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№ 9466

Neer Classification on X-Ray and Computed Tomography of Patients Treated Proximal Humerus Fracture by Surgery at Military Hospital 175

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December 13, 2022

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Abstract

Objectives: Survey on clinical characteristics and medical imaging of patients with proximal humerus fracture treated by surgery at Military Hospital 175.

Subjects and methods: Retrospective descriptive study, 62 Vietnamese patients with proximal humerus fracture treated by surgery at Military Hospital 175 from January 2021 to September 2022. Evaluation of the Neer classification on X-ray and Computed tomography (CT), before surgery.

Results: Among 62 patients, there were 34 female patients (54.84%) and 28 male patients (45.16%). The male/female ratio was 1/1.21. The average age of the study subjects was 57.71 ± 14.18 years old. The age group under 65 accounted for 62.9%. Causes of injuries due to traffic accidents accounted for the most proportion, with 61.29%. The concordance of diagnosis of fracture group according to Neer's classification based on X-ray compared with CT scan in group III was 41.67%, group IV was 92.31%, in group V and group VI the concordance was 100%.

Conclusion: In general, CT scan of proximal humerus fracture helps to make the diagnosis more accurate, thereby choosing the right treatment plan and better prognosis.

Key words: Proximal humerus fracture, Neer classification

Introduction

Proximal humerus fracture (PHF) include anatomical neck fractures, greater tuberosity fractures, lesser tuberosity fractures, and surgical neck fractures. PHF is the third most common fracture in people over 65 years old, after fracture of the lower radial and upper femur, with about 77.7% cases in people over 50 years old, and about 57% cases in people over 65 years of age [2]. At Military Hospital 175, the surgical treatment of PHF has been implemented for a long time, however, there is no specific report on the method. In order to investigate the characteristics of PHF lesions to serve the treatment of patients, we conducted a study with the following objectives: "Surveying the clinical and imaging characteristics of patients with PHF were investigated surgical treatment".

Methods

Study design and population

This was a retrospective descriptive study from January 2021 to September 2022 at the Military Hospital 175 in Ho Chi Minh city, Vietnam. We recruited patients with confirmed diagnosis of PHF who underwent surgical treatment. Exclusion criteria were: (1) Pathological fractures and (2) The medical record does not contain required information.

The main variables in the study:

- The independent variable: age; gender; causes of injury: traffic accidents (TRA), household accidents (HOA) , workplace accidents (WOA), sport accidents (SPA); combined pathology

- The dependent variable: Number of fracture parts on X-ray and Computed tomography (CT); Neer classification on X-ray and CT.

Statistical analysis

Patients' characteristics and study outcomes were summarized by counts and percentages for categorical variables, and median for continuous variables. P-values were two-sided and those of < 0.05 were considered as statistically significant difference. All analyses were performed using the statistical software Stata version 16.0.

Results

General characteristics of the study subjects

Table 1: General characteristics of the study subjects

	n=62	< 65 years old	≥65 years old
Gender	Male: 28 (45,16%) Female: 34 (54,84%)	Male: 23 (58,97%) Female: 16 (41,03%)	Male: 5 (21,74%) Female: 18 (78,26%)
Gender ratio	1 / 1,21	1,44 / 1	1 / 3,6
Mean of age	57,71 ± 14,18 years old min = 16 years old max = 80 years old	49,62 ± 11,35 years old min = 16 years old max = 64 years old	71,43 ± 4,71 years old min = 65 years old max = 80 years old
Causes of injury	TRA: 38 (61,29%) HOA: 22 (35,48%) SPA: 1 (1,61%) WOA: 1 (1,61%)	TRA: 31 (79,49%) HOA: 8 (20,51%)	TRA: 7 (30,43%) HOA: 14 (60,87%) SPA: 1 (4,35%) WOA: 1 (4,35%)
Combined pathology	TRA: 24/38 HOA: 18/22 SPA: 0/1 WOA: 1/1	TRA: 18/31 HOA: 5/8	TRA: 6/7 HOA: 13/14 WOA: 1/1

Comment: Among 62 patients, there were 34 female patients (54.84%) and 28 male patients (45.16%). The ratio of male/female was 1/1.21, the difference was not statistically significant (p>0.05, Chi-squared test). The age of the patients ranged from 16 to 80 years old. The cause of injury due to traffic accidents is the most with 61.29%. Among 62 patients, there were 43 patients with comorbidities.

Injury characteristics base on the diagnostic imaging

Table 2: Neer classification on X-ray (n=62)

Group	Number of fracture parts			Total	%
	2 parts	3 parts	4 parts		
I	0	0	0	0	0
II	0	0	0	0	0
III	25	0	0	25	40,32
IV	6	16	1	23	37,10
V	0	0	3	3	4,84
VI	3	5	3	11	17,74
Total	34	21	7	62	
%	54,84	33,87	11,29		100

Comment: There were no fractures in group I, group II. PHF into 2 parts was the most common with 34 cases, about 54.84%. The most common PHF in group III were 25 cases, with 40.32%.

Table 3: Neer classification on Computed tomography (n=36)

Group	Number of fracture parts			Total	%
	2 parts	3 parts	4 parts		
I	0	0	0	0	0
II	0	0	0	0	0
III	6	0	0	6	16,67
IV	2	11	6	19	52,78
V	0	0	2	2	5,56
VI	0	4	5	9	25,00
Total	8	15	13	36	
%	22,22	41,67	36,11		100

Comment: There were no fractures in group I, group II. PHF into 3 parts was the most common with 15 cases, about 41.67%. The most common PHF in group IV were 19 cases, with 52.78%.

Table 4: Compare the number of fracture parts between X-ray and Computes tomography

X-ray	Computed tomography			Total	%	Do not perform CT
	2 parts	3 parts	4 parts			
2 parts	7	9	1	17	47,22	17
3 parts	1	6	6	13	36,11	8
4 parts	0	0	6	6	16,67	1
Total	8	15	13	36		26
%	22,22	41,67	36,11		100	

Comment: Among 17 cases PHF into 2 parts on X-ray, there were 7 cases (41.18%) corresponding to the number of fracture parts on CT, 10 cases were not suitable. Among 13 cases PHF into 3 parts on X-ray, there were 6 cases (46.15%) corresponding to the number of fracture parts on CT, 7 cases were not suitable. Among 6 cases PHF into 4 parts on X-ray, 100% of cases corresponding to the number of fracture parts on CT.

Table 5: Compare the group of PHF between X-ray and Computes tomography

X-ray	Computed tomography						Total	%	Do not perform CT
	I	II	III	IV	V	VI			
I	0	0	0	0	0	0	0		
II	0	0	0	0	0	0	0		
III	0	0	5	7	0	0	12	33,33	13
IV	0	0	1	12	0	0	13	36,11	10
V	0	0	0	0	2	0	2	5,55	1
VI	0	0	0	0	0	9	9	25	2
Total	0	0	6	19	2	9	36		26
%			16,67	52,78	5,55	25		100	

Comment: Among 12 cases PHF group III on X-ray, there were 5 cases (41.67%) corresponding group III on CT, 7 cases were not suitable. Among 13 cases PHF group IV on X-ray, there were 12 cases (92.31%) corresponding group IV on CT, 1 case was not suitable. 2 cases of PHF group V and 9 cases of PHF group VI on X-ray were corresponding to the group of fractures on CT.

Discussion

General characteristics of the study subjects

In our study, the mean age was 57.71 ± 14.18 years old. The youngest case was 16 years old and the oldest was 80 years old. The mean age of male was 52 ± 14.87 years old, the mean age of female was 62.41 ± 11.85 years old. In this study, there were 39 patients aged under 65 years old (62.9%), this is the main working age of the family and society. There were 23 cases (37.1%) less in the age group over 65 years old than in the group under 65 years old, these were mainly elderly cases often associated with osteoporosis and and other comorbidity such as hypertension, diabetes, osteoarthritis, chronic bronchitis...

Reza M. (2014) reported that PHF accounted for about 5-6% of all adult fractures and tended to increase in the elderly. The author believed that this type of fracture was common in the elderly group with osteoporosis [6].

There were 34 female patients, accounting for 54.84%, 28 male patients, accounting for 45.16 %, the difference was not statistically significant ($p > 0.05$). However, in the group over 65 years old, there was a statistically significant difference in the proportion of male and female ($p<0.05$).

Hossam A. (2013) researched on PHF in young people showed that in the young age group, PHF in men were more common than in women [4]. The results of our study also have similar results, in the group of people under 65 years of age, the proportion of men with PHF is higher than that of women, mainly due to traffic accidents, accounting for 46.15%.

In our study, PHF were mainly caused by four groups of causes: traffic accidents, household accidents, workplace accidents, and sport accidents. The cause of traffic accidents had the highest number of 38/62 cases, accounting for 61.29%. The age group under 65 had 31/39 cases (79.49%), this was also the group with a great need to participate in traffic. The age group over 65 years old, the rate of PHF due to traffic accidents was lower, only 7/23 cases (30.43%). The report of Hessmann M. (1999) only had 18/142 cases (12.7%) with PHF due to traffic accidents [3]. Thereby, it showed that the rate of PHF due

to traffic accidents in our country was higher than that of developed countries. As a developing country, motor and rudimentary vehicles have increased rapidly in recent years and are concentrated in big cities. In addition, people's awareness is not good or they are not understanding about traffic. This requires us to strengthen propaganda and education to people to obey traffic laws to prevent transport crashes.

Besides, the cause of household accidents was 22/62 cases (35.48%), 14/23 cases (60.87%) of those aged over 65 years old. This ratio shows that, in the elderly, the quality of the bones is poor, so just a light trauma such as a slip and hit the shoulder, a fall on the arm when walking is enough to cause a fracture. The research by Hessmann M. (1999) had 76/142 cases (53.52%) fractures were caused by falls at home [3]. This poses the problem of propagating and educating people on preventing the risk of falls in the elderly such as: Maintaining physical activity; Vision and hearing tests; Get enough sleep; Limit alcohol and stimulants; Avoid sudden movements; Use a fall prevention aid.

In our study, 43/62 patients had comorbidities. The most common was hypertension with 11 cases (25.58%), in addition to diseases such as diabetes, respiratory disease, osteoarthritis, gout, ...

In the group under 65 years old, the combined injuries caused by traffic accidents such as bone injuries at other locations, wounds, and traumatic brain injuries accounted for the majority with 12 cases (30.77%), while those due to household accidents only had 5.13%. In contrast, in the age group over 65, the elderly's medical diseases were the main ones with 16/20 cases having a combination disease, accounting for 80%. This showed that the elderly had more complex health care problems, the stable screening of comorbidities, prolonging the treatment day for elderly patients needed to surgical treatment. In addition, in the elderly, often with multiple comorbidities, the diagnosis could be complicated, leading to slow, missed, or erroneous diagnoses, made drug use inappropriate. Therefore, comprehensive examination and evaluation must be carried out specifically and thoroughly to help improve care and clinical outcomes, more accurately diagnose, and reduce mortality.

Injury characteristics base on the diagnostic imaging

Surved on conventional X-ray images of 62 cases according to Neer's classification [1]. In our study, the number of group I, II - nondisplaced fractures was absent because the group I, II fractures were either undisplaced or less displaced and were treated conservatively.

For one thing, the results of Table 2 showed that when classifying based on X-ray, we encountered 25 cases of group III (only surgical neck fracture), about 40.32%. Group IV had 23 cases, accounting for 37.1%, according to Neer’s classification, group IV was the group with greater tuberosity fracture. In this group, we encountered 6 cases only with greater tuberosity fracture, the number of greater tuberosity fractures accompanied by surgical neck fractures was 16 cases and 1 case of four-part fracture, that was, both greater tuberosity, surgical neck, and lesser tuberosity were fracture. There were 3 cases (4.84%) of group V, in which all three cases had four-part fractures, that meant, both greater tuberosity, lesser tuberosity fractures, and surgical neck were fracture. There were no cases of two-part lesser tuberosity fracture and also no case of three-part lesser tuberosity fracture. And there were 11 cases of fracture in group VI (17.74%), in this group, there were 3 cases of surgical neck fracture with shoulder dislocation, 5 cases with surgical neck, greater tuberosity fracture and shoulder dislocation, and 3 case of four-part fracture combined dislocation.

For another, the results of Table 3 showed that the number of cases with CT scan after taking X-ray was 36. With these cases, based on the normal shoulder X-ray image, it is difficult to determine the displacement between the fragments because superposition. Therefore, there is not enough evidence to evaluate the displacement, so a CT scan is a necessary indication.

When classify these 36 cases with CT scan, we encountered 6 cases of group III (16.67%), 19 cases of group IV (52.78%), 2 cases of group V (5.56%), and 9 case of group VI (25%). According to the number of fracture parts, the result of CT scan from Table 3 showed that there were 8 cases of two-parts fracture (22.22%), in which there were 6 cases of displacement surgical neck fracture, 2 cases with displacement of greater tuberosity fracture (group IV). After that, the number of three-part fractures was 15 cases (41.67%), in which there were 11 cases of surgical neck fracture accompanied by greater tuberosity (group IV), 4 cases of surgical neck fracture, combined broken greater tuberosity and shoulder dislocation (group VI). Moreover, the number of four-part fractures was 13 cases (36.11%), including 6 cases of group IV, 2 cases of group V and 5 cases of group VI.

Compared with X-ray result, among 12 cases of group III on X-ray, when surveyed on CT, there were 7 cases classified into group IV due to additional fracture of greater tuberosity. Besides, among 13 cases of group IV on X-ray, there were 12 cases (92.31%) corresponding to group IV on CT, however, in those 12 cases, there were 4 cases increased in the number of fracture parts through CT scan, 1 case on CT showed that only had two parts, so it should be transferred to group III. And 2 cases of group V on X-ray, both corresponding to fracture group on CT scan. In addition, among 9 cases of group VI, there were 5 cases, although there were no change in the fracture group on CT, but had a change in the number of fracture parts. As a result, CT scan allowed us to assess more detailed and sufficient of the number of fracture parts, the displaced level, the attachment of the two ends and the multi-fragmentation fracture degree.

Meleán P. (2017) [5] studyed on 97 patients with PHF to analyze and find the correlation in the measurements between shoulder joint on X-ray and CT scan in patients with PHF. The results showed that, there were 12 cases initially based on X-ray, conservative treatment was indicated, but when surveyed on CT, it changed to surgical treatment and 19 other cases with PHF were indicated conservative treatment based on CT while X-ray images were directed towards surgical treatment.

Stoddart M. (2020) [7] studyed on 22 patients with PHF, the report showed that, with PHF, CT scan gave higher reliability than X-ray in classifying fracture, affecting to treatment decision, up to 41% of patients.

Conclusion

In general, it must be recognized that CT scan of the PHF helps to make the diagnosis which is more accurate, thereby choosing the appropriate treatment plan and the prognosis is better.

Petition

It is recommended to allow the indication of CT scan with three dimension reconstruction in PHF to have more scientific basis to develop a treatment plan for the patient.

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