Early Management of Brachial Plexus Injury in Adults

Thesis submitted for fulfillment of
Master degree in Surgery

By
Fady Mohammad Alkonaiesy
M.B.B.Ch., 2003

Under supervision of

Prof. Dr. Taher Ismail Ahmed
Professor of Plastic & General Surgery
Faculty of medicine - Cairo University

Prof. Dr. Khaled Makeen
Professor of Plastic & General Surgery
Faculty of medicine - Cairo University

Prof. Dr. Tarek A. Amer
Ass. Professor of Plastic & General Surgery
Faculty of medicine - Cairo University

Faculty of Medicine
Cairo University
2012

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ العَلِيمُ الحَكِيمُ)

صدق الله العظيم
سورة البقرة: آية (٣٢)

Abstract

. Primary reconstruction is the initial surgical management and may include nerve surgery /reconstruction (eg, direct repair, neurolysis, nerve grafting, nerve transfers) which is the topic of the this study . Secondary reconstruction may be necessary to improve function, either to augment partial recovery or to obtain function when none has been achieved. This may include soft tissue reconstruction (eg, tendon/ muscle transfer, free muscle transfer) and bony procedures (eg, arthrodesis, osteotomy), but typically not nerve surgery.

Key word: DREZ- MNCS- Plexus- Adults- Injury

Acknowledgement

*First and foremost, thanks to **Allah** who gave me everything & guided me to the frank clear way and offered me the assistance of honest professors.*

*I find no words by which I can express my extreme thankfulness, deep appreciation, and profound gratitude to **Professor Dr. Taher Ismail Ahmed** Professor of General & Plastic surgery, Faculty of medicine, Cairo University, who taught me the milestones of research work. To him, I would like to express my appreciation for his continuous guidance, encouragement and supervision.*

*I wish also to express my appreciation to **Professor Dr. Khaled Makeen** Professor of General & Plastic surgery, Faculty of medicine, Cairo University, who kindly helped me by his precious time, keen supervision and generous support.*

*It is of my pleasure to express sincere thanks to **Professor Dr. Tarek A. Amer** Ass.Professor of General & Plastic surgery, Faculty of medicine, Cairo University, for his continuous support, persistent encouragement and valuable expert advices.*

Last but not least, I would like to express my endless thanks and deepest gratitude to all my family, especially to my kindhearted parents and lovely wife for their support, understanding, assistance and tolerance all the time till this work was completed.

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List of abbreviations

CMAP	**:**	Compound muscle action potential
CNS	**:**	Central nervous system
CSF	**:**	Cerebrospinal fluid
CT	**:**	Computerized tomography
DC	**:**	Direct current
DREZ	**:**	Dorsal root entry zone
DRG	**:**	Dorsal root ganglion
EMG	**:**	Electromyography
ENDO	**:**	Endoneurium
ER	**:**	Emergency room
Ext EPI	**:**	external epineurium
ICN	**:**	Intercostal nerve
Int EPI		internal epineurium
LSS	**:**	Lower subscapular nerve
LT	**:**	Lower trunk
mA	**:**	Milli ampere
MABC	**:**	Medial antebrachial cutaneous nerve
MBC	**:**	Medial brachial cutaneous nerve
MNCS	**:**	Motor nerve conduction studies
MPN	**:**	Medial pectoral nerve
MRI	**:**	Magnetic resonance imaging
NAP	**:**	Nerve action potential
OBPP	**:**	Obstetrical brachial plexus palsy
PERI	**:**	Perineurium
PNS	**:**	Peripheral nervous system
SNAPs	**:**	Sensory nerve action potentials

SSN	**:**	Suprascapular nerve
TD	**:**	Thoracodorsal nerve
USS	**:**	Upper subscapular nerve
UT	**:**	Upper trunk

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Introduction

The surgical management of severe brachial plexus injuries has evolved over the past 40 years from one of amputation of the paralyzed arm to one of nerve reconstruction and free muscle transplantation. The alternatives in surgical management were amputation through the upper arm, arthrodesis of the shoulder, and fitting with prosthesis. At that time, all efforts were made to establish whether the injury was a preganglionic lesion (in which case there was no chance of spontaneous recovery) or a postganglionic lesion (in which case there was a chance for spontaneous recovery if the lesion was in continuity and for reconstruction if continuity was lost). Usually, a period of 3 months was allowed to elapse while awaiting spontaneous recovery before surgical exploration was performed. Developments in microsurgery and the principle of tension-free repair have expanded the strategies in brachial plexus management. Microsurgeons who are involved with the reconstruction of brachial plexus injuries still face the followings problems:

1. The lack of adequate proximal intraplexus donors.
2. The lack of adequate nerve grafts.
3. The great distances for elongating axons to travel ***(Terzis and Kostopoulos, 2007).***

Bonney (1983) preferred early surgery few days after the accident, even in closed injuries, for two reasons:

1. The anatomical situation can be easily clarified because a few days after the accident there is no fibrosis or scar tissue formation.
2. Early primary surgery may save time. However, the first argument is based on an error in basic thinking. The fibrosis or scar tissue formation is caused by the trauma. In cases of early surgery, it will develop after surgery and the surgeon accepts this risk in order to

deal with nerve stumps that can be easily seen but will become fibrotic in 2–3 weeks time. With early surgery the surgeon cannot allow for this. In addition, the eventual damage to neurons is dependent on the trauma and will happen anyway. There is good evidence that early secondary repair offers a better chance for regeneration. The neurons will be in an active phase, and the secondary trauma creates greater axon sprouting than the initial repair ***(Millesi, 2003)***.

Immediate plexus exploration and reconstruction is indicated for a penetrating injury, such as a stab wound, or after an iatrogenic injury, such as injury to the plexus at the time of first rib resection for the treatment of thoracic outlet syndrome. Occasionally, the reconstructive surgeon gets the opportunity to assess the degree of damage to the plexus when emergency vascular reconstruction of an injured subclavian or axillary artery is performed by the vascular surgeons at the time of injury. There are many arguments against immediate reconstruction of the plexus in traction injuries, in addition to the diagnostic dilemmas. Most surgeons believe that some period of time must pass to permit the surgeon to be able to delineate injured from non injured nerve ***(Hentz and Doi, 2008).***

If exploration is indicated at the time of injury (high-energy injury causing a total plexus palsy), we prefer to wait 6 to 8 weeks after injury. This waiting period allows time for diagnostic tests and permits the patient to experience the effects of the injury. Because the functional results of reconstruction of severe plexus injuries are, on average, disappointing when compared with the function of the normal limb, the patient who has lived with a flail limb for some time may better accept the ultimate functional limitations of microneural reconstruction ***(Allico et al, 1984).***

The surgical management of brachial plexus injuries has traditionally involved neurolysis and nerve grafting procedures. However, innovative nerve transfers, or neurotization techniques, have recently acquired a more prominent role in repair. Although nerve transfers were introduced as a means to augment plexus repair, they have proven to be particularly useful in the setting of severe proximal brachial plexus trauma, e.g., multiple root avulsions. The goal of nerve transfer is to use nerves or fascicles with redundant or less important function as donors to restore function in a more important damaged neuromuscular unit. The key principles governing nerve transfer include the selection of a donor nerve with adequate motor fibers, the sacrifice of which will not result in a loss of critical function. The recipient nerve should be re-innervated as close as possible to the target muscle. When possible, the repair should be done without an intervening nerve graft, surgery should be performed as early as possible after injury, and, ideally, the neuromuscular units involved should have agonistic properties ***(Nathan and Eric, 2008).***

Healing processes, surgeon, patient and rehabilitation program are the main factors influencing the outcome of the treatment. Healing processes involve age, degree, extent, and location of injury; and time interval between injury and surgery. The surgeon can directly influence the overall outcome, although assurance of functional restoration is unpredictable. A thorough knowledge of the gross and internal anatomy of the brachial plexus, an understanding of the nerve pathophysiology, meticulous microneurovascular skills, and familiarity with conventional hand reconstruction are basic requirements for the brachial plexus reconstructive surgeon. The rehabilitation program includes intensive physiotherapy, treatment of pain, and direction to use the crippled limb for return to normal work and life or in retaining for another occupation ***(Chwei and Chuang, 2006).***

Aim of the work

To investigate the proper timing and surgical technique of early management of adults with brachial plexus injury and to study the advantages and disadvantages of each technique.