Original Article

Incidence and Outcome of the Radial Nerve Injury following Open Fracture of the Humerus

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ABSTRACT

Background: Radial nerve injury is the most common peripheral nerve injury associated with humeral shaft fracture and can result in significant motor impairment of the arm and the wrist.

Objectives: To evaluate the incidence, pattern and outcome of the radial nerve injury following open fracture of the humerus.

Material and Methods: This is a multicentre cross-sectional descriptive study. It included all patients with radial nerve injuries following open fracture of the humerus presented to orthopaedic departments of the major hospitals in Khartoum State, Sudan during the period June 2009 - June 2013. Collected data were processed using SPSS computer package version 17.

Result: A total of 48 patients were included, 34 males and 14 females (ratio 1.5: 1). Mean age ± standard error of mean of 30.71 ± 1.78 years (ranged 4 – 64 years). About 60.4% of injuries were due to gunshot and 24 (50.0%) patients were from conflict areas. Most of the injuries were in left side in about 68.8% of patients. The common patterns of the humeral fractures associated with radial nerve injury were open comminuted and transverse of middle or distal part. Neurapraxia was common type of radial nerve injury in about 89.6%. About 91.7% of the patients were treated conservatively and 81.3% of them recovered completely.

Conclusions: Most of the radial nerve injuries following open fracture of the humerus were caused by gunshot injury in male soldiers mainly in the distal and middle parts. The fractures were mainly displaced comminuted and transverse types. The commonest type of radial nerve palsy was neurapraxia in 89.6% of cases. Most of the patients were treated conservatively and 81.3% of them recovered spontaneously after the first two months.

Keywords: Neurapraxia, Repair, Recovery, Gun shot, Sudan.

Radial nerve injury associated with humeral shaft fracture is an important injury pattern among trauma patients. It is the most common peripheral nerve injury associated with this fracture. Injuries to the radial nerve can result in significant motor impairment of the arm and the wrist with the loss of wrist extension. The ability to grasp is significantly reduced leading to a serious handicap[1].

The prevalence of radial nerve lesions after humeral shaft fractures lies between 9 and 18%[2,3]. Most commonly, radial nerve injuries are associated with middle third spiral humeral shaft fractures[3].

The radial nerve may be injured by the force that fractures the humeral shaft directly with contusion or laceration by a spur or by traction when the bone ends are forcibly separated during closed reduction[4].The risk results from the anatomic position of the radial nerve which turns around the distal portion of the humeral shaft and separated from it by a layer of triceps fibres. When the

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radial nerve pierces the lateral intermuscular septum to enter the anterior compartment of the arm, it is relatively more fixed and susceptible to injury. As a rule, radial nerve palsy following open fracture humerus regresses spontaneously, but in a few cases surgery may be required to achieve neurological recovery [5].

Strong convictions for and against either line of treatment conservative or operative can be drawn from the literature.

Opinion also differs regarding the time of operative intervention whether to go for early or delayed repair[6]. The management of radial nerve palsy associated with open fractures of the humerus is a controversial subject among upper-extremity surgeons and poses a challenge to the treating surgeon[1].

The rate of radial nerve injury following open fracture humerus is not studied before in Sudan. This study will give data about the rate and severity of radial nerve injury following open fractures of the humerus. There are no accurate records; however this is the first attempt to evaluate the condition and the outcome of management in Sudan.

MATERIAL AND METHODS:

This is a retrospective descriptive study that included 48 patients with open fractures of the humerus associated with radial nerve injury after having fulfilled the study criteria presented to orthopaedic departments during the period June 2009- June 2013. Detailed history with emphasis on mode of injury, time since injury, primary or secondary injury, details of any treatment received and history of any increase in the symptoms or recovery of the palsy was taken. Local examinations of the affected areas which include arm, forearm, wrist and hand with detailed neurological examination (motor and sensory) were performed. Motor power was tested using the medical research council scale (MRC scale). The muscles tested were brachioradialis, wrist extensors, thumb extensor and abductor, extensors of metacarpophalangeal joints. Sensory examination was done with emphasis on sensory loss over the dorsal aspect of forearm and dorsal surface of the first interosseous space that forms autonomous zone for the radial nerve. The sensations were graded subjectively compared to what the patients felt on the uninvolved side.

X-rays of arms anterior-posterior view and lateral view in order to document the level and type of fracture were reviewed. The patients with open fractures of the humerus using plain radiographs were classified using AO/OTA (Orthopaedic Trauma Association) group classification and size of wounds, and the associated radial nerve injury were evaluated clinically and with nerve conduction study (NCS) in some cases. Collected data were processed using SPSS computer package 17, after which data expressed as mean ± standard error of mean (SEM) and compared using the student's test where appropriate. Categorical data were presented as numbers with percentages and compared using X^2 analysis where appropriate. Tailed P values were used with significance at $P < 0.05$. Multivariate general linear models were used where appropriate. Ethical clearance was obtained from the ethical committees in the Sudan Medical Specialization Board and Khartoum State Ministry of Health. The limitations of our study; is the relatively small sample size. Therefore, the possibility of type 2 error with some true differences was not detected. The small sample size also restricts the ability to adequately perform multivariate analysis to identify independent risk factors.

RESULTS:

A total of 48 cases recruited from orthopaedic departments in the major hospitals in the Khartoum State between June 2009 and June 2013.

Patient age ranged between 4 and 64 years with mean ± SEM of 30.71 ± 1.78 years, 34

males and 14 females with male to female ratio 1.5: 1.

Most of the patients in this study were soldiers (47, 9%) and 24 (50.0%) patients were from conflict areas.

Forty two (87.5%) patients presented in the first week, six (10.4%) in the second week and one (2.1%) patient presented after six months. Open fractures were in the left humerus in 33 (68.8%) patients and 15 (31.3%) patients were in the right humerus.

Fractures caused by gunshot in 29 (60.4%) patients as seen in Table 1.

Table 1: Shows percentage of different mode of injuries of radial nerve (No = 48)

	Frequency	Percent
Gunshot	29	60.4
RTA	17	35.4
FFH	2	4.2
Total	48	100.0

Fractures were displaced in 43 (89.6%) patients and involve distal humerus in 21 (43.8%) patients and comminuted fractures in 20 (41.7%) patients.

The commonest type of fracture according to AO system is C 3 19 (39.6%) followed by A 3 12 (25.0%) and least common type is C1 (2.1%). Table 2

Table 2: Shows type of fracture according to AO system + their sub-groups and it is relation with radial nerve injury (No = 48)

	Frequency	Percent
A A1	5	10.4
A3	12	25.0
B B1	2	4.2
B2	3	6.3
B3	2	4.2
C C1	1	2.1
C2	4	8.3
C3	19	39.6
Total	48	100.0

Thirty seven (77.1%) patients presented with wrist drop, 25 (52.1%) patients with numbness and sensory loss from dorsolateral part of hand and radial three fingers and 20 (41.7%) patients with weakness of elbow extension.

The types of radial nerve injuries confirmed by nerve conduction studies were neurapraxia in 43 (89.6%) patients, neurotemesis four (8.3%) patients, and axonotemesis one (2.1%) patient.

Forty four (83.3%) patients with open fractures of the humerus associated with radial nerve injuries were treated conservatively and four (16.7%) patients underwent nerve exploration and repair. The patients were observed and followed for 12 months, the radial nerve recovered completely in 39 (81.3%) patients, partial recovery occur in three (6.3%) patients and there was no recovery in six (12.5%) patients. Out of thesix patients who did not recover, three patients were from those who underwent repair. In recovered cases the sensation recovered first.

Seven (14.6%) patients recovered within the first four weeks, six (12.5%) patients recovered within 8 weeks and 6 (12.55%) patients within 12 weeks.

DISCUSSION:

The study of radial nerve palsy associated with open humeral shaft fractures is limited by the relative infrequency of this injury.

The study included 48 patients with ages ranged between 4 and 64 years, with mean of 30.71 years. In literature, the ages range varied as in many studies[7-12]. Our data suggest that, the occurrence of radial nerve injury following open fracture humerus is commoner in males than females this is in agreement with the literature[7, 10, 11].

The study revealed that, the most common cause of open fracture humerus associated with radial nerve injury is gunshot in soldiers and this supported the results of others[12, 13].

In most of our patients the involved side was left humerus (68.8%) which is similar to that founded in the other studies[7, 8].

The study showed that, the radial nerve injury commonly occurred with fracture distal humerus 43.8% (21 patients) and middle third in 33.3% (16 patients) and this is comparable to that founded in the literature[7,8,11].

Most of the humeral fractures are displaced (89.5%) and this goes withthe result of the study of Ekholm R *et al.* [14].

The common pattern of humeral fractures associated with radial nerve injury was comminuted (41.7%) then transverse (20.8%) fractures and this is comparable to some reported studies[10, 11].

According to AO system the common fracture subgroup was C3 in about 39.6% followed by A3 in about 25% and this comparable to the results which founded in the studies of G Grass *et al.*[8] and Bercik *et al*[13].

In this study the most common type of radial nerve injury was neurapraxia (about 89.6%) which is comparable to the previous studies[11,15], followed by neurotemesis (about 8.3%) diagnosed by nerve conduction study and this is almost equal to the results obtained by G Grass *et al.*[8] and Ring *et al.*[10].

In our study, the common presentation was wrist drop 77.1% followed by numbness and sensory loss from dorsolateral part of hand and radial three fingers 52.1%. This is similar to results obtained in other studies[15,20]. Most of our patients were treated conservatively, observed and followed for 12 months. The frequency of complete 39(81.3%), partial 3(6-3%) and no 6(12.5%) recovery in this study is almost similar to the results of the studies of Y C Shao *et al.* [3]and G Grass *et al.*[8], and all these support the good outcome of non-operative treatment.

In this study follow-up was carried out for anaverage of 12 months. Most of the injured nerve recovered with in the first 4th week about 14.6% of patients followed by 8th week 12.5% and 3rd month 12.55% and this comparable to some studies[3,10,11,16,17]. The mean time to full spontaneous recovery was 6 months similar to others in five papers[18,19,20,21].

This study endeavour to answer the problems associated with this injury and sheds some light on its natural course in an attempt to suggest a rational treatment protocol for managing such injuries in Sudan.

CONCLUSION:

Most of the patients were males and soldiers working in the conflict areas and theypresented with wrist drop and sensory loss from dorsolateral part of hand. The commonest site of open fracture associated with radial nerve palsy was distal third fractures and common pattern of fractures was displaced comminuted fractures in the left upper limb. In agreement with other studies, most of the radial nerve injuries in our patients were neurapraxia, caused by comminuted or transverse fractures of the humerus and recovered completely after conservative treatment.

This study waves the way to multi-centres prospective and retrospective studies for longer time to evaluate the size of the problem and its incidence and outcome in our country.

There is high need to establish specialized centre for peripheral nerve injuries with optimum facilities in order to obtain better outcome.

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