Biomedical Research 2017; 28 (6): 2679-2683 *ISSN 0970-938X*
www.biomedres.info

Characteristics of the patients undergoing surgical treatment for hemothorax: A descriptive study.

Muharrem Cakmak*

Gazi Yasargil Education and Research Hospital, Thoracic Surgery Clinic, Diyarbakir, Turkey

Abstract

Introduction: Hemothorax is the accumulation of blood in the intrapleural space. We aim to discuss surgical methods applied to patients with traumatic hemothorax.
Materials and methods: We retrospectively examined 294 patients. Patients who received positive results with observation, underwent emergency thoracotomy and were not treated surgically were excluded from the study. Results of patients with hemothorax were analysed. P<0.05 was considered significant.
Results: The mean age was 39 ± 7.4. 73 of the patients with hemothorax were blunt trauma, while 221 of them were penetrating trauma. Male gender was found to be significant for patients with hemothorax. In terms of the associated injuries, extremities and head injuries were found significant for patients with blunt trauma. 249 of patients were performed tube thoracostomy, 38 were treated with thoracotomy, 6 got VATS, and one underwent sternotomy. Tube thoracostomy was found as primary and effective treatment method in treatment of patients with hemothorax. Morbidity was found significant for male patients with hemothorax.
Conclusion: Hemothorax is an urgent condition requiring rapid diagnosis. Definition of associated injuries is life-saving. Priority treatment is tube thoracostomy.

Keywords: Hemothorax, Trauma, Tube thoracostomy, Thoracotomy.

Accepted on November 9, 2016

Introduction

Hemothorax is the accumulation of blood in the intrapleural space. Etiologically, it is divided into two as traumatic and spontaneous hemothorax. Incidence is not known with any degree of certainty. However, the most common cause is chest trauma which occurs in approximately 60% of patients with multiple traumas [1].

In many cases, hemothorax is associated with procedures such as open or closed chest trauma or thoracentesis, pleural biopsy, and catheterization. On the other hand, spontaneous hemothorax is less common. Malignancies are observed in anticoagulation therapy, vascular injuries, arteriovenous malformations, endometriosis, pulmonary infarcts, pleural adhesions in pneumothorax, and haematological abnormalities such as haemophilia [2].

Hemothorax is the accumulation of pleural effusion, which has more than 50% of the blood haematocrit value, in the pleural space. However, haematocrit may decrease within a few days due to the secondary dilution. In this case, the actual haematocrit cannot be obtained. Thus, definition of hemothorax can also be considered as a value in the range of 25-50% of blood hematocrit and hematocrit in pleural effusion [2]. If hematocrit is less than a half, it is called as bloody pleural effusion [3,4].

Hemothorax is classified according to the amount of bleeding into the pleural range. It is divided into three as minimal hemothorax (≤ 400 ml), medium level hemothorax (400-1000 ml) and massive hemothorax (≥ 1000 ml). The reason why 400 ml is accepted as threshold level is that the amount of fluid becomes visible when it reaches approximately 400 ml in anteroposterior chest X-ray [3,4].

Symptoms change depending on the state of the lung functions which are impaired by the accumulated blood on that side. Depending on the amount of bleeding, the increase in the lung collapse and the consequent increase in dyspnoea, tachypnea, and cyanosis occur. The compression of lungs and mediastinum displacement increase the amount of bleeding. Depending on the non-existence of the effect of tamponade, bleeding continues. A hemitorax may be filled with blood up to 6 litres [3]. In adults, the bleeding up to 500-750 ml can be tolerated. Hypotension and tachycardia are observed in bleeding between 750-1500 ml. Symptoms of shock occur over 1500 ml of bleeding [5].

In diagnosis, chest X-ray is the preferred method in many centers. Hemothorax can be easily identified via bedside ultrasound. It is difficult to identify the minimal hemothorax in patients lying in the supine position. Affected hemithorax in central and massive hemothorax appears more blurred than the other parts of the chest. Hemothorax can be missed 20% rate

during X-rays taken in the supine position [4]. In suspicious cases, computed tomography confirms the diagnosis.

Observation, tube thoracostomy, thoracotomy, and Video Assisted Thoracoscopic Surgery (VATS) are the main methods used in the treatment [3].

In our study, we aim to share clinical features, demographic distributions, surgical methods of patients with hemothorax.

Material and Methods

Patients

We retrospectively examined 294 patients with hemothorax, who were admitted to our clinic and treated with surgery procedures between January 2004 and December 2014.

Study design

The average age, gender, symptoms, associated injuries, diagnostic methods, the localization of the disease, surgical method employed (recently implemented or having positive results were taken as criteria), complications and hospitalization time were identified.

Inclusion and exclusion criteria

Patients who received positive results with observation, underwent emergency thoracotomy and were not treated surgically were excluded from the study.

Statistical analysis

Data were analysed by Statistical Package for the Social Sciences (SPSS 21, Chicago, IL, USA).Numerical data were expressed as mean ± standard deviation and qualitative data as percent. Chi-Square test, Fisher Exact test were used in study between double and triple groups. The lowest level of significance was considered as $p<0.05$. The averages of countable parameters were determined. Chi-Square test (cross-tab) and fisher exact test were used to learn the percentage of uncountable parameters and to determine significant differences.

Results

The average age of patients was 39 ± 7.44. Penetrating trauma-related injuries were most frequently found between 20-40 years of age. On the other hand, injuries due to blunt trauma were between 40-60 years of age. 256 (87%) of the patients were male, while 38 (13%) were female. It was discovered that 57 (78%) of blunt trauma patients were male and 16 (22%) were female, whereas 199 (90%) of penetrating trauma patients were male and 22 (10%) were female. Male gender was found to be significant for patients with hemothorax ($p=0.0144$) (Table 1).

73 of patients (24.82%) were blunt trauma (traffic accidents: 51 (70%), falls: 21 (29%), assault: 1 (1%)), and 221 (75.17%) of patients were penetrating trauma (stab injuries: 201 (91%), gunshot wounds: 20 (20%)). The most common cause of trauma was stab injuries. Location of injury was on the right in 136 patients (46%) (Blunt trauma: 38 (52%), penetrating trauma: 98 (44%)). On the other hand, it was on the left in 158 patients (54%) (Blunt trauma: 35 (48%), penetrating trauma: 123 (56%)) (Table 1). The average time of admission to the hospital for patients ranged from 45 minutes to 3 days.

The most common complaints for the patients were shortness of breath and chest pain, while tenderness to palpation, skin incisions in different parts of body, entry or exit bullet holes, bruises on the skin, subcutaneous emphysema and hematoma and flail chest were the most common physical examination findings. Diagnosis was established via chest X-rays and computed tomography.

When associated injuries in patients were evaluated, the most common associated injuries following blunt trauma were extremities injuries (n=18), abdominal injury (n=13), head injury (n=9), and spinal cord injury (n=4). On the other hand, the associated injuries following penetrating injuries were abdominal injury (n=24), and extremity injury (n=12). The head and spinal injuries were equal (n=7). Extremities and head injuries were found significant for patients with blunt trauma (respectively; $p<0.0001$, $p=0.0027$) (Table 2).

249 of the patients (85%) underwent tube thoracostomy. Aspiration of blood in thoracentesis and being blunt of sinus in chest X-ray were accepted as an indication for tube thoracotomy. 38 of the patients (13%) were performed standard posterolateral thoracotomy. After tube thoracostomy, over 1000 ml of bleeding in the acute phase, 200 ml of bleeding in 2-4 hours, and the development of shock symptoms before tube thoracostomy application in some patients were accepted as an indication for thoracotomy. Those were cases having severe hemodynamic instability and respiratory failure, massive bleeding and gunshot wounds requiring emergency intervention. In addition, the cases having intrathoracic hematoma that was not drained after tube thoracostomy, and developed pleural thickening and fibrothorax were diagnosed as thoracotomy. 6 (2%) of the patients were performed video assisted thoracoscopic surgery. Despite tube thoracostomy, intrathoracic hematoma and the development of loculation were considered as the indication of video assisted thoracoscopic surgery. A patient suspected cardiac injury was seen as the indication of sternotomy Tube thoracostomy was found as primary and effective treatment method in treatment of hemothorax patients with blunt trauma ($p<0.0001$). While Thoracotomy was found significant for hemothorax patients with penetrating trauma ($p=0.0006$) (Table 3).

The most common intraoperative or radiologic pathology detected was rib fractures (n=47). Other pathologies detected were lung parenchyma laceration (23, 8%), intercostal artery injury (9, 8%), diaphragmatic injury (4, 1%), spleen injury (3, 1%), right internal mammary artery injury (2, 1%), liver injury (2, 1%), stomach injury (2, 1%), colon injury (2, 1%), ventricular injury (1, 0.34%), left internal mammary artery injury (1, 0.34%), left lower lobe pulmonary artery injury (1, 0.34%) and left upper common laceration (1, 0.34%). Patients

were performed primary repair for parenchymal lacerations, ligation for intercostal artery, rima or lima injuries, primary repair for diaphragmatic, liver, stomach and colon injuries. Additionally, 3 patients were performed splenectomy, 1 patient was performed left lower lobectomy, and 1 patient was applied left upper lobectomy (organ loss (n=5); 1.70%) (Table 4).

Mortality was seen 4 (1.36%) patients. The presence of associated injuries and hospital transportation time were closely related with mortality. In the male patients were found significant morbidity for blunt trauma (p=0.0112) (Table 5).

The most common postoperative complications were atelectasis, pneumonia and empyema. Average length of stay was 8 ± 3 days.

Table 1. *Distribution of location, etiology and gender of patients with hemothorax.*

	Blunt trauma	(n: 73), 25%	Penetrating	(n: 221), %75	P-value
	Accident	(51),70%	Stab	(201), 91%	
Etiology	**Fall**	(21), 29%	Gunshot	(20), 9%	
	Assault	(1), 1%			
Location	**Right**	(38), 52%		(98), 44%	
	Left	(35), 48%		(123), 56%	χ^2: 1.312* P=0.251
Gender	**Male**	(57), 78%		(199), 90%	0.0144**
	Female	(16), 22%		(22), 10%	

P*: Chi-Square test; P**: Fisher's exact test

Table 2. *Other injuries associated with thoracic trauma.*

Associated injuries	Blunt	Penetrating	P-value
Extremities injuries			
Present	18	12	χ^2: 22.140*
No present	55	209	P<0.0001
Head injuries			
Present	9	7	χ^2: 8.949*
No present	64	214	P=0.0027
Abdominal injuries			
Present	13	24	χ^2: 2.408*
No present	60	197	P=0.1206
Spinal cord injuries			
Present	4	7	χ^2: 0.814*
No present	69	214	P=0.3668

P*: Chi-Square test

Table 3. *Treatment procedures in hemothorax patients.*

Management	Blunt (n: 73) effective/ ineffective	Penetrating (n: 221) effective/ineffective	p
Tube thoracostomy	70/3	179/42	χ^2: 9.391*, P<0.0001
Thoracotomy	1/72	37/184	χ^2: 11.521*, P=0.0006
VATS	2/71	4/217	χ^2: 0.237*, P=0.6261
Sternotomy	-/73	1/220	χ^2: 0.331*, P=0.5648

VATS: Video Assisted Thoracoscopic Surgery; P*: Chi-Square test.

Table 4. *Pathology on patients undergoing operation.*

Location of injuries	Number	%
Lung parenchymal laceration	23	(7.825)
Intercostal vessel injuries	9	(3.06)
Diaphragm injuries	4	(1.36)
Spleen injuries	3	(1.02)
RİMA injuries	2	(0.68)
Liver injuries	2	(0.68)
Stomach injuries	2	(0.68)
Colon injuries	2	(0.68)
Ventricle injuries	1	(0.34)
LIMA injuries	1	(0.34)
Left lower lobe artery injuries	1	(0.34)
Left upper lobe laceration and bleeding	1	(0.34)

Table 5. *Mortality and morbidity rates of patients with hemothorax.*

	Blunt (n=73) Morbidity present/no	Penetrating (n=221) Morbidity present/no	P-value	
Male	13/44	20/179	χ^2: P=0.0112	0.331*,
Female	4/12	1/21	χ^2: P=0.0655	0.391*,
	Mortality present/no	**Mortality present/no**	**P-value**	
Male	1/26	3/196	χ^2: P=0.4167	0.659*,
Female	-	-	-	
P*: Chi-Square test				

Discussion

The most common intrathoracic pathologies in thoracic trauma are hemothorax and pneumothorax. The clinical importance of hemothorax varies according to the amount, speed, and etiology of bleeding into the intrapleural space. Additionally, it changes depending on the presence of accompanying lesions, such as pneumothorax, and whether these lesions become chronic. Mostly, it occurs due to trauma-related chest wall or thoracic organ injuries. In traumatic hemothorax, the early diagnosis and treatment is particularly mandatory. Even brief delays can lead to death [3].

The most common causes of hemothorax are blunt trauma related to the traffic accidents or penetrating thoracic trauma [6]. In our study, the most common cause of blunt trauma causing hemothorax was traffic accidents. Whereas, the most common cause of hemothorax was penetrating trauma related to stab injuries. We believe that the possible reason of this situation was that all patients participated in the study were treated with surgery.

In blunt trauma, isolated thoracic trauma is rare. It is accompanied by an extra-thoracic organ injury 75% [7]. Therefore, multidisciplinary approach and rapid diagnosis and treatment are required for hemothorax due to blunt trauma. In our study, associated injuries were identified in 44 patients developing haemothorax and performed surgical treatment. The most common associated injuries were the extremity and abdominal injuries respectively. Bleeding was usually due to the damage to lungs and intercostal vessels which was caused by broken rib ends [8,9].

During complicated chest wall injuries, multiple fractures are sustained in, at least, three or more ribs. If these fractures are in anterolateral area of the thorax, and in multiple locations, the flail chest occurs. Such traumas lead to significant damage to the chest wall, and difficulty in breathing. In our study, while forty-seven patients were found to have rib fractures, flail chest existed in 7 patients who were not required to have any mechanical ventilation support.

Clinical manifestations in patients with penetrating thoracic trauma depend on the type of penetrating object and the path in the thorax. Gunshot wounds and stab wounds are the common causes of penetrating injuries. In patients injured with firearms, bleeding and the deterioration of medical condition are greater than the stab wounds. In penetrating chest trauma, intercostal vessels are the most commonly injured vascular structures. However, whether diaphragm, liver, spleen and kidney injuries and intrathoracic organ injuries which have high mortality rates such as heart and great vessels injuries exist or not should be investigated. Most of the penetrating chest injuries constitute damage to the lung parenchyma. Bleeding often stops by itself in those cases. However, in cases where bleeding does not stop, thoracotomy, and, for some cases, lung resection may be necessary. Stab wounds constitute damage in the lung parenchyma, which is often accompanied by hemothorax and pneumothorax [10]. In our study, associated injuries were present in 50 patients with penetrating thoracic trauma. The most common associated injuries were the abdomen and extremity injuries. Extremities and head injuries were found significant for patients with blunt trauma (respectively; $p<0.0001$, $p=0.0027$).

The most common symptom is chest pain and shortness of breath. Symptoms vary depending on the amount of bleeding. The compression in lung and displacement in mediastinum increase the amount of bleeding, which may cause dyspnoea, tachypnea, and cyanosis. In our study, the most common symptoms are shortness of breath and chest pain.

The diagnosis is usually made by physical examination, and posteroanterior chest X-ray. The first preferred method in many centers is chest radiograph. Minimal hemothorax is difficult to identify in hospitalized patients lying in supine position. Affected hemothorax appears more blurred in central and massive hemothorax than the other side of the chest.

The first approach adopted in treatment is chest tube application [11]. Chest tube is often adequate to get the results. However, sometimes it does not drain enough blood through the chest tube, and empyema, accumulation of hematoma in thorax and air trapping in lungs may be developed [12]. Residual thoracic accumulation after trauma is an important risk factor for empyema and leads to severe complications in 5-30% of patients [12]. In our study, 70 patients with blunt trauma and 179 patients with penetrating thoracic trauma were treated with tube thoracostomy.

In one study, early VATS were suggested for discharging residual hemothorax [13]. Moreover, in recent studies, VATS has become a commonly used approach in traumatic hemothorax [14]. In some studies, VATS was suggested in the first 1 week-10 days, the period in which the probability of recurrent bleeding was low [15,16]. In our study, 2 patient with blunt trauma, and 4 patients with penetrating trauma were performed VATS.

Emergency thoracotomy rates varied between 10% and 70% in some studies [7,17,18]. In cases where hemodynamic stability is maintained, thoracotomy must be performed immediately. In this study, a total of 38 patients with blunt and penetrating thoracic trauma were performed urgent thoracotomy (12%). 27 of these patients got thoracotomy after the tube thoracotomy,

while 11 patients were directly performed thoracotomy. Additionally, Tube thoracostomy was found as primary and effective treatment method in treatment of hemothorax patients with blunt trauma ($p<0.0001$). While thoracotomy was found significant for hemothorax patients with penetrating trauma ($p=0.0006$).

In the literature, in thoracotomies due to traumatic hemothorax, mortality rates have been reported as 5-33% [19,20]. In our study, the mortality rate was 1.36% (n=4). It was found that additional injuries, especially head injuries affect mortality [21]. The most common additional injuries in our patients were extremity injuries in blunt trauma and abdominal injuries in penetrating thoracic trauma. Two of the patients died due to abdominal injury (intraabdominal bleeding), one died because of cardiac injury, and one patient died due to intracranial haemorrhage (subarachnoid haemorrhage).

As a result, hemothorax is an urgent medical condition that requires rapid diagnosis. The identification of associated injuries is life-saving. Priority treatment is tube thoracostomy, and emergency thoracotomy should be implemented in hemodynamic deterioration.

References

1. Boersma WG, Stigt JA, Smit HJ. Treatment of haemothorax. Respir Med 2010; 104: 1583-1587.
2. Ali HA, Lippmann M, Mundathaje U, Khaleeq G. Spontaneous hemothorax: a comprehensive review. Chest 2008; 134: 1056-1065.
3. Akay H. Hemotoraksta tani vs. tedavi yaklasimi. Solunum 2002; 4: 195-205.
4. Mowery NT, Gunter OL, Collier BR, Diaz j, Haut E, Hildreth A, Holevar M, Mayberry J, Strei E. Practice Management Guidelines for Management of Hemothorax and Occult Pneumothorax. J Traum Inj Infect Crit Care 2011; 70: 510-518.
5. Demircan S, Yorgancilar CD. Hemotoraks. Turkiye Klinikleri J Surg Med Sci 2007; 3: 68-71.
6. Battistella FD, Benfield JR. Blunt and penetrating injuries of the chest wall, pleura and lungs. General thoracic surgery. Philadelphia Lippincott Williams Wilkins (5th edn.) 2000; 815-831.
7. Galan G, Penalver JC, Paris F, Caffarena JM Jr, Blasco E. Blunt chest injuries in 1696 patients. Eur J Cardiothorac Surg 1992; 6: 284-287.
8. Hokema F, Donaubauer B, Busch T, Bouillon B, Kaisers U. Initial management of polytraumatized patients in the emergency department. Anasthesiol Intensivmed Notfallmed Schmerzther 2007; 42: 716-723.
9. Tatou E, Steinmetz E, Jazayeri S, Benhamiche B, Brenot R. Surgical outcome of traumatic rupture of the thoracic aorta. Ann Thorac Surg 2000; 69: 70-73.
10. Peloponissios N, Halkic N, Moeschler O, Schnyder P, Vuilleumier H. Penetrating thoracic trauma in arrow injuries. Ann Thorac Surg 2001; 71: 1019-1021.
11. de Rezende-Neto JB, Pastore Neto M, Hirano ES, Rizoli S, Nascimento B Jr. Management of retained hemothoraces after chest tube thoracostomy for trauma. Rev Col Bras Cir 2012; 39: 344-349.
12. Cangir AK, Nadir A, Akal M, Kutlay H, Ozdemir N, Gungor A, Kavukcu S, Akay H, Okten I, Yavuzer S. Toraks travmasi: 532 olgunun analizi. Ulusal Travma Dergisi 2000; 6: 100-105.
13. Velmahos GC, Demetriades D, Chan L, Tatevossian R, Cornwell EE 3rd, Yassa N, Murray JA, Asensio JA, Berne TV. Predicting the need for thoracoscopic evacuation of residual traumatic hemothorax: chest radiograph is insufficient. J Trauma 1999; 46: 65-70.
14. Hsu NY, Hsieh MJ, Liu HP, Kao CL, Chang JP, Lin PJ, Chang CH. Video-assisted thoracoscopic surgery for spontaneous hemopneumothorax. World J Surg 1998; 22: 23-26.
15. Lang-Lazdunski L, Mouroux J, Pons F, Grosdidier G, Martinod E. Role of videothoracoscopy in chest trauma. Ann Thorac Surg 1997; 63: 327-333.
16. Jerjes-Sanchez C, Ramirez-Rivera A, Elizalde JJ, Delgado R, Cicero R, Ibarra-Perez C, Arroliga AC, Padua A, Portales A, Villarreal A, Perez-Romo A. Intrapleural fibrinolysis with streptokinase as an adjunctive treatment in hemothorax and empyema: a multicenter trial. Chest 1996; 109: 1514-1519.
17. Robison PD, Harman PK, Trinkle JK, Grover FL. Management of penetrating lung injuries in civilian practice. J Thorac Cardiovasc Surg 1988; 95: 184-190.
18. Genc O, Dakak M, Gurkok S, Gozubuyuk A, Balkanli K. Thoracic trauma and management. Intern J Thorac Cardiovasc Surg 2000; 4.
19. Cansever L, Hacaibrahimoaylu G, Kutlu CA, Bedirhan MA. The clinical approach to the isolated traumatic hemothorax. Ulus Travma Acil Cerrahi Derg 2005; 11: 306-309.
20. Balci AE, Eren MN, Eren S, Ulku R, Onat S, Cebeci E. Travma torakotomilerinde mortaliteyi etkileyen faktorler. Turkish J Thorac Cardiovasc Surg 2001; 9: 215-220.
21. Ismail MF, al-Refaie RI. Chest trauma in children, single center experience. Arch Bronconeumol 2012; 48: 362-366.

*Correspondence to

Muharrem Cakmak

Gazi Yasargil Education and Research Hospital

Thoracic Surgery Clinic

Turkey