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A Retrospective, Cross-Sectional, Descriptive Research: Evaluation of Traumatic Respiratory Impairment Cases That Were Sent to the Turkish Council of Forensic Medicine 3rd Speciality Board in 2020

Adli Tıp Kurumu 3. Adli Tıp İhtisas Kuruluna 2020 Yılı İçerisinde Başvuran Travmatik Solunumsal Maluliyet Olgularının Değerlendirilmesi: Bir Retrospektif Kesitsel Tanımlayıcı Araştırma

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¹The Ministry of Justice Council of Forensic Medicine, İstanbul, Turkey

²Giresun University Faculty of Medicine, Department of Forensic Medicine, Giresun, Turkey

ABSTRACT

Objective: It is important to determine whether there is a long-term loss of respiratory function in people who have had thoracic trauma, both in respect of the clinical follow-up of cases and in judicial terms (punishment/compensation). As there are no recent studies of large case series on this subject in literature, the aim of this study was to examine the data related to the nature of trauma and sequelae associated with the respiratory disability of trauma origin, and by reviewing the basis of sequela evaluation, to contribute to future clinical studies to reduce morbidity in thoracic trauma patients and to specialists working in the field of disability.

Methods: A retrospective review was performed by examining the medical records of cases with thoracic trauma referred to (Turkish Council of Forensic Medicine 3rd Speciality Board) between 01/01/2020 and 31/12/2020 for evaluation of disability following trauma (workplace accident, assault, traffic accident). The data were retrieved from the electronic database.

Results: The ages of the cases included in the study ranged from 8 to 84 years, with a median age of 44. When the gender distribution was evaluated, it was seen that 85.3% of the cases were male (n=133), and 14.7% were female (n=23). As a result of all the evaluations, it was determined that 10 (6.4%) cases had a loss of pulmonary function due to thoracic trauma, and the disability rate was determined.

Conclusion: As evaluation made on the basis of test results or examination findings alone when determining respiratory function losses can be erroneous, the decision must be made with examinations in specialized centers by experienced physicians guided by respiratory function tests and assistive and supportive imaging results.

Keywords: Thorax trauma, respiratory functions, disability



Address for Correspondence/Yazışma Adresi: Hakan Efil, The Ministry of Justice Council of Forensic Medicine, İstanbul, Turkey
E-mail: hefil@hotmail.com
ORCID ID: orcid.org/0000-0002-6539-7219

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ÖZ

Amaç: Toraks travması geçiren kişilerde uzun dönemde solunumsal fonksiyon kaybının olup olmadığının tespiti hem olguların klinik takipleri açısından hem de adli açıdan (ceza/tazminat) önemlidir. Bu çalışmada literatürde geniş olgularla güncel çalışmaların bulunmadığı travma kaynaklı solunumsal maluliyet ile ilgili olarak, travmanın niteliği ve sekellerle ilgili verileri ortaya koymak, sekel değerlendirme esaslarını gözden geçirmek, göğüs travmalı hastalardaki morbiditenin azaltılması için yapılacak klinik çalışmalara ve maluliyet alanında çalışan uzmanlara katkı sunmak amaçlanmıştır.

Yöntem: 01/01/2020-31/12/2020 tarihleri arasında (Adli Tıp Kurumu 3. Adli Tıp İhtisas Kurulu'na) travma sonrası maluliyet ya da engellilik değerlendirilmesi için gönderilen olgulardan toraks travması olanların tıbbi belgeleri geriye dönük olarak elektronik ortamda incelenerek verilere ulaşıldı.

Bulgular: Çalışmaya dahil edilen olguların yaşları 8 ila 84 arasında değişmekte olup ortalama yaş 44'tü. Cinsiyet dağılımı değerlendirildiğinde, olguların %85,3'ünün erkek (n=133), %14,7'sinin kadın (n=23) olduğu görüldü. Yapılan tüm değerlendirmeler sonucunda 10 (%6,4) olguda toraks travması kaynaklı pulmoner fonksiyon kaybı olduğu tespit edilerek maluliyet oranı belirlendi.

Sonuç: Solunum fonksiyon kayıpları tespit edilirken tek başına tetkik sonuçları ya da muayene bulguları üzerinden değerlendirme yapılması hatalı olacağından, yardımcı ve destekleyici olarak kullanılan görüntüleme sonuçları ve solunum fonksiyon testleri eşliğinde deneyimli hekimlerce özelleşmiş merkezlerde yapılacak muayenelerle karar verilmelidir.

Anahtar Kelimeler: Toraks travmaları, solunum fonksiyonları, maluliyet

INTRODUCTION

The chest trauma can cause serious morbidity and mortality, therefore the appropriate treatment has vital importance. There may be distinctive chest pain, chest destruction, hypoventilation, infection and respiratory distress (1).

Thorax traumas are separated into two groups as blunt or penetrating trauma. Injuries from stubs and firearms injuries are classified as penetrating trauma, and blunt thorax trauma generally occurs as a result of traffic accidents within or outside the vehicle, falls from height, or from being struck with a blunt object (2). In various studies, rib fractures are generally the leading chest wall pathology due to trauma (3). Following thoracic trauma, although hemopneumothorax and contusion in the lungs are most frequently determined, early complications such as atelectasis, ARDS, infections, empyema, bronchopleural fistula, bronchial stenosis, and chylothorax are also seen (2).

The determination of whether or not there is a loss of respiratory function in the long-term in patients who have experienced thoracic trauma is important both in respect of the clinical follow-up of cases and in judicial terms (punishment/compensation). The combined use of radiographs, spirometry, arterial blood gas, and exercise tests is recommended in the evaluation of permanent function loss (4).

The aim of this study was to examine the data related to the nature of trauma and sequelae associated with the respiratory disability of trauma origin and to contribute to future clinical studies to reduce morbidity in thoracic trauma patients and to specialists working in the field of disability.

MATERIALS and METHODS

A retrospective review was made of the medical records of cases with thorax trauma referred to (Turkish Council of Forensic Medicine 3rd Speciality Board) between 01/01/2020 and 31/12/2020 for evaluation of disability following trauma (workplace accident, assault, traffic accident). The data were retrieved from the electronic database. The cases in this study are sent for evaluation of impairment from judicial authorities.

Age, gender, type of incidents that caused the trauma, signs of injury detected at the date of the incident (thoracic bone fractures, pulmonary injuries), performed interventions, examination findings at the stage of sequelae evaluation, pulmonary function test results, radiological examination results, and the disability rates determined by our center using the "Regulation on the Procedures on the Determination of the Loss of Working Power and Profitability Rate" were examined.

Pulmonary function test results were evaluated by taking into account the criteria in the respiratory function tests consensus report prepared by the American Thoracic Society (ATS) and the European Respiratory Society (ERS).

While all cases with thoracic trauma and complete examinations in the file were included in the study; the patients with a known lung disease before the trauma were excluded.

The cases were examined through comparisons of the final examination and test results together with details of the trauma experienced and the treatments applied.

This study is a retrospective, cross-sectional and descriptive research. The data obtained were analyzed statistically using IBM SPSS version 22 software. While age data are given as minimum-maximum and median, the distribution of other

data regarding the characteristics of traumas is given as numbers and percentages.

Permission for the study was obtained from the Education and Scientific Research Commission of the Council of Forensic Medicine, and it was carried out in accordance with the Declaration of Helsinki.

RESULTS

The evaluation was made of a total of 156 cases, comprising 133 (85.3%) males and 23 (14.7%) females with a median age of 44 years (range, 8-84 years).

The type of trauma incident was seen to be traffic accident within the vehicle in approximately half of the cases (n=82, 52.6%), followed by a workplace accident, traffic accident outside the vehicle, motorcycle accident, fall from height, stab injury, firearms injury, and physical assault (Graphic 1).

As a result of exposure to thoracic trauma, rib fractures were determined in 115 (73.7%) cases, at a mean number of 2.93 ± 2.80 , ranging from 1 to 14. Sternum fracture was determined in 7 (4.5%) cases, and flail chest in 2 (1.3%).

Pneumothorax was seen in 84 (53.4%) cases, lung contusion in 78 (50%), and hemothorax in 51 (32.7%) (Graphic 2).

When the treatments applied after the incident were evaluated, it was determined that 81 (51.9%) cases were followed up with conservative treatment, tube thoracostomy was applied to 65

(41.7%) cases, thoracotomy to 6 (3.8%), and an open reduction procedure for fractures in the chest wall to 4 (2.6%).

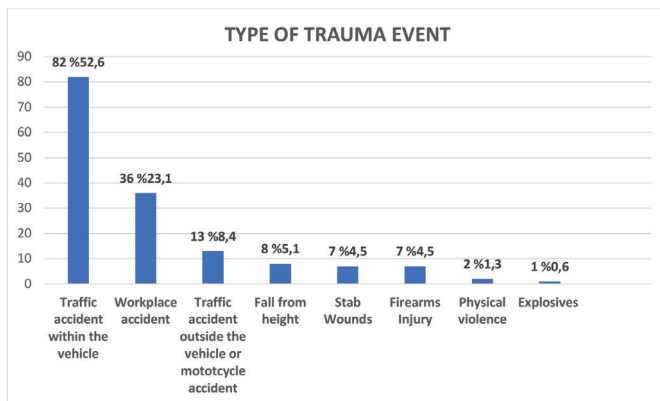
The cases were re-evaluated after an average of 2.1 years (min 7 months, max 8 years) after the trauma they experienced, and the respiratory function tests and imaging results before the examination were examined.

In the examinations of the cases for evaluation of disability, significant chest wall deformity was determined in 1 (0.6%) case. In the respiratory system examination, a decrease in respiratory sounds was determined in 5 (3.2%) cases, widespread rales in 1 (0.6%), widespread rhonchi in 1 (0.6%), and stridor in 2 (1.3%).

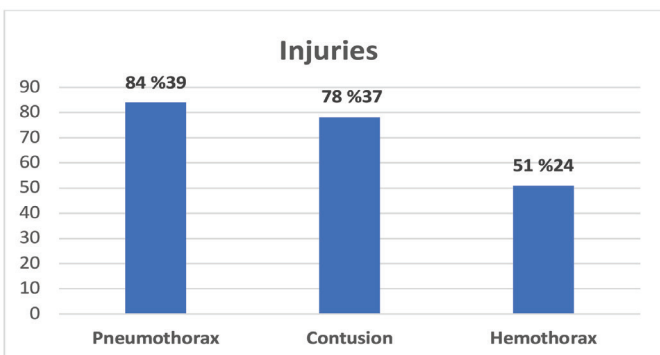
On the posterior-anterior pulmonary radiographs of the cases, there was a metallic stabilization image in 3 (1.9%) cases. In the examination of the parenchyma, an emphysematous appearance was determined in 5 (3.2%) cases, reduced volume in 2 (1.3%), unilateral sinus blunting in 3 (1.9%), sequelae of fibrotic changes in 3 (1.9%), diaphragm elevation in 11 (7.1%), and flattening in the diaphragm in 2 (1.3%).

In the evaluation of the respiratory function tests, the results were normal in 118 (75.6%) cases, restrictive in 17 (10.9%), and obstructive findings were determined in 16 (10.3%). The test could not be performed effectively in 5 (3.2%) cases. The respiratory function tests of the cases determined with restriction and obstruction were classified as mild, moderate, and severe. Of these, 22 (14.1%) cases were seen to be affected at a mild level, 6 (3.8%) at a moderate level, and 5 (3.2%) at a severe level.

As a result of all the evaluations, in 10 (6.4%) cases, the disability rate was determined with the relevant regulations by determining pulmonary function loss due to thoracic trauma. Although the relationship between the characteristics of trauma and clinical sequelae findings and radiological and functional tests in these cases could not be evaluated due to the small number of cases, all data of the cases were presented in a separate table. The characteristics of these cases are shown in detail in Table 1. There were no respiratory sequelae of a level to cause disability in 146 (93.6%) cases.



Graphic 1. The types of events causing thoracic trauma



Graphic 2. The classification of intrathoracic pathologies

DISCUSSION

Thorax traumas can cause morbidity as a result of impaired perfusion or oxygenation (5). The degree of the damage may vary according to the magnitude of the trauma, the nature of the damage to the bone structures and lung tissue, the treatment/rehabilitation process, and the physiological responses of the individuals.

The current study cases comprised 85.3% males. In a study of 440 cases by Haberal et al. (5), the majority of cases were males at the rate of 87.5%, and the rate of males was reported to be 78.2% in another study by Simon et al. (6). As in all trauma studies, there is a male predominance in thoracic traumas. This finding of our study is compatible with the literature.

Motor vehicle accidents are the most common reason for blunt thorax trauma (7). In an extensive study that assessed 592 cases, traffic accidents were predominant (75.7%) as the main reason (8). A previous autopsy study examined the findings of transportation injuries that resulted in death, and there were reported to be thoracic injuries in 60.6% of the cases (9). The thorax traumas in the current study were seen to have occurred most often as a result of traffic accidents.

Although it is known that all the bone structures that form the chest wall can be affected by trauma, rib fractures have been reported the most as a result of thorax trauma (5,8). Other than bone fractures, trauma can also cause hemothorax, pneumothorax, pulmonary contusion, and severe pulmonary dysfunction (7). Rib fractures were seen in the vast majority (73.7%) of the cases in this study. Flail chest deformity, which has a high mortality rate, has been reported to be seen in 5-13% of thorax traumas, but in the current study, flail chest deformity was identified in only 1.3% of the cases (5,7,10). This difference

was thought to be due to the fact that flail chest deformity is an injury with a high mortality rate, and the patient group in the current study was formed of cases evaluated in terms of trauma sequelae.

In a study that evaluated the morbidity and mortality of patients with thoracic trauma, the most frequently determined intrathoracic pathology was pulmonary contusion with a rate of 31.5%, followed by pneumothorax (30.5%), hemothorax (24%), and hemopneumothorax (14%) (11). In a study of pediatric cases with chest trauma, Holmes et al. (12) reported that pneumothorax, hemothorax, and pulmonary contusion were the most frequently seen thoracic injuries. Consistent with these findings in the literature, pneumothorax followed by pulmonary contusion and hemothorax were determined to be the most common injuries.

Traumatic diaphragm injuries have been mentioned in connection with increased early and late-term morbidity and mortality (13). In the radiological examinations of the cases in

Table 1. Characteristics of the cases determined with disability

Case	Age	Gender	Mechanism of trauma	Bone fractures	Injuries	Intervention applied	RFT	Radiological sequelae	Examination findings
1	52	Male	Workplace accident	5 rib fractures	Pneumothorax	Open reduction, tube thoracostomy	Mild degree of obstruction	Stabilizator images	Normal
2	41	Male	Traffic accident outside the vehicle	Sternum fracture	Pneumothorax, Pulmonary contusion	Tube thoracostomy	Mild degree of obstruction	Diaphragm elevation	Rhonchi
3	77	Male	Traffic accident inside the vehicle	14 rib fractures	Pulmonary contusion, Hemothorax, Pneumothorax	Tube thoracostomy	Normal Fev1/ Fvc ratio, reduced capacity	Diaphragm flattening	Normal
4	28	Male	Traffic accident inside the vehicle	4 rib fractures	Pulmonary contusion	None	Severe degree of restriction	Normal	Stridor
5	15	Male	Traffic accident inside the vehicle	No fractures	Pulmonary contusion	None	Severe degree of restriction	Normal	Stridor
6	35	Male	Traffic accident inside the vehicle	8 rib fractures	Pulmonary contusion, Hemothorax, Pneumothorax	Thoracotomy, Tube thoracostomy	Mild degree of restriction	Reduced volume	Dyspnea
7	55	Male	Workplace accident	4 rib fractures	Pulmonary contusion, Pneumothorax	Thoracotomy, Tube thoracostomy	Moderate degree of restriction	Diaphragm elevation	Reduced respiratory sounds
8	31	Male	Firearms injury	No fractures	Hemothorax	Tube thoracostomy	Normal Fev1/ Fvc ratio, reduced capacity	Diaphragm elevation	Normal
9	48	Male	Fall from height	7 rib fractures	Pneumothorax	Open reduction, Tube thoracostomy	Mild degree of obstruction	Stabilizator images, Sinus blunting	Normal
10	63	Male	Workplace accident	5 rib fractures	Pulmonary contusion, Hemothorax, Pneumothorax	Tube thoracostomy	Moderate degree of restriction	Diaphragm elevation	Thoracic wall deformity

*RFT: Respiratory function test

the current study, although healing was seen without sequelae at the rate of 81.4%, traumatic diaphragm pathologies were seen radiologically in half of the cases determined with loss in the functional evaluation. These findings should be supported with larger patient series and the long-term results should be examined with cohort studies.

Although impairment in the respiratory function test was determined in 33 of the 156 cases in the current study, these results were not seen to be correlated with respiratory sequelae of trauma origin. Another study of 136 cases similarly reported that there was no relationship between respiratory function tests and disability rates (14). The pulmonary function test is an auxiliary test that provides information about the loss of pulmonary function. Although cases with a known pulmonary disease before the incident were excluded from our study, functional losses that occurred between the incident date and the examinations due to non-traumatic reasons may affect these test results (i.e., fibrosis after lung infection or respiratory function losses due to occupational exposure).

In a study related to survivors of blast injuries, it was reported that the respiratory function tests of those who had pulmonary contusion were close to normal within 5 months, and exercise capacity was corrected after one year (15). A study conducted in 1990 evaluated the disability rates of cases with thoracic trauma, and although changes were seen in the respiratory function tests, functions close to normal were regained within 3 months, and permanent losses were reported to be <5% (4). Consistent with these findings in the literature, the results of the current study showed that the disability rate was determined by determining pulmonary function loss of trauma origin in only 6.4% of the cases.

Unlike clinical evaluations, in forensic medicine evaluation, an important criterion that must be considered by physicians is that examination findings are directed by considering the secondary gains of the individual being examined. To exclude this condition, which is known as simulation and super-simulation, the subjective complaints were not evaluated in all the cases included in the study. Moreover, it has been reported that dyspnea and similar symptoms are not an objective parameter in respiratory evaluation, and are not correlated with respiratory function test results (14,16).

In this study, trauma characteristics and findings of 10 cases with respiratory function loss due to traumatic events are shown in detail (Table 1). Considering the criteria in the respiratory function tests consensus report prepared by the ATS/ERS (17), the rates of respiratory function loss, radiological findings, and examination findings were evaluated together, and mild, moderate, or severe degrees of exposure were determined in the relevant regulation.

Study Limitations

The biggest limitation of a retrospective study that is performed by scanning the patient files is the difficulty of accessing all medical data of the individuals. It is difficult to reach the non-traumatic medical histories of individuals from medical documents in forensic files.

In addition, the small size of the studied population and the low number of specific patient groups prevent further statistical analysis. Although the results give an idea about the cause-effect relationships, the study should be done in centers specialized in this subject with large case series.

CONCLUSION

The determination of function losses of trauma origin is of great importance, especially in forensic cases. It must not be forgotten that the determination of sequelae caused by the trauma that occurred could be the subject of both criminal cases and compensation cases. For this reason, a causal link between trauma and its possible consequences should be established first. First of all, it is necessary to wait for the completion of the active treatment and rehabilitation process of the person after the trauma, in the claims of disability due to trauma with which a causal link is established. It should not be forgotten that early tests and examinations will be misleading. In addition, it should be kept in mind that an evaluation that is performed too late may complicate the evaluation with the addition of signs of diseases unrelated to trauma, such as chronic obstructive pulmonary disease.

As evaluation made on the basis of test results or examination findings alone when determining respiratory function losses can be erroneous, the decision must be made with examinations in specialized centers by experienced physicians guided by respiratory function tests and assistive and supportive imaging results.

Ethics

Ethics Committee Approval: This study was reviewed and approved by The Ministry Of Justice Council Of Forensic Medicine Research & Ethics Committee (21589509/2021/309).

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: H.E., H.İ.A., Ö.S.İ., C.K., P.B.K., Design: H.E., Ö.S.İ., C.K., P.B.K., Data Collection or Processing: H.E., C.K., P.B.K., Analysis or Interpretation: H.E., Ö.S.İ., Literature Search: H.E., H.İ.A., Writing: H.E., H.İ.A., Ö.S.İ., C.K., P.B.K.

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