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EVALUATION OF PERIPHERAL NERVE INJURIES AROUND ELBOW IN ASSOCIATION WITH FRACTURES

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Abstract

In this prospective study, 147 cases of trauma around elbow were examined and evaluated. All were unilateral. Only 22 were associated with peripheral nerve injuries (14.9%). Males were 19 (86%) and females were 3 (14%). Their ages were between 5 and 54 years (mean 24 years).

The radial nerve was found to be most vulnerable to injury (40.9%) followed by ulnar nerve (31.8%) and lastly the median nerve (9.1%).

The injurious agents in 2 patients were bullet and missile while in 20 were civilian causes.

In thirteen cases (59.1%) there were primary nerve palsy and in 9 (40.9%) there were secondary nerve palsies.

The degree of nerve injury in 13 patients were neuropraxia (59.1%) with complete recovery, in 6 were neurotmesis (27.3%) and in 3 were axonotmesis (13.6%).

The full recovery of the nerve was in 13 patients (59.1%), 12 of them by spontaneous recovery (54.5%) and one of them by surgical exploration and neurolysis (4.5%).Timing of nerve recovery were variable, range from 1.5 to 8 months. There was no recovery in 9 patients (40.9%).

We concluded that when closed fractures are complicated by primary nerve deficits, waiting for spontaneous re-innervation seems reasonable up to eight months and early surgical exploration is better to be avoided, conversely if closed fracture complicated by secondary nerve palsy early exploration of nerve is favored except in Tourniquet palsies.

Introduction

Due to the proximity of neurological structures to the elbow joint, many of procedures and pathologies around the elbow may result in nerve injury[1-5]. Distal humeral fractures, elbow dislocations, Montegia fracture dislocation, supracondylar facture and the proximal forearm trauma all have been associated with various types of nerve injuries with variable degree of recovery[5-7]. Nerve dysfunction after trauma around the elbow can lead to significant long term pain and functional deficit, fortunately most of these injuries are neuropraxias that will recover spontaneously after conservative treatment[6]. An under-standing and appreciation of the deficits likely to be encountered and the natural history and the treatment for such injuries with full alertness about the anatomy of area around the elbow can facilitate optimal outcome.

The aim of our study is to evaluate the importance of nerve injuries around elbow joint in relation to its common occurrence in orthopedic practice

Patients and Methods

This is a prospective descriptive study of 147 patients which was conducted in Basrah General Hospital, Ibn Al-Bitaar Private Hospital and Al-Mowaani General Hospital, between March 2009 and September 2010. All were cases of trauma around elbow, 22 of them were complicated by peripheral nerve injuries.

All patients were evaluated by detailed history according to a special questionnaire prepared for this purpose. Thorough physical examination with

special emphasis on peripheral nerve examination was carried out. All cases were sent for radiological evaluation (antero-posterior and lateral views), and repeated clinical examination was done mainly for peripheral nerves throughout the time of management. In the cases complicated by a peripheral nerve injury, in addition to periodic clinical examination, nerve conduction study and electromyography was done after a period of 6 weeks.

Of the 22 cases complicated with peripheral nerve injuries, 19 were associated with closed fractures and 3 with compound fractures.

The 19 Cases of peripheral nerve injuries associated with closed fractures, were subdivided into 3 groups according to types of nerve injury and lines of fracture management:

A) Closed fractures associated with primary nerve injury, that were managed by closed methods (5 cases) and the nerve injury were managed expectantly, and followed up closely as follows;

1) Splintage of the limb in a position of function.

2) Encourage exercise of joints of the paralyzed part passively as well as active exercises of the intact muscles to keep the joints supple &mobile.

3) Follow up was done every 2 weeks at outpatient department (OPD) clinically for assessment of the nerve function & radiologically for state of fracture union. If the nerve shows signs of recovery we continue follow up until full neurological recovery is obtained. If there are no signs of recovery after 6 weeks we send the patient for electrophysiological studies which is repeated every 2 months in addition to periodic clinical evaluation.

In one case (fracture neck of radius), surgical exploration of the nerve with neurolysis was done after 6 months of expectant management.

B) Closed fractures with primary nerve injury that were managed operatively (5 cases) by open reduction &internal fixation in 4 cases and one case by excision of the head of the radius. In these cases the nerve was not explored during the surgical procedure and was managed expectantly following the same regimen already outlined.

C) Closed fractures complicated by secondary nerve palsy (9 cases) which occur as a complication of our operative treatment of fractures. In these cases we send the patient for electrophysiological study 6 weeks after we discover the nerve injury. Nerve injuries in this group were treated according to the causative factor as follows: 6 cases were treated expectantly, 2 cases by primary nerve repair at time of nerve injury during the surgical procedure for fracture fixation, and one case of ulnar nerve injury by excision of scar tissue, nerve repair and anterior transposition.

Three cases of peripheral nerve injuries associated with compound fractures:

They were treated by thorough wound debridement and nerve exploration. The nerves were completely cut in all cases. Delayed primary repair was done in all with anterior transposition in the cases associated with ulnar nerve injury. The fractures were dealt with accordingly either by K wire fixation or by external fixation.

Postoperative follow-up &aftercare with the same regimen outlined for previous groups.

Of these 22 cases complicated by nerve injuries, 13 cases were primary nerve injuries (10 with closed fractures & 3 with compound fractures), 9 cases were secondary nerve injuries as outlined above.

Results

In this series, 147 cases of fractures around the elbow were examined for associated injuries to peripheral nerves, 22 (14.9%) were found to be so affected as shown in fig.1. These 22 cases were further evaluated & analyzed; the age range was between 5 and 54 years with

mean of 24 years, with the age distribution mostly between 11-30 years of age (54.4%), males were 19 (86%) and females were 3 (14%) as shown in table I.

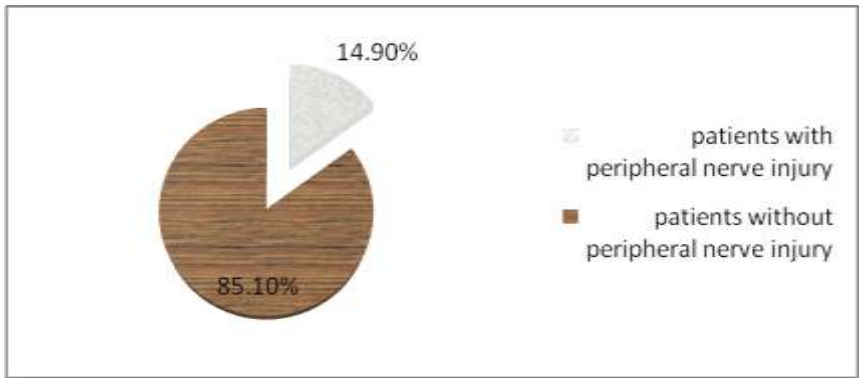

Fig.1: Incidence of peripheral nerve injuries in patient with trauma around elbow.

Table I: Age distribution

	Age	Frequency	Percent
1	1-10y	4 cases	%18.1
2	11-20y	6 cases	%27.2
3	21-30y	6 cases	%27.2
4	31-40y	3 cases	13.6%
5	>40y	3 cases	%13.6
Total		22 cases	%100

The radial nerve was found to be most frequently affected (40.9%) followed by ulnar nerve (31.8%) and lastly median nerve (9.1%). Combined involvement of nerves was found in (18.2%) of cases as shown in table II.

Table II: The frequency of specific nerve involvement.

Name of n.	Frequency	Percent
Radial n.	9	40.9
Ulnar n.	7	31.8
Median n.	2	9.1
Radial and ulnar n.	2	9.1
Radial, Ulnar and Median N.	2	9.1
Total	22	100%

The injurious agents in 2 patients were bullet and missile while in the 20 patients were civilian causes.

In thirteen cases (59 %) there were primary nerve injury, 3 cases were associated with compound fractures with complete cut of the nerves & 10 cases were associated with closed fractures. The three cases of primary nerve injuries that were associated with compound fractures, there was no recovery in all.

The remaining 10 cases of primary nerve injuries that were associated with closed fractures were subdivided into: group A (5 cases); 4 showed full recovery after a variable periods of time and one case showed no recovery after a period of 6 months and was treated by nerve

exploration & neurolysis and there was recovery after another 2 months.
Group B (5 cases); there was recovery of nerve function in 2 and no recovery in 3 cases. So cases of primary nerve injury associated with closed fractures (10 cases) there was recovery in 7, and no recovery in 3 as shown in table III.

Table III: Details of treat. of closed fractures associated with primary nerve palsy

Nerve name	Site and Type of fracture	Method of nerve treatment	Method of fracture treatment	Recovery time of nerve injury
Radial	Neck radius	Neurolysis	Closed reduction	2 months
Median	Sever comminuted Lower humerus and olecranon process	Expectant	Closed reduction	5 months
Ulnar	Proximal third of radius and ulna	Expectant	Open reduction	No recovery
Median	Proximal ulna	Expectant	Closed reduction	2 months
Radial and ulnar	Montegia fracture dislocation	Expectant	Open reduction	No recovery
Ulnar	Distal humerus	Expectant	Open reduction	1.5 months
Radial, ulnar and median.	Proximal radius and ulna	Expectant	Open reduction	No recovery
Ulnar	Proximal ulna	Expectant	Closed reduction	2 months
Ulnar	Elbow dislocation	Expectant	Closed reduction	2 months
Radial	Head of radius	Expectant	Excision of head of radius	2 months

Table IV: Details of treatment and mechanism of nerve injuries in patients complicated by secondary nerve palsies.

Nerve name	Site and Type of fracture	Mechanism of nerve injury	Method of fracture treatment	Method of nerve treatment	Recovery time of nerve injury
Radial	Proximal radius and ulna	Esmarch tourniquet	Plate and screws	Expectant	3 months
Radial, median ,ulnar	Proximal radius and ulna	Esmarch tourniquet	Plate and screws	Expectant	4 months
Radial	Supracondylar fracture	Esmarch tourniquet	k-wire	Expectant	1.5 month
Radial	Supracondylar	Esmarch tourniquet	k-wires	Expectant	1.5 month
Ulnar	Supracondylar	Hard ware	k-wire	after 3 months, removal of K-wire, anterior transposition, excision of scar and repair of ulnar nerve	No recovery
Radial	Proximal shaft of radius and ulna	Surgical dissection	Plate and screws	Repair at time of operation	No recovery
Radial	Proximal shaft of radius and ulna	Esmarch tourniquet	Plate and screws	Expectant	3 months
Ulnar	Lower humerus	Hard ware	Plate and screws	Expectant	3 months
Radial	Mid shaft humerus	Surgical dissection	Plate and screws	Repaired at time of operation, then tendon transfers	No recovery

In 9 cases (40.9%) there were closed fractures complicated by secondary nerve injuries which occur as a complication of the surgical procedure used for treating or fixing these fractures. There were full recovery in 6 patients and no recovery in 3 patients (one case by hard ware (k-wire) and 2 cases during surgical dissection, (one of these two cases was treated by tendon transfer) as shown in Table IV. The degree of nerve injury in 13(59.1%) patients were neuropraxia and there was complete recovery, in 6 (27.3%) patients were neurotmesis and in 3 (13.6%) patients were axonotmesis.

The full recovery of the nerves were in 13 (59.1%) patients, 12(54.5%) of them by spontaneous recovery and one (4.5%) of them by surgical exploration and neurolysis, and there was no recovery in 9 (40.9%) patients as shown in fig .2.

Times for nerve recovery were variable; in 3 patients, the full recovery time was 6 weeks ≈1.5 months (%13.6), in 4 patients (18.2%) the full recovery time was around 2 months, in 3 patients (13.6%) the full recovery time was around 3 months, in 1 patient (4.5%) the full recovery time was around 4 months, in 1 patient (4.5%) the full recovery time was around 5 months, in one patient (4.5%) the full recovery time was around 8 months as shown in fig.3.

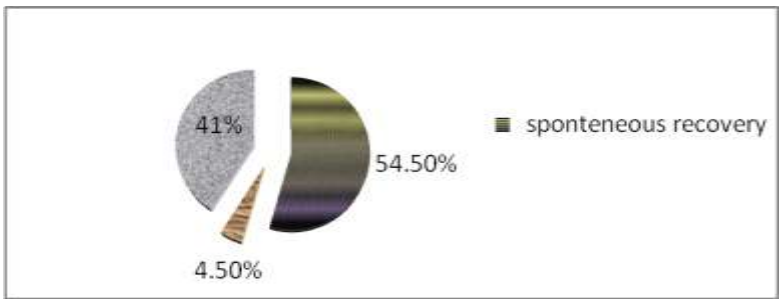

Fig. 2: incidence of spontaneous recovery, recovery by neurolysis and no recovery of peripheral nerve injuries.

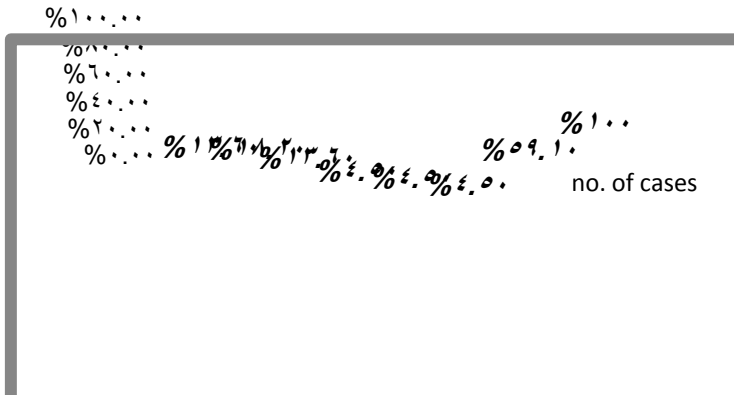

Fig 3: Incidence of recovery time of nerve injuries

Discussion

Peripheral nerve injuries are common. Despite numerous advances in microsurgical technique and inter-fascicular nerve grafting, many treatment principles obtained from World War II experiences are still applicable today[8].

In our study, the incidence of peripheral nerve injuries in association with trauma

around elbow &/or its treatment was high (14.9%) in comparison with other part of body, this is because of the subcutaneous nature of elbow and complexity of its anatomy that makes it vulnerable to injury during surgical dissection[7]. we agree with Adams et al that the incidence of nerve injury around elbow was from (10 to 19%)[6] but it is less than the incidence which was reported by Omer (22%)[9].

In this study (86.4%) of patients were under the age of 40 years, as reported by Jennifer et al that the incidence of peripheral nerve injury in association with trauma is more prone to occur in active young people since they are more exposed to injuries and this trauma are usually caused by higher-energy mechanisms[10].

Around (86.4%) of our patients were males, this high incidence in males may be due to social causes which make the males more active and more exposed to civilian (e.g. Road traffic accident) and war injuries (bullet & and missile injuries) than females.

The major causes of trauma in our cases were civilian in (90.9%), while Seddon reported that the missile and bullet injury were the major cause[11], this might be attributed to the relative decrease in bullet and explosion injuries at Basrah city in the last 2 years with relative increase of road traffic accident with non-licensed drivers (cars and motorcycles).

Most of nerve injuries around elbow are neuropraxia and recover spontaneously after conservative treatment[6]. In this study (59%) of cases the nerve injuries were neuropraxia, and (54.5%) of them treated conservatively and only (4.5%) was treated by exploration and neurolysis, the recovery times for these (59%) cases were variable from 1.5 months to 8 months. so if there was no clinical signs of nerve recovery after 8 months, we don't expect good outcome, therefore, we recommend to wait for 8 months before surgical exploration done. while Ristic and Randall prefer 6 months waiting before exploration[6,12] and FH Pollock advised surgical exploration after three and a half to four months if there is still no clinical or electromyographic evidence of recovery at that time[13].

There were 3 cases Axonotmesis and 6 cases Neurotmesis in all of these cases there were no recovery neither clinically nor by electrophysiological studies after 12 to 16 months of follow up, in these cases some reconstructive procedures are required to help patients to resume function.

As reported, the radial nerve is the most common nerve injured[8]. In this study, there was radial nerve injury in (59%) of our cases, (40.9%) there were only radial nerve involvement while in (18.2%) there were concomitant injuries to other nerves. Esmarch tourniquet was the most common cause of the radial nerve injuries and there were full spontaneous recovery in (53.8%) of cases and no recovery in (46.2%) (2 cases were due to compound fracture and they were Neurotmesis and 2 of them were due closed trauma (Axonotmesis) and 2 of them were due to surgical dissection (Neurotmesis) one was treated by tendon transfers and other one need the same procedure, but he refused further surgical interference, so the rate of spontaneous recovery of radial nerve injuries is 53.8%, in contrary to that reported by Jennifer et al which is 70%[10].

The ulnar nerve was next one it was injured in (50%) of cases, (31.8%) of them were only ulnar nerve involvement while in (18.2%) in association with other nerve injuries. The cause of ulnar nerve injuries were initial trauma (primary palsies) in (72.7%) of cases and iatrogenic causes in (27.3%) of cases and this agree with R. Watson in that the most common type of ulnar nerve palsies are primary palsy in association with medial epicondyle trauma[14].

In 45.5% of cases, there were full recovery and in 54.5% there were no recovery (2 of those cases were due to

compound fractures and they were Neurotmesis and treated by anterior transposition and direct repair, 3 cases were caused by initial closed trauma and treated by expectant and one case was by impalement by hardware (k-wire), the case was supracondylar fracture, the medial K-wire injured the ulnar nerve, after 3 months treated by anterior transposition, excision of scar and repair, therefore we advise exploration of the ulnar nerve before introduction of the medial transfixing K-wire or the use of lateral pinning alone in surgical fixation of supracondylar fracture of the humerus as recommended by Reza Omid et al. who claims that, it has the same stability of cross pinning and less incidence of ulnar nerve palsy[15]. The spontaneous recovery rate of ulnar nerve was 45.4% while radial nerve was 53.8% means that the radial nerve more recoverable than the ulnar in our study.

In our patients, the median nerve was injured in (18.%) of cases, the last one that is likely to be injured, in 2 cases only the median nerve were involved (in both there were full recovery and were primary palsies) and in 2 combined injuries with other, one was primary palsy by closed trauma and there was no recovery and other was secondary palsy by Esmarch tourniquet and there was full spontaneous recovery after 4 months), so the recovery rate for median nerve was 75% out of the 4 cases.

In this study 40.9% had secondary nerve palsies (Iatrogenic cause) which occur after injury around the elbow and during surgery while Samardzic et al reported (32%)[16], this higher percentage, in our study, may be due to high incidence of Esmarch tourniquet palsy which seen in 22.7% of cases, this figure reflect our practice of still using Esmarch tourniquet in almost all operations around elbow, which in other centers never used except in the middle and upper thirds of the thigh or used for exsanguinations only[17], the other 18.2% of secondary palsies were by different mechanism, 2 by impalement of the nerve by hardware, one by plate and screws and other by k-wire, and 2 during surgical dissection (treated by repair at time of operation), and this required full awareness about anatomy of this area[7].

The primary nerve palsies were in 59% of cases, 3 associated with compound fractures. The nerve injuries in all were complete cut (Neurotmesis) and were treated by early explorations and delayed primary nerve repair and there was no recovery in all, we think that the peripheral nerve repair, which need special equipments including operating microscope which we lack in our department, is less than ideal, this calls for more attentions to this issue to provide optimal conditions for nerve repair in order to improve our results.

The 76.9% of the primary palsies, were closed fractures (one treated by exploration and neurolysis and nine cases treated by expectant) there were full recovery in 53.8% of cases and no recoveries in 23.1%, so the recovery rate of primary nerve palsies in closed fracture more than that of compound fractures this agree with Seddon in that the prospect of spontaneous recovery are diminished in compound fractures because the external wound may be an indicator of violence severity which cause the fracture or it led to loss of muscle and with or without infection supervening, in either way the nerve is likely to be badly mauled[11].

Conclusion

Peripheral nerve injuries should be carefully excluded in every patient with an acute extremity injury. Equal diligence should be applied in evaluation after recovery from skeletal injury to detect secondary neural injury.

A precise knowledge of the course of the nerve, & related anatomy is essential in evaluating and treatment of peripheral nerve injury. Knowledge of the more common anatomic variation in nerve supply is extremely helpful.

When closed fractures are complicated by primary nerve deficits, waiting for spontaneous re-innervation seems reasonable up to eight months, and early surgical exploration is better avoided conversely if closed fracture complicated by secondary nerve palsy early exploration of nerve is favored except in Tourniquet palsies.

In compound fractures complicated by nerve injuries, the indication for early exploration for diagnostic, therapeutic and prognostic purposes seems reasonable.

Recommendations

1. In surgical treatment of upper limb, it is preferable to use pneumatic tourniquet properly with full alertness about its proper application, optimal pressure that should be applied and maximum duration.
2. For optimal results of nerve repair, there should be fully equipped operation theater, highly experienced surgeon, good & early physiotherapy.

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