INCIDENCE AND PROGNOSIS OF RADIAL NERVE LESION ASSOCIATED WITH HUMERAL SHAFT FRACTURE

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ABSTRACT

Background

Humerus is the long bone of the arm, radial nerve which is branch from the posterior cord of the brachial plexus commonly injured by fracture shaft of humerus because of close relation to the bone during it's course in the arm, and the average incidence of radial nerve palsy with fracture of humerus in the literature is 12%.

Objective

To study incidence, types and nature of radial nerve injury associated with humeral shaft fracture.

Subjects and Methods

This is prospective study conducted at the Sulaimani Teaching Hospital and Causality Hospital during the period of June 2009 – June 2010. The study included sixty-eight patients with fracture shaft of hummers (21 females, 47 males), with an age ranging from 6 to 75 years (mean ±SE = 40± 0.67 years). Among the 68 patients 14 of them presented with neurological deficit of radial nerve dysfunction with an age ranging from 6 to 44 years (mean ±SE = 25 ± 0.67 years) (6 female and 8 male). The entire subjects met certain inclusion and exclusion criteria. Nerve Conduction Study and needle electromyography examinations were performed for those patients with radial nerve Dysfunction. The following biochemical parameter were measured complete blood count, serum calcium, serum alkaline phosphatase also X ray examination were performed in more than one view (anterior-posterior and lateral view).

Results

Among 68 patients with fractured humeral shaft 14 of them presented with feature of radial nerve palsy, nerve conduction study and electromyographic result showed that 10 patients (72%) have only focal demyelinating lesion (neuropraxia), (21%) 3 patients with severe radial nerve injury (neurotmesis) and 1 patient (7%) with partial radial nerve injury (axonotmesis) with the over all prevalence of about 20.6%. Among those patients with radial nerve palsy 3 of them was presented with compound fracture and associated severe radial nerve injury (neurotmesis), the remaining 11 patients presented with closed fracture.

Conclusions

The incidence of radial nerve palsy with fractureed shaft humerus was 20.6%, transection of radial nerve is associated with open fractures of the humerus, nerve palsies that are part of closed fracture nearly always recovered.

Keywords: *Radial nerve, Nerve injury, Fracture, Humerus.*

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INTRODUCTION

The radial nerve is the principal nerve in the upper extremity that sub serves the extensors of the arms and fingers and the sensory nerves of the extensor surface of the arm. It has a long and winding course rendering it vulnerable to injury [1, 2]. There are two areas where the radial nerve is in direct contact with the humeral bone without any interposing muscle or fascial tissue as protection and therefore the most vulnerable [3]. One such area is the distal third of the humeral bone where the nerve lies directly lateral to the bone, which is the reason why fracture of the humerus at the supracondylar humeral shaft is the most common cause of a radial nerve lesion in the upper arm. The second area where the radial nerve is in direct contact with the humerus is approximately 6 cm centered around the midshaft of the humerus where the potentially palpable deltoid tuberosity is situated. Here the radial nerve lies posterior to the bone and is especially susceptible to injury in midshaft fractures (occurring in about 12% of such fractures) and iatrogenic injury after operative fixation of such fractures [4,5].

Humerus regarded as the long bone of arm, humeral shaft fractures account for about 3% of all fractures, Fractures of humeral shaft can be defined by their anatomic location or by (Arbeitsgemeinschaft fur Osteosynthesefragen) AO classification system [6], according to the AO classification all diaphyseal fractures of the humerus are divide in to type (A) simple fracture, type (B) wedge fractures and (C) type complex fractures, in general there are subdivision within each type according to the direction and extent of the fracture, fracture of middle third of the humeral shaft and AO type A are the most common type with incidence of 63.3-64. 3% [6, 7].

Holstein and Lewis found that radial nerve is vulnerable to injury at lateral supracondylar ridge by a spiral fracture of the distal third of humerus as at this point the nerve is in close contact with the bone [8]. Subsequently, Pollock and colleagues found radial nerve palsy associated with middle-third humerus fractures (60%) more often than with distal-third fractures (28%) [9].

The incidence of radial nerve injury is differ according to the site and type of humeral fracture, primary nerve palsy occurs at the time of injury and discovered during the patient's initial assessment while 10-20% of nerve palsies develop during the course of treatment following close reduction and known as secondary palsies [3,10].

According to seddons classification nerve injuries are divided in to three categories which are Neuropraxia, Axonotmesis & Neurotamesis, it has been recognized that many cases fall in to an area somewhere between axonotamesis and neurotamesis so that Sunderland (1978) offered a more practical classification (11).

Clinical presentation of radial nerve injury is vary according to the level of the injury, if the lesion is high the patient is present with wrist, thumb and finger drop with loss of sensation along the posterior surface of arm and forearm moreover low type lesion the patient presented with loss of fingers extension with preserved elbow extension and associated with loss of cutaneous sensation over the first dorsal web space [12, 13].

The aim of the study is to find the incidence, types and nature of radial nerve injury associated with humeral shaft fracture.

PATIENTS AND METHODS

This is prospective study conducted at the Sulaimani Teaching Hospital and Causality Hospital during the period of June 2009–June 2010. The study include sixty-eight patients with fractured shaft of hummers (21 females, 47 males), with an age ranging from 6 to 75 years (mean ±SE = 40± 0.67 years). Among the 68 patients 14 of them presented with neurological deficit of radial nerve dysfunction with an age ranging from 6 to 44 years (mean ±SE = 25 ± 0.67 years) (6 female and 8 male). Patients with the following conditions were excluded: fracture around the shoulder or elbow joint (supra condylar or intercondylar fractures) and pathological fracture while all patients with fracture shaft with or without radial nerve injury of different age group were included. The study has been approved by Local Research Ethics Committee of the School of Medicine. All patients gave their informed consent. A detailed questionnaire was completed for each patient. Information related to the patients condition, job, site of injury, mechanism of injury and neurologic and physical examinations were done.

Nerve Conduction Study and needle electromyography examinations were performed for those patients with radial nerve dysfunction according to the standard methods [14], using Micromed EMG/EP measuring machine (Model 171 S, code GH17ESSM/EDC, Italy) at 25 to 30°C room temperature. The following nerves were examined: a- Motor nerve conduction study of median and radial nerves, b- Median and superficial radial nerves sensory nerve conduction study, c- F

waves minimum latency (F min) of median and radial nerves.

Nerve conduction studies were performed with standard techniques of supramaximal stimulation with rings and surface recording electrodes were done for all participants [15].

The following biochemical parameters were measured:

Complete blood count.

Serum calcium.

Serum alkaline phophatase.

In addition to laboratory investigation X ray examination were performed in more than one view (anterior-posterior and lateral view), which help to diagnose the type of fracture, fracture line, and even for planning treatment.

After full investigation and clinical assessment we admit the patient and treated conservatively by applying U- shape slab, hanging cast or functional brace to stabilize the fracture site, relief pain and preserve the alignment as much as possible, after that x-ray were taken to assess the fracture or prepare the patients for surgical intervention. The majority of the patients with fracture humeral shaft treated non surgically even if there is nerve injury, some are treated surgically with open reduction and internal or external fixation. Different types of operation done specially for those with fracture humeral shaft and radial nerve injury including plate and screws, intramedullary nailing and external fixation with repair or mobilization of the nerve.

All patients with or with out radial nerve injury are followed after 4 weeks clinically and radio graphically to assess healing and alignment of the fracture and those with radial nerve dysfunction were send for nerve conduction study and electromyography to assess the type and severity of nerve injury, after that we follow up the patient clinically and electrophysiologically each 2 month, all the patients were followed up for about 6 month.

RESULTS

Among the 68 patients with fracture humeral shaft included in our study 47 patients were male (69%) and 21 patients were female (31%), and they were of different age group (Fig 1).

All the patients with fracture shaft presented with history of different types of trauma including road traffic accident (RTA), fall from a height (FFH), fall while walking or running on to the ground (FOG) or others (high velocity missile) (Table 1)

Table (2) shows that the most common site of fracture was at mid-third of humerus (48.5%) followed by lower third (29.4).

The most common type of fracture was transverse (32.4%) followed by spiral in (30.9) of patients, however oblique and comminuted constitute 26.6 and 10.3 respectively (table 3). Among 68 patients with fractured humeral shaft 14 of them presented with feature of radial nerve palsy, nerve conduction study and electromyographic assessment were performed after 4 weeks of the injury; result of EMG & NCS showed that 10 patients (72%) have only focal demyelinating lesion (neuropraxia), (21%) 3 patients with severe radial nerve injury (absent distal sensory & motor response) (neurotmesis) and 1 patient (7%) with partial radial nerve injury (axonotmesis) (fig 2)

Table (4) showing fracture type, surgical and electrophysiologic findings among patient with of humeral shaft fracture associated with radial nerveinjury

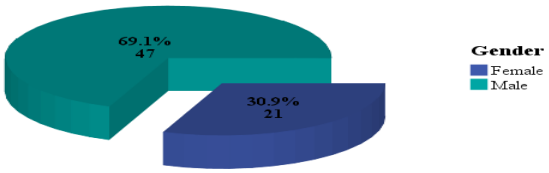

Figure 1. Gender of the patients with humeral shaft fracture.

Table 1. Shows auses of humeral fracture

	Frequency	Percent
RTA	34	50
FFH	20	29.4
FOG	11	16.2
Others	3	4.4
Total	68	100

Table 2. shows that the most common site of fracture was at mid-third of humerus (48.5%) followed by lower third (29.4).

	Frequency	Percent
Upper third	15	22.1
Middle	33	48.5
Lower third	20	29.4
Total	68	100

Table 3. shows frequency and percentage of the common site of humeral fracture.

	Frequency	Percent
Transverse	22	32.4
Spiral	21	30.9
Oblique	18	26.5
Comminuted	7	10.2
Total	68	100

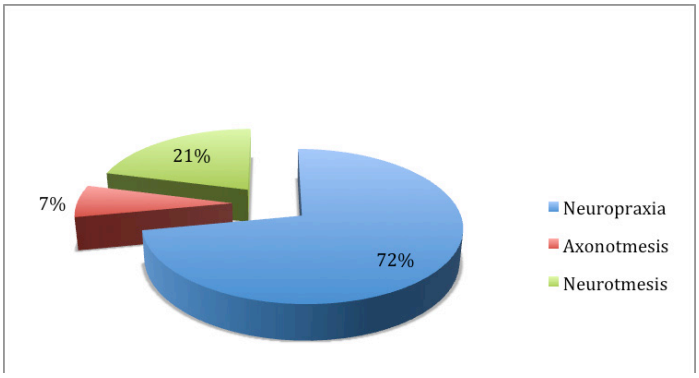

Figure 2. showing type of radial nerve injury according to neurophysiological study.

Table 4. showing fracture type, surgical and electrophysiologic findings among patient with of humeral shaft fracture associated with radial nerve injury

Number\age\sex	x-ray (Type of fracture)	EMG after 1month	EMG after 3month	Surgery	Result (Out come)
1\6 years\ Female	Oblique \ mid	Motor & Sensory loss	Complete recovery	Not performed	
2\ 15years\ Male	Oblique\ lower1\3	Motor & Sensory loss	Complete recovery	Not performed	
3\36years\Female	Oblique\ lower1\3	Motor & Sensory loss	Complete recovery	Not performed	
4\16years\Female	Transverse \ mid	Motor & Sensory loss	Motor & Sensory loss	Fixation, nerve entrapped Mobilization\ neurolysis	Cured after 6 M
5\37years\Female	Oblique\ lower1\3	Motor & Sensory loss	Motor & Sensory loss	Fixation \nerve cut \ nerve repair	Not cured
6\42years\Female	Transverse \ mid	Motor & Sensory loss	Motor & Sensory loss	Fixation\ neurolysis	Cured after 5 month
7\ 27years\ Male	Oblique \ mid	Motor & Sensory loss	Motor & Sensory loss	Fixation \ neurolysis	Cured after 4 month
8\ 35years\ Male	Comminuted \mid	Motor & Sensory loss	Motor & Sensory loss	External Fixation \ neurolysis	Cured after 5 month
9\ 25years \Male	Spiral\ lower1\3	Motor & Sensory loss	Motor & Sensory loss	Fixation \ neurolysis	Cured after 5 month
10\ 30years \Male	Spiral\ lower 1\3	Motor & Sensory loss	Motor & Sensory loss	Fixation \ neurolysis	Cured after 4 month
11\ 35years\ Male	Transverse \ mid	Motor & Sensory loss	Motor & Sensory loss	Fixation \ Neurolysis	Cured after 4 month
12\ 25years\ Male	Comminuted \mid	Motor & Sensory loss	Motor & Sensory loss	External fixation\ nerve repair	Not cured
13\ 20 years\Female	Comminuted \mid	Motor & Sensory loss	Motor & Sensory loss	External fixation\ nerve repair	Not cured
14\44years\Male	Oblique \ mid	Motor & Sensory loss	Motor & Sensory loss	Fixation \ neurolysis	Cured within 4 month

DISCUSSION

The present study showed that the prevalence of radial nerve injury in association with diaphyseal humeral shaft fracture is about 20.6% a finding which is consisting with that reported by Lim *et al* [16] and Lin *et al* [17] while our findings are consistent with that reported by Sho *et al* [3] and Amillo *et al* [18] in which they found that the incidence of radial nerve injury to be 12% and 11 % this may be due to that patients with fracture humerus with out radial nerve palsy are not consulting orthopedist instead they are treated traditionally.

Our study showed that humeral shaft fracture are more in male (69%) than female (31%), and the most common age group is below 30 years (29%) a finding which is in accordance to that reported by Bhardwaj, Swe [13] and Mast *et al* [19]. Moreover the most common site of humeral shaft fracture in this study is the middle third (48%) this is because mid shaft is the weakest area in humerus, this finding is in agreement with the study done by Tytherlieigh *et al* [20], which found that fracture of the middle third of humeral shaft are the common type.

In the present study, both clinical and electrophysiologic finding revealed that neuropraxia are the commonest form of radial nerve injury associated with fracture shaft of hummer which resolve completely and does not require any surgical intervention a finding consistent with Ammilo *et al* [18], Venouziou *et al* [21] and Ekholm *et al* [22] results. Moreover; we found that most common incidence of radial nerve injuries occur in the comminuted middle 1/3 of humeral shaft as radial nerve is in close contact with bone in the spiral groove at this level and at the junction of upper 2/3rd and lower 1/3rd where radial nerve pierces the lateral intermuscular septum. Hence, it is easily damaged by decreased mobility of the nerve and mainly associated with open wound caused by high energy injuries a findings agree with that of Foster *et al* [23].

We found that laceration of radial nerve in association with closed diaphyseal fracture of the humerus is unusual, even when the fracture is the result of a high energy injury which is in agreement with Ring et al [24] and Dabezies et al [25], while radial nerve laceration was commonly associated with open fracture of humerus this is in accordance with Venouziou *et al* [21] and Shah, Jebson [26], our data showed that only the high energy injuries are associated with nerve laceration.

In conclusion the prevalence of radial nerve injury associated with fracture shaft of hummers is higher than other literature which was 20.6% in compare 12% recorded by other authors. Moreover neuropraxia is the comments type of nerve injury in closed fracture of humeral shaft, while in comminuted fracture the prevalence of radial nerve injury is high and had poor prognosis.

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