Role of Nerve Transfer in Treatment of Traumatic Adult Upper Brachial Plexus Avulsion

A Systematic Article Review

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Abstract

Back ground: brachial plexus injuries represent devastating injuries with a poor prognosis. Neurolysis, nerve repair, nerve grafts, nerve transfer, functioning free-muscle transfer and pedicle muscle transfer are the main surgical procedures for treating these injuries. Among these, nerve transfer or neurotization is mainly indicated in root avulsion injury.

Aim of the work: the objective of the present study was to assess the results of nerve transfer in the treatment of adult traumatic avulsion of upper brachial plexus and which the nerve is the most favorable in the treatment.

Materials and Methods: PubMed database was searched for English-language articles using key words containing nerve transfer or brachial plexus injury. The search was also limited to articles published from January 1991 to January 2016 involving upper brachial plexus injuries. From the articles was collected information on the operation performed, number of operated cases, mean subject ages, interval between injury and surgery, source of nerve transfers, mean duration of follow-up, , and percentage of operative success in terms of elbow flexion and shoulder abduction. The recovery of elbow flexion and shoulder abduction was analyzed.

Results: according to data in this study, the management of brachial plexus injury by nerve transfer and the oberlin procedure leading to restore elbow flexion and shoulder abduction.

Conclusion: treatment of adult traumatic brachial plexus injuries remains a difficult problem.Nerve transfer techniques to restore shoulder and elbow function has revolutionized the care of these challenging injuries.

Keywords: Brachial plexus injuries - Nerve transfer – Oberlin procedure.

INTRODUCTION

The brachial plexus is a series of nerves formed by roots of cervical segments (C5–C8) as well as the first thoracic nerve (T1)[1].It begins at the neck and crosses the upper chest to the armpit, it functions to provide sensation and motor innervation to the skin and muscles of the chest and upper limb, it divides into: roots, trunks, divisions, and cords[2].

Anatomy of Brachial Plexus:

The brachial plexus (plexus brachialis) is a somatic nerve plexus formed by intercommunications among the ventral rami (roots) of the lower 4 cervical nerves (C5-C8) and the first thoracic nerve (T1) [3] (figure1). The plexus is responsible for the motor innervation of all of the muscles of the upper extremity, with the exception of the trapezius and levator scapula[4].

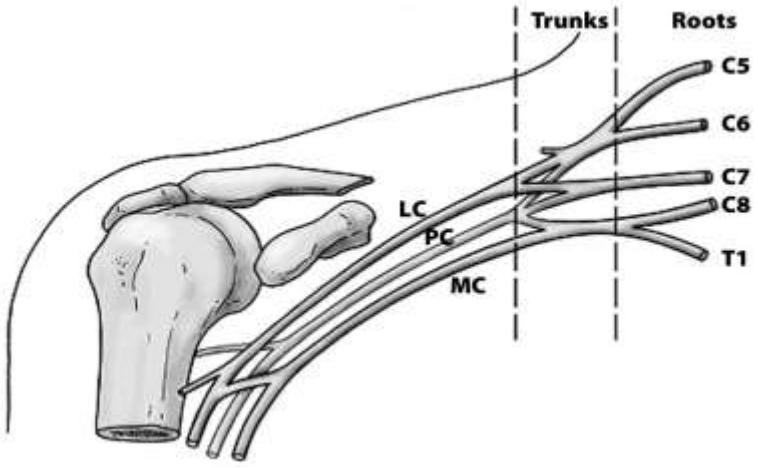

Figure (1): The basic anatomical relationships of the brachial plexus (BP). The BP is subdivided into roots, trunks, divisions, cords, and

branches. LC stands for lateral cord, PC stands for the posterior cord, and MC stands for the medial cord[3].

The brachial plexus supplies all of the cutaneous innervation of the upper limb, except for the area of the axilla (which is supplied by the supraclavicular nerve) and the dorsal scapula area, which is supplied by cutaneous branches of the dorsal rami[3].

Brachial plexus architecture

The brachial plexus is subdivided into roots, trunks, divisions, cords, and branches. Typically, the brachial plexus is composed of 5 roots, 3 trunks, 6 divisions, 3 cords, and terminal branches, as seen in the figure 2

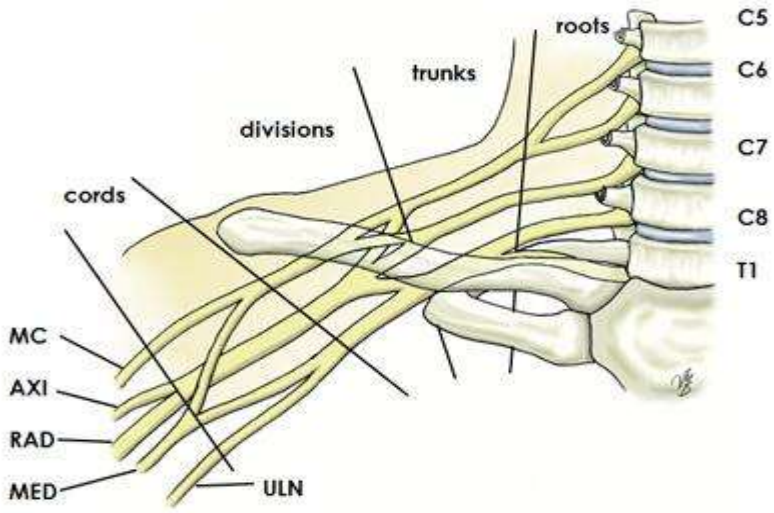

Figure (2): brachial plexus with terminal branches labeled. MC is musculocutaneous (nerve), AXI is axillary, RAD is radial, MED is median, and ULN is ulnar[4].

Roots

The ventral rami of spinal nerves C5 to T1 are referred to as the "roots" of the plexus[5].

The roots emerge from the transverse processes of the cervical vertebrae immediately posterior to the vertebral artery, which travels in a cephalocaudad direction through the transverse foramina. Each transverse process consists of a posterior and anterior tubercle, which meet laterally to form a costotransverse bar. The transverse foramen lies medial to the costotransverse bar and between the posterior and anterior tubercles. The spinal nerves that form the brachial plexus run in an inferior and anterior direction within the sulci formed by these structures[4].

Trunks

Shortly after emerging from the intervertebral foramina, the 5 roots (C5-T1) unite to form 3 trunks. The trunks of the brachial plexus pass between the anterior and middle scalene muscles[6].

The ventral rami of C5 and C6 unite to form the upper trunk. The suprascapular nerve and the nerve to the subclavius arise from the upper trunk. The suprascapular nerve contributes sensory fibers to the shoulder joint and provides motor innervation to the supraspinatus and infraspinatus muscles[5].

The ventral ramus of C7 continues as the middle trunk. The ventral rami of C8 and T1 unite to form the lower trunk[5].

Divisions:

Each trunk splits into an anterior division and a posterior division. These separate the innervation of the ventral and dorsal aspect of the upper limb. The anterior divisions usually supply flexor muscles. The posterior divisions usually supply extensor muscles[6].

Cords:

The cords are referred to as the lateral, posterior, and medial cord, according to their relationship with the axillary artery. The cords pass over the first rib close to the dome of the lung and continue under the clavicle immediately posterior to the subclavian artery[4].

The anterior divisions of the upper and middle trunks unite to form the lateral cord, which is the origin of the lateral pectoral nerve (C5, C6, C7), musculaocutaneus nerve (C5, C6, C7), lateral root of median nerve (C5, C6, C7)[4], (Figure 3).

The anterior division of the lower trunk forms the medial cord, which gives off the medial pectoral nerve (C8, T1), the medial brachial cutaneous nerve of the arm (T1), and the medial cutaneous nerve of the forearm (C8, T1), ulnar nerve (C7, C8,T1), medial root of median nerve (C8, T1)[5].

The posterior divisions from each of the 3 trunks unite to form the posterior cord[5].

The upper and lower subscapular nerves (C7, C8 and C5, C6, respectively) leave the posterior cord and descend behind the axillary artery to supply the subscapularis and teres major muscles. The thoracodorsal nerve to the latissimus dorsi (also known as the middle subscapular nerve, C6, C7, C8) also arises from the posterior cord[4], (figure 3). Axillary nerve (C5, C6) and radial nerve (C5, C6, C7, T1) are the terminal branches of posterior card[4].

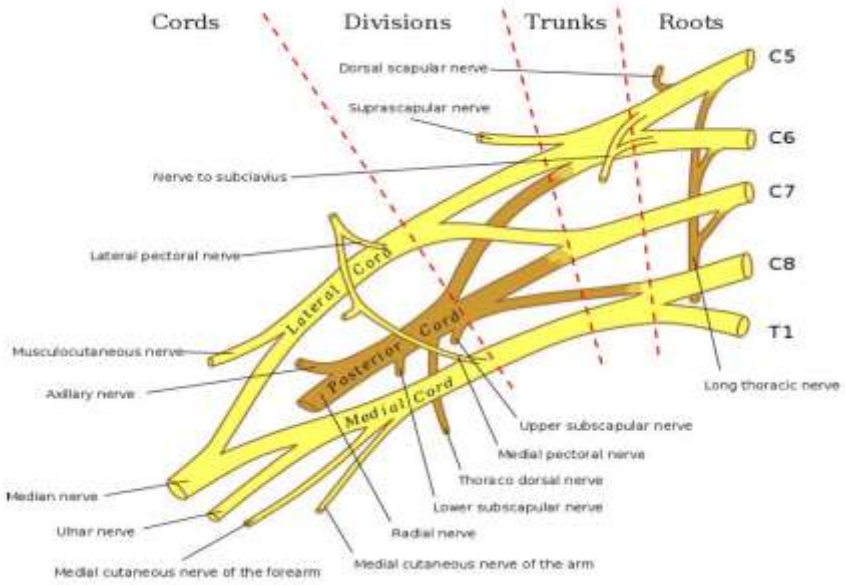

Figure (3): Showing terminal branches of brachial plexus[4].

Most traumatic brachial plexus injuries occur when the arm is forcefully pulled or stretched. Many events can cause the injury, including falls, motor vehicle and motorcycle collisions, knife and gunshot wounds[5].

It is not known exactly how many brachial plexus injuries occur each year, but the number seems to be growing throughout the world. Increased participation in high-energy sports and higher rates of survival from high-speed motor vehicle collisions may be factors in the growing number of these injuries[6].

The prevalence of brachial plexus injuries in the multiple trauma population is about 1.2% [2].