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The relation between scapula fracture and the severity of trauma in blunt thoracic trauma

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Background/aim: The aim of this study was to determine the level of presence of scapula fractures (SFs) in cases of blunt thoracic trauma and to identify other injuries accompanying SF.

Materials and methods: Blunt thoracic trauma cases with SF determined on direct radiography or computerized tomography (CT) were categorized as Group 1. Group 2 was constituted by selecting cases with high injury severity score (ISS) with no SF. The demographic characteristics and all injuries of the patients were evaluated.

Results: SF was determined in 77 (11.3%) patients (Group 1), and Group 2 consisted of 607 patients. The ISS was significantly higher in Group 1 (27.7 ± 16.1) than Group 2 (15.9 ± 9.5) (P < 0.001). The rate of SF with direct radiography was only 9.1%, and more than 90% of patients were evaluated using CT. The most common accompanying injury to SF was rib fracture (44.2%), and the odds ratio was 2.4 (95% CI: 1.51–3.72).

Conclusion: The incidence of SF in cases of blunt trauma was higher than in previous studies. The use of CT in blunt trauma can determine SF that cannot be identified through physical examination or radiography, and the most commonly observed accompanying damage in these patients is rib fracture.

Key words: Scapula fractures, Tomography, Trauma

1. Introduction

Blunt thoracic trauma patients constitute 20% of trauma-related deaths (1). Scapula fracture (SF) generally occurs as a result of high-energy trauma and is usually seen together with significant organ or system injuries. When SF is determined there could also be damage to other organs and systems, primarily the thorax (2–4). In patients with trauma, the injury severity score (ISS) is associated with the severity of the trauma. The values of ISS representing trauma severity are stated as 0–8 = minor, 9–15 = moderate, 16–24 = quite severe, and >24 = severe (5).

SF may often not be able to be initially identified on chest radiography. This may be due to the inadequate quality of radiographic imaging or that differentiation may not be able to be clearly made of radiographic images associated with thoracic damage (subcutaneous emphysema, pulmonary contusion, pneumothorax) (6,7). However, in the presence of life-threatening injuries in patients with SF, evaluation of the scapula may take second place and may cause the physician evaluating the patient to not recognize the fracture. In cases with thoracic trauma in particular, despite scapula injury not being considered in the physical examination or on radiographs, the determination of SF on computerized tomography (CT) is noticeable (7–10). In recent years, there has been increased use of CT in trauma patients due to the more easy availability of technology, increasing defensive medical practices, and concerns about malpractice. Therefore, according to previous studies, in patients with blunt thoracic trauma, when accompanying injuries and the energy level of the trauma are taken into consideration, there could be several differences.

The aim of our study was to determine the level of presence of SF in cases of blunt thoracic trauma and to identify other injuries, particularly thoracic injuries, accompanying SF.

2. Materials and methods

2.1. Study design

Approval for the study was granted by the local ethics committee (No. 2016-04/01). A retrospective study was made of patients who presented to the Emergency Department (ED) of Kırıkkale University Hospital

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with blunt thoracic trauma between January 2010 and January 2015. The patients' data were retrieved from the hospital archives and the computerized records system. Records were traced manually from the Medical Records Department with the help of ICD-10 coding. Missing records and cases with incomplete data were excluded. For all cases with thoracic trauma, a record was made of the demographic data, trauma mechanism, physical examination findings, anatomic classification of SF, and trauma scores such as the ISS, Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), and Pediatric Trauma Score (PTS).

2.2. Patient groups

Cases with SF determined on direct radiography or CT were categorized as Group 1. No SFs were classified in Group 2. In establishing Group 2, in order to be able to exclude cases of minor trauma, the lowest ISS value identified in Group 1 was employed as a reference, and Group 2 was constituted by selecting cases with high ISS values, rather than cases with (mild) blunt thoracic trauma below this ISS with no SF. In this way, all cases of SF were included in the study while cases of mild thoracic trauma were excluded.

2.3. Statistical analysis

All the data were analyzed using SPSS 23.0 (IBM Corp., Armonk, NY, USA). Data were presented as mean and standard deviation (SD). The statistical tests applied were Student's t-test for parametric data and Fisher's exact test and chi-square analysis for binary nonparametric data. ANOVA was used for multivariate continuous data and chi-square analysis for multivariate binary data. The results were evaluated at a 95% confidence interval and statistical significance was accepted as $P < 0.05$.

3. Results

A total of 2059 thoracic trauma patients were admitted in this period. SF was determined in 77 patients (Group 1). The lowest ISS was calculated as 9 in Group 1. Patients with ISS of <9 (those with local pain, grazes and abrasions related to assault, local trauma, and sports injuries) were excluded. The rest of the patients were considered as Group 2. Those were 607 cases without SF and ISS score ≥9 (Group 2).

In Group 1, 74% (n = 57) patients were male and the mean age of the group was 45.6 ± 17.4 years. In Group 2, 69.5% (n = 422) patients were male and the mean age of the group was 35.9 ± 21.4 years. Pediatric patients were significantly fewer in Group 1 (2.6%) than Group 2 (19.1%) ($P < 0.001$). There were no statistically significant differences between males and females in the groups ($P = 0.546$). However, we found a statistically significant difference between the groups in terms of age ($P < 0.001$).

The trauma scores were as follows: ISS, 27.7 ± 16.1 in Group 1 and 15.9 ± 9.5 in Group 2; GCS, 14.2 ± 2.6 in Group 1 and 14.6 ± 1.8 in Group 2; RTS, 11.6 ± 1.7 in Group 1 and 11.9 ± 0.7 in Group 2; PTS, 7.5 ± 0.7 in Group 1 and 11.8 ± 8.5 in Group 2. No statistically significant difference was determined between the groups with respect to GCS, RTS, or PTS. However, the ISS was determined to be statistically significantly higher in Group 1 ($P < 0.001$).

In both groups, the most common mechanism of the development of thoracic trauma was determined to be associated with a motor vehicle accident. The rate of assault and physical trauma was determined to be higher in Group 1 (11.7%), while the rate of a fall from heights was higher in Group 2 (27.3%) (P = 0.039, 0.028, respectively). No difference was determined between the groups with respect to other mechanisms of trauma (Table 1).

When the localization of injuries accompanying thoracic trauma was evaluated, in Group 1, there was no isolated thoracic trauma. In Group 2, the isolated thoracic trauma rate was 1.9%. In both groups, the most common injuries were head and maxillofacial injuries (36.4% and 39.7%, respectively) (Table 2).

The complaints of the patients with SF on presentation at the ED were determined as shoulder pain (50.6%) and chest pain (40.3%). The complaints on presentation could not be evaluated in 6.5% of cases as the patient was in a coma. In the evaluation of SFs with respect to anatomic localization, fractures were seen most in the scapula body

Table 1. Distribution of the groups according to the trauma mechanism.

Mechanism of trauma	Group 1 (n = 77),	Group 2 (n = 607),	Total (n = 684),	P
	n (%)	n (%)	n (%)	
Traffic accident	55 (66.2)	348 (57.5)	403 (58.9)	0.236
Falling from heights	9 (11.7)	166 (27.3)	175 (25.6)	0.028
Assault or physical trauma	9 (11.7)	40 (6.6)	49 (7.1)	0.039
Falling in place	4 (5.2)	18 (2.9)	22 (3.2)	0.518
Motorcycle accident	4 (5.2)	32 (5.3)	36 (5.3)	0.215

Table 2. The localization of other system injuries accompanying thoracic trauma.

Localization of trauma	Group 1 (n = 77), n (%)	Group 2 (n = 607), n (%)
Isolated TT	–	12 (1.9)
TT + MT localization	77 (100)	595 (98.1)
• Head and maxillofacial	28 (36.4)	241 (39.7)
• Upper extremity	19 (24.7)	183 (30.1)
• Clavicle	10 (12.9)	37 (6.1)
• Lower extremity	9 (11.7)	159 (26.2)
• Pelvis	7 (9.1)	80 (13.2)
• Abdomen	7 (9.1)	80 (13.2)
• Vertebra	6 (7.8)	104 (17.1)
• Other	1 (1.3)	8 (1.3)

TT = Thoracic trauma; MT = multiple trauma.

(44.2%), followed by the scapula spine (26%). Diagnosis of patients with SF was made from CT for 90.9% and from direct radiography for only 9.1%. Conservative treatment was applied for 97.4% of patients with SF and surgical treatment for only 2.6% (Table 3).

The patients were grouped according to the thoracic damage that developed and were examined separately for chest wall, pleura, and parenchyma damage, and the odds ratios were calculated. With respect to thoracic wall damage, while SF was accompanied by rib fracture in Group 1 at a rate of 44.2%, this rate was 18.6% in Group 2. According to these data, the odds ratio of rib fracture with SF was determined as 2.4 (95% CI: 1.51–3.72). With respect to pleural damage, the most observed pathology in both groups was simple pneumothorax and the odds ratio was 1.18 (95% CI: 0.56–2.47). With respect to lung parenchyma damage, the most observed pathology in both groups was pulmonary contusion and the odds ratio was 1.42 (95% CI: 0.71–2.81) (Table 4).

4. Discussion

Compared to other bones, SFs are rare (6). This is because not only is the scapula protected by the thick muscle layer that surrounds it, but also the scapula body is located posterolaterally (11,12). SF has been reported to be determined in 0.5%–3.8% of all multitrauma cases (13,14). Recent studies considering the ISS reported higher incidences for SF. Weening et al. and Veysi et al. reported the incidence of SF as 3.7% and 6.8% in selected patients with higher ISS values (ISS >12 and ISS >16, respectively) (15,16). Our study was conducted with patients presenting to the ED with moderate and high levels of isolated or

Table 3. Accompanying thoracic damage and odds ratios of the groups.

	Group 1 (n = 77), n (%)	Group 2 (n = 607), n (%)	Odds ratio (95% CI)
Chest wall injury			
• Rib fracture	34 (44.2)	113 (18.6)	2.37 (1.51–3.72)
• Sternum fracture	2 (2.6)	17 (2.8)	0.92 (0.21–4.09)
• Subcutaneous emphysema	8 (10.4)	32 (5.3)	1.97 (0.87–4.43)
• Flail chest	–	5 (0.8)	–
Pleural injury			
• Simple pneumothorax	9 (11.7)	60 (9.9)	1.18 (0.56–2.47)
• Tension pneumothorax	2 (2.6)	10 (1.6)	1.57 (0.33–7.32)
• Hemothorax	4 (5.2)	21 (3.5)	1.50 (0.50–4.48)
• Hemopneumothorax	6 (7.8)	41(6.8)	1.15 (0.47–2.80)
Parenchymal injury			
• Pulmonary contusion	11 (14.3)	61 (10.1)	1.42 (0.71–2.81)
• Pulmonary laceration	–	2 (0.3)	–
• Pneumomediastinum	1 (1.3)	7 (1.2)	1.12 (0.13–9.27)

CI = Confidence interval.

Table 4. The general characteristics of the scapula fractures.

Patients with scapula fractures (n = 77)	
Complaints and physical examination findings	n (%)
• Shoulder pain	39 (50.6)
• Chest pain	31 (40.3)
• Localized tenderness	27 (35.1)
• Limitation of range of abduction	23 (29.9)
• Dyspnea	21 (27.3)
• Local ecchymosis	8 (10.4)
• Coma	5 (6.5)
• Hemoptysis	3 (3.9)
Anatomical localizations of scapula fractures	
• Scapula body	34 (44.2)
• Scapula spine	20 (25.9)
• Coracoid process	6 (7.8)
• Acromion	4 (5.2)
• Glenoid cavity	4(5.2)
• Scapula neck	3 (3.9)
• Combined	6 (7.8)
Diagnostic method used in scapula fracture	
• Direct radiography	7 (9.1)
• Computerized tomography	42 (54.5)
• Computerized tomography + direct radiography	28 (36.4)
Treatment method applied for scapula fracture	
• Conservative	75 (97.4)
• Surgery	2 (2.6)

multiple trauma. SF was determined at the rate of 11.3%. The results from our study show that the incidence of SF in cases of blunt trauma with moderate and high ISS values was higher than those of previous studies (13–17). This result is closely associated with the use of CT in the study. In the current study, when investigating other organ or system injuries accompanying SF, trauma severity was defined as ≥9, and by excluding mild thoracic trauma, SF evaluation was made in moderate and severe trauma cases. Although previous studies did not give clear information on the use of CT in the diagnosis of SF, it can be understood that the majority of cases have been diagnosed with direct radiography. Compared with previous studies where the diagnosis of SF has been made with radiography, this result can be considered more accurate.

Variable results have been obtained in previous studies related to injuries accompanying SF. Pneumothorax has been reported at 9%–38% and pulmonary contusion at 8%–54% (18–25). Tucek et al. reported that rib fracture was the most common injury accompanying SF, followed by pleural and parenchymal injuries (pneumothorax, hemothorax, contusion) (26). Veysi et al. reported that in multitrauma cases with ISS >15, rib fracture was seen most often together with SF (16). In the current study, all thoracic trauma cases were evaluated and the most frequently observed chest wall damage was determined to be rib fracture, the most frequently observed pleural injury was pneumothorax, and the most frequent parenchymal damage was pulmonary contusion. The results obtained in the current study were similar to the findings reported in previous studies in the literature. Clavicular, extremity, and abdominal injuries are other injuries that may be seen accompanying SF. Previous studies reported upper extremity fractures (17%–37%), lower extremity fractures (8%–26%), and abdominal organ injuries (3%–13%) together with SF (21–24). In the current study, upper extremity fractures accompanying SF were determined at 24.7%, lower extremity fractures at 11.7%, clavicular fracture at 12.9%, and abdominal organ injuries at 9.1%. These results are low compared to the rates in previous studies, which may be attributable to the anatomic exposure points on the body affected by kinetic energy or different parts of the body of the current study's patients being exposed to less kinetic energy at the time of trauma.

In SF developing as a result of exposure to high-energy trauma, the most frequent mechanism of trauma is traffic accidents. While 50% of cases are caused by motor vehicle accidents, this is followed by pedestrian accidents and other reasons (fall from height, assault, sports injuries) (27,28). SF is rarely seen associated with isolated thoracal trauma. In the current study, traffic accidents were determined as the most common mechanism of trauma and no SF was observed in patients with isolated thoracic trauma. This suggested that the trauma energy to which there was exposure was related to much lower kinetic energy when compared with high-energy trauma such as traffic accidents and falls from heights.

When studies are examined related to the anatomic localization of SF, fractures of the scapula body are seen to be the leading site, followed by the glenoid cavity and other localizations. Although there is no detailed information in these studies about the degree of the fractures, there is a limited rate of CT use in fracture diagnosis (18,19). In the current study, with CT used in the identification of patients with SFs, the most frequent anatomic localization of fractures was the scapula body, followed by the scapula spine then other localizations (acromion, coracoid process, neck, and combined). That CT imaging was used in the identification of anatomic localizations of the fracture could be of point of guidance on this subject.

It has been reported in previous studies that conservative treatment is sufficient in cases of SF (29,30).

However, in fractures in some localizations (especially glenoid, neck, coracoid, and acromion), there is evident dysfunction in shoulder movements and conservative treatment remains insufficient. In these cases, surgical treatment may be necessary and the basic indicators of this are fracture localization, displacement, and adjacent organ damage (31,32). In the current study, the rate of anatomic fractures that could require surgery was determined as 22.1%. However, surgery was only applied in two cases. That the rate of the need for surgery was at a low level was considered to be related to a clearer understanding of the need of the patient for surgical treatment and better evaluation of fracture localization, displacement, or adjacent organ damage, associated with the use of CT.

In conclusion, with the increasing use of CT imaging in blunt thoracic trauma patients, this study can be considered of value in terms of showing the true incidence of SFs, and the incidence of SF was higher than that previously reported in the literature. The use of CT in patients with blunt trauma can determine SFs that cannot be identified through physical examination or radiography, and those that are also clinically unimportant and generally do not require surgery. The most commonly observed injury in patients with SF is rib fracture.

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