Rehabilitation of traumatic lesion of the brachial plexus: A case report.

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ABSTRACT

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| **Aims:** Most brachial plexus lesions are traumatic etiology, compromise the function of the upper limb and are often accompanied by neuropathic pain. In most cases, surgery is the best treatment; however, the recovery time is around two years, or it may not be a complete recovery. It is difficult to determine the location, extension and severity by physical examination, so electro physiology studies are required for diagnosis. Electromyography is important and must be performed carefully especially in muscles that are clinical weakness. **Sample and study design:** Report of a case.  **Description of case:** This is the case of a 54-year-old female patient, who was received in the emergency room, with a luxation of the right shoulder by a car accident. After three attempts, the dislocation was reduced. The patient was referred to rehabilitation where a probable lesion for right brachial plexus elongation was detected. The patient received 5 months of rehabilitation treatment with functional electrotherapy, sensory stimulation and use of antioxidant medications, neuromodulators and disodium monofostate cytidine. An electromyography was conducted before and after the rehabilitation treatment which suggested an improvement for patient recovery.  **Conclusion:** This case is an example that some lesions of brachial plexus can be management without surgery. |

*Keywords: Brachial plexus, plexopathy, electromyography, electrotherapy, case report*

1. INTRODUCTION

The brachial plexus is located in the neck. It comes from spinal roots C5, C6, C7, C8 and T1. It is responsible for the sensitivity and movement of the upper limb of the corresponding side. Most of the brachial plexus lesion (BPL) is due to trauma. In Mexico City, the BPL frequency is around 80% for young men, more than 50% is due to motorcycle accidents and about 17% is for acute knife injuries. BPL is often accompanied by other serious traumas [1]. The early diagnosis is essential for the patient to recover successfully. Unfortunately, the diagnosis may take several months and might cause permanent and disabled sequelae [1-3]. BPL is diagnosed by neurophysiological tests, nerve conduction studies, magnetic resonance imaging, electromyography and computerized tomography myelography, which are not available in all hospitals in Mexico or are not done in a proper time [4-6].

In addition to the late diagnosis, rehabilitation is usually initiated after a few months and is performed by physiotherapy professionals and not by rehabilitation doctors. Physiotherapy professionals might not have enough experience or necessary training to address brachial plexus injuries [7-10].

Electrotherapy options in physical rehabilitation have been used since the 60’s in vascular events, multiple sclerosis, neuropathies, and myopathies. These treatments provide functional improvement and reduce muscular limitations, nonetheless there is little known about the used-on BPLs [10-12].

Functional electrotherapy (FE) uses low-energy electrical pulses generating artificial muscle contractions on a paralyzed or week muscle [10-13]. As with other electrotherapy options, it has been used for more than six decades in patients, for instance, with cerebral vascular scars, who have spastic hemiparesis effect, patients with multiple sclerosis, who have mobility alterations in lower limbs, or patients with hybrid orthosis who use braces or other devices to align the ankle joint-foot. It discharges electrodes on the anterior fibula or tibia muscles to improve the march. During the application, patients are taught to perform activities that help to recover the movements; for example, up and down, opening and closing a bottle, and trying to draw a line on a sheet [8].

The use of medications in BPL is little known, as well as the time to begin the administration of them is variable [14-18]. Thioctic acid (TA) and resveratrol [16-17], with their antioxidant properties, limit damage to the injured area by decreasing oxygen free radicals. Both medicines have been used for neuropathic pain in diabetic patients. In conditions of extensive damage, they act as a powerful antioxidant that limits damage to the affected tissue [14-16].

The Citidin-5-Monophosphate (CMP) and Uridin-5'-TrifofofoStus (UTP) are complex lipids which form part of the neuronal membrane, especially the sphingomyelin. CPM and UTP are precursors to fundamental nucleic acids in protein synthesis. The UTP acts as co-enzyme in synthesis of the glycolipids of neuronal structures and myelin sheath, completing the action of the CMP. UTP supplies energy for the muscle contraction process. CMP and UTP, together, allow the regeneration of the myelin sheath, the restoration of the correct conduction of the nerve impulse, and the restoration of muscle trophism. This treatment increases the density or diameter of the nerve fiber. Furthermore, it increases the speed of axonal flow helping the recovering of the nerve conduction impulse [17]. It is used in neuropathic pain, which is one of the most frequent symptoms in BPLs. In this case, it is convenient the use of neuromodulators, such as pregabalin [18].

The objective was to describe a case, how she arrived at hospital, how was diagnosed and how was treated.

2. DESCRIPTION OF CASE

A 54 -year -old female, Hispanic patient, without medical relevant history, enters an emergency service after a car accident with right shoulder dislocation. Three reduction attempts are performed by personnel from the emergency area, without intervention of the traumatology and orthopedics service. After the reduction is placed with a sling and refers to be evaluated on traumatology and rehabilitation services for monitoring. She receives the first evaluation in rehabilitation services on February 18, 2023, clinical data for muscle strength, pain, osteotendinous reflexes and the most representative over time are described in Table 1.

**Table 1. Clinical evaluation at the beginning and its evolution over time**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2023 | Pain EVA | Muscular strength | | | | | | | Reflexes | | |
| Deltoid | Biceps | Triceps | Long supine | Round pronator | Extensor of fingers | Short abductor | Bicipital (C5) | Braquiradial (C6) | Tricipital (C7) |
| February 18 | 10 | 1 | 1+ | 1+ | 1 | 1 | 1 | 1 | - | - | + |
| March 3 | 8 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | + |
| April 14 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | + | + | + |
| May 12 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | + | + | + |
| June 14 | 0 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | + | + | + |

**Source:** Medical record

Before suspecting an injury due to the right brachial plexus elongation, rehabilitation treatment is initiated since time is crucial to prevent the deterioration of plexus [7-8] and electroneuromyography test (EMG) is requested.

Functional Electrotherapy (FE) is applied three times a week for 20 minutes to the brachial plexus muscles in shoulder, forearm and hand. The FE is a constant electrical impulse of low symmetric, mono or biphasic frequency, which is applied with an electrode surface on a paralyzed or weak muscle generating artificial muscle contractions [9]. This has been widely used since the 60s in patients with cerebral vascular event sequels. Also, it is used in patients who have a spastic hemiparesis sequel or in patients with mobility alterations in lower limbs due to multiple sclerosis, especially in the so-called hybrid orthosis where in addition to the splint to align the ankle-to-weight joint. There are electrode discharges on the anterior peroneus or tibial muscle to improve the characteristics of the march. During the application, the patient is taught to perform activities that help her recover the movement; for example, up and down, open and close a bottle, try to draw a line on a sheet [9].

After 20 minutes of electrotherapy with FE, sensory stimulation with contrasting textures is applied in the upward direction of the shoulder using jute fabric, felt fabric and a soft bristle brush for three minutes each texture. After that, an assisted routine of exercises to keep the mobility on shoulder - elbow - wrist - fingers.

Medicaments.

An oral TA pill (600mg) is indicated every 12 hours for 3 months. TA is an antioxidant used in neuropathic pain in diabetic patients. In conditions of extensive damage, TA acts as a powerful antioxidant that limits damage to the affected tissue [11].

The Nuclei CMP forte® is a complex formed by disodium monophosphate cytidin and trisodic tryphyse. It is used to improve the axonal flow speed, and it helps to restore the nerve impulse conduction in muscle trophism [12]. The oral administration is recommended one tablet every 12 hours for three months. Pregabalin is used to relieve neuropathic pain [13], it is oral administered for 8 weeks with a dose of 75 mg every 24 hours.

On February 28, results are received from EMG. The sensory conduction rates and the motor conduction speeds are widely reduced in radial, medium, and ulnar (Table 2) for the axillary nerve and cutaneous muscle. They show prolonged latencies, decreased amplitude. The radial nerve shows diminished amplitude, normal latency and speed. The medium has prolonged latencies amplitude and decreased speed. The ulnar suggests that amplitude decreased, from clavicle to wrist, prolonged latencies decreased speed. The needle test (Table 3) shows the right brachial plexopathic pattern with moderate denervation and active renovation, incomplete recruitment with maximum effort. Three right brachial plexus trunks show severe damage.

**Table 2. Sensitive nerve driving speeds**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2023 | Sensorial | | | |
| February 28 |  | Latency (m/s) | Amplitude ( µV) | Velocity (m/s) |
|  | Radial | 3.8 | 5.1 | 36.8 |
|  | Medium | 5 | 3.3 | 28 |
|  | Cubital | 2.3 | 4.1 | 60.9 |
|  | Radial | 1.93 | 2 | 62 |
| July 30 | Medium | 4.48 | 5.4 | 36 |
|  | Ulnar | 2.71 | 7.9 | 57 |

**Source:** Medical record

**Table 3. Motor conduction speeds**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **February 28, 2023** | | Latency  (N<5 m/s) | Amplitude (N >3 µV) | Velocity (m/s) | **July 30, 2023** | | |  |
| **Axillary** |  | 8.3 | 0.5 | -- |  |  |  |  |
| **Medium** |  | Latency  (N< 4.2 m/s) | Amplitude (N>5µV) | Velocity (N>50 m/s) |  | Latency  (N< 4.2m/s) | Amplitude (N>5 µV ) | Velocity (N>50 m/s) |
| Wrist | 4.8 | 6.3 | 46.2 | Wrist | 3.65 | 5.3 |  |
| Elbow | 8.7 | 6.7 | 40 | Elbow | 7.29 | 4.7 | 49 |
| Axillary | 12.7 | 2.2 | 60 | Arm | 8.33 | 4.7 | 67 |
| Erb | 15.7 | 0.4 | -- | -- | -- | -- | -- |
| **Musculo cutaneous** | Clavicle | 6.3 | 0.6 | -- | -- | -- | -- | -- |
|  |  | Latency  (N< 4 m/s) | Amplitude (N>3 µV ) | Velocity (N>50 m/s) |  |  |  |  |
| **Radial** | 4 cm | 2.3 | 1.4 | 78.9 |  |  |  |  |
| Elbow | 4.2 | 2.3 | 55.6 | Elbow | 3.96 | 4.9 | 74 |
| Above elbow | 6 | 2.1 | 48.9 | Above elbow | 4.64 | 4.5 |  |
| Erb | 9.5. | 0.4 |  |  |  |  |  |
| **Ulnar** |  | Latency  (N< 4.2 m/s) | Amplitude (N>3 µV) | Velocity (N>53 m/s) |  |  |  |  |
| Wrist | 2.5 | 0.9 | 60 | Wrist | 2.66 | 1.9 |  |
| Below elbow | 5.5 | 0.8 | 37 | Below elbow | 7.08 | 1.6 | 41 |
| Above elbow | 8.2 | 0.7 | 34 | Above elbow | 8.44 | 1.5 | 44 |
| Axillary | 12.3 | 0.5 |  |  |  |  |  |

Source: Medical record

On March 3, 2023 (Table 1), the orthopedics clinical evaluation reports neuropathic pain and persistent weakness and the loss of the function in the upper right limb is the conclusion. Electrodiagnostic tests suggest that surgery is required. However, the patient continues in rehabilitation. She does not report any improvement or changes in pain perception during rehabilitation sessions while she is waiting for surgery.

April 14, 2023, the patient reports an improvement (Table 1). On May 14,2023, she has her third orthopedic visit, and her surgery is suspended due to change in clinical conditions. The prognosis is modified due to the good clinical responses.

The FE rehabilitation treatment continues using three pounds of weight and low resistance leagues for progressive strengthening.

As observed, the early starting rehabilitation treatment, in the first four weeks of the lesion which includes active exercises assisted and progressively of strength, sensory stimulation, together with electrotherapy and the administration of antioxidant and regenerating medications of the myelin are effective.

The patient recovers a complete arc, a sufficient muscle force to perform their daily activities and does not present residual pain; therefore, the clinical results observed in this case are positive and show that the start of treatment in the first four weeks is effective. (Detailed instruction about this section is given below. After reading these instructions, please delete this paragraph and begin typing your text here. If you are using copy-paste option then select ‘match destination formatting’ in paste option OR use ‘paste special’ option and select ‘unformatted Unicode text’ option).

**3. DISCUSION**

There are few reports that describe the brachial plexus rehabilitation treatment [8-10] or the use of medicines for it.

Here, we compare this case with a 28-year-old patient report [8] who have a motorcycle accident; he presents complete paralysis of the entire upper limb muscles. Three months after the accident, he began rehabilitation with postural shoulder asymmetry, pectoral retractions, pronator, wrist flexor and fingers of the left hand, Eva pain [10]. Electromyography was performed by finding absence of electrical activity in the evaluated muscles.

He received 12 months of treatment, partial changes in sensitivity were achieved without progress in motor capacity, surgery was required to stabilize the humeral gleno joint and functional positioning of the forearm and hand. The pain decreased to four out of 10 on analogous visual scale (EVA), persisting the difficulty of the execution of upper limb activities.

In this case, the greatest effects of treatment were seen in pain management, in another case [9], the previous traumatic shoulder dislocation of the complicated shoulder is reported with brachial plexus paralysis. The rehabilitation process took approximately one year and the patient was residual in the shoulder.

Compared to our case, the patient began rehabilitation at 18 days after the start of clinical manifestations, presenting improvement in an average of 5 months without the need for surgical treatment. The management was multidisciplinary with trauma and rehabilitation, and it is important that medications began from the first month of the lesion seeking to benefit the recovery process of the affected nerve fiber from the water stage.

**4. CONCLUSION**

The treatment of brachial plexus lesions must be individualized taking into consideration age, cause, time of evolution and severity of the lesion. It is advisable to start rehabilitation as soon as you have clinical suspicious for time data at the acute moment of the lesion due to the Wallerian degeneration process suffered by nerve fibers and that can give us false negatives even with extensive injuries. The electromyography study provides relevant data from week five and must be repeated in an average of six to eight months after the first study with a great prognostic value of the extension and severity of the lesion. It cannot be affirmed that electrotherapy alone provides better results in rehabilitation, but if it is observed that it is effective associated with movements, assisted exercises and the application of sensory stimulation to recover not only the motor part but also the sensitive part of the affected nerves. The best approach to the application of functional electrostimulation is to apply it in more than one muscle group at least 3 times a week. The use of medicines that limit neuromuscular damage, improve painful symptomatology and favor the regeneration of nerve fiber should be a resource to be considered.

Consent

The patient signed the informed consent for her medical care at the General Hospital of Irapuato. Subsequently, informed consent was requested from the patient and 2 witnesses, to publish their clinical data and images from the clinical record, emphasizing that their personal data would not be published, nor would there be any possibility of the patient being identified.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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