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CLOSED DIAPHYSEAL HUMERAL FRACTURES IN ADULTS: A COMPARISON BETWEEN CONSERVATIVE AND OPERATIVE TREATMENT

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Abstract

Ninety patients who sustained closed humeral shaft fractures were treated in Basrah General Hospital from March 2007 to June 2008. They were 67 males and 23 females. Age ranged from 17 to 60 years. Forty-five patients (50%) were treated conservatively and the other forty-five treated surgically by open reduction and internal fixation using AO plate and screws. Middle third fractures occurred in 50 patients (55%) and the transverse fracture geometry was reported in 54 patients (60%). In conservatively treated patients, solid fracture union was achieved in 36 patients (80%) with restoration of nearly full range of motion in the shoulder and elbow joints, the average time of union was 45-60 days clinically and 60-75 days radiographically. The only complication of conservative treatment was nonunion which had occurred in 20% of cases. In surgically treated group the indications for surgery were multiple fractures in 19 patients (43%), inadequate alignment in 10 (22%), primary radial nerve palsy in 5 (11%), floating elbow in 5 (11%), non compliance in 5 (11%) and bilateral humeral fractures in one patient (2%). Following operative fixation bony union was achieved in 80% (36 patients) at an average time of 112-140 days with restoration of nearly full range of motion in shoulder and elbow joints.

Complications encountered were nonunion in 9 patients, post-operative simple wound infection in 3, osteomyelitis in 1 and secondary radial nerve palsy in 5 patients.

This study recommends conservative methods as the treatment of choice for closed fractures of the humeral shaft. Open reduction and internal fixation gives good results provided that correct indications and principles of fixation are adhered to.

Introduction

Fractures of the humeral shaft are commonly encountered by the orthopedic surgeons accounting for approximately 4-5% of all fractures[1]. Most of these fractures can be managed non-operatively with anticipated good results. The operative and non operative treatment of patient with humeral shaft fracture requires an understanding of the humeral anatomy, the fracture patterns and the level of patient activity. The role of open treatment of humeral shaft fractures remains controversial. Routine surgical management of these fractures is probably not appropriate since the results of nonoperative treatment are generally satisfactory. The generally accepted indications for surgical treatment are type III open fractures, polytrauma patient with significant head or chest injury, floating elbow (ipsilateral fracture of both forearm bones) and extensive local associated injury involving the joint, brachial plexus, muscle or tendon[2].

Patients and methods

During the period from March 2007 to June 2008, ninety adult patients with closed fractures of shaft humerus were treated at the orthopedic department in Basrah General Hospital. There were 67 males and 23 females. Age ranged from 17-60 years. Causes of injury were road traffic accidents, fall from height and

direct trauma to the arm. Conservative treatment was used in 45 patients and operative treatment in form of open reduction and internal fixation using the traditional AO plate and screws in 45 patients.

The indications for conservative treatment were nondisplaced fractures and reasonable position after closed reduction (the criteria for acceptable reduction or alignment are less than 3 cm of shortening, less than 30 degrees of varus or valgus angulation, and less than 20 degrees of anterior or posterior angulation). For stable, nondisplaced fractures, a cooptation U-shaped slab was used and retained for 7-10 days after which clinical and radiological re-evaluation of the fracture was performed. If the fracture remained nondisplaced, renewal of the slab was performed. Follow up observation of the patient and the fracture was continued at two weeks intervals until clinical and radiographic signs of union had occurred necessitating discard of the splint and the initiation of active exercises of the shoulder and elbow joints. For grossly displaced fractures, gentle closed reduction without anesthesia in the sitting position was performed either immediately after the injury or at 7-10 days following injury, as initial limb swelling which prevents early reduction had subsided. When acceptable reduction was achieved, a Plaster of Paris (POP) hanging cast was applied and the fracture was followed up every two weeks (the cast is renewed whenever needed if it had become loose) until the fracture had united and limb function was restored by active physiotherapy following removal of the POP cast.

The indications for surgical treatment of open reduction and AO plate fixation in 45 patients were: multiple fractures in 19 patients (43%), inadequate alignment in 10 (22%), associated radial nerve palsy in 5 (11%), floating elbow in 5 (11%), non compliance in 5 (11%), and bilateral humeral fractures (fracture shaft humerus in left side and supracondylar fracture in the right side) in one patient (2%). Surgery was performed between the 5th and up to the 14th day following injury. Prophylactic antibiotic (1 gram of third generation cephalosporin, Ceftriaxone) was given intravenously at 8 hourly intervals for 2 days, the first dose being started at time of induction of anesthesia. The anterolateral approach was the standard approach used in the study and it was utilized in 33 patients (73.3%). The posterior approach was reserved for lower third fractures and was used in the remaining 12 patients (26.7%). Radial nerve was explored, identified and protected in every case. A 4.5 mm AO compression plate was used in all patients and a minimum of six cortices in each proximal and distal fragment were applied through the plate. An interfragmentary compression by means of lag screw was used when required. A primary cancellous bone graft from proximal part of the ipsilateral tibia was added to fracture site in the presence of bone loss or comminution. Back slab was applied in all patients post operatively and was retained for the first week to allow for rest and soft tissue healing. After removal of the slab, a collar and cuff was used and active and assisted passive exercises for elbow and shoulder joints were encouraged. Follow up visits were arranged at two weeks intervals for the first two visits, and then at four weeks intervals. Clinical and radiographic assessments of the limb and fracture were monitored during follow up visits with special emphasis on the following parameters: wound infection, neurological status of the limb, fracture union, and restoration of limb function.

Results

Road traffic accidents were the most frequent causes of fractures in this study. It was reported in 45 patients (50%). Other mechanisms of injury are shown in

table I. Fractures in left humerus were found more frequently than in right humerus and was recorded in 51 patients (57%). The middle third of humerus was more prone to fracture and this was recorded in 50 patients (55%) followed by lower third and lastly upper third fractures (Table II). Transverse fractures of the shaft of humerus were the most commonly reported type of fracture geometry in this study. They were recorded in 54 patients (60%) followed by oblique fractures in 22 patients (24%) (Table III).

In 45 conservatively treated patients, fracture union was achieved in 36 patients (80%) with an average time of 45-60 days clinically and about 60-75 days radiologically. In the remaining 9 patients (20%), non union had developed. Of these non united fractures five were in mid shaft (all were transverse) and four were in proximal third (2 oblique and 2 comminuted fractures). No significant difference was reported between males and females in regard to susceptibility to nonunion.

In 45 surgically treated patients with plates and screws, post operative superficial wound infection had developed in 3 patients and was treated successfully by frequent wound dressing and parenteral antibiotic therapy. In another one patient frank osteomyelitis had developed and progressed to non union. Postoperative radial nerve palsy was reported in five patients (11%), the lesion in 4 patients was neuropraxia and had recovered full function within 8 weeks. One patient didn't recover and he also developed non union. Solid fracture union was also achieved in 36 out of 45 surgically treated patients (80%), but with much longer time when compared to conservative treatment (average 112-140 days for clinical and radiological union). In the remaining 9 patients (20%), non union had developed. All of them had transverse fractures, seven were in mid shaft and two in lower third (Tables IV&V). No significant difference was detected in the surgical group between males and females in regard to susceptibility to nonunion.

In surgical group, good limb function was regained in all patients who got union following a program of active shoulder and elbow exercises. The restoration of function was found to be faster in patients younger than 38 years and slower and less complete in older patients.

For both groups, conservative and surgical, nonunion of fracture had occurred in 18 patients (9 from conservative and 9 from operative treatment). Of these nonunited fractures, middle third fractures constituted 67% (total 12 cases, 5 from conservative and 7 from operative group), followed by upper third fractures in 22% and finally lower third fractures in 11% Table IV). Transverse fractures constituted 78% of all nonunited fractures in the study followed by equal distribution in comminuted and oblique patterns of 11% for each Table V. Comparison of important complications following conservative and surgical treatment is shown in table VI. The overall outcome of treatment, whether conservative or surgical is presented in table VII.

Table I: Mechanism of injury in 90 patients with humeral shaft fractures

Mechanism of injury	No. of pt.	Percent
Road traffic accidents	45	50%
Falling on the limb	30	33%
Other causes (direct trauma, falling of heavy object on the limb)	15	17%

Table II: Anatomical levels of fracture shaft humerus

Site of fracture	No. of pt.	Percent
Upper third	18	20%
Middle third	50	55%
Lower third	22	25%

Table III: Geometry of fracture shaft humerus.

Type of fracture	No. of pt.	Percent
Transverse	54	60%
Oblique	22	24%
Comminuted	8	9.5%
Long spiral	6	6.5%

Table IV:.Relation of fracture site to non union in both groups

Site of fracture	No. of pts			Percent
	conservative	operative	total	
Upper third	4	0	4	22%
Middle third	5	7	12	67%
Lower third	0	2	2	11%

Table V: Relationship of fracture geometry to non union in both groups

Type of fracture	No. of pts.	Percent
Transverse	14	78%
Oblique	2	11%
Comminuted	2	11%
Long spiral	0	0%

Table VI: Conservative versus surgical treatment with regard to complications

Complication	Conservative	Surgical
Radial N. palsy	0%	11%
Infection	0%	8%
Non union	20%	20%
Joint stiffness	0%	0%

Table VII: Outcomes following conservative and surgical treatments

Parameter	Conservative	Surgical
Union rate	80%	80%
Time of union	45-60 days	112-140 days
Alignment	Good-Accepted (some antero-posterior side way angulation)	Good
Function of the limb	Full function	Full function

Discussion

High energy trauma from road traffic accidents was the most common cause of humeral shaft fractures in this study and was reported in 50 % of patients. This was also reported to be the most common cause of humeral shaft fractures by other studies[3-6].

Involvement of left humerus in this study was more frequent than the right side (57 % versus 43% respectively). This was in contrast to many studies which had reported nearly equal side involvement in humeral shaft fractures[7].

Similar to other studies[8-11], the current study had found that middle third fractures were relatively the most common site of humeral shaft fracture and was reported in 55% of patients. Transverse fracture geometry was the most frequently reported in this study accounting for 60% of all fractures which is in acceptance with other studies[12-14]. This may reflect the high occurrence of direct and angulation forces at time of injury.

Nonoperative management remains the treatment of choice for most fractures of the humeral diaphysis; a high rate of union and satisfactory functional results has given credence to this method[8,10,14]. The conservative management utilized in this study included the use of U-shape slab for nondisplaced fractures and a hanging cast following achievement of acceptable alignment after gentle closed reduction for displaced fractures. A union rate of 80% was achieved following such conservative treatment in this study, with 45-60 days as the average time for clinical union to be evident. This time interval of clinical union achieved in the conservatively treated patients in the present study matches the results of other authors[9,11,15], but the 80% union rate in our patients seems to be relatively lower than that reported in the literatures[15-17]. Lack of compliance and tendency of our patients to early removal of the cast by themselves might be one of the causes of relative low union rate reported in this study.

If open treatment is required in humeral shaft fractures, the choice of implants includes plates and screws, intramedullary nails (reamed or unreamed and with or without locking), or external fixators. External fixation is indicated only for open fractures with extensive bone loss or when extensive comminution preludes the use of internal fixation[18]. For the operatively treated fractures in this study using AO plate and screws, a union rate of 80% was achieved with an average union time of 112-140 days. These union rates were nearly similar to the results of Muller et al[10] who reported 75% union rate with an average time of 19 weeks in their patients treated surgically with plate and screws, but lower than the 94% union rate achieved by Raghavendra and Bhalodiya[19], and 97% union rate reported by Bell et al[20] with an average time of 19 weeks in humeral shaft fractures treated by open reduction and internal fixation using plate and screws.

In this study it was noted that middle third fractures and the transverse fracture geometry were at high risk of developing nonunion whether the line of treatment was conservative or operative. The most common site for nonunion in the study was the middle third. It was reported in 12 patients (67% of all nonunited fractures) and was in acceptance with the results of other studies[8,10,11]. We agree with Klenerman[11] that the cause behind the high rate of nonunion in the middle third fractured humerus was the interference with the blood supply to the bone. The main nutrient artery usually enters the bone at the junction of the middle and lower thirds, or in the lower part of the middle third. The foramina are concentrated in a small area in the region. Damage to this vessel is most likely in fractures of the middle third of the humerus whether by the force of injury or by the surgery itself. In considering the association between transverse fracture line and the development of nonunion, 14 patients (78% of all nonunited fractures) had initial transverse fractures which had passed into nonunion following both conservative and operative treatments. This result was in acceptance with the results of other studies[8,21,22]. which had reported nonunion rates in transverse fractures to be 71%, 66%, and 70% respectively. The inherent instability of the transverse fracture and probability of

soft tissue interposition might explain the cause for the high rate of nonunion in this fracture geometry. Patient's gender was found to be a non important factor in predicting the susceptibility to nonunion in this study.

Because of the close anatomical relationship of the radial nerve with the humerus as the nerve course through the middle and distal third of the arm, and because of diminished mobility of the nerve where it pierces the lateral intermuscular septum, radial nerve may be injured by the mechanism of fracture and its consequences or by the method of treatment of humeral shaft fracture whether conservative or operative. Postoperative radial nerve palsy was reported in 5 patients (11%) in the study, four of them had recovered spontaneously within 8 weeks. The rates of postoperative radial nerve palsy reported in the literatures were variable. While Ekholm et al[23] reported that 8% of their patients developed radial nerve palsy, Gred Bodner et al[24] reported a range of 2%-18% and Bell et al[20] reported 20% occurrence of radial nerve palsy postoperatively.

Regarding the functional recovery of the limb, almost all our patients developed full recovery of shoulder and elbow movements following both treatment modalities, and this fact correlated well with other studies[8,10,11,17 and 20].

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