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The importance of early and long-lasting medical rehabilitation in patients with brachial plexus injury

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Abstract

Introduction. Brachial plexus lesions vary in severity, depending on the etiopathogenic mechanism and the level of force to which the plexus is exposed. In the same patient, several nerves of the plexus can be damaged in varying degrees of severity. Brachial plexus injuries lead to upper limb paralysis and disability. **Material and Methods.** We present the case of a 68-year-old woman diagnosed a year ago with multiple myeloma, clavicular plasmacytoma and secondary spontaneous clavicle fracture. At the same time she presented several dislocations of the shoulder and was diagnosed with brachial plexus palsy after the last dislocation. The patient was hospitalized in our department with a large motor deficit in the upper limb. A comprehensive motor rehabilitation program has been established three weeksafter installing the palsy. **Results and discussion.** The evolution of the patient was favorable. It was noticed the reduction of the symptoms and slight improvement in motor deficit of the affected upper limb. Thepatient rehabilitation should continue for several months because the nerve regenerates slowly. **Conclusion.** In patients with brachial plexus injury, motor rehabilitation should be instituted as early as possible and continued for a longer periodoftime until nerve regeneration occurs.It results that early and continuous medical rehabilitation is essential in patients with brachial plexus injury.

Keywords: *Brachial plexus injury, shoulder dislocation, rehabilitation,*

Introduction

Brachial plexus injury can occur through several mechanismsis such as stretching, pressure, or cutting. Incomplete or complete paralysis of the upper limb results depending on the severity of the injury (1,2). The disability occurredwill affect the quality of life of these patients. Regarding the causes of this condition, the most common is traffic accidents, especially motorcycle accidents.In thesecases the most of the
victims being young males. Other traumatic causes are worth mentioning: accidents at work, sports injuries, incised wounds, gunshot wounds, carrying a heavy rucksack and patient malpositioning during surgery. The tumors, irradiation, and congenital abnormalities such as cervical ribscan be nontraumatic causes of brachial plexus injury (3,4,5). Shoulder dislocation is a common pathology with an annual incidence of 23.9/100000 of which 85-98% are anterior dislocations. The peak incidence is in young males; however, in women, the peak age of incidence is 61-80 years (6). Nerve injuries resulting from shoulder dislocation occur rarely (13,5%) but they associate a high risk of persistent compromise of limb function (7). Neurologic injuries seccondary to this condition are characterised mainly by neurapraxia and rarer axonotmesis (8). The three major mechanism of brachial plexus injury are traction of neural structures by the humeral head, compression of the brachial plexus exerted by the humeral head or nerve compression by haematoma and fibrous tissue (8). Clinical assessments, electrophysiologic examinationsand imaging studies (standard myelography, computed tomographic myelography, and magnetic resonance imaging) are used for evaluation of the brachial plexus (5,9). The pathological condition and the location of the lesion guide the therapeutic measures. The treatment of this disease is either conservative or surgical (5,9).

Objective

The goal is to demonstrate the need and importance of early and long-lasting medical rehabilitation in brachial plexus palsy.

Material and methods

We present a case of brachial plexus injury that was hospitalized and treated in our Physical Medicine and Rehabilitation department for two weeks. The case presented is that of a 68-year-old woman from the urban environment. She was admitted in our department for pain and functional deficit in the right shoulder and also a significant motor deficit in the right upper limb. One year ago, our patient was diagnosed with Multiple Myeloma which was treated with chemotherapy and stem cell transplantation. Multiple myeloma was discovered

following a spontaneous clavicle fracture on the pathological bone in the context of this disease (clavicular plasmacytoma). It should be noted that the patient had several recurrent shoulder dislocations for which she was immobilized in the Dessault bandage. For the last dislocation of the shoulder, surgery was performed by fixing the humeral head with two Kirschner brooches. Our patient states that the motor deficit in the right upper limb appeared after thelast shoulder dislocation.She presented for admission three weeks after the onset of paralysis. Diffuse osteoporosis and dyslipidemia are also noted in the patient's personal pathological history. Physical examination revealed: right scapular girdle muscle hypotrophy; right shoulder inferiorsubluxated 1 centimeter, with pain and stiffness on mobilization; "fallen" right hand, with the appearance of a "swan neck"; significant motor deficit in the right upper limb. Evaluation of the muscle strength using the Medical Research Council scale (MRC) highlightedmotor deficit in:shoulder flexor and abductor muscles (value 1/5 MRC); elbow extensors (value 1/5 MRC) and flexors (value +3/5 MRC);fist extension (value 1/5 MRC);metacarpophalangeal extension of the fingers (value -2/5 MRC); hand supination (value 1/5 MRC); thumb abduction (value 1/5 on the MRC); finger flexion (value +3/5 MRC). Examination of deep tendon reflexes shows abolished tricipital reflex and diminished stiloradial reflex.Superficial hypoesthesia in the right C7 root territory was found.

Functional evaluation reveals: the visual analog scale (VAS) for pain intensity index = 8, the activities of daily living scale (ADL) index=7(assisted independence). The instrumental activities of daily living scale (IADL) index = 5/8 and the quality of life scale (QoL) index =70, proving a moderate impairment of quality of life.

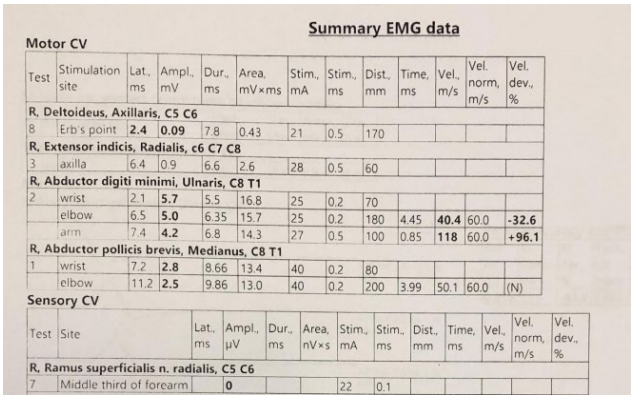
The results of radiological examinations performed pre and postoperatively at the last shoulder dislocation are presented below (Fig 1, Fig 2, Fig 3).

Fig 1. Inferior subluxation of the right scapulohumeral joint and clavicle fracture with pseudarthrosis, diffuse bone demineralization

Fig 2. The condition of the joint after stabilizing the subluxation of the shoulder with 2 Kirschnerbrooches

Fig 3. Reduction of dislocation in the control radiography.

Electrodiagnostic studies reveals severe axonal degeneration of the right radial and axillary nerves (Fig 4).



Summary EMG data

Motor CV

Test	Stimulation site	Lat., ms	Ampl., mV	Dur., ms	Area, mV×ms	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s	Vel. norm, m/s	Vel. dev., %
R, Deltoideus, Axillaris, C5 C6												
8	Erb's point	**2.4**	**0.09**	7.8	0.43	21	0.5	170				
R, Extensor indicis, Radialis, c6 C7 C8												
3	axilla	6.4	0.9	6.6	2.6	28	0.5	60				
R, Abductor digiti minimi, Ulnaris, C8 T1												
2	wrist	2.1	**5.7**	5.5	16.8	25	0.2	70				
	elbow	6.5	**5.0**	6.35	15.7	25	0.2	180	4.45	**40.4**	60.0	**-32.6**
	arm	7.4	**4.2**	6.8	14.3	27	0.5	100	0.85	**118**	60.0	**+96.1**
R, Abductor pollicis brevis, Medianus, C8 T1												
1	wrist	7.2	**2.8**	8.66	13.4	40	0.2	80				
	elbow	11.2	**2.5**	9.86	13.0	40	0.2	200	3.99	50.1	60.0	(N)

Sensory CV

Test	Site	Lat., ms	Ampl., µV	Dur., ms	Area, nV×s	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s	Vel. norm, m/s	Vel. dev., %
R, Ramus superficialis n. radialis, C5 C6												
7	Middle third of forearm		**0**			22	0.1					

Fig4. Impairment on electromyography of the right radial and axillary nerve.

Results

The objectives of the rehabilitation program in this case are: pain relief, maintaining/restoring the mobility of the joints, maintaining muscle trophicityand preventing the atrophy of the denervated muscles, prevention and treatment of vasculotrophic phenomena, motor and sensitive rehabilitation of the affected upper limb,training of ADLs, increase in bone mineral density.

In our department, the patient followed pharmacological treatment consisted of analgesics, neurotrophic drugs and antiosteoporotic drugs/bone-strengthening drugs. The medical rehabilitation program was applied twice a day and consisted in analgesic electrotherapy, electrical stimulationon the denervated muscle groups, kinetotherapy, mirror therapy, occupational therapy. It was also used orthosis for fist and fingers posture of the right hand. The patient was also recommended to wear a scarf to avoid subluxation of the humeral head with ligamento-capsular distension.It should be mentioned that the motor rehabilitation was not initiated until three weeks after the installation of the motor deficit. The evolution of the patient was favorable regarding the improvement of the symptoms (admission index= 8 / discharge index= 4 on the visual analogue scale). But the evaluation of the muscle strength at discharge shows aslightimprovement of the motor deficit of the affected upper limb.This fact can be attributed to slow nerve regenerationand to the late presentation in our servicethree weeks after the installation of motor deficit.

Discussion.

In our case the injury of the brachial plexus was determined by the clavicle fracture complicated with pseudarthrosis and recurrent dislocations of the shoulder.In this situation, several possible mechanisms can be discussed: stretching of the brachial plexus by recurrent shoulder dislocation or compression exerted by the humeral head. Our patient would have needed magnetic resonance imaging, this investigation being valuable in the evaluation of the brachial plexus (10).

The results of several clinical studies have shown that in addition to the deficiency of sex hormones, dyslipidemia promotes the development of osteoporosis in both women and men (11,12). In our patient menopause and dyslipidemia can be considered predisposing factors for osteoporosis. In this case neglected osteoporosis can adversely affect the evolution of the clavicular fracture and can cause other fractures. Instead antiosteoporotic treatment with bisphosphonates can lead to a favorable evolution of the case.

Furthermore the patient's advanced age represent an additional risk factor. According to the specialized literature one of the major risk factors for neurologic complications of shoulder dislocation is considered to be the age above 50 years old (8). The risk of nerve deficit secondary to shoulder dislocation is higher in case of low-energy trauma as shown in some studies (7,8). In reference to our patient, the dislocation occurred in the absence of any significant trauma. Regarding the affected nerves, studies have shown that the axillary nerve is the most commonly one to be injured in scapulohumeral dislocation (with a 100% rate in some studies). In addition, multiple nerve injuries were more often than mononeuropathy. Complex neurologic deficits were found in association with older age, female sex and low-energy trauma (7). In our case, the electrodiagnostic studies examination performed on the 68 years old female patient showed multiple nerves injuries including the axillary nerve.

A study stated that the majority of neural complications have been observed after the first time than after recurrent scapulohumeral dislocations (13). On the contrary, our female patient presented motor deficit after a recurrent shoulder dislocation.

The main goals in the rehabilitation of brahial plexus injury are pain supression, recovery of somato-sensory deficits, prevention of muscle atrophy, prevention of secondary deformities. Neuropathic pain can be an obstacle in the recovery of patients with this condition. Pharmacotherapy is frequently used to control neurological pain. International guidelines recommend as a first line treatment anticonvulsants such as gabapentin or pregabalin and tricyclic antidepressants. Our patient received 600 milligrams of gabapentin per day. In case of postganglionic lesions or when some fibers are preserved, Transcutaneous electrical nerve stimulation (TENS) can be used as analgesic therapy (14). Kinetic exercises helps restoring the deficits caused by the disease. Passive muscle stretching and electrostimulation of the denervated muscles are useful in preventing or limiting the development of muscle atrophy (14). These means were applied to our patient.

Medical rehabilitation has a very important role in the management of brachial plexus injury and should be started as early as possible after installing the motor

deficit to prevent irreversible tissue changes such as muscle atrophy (15). Alsomotor rehabilitation requires longer time due to slow nerve regenerationat a rate of approximately 1-3 mm/day. Mirror therapy is an important rehabilitation treatment method. It is very efficient in the neurological fields and also in hand rehabilitation. The brain can be trained to relearn some movements through the help of the mirror. The general method of practicing this therapy initially involves explaining it to the patient and his/her agreement on it. The patient sits at a table with his/her hands on it. It is important that the hands do not have clothes or jewelry on. In front of him, on the table, is placed a mirror across the midline of his/her body. In front of the mirror the patient places the hand without motor deficit and behind the mirror he/she puts the hand with motor deficit. The patient's attention and visual axis are concentrated in front of the mirror to the movements of the healthy hand. This induces an optical illusion and the patient has the impression that he/she performs those movements with the motor deficit hand, so the brain transmits signals to the affected hand and can initiate those movements. Mirror therapy should be stopped immediately if the pain increases on the injured side (16). Our patient performed this type of revolutionary therapy achieving good results.

In our patient, medical rehabilitation played a very important role not only in regard to the neuromotor outcome, but also in some psychological aspects. A study from 2018 relates that brachial plexus injury can significantly influence psychological well-being, resulting in conditions such as posttraumatic stress disorder, depression whichfurther interfere with the physical rehabilitation outcome (17). However, our patient stated that she felt progress after the first few medical rehabilitation treatment sessions which improved her motivation, treatment engagement and the neuromotor outcome.

Conclusions

The peculiarity of the presented case is that the brachial plexus palsy occurred as a result of a recurrent dislocation of the shoulder and a spontaneous clavicular fracture on the background of a monoclonal gammopathy and clavicular plasmacytoma. Motor rehabilitation followed by the patient led to a slight improvement in motor deficit butits continuation is necessary to achieve optimal results.

It can be concluded that brachial plexus injury requires early, sustained, and long-lasting motor rehabilitation.

Conflict of interest

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

Informed consent

In this article was included an informed consent that was obtained from the patient.

References:

1. YoshikawaT,Hayashi N, Yamamoto S, Tajiri Y, Yoshioka N, MasumotoT, OhtomoK.Brachial Plexus Injury: Clinical Manifestations, Conventional Imaging Findings, and the Latest Imaging Techniques. RadioGraphics.2006; 26(1),S133–S143.
2. BonhamC, GreavesI. Brachial plexus injuries. Trauma. 2011;13(4), 353–363.
3. Rankine JJ. Adult traumatic brachial plexus injury. Clinical Radiology. 2004;59(9), 767–774.
4. Mansukhani K.Electrodiagnosis in traumatic brachial plexus injury. Annals of Indian Academy of Neurology. 2013; 16(1), 19.
5. Moran SL, SteinmannSP, Shin AY. Adult brachial plexus injuries: mechanism, patterns of injury, and physical diagnosis. Hand Clinics. 2005; 21(1), 13–24.
6. Sharon RW. What is the prevalence of shoulderdislocation.Medscape. 2018; 10(1), 112-115.
7. Robinson CM, Shur N, Sharpe T, Ray A, Murray IR. Injuries associated with traumatic anterior glenohumeral dislocations.The Journal of Bone and Joint Surgery. 2012; 94(1), 18-26.
8. Gutkowska O, Martynkiewicz J, Stępniewski M,GoskJ. Analysis of Patient-Dependent and Trauma-Dependent Risk Factors for Persistent Brachial Plexus Injury after Shoulder Dislocation. BioMed Research International. 2018;1(1), 1–8.
9. Thatte M, Babhulkar S, Hiremath A. Brachial plexus injury in adults: Diagnosis and surgical treatment strategies. Annals of Indian Academy of Neurology. 2013; 16(1), 26.
10. Petit-Lacour MC, DucreuxD, Adams D. IRM du plexus brachial. Journal of Neuroradiology. 2004; 31(3), 198–206.
11. Popa FL, Stanciu M, Bighea A, Berteanu M, Totoianu IG, Rotaru M. Decreased serum levels of sex steroids associated with osteoporosis in a group of Romanian male patients. Rev Romana Med Lab. 2016;24(1):75-82; ISSN online: 2284-5623; ISSN-L: 1841-6624.
12. Popa FL, Stanciu M, Banciu A,Berteanu M. Association between low bone mineral density, metabolic syndrome and sexsteroids deficiency in men.ActaEndocrinologica.2016; ISSN: 1841-0987, 12(4):418-422.
13. McLaughlin HL,MacLellan DI. Recurrent anterior dislocation of the shoulder. II. A comparative study. The Journal of Trauma: Injury, Infection, and Critical Care. 1967; 7(2), 191-201.
14. Smania N, Berto G, La Marchina E, Melotti C, Midiri A, Roncari L, NenoriniA, Ianes P, Picelli A, Waldner A, Faccioli S, Gandolfi M. Rehabilitation of brachial plexus injury in adults and children.Eur J Phis Rehabil Med. 2012; 48, 483-506.
15. ArzilloS, Gishen K, Askari M. Brachial Plexus Injury. Journal of Craniofacial Surgery. 2014; 25(4), 1200–1206.
16. Grünert-PlüssN, Hufschmid U, Santschi L, GrünertJ. Mirror Therapy in Hand Rehabilitation: A Review of the Literature, the St Gallen Protocol for Mirror Therapy and Evaluation of a Case Series of 52 Patients. The British Journal of Hand Therapy. 2008; 13(1), 4–11.
17. LandersZA,JethanandaniR, Lee SK, Mancuso CA, SeehausM, WolfeSW. The Psychological Impact of Adult Traumatic Brachial Plexus Injury. The Journal of Hand Surgery.2018; 1(1), 13-18.