Clinical Article

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Traumatic Brachial Plexus Injuries: Epidemiological Study at two Egyptian Centers over 2 Years

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Abstract

Background Data: Improving the knowledge about the epidemiology of the traumatic brachial plexus injuries (BPI) helps in providing an appropriate assessment and management of these cases. This issue is important especially in those injuries that have much burden on the individual and national income.

Purpose: To evaluate the epidemiological, clinical, and outcome of traumatic brachial plexus injuries in Suez Canal University and Damanhur Medical National Institute Hospitals over 2 years.

Study Design: A retrospective descriptive clinical case study.

Patients and Methods: Eighteen patients had traumatic brachial plexus injury were operated by our team from January 2014 to December 2015. Data regarding the age, sex, causes of BPI, patterns of injury, surgical approaches, surgical procedures and recovery outcome were collected.

Results: All the patients were males with mean age 31 years, 72% encountered road traffic accidents (RTA), and 90% were because of motorbike accidents. 60% showed upper BPI. Neurolysis, nerve grafting and nerve transfer were the surgical procedures that were followed. Functional recovery had been achieved in about 61% of the study population.

Conclusion: Our study gives insight into epidemiological aspects of the BPI in Egypt and the role of our new center in the management of those injuries. Taking into consideration the small number of the study population, our results were more or less similar published literatures. (2016ESJ112)

Keywords: Epidemiological study, traumatic brachial plexus injuries, neurolysis, nerve graft

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Introduction

Most of the published studies focus on the treatment and prognosis of various types of the brachial plexus injuries (BPI). In this study we demonstrate our experience that resembles a new established unit at the Suez Canal University and Damanhur Medical National Institute Hospitals in management of such injuries. In Canada, Midha et al,[18] studied the incidence of BPI in their center and found that the BPI patients who had constituted about 1.2% of the all multi trauma patients. Goldi and Coates[6] in United Kingdom reported incidence of 450 to 500 closed supraclavicular injuries every year.

Brachial plexus injuries (BPI) constitute part of the most devastating medical problems that constitutes a major economic, medical, psychological, and social burden at the level of nation and patients.

Most of the brachial plexus surgeons face the patients whose obstetric brachial plexus palsy (OBPP). Many studies that were published by other Egyptian centers [2,5,6] showed the incidence and management of those cases, however, in this study we focus only on the traumatic type of the BPI. This study has been designed to evaluate the epidemiological, clinical, and outcome of traumatic brachial plexus injuries in our institutions.

Patients and Methods

Eighteen patients who had traumatic brachial plexus injuries were operated upon by our team from January 2014 to December 2015. The retrospective analysis reviewed the age, sex, mode of trauma, pattern of injury, level of injury, associated injuries, time interval between trauma and surgical intervention, type of the surgical procedure, transferred nerves, grafted nerves, functional outcome and the period of follow up. The regular follow up each 3 months was the rule for most of the patients and the data sheet was updated regularly. We lost contact with one of our operated patients as he changed his address. Functional motor power recovery was assessed by using the scale of Medical Research Council (MRC).[11]

Results

Through this retrospective analysis of our study population, (RTA) accounted for 72%, gunshot injury (GSI) accounted for 16% (Table 1, Figure 1) and falling of heavy subject on shoulder accounted for 11%. This is mostly related to that Egypt loses about 12 000 lives due to road traffic crashes every year.[10] It has a road traffic fatality rate of 42 deaths per 100 000 population. Majority (48%) of those killed are passengers of four-wheelers though pedestrians also constitute a significant proportion (20%) of these fatalities.

All the patients of this study were males and the age ranges from 21 to 30 years old accounted for 38% of patients, (Table2). This is mostly because young male youth are usually used to ride motor bikes with high speed.

Closed BPI accounted for 14 patients in our study and 4 had open BPI, (Table 3). Five patients showed associated injuries were accounted with some patients like subclavian artery injury, vertebral artery injury, fracture clavicle, fracture humerus and intracranial hemorrhage that accompanied with admission at intensive care unit.

According to the inclusion criteria that included any age, that caused by trauma, gunshot wound or birth related and who fulfilled the preoperative physiotherapy programs and not reached the satisfactory motor recovery and not exceeding 12 months after onset of injury, The surgical procedures like neurolysis, nerve grafting (Figure 2) and nerve transfer were selected according to the appropriate protocols of management[8] (Table 4) and Also the exclusion criteria included patients who had cervical congenital anomalies, cervical cord injuries and who had previous brachial plexus surgery. In our

study the average time interval from date of trauma to the surgical intervention was 110 days (minimal was 90 days and maximum 340 days). The average of in patient days was about 48 hours postoperatively. No Postoperative complications were happened except one case that showed immediate postoperative ipsilateral panplexopathy that improved spontaneously after 3 weeks, and one case that had post-operative phrenic nerve injury and ICU admission for 4 months before he died.

Table 1. Reported Causes of the brachial plexus injury.

Cause of Injury	NO.(N=18)	%
Road Traffic Accident	13	72%
Gunshot Wound	3	16%
Falling Heavy Object	2	11%

Table 2. Age distribution of reported Patients.

Age	NO.(N=18)	%
10- years	5	27%
20- years	7	38%
30- years	4	22%
40- years	2	11%

Table 3. Pattern of Brachial Plexus Injury of Reported Patients.

Pattern of Injury	NO. (N=18)	%
Upper BPI C5-7	11	61%
Lower BPI C8-T1	4	22%
Panplexus injury C5-T1	3	16%

Table 4. Surgical Procedures Used in this Study.

Surgical Procedure	NO. (N=18)	%
Neurolysis	6	33%
Nerve grafting	5	27%
Nerve transfer	7	38%

Table 5 Surgical Positions Used in this Study.

Position	NO. (N=18)	%
Supine	13	72%
Prone	5	27%

Table 6. Nerves Used in our Procedures for Nerve Transfer.

Neuronal Donor Element	NO. (N=7)	%
ICN	2	28%
SAN	3	42%
Radial Nerve	4	57%
MPN	1	14%
Thoracodorsal Nerve	1	14%
Median Nerve	1	14%
Ulnar Nerve	1	14%

Table 7. Nerves Used for Nerve Transfer as Recipient Elements.

Recipient Nerves	Number (N=7)	%
MCN	3	42%
SSN	3	42%
Axillary N.	4	57%
Radial N.	1	14%

Table 8. Neuronal Elements Used for Innervation and Grafting.

Neural Element	NO. (N=5)	%
Upper trunk	1	20%
Medial cord	1	20%
Lateral cord	2	40%
Posterior cord	1	20%

Table 9. Summary of 18 Patients Reported in this Study.

Case No	Age	Time to repair	Involved Nerves	Surgical Procedure	follow up	MRC Scale Outcome	Morbidity
1	22 Y	5 M	C5-T1	Neurolysis	24 M	Recovered elbow flexion G3, elbow extension G4-, shoulder abduction G4	–
2	18 Y	7 M	C-7	Nerve grafting (UT)	21 M	Elbow flexion G4, shoulder abduction G4	–
3	31 Y	6 M	C8-T1	Neurolysis	18 M	No recovery	–
4	20 Y	7 M	C5-7	Nerve transfer ICN to MCN, SAN to SSN	17 M	Elbow flexion G4+, Shoulder abduction G 4-	–
5	20 Y	4 M	C-7	Nerve transfer radial N to Axillary Neurolysis of SSN	16 M	Shoulder abduction G5	Panplexopathy recovered in month
6	25 Y	5 M	C5,6	Nerve grafting (lateral cord)	16 M	Elbow flexion G4	–
7	25 Y	5 M	C5-T1	Nerve grafting (posterior cord)	14 M	Shoulder abduction G4-, elbow extension G3, elbow flexion G4-	–
8	32 Y	6 M	C8-T1	Neurolysis	13 M	Shoulder abduction G4, Elbow flexion and extension G3, fingers flexion G2	–
9	20 Y	6 M	C5,6,7	Nerve transfer (Radial N to Axillary, SAN to SSN)	13M	Shoulder abduction G5	–
10	33 Y	8 M	C5-T1	Nerve transfer (SAN to SSN, ICN to MCN, contralateral C7 to ulnar N)	2 M	No recovery	Bilateral phrenic nerve injury & death
11	40 Y	7 M	C5,6,7	Nerve transfer (radial N to axillary N)	12 M	No recovery	–
12	30 Y	5 M	C5,6	Nerve transfer (Oberlin technique, SAN to SSN, MPN to Axillary N)	12 M	Shoulder abduction G4, elbow flexion G4-	–
13	19 Y	6 M	C8,T1	Neurolysis	11 M	Shoulder abduction G4-, elbow flexion G4, fingers flexion G2	–
14	42 Y	8 M	C5,6,7	Nerve transfer (radial N to axillary N, SAN to SSN)	10 M	Shoulder abduction G3 (up to 15 degrees of range of motion only)	–
15	27 Y	7 M	C5,6,7	Nerve grafting (lateral cord)	9 M	Showing improvement but without functional recovery	–
16	30 Y	6 M	C8, T1	Nerve grafting (medial cord)	8 M	No recovery	–
17	30 Y	5 M	C5,6	Neurolysis	8 M	No recovery	–
18	45 Y	8 M	C5,6	Neurolysis	7 M	Shoulder abduction G5, elbow flexion G4	–

ICN: Intercostal Nerve, ICU: Intensive Care Unit, MCN: Musculocutanous Nerve, MRC: Medical Research Council, SSN: Suprascapular Nerve, SAN: Spinal Accessory Nerve, UT: Upper Trunk, PC: Posterior Cord, LC: Lateral Cord, MC: Medial Cord, Y: Year, M: Month, G: Grade, C: Cervical, T: Thoracic.

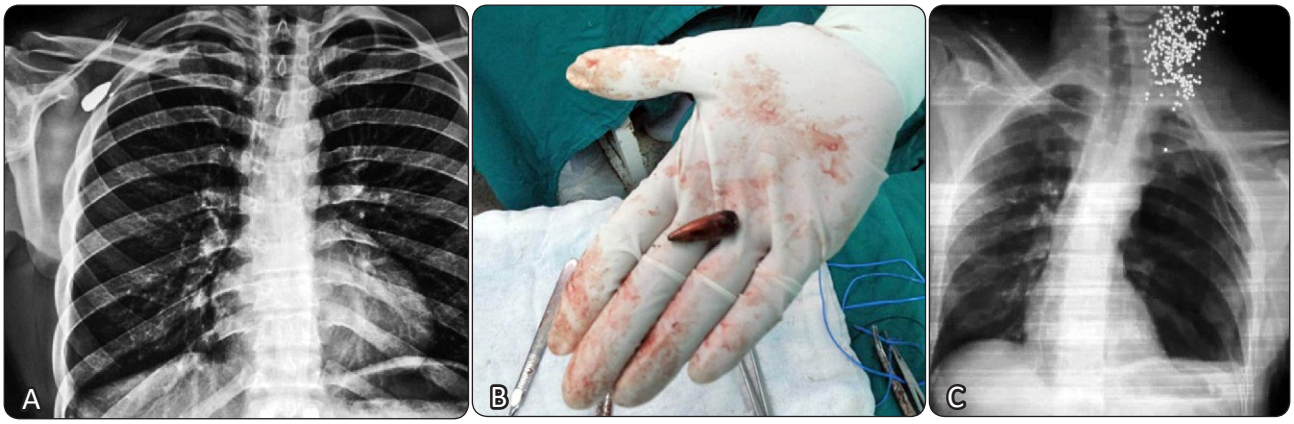

Figure 1. (A) Chest X-ray of one of our patients bullet injury (B) extracted bullet, (C) X-ray chest of another patient presented to the team with history of gunshot injury

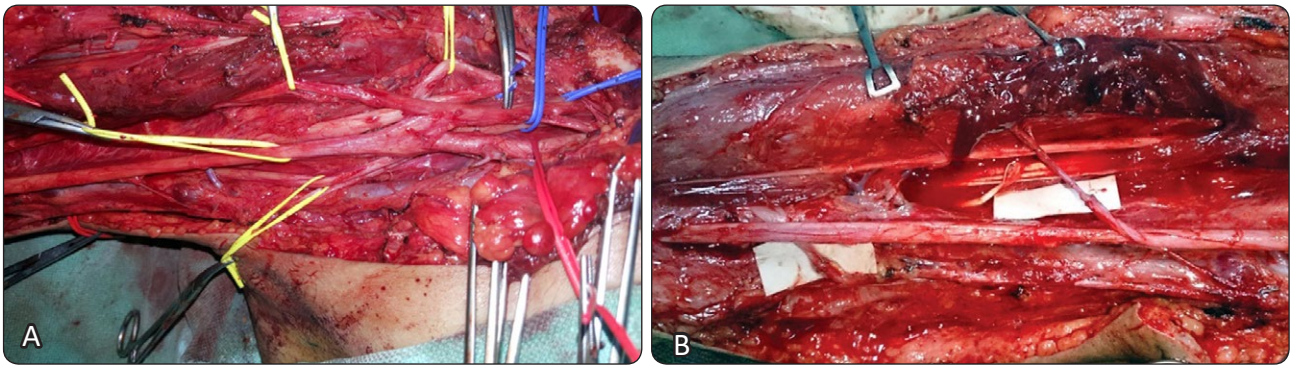

Figure 2. (A) Intraoperative picture showing neural elements of the brachial plexus after full neurolysis. (B) Intraoperative picture shows the neurotization of the musclocutanous nerve using part of the median and ulnar nerves (Obrelin's technique).

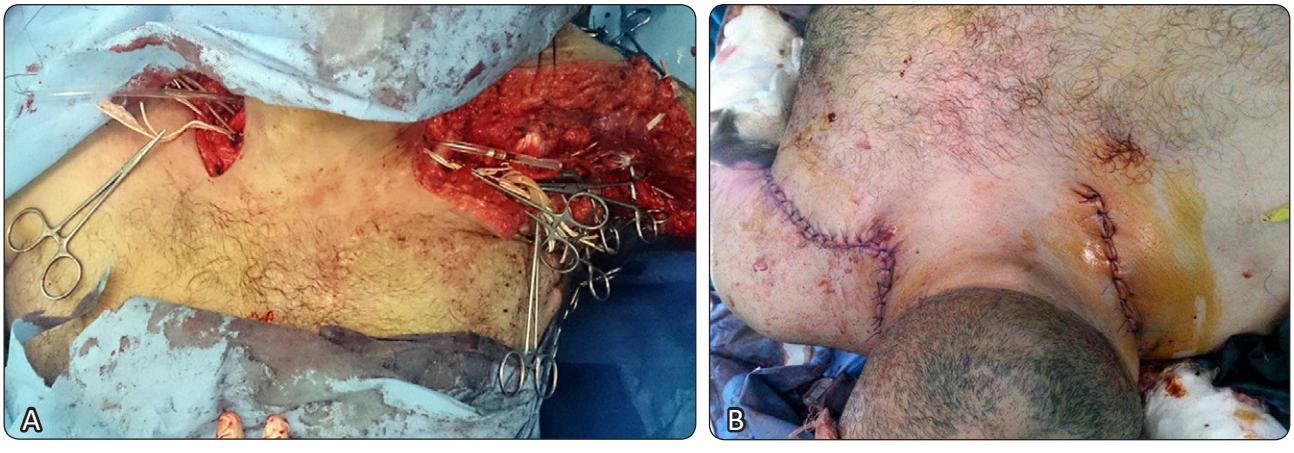

Figure 3. Intraoperative images showing (A) bilateral skin incision and exploration of the brachial plexus elements while using the technique of contralateral C7 nerve transfer, (B) The skin closure.

Discussion

Many published epidemiological studies on the traumatic brachial plexus injuries have been acknowledged as references**.** Near the end of the 1988, Narakas and Hentz[13] published the Rule of Seven Seventies**.** He stated that 70% of the traumatic BPI occurred secondary to motor vehicle accidents, and 70% involve motorcycles or bicycle; 70% of these motorcycle riders have multiple injuries whereas 70% of those patients had supraclavicular BPI and at least one avulsed root. 70% of the avulsed roots involve C7, C8 and T1. Of the 70% avulsed roots whereas 70% had chronic pain. Due to the large population (1068 patients) in this study of Narakas et al,[13] it is considered an important reference for most of the brachial plexus surgeons.

In USA, Yun et al,[18] published a study of 1019 patients who underwent surgical intervention. Patients who had thoracic outlet syndrome and brachial plexus tumors were included in this study. Also in USA, Terzis et al,[15] published study of 204 patients who underwent various surgical techniques of repair of the brachial plexus elements.

A study conducted in India revealed that 94% of the traumatic brachial plexus injuries were due to RTA and 90% of these RTA were motorbike.[8] In Belgium, Dubuisson and Kline[4] reported that 60% of traumatic BPI was due to RTA and 31% of these occurring while riding motorbikes. In Thailand, Limthongthang et al,[11] reported that 91% of the Traumatic BPI was due to RTA and 82% were due to motorbike accidents. In Germany, Kandenwein et al,[9] advocated that 81% of the traumatic BPI was due to RTA while 65% of these were because of motorbike accidents. In our study, we found that RTA accounts for72% of the traumatic BPI while 92% of these were because of motor bike accidents.

Dubuisson and Kline[4] reported that 23% of patients in his study had open BPI, while Yun et al,[18] reported that 19% had open BPI. In our study, we report that 22% had open BPI.

We report 1 case with subclavian artery injury, 1 case of vertebral artery injury (11% vascular injuries), 2 cases of fractures clavicle, 1 case of fracture humerus and 1 case of intracranial hemorrhage. Terzis and Papakonstantinou[16] reported that 28% of patient in his study associated vascular injuries, while Sinha et al,[14] reported 4.6% associated vascular injuries.

Brophy and Wolfe[1] reported that about 70% of the traumatic BPI had supraclavicular lesions. Narakas et al,[13] reported about 86% of the traumatic BPI had supraclavicular lesions, while we report that about 60% of patients in our study had supraclavicular lesions.

The average time interval from the date of injury to the surgical intervention in our study was about 110 days. Close follow up was done till we reach the point that we decide it is necessary to adopt the surgical way of management. We prepared at least 3 plans for every case suspecting presence or occurrence any intraoperative event that can change the current plan. The team operated 18 patients using different surgical positions (Supine position that was used in the supraclavicular or Infraclavicular approaches, while prone position that used in innervation of the axillary nerve by harvesting the branch of the radial nerve that innervate the medial head of triceps muscle, table 5), approaches and procedures. (Figure 3)The team used the intraoperative nerve stimulator set for ensuring the functional anatomy of the neuronal elements especially in the cases whose extensive scars. Nerves that used as donors (The intercostal nerve(ICN), Spinal accessory nerve (SAN), radial nerve, medial pectoral nerve (MPN), thoracodorsal nerve, median nerve and ulnar nerve were used as nerve donors in the technique of nerve transfer but each of them has its own protocol according the internal topography, Table 6) and recipients (Recipient elements were Musclucutanous nerve (MCN) was innervated

to restore the elbow flexion, Suprascapular nerve (SSN) and axillary nerve were innervated to restore the shoulder abduction while the radial nerve was innervated to restore the elbow extension mainly, Table 7) in the procedure of nerve transfer and those that underwent grafting (The upper trunk, medial cord and posterior cord were innervated once while the lateral cord was innervated twice, table 8) were viewed and reflected the planning of many scenarios for each case.[12,17]

The percentage of the functional motor recovery in our study reached about 61% and the supraclavicular lesions accounted for about 63% of the recovered cases. All the cases had continuous rehabilitation sets of physiotherapy that was recommended by the surgical team after one month of the surgery. We reported that no Postoperative complications were happened except one case that was complaining of total loss of shoulder abduction and while preserved elbow and hand movements, was operated neurotization of the axillary nerve, then showed postoperative total loss of motor power in all movements of the same upper limb. The motor power was improved spontaneously totally after 3 weeks. This was explained by our team as panplexopathy that related to the possibility improper surgical positioning and checked in all coming cases. We reported one case that had post-operative phrenic nerve injury and ICU admission for 4 months before he died because of inability of spontaneous breathing that believed to be mostly as a cause of manipulation of the phrenic nerve bilaterally, (Table 9).

Conclusion

Our study gives insight into epidemiological aspects of the BPI in Egypt and the role of our new center in the management of those injuries. Taking into consideration the small number of the study population, our results were more or less similar published literatures.

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الملخص العربي

اعتلال الضفيرة العضدية الناجم عن الإصابة: دراسة متوطئة بمركزين مصريين على مدار سنتين

البيانات الخلفية: تحسين المعرفة حول وبائيات الإصابات الضفيرة العضدية يساعد في توفير التقييم المناسب وإدارة هذه الحالات. هذه القضية مهمة، خاصة في تلك الإصابات التي تحمل عبئا كبيرا على الدخل الفردي والدخل الوطني.

الغرض: تحليل وتقييم إصابات الضفيرة العضدية الناتجة عن الإصابة بقسم جراحة المخ والأعصاب بالمستشفى الجامعي بجامعة قناة السويس وبالمعهد الطبي القومى بدمنهور بجمهورية مصر العربية.

تصميم الدراسة: دراسة حالة سريرية وصفية بأثر رجعي.

المرضى والطريقة: دراسة استعادية استعرضت ثمانية عشر مريض باعتلال الضفيرة العضدية ناتجة عن إصابات متنوعة وخضعوا للتدخل الجراحي حسب شروط الانضمام والاستبعاد والاعتبارات الأخلاقية لبرنامج الدراسة وذلك لإدارة الاعتلال الناجم عن الإصابة وقد تم تسجيل الخصائص الديموغرافية وبيانات العمليات الجراحية والنتائج الوظيفية.

النتائج: جميع المرضى التي استعرضتهم الدراسة كانوا ذكورا، ومتوسط العمر كان ٣١ عاما. ١٣ مريض منهم أصيب في حوادث طرق، ٢ سقطوا من ارتفاع عال و٣ أصيبوا نتيجة طلق ناري. تم استخدام طريقة نقل العصب في ٧ مرضى، وطريقة ترقيع العصب في ٥ مرضى، وطريقة تسليك الأعصاب فقط في ٦ مرضى. بالمتابعة المنتظمة باستخدام الكشف الأكلينيكي لاختبار القوة الحركية باستخدام تدريج المجلس الطبي للبحوث، تبين تحسن وظيفي واستعادة للقوة الحركية لعدد ١٢ من المرضى، وهناك أيضا مضاعفات قليلة تم تسجيلها في الدراسة.

الخلاصة: أسفر التدخل الجراحي باستخدام طرق نقل وترقيع وتسليك الأعصاب إلى نتائج جيدة مع وجود نسبة مضاعفات قليلة، ويأمل الطاقم الجراحي لإسقاط الضوء على دور هذين المركزين في علاج مثل تلك الإصابات وقيمة تلك الدراسة التي تضاف إلى قواعد البيانات في الدوريات العلمية المختلفة والتي يمكن استخدامها في البدء في مزيد من الدراسات العلمية وخصوصا في جمهورية مصر العربية.