

Tube thoracostomy cases and emergency department

Rebi Duran¹, Ali Karakuş^{2*}, Mustafa Polat², Salih Denis Şimşek³, Pınar Baydar Yücel⁴

¹Hatay Kırıkkhan State Hospital, Emergency Service, Hatay, Türkiye.

²Hatay Mustafa Kemal University, Medical Faculty, Department of Emergency Medicine, Hatay, Türkiye.

³Nevşehir Government Hospital, Emergency Medicine Department, Nevşehir, Türkiye.

⁴Gülınar Government Hospital Emergency Medicine Department, Mersin, Türkiye.

*Correspondence

Ali Karakuş

drkarakus@yahoo.com

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Background: Tube thoracostomy is a surgical method frequently used by thoracic surgeons and emergency physicians to drain air, fluid, pus, blood and bile from the pleural cavity. In our study, we aimed to evaluate the demographic and clinical characteristics, complications, morbidity/mortality of patients who underwent tube thoracostomy in the emergency department of our hospital.

Methods: We retrospectively analysed 111 patients who presented to the emergency department and underwent tube thoracostomy. Pearson chi-square test, Fisher's Exact test and Mann Whitney U test were used to analyse the data in our study.

Results: In our study, 22.5% (25) of the patients died and 54.1% (60) were discharged. The mean duration of hospitalisation was 8.9±6.3 days. Among the patients who underwent tube thoracostomy, 79.3% (88) had traumatic and 20.7% (23) had spontaneous pneumothorax. The incidence of pneumothorax was significantly higher in patients under 40 years of age than in patients over 40 years of age (p=0.003). Complications developed in 17.1% (19) of the patients. The most common complication was malposition.

Conclusion: Tube thoracostomy is frequently performed in our emergency department. Although it is a life-saving procedure, complications are common and may result in death. Morbidity and mortality can be reduced with experience and compliance with surgical sterility.

Keywords: tube thoracostomy, complication, pneumothorax, emergency department

Introduction

Tube thoracostomy (TT) is the insertion of a drainage tube to drain air, fluid, pus, blood and bile from the pleural cavity. Tube thoracostomy is a surgical method that thoracic surgeons and emergency physicians often have to use. Since it is a life-saving procedure, general surgeons, intensive care physicians and pulmonologists can also perform it (Kesieme et al., 2011). Tube thoracostomy is the procedure of placing a drainage tube to drain air, fluid, pus, blood and bile from the pleural cavity. TT is usually placed through the 4th or 5th intercostal space over the anterior axillary or middle axillary line (Kuhajda et al., 2014). With a deep inspiration, the lung fills with air with the effect of the negative pressure in the pleural cavity, but if the pleural cavity fills with blood (haemothorax), air (pneumothorax), pus (pleurothorax) or lymph (chylothorax), this negative pressure disappears and the expansion capacity of the lung is limited. The main aim of TT is to remove this air or fluids (Durai et al., 2010). Although tube thoracostomy seems to be a simple procedure, it may cause

very serious complications. Fatal situations may occur at the time of insertion, afterwards and at the termination of the tube. Organs that can potentially be damaged during the procedure can be divided into primary and secondary. These are lung, intercostal and intrathoracic vascular structures and oesophagus, diaphragm, stomach, liver, spleen and cardiac structures, respectively (Kwiat et al., 2014). Therefore, indications and contraindications of tube thoracostomy, principles of application technique and post-TT care should be well known (Iberti & Stern 1992). In our study, we aimed to evaluate the demographic and clinical characteristics, complications, morbidity/mortality, length of hospitalisation and outcomes of patients who were admitted to the emergency department of our hospital, diagnosed by chest radiography or thorax tomography, had a TT indication and underwent tube thoracostomy by emergency medicine residents.

Materials and Methods

This cross-sectional study aimed to investigate the demographic and clinical characteristics, complications, morbidity and mortality of patients who underwent TT in the emergency department by Emergency Medicine Assistants (EMTA) at Hatay Mustafa Kemal University. Parameters such as the diagnoses for which TT was performed, imaging techniques used during diagnosis, complications related to TT and the outcome of the patients were investigated.

In this retrospective study, 111 patients aged 18 years and older who were brought to Hatay Mustafa Kemal University Hospital by 112 or who applied by their own means and who underwent tube thoracostomy were included. The study was conducted after the preliminary preparations such as literature review, obtaining the necessary ethics committee and administrative permissions were completed. Ethics committee permission was obtained from Hatay Mustafa Kemal University Non-Interventional Clinical Research Ethics Committee (24.09.2020/10).

The data of the patients obtained for the study were entered into the Statistical Package for the Social Sciences (SPSS) version 20.0, and data analyses were performed in this programme. In the statistical analyses, number, percentage, mean, median, standard deviation, highest and lowest values were used for descriptive statistics. In addition, Pearson chi-square, Fisher's exact and Mann-Whitney U tests were used in the study. In statistical analyses, p-values less than 0.05 were considered significant.

Patients who underwent tube thoracostomy from an external centre (Syrian border or other centres) and sent to our clinic. Patients under 18 years of age and pregnant patients were not included. No support was received from any financial institution in the planning and execution of the study.

Results

Our study included 111 patients who underwent TT procedure. 77.5% of the patients were male and 22.5% were female. The mean age of the patients included in our study was 40.5 ± 20.4 years, the median value was 33, the youngest age was 18 years and the oldest age was 88 years. 60.4% of the patients were under 40 years of age. While 22.5% of the patients in our study died, 54.1% were discharged. The mean hospitalisation time of 60 discharged patients was 8.9 ± 6.3 days. Patients were hospitalised for a minimum of 2 days and a maximum of 30 days. In our study, 79.3% of the patients had traumatic and 20.7% had spontaneous pneumothorax. Only 9.9% of the patients in our study had haemothorax, 20.7% had only pneumothorax and 49.5% had haemothorax+pneumothorax. In total, 58.6% of the patients had haemothorax and 70.3% had pneumothorax. Although the incidence of traumatic pneumothorax was higher in female patients in our study, there was no significant relationship ($p=0.920$).

Table 1. Types of traumatic pneumothorax by age*

		Gender				P Value**
		Under 40 years old		40 years and over		
		Number	Percent	Number	Per cent	
Haemothorax(HT)	Yes	39	58.2	26	59.1	0.929
	No	28	41.8	18	40.9	
Pneumothorax(PT)	Yes	54	80.6	24	54.5	0.003
	No	13	19.4	20	45.5	
HT+PT	Yes	37	55.2	18	40.9	0.140
	No	30	44.8	26	59.1	

* Column percentage used. ** Pearson chi-square analysis was performed.

In addition, the incidence of traumatic pneumothorax was 83.6% in patients under the age of 40 years and 72.7% in patients aged 40 years and over, and no significant relationship was observed ($p=0.168$). In our study, 17.4% of the spontaneous pneumothorax cases died and 23.9% of the traumatic pneumothorax cases died. There was no significant correlation between the type of pneumothorax and patient outcome ($p=0.482$). In our study, while the frequency of traumatic pneumothorax was higher in women than in men, the frequency of haemothorax and HT+PT was higher in men. However, no significant relationship was found between the types of traumatic pneumothorax and gender ($p>0.05$). The comparison of the frequency of development of traumatic pneumothorax according to the age groups of our patients is analysed in Table 1. In patients under 40 years of age, the frequency of traumatic pneumothorax is significantly higher than in patients aged 40 years and older ($p=0.003$). Among the types of traumatic pneumothorax in our study, haemothorax with 27.7% resulted in the highest number of exceptions and pneumothorax with 23.3% resulted in the lowest number of exceptions (Table 2).

Table 2. Distribution of the types of traumatic pneumothorax according to the emergency discharge status of the patients

	Last Condition of Patients					
	Died		Discharged		Dispatch	
	Number	Percent	Number	Percent	Number	Percent
Haemothorax (HT)	18	27.7	29	44.6	18	27.7
Pneumothorax (PT)	18	23.1	42	53.8	18	23.1
HT+PT	15	27.3	26	47.3	14	25.5

Complications developed after tube thoracostomy in 17.1% of the patients in our study. Drain exchange was performed in 5.4% of the patients. Complications in 19 patients with complications are analysed in Table 3. The most common complication was malposition, which was seen in all patients with complications. Haemothorax+pneumothorax was seen in 2 patients with subcutaneous emphysema. In addition, these patients were over 40 years of age and male. The patient whose drain was inserted into the abdominal cavity was under 40 years of age, male and developed haemothorax+pneumothorax. There was no significant correlation between the types of complications and gender, age and types of pneumothorax ($p>0.05$).

Table 3. Characteristic of the complications seen in patients

<i>Complications</i>	Number	Percent
Malposition	19	100.0
Subcutaneous emphysema	2	10.5
Insertion of the drain into the abdominal cavity	1	5.3

Although the incidence of complications was higher in men and under 40 years of age, no significant difference was found. ($p>0.05$).

Complications developed in 19.3% of traumatic pneumothorax cases and 8.7% of spontaneous pneumothorax cases. There was no significant correlation between the type of pneumothorax and the development of complications. ($p=0.353$).

Complications developed after tube thoracostomy in 13.8% of patients with haemothorax, 20.5% of patients with pneumothorax and 14.5% of patients with haemothorax+pneumothorax.

Among the patients in our study, 10.5% of those who developed complications died, while 25.0% of those who did not develop complications died (Table 4). ($p=0.233$).

Table 1. Comparison of the development of complications and the outcome of the patients

		Patient outcome				P Value**
		Died		Discharge - Referral		
		Number	Percent	Number	Percent	
Complication	Yes	2	10.5	17	89.5	0.233
	No	23	25.0	69	75.0	

* Fischer Exact test was used.

The comparison of the length of hospitalisation, type of pneumothorax and complication development status of the discharged patients among the patients in our study is analysed in Table 5. The median length of hospitalisation was 7 days

in traumatic pneumothorax cases and 6 days in spontaneous pneumothorax cases ($p=0.151$). The median hospitalisation time was 8 days in cases with complications and 7 days in cases without complications. ($p=0.429$).

Table 5. Comparison of the length of hospitalisation, type of pneumothorax and complication status of the patients

		Length of Stay		P Value*
		Median	Min-Max	
Type of pneumothorax	Spontaneous	6	2-20	0,151
	Traumatic	7	2-30	
Complication	Yes	8	3-30	0,429
	No	6	2-30	

* Mann Whitney U test was used

Discussion

Emergency medicine is a medicine that is responsible for applying the necessary interventions to patients quickly and correctly in emergency situations that develop acutely and may threaten life. Although tube thoracostomy procedure is mostly used by thoracic surgeons, it is also frequently applied by emergency physicians since it is a life-saving intervention. Complications that may occur depending on the experience of emergency physicians vary. When patients requiring tube thoracostomy are analysed according to their sex, it is observed that the male sex is more common in studies (Kantar 2016 ; Şentürk 2011). In our study, the rate of male gender was compatible with the literature. This situation may be explained by the fact that men are at the forefront as drivers in traffic, they work in heavy labour, and injuries are more common in men. However, it should be investigated why diseases requiring TT, especially pneumothorax, are more common in men. The reasons for the hospitalisation of the cases should be recorded regularly and solutions should be developed for the etiological reasons. Tube thoracostomy is a life-saving procedure which should be performed in all age groups in accordance with the indication. In a study performed in Trakya University Faculty of Medicine, the mean age of patients who underwent tube thoracostomy was found to be 39.7 ± 4.7 years (Değirmenci 2006). In a study by Edaigbini et al. the mean age of the patients was found to be 34.85 years (Edaigbini et al., 2014). In a study by Chan et al. the mean age was found to be 37 years and in a study conducted in Istanbul Sisli Etfal Training and Research Hospital, the mean age of patients who underwent TT was found to be 35.89 ± 17.47 years (Chan et al., 1997); Ergenç H. 2017). There are also studies in the literature showing that the mean ages were 43 and 44.2 years in similar studies (OMS et al., 1993; SKJ et al 2005). The median age of the patients in whom we performed tube thoracostomy was 33 years and 60.4% of the patients were under 40 years of age. The differences between the mean ages may be thought to be related to the distribution of the young-older population in the regions where the studies were performed. However, it is noticeable that patients who underwent TT were mostly in the young population. The duration of hospitalisation in patients who underwent tube thoracostomy is important in terms of the prognosis of the patients. In a study performed in 981 patients with chest trauma, it was found that the mean duration of hospitalisation was 9.6 ± 8.6 days (Çakan et al., 2001). In a study performed in 85 patients who underwent TT procedure, the mean hospitalisation time was found to be 9.7 days (Kesim et al., 2013). In a study conducted by Ak among patients with empyema, the mean duration of hospitalisation was 8.4 days, and in a study by Çelik et al. investigating pneumothorax cases, the mean duration of hospitalisation was 9.3 ± 5.3 days (Ak 2001); Yucel et al., 2009). The mean hospitalisation time of the patients in our study was 8.9 ± 6.3 days. It is seen that the mean hospitalisation duration of the patients who underwent TT in the emergency department of our hospital is compatible with the studies in the literature. One of the most important results showing the efficiency and success in cases in which tube thoracostomy is performed is the rate of excitus in patients after TT. In a study conducted in 2016, 4% of patients who underwent TT in the last 1 year were excitus (Kantar 2016). In a study conducted by Çorbacioğlu et al. in 2015, 18.1% of the patients were hospitalised in the intensive care unit and 34.2% in the wards, and the excitus rate was found to be 0.8% (Çorbacioğlu et al., 2015). In a study conducted in Isparta Süleyman Demirel University, the mortality rate was found to be 9.4% (Kesim et al., 2013). The mortality rate was found to be 4.65% in a study by İnce et al. (Ince et al., 2013). In a study conducted in the emergency department in Istanbul in 2012, the rate of excitus was found to be 11.1%. In this study, it was reported that 3.9% central nervous system, 3.3% gastrointestinal system, and 2.9% cardiovascular system pathologies accompanied excitus (Afacan 2012). In our study, 22.5% of the patients resulted in excitus. Considering the studies in the literature, it is noteworthy that the rate of excitus in the patients in whom we performed TT was high. The reasons for this should be investigated in detail, especially comorbid diseases accompanying excitus cases should be determined, and new studies and analyses should be performed by considering the sociodemographic and all clinical characteristics of the patients. Traumatic pneumothorax is present in a significant majority of patients who underwent tube thoracostomy. In a study, it was reported that 58 (59.2%) of 98 patients who underwent TT were traumatic pneumothorax cases (Kantar 2016). In a study conducted with 242 patients, it was reported that 83% of the patients who underwent TT were admitted to the emergency department for traumatic reasons (Sethuraman et al., 2011). In a study conducted in

Denizli, traffic accidents were reported as the most common responsible mechanism with 33.3% (Şentürk 2011). In our study, 79.3% of the patients were traumatic pneumothorax patients. As seen in the literature, there are differences between the frequencies of the etiological causes of patients who underwent TT. Possible reasons for this may include factors such as the location of the hospitals, the population served, and the fact that the hospital is a trauma centre. In addition, the detection of spontaneous cases in outpatient clinics without referral to the emergency department may explain the result we obtained in our study. Considering that our hospital is a trauma centre, it is inevitable that a significant proportion of the patients who underwent TT were due to trauma.

In our study, haemothorax was present in 58.6%, pneumothorax in 70.3% and haemothorax+pneumothorax in 49.5% of traumatic pneumothorax cases who underwent TT. In a study evaluating 216 patients who underwent TT in the emergency department for 3 years, it was reported that 49.5% of the patients had pneumothorax, 35.8% had haemothorax and 7.8% had haemothorax+pneumothorax (Şentürk 2011). In a study conducted in Istanbul in 2017, tube thoracostomy intervention was performed in 174 cases (66.2%) due to pneumothorax, 74 cases (28.2%) due to haemo-pneumothorax, 10 cases (3.8%) due to haemothorax and five cases (1.9%) due to effusion and empyema (Ergenç 2017). According to a study conducted by Ball among traumatic patients, TT was performed in 62% of patients due to pneumothorax, 30% due to haemopneumothorax and 8% due to haemothorax (Ball 2007). In a study by Kong et al. 1042 patients were analysed and it was observed that TT was performed in 37% of patients with the diagnosis of pneumothorax, 33% with haemopneumothorax, 30% with haemothorax and 8% with tension pneumothorax (Kong et al., 2015). In the study by Afshar et al. 37.1% pneumothorax, 35% haemothorax and 26.3% haemopneumothorax were found (Afshar et al 2015). It is seen that the number of haemothorax+pneumothorax cases in our study is higher compared to the studies in the literature. The reasons for this may include the fact that our hospital is a 3rd level trauma hospital.

One of the important problems after TT intervention in the emergency department is the possibility of complications. It was reported that the incidence of complications was 4% in TT procedures performed in the emergency department of Erciyes University Faculty of Medicine in the last 1 year. It was explained that the most common complication was diaphragmatic laceration (Kantar 2016). In the study by Deneuville et al. the complication rate according to branches was 6.8% in thoracic surgeons, whereas this rate was 65% in emergency medicine and intensive care physicians (Deneuville 2002). Martin et al. reported that the complication rate after TT performed by surgeons was 6%, while this rate was 13% in emergency medicine physicians (Martin et al., 2013). In a study conducted in Canada, the complication rate in traumatic patients who underwent TT was 22.4%, 11.8% of these were malposition and 7.9% were interventional complications (Ball et al., 2007). In our study, the complication frequency in patients who underwent TT was 17.1%. The most common complication was malposition. It is observed that there are significant differences between complications in the studies. In addition, it has been reported that there are differences between the frequency of complications according to the branches of physicians performing TT procedure. In our study, all physicians who performed TT were emergency physicians. Therefore, a comparison with other speciality branches cannot be made. However, in general, it can be said that the frequency of complications is lower than the previous studies. It is noteworthy that the high complication rates reported in the literature in emergency physicians are not compatible with our study. In our university, emergency physicians receive specialty training 24 hours a day without interruption and TT is frequently performed because our hospital is a trauma centre. We are of the opinion that the success of TT procedures is related to the knowledge and experience of the practitioner, not to his/her speciality.

Conclusion

A significant proportion of patients undergoing tube thoracostomy are male, young population and traumatic cases. The most common complication is malposition and mortality rates are high. When performed without knowledge and skill, very serious complications develop and may lead to death. A successful TT procedure can be performed without complications, especially by following the rules of surgical sterility and antisepsis. Careful application of the procedure and careful care will minimise possible complications, hospitalisation time and patient cost.

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A.K. : Concept, Design, Data collection, Analysis or Interpretation Literature search, Writing.

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Conflict of interest

The authors declare no conflict of interest. The manuscript has not been submitted for publication in other journal.

Ethical concern and informed consent

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