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Case report

Favorable outcomes within a comprehensive therapeutic rehabilitative program in a complex case of severe polytrauma

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ABSTRACT: A polytrauma patient after a car accident represents a challenge for the health care system due to the multiple traumatic injuries, at least one of them potentially being life threatening. Many of these injuries require intense nursing and rehabilitation treatment, because some of them can cause permanent disability, affecting the patient's future quality of life. **Materials and methods**: With the permission of the THEBA Ethics Committee (no *24389 / 28.06.2021*), this paper presents a case of a 37-year-old patient with a severe polytrauma due to a car accident (driver), occurred on October 18, 2020. The patient was hospitalized in the Intensive Care Unit of the Emergency County Hospital of Targoviste, in a severe condition, being orotracheal intubated and having a thoracic polytrauma (multiple bilateral costal fractures, anterior-superior flail chest with acute respiratory failure) and mandible fracture. After clinical and hemodynamic stabilization, he was transferred to Bucharest Emergency University Hospital and after specific paraclinical investigations, he was surgically treated with thoracic fixation with metal plates, sternal fixation with plate and screws, thoraco-abdominal skin grafting and mandibular stabilization. Afterwards he was transferred to THEBA at the Plastic Surgery Clinic Department for lumbar-sacral pressure sore, where he suffered multiple surgical interventions. In our Neuromuscular Rehabilitation Department, the patient was admitted in 16.02.2021 with pain and severe functional impairments in the right elbow and the right knee, surgically treated sacral pressure sore still in the process of healing and having a severe deficiency of self-care and locomotion. He initially followed a rehabilitative nursing program and continued with a recovery therapy according to clinical stages. The patient was functionally assessed using the following scales: Medical Research Council (MRC) Scale for Muscle Strength, Functional Independence Measure (FIM), Life Quality Assessment (QOL), FAC International Scale and Independence Assessment Scale in Daily Activities (ADL/IADL). **Results:** Although the patient's evolution was slow, he had favourable outcomes with an increase in the scores of the evaluated scales at discharge. He benefited from a specific surgical care of the pressure sores and a complex neuro-muscular rehabilitative program. The patient's final performance in our clinic was walking on medium distances with support from another person. **Conclusion:** The multidisciplinary team approach with the addition of complex nursing measures and a personalized rehabilitative program for a young patient with polytrauma caused by a car accident established neuro-locomotor improvements which led to an increase in patient's quality of life.

Keywords: *neuro-muscular rehabilitation, polytrauma*

INTRODUCTION

Trauma is still one of the most significant causes of death worldwide, killing approximately 16,000 people every day (1) and it continues to be one of the main causes of death in the population between 10 and 40 years of age (2). A polytrauma patient after a car accident represents a challenge for the health care system due to the multiple traumatic injuries, at least one of them potentially being life threatening.

The musculoskeletal injuries are common in this pathological context and the flail chest represents a severe condition with high risk of mortality and morbidity. The most common injuries associated with the flail chest are pneumothorax, hemothorax and pulmonary contusion (3). Multiply fractured ribs or flail chest can significantly compromise respiratory function (4). In accordance with other studies only 10% of polytrauma patients requires surgical treatment for their chest injuries due to unsuccessful non-operative treatment such as non-resolving pneumothorax despite thoracic drainage (3), (5). An indication for surgery is represented by the flail chest with paradoxical movement and/or the need for positive pressure ventilation for more than 48 hours (6), (7), (8).

After a complex surgical treatment of a car crash polytrauma, we face multilevel patient problems, from algodisfunctional to psychological consequences, which are very difficult to manage. The algodisfunctional status and psychological impact of a survivor from a car accident typically includes pain, pain related insomnia, post-traumatic stress disorder (PTSD), post-concussion and whiplash syndrome, depression, generalized anxiety, and driving anxiety (9), (10).

A frequent complication of prolonged immobilization in bed is represented by the appearance of pressure sores. They are usually found over bony prominences subjected to external pressure greater than capillary pressure for prolonged periods (prolonged pressure greater than capillary pressure of 32 mm Hg can result in ischemia of underlying tissues) (11). Complications of grade 3 and 4 pressure sores can be life threatening, infection being the most common problem (which can latter result in periostitis, sinus formation, osteomyelitis, and septic arthritis) (11).

CASE REPORT

History data

This paper presents a case of a 37-year-old patient with a severe polytrauma due to a car accident (driver), occurred on October 18, 2020, when he was hospitalized in the Intensive Care Unit of the Emergency County Hospital of Targoviste, in a severe condition, including a mild traumatic brain injury (TBI) with a Glasgow Coma score = 15 points, being also orotracheal intubated. The patient presented a severe thoracic polytraumatism (multiple bilateral costal fractures, anterior-superior flail chest with acute respiratory failure) and mandible fracture. After clinical and hemodynamic stabilization, he was transferred to Bucharest Emergency University Hospital where he was surgically treated for thoracic trauma with fixation with metal plates, sternal fixation with plate and screws, thoracoabdominal skin grafting and mandibular stabilization. During this hospitalization, the patient becomes infected with SARS-COV-2 virus. After infection, a right pleural effusion persisted in small quantities for about 4 months. Afterwards, in 18th December 2020, he was transferred to THEBA at the Plastic Surgery Clinic Department for 4th degree lumbar-sacral pressure sore, where he suffered multiple surgical interventions with skin grafts harvested from the thighs. He also suffered surgical intervention for left calcaneal pressure sore.

Patient's evaluation

In our Neuro-Muscular Clinic Division, the patient was admitted in 16th February 2021 with: pain and severe functional impairments in the right elbow and the right knee, surgically treated 4th grade sacral pressure sore (still in the healing process) and a severe deficiency of self-care and locomotion. He was in a good general state, conscious, alert, cooperative, temporal-spatial oriented, underweight (BMI = 22,6 kg/m^2), with a depressive figure. He presented with a 4th degree sacral pressure sore, surgically treated, still in the healing process with a 5/5 cm de-epithelized zone and a 1st degree bilateral calcaneal pressure sore, in the process of healing.

The patient also presented with numerous postoperative scars on the anterior and posterior thorax, with lack of skin substance on the sternal area, post flap harvesting scars on the right and left thigh (figure 1), mandibular postoperative scar, post traumatic partial edentate and an occipital plague in the process of healing.

The patient was functionally assessed using the following scales: Medical Research Council (MRC) Scale for Muscle Strength, Functional Independence Measure (FIM), Life Quality Assessment (QOL), FAC International Scale and Independence Assessment Scale in Daily Activities (ADL/IADL).

He was oriented temporal-spatially, with no signs of meningeal irritation, no sensory loss, with decreased osteotendinous reflexes on the left side, untestable osteotendinous reflexes on the right side, pain and severe functional impairments in the right elbow and the right knee. Right elbow: severe joint stiffness, locked in extension (possible periarticular calcifications), flexion impossible (0°). Right knee: mobility limitation for flexion (maximum passive flexion at 60°) with severe joint stiffness (after prolonged bed rest). The patient presented on the MRC assessment diminished motor force in the upper limbs (left side: C5 = 4/5, C6 = 4/5, C7 = 4/5, C8 = 4/5, T1 = 3/5 and right side: C5 = untestable, C6 = 4/5, C7 = 3/5, C8= 4/5, T1 = 3/5).

From functional point of view the patient was immobilized in bed but with indication of mobilization. During hospitalization, the patient has been positioned on anti-pressure sore mattress.

Figure 1 - Clinical evaluation (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Paraclinical assessments

Paraclinical blood exam emphasized: hypertriglyceridemia, mild anemia normochromic, normocytic and moderate inflammatory biological syndrome.

For a complete evaluation of the patient, were made several radiography, including chest radiography, right elbow and right knee radiography.

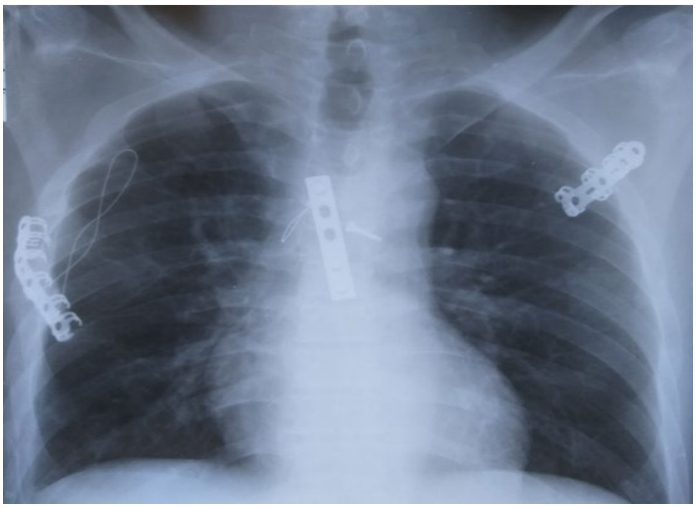

Figure 2 - Chest radiography (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Figure 3 - Right elbow radiography

Figure 4 - Right knee radiography

(Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

The chest radiography (figure 2) detected the postoperative status of the patient, without pneumothorax, without evolutionary lesions in the lung parenchyma. Following the investigation, a screw in the mediastinum was observed (a possible life threatening complication), reason why a thoracic surgery consultation was requested. At the indication of the thoracic surgeon, a thoracic computed tomography (CT) scan was performed, which detected a mediastinal foreign body. However, this mediastinal screw did not present a risk of migration. Therefore the sternal osteosynthesis material might be extracted after a month.

The right elbow radiography (figure 3) and right knee radiography (figure 4) showed demineralization of radiographed bone segments, multiple intra-articular calcifications, without fracture trajectories visible on radiography.

Given the severe joint stiffness and pain in the right elbow, an orthopedic consultation was requested in order to establish the therapeutic behavior. Following the orthopedic consultation, the orthopedic doctor recommended performing a CT scan of the right elbow with subsequent reassessment and physiotherapy. The right elbow CT scan detected a vicious callus present between the medial epicondyle of the humeral palette and the proximal ulnar epiphysis with articular interest in the lateral portion. Subsequently the orthopedic recommendations were: physiotherapy and orthopedic reassessment for surgical treatment for elbow centrolysis with ablation of the right elbow ossifications.

During hospitalization the patient was also evaluated several times by the plastic surgeon. The granular wound in the sacral region was in the process of epithelialization, with favorable evolution. Recommendations from the plastic surgeon were to avoid prolonged dorsal decubitus on the pressure sore area (60 minutes), local toilet with antiseptic solutions and sterile dressing with microdacyn, alternatively with rifampicin.

The rehabilitation program

During hospitalization, the patient received complex drug treatment with: injectable anticoagulant for preventing pulmonary embolism (PE) and deep vein thrombosis (DVT) and when he began mobilization at the physiotherapy room he began the anti-aggregation therapy, hydro electrolytic parenteral hydration, analgesics, NSAID, gastric protector, neurotrophic, vitamins. Following the repeated consultations of plastic surgery and the received recommendations, the patient's sacral pressure sore and scars from the anterior thorax and from the both thighs were tended with antiseptic solutions, Sinerdol and sterile dressings.

The kinetic objectives were as follows: general relaxation, correction of posture and body alignment, increasing joint mobility, increasing muscle strength and endurance, re-education of coordination and balance, exercise training (12),(13).

The patient's personalized program consisted of:

- correct positioning in bed for prevention of vicious joints positions or thrombophlebitis or forming new pressure sores, with protection for the existing ones;
- initially only in bed – passive, then passive-active and finally active movements at the joints level;
- muscle toning on the upper and lower body in order to perform walking and daily living activities;
- progressive mobilization, initially at the edge of the bed then in the wheelchair with the protection of the sacred area, subsequently re-education of walking at the physiotherapy room (see below the stages);
- for the right elbow stiffness – muscle stretching, passive – active and active movements in order to increase joint mobility and to improve the flexion movement of the forearm on the arm (flexion impossible at this level on the admission);
- for the right knee stiffness - muscle stretching, passive – active and active movements in order to increase joint mobility and to improve the flexion movement of the calf on the thigh.

At the physiotherapy room, the patient performed exercises at Moto Med bicycle, exercises on roller device, exercises on pedal exerciser, orthostatic lifting at the trellis, exercises with wooden stick, walking through parallel bars first with an important help from the kinesiotherapist, walking with forearm crutches for short distances and finally he performed walking for short distances (10-20 m) without support, only supervised from the kinesiotherapist (figure 5).

Figure 5 - The patient performing walking on short distance supervised from the kinesiotherapists (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Figure 6 – Diapulse (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Figure 7 – LASER (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Figure 8 – Shockwave therapy (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

Figure 9 - Deep oscillation (Neuro-Rehabilitation Clinic Division of the THEBA, casuistry)

The patient also followed 10 sessions of each physiotherapy procedure:

- *Diapulse* for the right elbow (figure 6): emitter treating zone distance=1.5 cm, TF=400 impulses/second, TP=4, 10 minutes;
- *LASER* for the right elbow (figure 7): 3 points, 4 J/cm² dose, 10 Hz frequency, 125 mW power;
- *Shockwave therapy* for the right elbow (figure 8): continues mode, 10 Hz frequency, 2,5 Barr pressure, 2000 shocks, 4 minutes;
- *Deep oscillation* for the right elbow (figure 9): 100 Hz frequency, impulse duration: pause duration = 1:1, 10 minutes.

Results

The patient benefited from a specific surgical care of the pressure sores and a complex neuro-muscular rehabilitative program. Biological, inflammatory syndrome and the normocytic normochromic anemia have improved. Following the physiotherapy and kinesiotherapy sessions, the patient's joint stiffness slightly improved and he also reported a good relief of pain. He also benefited, after the complex rehabilitation program, of an improvement of both pronation and supination movements, making them possible on the upper right limb and also a minimal flexion movement was possible on the right elbow at the time of discharge from hospital.

Also, muscular force and articular mobility have improved in all four limbs (table 1).

The patient's evolution was slow, but he had favorable outcomes with an increase in the scores of the evaluated scales at discharge (table 1).

The patient's final performance in our clinic was walking on short distances supervised by another person and on medium distances with support from another person.

The patient also benefited from psychological therapy, his anxiety being reduced, with the improvement of the quality of sleep.

Discussions

In our case the *ad vitam prognosis* is satisfying because of the patient's lack of co-morbidities and because he was surgically treated for his life-threatening conditions, with a good recovery, including the fact that he is not immobilized in bed anymore, being able to take care of himself.

Table 1 Comparison between evaluated scales at admission and discharge

Admission		Discharge
motor subtotal = 27/91 points cognitive subtotal = 35/35 points total = 62/126 points	FIM	motor subtotal = 59/91 points cognitive subtotal = 35/35 points total = 94/126 points
103/112 points	QoL	108/112 points
0 (nonfunctional)	FAC	3 (dependency – supervision)
2 points	ADL	2 points
1/8 points	IADL	5/8 points
left side upper limb: C5 = 4/5, C6 = 4/5, C7 = 4/5, C8 = 4/5, T1 = 3/5; *right side upper limb*: C5 = untestable, C6 = 4/5, C7 = 3/5, C8= 4/5, T1 = 3/5)	MRC	*left side upper limb*: C5 = 5/5, C6 = 5/5, C7 = 4/5, C8 = 4/5, T1 = 3/5; *right side upper limb*: C5 = 2/5, C6 = 4/5, C7 = 3/5, C8= 4/5, T1 = 3/5)

The *ad functionem prognosis* is also satisfying taking into account the patient's good evolution during neuro-rehabilitation program, with the condition he will continue the kinesiotherapy.
The *ad laborum prognosis* is reserved on short term because the patient at the moment has his right arm unable to work (no functional flexion) and his profession is of driver. Ad laborum prognosis can be satisfying on long term, if the patient will have an orthopedic intervention on his elbow for reducing the stiffness and increasing elbow mobility and of course if the patient will be evaluated by the Expertise Commission of Work Capacity with a professional reorientation and reintegration.
An important fact is the future medical control (neuro-rehabilitation, thoracic surgery, plastic surgery, dental surgery), including thoracic CT for the periodic reevaluation of lung function and the appearance of possible complications.
The case particularity is represented by the fact that the patient suffered a severe thoracic polytrauma with: multiple bilateral costal fractures, anterior-superior flail chest with acute respiratory failure and mandible fracture following a road traffic accident. Consequently he occurred some long term immobilization complication: severe stiffness, pressure sores that hinder its evolution. The patient had a life threatening condition – the flail chest, but he had a good evolution after thoracic surgery and also a good evolution after the plastic surgery for 4th grade pressure sore.

Conclusions

The neuro-rehabilitation program was essential for his recovery, helping him to increase his strength and to be able at the outcome to perform walking on short distances, becoming in this way more self-confident, more independent and with an increased autonomy and quality of life. An important factor that has contributed to his favorable evolution, was the fact that the patient was at a young age, with no associated co-morbidities.
Managing pain, somatic dysfunction and posttraumatic stress in a polytrauma case is a complex process that requires a multidisciplinary team, including psychological approach and the possibility of long term rehabilitative programs and social interventions. The multidisciplinary team approach with the addition of complex nursing measures and a personalized rehabilitative program for a young patient with polytrauma caused by a car accident established neuro-locomotor improvements which led to an increase in the patient's quality of life.

Ethics approval and consent to participate This paper has the approval from THEBA Bioethics Committee (no24389/ 28.06.2021). Written informed consent was obtained from the patient.

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