Original Article

Outcome Analysis of Upper Brachial Plexus Injury at Government Stanley Hospital

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Abstract

Objective: To analyse all the traumatic brachial plexus patients attending Physical Medicine and Hand Rehabilitation Department under Institute of Research Rehabilitation of Hand, Govt. Stanley Medical College and Hospital, Chennai. The demographic and outcome analysis are made.

Methods: Thirty-five patients were analysed their age, sex, level of injury, side of injury, mode of injury, occupation, postoperative cases assessment are made. Physiotherapy and orthosis given and followed.

Age—46% - 21 - 30 years; Sex—M:F - 31 : 04.

Level of injury: Pan palsy 40% C56 26% C567 31% C8T1 03%

Side right is common: 60%

Mode of injury: 77% road traffic accident

Occupation: Students: Manual labourer: Sedentary worker 10:12:13

Associated injuries: 42% in pan palsy; 55% in C567 level.

Conclusion: Productive age group of 21 to 30 years. Total brachial plexus, males and right side commonly are involved. Outcome analysis revealed moderately good results in surgical treatment of upper brachial plexus lesions. Management of the patient is difficult pre- and postoperatively.

Key words: **Brachial plexus injury, outcome analysis, demographic analysis.**

Introduction:

The brachial plexus is formed by the anterior primary rami of the lower cervical (C5-8) and the first thoracic (T1) spinal nerve. In prefixed brachial plexus C4 provides significant contribution to C5, but T2 does not contribute. In post-fixed brachial plexus, T2 has significant contribution to T1 but C4 does not[1].

Prefixed and post-fixed contribute in about 3% of the cases[2]. The brachial plexus starts at the scalenes, courses under the clavicle, and ends at the axilla. It is typically composed of 5 roots, 3 trunks, 6 divisions (2 from each trunk), 3 cords and terminal branches. Each spinal nerve is formed by the adjoining of the ventral root (motor fibres) and dorsal root (sensory fibres). The dorsal root ganglia are formed within the inter-vertebral foramen, immediately outside the dura mater of the spinal cord. The dorsal and ventral roots unite a few millimeter distal to the dorsal root ganglion to form a mixed spinal nerve[3].

Brachial plexus injury may be caused by trauma (open or closed injury), compression, tumour, infection, inflammation, toxins and others. Millesi[4] classified brachial plexus injury into four levels.

1. Supraganglionic root (level I)
2. Infraganglionic root (level II)

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3. Trunk (Supraclavicular) (level III)
4. Cord (infraclavicular) (level IV).

Based on the surgeon's findings, adult patients may be diagnosed with any one of the following conditions like neurapraxia, neuroma, rupture and avulsion. Multiple root avulsion is the most common diagnosis in high-energy traumatic brachial plexus injuries, such occurs in a motorcycle or off-road vehicle accident[5].

Aim of the study:

I. To look for demographic profile of brachial plexus injury.
II. To analyse the functional outcome after physical and surgical management and follow-up.

Materials and Methods:

Study Design: Prospective study
Duration: 6 months
Place of study: Department of Physical Medicine and Rehabilitation, Govt. Stanley Medical College and Hospital, Chennai

Inclusion criteria:

- All traumatic brachial injury patients with or without associated injuries.
- Patients of all age groups and both sexes
- Any racial and socio-economical denominations.

Exclusion criteria:

- Unconscious patient.
- Any patient unable to give proper history.
- Unwilling patient
- Acute trauma.

All the patients registerd in the physical medicine and rehabilitation section in the plastic surgery department Govt. Stanley Hospital were assessed. Initially 30-50 patients were planned to analyse. We have clinically assessed 35 patients of brachial plexus injury who presented at the Institute of Research Rehabilitation of Hand Department of Plastic Surgery from 1.5.2010 to 30.9.2010 and were followed for nearly 10 months. Assessment of each patient made and recording made in the proforma.

After the history recording inspection finding recorded and main examination is to exclude the involvement of root. Examination of trapezius muscle and rhomboidus muscle are important. We can see the contraction of rhomboidus muscle on adduction of scapula and we need to palpate the contraction of the muscle adduction of scapula against resistance. Same way latissimus dorsi muscle also seen contracting on coughing we need to palpate contraction of the muscle when shoulder is extended and adducted against resistance. Pectoralis major is having clavicular and sternal origin should be examined individually and recorded.

The examination of each root supplied muscles described below:

- Thumb: tests median nerve supplied by C6.
- Middle finger: tests median nerve supplied by C7.
- Little finger: tests ulnar nerve supplied by C8.
- C5: Shoulder movement in all directions, flexion of elbow (to some degree).
- C6: Flexion of elbow, rotation of forearm, flexion of wrist (to some degree).
- C7: Mainly a sensory trunk. (Produces generalised loss of movement in the arm, without total paralysis in any given muscle group. Always supplies latissimus dorsi).
- C8: Extension and flexion of fingers, flexion of wrist, hand movement.
- T1: Intrinsic muscles of the hand, e.g.adduction or abduction of fingers.

Sensory system examined on each dermatomes C5, C6, C7, C8 and T1 and a small area on the inner aspect of the arm supplied by T2 dermatome.Sensory modalities examined are touch using cotton, brush or Semmes-Weinstein pressure monofilament. Pain tested with pinprick and two-point discrimination tested at the finger tip by Manner felt apparatus consisting of two pins placed with distance of 2mm, 4mm, 6mm, 8mm,10mm and 12mm and recorder.

Results:

A demographic analysis was done on 35 cases of brachial plexus presenting at our Institute and 20 cases belonged to C5, C6, C7 brachial plexus.

I. Age: Commonest involved as the 21-30 years age - 46% (Table 1).
II. Sex: Commonest involved is male 90% (M : 18 to F : 2) (Table 2).
III. Level: The upper B.P.I contributed 57% of the total. (Table 3).
IV. Side: Common is right side which is about 60% (Table 4).
V. Mode of injury: R.T.A occupy about 77-80% of the cases (Table 5).

VI. Occupation: Students, manual labourers and sedentary workers being equally involved (Table 6).

VII. Associated injury: Common in the patients with upper brachial plexus injuries about 55% (Table 7).

VIII. Surgeries done: Upper BPI-8 patients were operated upon (Table 8).

IX. The results of the surgical correction was concerned, 75% of the patients had improvement (Table 9).

Table 1: *Age Distribution of Total BPI*

S. No	Age distribution	Total cases	Upper BPI
1	1-10 years	03	00
2	11-20 years	06	03
3	21-30 years	16	13
4	31-40 years	07	03
5	41-50 years	03	01

Table 2: *Sex Distribution of Total BPI*

	Male	Female
Total BPI	31	04
Upper BPI	18	02

Table 3: *Level of Injury*

Panpalsy	C56	C567	C8T1
14	09	11	01

Table 4: *Side of Injury*

Side	Right	Left
Total	21	14
Upper BPI	13	07

Table 5: *Mode of Injury*

Mode of Injury	Total BPI	Upper BPI
RTA	27	16
Birth	04	01
Fall from height	01	01
Fall of weight Over shoulder	01	01
Industrial	02	01

Table 6: *Occupation*

Occupation	Total	Upper BPI
Student	10	06
Manual labourer	12	05
Sedentary worker	13	09

Table 7: *Associated Injuries*

	With associated injuries	Without associated injuries
Total	19	26
Upper BPI	11	9

Table 8: *Surgeries Done for Upper BPI*

Surgery done	No of cases
Neurolysis	3
Oberlin nerve transfer	2
Transfer of spinal accessory nerve to suprascapular nerve	3

Table 9: *Results of Surgical Correction*

Surgery done	Improved	Not improved
Neurolysis	3	0
Oberlin nerve transfer	2	1
Transfer of spinal accessory nerve to suprascapular nerve	2	0

Discussion:

In our study among the 35 patients who were analysed, the commonest age group involved was 21-30 years, which forms about 46%. The next common age group involved was 31-40 years which is about 20%. This group of individuals are important for the development of the family and the nation. Of these 35 patients, 20 patients had upper brachial plexus injury. Even among the patients with upper brachial plexus injury, the commonest age group was 21-30 years. Commonest sex involved is male 90% (M: 18 to F: 2), most probably because it is the males who are the fast motor cycle riders and so more prone for such injuries. In one analysis of brachial plexus injury a survey of 100 consecutive cases from a Department of Neurosurgery, Belgium[6] showed the patient group comprised 80 M and 19 F 1M bilateral BPI ranging from 5 to 70 years of age. Causes of injury were largely sudden displacement of head, neck, and shoulder and included 27 motorcycle accidents. Loss was exhibited at C5-C6 in 19 patients, at C5-C7 in 15 patients, and at C5-T1 in 39 patients, and 8 patients had another spinal root pattern of injury. Nineteen patients had injury at the cord or the cord to nerve level. Associated major trauma was present in 59 patients. Emergency surgery for vessel or nerve repair was necessary in 18 patients. The surgical procedures performed included neurolysis alone in 12 patients and nerve grafting, end-to-end anastomosis, and/or neurotisation in 81, 5, and 47 patients, respectively. Brachial plexus injury represents

a severe, difficult-to-handle traumatic event. The incidence of such injuries and the indications for surgery have increased during recent years. Graft repair and neurotisation procedures play an important role in the treatment of patients with such injuries[6].

In our sudy out of the total of 35 patients involved with brachial plexus injury, 14 patients (40%) had total palsy which involved all the roots brachial plexus. The upper brachial plexus injury contributed 57% of the total. This upper brachial plexus injury consists of C5, 6 and C5, 6, 7 lesion categories. The C5, 6 level injury was seen in 9 patients (26%) and C5, 6, 7 lesion injuries was seen in 11 patients (31%). Patients with C8T1 injuries formed only 3% of the total brachial plexus injuries analysed. Thus, it is obvious that the second largest group of brachial plexus injury involves the upper trunks, and hence results of surgical correction are better. This is because results of C8T1 lesions are proved to be poor.

Side of injury common is right side which is about 60% probably due right being dominant tries to protect injury to other part of the body. So the dominant hand is commonly involved. Hence, the skills they learned in years together they lose in a few seconds. In our analysis R.T.A occupy about 77-80% of the cases. This compares with the review of western literature, where RTA forms about 60% of the cases. The next common mode of injury is gunshot injuries. In our series, the second commonest mode of traumatic brachial plexus injury was industrial accident (6%). In road traffic accident two wheeler accident is the most commonest one.

In another analysis Mayo Clinic[7] as the number of survivors of motor vehicle accidents and extreme sporting accidents increases, the number of people having to live with brachial plexus injuries increases. Although the injured limb will never return to normal, an improved understanding of the pathophysiology of nerve injury and repair, as well as advances in microsurgical techniques, have enabled the upper extremity reconstructive surgeon an opportunity to improve function in these life-altering injuries. The purpose of this review is to detail some of the current concepts of the treatment of adult brachial plexus injuries and give the reader an understanding of the nuances of the timing, available treatment options, and outcomes of treatment. Another analysis at Washington University School of Medicine[8], severe trauma to the brachial plexus most often occurs in young adult men and is a crippling injury that requires management in a timely fashion for optimal functional recovery and pain control. Current management options consist of primary repair in the acute setting, neurolysis, neuroma resection and nerve grafting, motor and sensory nerve transfers, and muscle and tendon transfers. Shoulder and wrist fusion can also play a role in the overall management of these patients. The total reconstructive process generally consists of more than one operation, and the postoperative rehabilitation is long and intensive. Nevertheless, with a highly motivated patient and a dedicated and specialised surgical team, the prognosis for functional recovery is good, and these patients can still lead productive and satisfying live.

In our study as far as the occupation of the patient was concerned, there was no appreciable difference, with students, manual labourers and sedentary workers being equally involved. Associated injuries like fracture clavicle, shoulder dislocation, fracture ribs, head injury were more common in the patients with upper brachial plexus injuries i.e. about 55%. This was high when compared with patients with total brachial plexus injuries having associated problems, which was about 42% only. This was probably because of the unique mode of injury in upper brachial plexus involvement, where, the forcible separation of the head and upper limb is the causative factor. Hence the force is borne by the head and the shoulder. Of the 20 patients with upper brachial plexus injuries, only 8 patients were operated upon. The rest of the 12 patients were lost to follow-up. The type of surgeries done were three in number. They were neurolysis (37%), nerve transfer of the spinal accessory nerve to the suprascapular nerve (37%), and Oberlin transfer (26%). Neurolysis refers to the surgery where the nerves are intact but engulfed in scar tissue, requiring a release of the scars which cause conduction blocks in the brachial plexus. The surgery of nerve transfer was done in the cases where the proximal nerve root was not available due to avulsion injury, and hence direct nerve suturing was not possible. In these cases, transfer of the intact spinal accessory nerve was done to the suprascapular nerve to achieve neurotisation of the supraspinatus and infraspinatus which would stabilise the shoulder. The third surgery of Oberlin transfer was done for the patients who had upper brachial plexus lesion for whom the neurotisation of the biceps and brachialis muscles was done with intact fascicles from the ulnar nerve and the median nerves.

Yet another analysis at University of Western Ontario, London, Canada[9], 4th analysis Traumatic brachial plexopathies can be devastating injuries. In addition to motor and sensory deficits, pain and functional limitations can be equally debilitating. Thirty-one

patients with a mean age of 32.7 years at the time of injury participated in this study. The mean time to surgery was 7.5 months, and the mean follow-up period was 42.7 months. Patients who underwent surgery within 6 months of injury scored consistently better on the disability of the arm, shoulder, and hand questionnaire.

There was no difference between supra- and infra-clavicular injuries; however, patients with root avulsion injuries were more likely to have pain and scored lower on the disability of the arm, shoulder, and hand questionnaire. Root avulsion injuries and delayed surgical repair correlated negatively with functional outcomes. As far as the results of the surgical correction was concerned, 75% of the patients had improvement. Surgical techniques include neurolysis, nerve grafting and neurotisation. Our studies in comparison to the reference almost same. Mode of injury, age, sex associated injury difficulty in management and advantage of early surgical intervention[6-9].

Conclusion:

The study revealed that the productive age group of 21 to 30 years was commonly injured with brachial plexus injury. It was the males who were mostly involved. Panbrachial plexus injury formed a large chunk of the patients with brachial plexus injuries, but the second commonest involvement was the upper trunk lesion of C5, 6 or C5, 6, 7.

It was commonly the right side that was involved and thus involved the dominant hand. Road traffic accidents with two wheelers formed the majority of cases with brachial plexus injuries. The occupation of the patient did not show any significant difference whether student, manual labourers of sedentary worker was concerned.

The demographic pattern of injuries of brachial plexus was almost similar when the total plexus injury and the upper plexus injury were concerned, except in the presence of associated injuries, where, upper lesions appeared to have more percentage of associated injuries.

Outcome analysis revealed comparatively good results in surgical treatment of upper brachial plexus lesions, except in the Oberlin procedure of nerve transfer where the results were comparatively poorer.

Management of the patient is difficult pre- and post operatively.

A correct evaluation of the patient pre-operatively, and planning and execution of the correct surgical procedure and postsurgical rehabilitation are essential.

Nevertheless, with a highly motivated patient and a dedicated and specialised surgical team, the prognosis for functional recovery is good, especially in upper brachial plexus injuries, and these patients can still lead productive and satisfying lives.

Education of public regarding speed control, obeying traffic rules should be done especially for college students, who are the pillars of the countries, for prevention of brachial plexus injuries, which is much easier than curing these problems.Awareness programme for college students may be the solution.

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