissues.

It is to be noticed that there is a significant risk of hearing loss with surgical removal of acoustic neuroma. (12)

Hearing Loss

People with NF-2 hearing problems (including deafness) are more likely to resort to auditory assistive technology such as the cochlear implant which can be used as a device for restoring a high level of auditory function even when natural hearing is totally lost.

An auditory brainstem implant may be another option when the cochlear nerve is destroyed, in order to restore some level of hearing, supplemented by lip reading (13)

Hearing may be preserved if diagnosed in time, but if not, patients may require an auditory assistive device, as mentioned above. (14)

Prognosis

The long-term prognosis for people with NF-2 depends on a number of factors, as the age onset and the number and location of tumors as they can vary significantly from person to person. The tumors associated with NF-2 are mostly benign, but they can reduce significantly the quality of life of these patients.

The average age of death in people with NF-2 is 36 years and earlier diagnosis followed by the proper treatment in specialty centers may improve life expectancy with more than 15 years. (15, 16,17)

Case Presentation

This paper presents (with the approval of the Bioethics Commission no.17464/14.06.2019) the case of a 43 year-old patient, with personal antecedents of hearing dysfunction and phonation disorders, diagnosed in 2013 with neurofibromatosis (he accused some headache and tinnitus for two years before the NF confirmation and he went to many doctors until an ORL doctor recommended him a brain MRI – that revealed the multiple expansive intracranial processes).

In 2018, he begun to develop subjective severe thoracic-lumbar pain and neurologic deficit on lower limbs and he was hospitalized at Emergency Hospital Floreasca, where following investigations, a tumoral mass at T10 level was identified.

The first exploratory intervention – considering the risk of a vascular malformation - on the spinal cord lesion, at T7-T10 level, has been done on December 2018, at the hospital above mentioned.

Next, because he was still having thoracic pain and neurologic impairment, he was hospitalized at the IV Neurosurgery Clinic of TEHBA in January 2019 where he was subjected to a re-intervention for the removal of the spinal cord tumor, with a spinal cord decompression.

The anatomo-pathological examination revealed at a macroscopic analysis multifragmentary piece of 3,5 /2/ 1,5 cm, grey color, with elastic consistency and the microscopic analysis pointed out a psammomatous meningioma from NF-2.

After an insidious evolution, the patient was admitted in TEHBA Neuro-Muscular Clinic Devision 25.01-21.03.2019. In our clinic, the patient initially followed a complex nursing program and subsequently a rehabilitation adequate program.

The onset of the patient's symptoms: motor deficit in lower limb, sphincter's impairment, phonation disorders and moderate deficit of locomotion/ selfcare.

Physical examination: he was underweight, afebrile, with a satisfactory general appearance. The blood pressure was 110/70 mmHg, pulse 98/min, oxygen saturation was 98% spontaneously, irradiated systolic blow on carotids, pale teguments with a post-operative plague at thoracic level, important muscular hypotrophy (lower limbs more than upper limbs). He had a persistent neurogenic bladder dysfunction – using a fixed urinary catheterization- and also, of neurogenic bowel – including constipation.

The patient presented 6 pigmentary café au-lait macules on the anterior thorax that spotted around the age of 20 years old with only 2 of them having more than 15 mm in diameter.



Fig. 1: Pigmentary café au-lait macules on the patient's anterior thorax (from TEHBA Neuro- Rehabilitation Clinic Devision). Neurofibromas with small dimensions, less than 4 cm in diameter (soft, fleshy growths under the skin) situated on the left forearm, on the left ear, right hand that appeared for 4 years.



Fig. 2: Neurofibromas on the patient's forearm (from TEHBA Neuro-Rehabilitation Clinic Devision).

Neurological examination showed a temporo-spatial oriented, conscious and cooperative person, with important dysphonia (right vocal cord paralysis when he was 20 years old), injury on cranial nerve X bilateral hearing loss (left> right), injury on cranial nerve VIII, motor deficit (according to AIS/Frankel Scale- AIS/Frankel C) of paraplegia type, with T8 neurological level.

Initially the osteotendinous reflexes were decreased and after one month he had bilateral Babinsky reflex.

The patient was assessed functionally using the following scales:

- AIS/Frankel (American Spinal Injury Association Impairment Scale): 74 motor from 100 points, sensory 204 from 224 points

- Ashworth Modified Scale: Spasticity = 2 on left leg

- FIM (Functional Independence Measure): motor 45 points; cognitiv 35 points

- QoL (Life Quality Assessment Quality of Life): 57 points,

- Walking Scale for Spinal Cord Injury (WISCI): 0 points

- Functional Ambulation Categories (FAC) International Scale: 0

From the functional point of view, the patient was immobilized in bed.

Patient Name _____ Examiner Name _____ Date/Time of Exam _____

ASIA STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY **ISC**

MOTOR KEY MUSCLES (scoring on one side)

	R	L
C5	<input type="checkbox"/>	<input type="checkbox"/>
C6	<input type="checkbox"/>	<input type="checkbox"/>
C7	<input type="checkbox"/>	<input type="checkbox"/>
C8	<input type="checkbox"/>	<input type="checkbox"/>
T1	<input type="checkbox"/>	<input type="checkbox"/>
TOTAL (MAXIMUM)	(20)	(20)

UPPER LIMBS TOTAL (MAXIMUM) (20) (20)

SENSORY KEY SENSORY POINTS

	R	L
C2	<input type="checkbox"/>	<input type="checkbox"/>
C3	<input type="checkbox"/>	<input type="checkbox"/>
C4	<input type="checkbox"/>	<input type="checkbox"/>
C5	<input type="checkbox"/>	<input type="checkbox"/>
C6	<input type="checkbox"/>	<input type="checkbox"/>
C7	<input type="checkbox"/>	<input type="checkbox"/>
C8	<input type="checkbox"/>	<input type="checkbox"/>
T1	<input type="checkbox"/>	<input type="checkbox"/>
T2	<input type="checkbox"/>	<input type="checkbox"/>
T3	<input type="checkbox"/>	<input type="checkbox"/>
T4	<input type="checkbox"/>	<input type="checkbox"/>
T5	<input type="checkbox"/>	<input type="checkbox"/>
T6	<input type="checkbox"/>	<input type="checkbox"/>
T7	<input type="checkbox"/>	<input type="checkbox"/>
T8	<input type="checkbox"/>	<input type="checkbox"/>
T9	<input type="checkbox"/>	<input type="checkbox"/>
T10	<input type="checkbox"/>	<input type="checkbox"/>
T11	<input type="checkbox"/>	<input type="checkbox"/>
T12	<input type="checkbox"/>	<input type="checkbox"/>
L1	<input type="checkbox"/>	<input type="checkbox"/>
L2	<input type="checkbox"/>	<input type="checkbox"/>
L3	<input type="checkbox"/>	<input type="checkbox"/>
L4	<input type="checkbox"/>	<input type="checkbox"/>
L5	<input type="checkbox"/>	<input type="checkbox"/>
S1	<input type="checkbox"/>	<input type="checkbox"/>
S2	<input type="checkbox"/>	<input type="checkbox"/>
S3	<input type="checkbox"/>	<input type="checkbox"/>
S4-S5	<input type="checkbox"/>	<input type="checkbox"/>
TOTALS (MAXIMUM)	(20)	(20)

LOWER LIMBS TOTAL (MAXIMUM) (20) (20)

NEUROLOGICAL LEVEL (The first level segment with normal function)

ASIA IMPAIRMENT SCALE

COMPLETE OR INCOMPLETE? (Impairment in sensory or motor function in S4-S5)

ZONE OF PARTIAL PRESERVATION (Caudal extent of sensory/motor impairment)

KEY SENSORY POINTS

Any anal sensation (Yes/No) ☐ **PIN PRICK SCORE** (max: 112) ☐ **Any sensory or motor function in S4-S5** ☐

Comments:

Fig. 3: American Spinal Injury Association (ASIA) Impairment Scale (AIS) scoring (after: <http://www.scribd.com/doc/37064936/2006-Classif-Worksheet>) – with included/ adapted Frankel's grading semi-quantitative system – to describe/ assess the severity of cord lesion's consequent (neurologic and functional) impairment – with some main related clinical syndromes



Fig. 4: Bulbo- cavernous reflex (with permission, by elearnSCI.org Submodule: Clinical assessment of patients with SCI - Doctor's Module - Aito S (Coordinator) et al., 2012 - <http://www.elearnsci.org/>

FIM™ instrument				
LEVELS	7	Complete Independence (Timely, Safely)	NO HELPER	
	6	Modified Independence (Device)		
LEVELS	5	Modified Dependence	HELPER	
	4	Minimal Assist (Subject = 75%+)		
	3	Moderate Assist (Subject = 50%+)		
LEVELS	2	Complete Dependence		
	1	Maximal Assist (Subject =25%+)		
	0	Total Assist (Subject = less than 25%)		
<hr/>				
	Self-Care	ADMISSION	DISCHARGE	FOLLOW-UP
	A. Eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	B. Grooming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C. Bathing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	D. Dressing - Upper Body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E. Dressing - Lower Body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F. Toileting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Sphincter Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	G. Bladder Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	H. Bowel Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Transfers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	I. Bed, Chair, Wheelchair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	J. Toilet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	K. Tub, Shower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Locomotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	L. Walk/Wheelchair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	M. Stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Motor Subtotal Score	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	N. Comprehension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	O. Expression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Social Cognition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	P. Social Interaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q. Problem Solving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	R. Memory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Cognitive Subtotal Score	<input type="text"/>	<input type="text"/>	<input type="text"/>
	TOTAL FIM Score	<input type="text"/>	<input type="text"/>	<input type="text"/>

Fig. 5: Endorsed by the USA Department of Veterans Affairs, since 2003 Guide for the Uniform Data Set for Medical Rehabilitation, Version 5.1 Buffalo, State University of New York at Buffalo - from Uniform Data System for Medical Rehabilitation, UBFA – cited in Braddom R. L. et al. – Physical Medicine & Rehabilitation (3rd edition). W. B. Saunders Company, Philadelphia, USA., 2007

Nr.	Categorie	Caracterizare
0	Nefuncționalitate	Pacientul nu poate merge sau necesită ajutor de la 2 sau mai multe persoane
1	Dependență - nivel 2	Pacientul necesită sprijin ferm și continuu din partea unei persoane
2	Dependență - nivel 1	Pacientul necesită sprijin continuu sau intermitent din partea unei persoane pentru ajutor cu echilibrul sau coordonarea
3	Dependență - supraveghere	Pacientul necesită coordonarea verbală sau ajutor potențial din partea unei persoane fără contact fizic
4	Independență - pe teren plan	Pacientul poate merge independent pe teren plan, dar necesită ajutor la scări, pante sau suprafețe denivelate
5	Independență	Pacientul poate merge independent oriunde

Fig 6: FAC (Functional Ambulation Categories) international scale – utilised in our Clinic Division

Clinical/ Paraclinical evaluation

During hospitalisation, the patient presents some short episodes of: anaemia normochrome, relapsed urinary infections treated with specific antibiotics according to antibiograms and ocular and cutaneous allergy with erythema and itching that were treated with antihistaminic drugs and SAID injections.

On brain MRI appear space replacement processes located extra-nevraxial above and infratentorial at the level of bilateral ponto-cerebellar angles, intra-ventricular, at the level of the bilateral occipital horns at the level of the brain and at the level of the bilateral frontal meninges, in conclusion: NF-2 (schwannomas pontocerebellar, ependynomas - occipital horns and meningiomas).

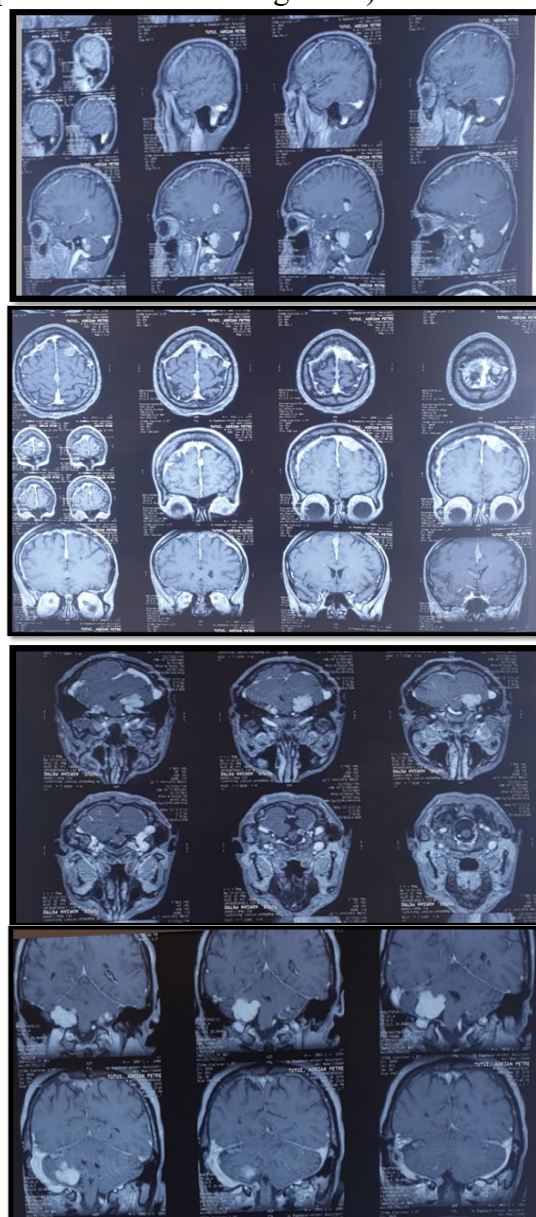


Fig 7,8,9,10 MRI examination of our patient: NF-2 (schwannomas pontocerebellar, ependynomas - occipital horns and meningiomas) ((from TEHBA Neuro-Rehabilitation Clinic Devision)

Interdisciplinary evaluation

Gamma knife evaluation: the patient is out of radiosurgery treatment recommendation; if he decides the neurosurgery of the right neurinoma, he can then benefit of gamma knife treatment on the tumoral residue.

Neurosurgery evaluation: multiple expansive intracranial processes without any important modification comparing to the last evaluation. Recommendation: repete the cerebral MRI in 6 months with a comparative evaluation with the last MRI; continue the rehabilitation program and a short term treatment (10days/ month) with steroid drugs.

ORL examination confirms NF-2, normal from otoscopy examination point of view, perception bilateral hearing loss, Recommendation: total audiogram.

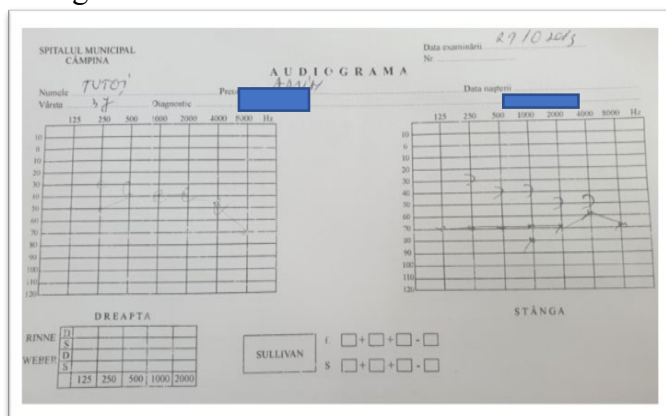


Fig. 11: ORL examination in our patient

Ophtalmological evaluation shows well- defined flat papillae, normal dilated, diminished calibre vessels.

Infectious disease specialist evaluation revealed a urinary tract infection with E. Coli and recommended 7 days Colistin 6mil/day treatment.

Diagnosis

Based on the anamnesis data, on the clinical examination and parclinical investigation the established diagnosis is the following:

- Incomplete paraplegia AIS/Franel C with T8 neurological level post intramedular thoracic tumor T7-T10 surgically treated (on 08.12.2018 and on 10.01.2019)
- Neurogenic bladder in remission
- Neurofibromatosis type 2 with:
- Multiple expansive intracranial processes (ponto-cerebellar schwannomas, meningiomas, and occipital ependymomas)
- Perception bilateral hearing loss
- Right vocal cord paralysis
- Relapsed urinary infections treated

Treatment

During hospitalization, the patient received complex drug treatment with: injectable anticoagulant and when he began mobilization at the kinetotherapy room antiagregant drugs, analgesics, NSAID, SAID, antibiotics, urinary antiseptics, gastric protector, vitamine C, antihistaminic drugs.

Kinetotherapy, initially only in bed (limited by the surgery restriction for 2 weeks) with a personalised program : passive movement at the joints level, active ones, active with lower limb resistance, correct positioning in bed for prevention of vicious joints positions or thrombophlebitis, and after that at the physical therapy room: exercises at MotoMed bicycle, lifting at stall bar bench, exercises on roller device, on pedal exerciser, walking through parallel bars first with an important help from the kinetotherapist.

Results

The patient benefited from a complex neuro-muscular rehabilitation program, having a favourable evolution, with an increase in the evaluated scales scores:

- AIS/ Frankel score from 74 motor to 80 points, and sensory score from 204 to 214 points → from AIS/ Frankel C to D
- Ashworth modified scale from 3 to 2
- FIM motor from 45 points to 74 points; cognitiv 35 points
- QoL from 66 points to 80 points
- WISCI from 0 points to 13 points
- FAC International Scale from 0 to 3

And he had as final performance, walking with a careframe for short distances as well as a sphincter re-education with the neurogenic bladder remission. The paraclinical assessments (cerebral and spinal cord MRI) detect multiple cerebral tumors and micro-nodules adjacent to the lumbar spinal roots, which, associated with the bilateral acoustic neurinoma (diagnosed in 2013), contributed to the confirmation of the NF2 diagnosis.

The patient had two admissions in our clinic division 25.01-21.03.2019 and 07.05-20.06.2019, benefited from a multidisciplinary team evaluation, complex neuro-muscular rehabilitation program, having a favourable evolution, with an increase in the evaluated scales scores, now performing walking with a support from another person in walking frame, as well as sphincter reeducation, with the neurogenic bladder remission.

Possible complications

- Associated with brain tumors: deafness, headaches, epilepsy, visual affections, respiratory and possible deglutition problems if the tumor grows.
- Associated with spinal tumors: becoming a complete paraplegic if another compressive spine tumor will appear.
- Increasing the pain and the tingling/numbness in the lower limbs
- Pressure sores

Prognosis

In our case the *ad vitam* prognosis – is reserved because of the localisation of the brain tumor, their increased dimensions and number and because of the possible complication including exitus.

Ad functionem prognosis is satisfying taking into account the patient's good evolution during neurorehabilitation program if he will continue the kinetotherapy.

Ad laborum prognosis is reserved, the patient being at the moment a wheelchair user and his profession is a construction worker.

An important fact is the medical control (neurorehabilitation, neurology, neurosurgery-gammaknife, ORL, ophtalmology), including MRI, at every 6 months for estimating the tumor growth and the appearance of possible complication.

Case particularity

The case particularity is the fact that the patient's symptomatology has both elements from NF-1 and NF-2 symptoms and they began at an older age than the one at which the disease usually begins'

The more important symptomatology began when the spinal tumor had developed, and after the first neurosurgery intervention including the fact that the symptoms generated by the brain tumors were amplifying as a consequence of marrow edema and subsequently of an increased cerebrospinal fluid pressure including after two general anesthesia procedures. The patient had a very good evolution after the second neurosurgery intervention and following the neuro-rehabilitation program.

Conclusion

Even if there is no cure for neurofibromatosis and no standard treatment, it is important to promptly diagnose such a rare disease and to give an adequate treatment (NSAID/ SAID or other analgesic drugs, surgery, chemotherapy or radiation –when it's needed, or psychotherapy) for controlling symptoms and also a personalized rehabilitation program (including nursing measures) enhancing including patient's quality of life (18).

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Self-defence techniques and procedures, adapted for paraplegic persons independent in wheelchair, to counteract hetero-aggressive behavior

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Abstract

Introduction. Persons living in wheelchair are often target of hetero-aggressive behavior. The aggressors perceive persons in wheelchair as easy victims.

Objectives Acquisition of adapted self-defense techniques and procedures by young paraplegic persons, independent in wheelchair, to counteract some possible hetero-aggressive behavior against them.

Material and methods. A young male person, former sportsman (familiarised with wrestling techniques), living with T11 AIS-A (complete) paraplegia after a spinal cord injury and independent in wheelchair, was instructed some various taekwondo techniques and maneuvers: blocking an attack with the hand at the head region (Olgul Jireugi), hand block (Olgul Maki), hand counterattack (Momntong Jireugi), foot attack at the head region (Olgul Dollyo Chagi), hand block (Sonnal Olgul Maki), hand counterattack (Arae Jireugi).

The young female who plays the role of attacker has black belt in taekwondo, therefore the maneuvers were performed in total safety, without endangering the patient.

Both protagonists of this presentation have given written consent to be photographed and filmed, for academic purpose. The paper has the approval of the Ethics Committee of “Bagdasar-Arseni” Clinical Emergency Hospital, n.o. 17464/14.06.2019.

Results: We realized photographs and films depicting the aforementioned taekwondo techniques, to demonstrate some possible scenarios of aggression.

Discussion Acquisition of martial art techniques and procedures by paraplegic people, independent in wheelchair, is essential and may improve their safety, participation, self-esteem and quality of life.

Conclusions: Prevention, as a self defense method, is essential. The best way is to avoid conflictual situations, but ideal is to be prepared for any situation.

Key words: *paraplegia, spinal cord injury sequelae, taekwondo, self defense techniques, participation, quality of life,*

Introduction

Wheelchair dependend individuals are often easy target, *victim* of aggressors, because they can't efficiently protect themselves in order to escape from a hetero-agresive, conflictual situation (1,2). Self defense techniques and procedures addapted for wheelchair users have a special semnification, because persons with disabilities are two times more susceptible for being attacked, according to the USA Bureau of Justice (3).

Material and methods A young male person, former sportsman (familiarised with wrestling techniques), living with T11 AIS-A (complete) paraplegia after a spinal cord injury and independent in wheelchair, was instructed some various taekwondo techniques and maneuvers: blocking an

attack with the hand at the head region (Olgul Jireugi), hand block (Olgul Maki), hand counterattack (Momntong Jireugi), foot attack at the head region (Olgul Dollyo Chagi), hand block (Sonnal Olgul Maki), hand counterattack (Arae Jireugi) etc.

The young female who plays the role of attacker has black belt in taekwondo, therefore the maneuvers were performed in total safety, without endangering the patient.

Both protagonists of this presentation have given written consent to be photographed and filmed, for academic purpose. The paper has the approval of the Ethics Committee of “Bagdasar-Arseni” Clinical Emergency Hospital, n.o. 17464/14.06.2019.

Results Photographs and films were realized to illustrate possible scenarios of aggression the victim might experience. Limited by the editorial space, we have selected the most important and demonstrative ones (fig 1-5).



Fig.1 Blocking an attack at the head region, with both hands



Fig.2 Blocking an attack (grabbing the victim's shirt)



Fig.3 Blocking a punch (an attack with the fist at the head region)



Fig.4 Hand blockage and counterattack



Fig .5 Blocking a foot kick at the head and counterattack (a punch in the groin region)

Discussion Paulo Coelho quote that says: “fear generally manifests itself in two ways: through aggressivity or submission”.

The purpose of this paper is to depict some simple martial art techniques, adapted for persons living with spinal cord injury sequelae.

The aggressor can be countered through self-defense techniques performed by the victim, and this psychological aspect could provide an element of surprise [3,4].

Acquisition of self-defense techniques and procedures by paraplegic people, independent in wheelchair, may improve their safety, participation, self-esteem and quality of life [5, 6].

Conclusions: Prevention, as a self-defense method, is essential. The best way is to avoid conflictual situations, but ideal is to be prepared for any situation. It is not easy to find articles with this subject, aspect reflected also by the evaluation of all published articles in Balneo Research Journal until now [7].

Conflict of interest

The authors have no conflict of interest to declare.

Author contributions

Diana-Elena Serban is the female protagonist depicted in fig 1-5, contributed in processing the illustrations, and writing the manuscript.

Aurelian Anghelescu designed the study, contributed in editing pictures, writing, and rewuing the manuscript.

Elena Constantin realised and processed the illustrations.

Gelu Onose rewued and aproved the final version of the paper.

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Clinical-evolutive particularities and a multimodal therapeutic-rehabilitative approach, as well as through connected care approach, in the case of hemiplegia after ischemic cardio-embolic stroke within a polypathological context – A case report

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Abstract

Introduction: Cardiac embolism is one of the most common causes of embolic CVA. The recovery of patients with cardio-embolic stroke is a complex process which requires taking into account all associated pathologies (e.g. diabetes mellitus) that can play a decisive role in the evolution of the patient. A multidisciplinary team is required for such a purpose.

Material and methods: The paper presents the case of a 63-year old patient with hemiplegia after an ischemic cardio-embolic stroke within a poly-pathological context. In January 2019, the patient suffered from an ischemic stroke in the carotid region with an ataxic spastic hemiparesis and left facial paresis with cerebraesthesia and bradylalia and he was admitted to "St. Ioan" Clinical Emergency Hospital in Bucharest. After the patient was stabilized and received specialized treatment, following the investigations and the interdisciplinary consultations, he received indication of neuromuscular recovery and for this reason he was admitted to our clinic.

The patient was clinically and functionally evaluated, according the standardized protocols implemented in our clinic, through the assessment scales (MMSE, GOS-E and Rankin, MoCA, FIM, FAC, QoL, Asworth and Penn) and also para-clinically, in order to evaluate his biological reserve and his bearing availability of the recovery program.

Results: After a complex neuro-recovery program undertaken by a multidisciplinary team formed by doctors, kinesiotherapists, medium healthcare and paramedical personnel, the patient displayed a slowly favorable evolution (hardened by his multiple associated diseases due to the above-mentioned co-morbidities) from a functional point of view with the improvement of the walking program and the increase in the muscle force and self-autonomy.

Conclusion: The recovery of patients with cardio-embolic stroke is a complex process, which requires taking into account all associated pathologies that can play a decisive role in the evolution of the patient. A multidisciplinary team is required for such purposes.

Key words: stroke, hemiplegia, poly-pathologic, ischemic,

Introduction

Cardiac embolism is one of the most common causes of embolic CVA.(1) It is also responsible for some of the CVAs which are considered cryptogenic, that is, without a deceiving cause.(2) Because cardio-embolic causes leading to stroke are pretty well-known (atrial fibrillation, bacterial endocarditis, thrombi, or intra-cardiac tumors), the incidence of cardio-embolic stroke has decreased in recent years due to prophylaxis, imaging and therapeutic progress. (3) The recovery of patients with cardio-embolic stroke is a complex process which requires taking into account all associated pathologies (e.g. diabetes mellitus) that can play a decisive role in the evolution of the patient.(4) A multidisciplinary team is required for such a purpose. (5, 6)

Material and methods: The present paper presents the case of a 63-year old patient who was admitted to our clinic for: ataxic spastic hemiparesis, left

facial paresis, cerebraesthesia, bradylalia, locomotor dysfunction and severe self-care, stage recovery treatment. In January 2019, the patient suffered from an ischemic stroke in the carotid region with an ataxic spastic hemiparesis and left facial paresis with cerebraesthesia and bradylalia and he was admitted to "St. Ioan" Clinical Emergency Hospital in Bucharest. After the patient was stabilized and received specialized treatment, following the investigations and the interdisciplinary consultations, he received indication of neuromuscular recovery and for this reason he was admitted to our clinic.

Among the personal pathological history of the patient: insulin-dependent type 2 diabetes, severe carotid and vertebrobasilar atheromatosis, ischemic coronary disease, stage III essential high blood pressure, chronic atrial fibrillation, operated type III aortic-iliac occlusive disease, stage IV right lower

limb chronic ischemia Fontaine (with ulceration at the level of the calf contaminated with *Proteus*, which required the surgical excision of the necrotic area, fasciectomy, and defect covering by freely detached skin), otitis media, right eye cataract, myopia, astigmatism, organic affective lability.

The physical examination upon admission revealed: excess represented by adipose connective tissue (class II hypercellular obesity), left facial paralysis, muscular system hypertonia, hypokinetic, pallor, ulceration at the level of the calf, which required the surgical excision of the necrotic area, fasciectomy, and defect covering by freely detached skin.

NMAK examination revealed: the patient was conscious, cooperative, temporally and spatially oriented, auto and allo-psychically oriented, no signs of meningeal irritation, cranial nerves: vertical nystagmus, left facial paresis, swallowing disorders, Babinski present bilaterally, motor deficit of the spastic hemiparesis type – left lower and upper limbs, left lower and upper limbs hypoesthesia. Muscular force: right upper limb 5/5 proximal, intermediate, distal; left upper limb 0/5 proximal, intermediate, distal; right lower limb 5/5 proximal, intermediate, distal; left lower limb 2/5 proximal, intermediate, distal.

From a functional point of view, the patient keeps resting in bed and not sitting at the edge of the bed. The patient was clinically and functionally assessed, according to the standardized protocols implemented in our clinic by means of the assessment grading scales: MMSE (Mini Mental Scale Examination), GOS-E (Glasgow Outcome Scale Extended) and Rankin, MoCA (Montreal Cognitive Assessment), FIM (Functional Independence Measure), FAC, QoL-Quality of Life, Asworth and Penn.

The patient was para-clinically examined in order to evaluate his biological reserve and his availability in bearing the recovery program. To this purpose, both laboratory and imaging investigations have been used. The laboratory investigations revealed: biological inflammatory syndrome, normochromic normocytic anemia and normal left calf X-ray.

During the hospital stay, the patient underwent a complex recovery program which included: treatment with medication (neurotrophic, muscle relaxing drugs, peripheral vasodilatation drugs, anticoagulants, antiarrhythmic drugs class Ic, statin drug, insulin, anxiolytic, beta-blockers, digital glycoside, loop diuretic, potassium-sparing diuretic) and physical treatment (kinesiotherapy).

Results: After a complex neurorecovery program undertaken by a multidisciplinary team formed by doctors, kinesiotherapists, medium healthcare and paramedical personnel, the patient displayed a slowly favorable evolution (hardened by his multiple associated diseases due to the above-mentioned comorbidities) from a functional point of view with the improvement of the walking program and the increase of muscle force and self-autonomy. Given the complexity of the case, a multidisciplinary team was required, consisting in a medical rehabilitation doctor, a cardiologist, a diabetologist, an imaging physician, a plastic surgeon and an infectious disease physician.

Conclusions: In recent years, the incidence of cardio-embolic stroke has decreased due to prophylaxis, imaging and therapeutic progress.

The recovery of patients with cardio-embolic stroke is a complex process, which requires taking into account all associated pathologies that can play a decisive role in the evolution of the patient.

A multidisciplinary team is required for such purposes.

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Clinical-therapeutic and recuperatory features in a patient with pluripatology: ischemic stroke, ischemic heart disease (sechelar myocardial infarction), chronic kidney disease and monstrous gout

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Abstract

Introduction: gout is a chronic inflammatory arthropathy produced by depositing crystals of monosodium uric acid (in joints and tissues) following an anomaly (genetics or acquired) in the purine metabolism (1,2). The manifestations of the disease are: hyperuricemia, recurrent episodes of acute arthritis, the presence of tophi, chronic kidney disease, urinary lithiasis(2). Stroke represents,, the rapid development of localized or global clinical signs of cerebral dysfunction with symptoms exceeding 24 hours, leading to death, without any other cause, except for vascular origin". (3)

Materials and Methods: with the permission of the THEBA Ethics Commission (no.17464/14.06.2019), we will present the clinical case of a 57-year-old patient admitted to the TEHBA Neuromuscular Recovery Clinic presenting a right hemiplegia and mixed aphasia after an ischemic stroke in the territory of the left middle cerebral artery, on the background of complex polypathology (monstrous gout arthropathy, chronic smoking, arterial hypertension, myocardial infarction with coronary artery stenosis, chronic kidney disease).

Results: the patient did in our clinic a neuro-muscular recovery treatment, adapted to his needs, which consisted of kinetotherapy and speech therapy and received appropriate medical treatment. The clinical evolution of the patient was slowly favorable, with improvement in language disorders and motor control of paralyzed limbs.

Conclusions: the case of this patient has several particularities. This is a patient with a vicious life style, with a severe arthropathy, with severe cardio-vascular sufferers, hospitalized for recovering neuro-muscular deficits after an ischemic stroke. Despite limited prognosis, the patient has improved ADL and the quality of life after recovery treatment.

Key words: *stroke, hemiplegia, poly-pathologic, ischemic,*

Introduction

Stroke is: ,, the rapid development of localized or global clinical signs of cerebral dysfunction with symptoms exceeding 24 hours, leading to death, without any other cause, except for vascular origin"

(3) Stroke is: 80-85% ischemic (thromboembolic: atrial fibrillation, acute myocardial infarction, valvulopathy, congenital heart disease, atherosclerosis, hypercoagulability, arteriopathy) and 10-15% haemorrhage (after traumatic brain injury, broken arterio-venous malformations, hypertensive encephalopathy, coagulopathies) (3)

Ischemic heart disease is: "stable coronary heart disease is characterized by reversible episodes between myocardial demand – supply, which can be attributed to ischemia or hypoxia, induced by exercise, effort or stress, which are reproducible, but which can also occur spontaneously" (4). Cardio-vascular diseases are a very important cause of mortality and morbidity in the modern world (5). Chronic kidney disease (6):

Classification of chronic kidney disease using GFR and ACR categories

GFR and ACR categories and risk of adverse outcomes		ACR categories (mg/mmol), description and range		
		<3 Normal to mildly increased	3–30 Moderately increased	>30 Severely increased
GFR categories (ml/min/1.73m ²) description and range	≥90 Normal and high	G1	A1	A2
	60–89 Mild reduction related to normal range for a young adult	G2		
	45–59 Mild-moderate reduction	G3a ¹		
	30–44 Moderate-severe reduction	G3b		
	15–29 Severe reduction	G4		
	<15 Kidney failure	G5		

¹ Consider using eGFRcystatinC for people with CKD G3aA1 (see recommendations 1.1.14 and 1.1.15)

Abbreviations: ACR, albumin:creatinine ratio; CKD, chronic kidney disease; GFR, glomerular filtration rate

Adapted with permission from Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group (2013). KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney International (Suppl. 3): 1–150

Gout is a chronic inflammatory arthropathy produced by depositing crystals of monosodium uric acid (in joints and tissues) following an anomaly (genetics or acquired) in the purine metabolism(7,8). Gout affects up to 7% of the population (men: women's ratio is 3.6-1): men aged 75-84 years and women > 85 years of age(9).

2015 ACR/EULAR Gout Classification Criteria

Criteria	Categories	score
C L I N I C A	Pattern of joint/bursa involvement	Ankle OR midfoot (mono-/oligo-) 1
		1 st MTP (mono-/oligo-) 2
	Characteristics of episode(s) ever	One characteristic 1
		Two characteristic 2
		Three characteristics 3
	Time-course of episode(S) ever	One typical episode 1
		Recurrent typical episodes 2
Clinical evidence of tophus	Present 4	
L A B	Serum Urate	6 - <8 mg/dL 2
		8 - <10 mg/dL 3
		≥ 10 mg/dL 4
I M A G E	Imaging evidence of urate deposition	Present (U/S DCS or DECT) 4
	Imaging evidence of gout-related joint damage	Present (X-ray gouty erosion) 4
	SUA<4 / MSU<2	

Score ≥ 8 ⇒ High sensitivity (92%) and specificity (89%)

Arthritis Rheumatol. 2015;67:2257-68

(10)

Clinical forms of gout are: asymptomatic / symptomatic hyperuricemia, acute gout attack, intercritical gout, chronic tophaceous gout (11). Complication of gout can be: metabolic syndrome, cardiovascular diseases, chronic kidney disease, urinary lithiasis, atherosclerosis (8). Gout treatment is done by: dietary and lifestyle (physical exercises, weight loss)(9) , limiting excessive consumption of purines (seafood, meat, beer)(10), drugs: acute phase (Colchicine, NSAI's, CS's) and chronic phase (Allopurinol, Febuxostat, Probenecid, Sulpyrinazone, Benzbromarone, Losartan, Fenofibrat)(11), surgical methods: radical debridement of tophi, joint replacements, resection arthroplasty, joint arthrodesis, primary amputation (9).

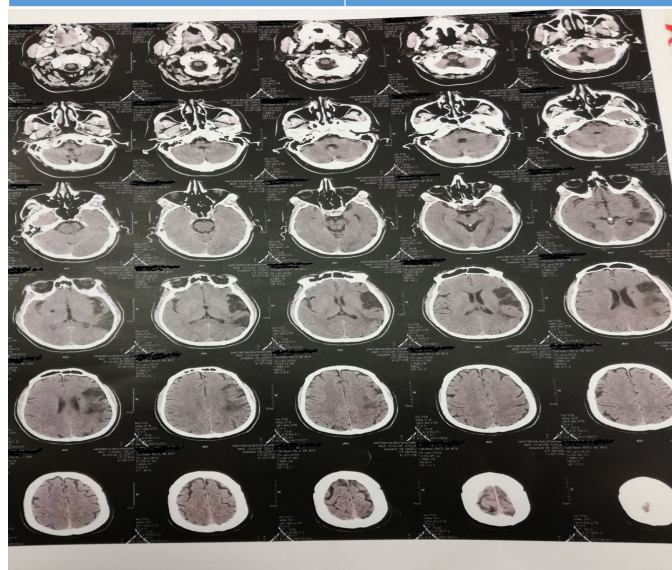
Case presentation we present the clinical case of a 57-year-old patient admitted to the TEHBA Neuromuscular Recovery Clinic for: right spastic hemiplegia, mixed aphasia, specialized evaluation and treatment. From the history of the disease we find next pathology: in 1996: gout (treated with Allopurinol, Colchicine), in 2012: acute anterior transmural myocardial infarction (treated with anterior interventricular artery PTCA stent), in 20.12.2018: ischemic stroke in the middle cerebral artery (superficial territory), essential hypertension, chronic kidney disease, urinary lithiasis, systemic atherosclerosis, chronic smoking. In general clinical examination, we see: slight facial asymmetry, numerous tophi (hands, feet, knees, elbows, right ear), IV right hand finger amputation , BP= 170/90 mmHg, VA= 62/min.

The neurological examination showed: right spastic hemiplegia, central facial paresis, mixed aphasia, relatively good motor control proximal-intermediate-distal right limbs, walking independently possible on short distances, on flat ground. Patient evaluation scales are: FIM (Functional Independent Measure): 35 (admission) –

55 (discharge), GOS (Glasgow Outcome Scale): 3 - severe disability (admission and discharge), modified Rankin Scale: 3 -moderate disability (admission and discharge), Ashworth Scale: 1 - discrete spasticity in the right limbs, Penn Scale: 0 - without spasms.



GPT	65 mg/dl
GOT	35 mg/dl
GGT	62 mg/dl
Creatinine	1,74 mg/dl
Uric acid	7,5 mg/dl
Urea	38 mg/dl
Fibrinogen	854,246 mg/dl
Hemoglobin	11,5 g/dl
GFR Value	43 mL/min/1.73 m2





The established diagnosis was: right spastic hemiplegia, mixed aphasia, sechelar ischemic stroke in the middle cerebral artery (superficial territory), essential hypertension –stage 3, acute anterior transmural myocardial infarction - anterior interventricular artery PTCA stent (2012), monstrous gout, chronic kidney disease -G3b stage. Clinical-functional evolution of the patient was favourable. The patient received medical treatment (with: injectable anticoagulants, analgesics, alpha blockers, platelet anti-aggregates, hypotensive agents, hypolipemic agents, xanthine oxidase inhibitors, vitamins, antibiotics), has practiced logopedy and a suitable kinetotherapeutic program (passive and active exercises at the bed level, then at the gym).

Discussion and conclusion: I have presented the complex case of a patient with multiple comorbidities, who had a stroke that complicated the clinical picture. However, neurological deficits were not complete. And, despite the limited prognosis, the patient progressed in the recovery process. This is a contradictory case that raises etiological and evolutive questions

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Therapeutic difficulties in recurrent, multidrug-resistant epilepsy and vagal nerve stimulation, with recent traumatic brain complications needing iterative neurosurgical interventions

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Abstract

Introduction: Focal epilepsy (possible with secondary generalization) may be a secondary complication to any brain damage (traumatic, vascular, infectious), and is characterized by abnormal excessive neuronal activity with motor, cognitive and psychosocial manifestations. About one third of the patients who suffer from epilepsy have a refractory, multidrug clinical form. Falls are one of the most common medical complications in neurologic patients, occurring during paroxysmal epileptic attacks, or due to sequelary gait limitations. Physical injuries are common, and about 47% patients with epilepsy report at least one injury in the past 12 months.

Case presentation: We present a 36-years-old male patient with a medical history of right frontal congenital arteriovenous malformation, ruptured and operated at the age of eight, complicated with left spastic hemiplegia and refractory epilepsy, needing three antiepileptic drugs (AED) and vagus nerve-stimulation (VNS). This presentation was approved by THEBA Bioethics Committee (No.17464/14.06.2019). During a recent epileptic seizure he suffered a severe traumatic brain injury with coma (GCS 5), needing iterative neurosurgical interventions, intensive care supervision, and orotracheal intubation. CT cerebral scan revealed right hemispheric subdural hematoma, operated (on the 2nd May 2019). Rebleeding occurred seven days later, due to an extradural hematoma, and neurosurgical intervention was performed again. The patient was transferred in our neurorehabilitation clinic with left spastic hemiplegia (global motor score was 65/100, and functional independence measure (FIM) 24/91). Neuropsychological assessment revealed an obtunded level of consciousness, depression and dysmnnesia for recent events, MMSE 9/30.

During hospitalization the patient has continued his previous daily AED treatment with: levetiracetamum 2000 mg + clonazepamum 1mg + carbamazepinum retard 600 mg, associated with VNS. During hospitalization emerged three new short jacksonian seizures, who gave up spontaneously. The overall evolution was favorable with rehabilitation program and psychological support, with improvement of the global motor score, FIM (44/91), and partial restoration of walking ability, but still needing human help.

Discussion: The pathophysiological mechanism of relapsed seizures has complex, multiple causes: imbalance of the local brain metabolism and /or a dysfunctional VNS procedure (a possible technical issue due to an impaired electronic device or a bioelectrical one, due to local fibrosis and increased impedance at the contact level between the electrode and the vagal nerve). Specialized technical control disclosed normal electric parameters provided by the electronic device. Other neuromodulatory devices and related technologies, such as deep brain stimulation (DBS) immediately demonstrate their effect control (motor correction) of Parkinson's or dystonic movements. Unfortunately VNS has not the possibility of immediate clinical feed-back control.

The AED schedule was modified, by increasing clonazepamum to 2 mg daily. Video-EEG monitoring was recommended. The *quod ad vitam* prognosis might be unfavorable, because seizures can relapse anytime and evolution is uncontrolled. Furthermore, new brain injuries may exacerbate the severity of the epilepsy, any new seizure may worsen the neurologic evolution. The *quod ad functionem* rehabilitation outcome might be precarious. The family support is essential in the therapeutic efforts. This clinical case underlines the necessity to implement a fall prevention program in patients with epilepsy, the importance of therapeutically tailoring AED for different pathophysiological stages of the disease, and emphasizes the limits of the modern techniques for seizures control. A multi-/ interdisciplinary team management of a such complex clinical case is mandatory.

Key words: cerebral arteriovenous malformation, multidrug-resistant (refractory) epilepsy, vagal nerve electrostimulation (VNS), falls, traumatic brain injury,

Introduction

Focal epilepsy (possible with secondary generalization) may be a complication of any brain damage: traumatic, vascular, infectious, tumoral, or degenerative (1). It is characterized by abnormal, excessive neuronal activity, with motor, cognitive and psychosocial manifestations (2).

Patients are considered to have uncontrolled or refractory epilepsy if disabling seizures continue, despite appropriate trials of two antiepileptic drugs (AEDs), either alone or in combination. It is estimated that 30 - 40% of people with epilepsy have seizures that are not controlled by medication (3). Vagal nerve electrical stimulation therapy (VNS) is used for patients who have multidrug resistant epilepsy, as an adjunctive therapy to medication management, surgical resection, and other epileptic therapies (4).

Falls are one of the most common medical complications in neurologic patients, occurring during paroxysmal epileptic seizures, or due to sequelae of gait impairments (5),(6).

Physical injuries are common at patients with epilepsy; about 47% have reported at least one injury in the past 12 months. Most of the injuries were mild and only 14% of patients reported severe injuries (6).

The risk factors are: neurodevelopmental abnormalities, seizures type and frequency, uncontrolled epilepsy, comorbidities and co-medication related adverse effects (7).

Case report: This is a retrospective case study of a 36-years-old male patient with residual neurological impairments after right frontal cerebral arteriovenous malformation, operated at the age of eight: left spastic hemiplegia and refractory epilepsy, needing 3 AEDs and left VNS.

The paper was approved by our Hospital Bioethics Committee, no.17464/14.06.2019.

Medical history of the chronological neurologic evolution is presented below:

- the first seizure has occurred at the age of nine, and was controlled with 1 AED (phenobarbital);
- seizures had a secondary “pick”, being aggravated at the age of 33 y.o. Their daily frequency gradually increased (from 2-3, up to 10 crises / daily, occurring at one week interval between them). Convulsions were poorly

controlled with 3 associated AED (carbamazepinum retard, clonazepamum, levetiracetamum), and were probably related to emotional distress (divorce).

- on May 2017, at the age of 34 y.o. treatment was supplemented by adding left vagus nerve electrical modulation.
- Subsequent evolution and outcome were favorable, with this complex therapeutic approach: 3 associated AEDs (levetiracetamum 2000 mg + clonazepamum 1mg + carbamazepinum retard 600 mg) and VNS.
- during 2018 (at the age of 36 y.o.) seizures occurred at 1.5-month intervals, with an average frequency of 5-6 crisis daily.

On 02.05.2019 after a severe seizure occurred at home, the subject suffered a severe traumatic brain injury (TBI) with left subdural hematoma. He was admitted in the neurosurgical department with severe coma (GCS 5) needing tracheal intubation, and emergent surgical intervention. Seven days later (on 09.05.2019) bleeding has relapsed (extradural hematoma in the left cerebral hemisphere) needing an iterative neurosurgical intervention. The subject was supervised in the intensive care unit since 02.05.2019 until 15.05.2019. The tracheal intubation was discontinued on 09.05.2019.

Post surgery cerebral CT scan control is depicted in fig.1

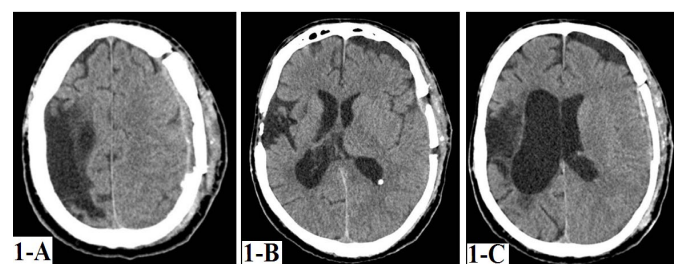


Fig.1 CT cerebral scan control (on 20.05.2019, after two consecutive neurosurgical interventions).

(1-A) right hemisphere hypodense sequelae, after neurosurgical intervention for arteriovenous malformation.

(1-B) Increased intracranial pressure and subfalcine herniation. (1-C) Residual, asymmetric, frontal subdural hygroma.

He was admitted in our neurorehabilitation clinic during 29.05.2019 - 13.06.2019.

The clinical examination has revealed: left spastic hemiplegia, obtunded level of consciousness, depression and dysmnnesia for recent events.

Global motor score at admission was 65/100. Left upper limb motor score was: proximally (biceps) 2/5, triceps 3/5; distally 0/5. Assessment of the left lower limb: proximally (3/5), quadriceps 3/5, distally 2/5.

FIM (subtotal motor) score at admission was 24/91. Spasticity: 1+ for the left upper extremity and 2 for the left lower limb (assessed with Asworth scale).

Respiratory rate was 22/min, heart rate 74/min, blood pressure 110/70 mmHg.

Usual blood tests. Before surgery (on 02.08.2019) slight anemia (10.82 g/dL) and leukocytosis (WBC $15.03 \times 10^3/\mu\text{L}$), were present, subsequently were normalized (during admission in the rehabilitation clinic, on 29.05.2019)

Cerebral CT scan control performed in the Neurorehabilitation clinic (on 11.06.2019) is depicted in fig 2.

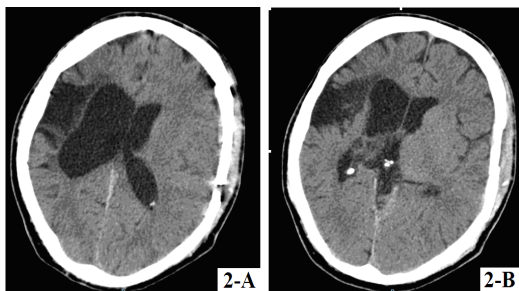


Fig 2. Cerebral CT scan control (11.06.2019):

(2-A) Hypodense sequelae in the right hemisphere (since childhood). Resolution of the left hemisphere hygroma.

(2-B) A slight modification of the intracranial pressure has still persisted (insignificant subfalcine herniation and offset of the midline).

Psychological examination identified: severe auto- and allopsychic temporal-spatial disorientation, severe attention deficit, accentuated fatigue, massive concentration efforts, major latencies. Memory had conserved its immediate “recording” capacity, with antero-retrograde amnesia of the trauma.

Cognitive processes were impaired, operating at a low level, with loss and degradation, QD = 0.4 (44%) MMSE = 9p/30. Severe anxiety and masked depression (due to dissimulation and denial) were evaluated with a HARD score of 23p.

Bach floral therapy was initiated. Psychotherapy for cognitive support and reorganization was initiated. Counseling identified a post-divorce depression and a recent psycho-trauma (his father's death).

Pharmacological therapy during admission in our department consisted in 3 antiepileptic drugs (AED): levetiracetamum 2000 mg + clonazepamum 1mg + carbamazepinum retard 600 mg.

Furthermore the patient has benefited from synergic association of neurotrophic drugs, anxiolytic therapy (flurazepamum), and gastric protection.

During hospitalization two new tonic-clonic seizures have occurred lasting few seconds, giving up spontaneously. The first one was in the gym room (during subliminal effort) and the last one on the stretcher, in the elevator, returning from CT native brain control.

The patient's overall evolution was favorable after the complex neurorehabilitation program and psychological support, with improvement of the global motor score and FIM 44/91. The subject acquired partial restoration of walking ability, on small distances, still needing human support. At discharge Barthel score was 60%, ADL was 3/10 (assisted independency), and I-ADL score 2/8.

Discussion:

Relapse of convulsions imposed a careful pathophysiological analysis: imbalance of the local brain metabolism (after the severe, recent TBI and neurosurgical interventions (7) and/or a dysfunctional VNS procedure (due to either an impaired electronic device, or a biological issue - local fibrosis and increased impedance at the contact level between the electrode and the vagal nerve) (8). The electronic device was assessed on 13.06.2019, and its electrical parameters were within normal limits (output 1.75 mA, signal frequency 30Hz, pulse width 250 μsec , signal off time 5.0 min, Mag current 2.00 mA, Mag on time 60 sec, Mag pulse width 500 μsec). When the stimulator was turned on the patient felt hoarseness.

At discharge the daily dose of Clonazepamum was raised to 2 mg, with a further progressive increase by 0.5 mg weekly. He was recommended video EEG monitoring.

Rehabilitation targets and objectives aimed at: improvement of basic activities of daily living (B-ADL), familial reintegration and (eventually) socio-professional independence, enhancement of the quality of life, and identification of the risk factors, to prevent further seizures and injuries.

The immediate *quod ad vitam* outcome might be unfavorable, because epileptic seizures could relapse anytime and evolution is uncontrolled. Any new brain injury may exacerbate the severity of the epilepsy, and any relapsed seizure may worsen the neurologic evolution.

The rehabilitation *quod ad functionem* prognosis might be precarious. The family support is essential in the therapeutic efforts.

Vagus nerve stimulation (VNS) is an invasive procedure approved by FDA in 1997, and has become an integral part of epilepsy therapy, indicated in individuals with refractory disease who are not candidate for epilepsy neurosurgery (9).

In 2005, VNS has received FDA approval for the treatment of resistant depression.

The VNS device for epilepsy and depression is manufactured by Cyberonics (Houston, Texas).

In 2013, the FDA approved the RNS® Neurostimulator by NeuroPace RNS System (Mountain View, California) for treatment-resistant epilepsy.

In January, 2015, the FDA approved another implantable VNS device, the vBloc® Maestro® system manufactured by Entero Medics (St Paul, Minnesota) as a hunger suppressant, to treat refractory obesity in patients with a body mass index (BMI) of 35-45 kg/m².

The vagus nerve contains myelinated A and B fibers, as well as unmyelinated C fibers. Chronic VNS stimulation appears to primarily engage afferent A fibers (10),(11). Afferent signals target the brainstem and, ultimately, the limbic, reticular, and autonomic centers of both hemispheres (10). The device provides an electrical pulse that stimulates the nerve in an afferent direction, up into the brainstem, thereby up regulating the neurotransmitters GABA, norepinephrine and serotonin. These are thought to balance out the excitatory neurotransmitters, like glutamate. Potential mechanisms of action include a desynchronizing effect, changes in neurotransmitters and neuronal metabolism, and an increase in Fos expression (10).

Neuroimaging has revealed VNS-induced changes in the cerebellum, limbic system, and thalamus (11). However, the exact anticonvulsant and antidepressant mechanisms of VNS are unknown (9-11).

To date, more than 70000 patients worldwide have received a VNS implant (8, 9). Adverse events of VNS include: chest pain, bradycardia, dyspnea, paresthesia, nausea, coughing, throat pain and voice

alteration (hoarseness) (12). Surgical side effects are rare, but might occur: significant bleeding, infection and permanent vocal cord paralysis.

A $\geq 50\%$ reduction in seizure frequency is often used as outcome measure to assess efficacy in epilepsy drug trials (13). In a multicenter, double-blind, 3-month, randomized study (14) of 191 patients with AED refractory partial-onset seizures, emphasized that when device was turned on, the seizure were reduced in more than twice of the cases, compared with those with the device turned off (38% vs 17%, respectively). Unlike the situation with many AED, seizure control improved over time. Cognition and mood were not adversely affected (14).

Even though seizure freedom is rarely achieved, patients who have undergone VNS have generally experienced fewer and less severe seizures, fewer consultations to the emergency room, and less admissions for hospital care (15,16,17,18).

Conclusions:

The multi- / interdisciplinary team management of such a complex clinical case is mandatory.

This case report underlines the importance of falls prophylaxis in patients with epilepsy, and the significance of individualized / tailored therapeutic program, for each different pathophysiological stages of the disease. It also emphasizes the limits of the modern neuromodulation techniques to control seizures.

Conflict of interest: Authors have no conflicts of interest to declare.

Written informed consent for publication was obtained from the next of kin (the patient's mother).

Author contributions:

Anghelescu Aurelian has designed the study, was involved in writing, analyzing and reviewing the manuscript.

Deaconu Valentin and Axente Catalina were involved in drafting the figures, and writing of the manuscript.

Onose Gelu was involved in supervision of the work, reviewing and approving of the final paper.

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Diagnostic particularities and multimodal therapeutic and rehabilitation approaches to a complex case of post ischemic stroke with dysphagia and dysphonia, associating Millard-Gubler and Wallenberg syndromes- case report

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Abstract

Introduction. Millard-Gubler syndrome (MGS), also known as the ventral pontine syndrome or hemiplegic syndrome, is one of the classical crossed syndromes characterized by a unilateral lesion of the basal portion of the caudal part of the pons. MGS manifests as ipsilateral palsy of CN VI and VII with contralateral hemiplegia.

Wallenberg syndrome or lateral medullary syndrome, is characterized by the triad of Horner's syndrome, ipsilateral ataxia and contralateral hypoalgesia. Other clinical symptoms may include difficult swallowing, slurred speech, vertigo, nausea, vomiting, dyspnea, tachycardia, headaches and muscular hypertonia.

Materials and Methods

Having the patient's consent and The Teaching Emergency Hospital "Bagdasar-Arseni" Ethics Committee N.O 20270 from the 26th of June 2019, the current case report presents a 67-year-old male patient from rural area with left hemiplegia (complete brachial and crural motor deficit), right eye abduction paresis, dysphagia, dysphonia, central facial palsy - all post acute ischemic stroke. The patient was also diagnosed with ischemic cardiomyopathy, atherosclerosis, alcoholism, type 2 diabetes with Insulin therapy and oral antidiabetic agent. The patient was admitted in the Neurorehabilitation Clinic of the Teaching Emergency Hospital „Bagdasar-Arseni” (TEHBA) Bucharest, Romania, associating severe alteration in self-care abilities, locomotor dysfunction, memory disorders, slurred speech, for specialized rehabilitation treatment and nursing.

Results. A case of rare pathology for which, unfortunately, there is a discrepancy between functional improvement and the poor motor control in the in the lower limbs (muscle force was 0-1 out of 5 on the Medica Research Council scale), within an overall favorable evolution, including elements of the clinical status afferent to the two above mentioned syndromes.

Conclusions. Approaching such a clinical case has been a complex and extensive challenge for the entire neuromuscular recovery team and remains similar for any other squad. This pathology remains an issue that demands our earnest attention.

Key words: *Millard-Gubler syndrome (MGS), Wallenberg syndrome, crossed syndromes, hemiplegia, neurorehabilitation, stroke,*

Introduction

A characteristic of medullary lesions is the presence, in many instances, of a crossed sensory disturbance - pain and temperature sensation loss on one side of the body and on the opposite side of the face (1). Some example of these manifestations are presence in Lateral Medullary Syndrome (Wallenberg Syndrome) or Ventral Pontine Syndrome (Millard-Gubler Syndrome).

The World Health Organization (WHO) defines the stroke as: "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than vascular origin" (2,3).

Stroke are 80-85% ischemic (eg thromboembolic) and 10-15% haemorrhage. In general, the clinical evolution is favorable (in the most cases). The treatment includes anticoagulants and antiplatelets (3). The syndromes resulting after stroke are various and greatly depending on aetiology, severity, prognosis and recovery possibilities (4).

Wallenberg syndrome or lateral medullary syndrome was described first time in 1895. The syndrome is caused most often by atherothrombotic occlusion of the vertebral artery, followed less commonly by the posterior inferior cerebellar artery (PICA) (5). In clinical practice it is the most typical posterior circulation ischemic stroke syndrome (5,6). The typical patient is an elderly with vascular risk factors

and different combinations of deficits (5). The most common symptoms are the triad of Horner's syndrome, ipsilateral ataxia and contralateral hypoalgesia. Other clinical symptoms may include difficult swallowing, slurred speech, nausea, vomiting, dyspnea, tachycardia, headaches and muscular hypertonia, vestibular symptoms: vertigo and nystagmus and ipsilateral cerebellar signs (1,5,6). The diagnosis is suspected from anamnesis and clinical examination. To confirm the infarct in the lateral medulla or in the inferior cerebellar area the best diagnostic test to use is MRI with diffusion-weighted imaging (7). As a prognosis, the Wallenberg syndrome has a better functional outcome than most of the other stroke syndromes. Most patients can return to satisfactory daily basis activities (5).

Millard-Gubler syndrome (MGS), also known as the ventral pontine syndrome or hemiplegic syndrome, is one of the classical crossed syndromes characterized by a unilateral lesion of the basal portion of the caudal part of the pons. MGS manifests as ipsilateral palsy of CN VI and VII with contralateral hemiplegia (8). Motor deficits in strokes are common, being caused by lesions of the motor areas and pyramidal tract (*corticospinal tract* originate from *pyramidal* cells for MGS) (9). The diagnosis of MGS is confirmed by clinical examination, reinforced by neurological imaging (computed tomography and magnetic resonance imaging) for identifying the lesion. If the lesion is caused by an occlusion of the basilar artery, a vertebral angiography may be helpful to diagnose the syndrome (8). In some cases, the patient present multiple deficits that requires a multidisciplinary rehabilitation and early conservative measures. The prognosis depends on the etiology and the extent of the lesions (8,10).

Case report

The informed consent of the family and the approval no. 20270/26.06.2019 of the Bioethics Commission of „Bagdar-Arseni Hospital” in Bucharest were obtained for the communication of this case.

A 67-years-old male patient, from the rural area was admitted in our NeuroRehabilitation Clinic's Division on 9th of January 2019, with motor deficiency - left hemiplegia (complete brachial and crural motor deficit), swallowing disorders (dysphagia for solid and liquid), dysphonia, memory disorders, slurred speech, and severe self-care and locomotor dysfunction. In the personal pathological history, the patient had an acute

ischemic cerebrovascular accident on the 3rd of December 2018 (followed by aspiration pneumonia), and he is known with atherosclerosis, 3rd degree hypertension, ischemic cardiomyopathy, alcoholism, type 2 diabetes with Insulin therapy and oral antidiabetic agent. The history of the disease: the patient was admitted in December (2018) at The Neurosurgical Department of the National Institute of Neurology and Neurovascular Diseases where he was treated conservatively for right hemiplegic acute ischemic stroke treatment. Upon the discharge the following diagnostics were established: acute ischemic cerebrovascular accident of right pons region, Millard-Gubler syndroms, left hemiparesis, right abducens paresis, cerebral and systemic atherosclerosis, aspiration pneumonia (treated), dysphagia (Nasogastric tube). He was transferred to the Neurorehabilitation Clinic, Teaching Emergency Hospital “Bagdasar-Arseni” (TEHBA) for specialized recovery treatment.

At his admission the general state of the patient was stable, as the vital signs were normal: respiratory rate = 25 breaths per minute, SpO₂ (peripheral oxygen saturation) = 93%, blood pressure = 110/73 mm Hg, heart rate = 73 bpm. The physical examination revealed: slightly altered general condition, afebrile, overweight, the body mass index (BMI) = 28, postoperative left thigh scar (femoral diaphysis fracture in 1966 after road accident) and post-appendectomy scar, dry mucous membranes, hypotonic and hypokinetic muscular system, nasal feeding tube, large volume abdomen through the adipose tissue and reflex urination in adult diaper.

Regarding the neuro-mio-artro-kinetic (NMAK) examination, the patient was slightly temporo-spatial disoriented, *auto* and *allopsychically* without signs of meningeal irritation. The cranial nerves examination revealed dysphagia for liquid and solid (nasal feeding tube), dysphonia, slightly right peripheral facial paresis, right eye abduction paresis and no sensibility disorders. The deep tendon reflexes showed distinct value on different segments of the body: accentuated in the right superior limb, abolished in the right inferior limb, normal in the left superior limb and abolished in the left inferior limb. The babinsky signs was indifferent in right inferior limb and slightly modified in left inferior limb.

The patient has no muscular strength and control on left hemibody. The muscle force on the Medical Research Council (MRC) Scale (11) in the right superior limb was 4 out of 5 on all levels. The muscle force in the right inferior limb was: proximal

(1/5 thigh flexion, 2/5 thigh extension), 2+/5 intermediar and distal 2-/5 dorsiflexion, plantar flexion 3/5, hallux dorsiflexion 3/5. Also, the patient was clinically and functionally assessed, according to the standardized protocols (grading scales/scores) implemented in our Clinic's Division: Functional Independence Measure (FIM) (12), Quality of Life Scale (QOL) (13), Functional Ambulation Category (FAC) (14), Montreal Cognitive Assessment (MoCA) (15), Mini-Mental State Examination (MMSE) (16), Modified Asworth Scale (17) and Penn Spam Frequency Scale (PSFS) (18), Glasgow Outcome Score Extended (GOS-E) (19), modified Rankin scale(mRS) (20), STRATIFY Scale for Identifying Fall Risk Factors (21).

Tabel 1- Scale Examination

	ADMISSION	DISCHARGE
Modified Rankin Scale	4	4
MOCA, MMSE	unable to test	Unable to test
STRATIFY Scale for Identifying Fall Risk Factors	0/5 (low risk)	0/5 (low risk)
FIM (Functional Independence Measure)– cognitive	21/35	21/35
FIM - motor	25/91	38/91
QoL (Quality of Life)	67/112	69/112
Modified Asworth and Penn Scales	0/4	0/4
FAC (Functional Ambulation Category)	0/5	0/5
GOS-E (The Glasgow Outcome Scale Extended)	3/8	3/8

The patient was paraclinically examined in order to evaluate his biological reserve and his availability in bearing the recovery program. To this purpose, both laboratory and imaging investigations have been used.

Tabel2- Laboratory Investigations

Test	Results 10.01	Results 29.01	Results 04.02	Laboratory range
Total proteins		5.9 g/dL	1.7 g/dL	6.4-8.2 g/dL
Albumin	2.9 g/dL	2.6 g/dL	3.8 g/dL	3.4-5 g/dL
VSH	10 mm/h	70 mm/h		3-8 mm/h
Fibrinogen		797.979 mg/dL		169-515 mg/dL
Hemoglobin	15.7 g/dL	12.6 g/dL		14-18 g/dL
Platelets	114 x10 ⁹ /uL	255 x10 ⁹ /uL		130-400x10 ⁹ /uL
Glycemia	65 mg/dL	122 mg/dL	213 mg/dL	74-106 mg/dL
CK-MB	30 U/L	16 U/L		7-25 U/L
Sodium	133 mmol/L		139 mmol/L	135-148 mmol/L
Potassium	3.06 mmol/L	3.38 mmol/L	3.62 mmol/L	3.5-5.3 mmol/L
Chloremia	95 mmol/L		104 mmol/L	96-107 mmol/L
Calcium	8.5 mg/dL	8.4 mg/dL		8.5-10.1 mg/dL
Magnesium	1.7 mg/dL	1.7 mg/dL	1.7 mg/dL	1.8-2.4 mg/dL
Iron	83 microg/dL	117 microg/dL	107 microg/dL	65-165 microg/dL
LDH	234 U/L		219 U/L	85-227 U/L
HDL-Cholesterol	41 mg/dL	18 mg/dL	21 mg/dL	40-60 mg/dL
LDL-Cholesterol	65.4 mg/dL		56.8 mg/dL	150-190 mg/dL
Bronchial aspiration	No pathogen germs identified			
Urine test	normal	Proteins – 3+; Erythrocytes – 3+; Leucocytes – 500/microl; frequent germs		
Urethral secretion test		Klebsiella pneumoniae		
Urine culture test		Klebsiella sp		

Relevant for the diagnosis and case evolution are the following imagistic investigations results:
Pulmonary x-ray (1) : infra-hilar alveolo-interstitial infiltration situated in the left lung;
supradiaphragmatic left pulmonary opacity determining the retraction of the pleura with fibrotic component.



Fig1 - 10.01.2019- x – ray from the files of “Bagdasar-Arseni” Hospital

Pulmonary x-ray (2): absence of acute pleuropulmonary lesions

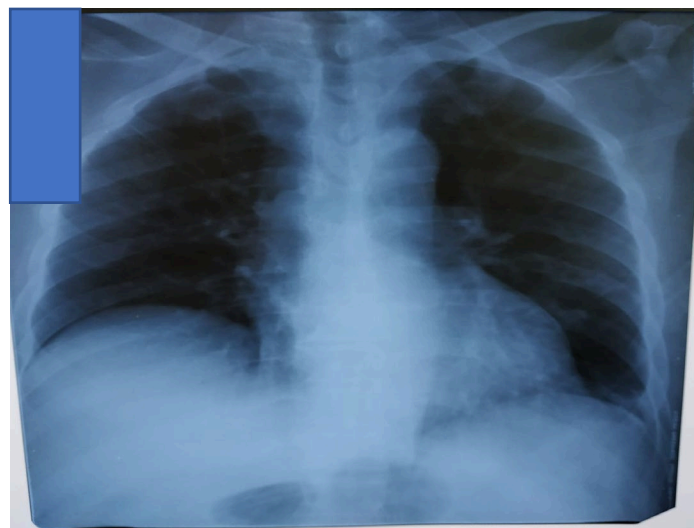


Fig2 - 22.01.2019- x – ray from the files of “Bagdasar-Arseni” Hospital

Angio Cerebral IRM: absence of hemorrhagic cerebral lesions; micro lacunar bulbopontine lesions on different stages of evolution, chronic demyelination lesions in the white bifrontal matter, cortical diffuse atrophy, absence of thrombosis of the anterior and posterior cerebral arteries.

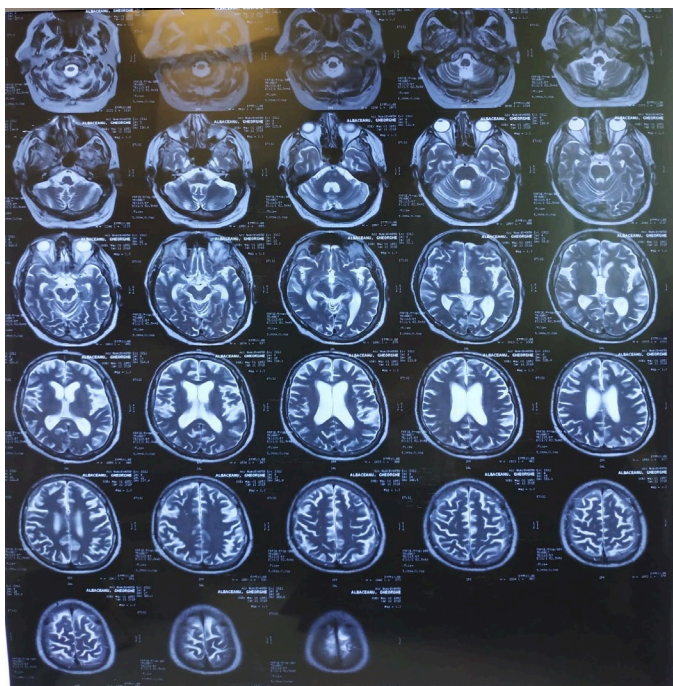


Fig3-11.01.2019- angio cerebral IRM from the files of "Bagdasar-Arseni" Hospital

Based on the patients' background, the clinical and para-clinical parameters taken into consideration, the admission and the 72 hours diagnosis were established: Left Hemiplegia with complete (brachial and crural) motor deficits, right eye abduction paresis, slightly right peripheral facial paresis, dysphagia for liquid and solid (nasal feeding tube), dysphonia, Millard-Gluber and Wallenberg syndrome and severe self-care and locomotor dysfunction - all post acute ischemic stroke (03.12.2018). Chronic ischemic cardiomyopathy. Systemic atherosclerosis. Alcoholism. Type 2 diabetes with Insulin therapy and OADs. Moderate hypoalbuminemia and hypokalemia. Mild hypochloroemia, cytotoxic syndromes, hyponatremia, thrombocytopenia, inflammatory syndrome.

Evolution

During the hospital stay, the patient underwent a complex recovery program which included pharmaceutical treatment with injectable anticoagulant type HGMM, anti-platelet aggregation, neurotrophic, gastric protector (IPP and H2 receptor inhibitor), statine, antianginos drug, beta-blocker, ADOs and Insulin, vitamin supplements, hydric and electrolytic reequilibration with KCL and NaCl 0.9%, loop diuretic, antibiotics, anxiolytic, urinary antiseptics, expectorants/

mucolytics, physical treatment (kinesiotherapy), speech therapy evaluation and aerosol therapy.

The main objectives of the rehabilitation program individualized for this patient were to prevent short-term complications (thrombophlebitis, bedsores, respiratory complications, urinary infections), depression and regain functionality in order to improve patient's quality of life (22,23,24).

The recovery team collaborated with other specialists to provide the patient a complete, individualized recovery plan, based on the particularities of the case.

A cardiological consult was performed, and the specialist recommended double anti-platelet aggregation, statine and clinical reevaluation when needed. The thoracic surgery consult objectified a rare and inefficient cough and bilateral rales for which were recommended respiratory physiotherapy, aerosols, taping, assisted cough, proper hydration and mucolytics.

In order to evaluate the possibility of replacing the nasogastric tube with percutaneous gastrostoma (PEG), we performed an gastroenterology consult, an upper gastrointestinal endoscopy and an abdominal ultrasound. As the endoscopic aspect showed a haemorrhagic gastritis, the PEG is postponed for 5-7 days and pharmaceutical treatment with *proton-pump inhibitors* (PPIs) was recommended. After six days, the nasogastric tube was replaced with PEG.

In evolution, the patient presented urinary tract infection (UTI) with *Klebsiella* spp. The urethral secretion cultures revealed infection with *Klebsiella* pneumonia that was treated according to the antibiogram.

After five days from the PEG intervention, the general surgery consult showed a fetid odor and an erythematous area around the gastrostoma for which were recommended local toilet and treatment with silver sulfadiazine, daily dressing and antibiotic therapy, followed by repositioning of the gastrostomy tube to the abdominal wall. The last endoscopic control showed a good functioning and good digestive tolerance of the PEG.

At the general *medical reexamination*, *abnormal* respiratory sounds (crackles) were objectified, for which an wide-spectrum antibiotic was recommended.

In order to manage anxiety and episodes of reactive depression, psychiatric consultation was performed.

The kinesiotherapy program in the first two weeks consisted of passive movements of upper and lower

limb performed at the patient's bed by the physiotherapist, followed by exercises in gym, such as motomed, squat, foot pedal exercises, exercises with the gym stick and for walking re-education; muscle strength training: pedal with wheels; breaking the gait cycle down into smaller more manageable chunks and repeating movement to stimulate nerve pathways; unilateral support on parallel bars; stretching to increase range of movement.

After the kinesiotherapy program, the patient was able to tolerate the position in the wheelchair for about 1-1.5 hours. Also, the patient has an overall increased endurance in his respiratory capacity, but cannot perform the transfer alone. The patient had slight progress in terms of muscle strength: with bilateral support- one-sided force support on the parallel bar / tetrapod and slightly-moderate support from the kinesiotherapist-, the patient manages to walk approximately 10 m.

Results

A case of rare pathology for which, unfortunately, there is a discrepancy between the functional improvement in the lower train, which is relatively important for the short-term hospitalization (only 42 days), in relation with the poor motor control in the lower limbs (muscle force was 0-1 out of 5 on the Medica Research Council scale). It is worth mentioning an overall favorable evolution, including elements of the clinical status afferent to the two above mentioned syndromes.

Prognosis

The patient's prognosis is reserved due to multiple comorbidities (*hypertension* stage 3, ischemic heart disease, atherosclerosis, diabetes), with the risk of recurrence at any time (ad vitam and ad functionem – reserved). Ad laborem is not necessary to be evaluated.

Recommandations

Upon discharge, it is recommended that the patient continues the rehabilitative treatment (according to the instructions given - drugs and kinesiotherapy program) at home or at another neurorecovery unit and, a regular check-up at our clinic.

Conclusions

Approaching such a clinical case has been a complex and extensive challenge for the entire neuromuscular recovery team and remains similar for any other squad. This pathology remains an issue that demands our earnest attention.

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Particularities of complex therapeutically-rehabilitative management, stepwise, in a patient with post-CCT psycho-cognitive impairment in a large polytraumatic context - case report

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Abstract

The subject matter of the present scientific paper is the report of a sustained, sequential, stage-adjusted and persistent therapeutic rehabilitation team-run program over a relatively short period of time in the case of a polytraumatized patient with severe TBI (GCS=4), multiple pelvic fractures, right clavicle fracture, incomplete fracture of the left transverse apophysis L5 - unoperated, perivesical hematoma, thoraco-abdominal contusion, neurogenic bladder and antero-retrograde amnesia related to trauma that led to a favorable progression despite the contraindication of sitting positioning and the mental state of the patient during hospitalization.

Key words: *neuromuscular rehabilitation, cranio-cerebral trauma, pelvic fracture, polytraumatism, antero-retrograde amnesia related to trauma,*

Introduction

Cranio-cerebral trauma (CCT) or traumatic brain injury (TBI), associated with other lesions occurring in polytraumatic context, is the most commonly encountered neurological pathology with vital risk in younger patients, often the consequence of road accidents. (1)

Traumatic brain injury (TBI) is a nondegenerative, noncongenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness(2) Severe TBI is indicated when the GCS score is below 9 within 48 hours of the injury (3,5,6)

Method: case presentation

The informed consent of the family and the approval of the Ethics Commission of „Bagdar-Arseni Hospital” in Bucharest (N.O. 14646/14.06.2019) were obtained for the communication of this case.

We present the case of a 20-year-old male patient who suffered a road accident at the beginning of 2019. On February 9, 2019, the patient is admitted in the department of neurosurgery. At the time of the first medical contact the clinical and imaging examination revealed: loss of consciousness (GCS=4), multiple pelvic fractures, right clavicle fracture, incomplete fracture of the left transverse apophysis L5, perivesical hematoma, thoraco-

abdominal contusion and neurogenic bladder. An intracranial pressure sensor is mounted and the patient is moved to the anesthesia and intensive care unit, where he has a favorable progression of the head trauma. On February 16, 2019, after stopping the analgesic and sedative treatment, the patient is temporospatially disoriented and becomes psychomotor agitated. On February 18, 2019, following the psychiatric evaluation, behavioral disinhibition is found, associated with the impossibility of maintaining and focusing attention. On March 18, 2019, the patient is admitted in the department of neuromuscular recovery for psycho-cognitive status with antero retrograde amnesia post severe TBI (GCS=4) in polytraumatic context, sensitivity disorders in the right hand and foot, severe locomotor dysfunction and self-care, ability impairment. He was in a relative good general state, afebrile and had poorly represented adipose connective tissue. At the level of the skin and mucous membranes he presented a right frontal scar (with suture thread) and a panaritium of the right thumb. Osteo-articular system was apparently integer, except multiple pelvic fractures, right clavicle fracture, incomplete fracture of the left transverse apophysis L5 - unoperated. The patient was equilibrated from a cardiovascular, respiratory, digestive and renal point of view with oxygen saturation of 98% spontaneously, blood

pressure of 90/70 mmHg and heart rate of 84 rhythmic beats per minute. At the time of admission, the patient had a fixed permeable urine probe. Regarding the neuromioarthrokinetic examination the patient was partially conscious, partially cooperative, psychomotor agitated, temporally, spatially, auto and allopsychically disoriented and presented antero-retrograde amnesia. Osteotendinous reflexes were sharpened in the lower limbs bilaterally. The patient presented sensitivity disturbances in the right hand and foot and pathological reflexes (Babinski sketched bilaterally). Motor control was present with muscle strength of 3+/5 MRC on all levels (proximal, intermediate and distal) at the left superior and inferior limb and 4/5 on all levels at the right superior and inferior limb. Clinico-functionally, the patient kepted resting in bed, posturing into the wheel chair was non-recommended, given the multiple pelvic fractures. The patient was clinically and functionally assessed, according to the standardized protocols implemented in our clinic by means of the assessment grading scales: FAC (Functional Ambulation Category) = 2, FIM (Functional Independence Measure) cognitive = 26, FIM motor = 47, Modified Rankin Scale = 4, The Glasgow Outcome Scale Extended (GOS-E) = 3, Asworth = 4, Penn = 0, QoL (Quality of Life) (Flanagan completed by Burckhard) = impossible to test at admission, MMSE (Mini-mental state examination) = impossible to test at admission, MoCA (Montreal - Cognitive Assessment) = impossible to test at admission.

The patient was paraclinically examined in order to evaluate his biological reserve and his availability in bearing the recovery program. To this purpose, both laboratory and imaging investigations have been used.

The thoracic pulmonary radiography (Fig. No.1) showed no signs of acute or evolutionary pleuropulmonary lesions.

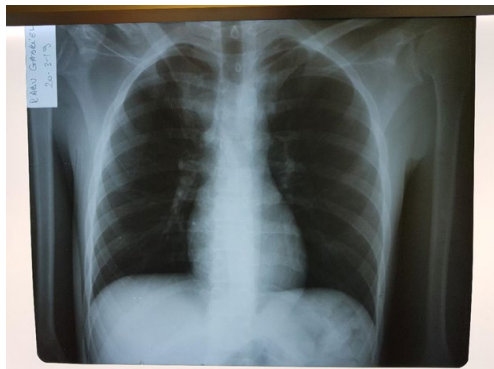


Figure No. 1 - Thoracic-pulmonary radiography



Figure No. 2 - Right clavicular radiography

Right clavicular radiography (Fig. No.2) showed an old right middle-clavicular fracture with displacement and vicious calyx.

On the pelvic radiography (Fig. No.3) could be seen complete bilateral fracture of the superior pubic arch and left side complete fracture of the inferior pubic arch.



Figure No. 3 - Pelvic radiography

A bone CT scan (Fig. No. 4, Fig. No.5) was also performed for a better visualization of the pelvic fractures, necessary to evaluate the possibility of mobilizing the patient. The result showed multiple fractures: comminutive fracture of the left sacral wing with the interest of conjugation holes S1, S2 and S3; left S1 apophyseal fracture; bilateral acetabular comminutive fracture; fracture of both pubic branches adjacent to the symphysis; left ischiatic comminutive fracture; right ischial fissure; left L5 transverse apophyseal fracture.



Figure No. 4 - Pelvic bone CT scan



Figure No. 5 - Pelvic bone CT scan

The results of brain computed tomography investigation (Fig. No. 6) revealed craniocerebral lesions: right frontal subdural hematoma with a thickness of 5 - 6 mm, left frontal hygroma, without deviation from the midline.

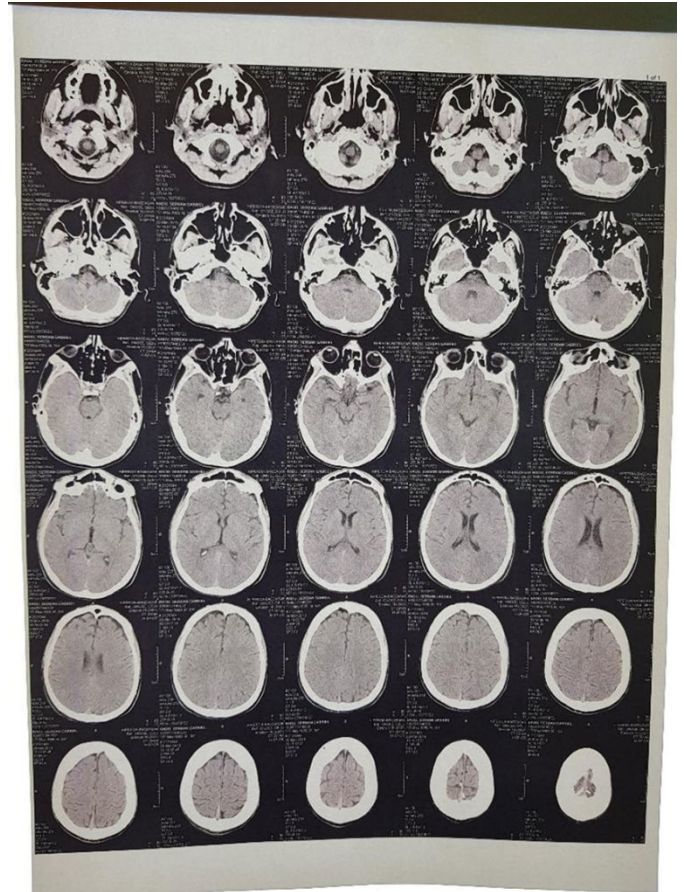


Figure No. 6 - Brain CT scan

After the clinical and paraclinical investigation of the patient (who revealed hepatic cytolysis syndrome - ALT (TGP) = 92U/L; AST (TGO) = 44U/L -, mild normochromic and normocytic anemia, moderate eosinophilia) the diagnosis at admission and at 72 hours was established: „Psychocognitive status, impairment of ability and relatively mild sensitivity disorders hyperesthesia type at the right limbs after severe traumatic brain injury (GCS = 4) in polytraumatic context (road accident - driver 9.02.2019): vicious consolidated right clavicle fracture (radiological aspect), multiple pelvic fractures (unoperated, undergoing consolidation), perivesical hematoma remitted, thoracic-abdominal contusion remitted. Neurogenic bladder (fixed urinary tract carrier). Purulent sinusitis (MRI imaging). Panaritium at the right thumb”.

The main general objectives of the neurorehabilitation program were: combating pain and regaining functionality that allows the patient self-grooming and locomotion, treating the associated orthopedic diseases and preventing complications, improving the patient's psycho-

cognitive, mental and emotional status and obtaining socio-professional, respectively family reestablishment in order to improve patient's quality of life (4,5,6).

Evolution

During the hospital stay, the patient underwent a complex recovery program which included pharmaceutical treatment with: injectable anticoagulant type HGMM, anti-platelet aggregation, neurotrophic, xanthine oxidase enzyme inhibitor, pain reliever for neuropathic pain calcium channel blocker, antidepressant, anxiolytic, urinary antiseptics, gastric protector, COX 2 receptor inhibitor; physical treatment (kinesiotherapy) and psychotherapy. The recovery team collaborated with other specialists to provide the patient with a complete, individualized recovery plan, based on the particularities of the case.

For managing the psycho-cognitive and mental status, the neurologist, the psychiatrist and the psychologist were consulted repeatedly. In addition to the psychiatric treatment administered for anxiety and the episode of reactive depression, multiple psychotherapy sessions were required, especially in the context in which the patient lost family members in the road accident suffered.

In order to mobilize the patient, the recovery team consulted both the neurosurgeon and the orthopedist. The mobilization was made gradually, with postural support in orthostatism and avoiding sitting position. The physical-kinetic rehabilitation program included the prevention of amyotrophy, maintenance of joint mobility and quality of articular movement, reeducation of the patient's orthostatic posture, teaching the patient to perform the transfer from bed to orthostatic position, avoiding the sitting position and relearning of the fine motor skills of the wrists, hands and fingers.

For the treatment of the sinus rhinitis revealed at imaging examination (MRI) an otolaryngologist was consulted. Plastic surgery specialist consulted the patient in order to evaluate the possibility of a surgery at the right thumb level to treat the panarititis. The procedure was carried out on April 8, 2019.

Results

The patient remained afebrile, cardio-respiratory balanced throughout the hospital stay and had a favorable evolution from a pain-dysfunctional point

of view: marked improvement, with the patient verticalization, maintaining orthostatism and independent mobilization over long distances. Muscular strength improved to 5/5 MRC on all levels, right and left limbs. A marked improvement was also recorded regarding the psycho-cognitive, mental and emotional status. After one month in our clinic, before discharge, the results of the recovery program were evaluated using the same scales applied at the admission (Table No.1).

Scale	Admission	Discharge
FAC	2	4
FIM cognitive	26	35
FIM motor	47	85
GOS-E	3	6
Rankin	4	2
Asworth	0	0
Penn	0	0
QOL	impossible to test	96
MMSE	impossible to test	26
MoCA	impossible to test	25

Table No.1 - Evaluation scales at admission and discharge

3 months after discharge, the patient returned to our clinic for a checkup, on which occasion he attended sessions of ergotherapy for the ability impairment.

According to the data provided by the patient at the last hospitalization, he had no difficulties in functioning independently at home, he re-enrolled at the university and even started a romantic relationship.

The MRI performed during the second hospitalization highlighted the damage of the central white matter, lesions with a sequel aspect at the level of the calyx body.

Prognosis

The patient's prognosis is favorable (at vitam: favorable, at functionem: favorable, at laborem: favorable), provided that the recommendations from the discharge will be respected (continuing the recovery program according to the instructions given at discharge, including avoiding the sitting position until the consolidation of the pelvic fractures, regular check-up at our clinic).

Conclusions

The combined and complex rehabilitation led to a complete cognition remission and complete locomotor regaining at discharge, the patient progressed from psycho-cognitive status after severe TBI (GCS=4) in polytraumatic context associated with antero-retrograde amnesia related to trauma and severe locomotor and self-care dysfunction to psycho-cognitive status in marked improvement, with the patient verticalization, maintaining orthostatism and independent mobilization over long distances.

The favorable progression emerged after a sustained, sequential, stage-adjusted and persistent therapeutic rehabilitation team-run program over a relatively short period of time, in the context of both the contraindication of sitting positioning and the mental state of the patient during hospitalization.

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Medical-rehabilitation endeavors, care interventions and connotations of a medical-social type, in a complex polypathological case: paraplegia, spondylodiscitis, kidney failure in the haemodialysis stage, and bilateral nephrostomies post operated bladder neoplasm

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Abstract

Introduction Paraplegia or paralysis of lower extremities is caused mainly by disorders of the spinal cord and cauda equina. They are classified as traumatic and non traumatic. Non traumatic paraplegia has multiple causes such as cancer, infection, intervertebral disc disease, vertebral injury and spinal cord vascular disease.

The current case report presents the case of a male patients with paraplegia related to the thoracic spondylodiscitis in a patient on haemodialysis. **Material and method.** Having the patient's consent and The Teaching Emergency Hospital "Bagdasar-Arseni" Ethics Committee's approval, N.O. 17464/14.06.2019, a 72 years old patient, which known with operated bladder neoplasm (2015-neobladder), Chronic kidney failure in haemodialysis program and spondylodiscitis T10-T11 operated in 29.12.2018. **Results and discussions.** The patient improved on most of the assessment scales/scores implemented in our clinic's Division Motor FIM (Functional Independence Measure) from 43/91 to 54/91,AIS (American Spinal Injury Association Impairment Scale) from 85/100 motor to 92/100. **Conclusions.** Infectious diseases are important causes of non-traumatic paraplegia. The risk of infection on haemodialysis patient is further increased because of frequent routine skin penetration for venipuncture and operative procedures such as placement of venous catheters and vascular grafts.

Key words: *paraplegia, haemodialysis, spondylodiscitis, neoplasm, nephrostomy,*

Introduction

Paraplegia or paralysis of lower extremities is caused mainly by disorders of the spinal cord and cauda equina. They are classified as traumatic and non traumatic. Traumatic paraplegia occurs mostly as a result of traffic accidents and falls caused by lateral bending, dislocation, rotation, axial loading, and hyperflexion or hyperextension of the cord. Non traumatic paraplegia has multiple causes such as cancer, infection, intervertebral disc disease, vertebral injury and spinal cord vascular disease. (1,2,6,7). One of the most important causes of paraplegia among infectious causes is bacterial infection. These organisms can produce subdural empyema, epidural abscesses, radiculomyelitis or cause spondylitis with bony destruction or pressure effect. (5). Spondylitis is osteomyelitis of the spinal column. This is defined as infection accompanied by destruction of the vertebral bodies, starting at the endplates, but with secondary involvement of the intervertebral discs. The term "spondylodiscitis" means primary infection of the intervertebral disc by a pathogen, with secondary infection of neighboring vertebral bodies. At diagnosis, inflammatory changes in both the vertebral bodies and intervertebral discs are usually evident in the x-ray,

so that the origin of the bacterial infection is no longer clear. For this reason, both terms are used (3 4)

Case presentation

This paper presents the case of a 72-year-old patient (having the TEHBA Bioethics Committee approval no17464/14.06.2019), with Personal Antecedents of: operated spondylodiscitis T10-T11 29.11.2018, operated bladder neoplasm and kidney failure in the haemodialysis stage.

The reasons for admission: motor deficit in lower limb, deficit of locomotion and self-care.

General clinical examination: afebrile, Blood Pressure=125/70 mmHg, Pulse=73/min, SpO2=95% Neurological examination: temporal-spatial oriented, conscious, cooperative, motor deficit (according to AIS/Frankel Scale) of paraplegia type, with T10 neurological level

The patient was assessed functionally using the following scales : AIS (American Spinal Injury Association Impairment Scale) = 85 motor from 100 points, sensory = 224 from 224 points, spasticity = 0 on Ashworth modified scale, FIM (Functional Independence Measure):motor = 43 points; cognitive = 35 points, QoL (Life Quality Assessment Quality of Life) =82 points, Functional

Ambulation Categories(FAC) International Scale = 0.

Paraclinic: Creatinine was 4.99 (0.7-1.3 mg/dL) Iron was 32 (65-165 Aug) Magnesium was 3.3 (1.8-2.4 mg/dL) Urea was 72 (15.75-40 mg/dL) and ESR was 75 (3-8 mm/h).

During hospitalization, the patient received complex drug treatment with: injectable anticoagulants(intermittently, except for haemodialysis days), antiarrhythmic, vitamin supplements and osteotropic minerals, gastric protector, antibiotic, probiotic, uricoinhibitor drugs, also the patient benefitted from kinesiotherapy.

Results: The patient benefitted from a complex neuromuscular rehabilitation program, having a favorable evolution, with an increase in the evaluated scales scores: AIS/ Frankel score from 85 motor to 92 points, and sensory score from 224 to 224 points → from AIS/ Frankel C to D; FIM motor from 43 points to 58 points; cognitiv 35 points; QoL from 82 points to 90 points; FAC International Scale from 0 to 2-3.

Muscular strength upper limbs 5 at admission and discharge. Lower limbs at admission; 2 proximal, 3 intermediary and 4 distal. Lower limbs at discharge 4+.

As a final performance, the patient walks with support in the tetrapodal frame, with supervision.

After a complex neurorecovery program undertaken by a multidisciplinary team formed by doctors, kinesiotherapists, medium healthcare and paramedical personnel, the patient displayed a favorable evolution.



Fig.1. MRI- inflammatory bone structure, affecting the T10-T11 disco-vertebral complex

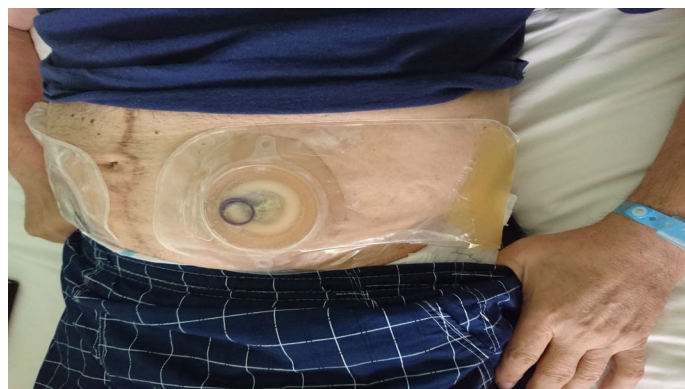


Fig. 2. Nephrostomy



Fig.3 .The patient walks with support in the tetrapodal frame, with supervision

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Diagnostic and therapeutic approaches in rehabilitation correlated to a case of tetraparesis (with predominance of paraparesis) after severe CCT - bifronto - basal and bitemporal contusion.

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Abstract

Introduction. Cranio-cerebral trauma (CCT) can be defined as a brain damage caused by an external factor. It may or may not penetrate the skull. Examples of CCT causing sources can be: car accidents, falls (from height or same level), blows with blunt objects, shooting, etc. The diagnosis is generally easy to establish through anamnesis with the patient or witnesses, then by tomography. Having the patient's consent and The Teaching Emergency Hospital "Bagdasar-Arseni" Ethic committee's approval, N.O. 17464 per 14.06.2019, this article presents the evolution of a 32-year-old male, tetraparetic with predominance of paraparesis, bradylalia and cerebrastenia (with significant improvement) and disgraphy, following a severe CCT - bifronto-basal and bitemporal contusion. Operated temporo-parieto-occipital fracture (right parietal decompression flap) - all by falling off the horse (affirmative). Joint stiffness in the knees (by Pellegrin-Shida heterotopic periosteal calcifications). Total post-traumatic optic atrophy RE and partial optic atrophy LE. Multiple bedsores. Neurogenic bladder (carrier of indwelling urinary catheter). UTI with Proteus Mirabilis (etiologically treated) was admitted in the Neurorehabilitation Clinic of the Teaching Emergency Hospital "Bagdasar-Arseni" (TEHBA) for tetraparesis motor deficit, retention sphincter disorders, locomotor and severe auto-care dysfunctions, specialized recovery and nursing treatment with favorable development. **Discussion:** The peculiarity of this case is the good evolution of a patient with severe CCT and multiple associated complications. Last but not least, we can highlight how the CCT was produced, namely by falling off the horse. This tells a lot about the importance of the precautions and equipment needed during a sport, in our case wearing a helmet.

Key words: cerebral cranial trauma, tetraparesis, paraparesis, recovery,

Introduction

Traumatic brain injury (TBI) is a nondegenerative, noncongenital insult to the brain from an external force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness (1).

TBI classification by:

- Causes²: car accidents, blows to the head, sport injuries, falls or accidents, physical violence
- Evolution: acute < 3 days, subacute < 3 weeks, chronic > 3 weeks
- Pathogenesis: primary lesions, secondary injuries
- Severity (MAYO TBI SEVERITY CLASSIFICATION SYSTEM³): symptomatic (possible) TBI, mild (probable) TBI, moderate-severe (definite) TBI

Tetraplegia is the term used to describe spinal cord injuries or lesions in the cervical region. People with tetraplegia have compromise of motor/sensory functions to their upper limbs as well as to the lower limbs⁴.

Case report: A 32-year-old male patient with severe TBI, by falling off a horse on 01.01.2019, with bifronto-basal and bilateral temporal contusion, temporo-parieto-occipital fracture surgically treated - decompressive left parietal flap, neurogenic bladder (carrier of indwelling urinary catheter), suppressed on 08.04.2019.

He was admitted to the Neurorehabilitation Clinic of the Teaching Emergency Hospital "Bagdasar-Arseni" for: tetraplegia motor deficit, locomotor dysfunction and severe auto-care, specialized recovery and nursing treatment.

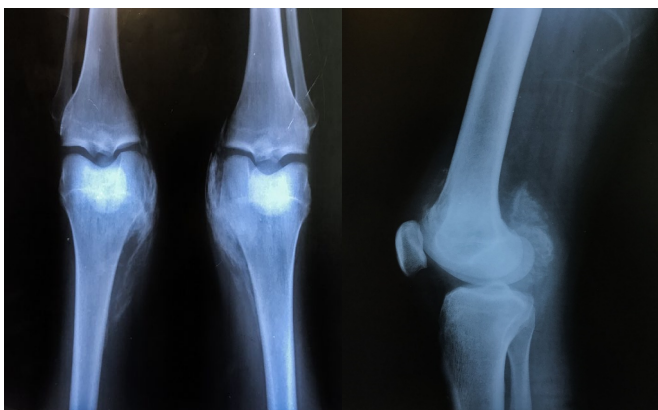
The physical examination showed the following: skin pressure ulcer stage II in left parieto-occipital area, healed post-tracheostomy scar, pressure ulcers stage II-III located on left knee, right calf and heels, osteoarticular system: bifronto-basal and bilateral temporal contusion, left temporo-parieto-occipital fracture surgically treated - decompressive left parietal flap, bilateral knee joint stiffness, respiratory system: 18 breaths per minute, SpO₂ 96% spontaneous, CV system: BP 120 / 90mmHg, HR= 107 bpm, sinus rhythm, excretory system: former

carrier of indwelling urinary catheter(suppressed on 08.04.2019).

Neuro-myo-arthro-kinetic clinical examination (NMAK): cooperative and temporo-spatial oriented patient, cranial nerves: vision disorders, present pupillary light reflex, without swallowing difficulties, bradylalia, dyslalia, bradypsychia and crying easily, showed no signs of meningeal irritation, sensory dysfunction in the lower limbs, muscle strength 3/5 in the upper limbs; lower limbs cannot be tested because of the joint stiffness, osteotendinous reflex (OTR) increased at the upper limbs, right more than left.

Scales: Modified Ashworth = 1 + / 5, Penn = 0/4, GOS-E = 3, Rankin = 4, FAC = 0, FIM motor = 26/91, Cognitive FIM = 20/35 QOL, MMSE, MoCA could not be tested due to intense psycho-emotional disorders.

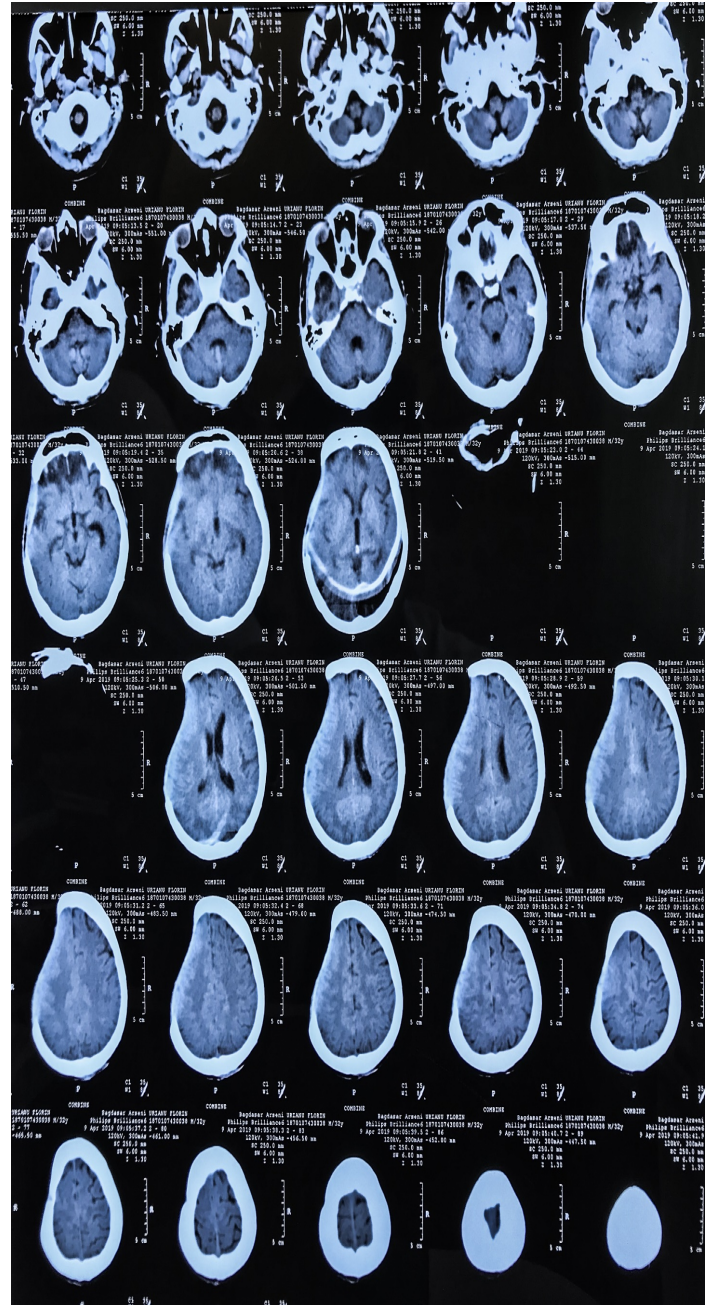
Paraclinical examination: Knee bilateral radiography and brain MRI. In the X-rays, we can notice the heterotopic periosteal calcifications. In the MRI image, we can notice the decompressive flap.



Following the clinical and paraclinical examinations the following diagnoses were established:

- Tetraplegia with paraparesis predominance, severe TBI after bifronto-basal and bilateral temporal contusion
- Left TPO fracture surgically treated (right decompressive parietal flap) – after falling off the horse (01.01.2019)
- Bilateral knee stiffness due to Pellegrin-Shida heterotopic periosteal calcifications
- Healing parieto-occipital pressure ulcers, pressure ulcers stage II-III located on left knee, right calf and heels
- Urethritis with *Proteus Mirabilis* (etiologically treated)

- Total right eye optic post-traumatic atrophy and partial left eye post-traumatic atrophy
- Mild hypercalcemia, hypercholesterolemia, hypertriglyceridemia, normocytic normochromic anemia
- Marked inflammatory biological syndrome



During hospitalization, the patient followed anticoagulant treatment, calcium channel blocker beta-blocker, antibiotic treatment, neurotrophic factors, gastric protector, topical NSAIDs, ophthalmic drops, urinary antiseptic also physical therapy and diapluse therapy.

Evolution.

Over a period of 5 months the patient was admitted 4 times in the Neuromuscular recovery clinic, once in the Neurosurgery clinic, where the decompressive flap was re-operated on 05.06.2019 and once in the Orthopaedics-Traumatology Clinic where the heterotopic ossification of the knees were resected. The evolution from a functional point of view is good: the muscular strength has significantly improved globally, the patient manages to walk without support, but only with the supervision of the kinetherapist between the parallel bars over a distance of 6-8 meters. He can exercise at the pulley counterweight with lower limbs. Stays suspended unaided. The pressure ulcers have healed.

Prognosis ad vitam is good, ad functionem with the possibility of incomplete recovery and ad laborem he requires retirement for chronic disease.

Upon discharge, it was recommended to continue the recovery treatment at home or in another recovery clinic and, if necessary, be readmitted to our clinic.

Discutions.

The importance of interdisciplinary and interclinical communication and collaboration

Efforts by physicians who have treated this case have been fully rewarded morally by the patient's particularly favorable progression despite its severe multimorbidity. Last but not least, I would like to mention the importance of wearing the appropriate sports equipment, in our case, a helmet.

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Ionophoresis and LASER applications in facial nerve palsy

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Abstract

Background and aim of the study. The aim of this article is to present the functional gain of the specific rehabilitation program in patients with facial nerve paralysis, irrespective of etiology, following a complex physiotherapeutic treatment, consisting of the combined application of ionophoresis and LASER.

Material and Method. We performed a retrospective analysis of 26 patients having their consent and The Teaching Emergency Hospital “Bagdasar-Arseni” (TEHBA) ethics Committee’s approval, N.O. 683/21.02.2019. The patients were admitted to the Neuro-Muscular Rehabilitation Clinic Division of TEHBA between April 2011 and March 2019. The patients were over the age of 18, diagnosed with facial nerve palsy and received physiotherapy consisting of the combined application of: ionophoresis with 1% potassium iodide, applied to positive electrode, preauricular, and the negative electrode, retroauricular, for 20 minutes and LASER, to the temporomandibular joint on the affected part, 4 points : radiant exposure per dose 3 J/cm², frequency 5 Hz, probe area 1 cm², power 62 mW, for 10 sessions and two sets of the same formula at the temporomandibular joint on the opposite side.

Results. From the etiological point of view, the study included an equal number of patients with peripheric facial palsy (PFP) and with central facial palsy (CFP), respectively 13 in each group. Overall, at least 1 patient in 2 had a positive response to physiotherapy. In the patients with PFP, 77% of patients responded to the treatment and 46% had complete remission. In the patients with CFP, only 30% responded to treatment and only one had complete remission. Approximately half of the patients did not have any adverse reactions (46%), while the rest showed temporary erythema (46%), or local tingling sensation over a variable period of time (8%).

Conclusion. Applying the combination of ionophoresis and LASER as physiotherapeutic treatment is particularly effective in peripheric facial nerve paresis. The method is safe and well tolerated, therefore we propose its use in this type of pathology.

Key words: *Laser therapy, facial nerve paralysis, ionophoresis,*

Introduction

This study has the approval of the Bioethics Committee number 683/21.02.2019. The aim of this article is to present the functional benefit of the specific rehabilitation program in patients with facial nerve paresis irrespective of etiology, following a complex physiotherapeutic treatment.

LASER Therapy

The frequency dependent action at the level of the mitochondria, the photonic absorption by the chromophores, causes the increase of the production of ATP by activating the respiratory chain -> this results in an important energetic load with an important role in the tissue repair processes (this is the main mechanism involved) (1,7,9). LASER therapy favors the release of neurotransmitters and

prostaglandin and it acts on the endoplasmic reticulum (ER), promoting protein synthesis in ER (1,4,12).

LLLT promotes neuronal regeneration by restoring functionality through the phenomenon of axonal growth; this effect is consecutive to that of energetic stimulation; metabolic photobiomodulation of the nerve cell and activation of the immune response is exerted at λ 810 nm, in the sense of integrating the de novo developed axonal structure into tissue morpho-functional activities (1,5,8). LLLT promotes vascular regeneration by promoting neoangiogenesis. It also activates microcirculation at the place of application (1,5,6).

Ionophoresis

Ionophoresis represents the electrotherapy method by which, using galvanic current, pharmacologically active substances in ionized form are introduced (1,10,11). Specifically, the hydrophilic coating of an electrode will be soaked with a drug substance, and the effects obtained will combine the specific effects of the CG with those of the pharmacologically active substance chosen (2,3,5).

In the case of CG application, at the site of application of the negative electrode (cathode) the following effects occur: alkaline reaction, vasodilation, anti spastic and decontracturant effect, myorelaxant, hyperemia, tissue hydraulic / hydration inhibition, excitostimulation (electrical excitation of the nervous structures, catelectrotonus) (1,2,4).

In the case of CG application, at the site of application the positive electrode (anode) produces the following effects: acid reaction, vasoconstriction, analgesia, anti-edema effect, resorptive, minimal hypertension, sedation (decreases nerve excitability, anelectrotonus) (1,2,4).

Soaking the hydrophilic coating of the negative electrode with 1% potassium iodide, has the effect of activating the nerve conduction. In combination with LASER therapy it causes neurobiotrophic, regenerative effects (1,2,11).

Material and Method

We performed a retrospective analysis of 26 patients admitted to the Neuro-Muscular Clinic Division of the Teaching Emergency Hospital Bagdasar Arseni between April 2011 and March 2019.

General criteria for inclusion in the retrospective study

- patients diagnosed with facial nerve palsy (regardless of etiology)
- patients over 18 years old
- patients who have been treated with physiotherapy (ionogalvanization and LASER) for facial nerve palsy
- patients who performed 10 sessions of physiotherapy (5 days a week, Monday to Friday, Saturday and Sunday break).

General criteria for exclusion from the retrospective study

- patients diagnosed with facial nerve palsy regardless of etiology under the age of 18,
- patients who were NOT treated with physiotherapy (ionogalvanization and LASER) for facial nerve palsy

The physiotherapy treatment received by the patients **Ionophoresis** with 1% potassium iodide, applied as follows:

- negative electrode, preauricular, dimensions of 2/2 cm, the coating impregnated in KI 1%
- positive electrode, retroauricular, dimensions of 5/5 cm

Application time of 20 minutes

Intensity: vibration

I threshold = $4 \times 0,15 = 0,6$ mA

LASER at the level of the affected temporal-mandibular joint 4 points: radiant exposure per point (dose) $3 \text{ J} / \text{cm}^2$, frequency 5 Hz, probe area 1 cm^2 , power 62 mW, 1 minute application per point (neuralgia formula, BTL device) for 10 sets and at the level of the contralateral joint 2 points, the same formula.

Evaluation criteria

A. *Epidemiological criteria*: Age, Distribution by sex, urban or rural provenance.

B. *Criteria for evolvability, clinical, functionality*

I. The type of facial paresis

- 1) Central: within the pyramidal syndrome in conditions such as: stroke (hemiplegia, central facial paresis) or Craniocerebral trauma (central facial paresis)
- 2) Peripheral (Bell): of different etiologies, idiopathic, a frigore

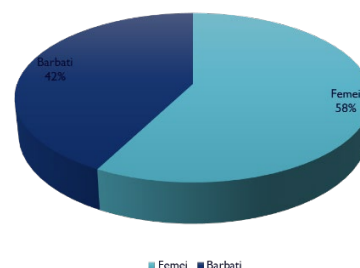
II. Type of drug therapy received:

- 1) neuroprotective,
- 2) anti-inflammatory (steroid and non-steroidal) and neuroprotective

C. *Physiotherapy criterion*: Adverse reactions to treatment

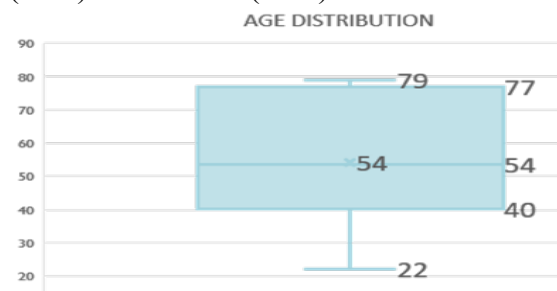
Being a retrospective analysis of the evolution of patients with facial nerve palsy, we did not use comparative tests of statistical discrimination, but descriptive analysis of the patients studied: averages and percentages.

Demographic analysis



Patients treated with physiotherapy for facial appearance have approximately similar sex

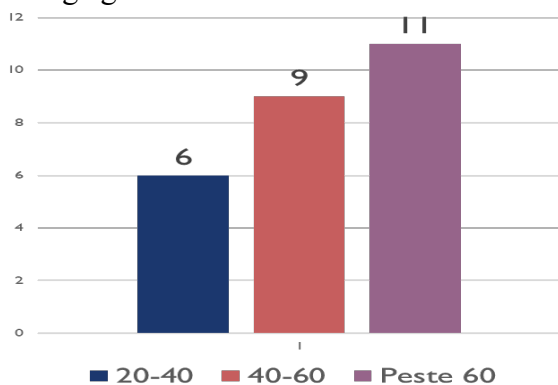
distribution, with a slight predominance of women (58%) versus men (42%).



In the studied group we observed that:

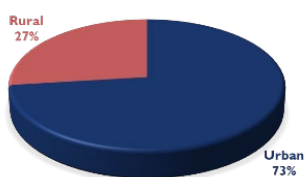
- the minimum age is 22 years
- the maximum age is 79 years
- the average age is 54 years
- the median age is 54 years

The age group distribution shows that the percentage of patients with facial paresis is higher with increasing age.



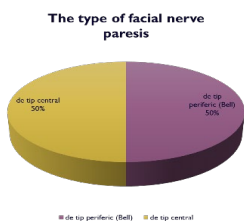
In the studied group, the patients from the urban area predominate: 19 (73%) versus 7 (27%) from the rural area.

Patient origin	Studied lot
Urban	19
Rural	7
Total	26



We observe that in the studied group we have an equal number of central and peripheral type paresis 13:13 (50% vs. 50%).

The type of facial nerve paresis	
Peripheral (Bell)	13
Central	13

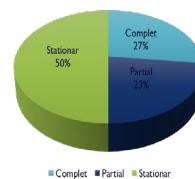


Results

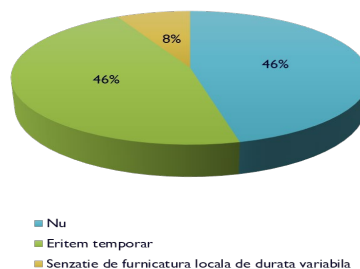
We observe that half of the patients (50%) of the entire study group had a response following hospitalization. At least one in two patients

responded to treatment of which 7 (27%) completely recovered at the end and 6 (23%) only partially recovered.

Remission of facial nerve paresis	PFP	CFP
Comple	7	1
Partial	6	2
Stationary	13	10

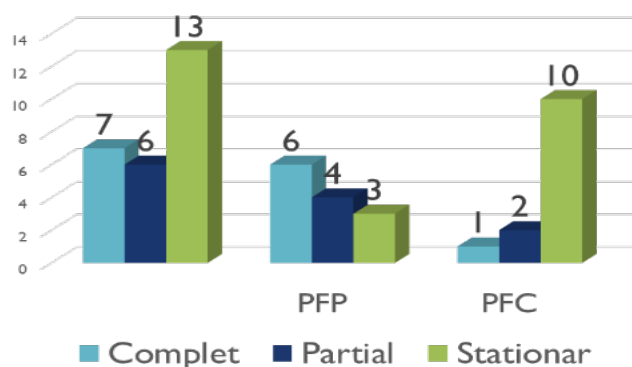


Adverse reactions to treatment



We observed that several patients with peripheral facial palsy (PFP, 6 patients) recovered compared with those with central facial palsy (1 patient). Better results are obtained for patients with peripheral facial palsy (PFP).

Results



Peripheric facial paresis (PFP)

We note that in the case of patients with PFP, a good response was obtained at the end of the hospitalization in the patients who have associated physiotherapy with neuro-protective and anti-inflammatory treatment.

Physiotherapy response	Full recovery	Partial response	Stationary
No associated drug treatment	1	1	0
Neuroprotective	2	3	3
Anti-inflammatory and neuroprotective	3	0	0
Total	6	4	3

Central facial paresis (CFP)

We observed that patients with CFP did not receive any anti-inflammatory drugs, and good responses were obtained even in patients not treated with medication.

Physiotherapy response	Full recovery	Partial response	Stationary
No associated drug treatment	1	0	0
Neuroprotective	0	3	10
Anti-inflammatory and neuroprotective	0	0	0
Total	1	3	10

Adverse reactions to treatment

We observed that only less than half of the patients had no adverse reactions (46%) while the rest had at least temporary erythema (46%), or sensation of local tingling of variable duration (8%).

Physiotherapy response	Full recovery	Partial response	Stationary
No associated drug treatment	1	0	0
Neuroprotective	0	3	10
Anti-inflammatory and neuroprotective	0	0	0
Total	1	3	10

Discussions

- We asked the question of the efficiency of the association between the physiotherapy treatment with the anti-inflammatory and neuroprotective treatment.
- It seems to be the winning solution for peripheral facial nerve palsies because most patients who have recovered have had this therapeutic plan.
- In contrast, in patients with central type facial lesions, we observed that they did not receive any anti-inflammatory drugs, and good responses were obtained also in the patients who were not treated medically, which highlights the role of the applied physiotherapy.

Conclusions

1. The combination of ionogalvanization and LASER is a useful and effective method for treating facial nerve palsy, one of two patients responding to treatment.
2. Physiotherapy treatment combined with drug treatment (anti-inflammatory, neuroprotective) is preferable in peripheral type facial
3. The combination of ionogalvanization and LASER in the facial nerve palsy is a safe method in terms of its tolerance.

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Research on neurorehabilitation results in vertebro-medullary post-traumatic conditions associating fractures, in a politramatic context

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Abstract

Introduction

Polytrauma is considered to be an array of traumatic injuries, of which at least one is directly life-threatening. In another definition, polytrauma refers to the existence of two or more organ and / or system impairments, one of which is life-threatening, leading to physical, cognitive, psychological, psychosocial and consecutive functional disabilities, all requiring a complex and long-lasting rehabilitation program. The essential condition for polytrauma is the existence of a severe damage that involves one of the vital functions of the body. The first aim of this paper is to evidence the functional benefit of the specific rehabilitation program of patients with polytrauma, mainly associated with spinal cord injury (SCI) and other fractures. **Materials and method.** We performed a retrospective analysis of 68 patients having their consent and The Teaching Emergency Hospital "Bagdasar-Arseni" ethics Committee approval, N.O. 684/21.02.2019. Patients were admitted to the Neuro-Muscular Rehabilitation Clinic Division, between October 2017 and May 2019 between the ages of 19 and 79, divided into two lots of 34 patients: the study group, composed by patients with SCI and associated fractures and the control group composed by patients who had only SCI. **Results.** The level of severity is much higher in the study group, which includes AIS A patients (38%) and AIS C (29%), than the control group composed mostly by incomplete patients - AIS D (41%) and C (26%). The FIM average at admission and discharge is statistically significantly lower in the study group compared with the control group both at admission (25.05 versus 42.29; $p = 0.001$) and at discharge (38.47 vs. 55.55; $P = 0.009$). **Conclusions.** Spinal cord injury in combination with multiple fractures is a negative functioning prognostic factor, both before and after the rehabilitation program.

Key words: Polytrauma, spinal cord injury (SCI), rehabilitation program,

Introduction

Polytrauma is considered to be an array of traumatic injuries, of which at least one is directly life-threatening (1,2,6). In another definition, polytrauma refers to the existence of two or more organ and / or system impairments, one of which is life-threatening, leading to physical, cognitive, psychological, psychosocial and consecutive functional disabilities, all requiring a complex and long-lasting rehabilitation program(1,4,5). The essential condition for polytrauma is the existence of a severe damage that involves one of the vital functions of the body (3,7,8).

The first aim of this paper is to evidence the functional benefit of the specific rehabilitation program of patients with polytrauma, mainly associated with spinal cord injury (SCI) and other multiple fractures(9,11,13). All of deficiencies mentioned before are requiring a complex and long-lasting rehabilitation program(7,10,12).

Rehabilitation is mandatory for a good recovery and functional life(3,6, 11).

Materials and method

We performed a retrospective analysis of 68 patients having their consent and the Teaching Emergency Hospital "Bagdasar-Arseni" ethics Committee approval, N.O. 684/21.02.2019. Patients were admitted to the Neuro-Muscular Rehabilitation Clinic Division, between October 2017 and May 2019. The 68 patients of the study, between the ages of 19 and 79 were divided into two lots of 34 patients: the study group, composed by patients with SCI and associated fractures and the control group composed by patients who had only SCI (without associating limb fractures).

Regarding the general criteria of the retrospective study we mention on the one hand the inclusion criteria - patients diagnosed with SCI (with different neurological levels and degrees of severity Frankel /

AIS) all over 18 years old. On the other hand, the general exclusion criteria was represented by subjects over 18 years old who were not diagnosed with SCI.

The evaluation criteria of the study were: **epidemiological items** - the age at which SCI has been produced, gender distribution, environment origin (urban / rural); **functional, clinical and evolution items** : the severity grade of SCI, the neurological / traumatic level of SCI, the type of fractures associated, the level of functional independence (FIM) at admission.

The analysis of population normality was made by using frequency histograms and data presentation was realized with box and whisker plot statistical charts. Also important, T test revealed that if the p value was less than 0.001, the difference was considered statistically highly significant (Figure 1). These results were considered credible and had been communicated in this study. For comparing the average values, the T test was used considering the independent samples, with normal distribution.

Statistic value	Unimportant statistic	Comparable value	Statistic important	High statistic important
Valoare variabila	$p > 0,05$	$0,05 > p > 0,01$	$0,01 > p > 0,001$	$P < 0,001$

Figure 1

In what regards the demographic analysis and gender distribution, in both studied groups male patients predominate: in the study group were 20 men (59%) and in the control group were 28 men (82%).

About the age item we can confirm that in our study were included patients with the age between 19 to 79 years, having an average of 54 years (Figure 2).

	Minimum age	Maximum age	Average	Standard deviation
Study group	22	79	55	16,03
Control group	19	78	48	15,61
Total	19	79	54	16,14

Figure 2

In the study group, the patients in the urban area predominate - 23 versus 14 and in the control group they are equally distributed 17:17.

The most important item from the functional, clinical and evaluation criteria was the severity grade of SCI, determined by the use of Frankel scale:

- A - complete (plegia + anesthesia + autonomic denervation)

- B - sensitive only (has sacral sparing: perineal sensitivity S 4-5, anal sphincter contraction)
- C - useless motor (force below lesion level is less than 3 for most of myomers)
- D - usefull motor (force below lesion level is over 3 for most myomers)
- E - complete recovery (force 5 for all segments, sphincter control, etc.)

We discovered that the majority of patients in the study group were Frankel A complete level (38%) and the association of fractures leads to the worsening of their functional prognosis. On the other side, the most patients from the control group were Frankel D incomplete level (41%) and the lack of fractures could have improve their functional prognosis.

Analysing the neurological level we found that in the control group there were more patients with cervical vertebra-modularly fractures, SCI C (76%) despite of the study group in which the proportions were relatively equal (Figure 3, Figure 4).

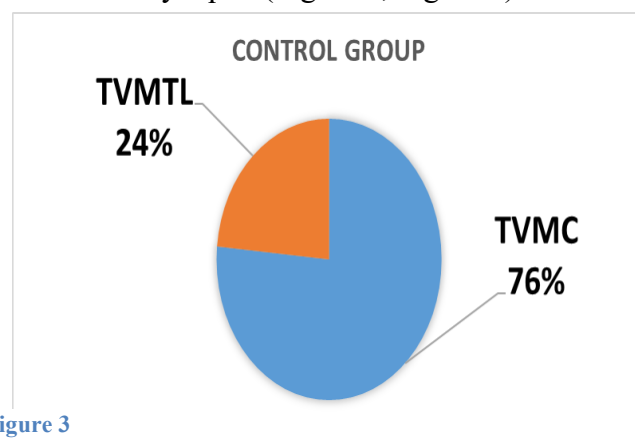


Figure 3

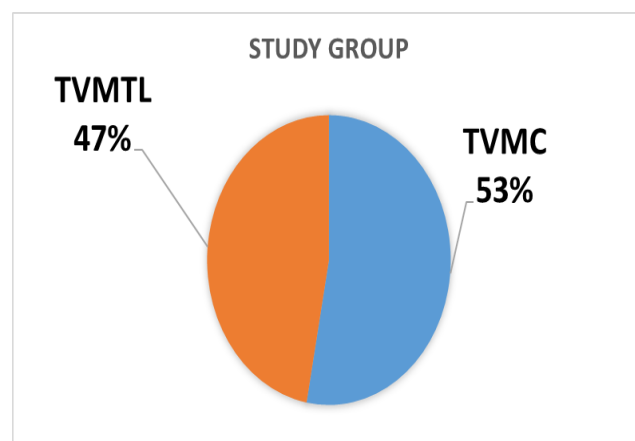


Figure 4

We also made a fracture analysis and the result was the following: in the study group it was not observed the predominance of a single type of fracture but multiple of this, which affected the patients further more. There are some types of associated fractures: left occipital fracture, right radio-carpal fracture and

left mastoid fracture, multiple costal fractures bilaterally, sternum fracture, right clavicle fracture, multiple skull fractures, pelvic ring fracture, right leg fracture, right leg fracture, right radius fracture, multiple rib fractures, right hemorrhage, fracture 1/3 proximal humerus left, fracture of acetabulum left. Each patient had minimum one associated fracture and maximum 5.

Very important for this study was the functional level of independence (FIM). Lower the numerical value of the FIM was, the more functional affected patient was (Figure 5).

FIM value	Level
under 50-55	Bedridden
56-70	Autonomy in the wheelchair
70-80	Ortostatism, roller walker
80-90	Assistive device (walker)
90-100	Walking stick
100-110	Stair climbing
110-126	Normal

Figure 5

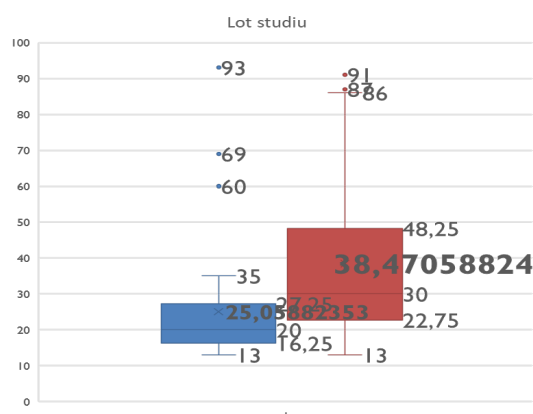


Figure 6

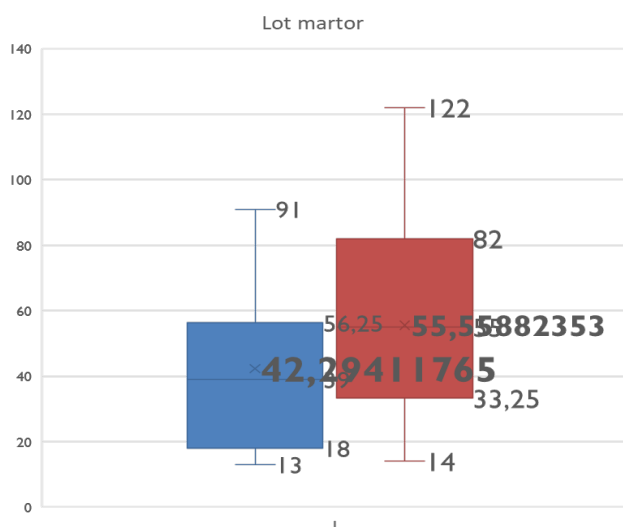


Figure 7

FIM scale of functionality evaluation was completed both at admission and at discharge. Both groups have good evolution but with but with few significant differences. Using statistic method box and wiskerplot we observed that in the control group FIM results were better - the admission FIM was 40 and the when discharged, 25% of patients were walking and 50% were at least standing (Figure 6 and 7). Study group FIM was lower, only 25% of patients were barely standing, excepting 5 cases (aberrant values).

Discriminate analysis, t test, p value <0.001, indicated a statistically significant evolution. The FIM average at admission and at discharge was statistically significant better in the control group, in patients without fractures (42 and 55) compared to the study group (25 and 38). This proved once more that the association of fractures with SCI is a functionally unfavorable prognostic factor.

Disccusions

The level of severity was much higher in the study group, which includes AIS A patients (38%) and AIS C (29%), than the control group composed mostly by incomplete patients - AIS D (41%) and C (26%) (Figure 8). The FIM average at admission and discharge was statistically significantly lower in the study group compared with the control group both at admission (25.05 versus 42.29; p = 0.001) and at discharge (38.47 vs. 55.55; P = 0.009).

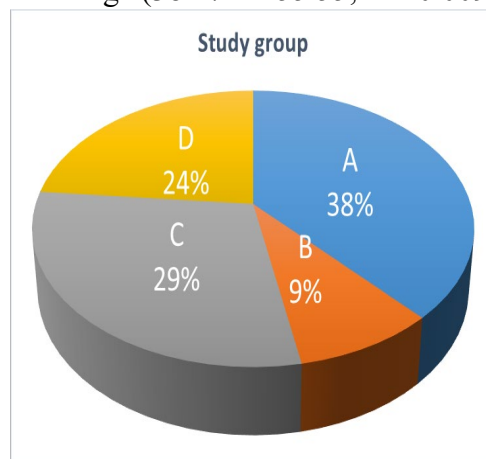


Figure 8

Patients with vertebra-medullar traumatism and associated fractures had a seriously bad general condition since admission. They were severe neurologically affected and despite of the specific rehabilitation program followed, their functional gain was maintained at a lower level than the patients who had no associated fractures. The presence of 1-5 associated fractures could led to complications and in principle made the patient's rehabilitation program more difficult.

Conclusion

Vertebral-medullary trauma in association with multiple fractures is a bad functional prognostic factor, both before and after performing the recovery program. Also, spinal cord injury in combination with multiple fractures is a negative functioning prognostic factor, both before and after the rehabilitation program.

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“Prevention is cure, Education is essential” – responsible implications of young people in educational and prophylactic actions against accidental cervical spinal cord injury and severe disabilities by diving in unverified waters

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Abstract

Introduction: Encouraged by the favorable outcomes of previous mediatic national prophylactic campaigns, initiated and sustained by the medical team of Teaching Emergency Hospital “Bagdasar-Arseni” and National TV Channels (ProTv, TVR1) focused on the risk of severe disability after cervical spinal cord injury (CSCI) by diving in unknown waters, we decided to continue increasing awareness education actions. The previous prophylactic campaigns were followed by a statistically significant reduction in the number of young patients admitted to hospital with quadriplegia after diving in unverified waters (26.8% in 2016 and 39% in 2017). Starting from the ISCoS paradigm “**Prevention is cure**”, we have resumed the prophylactic educational actions addressed to healthcare professionals (students, residents, young doctors) in campaigns to prevent CSCI and accidental tetraplegia during summer sports. The objective of the study was to test medical, diving biomechanical level of knowledge and circumstances regarding risks associated with diving in unknown waters, among young kinetotherapy FMAM students (under the age of 35). The study has the Teaching Emergency Hospital “Bagdasar-Arseni” Ethics Committee's approval NO 17464/14.06.2019.

Materials and methods: The research was conducted using the questionnaire technique, containing 16 closed questions addressed to a number of 40 students from Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

Results: We observed that most of the young students act precociously: 67.5% swim in special designated places, 77.5% dive with their feet first, versus 22.5% plunge the head first. Students have a low level of knowledge about biomechanics of plunging and the impressive speeds reached during diving. More than two-thirds of them did not answer the question about the speed reached during diving from 1 m (7.5 m/s, equivalent to 27 km/h) (67.5% students), from 10 m platform (17.5 m/s, 63 km/h) (70% students) and diving from 30 m (25 m/s, 90 km/h) (67% students). Regarding the alcohol consumption before diving, 80% of them responded with “no”, and only 5% responded with “occasional consumption”. Eighteen students (45%) know the main risk of diving in unknown and shallow waters, and 20 students (50%) have responded incorrectly.

Conclusions: Young students - future therapists have a low level of knowledge about CSCI risk and the severe disabilities that can occur accidentally by diving. It is mandatory to continue the education prophylactic initiative sustained activity through mass media, started in 2016-2018.

Key words: *traumatic spinal cord injury, tetraplegia, diving, plunging, unverified / unfamiliar water, summer sports,*

Introduction

Water sports are one of the most popular activities during summertime. However, it can be dangerous due to the fact that many lives are lost each year by drowning. Apart from death, a large number of young people become permanently disabled as a result of diving accidents. (1) High diving injuries are mostly located in the cervical spine, generally at the fifth and the sixth vertebra. Diving accident incidence has been reported to range between 1.2 and 21% (2-6) of all SCI. The average age is 21 years, most patients are males, and associated injuries are rare. (3, 7)

Albrand and Walter (8) provided some useful advice: don't dive in water less than twice your height, don't drink and dive, don't dive into unfamiliar water, don't permit or indulge in horseplay while swimming or diving. (8) Another helpful recommendation is to “lock” hands, with the arms extended in the diving position, in order to protect the head and neck when diving into shallow water. (3)

Blivitch et al (9) recommend that “divers strive to surface in as short a distance as possible by

maximizing flight distance and aiming for a low entry angle”.(8, 9)

Therefore education and diving technique appear to be outstanding considerations in injury prevention. Diving injuries of the cervical spine demonstrate high mortality and morbidity rates. Recovery depends on the severity of the initial neurological damage. (10)

Objective:

The objective of the study was to test medical and biomechanical level of knowledge on diving and the circumstances regarding risks associated with diving in unknown waters, among young kinetotherapy students (under the age of 35).

Materials and methods:

The research was conducted using the questionnaire technique, containing 16 closed-ended questions addressed to a number of 40 students (aged 19-23) from “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

A questionnaire represents a research instrument consisting of closed-ended questions which aims to gather specific information from the chosen respondents. Questionnaires focus on the sampling of a smaller population statistically representative of the wider population in question. The technique was invented by the Statistical Society of London in 1838. (11-13)

A distinction is made between open-ended and closed-ended questions. An open-ended question asks the respondent to formulate his own answer, whereas a closed-ended question has the respondent pick an answer from a given number of options. The response options for a closed-ended question should be exhaustive and mutually exclusive. (14)

Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data.

Results:

1. Do you take a bath in waters that are not specially designed for swimming?

a.Never, b. Rarely, c. Often, d. Always

We observed that most of the young students act precociously, 67,5% of them swim in special designated places (fig 1)

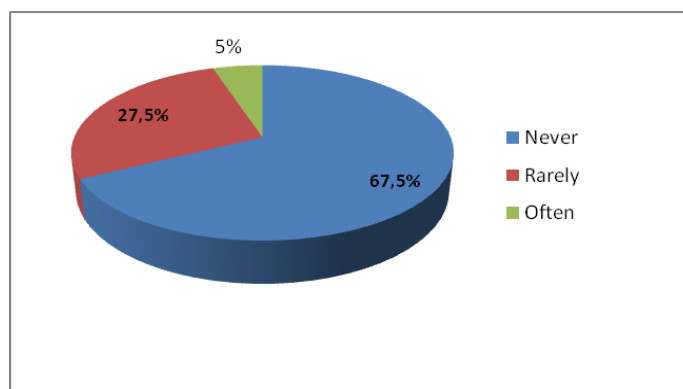


Fig 1

4. Do you check how deep the water is before jumping?

a.Never, b. Rarely, c. Often, d. Always

In the chart below, we observe that 92,5% always or often check the depth of the water, whereas 7,5% of them rarely check the depth of the water before jumping (fig 2)

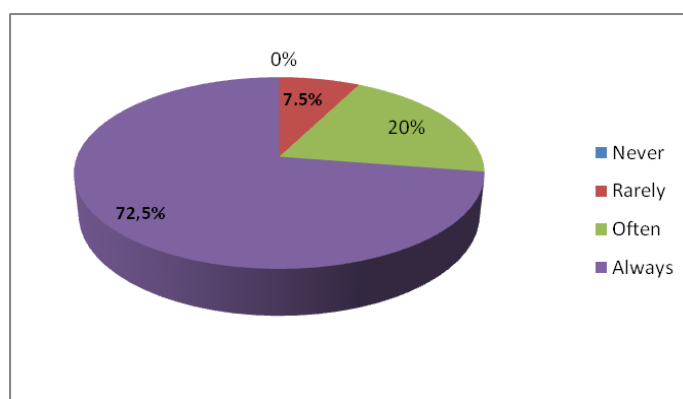


Fig 2

2. How do you plunge into the water?

a. Head first, b. On your back, c. On your belly, d. Feet forward, e. Feet crouching (fig 3)

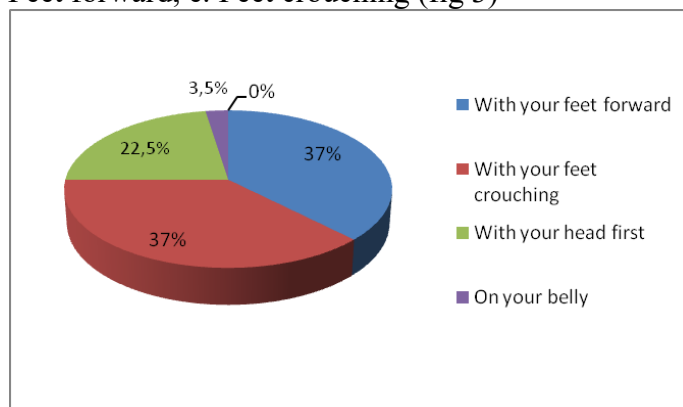


Fig 3

The chart above represents the sum of the second and third questions.

3. How often do you jump head first into the water ?

a. Never, b. Rarely, c. Often, d. Always

Most of them, 77,5% jump feet first and 22,5% head first. (fig 3)

5. What are the risks of diving in shallow water?

a. Cervical spine fracture, b. Head injury and loss of consciousness, c. Fractures of the limbs, d. Epistaxis (bleeding on the nose), e. There is no risk

Eighteen students (45%) know the main risk of diving in unknown and shallow waters, which is represented by cervical spine fracture (SCCI).

Meanwhile, 20 students (50%) have responded incorrectly (fig 4).

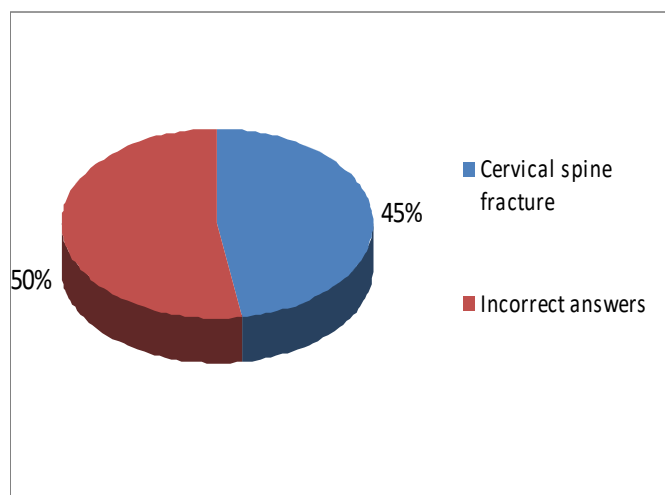


Fig 4

6. Do you consume alcohol before diving? a.

Never, b. Rarely, c. Often, d. Always

About 80% responded with "no", 15% "occasional consumption", and 5 % "often". Therefore, most of the students do not consume alcohol before diving (fig 5).

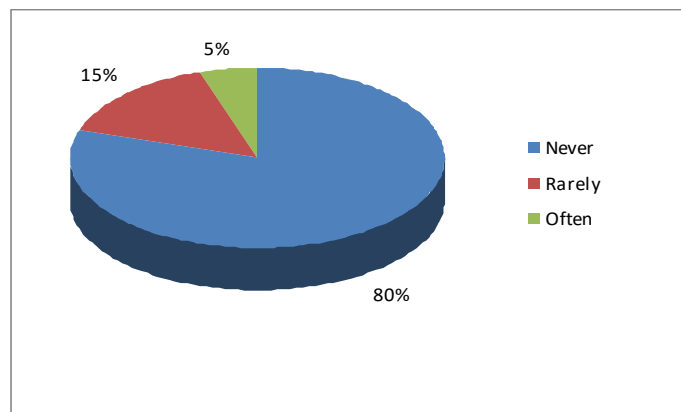


Fig 5

Referring the biomechanics of plunging

9. How deep should the pool be so you can safely dive from the starter block ?

a. 1 m, b. 1,5 m, c. 2 m, d. 3 m, e. I don't know

A small part of the respondents (32,5%) knew the correct answer, which is 3 meters. Most of the respondents, though, did not know the correct answer (67,5%) (fig 6)

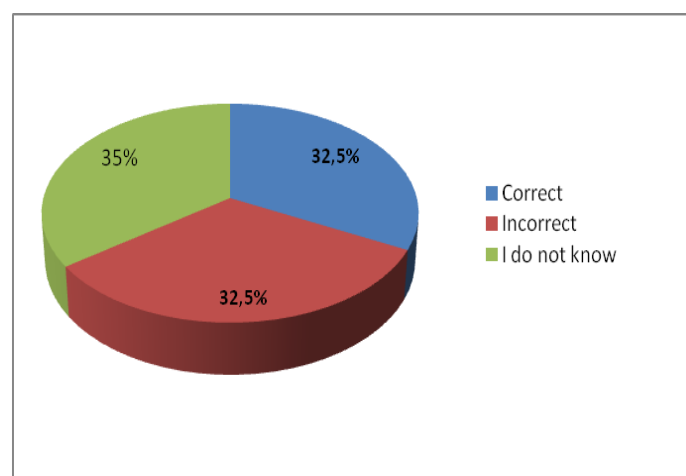


Fig 6

12. At what speed does a person weighing 60 kg reach the water if he plunges obliquely from 1 meter?

a. 1m/s, b. 3m/s, c. 5m/s, d. 7,5 m/s, e. I do not know.

15. At what speed does the person who dives from the 10 meter platform reach the water?

a. 1 m/s, b. 3 m/s, c. 5 m/s, d. 17,5 m/s, e. I do not know

16. In the case of diving in water from 30 meters it is estimated that the water is reached with a speed of:

a. 10 m/s, b. 15 m/s, c. 20 m/s, d. 25 m/s, e. I do not know

In the charts below, we noticed that students have a low level of knowledge about biomechanics of plunging and the impressive speeds reached during diving. More than two-thirds of them did not answer the question about the speed reached during plunging.

Therefore, from 1 m (7.5 m/s, equivalent to 27 km/h) 67.5% of the students did not know the correct answer, from 10 m platform (17.5 m/s, 63 km/h) 70% students of the students, and from 30 m (25 m/s, 90 km/h) 67% of them responded incorrectly (fig 7,8,9).

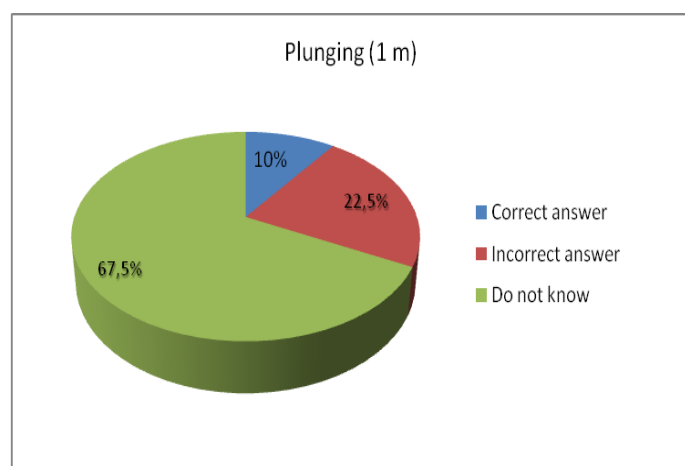


Fig 7

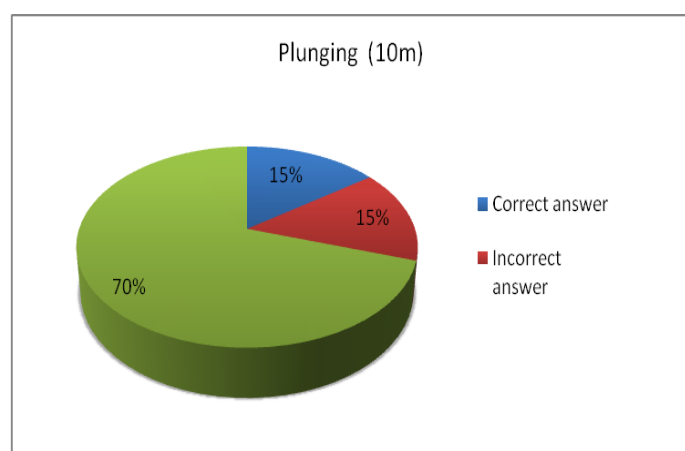


Fig 8

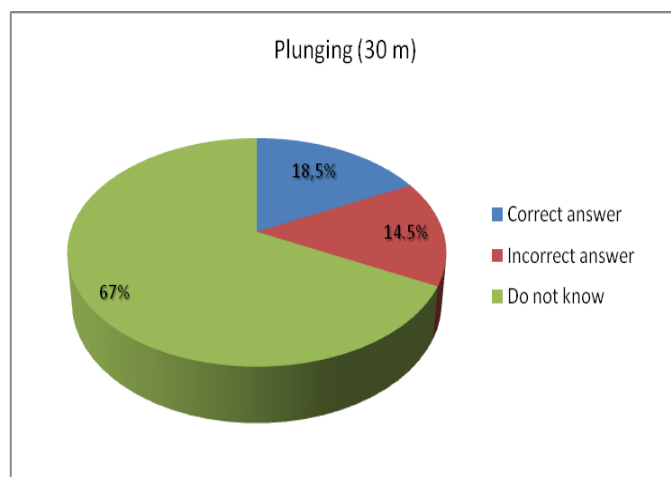


Fig 9

14. How deep should the pool be, in order to dive from above (trampoline, platform, rock)?

a. 2 m, b. 3 m, c. 5 m, d. 8 m, e. I do not know

The pool should have 8 meters, and a small percentage of the students (25%) knew the correct answer, but most of them (75%) did not know or responded incorrectly. (fig 10)

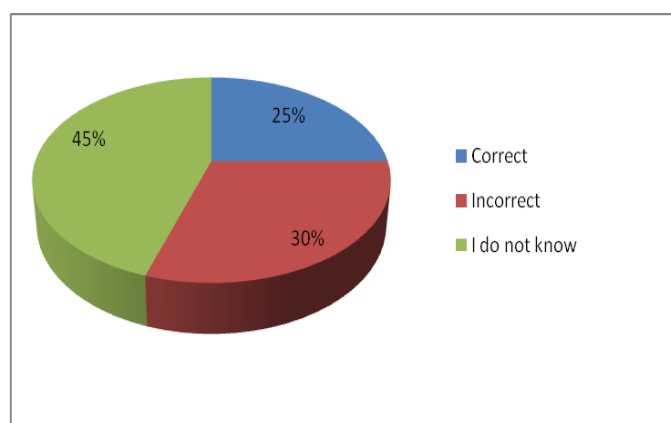


Fig 10

Discussion

Encouraged by the favorable outcomes of previous national prophylactic campaigns, initiated and sustained by the medical team of Teaching Emergency Hospital "Bagdasar-Arseni" and National TV Channels (ProTv, TVR1) focused on the risk of severe disability after cervical spinal cord injury (CSCI) by diving in unknown waters, we decided to continue increasing awareness on education endeavors. (15) The previous prophylactic campaigns were followed by a statistically significant reduction in the number of young patients admitted to hospital with quadriplegia after diving in unverified waters, 26.8% in 2016, 39% in 2017.

Starting from the ISCoS paradigm "**Prevention is cure**" (16), we have resumed the prophylactic educational actions addressed to healthcare professionals (students, residents, young doctors) in campaigns to prevent CSCI and accidental tetraplegia during summer sports.

CONCLUSIONS

This study revealed that young population, future therapists, have a low level of medical and biomechanical knowledge about plunging head first, the risk for CSCI and the severe disabilities that can occur accidentally by diving. The majority of them responded well in terms of knowledge about the alcohol consumption before diving, never swim in waters that are not specially designed for swimming in, and checking the depth of the water before plunging.

Although our campaign had promising results, we make a permanent objective of our clinic's division to **continue** the sustained education and prophylactic initiatives through mass media.

Author contributions

Anghelescu Aurelian has designed the study, collected data, and contributed to writing the manuscript

Constantin Elena and Mihaescu Anca Sanda processed data and contributed to writing the manuscript

Gelu Onose reviewed and approved the manuscript

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Complex clinical and therapeutic rehabilitation approach of a patient with complete AIS/Frankel A tetraplegia post cervical spinal cord injury after accidental fall off a trailer and multiple complications occurring during disease progression - case study

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Abstract

Introduction: Spinal cord injury is a complex neurologic condition that embeds multiple complications, which are often debilitating for patients as the disease progresses.

Materials and Methods: This paper presents a case of a 44-year-old patient with a longilin asthenic constitution and no previous medical history, who accidentally fell off a trailer resulting in burst fracture dislocation of C6/C7 associated with immediate loss and consciousness and onset of complete ASIA-A tetraplegia with C5 neurologic level. The patient received a complex nursing program, which included extensive debridement of the necrotic tissue, daily antiseptic wound dressing using Chloramine solution and silver sulfadiazine cream along with wide-spectrum antibiotic therapy with slow but favorable progression. During hospitalization the patient developed an episode of respiratory distress which responded favorably to Levocetirizine daily.

Results: The complex neuro-muscular rehabilitation program along with the medical treatment and surgical debridement the patient received have improved of the clinical outcome with the shrinkage of the pressure point lesions, adequate respiratory function which permitted the mobilization of the patient with the wheelchair.

Conclusions: Patients with spinal cord injuries are prone to a vast majority of complications including pressure sores complicated with necrotizing fasciitis and respiratory distress that could alter the quality of life. Proper monitoring and management of these kind of complications in the context of neuromuscular rehabilitation are necessary for the enhancement of the quality of life.

Key words: *spinal cord injury, tetraplegia, complications,*

Introduction

Spinal cord injury is a complex neurologic condition that embeds multiple complications, which are often debilitating for patients as the disease progresses.

The American Spinal Injury Association classifies the spinal cord injuries as follows (1,6,7):

- A- Complete: no preservation of sensory or motor function
- B- Incomplete: sensory but no motor function preserved below the neurologic level
- C- Incomplete: motor function preserved below the neurologic level and key muscles have strength less than 3
- D- Incomplete: motor function preserved below the neurologic level and key muscles have strength equal or greater than 3
- E- Normal function both and sensory and motor

Unfortunately, patients with SCI often develop severe secondary complications which lead to increase number of rehospitalization and, decrease quality of life and increase morbidity and mortality. In literature, respiratory dysfunction and pressure

ulcers are amongst the most debilitating complications that occur in tetraplegic patients. This paper presents our approach to hemodynamically stabilize and treat these kinds of complications in a young tetraplegic ASIA -A patient.

Case report: a 44-year-old patient with a longilin asthenic constitution and no previous medical history, who accidentally fell off a trailer resulting in burst fracture dislocation of C6 / C7 associated with immediate loss and consciousness and onset of complete ASIA-A tetraplegia with C5 neurologic level.

The patient was admitted in the Neurosurgical Department II of the Teaching Emergency Hospital "Bagdasar Arseni" (TEHBA) in critical condition. Neurosurgical intervention was decided after hemodynamic and respiratory stabilization of the patient was achieved. After complex surgery the patient was transferred to the neurorehabilitation clinic of TEHBA with motor complete tetraplegia at

C5 level and a complex rehabilitation program adequate for this pathology was initiated.

Favorable in-house evolution pleaded for the patient to be discharged. Months later he returned to our clinic with multiple pressure ulcers stage III-IV located bilaterally on trochanters and severe necrotizing fasciitis localized at the level of coccyx.

The physical exam showed a cachexic patient with pale teguments and mucosae, multiple skin pressure ulcers stage III-IV located bilaterally on trochanters and severely infected massive stage IV ulcer on coccyx, poor chest expansion with decreased air entry, polypnea 22 breaths per minute, moist cough with pulmonary rales presented bilaterally, SpO₂ 86% spontaneously in atmospheric air corrected to 94% on O₂ therapy 2L/min; BP- 93/55mmHg; HR- 118bpm; chronic carrier of indwelling urinary catheter.

Neuro-myo-arthro-kinetic clinical examination (NMAK): cooperative, oriented to space, time and self, cranial nerves in normal limits without swallowing deficits, complete spastic tetraplegia C5 level with muscle strength 1/5 in the upper limbs and 0/5 in lower limbs.

Scales: Modified Ashworth = 0 / 5, Penn = 0/4, GOS-E = 3, Rankin = 5, FAC = 0, FIM motor = 11/91, Cognitive FIM = 27/35.

Paraclinical examination revealed leukocytosis, severe iron deficiency anemia, electrolytic disturbances especially hyponatremia and hypopotassemia. Following the clinical and paraclinical examination, the patient was initiated on a complex rehabilitation program.

The main goal was the hemodynamic stabilization of the patient to prevent further multiorgan dysfunction. Wide-spectrum systemic antibiotic therapy was immediately introduced in the therapeutic plan being followed by targeted therapy according to the antibiogram. Oxygen supplementation via nasal cannula was given until spontaneous SpO₂ remained stable at 96% in the atmospheric air. Also, Levocetirizine was administered twice a day to reduce the mucus. Levocetirizine is an antihistamine which acts by decreasing the histamine H1 receptors and is usually used in allergic rhinitis (2). In this case it was used for its side effect to dry out the pulmonary mucus and decrease the wet cough.

Moreover, extensive debridement of the necrotic tissues present on the ulcerated pressure points was performed by a specialized plastic surgeon.

The wounds were then dressed daily for about a month using an antiseptic solution followed by silver sulfadiazine cream. The antiseptic solution used was a hypochlorous acid solution which ensures reduction of the microbial load and prevents the recurrence of pathogens. It has been demonstrated that hypochlorous acid is very effective against bacterial, viral, and fungal pathogens in a short time period³. Hypochlorous acid is an important component of our own immune system formed and released by macrophages during phagocytosis³. In the body, it kills pathogens by inhibition of protein synthesis, decreased oxygen uptake, oxidation of respiratory components, decreased adenosine triphosphate production, breaks in DNA, and depressed DNA synthesis (3).

On the other hand, the silver sulfadiazine cream used to treat this patient is a common topical antimicrobial used for decades in the treatment of burn (4). It is thought that the silver ions bind with the DNA of the organism, releasing the sulfonide which interferes with the metabolic pathway of the microbes (5). It is most effective against *P. aeruginosa* and the enterics, and equally effective as any antifungal drug against *C. albicans* and *S. aureus* (5).

The pictures below illustrate the trochanteral and coccyx pressure ulcers before and after being surgically addressed and treated with hypochlorous acid solution and silver sulfadiazine topical cream. The evolution was slowly favorable.



Upon discharge, it was recommended to continue the wound treatment at home until complete regeneration of normal skin over the lesions. Physical therapy was also recommended in order to strengthen the thoracic muscles and avoid further pulmonary complications.

Results: The complex neuro-muscular rehabilitation program along with the medical treatment and surgical debridement the patient received have improved of the clinical outcome with the shrinkage of the pressure point lesions, adequate respiratory function which permitted the mobilization of the patient with the wheelchair.

Healing of wounds that involve the deep dermal layer takes longer than the superficial ones because they are more susceptible to bacterial infections which often leads to disintegrated necrosis of the skin as seen in this patient⁴. Adequate cleaning of the wounds and silver compounds with antimicrobial activity are used worldwide to prevent infections⁴. Silver sulfadiazine has been considered “gold standard” topical treatment for wounds because is painless on application and it can be used with or without dressing⁴.

Moreover, early hemodynamic stabilization of a critically ill tetraplegic patient has a significant effect on outcome. Respiratory disfunctions are very common in cervical tetraplegic patients due to inefficient respiratory muscles. Therefore, proper rehabilitation techniques which include training of the respiratory muscles, respiratory physiotherapy to aid the expectoration of secretions are crucial in the management of respiratory complications.

Conclusions: Patients with spinal cord injuries are prone to a vast majority of complications including pressure sores complicated with necrotizing fasciitis and respiratory distress that could alter the quality of life and even lead to multiorgan disfunction. Proper monitoring and management of these kind of complications in the context of neuromuscular rehabilitation are necessary for the enhancement of the quality of life.

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Multimodal therapeutical-rehabilitative approaches in a complex case of pathology including possibly evolving discariotic type- case report.

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Abstract

Introduction Having the patient's consent and The Teaching Emergency Hospital "Bagdasar-Arseni" Ethics Committee N.O 20270 from 26.06.2019, the current case report presents the case of a female patients with both hemiplegia following a thalamic vascular accident and a long history of neglected auricular melanoma. The management of a patient diagnosed with melanoma is a complex one, involving wide local excisions with safety margins, with sentinel lymph node biopsy. Auricular melanomas have recently evolved from radical procedures involving the amputation of the involved organ, to much less radical procedures, which help save more of the patient's tissue and functionality. (1) Another important factor that threatens the rehabilitation process in the case of hemiplegic patients is the presence of clinical depression, both as a pre-existing comorbidity and as a common psychiatric complication of stroke. (2) Depression jeopardizes the patient's quality of life and increases mortality. (2) There is also relevant date supporting the hypotheses that depression history is associated with melanoma risk, although no effect on survival was observed. (3) **Materials and Methods** A 70 years old patient, which suffered right thalamic vascular accident in december 2018 was admitted in our Neuromuscular clinic division with the following comorbidities: basal-cell carcinoma (BCC), diagnosed 20 years ago, with slow evolution. When admitted in our division, the patient presented with a moderately large ulcerated tumor in the temporal region and the left auricular pavilion – with surgical indication. She was also diagnosed with arterial hypertension stage III, chronic, cardiac insufficiency class III NYHA, chronic cervicgia and lumbosacralgia, class II obesity, clinical depression. She was admitted into our clinic for hemiplegic motor deficit, sensibility disorders, severe locomotor and self-grooming dysfunction. **Results** The patient improved on most of the assessment scales/scores implemented in our Clinic's Division Motor FIM (Functional Independence Measure) from 35/91 to 38/91, FAC (Functional Ambulation Categories) from 0/5 to 1/5, GOS-E (The Extended Glasgow Outcome Scale) from 4/8 to 5/8. The most important improvement in our patient's evolution was her ability to start walking again. During her admission into our Clinic, she was also briefly admitted into the hospital's Plastic Surgery Division, where she received the necessary surgical treatment for the melanoma. **Conclusions** Following a complex neuro-recovery program developed by a multidisciplinary team made of doctors, kinesio-therapists, middle and allied health personnel, the patient had an extremely good evolution (during a short period of time) - attested on the scales and also - on a psycho-cognitive and behavioral level.

Key words: neuromuscular rehabilitation, stroke, hemiplegia, melanoma, basal-cell carcinoma,

Introduction

The management of a patient diagnosed with melanoma and hemiplegia following a right thalamic vascular accident is a complex one. The treatment of the melanoma usually involves wide local excisions with safety margins, with sentinel lymph node biopsy. Auricular melanomas have recently evolved from radical procedures involving the amputation of the involved organ, to much less radical procedures, which help save more of the patient's tissue and functionality. (1) Another important factor that threatens the rehabilitation process in the case of hemiplegic patients is the presence of clinical

depression, both as a pre-existing comorbidity and as a common psychiatric complication of stroke. (2) Depression jeopardizes the patient's quality of life and increases mortality. (2) There is also relevant date supporting the hypotheses that depression history is associated with melanoma risk, although no effect on survival was observed. (3) Depression is also a consequence of stroke, being one of the most common functional impairments after stroke, along motor deficits, language troubles neglect, sensory deficits, cognitive dysfunctions, visual field deficits. (5)

Method: case presentation

The informed consent of the family and the approval of the Ethics Commission of „Bagdasar-Arseni Hospital” in Bucharest were obtained for the communication of this case.

We present the case of a 70 years old patient, which suffered a right thalamic vascular accident on December 2018. The date of the stroke was consistent with literatura data (6,7,8). For ischemic stroke, there are two incidence peaks: one in the winter (December-January), with a higher value, and the second one in the summer (July). Twenty years ago, she was diagnosed with basal cell carcinoma (BCC), with slow evolution. When admitted in our division, the patient presented with a moderately large

ulcerated tumor in the temporal region and the left auricular pavilion – with surgical indication. She also presented the following comorbidities: arterial hypertension stage III, chronic cardiac insufficiency class III NYHA, chronic cervicalgia, and lumbosacralgia, class II obesity, clinical depression. Her personal pathologic history included acute renal failure, the insertion of an indwelling catheter, respiratory virosis associated with acute bronchitis, a flare of a chronic urinary tract infection. She was admitted into our clinic for hemiplegic motor deficit, sensibility disorders, severe locomotor and self-grooming dysfunction.

At her admission, the general state of the patient was stable from a cardiovascular, respiratory, digestive and renal point of view (respiratory rate – 18/min, heart rate – 76 bpm, blood

pressure- 165/90 mmHg). She presented with a moderately large ulcerated tumor in the temporal region and the left auricular pavilion. The clinical examination revealed erythematous lesions with small papules in the left hemibody, later diagnosed as a fungal infection.

Regarding the neuromioarthrokinetic examination, the patient was conscious, alert, cooperant, temporospatial orientated. The cranial nerves examination revealed a left central facial paralysis, horizontal nystagmus, superficial sensibility disorders in the left hemibody. The patient has no muscle control in the left inferior limb, and 5/5 MRC in the right inferior limb. The muscle force in the left superior limb was 4/5 proximal, 2+/5 intermediate and 2/5 distal. In the right superior limb, the muscle force was 5/5 MRC on all levels. Reflexes osteodentinous were accentuated in the left

superior limb, and they were abolished in the left inferior limb

The patient was clinically and functionally assessed, according to the standardized protocols implemented in our clinic by means of the assessment grading scales: FAC (Functional Ambulation Category) = 0/5, FIM (Functional Independence Measure) cognitive = 35/35, FIM motor = 35/91, Modified Rankin Scale = 5/5, The Glasgow Outcome Scale Extended (GOS-E) =4/8, Ashworth = 0, Penn = 0, QoL (Quality of Life) (Flanagan completed by Burckhard) =69/112. MMSE (Mini-mental state examination) and MoCA (Montreal - Cognitive Assessment) were impossible to test at admission due to visual impairment.

The patient was paraclinically examined in order to evaluate his biological reserve and his availability in bearing the recovery program. To this purpose, both laboratory and imaging investigations have been used.

The radiography of both knees showed osteoarthritis in both knees. The right knee radiography showed cartilage erosion, osteophytes in the tibial epiphysis and the femoral condyles. Superior and inferior marginal osteophytes in the patella. Radiography of the left knee showed cartilage erosion and loss of space in the articulation.

The cerebral IRM showed sequelae modification following a right thalamic cerebrovascular accident and cortical and sub-cortical demyelinating lesions on both sides, more accentuated on the right. Nodular lesion of 11/5/6 mm localised on the falx cerebri was also present.

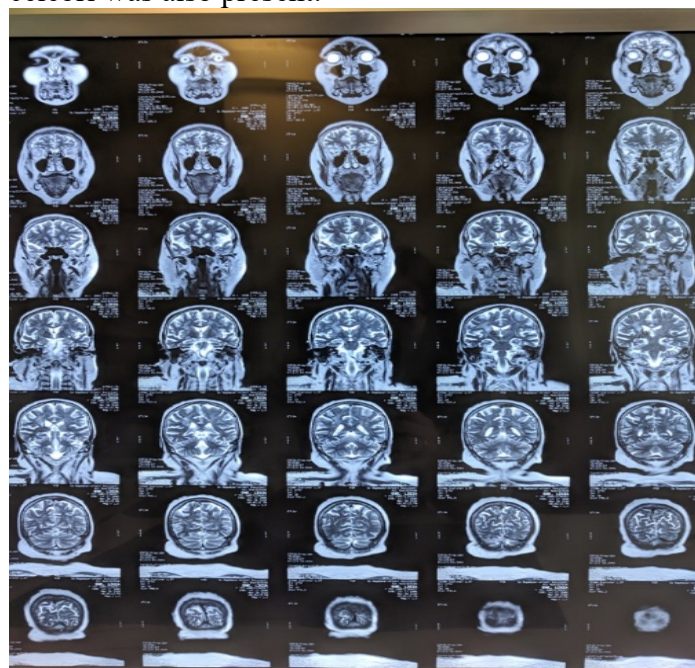


Figure No. 1 – Cerebral IRM

The main general objectives of the neurorehabilitation program were: combating pain and regaining functionality that allows the patient self-grooming and locomotion, treating the associated oncological diseases and preventing complications, improving the patient's psycho-cognitive, mental and emotional status and obtaining socio-professional, respectively family reestablishment in order to improve patient's quality of life

Evolution

During the hospital stay, the patient underwent a complex recovery program which included pharmaceutical treatment with: injectable anticoagulant type HGMM, per os anticoagulant, neurotrophic, xanthine oxidase enzyme inhibitor, nervous system stimulant antialgic, calcium channel blocker, antidepressant, anxiolytic, statin, silymarin, dietary supplements with vitamin D, calcium, magnesium and zinc, iron supplement, urinary antiseptic and physical treatment (kinesiotherapy). The recovery team collaborated with other specialists to provide the patient with a complete, individualized recovery plan, based on the particularities of the case. The main general objectives of the rehabilitation program were combating pain and regaining functionality that allows the patient self-grooming and locomotion, improving the patient's psycho-cognitive, mental and emotional status and family reestablishment in order to improve patient's quality of life.



Figure No.2 – The patient during the physical treatment

A Doppler ultrasonography of the left inferior limb is performed, following algic symptoms in the respective limb. No deep vein thrombosis (DVT) signs were present. On the same day, a plastic surgical consult is requested. Surgical excision of the left temporal and auricular tumor is recommended. Following the worsening of the

patient's psychological symptoms, a psychiatric consult is also requested. The patient was diagnosed with organic anxiety disorder, which was treated with lorazepam 2 mg per day.

After the surgical excision of the auricular tumor, the patient presented with auditory symptoms. A new plastic surgery consult is requested. The plastic surgeon observed the skin graft, which was small non-epithelized areas and recommended an otolaryngology consult, which was performed the next day. The otolaryngologist recommended otic aspiration, after the healing of the surgical scar.

A neurology consult was also performed. The neurology specialist recommended an ongoing recovery treatment, antihypertension treatment, and clinical reevaluation when needed.

After a few weeks, an inferior limb asymmetry is noticed. Consecutively, a Doppler ultrasonography of the left inferior limb is performed. The patient is diagnosed with deep vein thrombosis in the left popliteal vein. The patient starts treatment with injectable anticoagulant type HGMM, topical heparinoids, and bioflavonoids. A third Doppler ultrasonography of the left inferior limb is performed after a week. There is no improvement of the deep vein thrombosis.

Afterward, a hyperchromic lesion is observed in the left frontotemporal area. It is advised by the plastic surgery team to perform a dermatological consult, followed by a biopsy and a histopathological examination of the lesion. Following the dermatological consult, a local relapse of the basal-cell carcinoma cannot be excluded. A surgical consult is recommended.

Two weeks after the diagnosis of the deep vein thrombosis, another cardiological consult and another Doppler ultrasonography are performed. There is a clear improvement in the sonographic aspect. It is recommended that the injectable anticoagulant type can be replaced with a per os anticoagulant.

A day before the patient's discharge, a last surgical consult is performed. The histopathological examination is again strongly recommended to the patient. She refuses, and asks to be released from the hospital and sent home.

Results

The patient remained afebrile, cardio-respiratory balanced throughout the hospital stay and had a favorable evolution from a pain-dysfunctional point of view. Before discharge, the results of the recovery

program were evaluated using the same scales applied at the admission (Table No.1).

	ADMISSION	DISCHARGE
Modified Rankin Scale	5	4
STRATIFY Scale for Identifying Fall Risk Factors	0/5 (low risk)	2/5 (major risk)
FIM - cognitive	35/35	35/35
FIM - motor	35/91	38/91
QoLzz	69/112	72/112
Asworth, Penn	0/16	0/16
FAC	0/5	1/5
GOS-E	4/8	5/8

Table No.1 - Evaluation scales at admission and discharge

Following the pharmaceutical treatment in a period of several months, her blood tests also improved significantly. (Table 2)

	Admission	Two weeks later	Final discharge (five months later)
Albumina	2.9 g/dL	2.9 g d/dL	3.4 g/dL
Fier	34 ug/dL	70 ug/dL	50 ug/dL
GGT	102 U/L	68 U/L	50 U/L
NE%	77.0	75.1	67.4
LY%	12.8	15.6	20.7
LY#	0.8 x10 uL	1.2	1.1
RBC	2.98	3.29	3.65
HGB	9.8	10.4	11.7
HCT	29.2	32.1	34.9
MCH	32.7	31.6	32.0
RDW	18.1	17.8	13.5
MPV	10.5	9.7	10.8
VSH	68	62	56

Table No.2 – Evolution of blood tests

Prognosis

The patient's prognosis is mainly favorable (ad Vitam – mainly favorable, without taking into consideration the oncological prognosis, ad functionem – reserved). The mobility recovery was hampered by the cardiologic comorbidities, especially the chronic cardiac insufficiency and the psychological symptoms, which worsen the prognosis. The ad laborem prognosis is not necessary to be evaluated.

Conclusions

The combined and complex rehabilitation led to a significant remission of the hemiplegic motor deficit and sensibility disorders. The favorable progression emerged after a sustained, sequential, stage-adjusted and persistent therapeutic rehabilitation team-run program in the context of both the presence of auricular melanoma and clinical depression.

All of the mentioned factors improved the patient's quality of life.

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Unedited pathological recurrent association of palmomental and rooting archaic reflexes in a young woman with severe traumatic brain lesions – case presentation and physiopathological considerations

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Abstract

Introduction. Archaic reflexes are present in infancy, disappear as the brain matures, but reappear in pathological conditions. **Case report.** A 29-years-old woman has suffered a severe traumatic brain injury. She was admitted to neurorehabilitation 6 months after neurosurgical interventions (ventriculoperitoneal shunt for traumatic hydrocephalus, emerged after decompressive craniectomy). Neurological examination revealed a minimal conscious state, spastic tetraparesis, trismus, central facial palsy, nystagmus, bilateral palm-chin reflex, and a “mitigated” variant of the rooting reflex. The left corneal, snout and glabellar reflexes were absent. Osteotendinous reflexes were brisk, Babinski sign was bilaterally present, palmar and plantar grasp reflexes were absent. The trismus has persisted and chewing remained severely disabled after botulinum toxin injected in the left temporalis muscle and bilaterally in the masseter. The patient was fed by percutaneous endoscopic gastrostomy tube. Neurologic evolution remained stationary after two months of rehabilitative nursing. **Discussion.** The palmomental reflex described by Marinescu and Radovici, is elicited by scratching the thenar eminence of the palm, and consists of an ipsilateral twitch of the mentalis muscle. Baby rooting for milk is a primitive trigemino-facial reflex found in newborn infants. The lower lip is lowered, and the tongue is moved in the direction where the cheek near the corner of the mouth is brushed. The lockjaw has “mitigated” the classical pattern of clinical response. Repeated stimulation causes a unilateral mentalis muscle response, similar to the palm-chin reflex. The severe traumatic brain lesions have induced pathological reappearance of the palmomental and rooting archaic reflexes, in a unique, unedited pathological association.

Key words: *palmomental reflex (Marinescu Radovici reflex); rooting reflex; archaic reflexes; botulinum toxin; traumatic brain injury; minimal conscious state,*

Introduction

Primitive oral reflexes (rooting, snouting, pouting) are referred as archaic, developmental, atavistic reflexes, or “frontal release” signs. They are a group of pre-programmed behaviors, typically exhibited by normal infants in response to particular stimuli, and suppressed during normal development.

Baby rooting for milk (“reflexe des points cardinaux”) is a primitive oral trigemino-facial reflex, found in newborn infants and disappears at about the sixth week of life. The lower lip is lowered, and the tongue is moved in the direction where the cheek near the corner of the mouth is brushed.(1)

The palmomental reflex (PMR) is elicited by scratching the thenar eminence of the palm. It consists in a brief, involuntary contraction of mentalis muscles of the chin, usually unilateral and ipsilateral to the stimulated thenar eminence.(2) Mentalis muscle contraction might be weakly evoked (uni- or bilaterally) in some healthy subjects by means of a sufficiently strong mechanical stimulus or by electrophysiological

examination.(3,4) It seems that the electrically or clinically elicited contractions do not share the same mechanism of muscle responses.(4) A pathological PMR can be the only sign of suprasegmental lesions (2, 5-8) and may have the clinical semiotic significance as the extensor plantar response.(8)

Case report

A 29-years-old woman who suffered a severe traumatic brain injury was admitted to our neurorehabilitation clinic 6 months after neurosurgical interventions (ventriculoperitoneal shunt for traumatic hydrocephalus, emerged after decompressive craniectomy).

Neurological examination revealed a minimal conscious state, spastic tetraparesis, neurogenic bladder, trismus, central facial palsy more evident in the expressive mimic, nystagmus, bilateral palm-chin reflex (fig.1 A,B), and a “mitigated” variant of rooting reflex (fig.1 C,D).

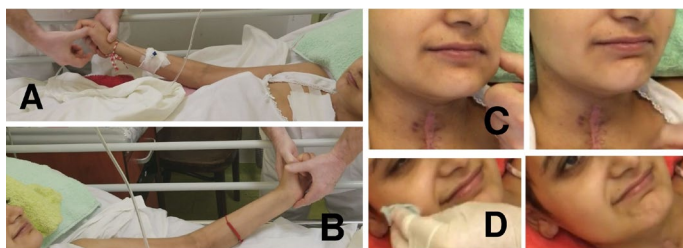


Fig.1 (A, B) Bilateral palmomental reflex: stroking the palm of the hand while watching for the contraction of the ipsilateral mentalis muscle (A: right PMR; B: left PMR) (C, D) Clinical variant of the rooting reflex. Repeatedly cheek stimulation with the finger drawn across the mid-cheek towards the corner of the mouth, elicited an ipsilateral visible wrinkling of the skin over the chin, and slightly elevation of the corner of the mouth, similar to the palm-chin reflex (C: left; D: right)

The left corneal, snout and glabellar reflexes were absent.

Osteotendinous reflexes were brisk (+3/right, +4/left side), Babinski sign was bilaterally present, palmar and plantar grasp reflexes were absent.

Assessing facial anatomical features incidentally revealed contractions of the mentalis muscle, occurring whenever a moderate pressure tactile stimulus was applied to the cheek, beside the mouth. The visible, not exhausted chin twitch was ipsilateral to the stimulated midface, and clinically similar to the PMR.

Conventional MRI (1.5T) was not sufficiently informative to show in detail all the tiny, diffuse brain damage (fig.2).

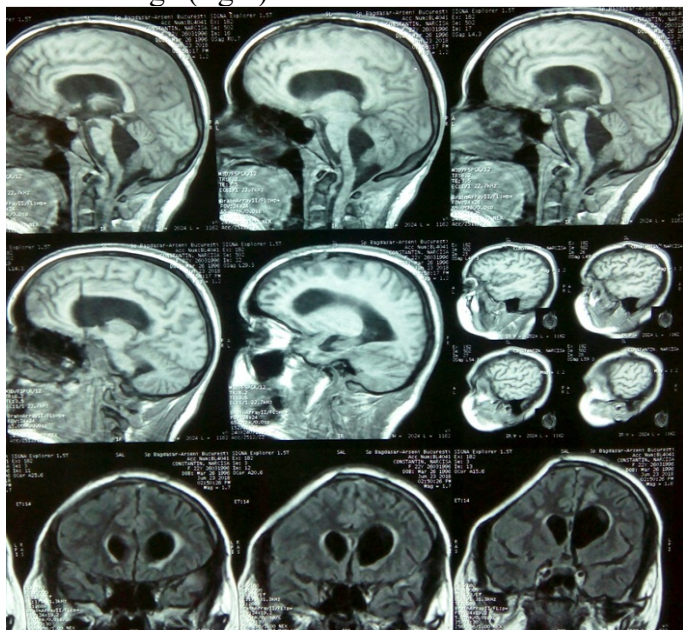


Fig.2 MRI scan. T1- sagittal sections (up) and coronal section (bottom): craniectomy, posttraumatic hydrocephalus, and ventriculoperitoneal shunt.

A synergistic combination of neurotrophic factors and vitamins was associated with systematic passive physiotherapy and joint mobilization with a robotic assistive device.

A total dose of 500 U of Botulinum toxin was safely injected in the left temporalis muscle, and bilaterally in the masseter muscle. Passive and active opening of the mouth remained severely disabled after toxin administration. Neither PMR nor the clinical variant of the rooting reflex was clinically influenced by the spasmolytic agent.

Neurologic status remained stationary after two months of rehabilitative nursing program. The subject was discharged with indications to be fed by the gastrostomy tube. *Ad functionem* outcome remained poor, and *ad vitam* prognosis uncertain.

Discussion

Pathological reappearance of the archaic palmo-mental and rooting reflexes, re-emerged in a young woman with significant bilateral brain dysfunction is, to our best of knowledge, a unique, unedited aspect. This clinical case reflects the severe cortical inhibitory pathway disruptions and imbalance of the excitatory and inhibitory influences on the facial motor neurons, respectively on the trigemino-facial interconnected neuronal circuits.(5,6)

Gheorge Marinescu was one of the most remarkable neuroscientists of the last century, founder of the Romanian school of neurology. He realized the first scientific application of cinematography in medicine (1898-1901), and described the palm-chin reflex, useful in clinical roundsmanship, as a sensitive marker for severe neurological impairments.(2,5-8)

The polysynaptic PMR is served by neuronal circuits extending from the lower cervical spinal cord to the facial motor nucleus localized in the lower pons. (4,6) Its afferent sensitive pathway is represented by the median nerve and conducted through C6-C7 roots of the cervical plexus. The complex volley of intrasegmental impulses reaches facial motor nuclei either through short-(paucisynaptic) or long-loop (thalamocortical) circuits.(4) The efferent pathway involves the motor nuclei and branches of the facial nerve.

In normal adulthood conditions PMR is highly suppressed (as other local reflexes) by suprasegmental control. Habituation (extinction of the muscular response) is more frequent in healthy controls than in other different patients groups, and represents the most important clinical discriminating

aspect between the physiological or pathological reflex.(4,8)

The exaggerated stimulus response, on occasion differing on each side, under routine stimulus is pathologic.(2,5-8) Strong, sustained, easily repeatable contractions of the mentalis muscles, elicited by mechanical or electrical stimulation of a much wider receptive area (other than the palm) indicate cerebral (especially frontal lobe) damage.(2,5-8)

The lockjaw has “mitigated” the stereotype clinical pattern of the archaic trigemino-facial rooting reflex (reveled in newborn baby). Botulinum toxin had no effect on the inexhaustible, easily repeatable twitching of the mentalis muscle, or on the possibility for either passive or active opening of the mouth.

The association of these two archaic reflexes brings a supplementary clinical argument to reinforce the supposition that PMR is co-occurring in the general feeding behaviour, rather than being only a primitive reflex involving the mentalis muscle.(9) In newborn baby palmomental and rooting reflexes might represent “pieces of puzzle” in the complex interaction between the hand and mouth, integrated in the concept of grabbing, bringing the nutrient to the mouth, mouth opening, chewing and swallowing. Neural circuits located within the brainstem and spinal cord provide the morphological and functional substrate for transmitting and coordinating sensory inputs to motor outputs, responsible for orofacial behaviors.

Feeding, driven by central circuits (pattern generators), implies coordinated activity of multiple groups of motoneurons that control jaw-tongue-facial muscle targets. These vital behaviors are based on complex neuronal circuits with several interneurons, but also on simple functional reflex circuitry, with only three to four neurons.(10)

The classical somatotopic and laminar organization of the afferents from the peripheral orofacial receptive fields corresponds to a somatotopic map in the trigeminocervical complex, situated in the medullary and lamina V of the upper cervical dorsal horn. This topographic region is essential for the orofacial behaviors, because it appropriately links to the facial motor nuclei, and corresponds to their musculotopy pattern.

Compliance with Ethical Standards

The author discloses any potential conflicts of interest.

Written informed consent has been obtained from the patient's next of kin (mother) to the inclusion of material pertaining to the case.

Institutional consent for publication was obtained from our Hospital Ethic Commission.

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