TÜBİTAK

Original Article

Turk J Med Sci
2012; 42 (6): 1082-1085
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E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-1203-56

Penetrating chest injuries: analysis of 99 cases

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Aim: To investigate the patterns of penetrating thoracic injuries and techniques used in their management, and to contribute further data on the knowledge of penetrating thoracic trauma.

Materials and methods: The records were reviewed of 99 patients seen at our thoracic surgery hospital over a 4-year period.

Results: The group comprised 90 male (90.9%) and 9 female (9.1%) patients, with a mean age of 29.0 years. Of these patients, 62 (62.6%) had left-sided, 33 (33.3%) had right-sided, and 4 (4%) had bilateral penetrating injury. Stab wounds comprised 89 cases (89.9%) and the remaining 10 patients (10.1%) suffered gunshot wounds. Intercostal tube thoracostomy was the only therapy required in 68 patients (68.7%), whereas 21 patients (21.2%) had conservative management and only 10 patients (10.1%) underwent thoracotomy and exploration. Mean hospitalization period was 4.5 days in the tube thoracostomy group whereas median hospitalization duration in the exploration group was 11 days.

Conclusion: In this study we emphasize that chest tube thoracostomy should remain by far the most common and appropriate method of treating penetrating injury to the thorax.

Key words: Penetrating thoracic trauma, chest trauma, tube thoracostomy, thoracotomy

Introduction

Trauma is perhaps the oldest of humankind's afflictions, and the history of trauma is as old as medicine itself. One of the earliest writings on thoracic injury was found in the Edwin Smith Surgical Papyrus, written in 3000 BC, which describes cases of penetrating thoracic trauma (1).

Thoracic injury is a common cause of mortality and major disability, and it is the leading cause of death in the first 3 decades of life (1,2). Thoracic injuries account for 20%-25% of deaths due to trauma (2,3). Penetrating thoracic trauma accounts for almost 33% of total chest traumas (2). The Turkish population has suffered increasing rates of penetrating trauma, with such trauma thus becoming a public health problem, associated with increasing levels of violence in society (4,5).

Penetrating thoracic trauma is mostly attributed to violence and has a higher mortality rate than blunt trauma (2,6). It is more common in men due to their propensity to violence and the mechanism of injury is usually a gunshot wound or stab wound. Early recognition and timely treatment of life-threatening injuries, better resuscitative techniques, preoperative care, and effective surgical procedures can significantly affect outcomes in these patients (2). Studies have shown chest tube thoracostomy to be the primary modality for managing nonmediastinal, peripheral chest injury, with a very low incidence of thoracotomy (2,7). Our study aims to emphasize patterns of penetrating thoracic injuries, including their causes and the techniques used in management, and to add further data on the knowledge of penetrating thoracic trauma.

Received: 14.03.2012 – Accepted: 15.05.2012
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Materials and methods

The study retrospectively reviewed the records of 99 patients presenting to our hospital with penetrating chest trauma during the previous 4 years (April 2007 to June 2011) from all over Ankara, the capital of the Republic of Turkey. Our study included patients with penetrating chest trauma only, excluding blunt chest injuries. There were no cases of both blunt and penetrating chest injury in combination. A standard posteroanterior chest X-ray is the most frequently used diagnostic modality in patients who sustain traumatic lung injury. Chest X-ray was the initial radiographic diagnostic tool for all cases. When pneumothorax and/or hemothorax were suspected or confirmed from chest X-ray, a computerized thorax tomography was performed. Chest tube thoracostomy was the initial treatment modality in cases of advanced pneumothorax or hemothorax. If there was only subcutaneous emphysema or minimal pneumothorax, conservative treatment modalities were performed.

Immediate thoracotomy was performed if the chest was full of blood, if more than 1000 cm^3 of blood had drained with insertion of a chest tube, if drainage exceeded 200 cm^3/h for 3 h, or if there was a major air leak. In those patients who had massive drainage or air leakage, standard exploratory posterolateral thoracotomy was performed in order to control bleeding and to remove destroyed or devitalized lung tissues. Primer suturation of lung parenchyma, with or without wedge resection, was performed in lung trauma cases.

All patients postoperatively had appropriate antibiotic and analgesic medicines. Removal of chest tubes depended on air leakage and drainage of the chest tube. If the patient ceased air leakage and drainage of the effusion was less than 100 cm^3/day, then chest tubes were removed.

Data were analyzed using SPSS 17.0 with the help of a statistician.

Results

Our study included 90 male (90.9%) and 9 female (9.1%) patients with a mean age of 29.0 years (range: 15-63 years). Of those, 62 patients (62.6%) had left-sided penetrating injury, 33 patients (33.3%) had right-sided penetrating injury, and 4 patients (4%) had bilateral injury. The left-to-right injury ratio was 1.8:1. Stab wounds were the most frequent mode of injury, comprising 89 cases (89.9%); the remaining 10 patients (10.1%) suffered from gunshot wounds, comprising both homicidal and suicidal penetrating traumas. In terms of management, 68 patients (68.7%) were treated with only tube thoracostomy, 21 patients (21.2%) had conservative management, and 10 patients (10.1%) had thoracotomy and exploration. In the 10 gunshot wound patients, 3 (30.0%) had thoracotomy, whereas only 7 (7.9%) of the 89 stab-wound patients had exploration. Mean duration until removal of chest tubes (range: 2-20 days) was 8.8 days in the exploration group and 4.1 days in the tube thoracostomy group.

Sixty-eight patients (68.7%) were treated with only tube thoracostomy. The indications for tube thoracostomy were hemothorax in 14 patients (20.5%), pneumothorax in 25 patients (36.7%), and both hemothorax and pneumothorax in 29 patients (42.7%). Twenty-one patients (21.2%) had conservative management, of which 18 patients (85.7%) had accompanying pneumothorax whereas only 3 patients (14.3%) did not have injury beyond pleura. The exploration group included 10 patients (10.1%). The indications of exploration were hemothorax for 8 of the patients; the remaining 1 patient had chylomediastinum and chyloptysis, and another patient underwent exploration for a foreign body in his chest. Of those 8 patients who underwent exploration for hemothorax, 5 patients had bleeding from the pulmonary parenchyma, 1 patient from intercostal arteries, 1 patient from the pulmonary hilus, and 1 patient from the right auricula.

Duration of hospitalization ranged between 1 and 75 days (median: 4 days; mean: 5.5 days). Median hospitalization time in the exploration group was 11 days. Mean hospitalization time was 4.5 days in the tube thoracostomy group compared with 1.5 days in the conservative management group.

Twenty patients (20%) had accompanying penetrating injuries (13 in extremities, 2 abdominal, and 2 facial; 2 lumbar region stab wounds and 1 cardiac injury). Only one patient had additional cardiac injury in which auricular laceration was observed. This case was operated by cardiac surgeons

and simple suturation of the right auricula without cardiopulmonary bypass successfully controlled bleeding.

One patient had a major morbidity of chylomediastinum and chyloptysis following a handgun attack. The patient was initially treated by conservative management, with nil-by-mouth and total parenteral nutrition. This was unsuccessful, and he later underwent a left thoracotomy along with drainage of the mediastinal pouch, wedge resection of the left upper lobe, and mass ligation of the thoracic duct. One patient died due to hemorrhage and the mortality rate in the study was 1%.

Discussion

The true incidence of pulmonary injuries is unknown and difficult to estimate from the literature (8). The reported incidence of civilian pulmonary injuries varies according to authors and institutions. Graham et al. (9) reported a 1-year experience in which 373 patients sustained penetrating pulmonary injuries. Robison et al. (7) described a 13-year civilian experience in the management of pulmonary injuries in 1168 patients. Tominaga et al. (10) described a 7-year single institutional experience of 2934 patients sustaining both blunt and penetrating chest trauma. Petrone et al. (8) described 101 patients who sustained complex penetrating pulmonary injuries.

Mechanism of injury is important; penetrating injury is usually the result of direct application of a mechanical force to a focal area and depends on the velocity and biomechanics of the projectile (1). Penetrating injuries can be divided into 3 groups (low, medium, or high) according to the velocity of the projectile. Low-velocity injuries include stab wounds that disrupt only the structures penetrated. Medium-velocity injuries include bullet wounds from handguns and are characterized by much less primary tissue destruction than wounds caused by high-velocity injuries. Those injuries include bullet wounds caused by rifles, which produce injury in adjacent structures in addition to that in the bullet path, tissue cavitation, and shock waves that extend beyond the area of tissue damage. The velocity of the penetrating projectile is the single most important factor that determines the severity of the wound (1). The degree of injury also depends on the biomechanics of the penetrating projectile, in which energy is transferred from the object to the body tissues (1).

Studies have shown that most chest injuries can be treated by relatively simple nonsurgical methods, such as tube thoracostomy, appropriate analgesics management, oxygen inhalation therapy, and good pulmonary toilet (11). In our study, 68 patients (68.7%) were treated by only tube thoracostomy and 21 patients (21.2%) were treated by medical treatment. Treatment of both groups included oxygen inhalation therapy (2 L/min), appropriate analgesics, and pulmonary toilet. Overall, 89.9% of patients were treated without thoracotomy. Only 10 patients (10.1%) in the study had exploration with thoracotomy.

The majority of thoracic injuries requiring surgical intervention were due to penetrating mechanisms such as gunshot wounds or stab wounds. Gunshot wounds represent the major penetrating mechanism of injury for patients requiring surgical treatment, ranging from 33% to 80% of cases, while stab wounds account for 17% to 67% of these injuries (8,12). In our study only 7 patients (7.9%) had thoracotomy due to stab wounds and 3 patients (30%) had thoracotomy due to either handgun or rifle bullets.

Males outnumbered females by a huge margin of 10:1 due to their greater exposure to outdoor activities and propensity to violence. The male preponderance of 10:1 is higher than the 5.5:1 ratio reported in a prospective analysis of 168 patients in Nigeria (13). A higher incidence of 14.9:1 was found in a Pakistani study with 191 cases (2). Left-sided injuries outnumbered right-sided injuries with a margin of 1.8:1 because culprits were mostly right-handed.

During the 4-year duration of our study, 10 of 99 patients (10.1%) underwent exploratory thoracotomy. This is very similar to the 10.2% reported in a Belgian study (14), but much less than the 16.1% reported in Nigeria by Thomas et al. (13). The difference may be because only 10.1% of our cases were gunshot wounds, compared with 60.1% of injuries in the Nigerian study.

Among those patients requiring thoracotomy for pulmonary injuries, most can be treated by simple oversewing of the lung. Some patients, however, may require formal pulmonary resection to control massive hemorrhage, to repair severe injuries, or to remove devitalized and destroyed tissue (15). Lobectomy is performed for massive tissue destruction isolated to a lobe or a bronchovenous communication that is not controllable by local techniques, or for pulmonary hemorrhage that may not be controlled by simple oversewing. Because pneumonectomy has a mortality rate of 50% according to a study by Tominaga et al. (10), it should be reserved for central irreparable pulmonary parenchymal, vascular, or bronchial injuries (7). The decision of whether to perform pulmonary resection is made at operation and depends on the location and extent of the injury (7). In our series, 10 patients had thoracotomy due to morbidities and/or hemorrhage. All patients had simple oversewing of the lung parenchyma, bleeding control, and appropriate positioning of chest tubes. There was no necessity for any type of anatomic lung resections in our cases. One patient with diaphragmatic injury underwent primary suturation of the diaphragm and another patient had right auricular laceration. In their study, Özyazıcıoğlu et al. mentioned that mortality rates from penetrating cardiac injuries have declined over the years (16). Our case was operated successfully by simple suturation of right auricula.

The estimated mortality for penetrating chest trauma patients is also very variable. The overall mortality rate reported in the literature for patients with traumatic pulmonary injuries ranges from 1.7% to 37% (8). In our study only 1 patient died, caused by massive hemorrhage before thoracotomy was performed, and the mortality rate was recorded as 1%.

The results of our series add further data on the knowledge that penetrating thoracic trauma is not a negligible cause of morbidity and mortality in our hospital. In conclusion, chest tube thoracostomy should remain by far the most common method of treating penetrating injury to the thorax, with only 10.1% of patients requiring thoracotomy.

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