

## A THOROUGH VIEW OF TUBE THORACOSTOMY, THE MOST COMMON SURGICAL PROCEDURE PERFORMED BY THORACIC SURGERY CLINICS: TEN YEARS' CLINICAL EXPERIENCE

Göğüs Cerrahisi Kliniklerinin En Sık Yaptığı Cerrahi İşlem Olan Tüp Torakostomilere Her Yönüyle Bakış; 10 Yıllık Klinik Deneyimimiz

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## ABSTRACT

**Aim:** The objectives of this study were to determine the demographic and clinical characteristics of the patients undergoing tube thoracostomy and to assess the complications due to the procedure.**Material and Method:** The study was planned retrospectively. Patients who underwent tube thoracostomy due to any reason in our hospital during the 10-year period between January 2008 and December 2017 were included in the study. Tube thoracostomies performed after thoracic and cardiac operations were excluded from the study. Demographic data of the patients were evaluated in terms of indications for tube thoracostomy, duration of tube thoracostomy, thoracostomy-induced complications, clinical findings, and the total hospitalization duration.**Results:** A total of 3567 tube thoracostomies was performed during the 10-year period between January 2008 and December 2017. 2072 (58.1%) were traumatic and 1495 (41.9%) were due to non-traumatic reasons. The indications of the thoracostomy were 1665 (46.7%) pneumothorax, 688 (19.3%) hemothorax, 324 (9.1%) hemopneumothorax, 752 (21.1%) pleural effusion, 130 (3.6%) empyema and 8 (0.2%) chylothorax.**Conclusion:** Tube thoracostomy has been a life-saving procedure frequently used under elective and emergency conditions in the field of thoracic surgery. Although the procedure is easily performed by the experienced surgeons within minutes, its emergent complications may be serious and life-threatening if careful attention is not paid. It achieves excellent results when tube thoracostomy conducts accurately and carefully.**Keywords:** Chest Tubes, Thoracic Surgical Procedures, Thoracostomy

## ÖZ

**Amaç:** Bu çalışmada tüp torakostomi uygulanan hastaların demografik ve klinik özelliklerini belirlemek ve işlemle ilgili komplikasyonları değerlendirmek amaçlandı.**Gereç ve Yöntem** Çalışma retrospektif olarak planlandı. Ocak 2008- Aralık 2017 tarihleri arasındaki 10 yıllık sürede herhangi bir nedenle hastanemizde tüp torakostomi uygulanan hastalar çalışmaya alındı. Torasik ve kardiyak operasyonlardan sonra uygulanan tüp torakostomiler dışlandı. Olguların demografik verileri, tüp torakostomi uygulanma endikasyonu, tüp torakostomi kalış süresi, klinik bulgular, gelişen komplikasyonlar ve toplam yatış süresi açısından incelendi.**Bulgular:** Ocak 2008- Aralık 2017 tarihleri arasındaki 10 yıllık sürede 3567 adet tüp torakostomi işlemi yapıldı. 2072 (%58.1) işlem travmatik, 1495 (%41.9) işlem ise travma dışı nedenlerden dolayı uygulandı. İşlem endikasyonları ise 1665 (%46.7) pnömotoraks, 688 (%19.3) hemotoraks, 324 (%9.1) hemopnömotoraks, 752 (%21.1) plevral efüzyon, 130 (%3,6) ampiyem ve 8 (%0.2) şilotoraksti.**Sonuç:** Tüp torakostomi, göğüs cerrahisinde elektif ve acil şartlarda sıkça kullanılan hayat kurtarıcı bir işlemdir. Tecrübeli ellerde dakikalar içinde ve kolayca uygulanan bir yöntem olmasına rağmen dikkat edilmezse oluşacak komplikasyonları ciddidir. Doğru ve dikkatli bir şekilde yapılan tüp torakostomi mükemmel sonuçlar verir.**Anahtar Sözcükler:** Toraks dren, Toraks Cerrahi işlemleri, Torakostomi

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## INTRODUCTION

Tube thoracostomy, which is one of the most common surgical interventions performed in thoracic surgery, is the procedure of inserting a catheter from the intercostal space into the pleural space so as to provide drainage of the air or fluid (blood, lymph, pus, etc.) in the pleural space. Although the procedure is perceived as a simple and technically easy procedure by other branch physicians, it makes things difficult for even experienced thoracic surgeons in patients with adherent pleural leaves and in obese patients. Therefore, the procedure is always open to serious complications.

Indications of tube thoracostomy include pneumothorax, hemothorax, empyema, pleural effusion, chylothorax, other therapeutic applications (anesthesia, chemotherapy), and those due to drainage after pulmonary and cardiac surgery (1). While the site, which is located behind the pectoralis major muscle where 3<sup>rd</sup> to 5<sup>th</sup> intercostal spaces intersect with the midaxillary line and is identified as the safe triangle, is often preferred for the procedure, the tube can be inserted from pleural adhesion and loculations and from any possible different localization, if available (1, 2).

The objectives of this study were to determine the demographic and clinical characteristics of the patients undergoing tube thoracostomy and to assess the complications due to the procedure.

## MATERIAL and METHOD

Ethics committee approval was gained from the clinical research ethics committee of Adana City Training and Research Hospital (Date: 19/06/2018, Decision No: 208). The study was planned retrospectively. Patients who underwent tube thoracostomy due to any reason in our hospital during the 10-year period between January 2008 and December 2017 were included in the study. Tube thoracostomies performed after thoracic and cardiac operations were excluded from the study. All the patients were treated by thoracic surgery specialists. In order to retrieve the data of the patients from the hospital information management system, permission was received from the education committee on the spe-

cialty in medicine and the data were analyzed retrospectively. Demographic data of the patients were evaluated in terms of indications for tube thoracostomy, duration of tube thoracostomy, thoracostomy-induced complications, clinical findings, and the total hospitalization duration.

Technically, the patient to be undergone tube thoracostomy was positioned semi-upright or uprightly and the arm was placed on the head and removed from the surgical field. The site to be performed an operation was widely stained with an antiseptic solution. We firstly pinpointed the intercostal space where thoracostomy would perform. Then, skin, subcutaneous tissues, muscles, and parietal pleura were anesthetized with local prilocaine. The anterior or middle axillary line at the 5<sup>th</sup> intercostal space was preferred when tube thoracostomy should be performed for pneumothorax. The posterior axillary line at the 6<sup>th</sup> intercostal space was used when it should be applied to hemothorax or pleural effusion. In addition to these, the site where the fluid is present was marked with the help of ultrasound guidance. Then, tube thoracostomy was performed for locular fluids. After local anesthesia, an incision not parallel to the ribs was made with a scalpel through the skin and subcutaneous tissues. The incision was deepened through the subcutaneous tissue, muscles, and pleura by blunt dissection with the help of a dissector until the pleural cavity was exposed. After the pleura was exposed, the drain was inserted into the thorax cavity with forceps. After the drain was fixed to the skin, it was connected to the closed underwater drainage system. After dressing the drainage area, a control radiograph was taken from the patient. Air leak and 24-hour drainage were followed from the tube thoracostomy, and posterior-anterior chest radiography was performed daily. In pneumothorax cases where the air drainage completely stopped and the oscillation reduced to 2-3 cm, the tube was clamped and waited for a minimum of 8 hours. Chest radiography was controlled by the end of the duration. The drain was removed from patients who had no expansion defect and had no air leak after being opened the clamp. Tube thoracostomy was discontinued in the effusion cases where the daily drainage fell below 100 cc.

**Table 1.** Demographic data, etiology and indications of patients undergoing tube thoracostomy.

<b>Total (n)</b>	3567
<b>Age (mean ± SD)</b>	52±23.9
<b>Gender (n (%))</b>	
Male	2753 (%77.2)
Female	814 (%22.8)
<b>Etiology</b>	
Trauma	2072(%58.1)
No trauma	1495(%41.9)
<b>Indication (n (%))</b>	
Pneumothorax	1665(%46.7)
Hemothorax	688 (%19.3)
Hemopneumothorax	324 (%9.1)
Pleural effusion	752 (%21.1)
Empyema	130 (%3,6)
Chylothorax	8 (%0.2)
<b>Unilateral tube (n (%))</b>	3467 (%97.2)
<b>Bilateral tube (n (%))</b>	100 (%2.8)
<b>Tube time, days (n (%))</b>	
0-3 days	1030(%28.9)
4-7 days	1068 (%29.9)
8-14 days	855 (%24)
15 ≥ days	614 (%17.2)

Data coding and statistical analysis were performed using IBM SPSS 22 software. The numerical values of the patients were presented as Mean ± Standard Deviation (mean ± ss). The categorical values were given as median ± minimum maximum (median ± min-max). Column or line graphs were plotted to show mean ± ss and median ± min-max values.

## RESULTS

A total of 3567 tube thoracostomies was performed during the 10-year period between January 2008 and December 2017. 3467 (97.2%) were unilateral and 100 (2.8%) were bilateral tube thoracostomy. 2753 (77.2%) were performed in male patients and 814 (22.8%) in female patients. The mean age was 52 ± 23.9 years (within the range of 0-104 years). 2072 (58.1%) were traumatic and 1495 (41.9%) were due to non-traumatic reasons. The indications of the thoracostomy were 1665 (46.7%) pneumothorax, 688 (19.3%) hemothorax, 324 (9.1%) hemopneumothorax, 752 (21.1%) pleural effusion, 130 (3.6%) empyema and 8 (0.2%) chylothorax.

The duration of tube thoracostomy was 0-3 days in 1030 (28.9%) thoracostomies, 4-7 days in 1068 (29.9%), 8-14 days in 855 (24%) and more than 15 days in 614 (17.2%). Complications due to tube thoracostomy were developed in 225 patients (6.3%). These complications may collect under five main headings: (1) complications associated with thoracostomy (4 lung parenchymal damages, 15 fissural insertions, 6 subcutaneous and intramuscular insertions, 3 abdominal placements without organ damage, 25 subcutaneous emphysema, 10 reexpansion pulmonary edema), (2) infective complications (14 wound site infections, 5 empyema) and 4 pneumonia), (3) positional complications (46 kings), (4) complications due to drainage (33 prolonged air leaks, 30 problem of pleural fluid and blood drainage, and hematoma formation), and (5) complications due to tube removal (17 minimal pneumothorax, 3 recurrent drain-required pneumothorax and self-dislodgement of 10 tubes because of bad fixing). Demographic data, etiology, and indications of all the tube thoracostomies are presented in Table 1.

**Table 2.** Tube thoracostomy complications

Total (n)	225
Insertional complications	63 (%28)
Lung parenchymal damage	4
Fissural insertion	15
Subcutaneous and intramuscular insertion	6
Abdominal placement without organ damage	3
Subcutaneous emphysema	25
Re-expansion pulmonary edema	10
Infective complications	23 (%10.2)
Wound site infection	14
Empyema	5
Pneumonia	4
Positional complications	46 (%20.5)
King	46
Complications due to drainage	63 (%28)
Prolonged air leak	33
Problem of Pleural fluid and blood drainage, hematoma	30
Complications due to tube removal	30 (%13.3)
Minimal pneumothorax	17
Recurrent drain-required pneumothorax	3
Self- dislodgement of the tube	10

Complications due to the thoracostomies are given in Table 2.

## DISCUSSION

Drainage procedures for many pleural diseases have been defined since the Hippocrates period. Hippocrates (460-370 BC) drained empyema by inserting a metal tube into the pleural space. In 1870, Playfair also treated empyema using the first underwater drainage system. It is very important that the procedure should be performed by thoracic surgery specialists as much as possible for the tube thoracostomy application to be beneficial to the patient, and followed and discontinued by the same specialists.

This procedure, which appears to be simple, will be pain and suffering rather than beneficial for the patient in the case that surgeons are inexperienced. Today sizes 28 and 32 Fr are most commonly used for adults while sizes 16-24 Fr are used for children. However, the tube size should be determined according to the etiology. The tubes within the range of 24-36 Fr should be used for pneumothorax. The sizes 24-36 Fr should be selected for hemothorax, malignant pleurisy, empyema, and perioperative conditions in order to drain hemorrhagic or dense fibrin-containing fluid (3-5). Tube thoracotomy includes a variety of indications such as pneumothorax (spontaneous, iatrogenic and traumatic pneumothorax),

pleural effusion (malignant pleurisy, simple pleural effusion causing respiratory distress, empyema or complicated parapneumonic effusion, traumatic hemothorax and chylothorax) and perioperative cases (all kinds of post-thoracotomy and cardiothoracic surgery) (6,7). A study carrying out at the emergency department reported that 51% of patients underwent tube thoracostomy for traumatic reasons and 49% for nontraumatic reasons (8). In another study, the etiology was associated with trauma in only 195 (16.7%) of 1169 tube thoracostomies undergone in the 10 years (9). In the tube thoracostomy performed in our clinic for 10 years, the etiology was traumatic in 2072 (58.1%) patients and non-traumatic in 1495 (41.9%) patients. In another study covering 607 tube thoracostomies, 59.8% of the indications were pneumothorax, 15.7% hemothorax, 21.5% hemopneumothorax, 2.8% empyema and 1.2% pleural effusion (10). Our findings show that 46.7% of the indications were pneumothorax, 19.3% hemothorax, 9.1% hemopneumothorax, 21.1% pleural effusion, 3.6% empyema and 0.2% chylothorax.

The use of prophylactic antibiotics in patients with the tube is still a controversial issue. It has been reported that prophylactic antibiotics should not be used when the patient does not have thoracic trauma and asepsis is observed (11). There are also studies showing that prophylactic antibiotics are able to reduce the incidence of pneumonia or empyema that might be associated with tube thoracostomy (12). Infection is less likely to develop, especially when prophylactic antibiotics are used in penetrating thoracic injuries (13). We are starting to prevent the infection by administering a recommended dose of cefazolin, the first-generation cephalosporin, prophylactically to patients undergoing tube thoracostomy in our clinics.

Although surgeons are experienced, many complications can develop due to tube thoracostomy procedure and the complication rate varies between 3 to 8% (14). In general, the rates of complications were 38% due to insertion, 44% for positional, 9% due to removal, and 9% for infective/immunological origin (15). Another researcher reported a 19% rate of complication and graded them as 18% of king, 18% of subcutaneous insertion, 13% of too shallow, 7% of dislodged, 2% of visceral injury, 1% of vascular injury, 1% of wrong side and 41% of outside safety triangle (16).

Large skin incision, insufficient liquid in the bottle, clamping the drain during transport, leaving the bottle cap closed and tipping the bottle would increase the complications and/or its rates. We observed complications (6.3%) in 225 thoracostomies. In order to avoid these complications, VATS was performed in patients with prolonged air leakage. Damage seen in the lung parenchyma was repaired. In the fissural insertion, if the drain was functional and did not cause problems in the air and fluid drainage, we did not perform anything. Old drain was replaced with a new one with non-thoracic insertions.

2nd tube thoracostomy was performed in advanced subcutaneous emphysema if needed. Negative pressure aspiration thopas device was used in some patients and VATS was applied if necessary. Appropriate supportive treatment was applied to patients with re-expansion pulmonary edema. They were followed up in the intensive care unit. Antibiotherapy was performed in wound site infection and pleural lavage was carried out in addition to the antibiotic in empyema. In cases of insufficient drainage due to kink or malposition, reposition was tried first, and tube thoracostomy was performed again in the event of failure.

The tube may remove after 24 hours after the air leak has stopped, the chest radiograph reveals the complete expansion of the lungs and daily drainage drops below 100 ml (3). End-inspiration, end-expiration, Müller's maneuver, Valsalva maneuver, spontaneous breathing, and suction are the techniques used to remove the tube thoracostomy. Different techniques can also employ for this purpose (17). During the procedure we used to remove the tube in our clinic, the patients were instructed to take deep inspiration and hold their breath. While one person removes the tube, the other person connects the removal suture simultaneously. After the tube is removed, the assessment is carried out with control chest radiography.

In conclusion, tube thoracostomy is a life-saving procedure frequently used under elective and emergency conditions in the field of thoracic surgery. Although the procedure is easily performed by the experienced surgeons within minutes, its emergent complications may be serious and life-threatening if careful attention is not paid. It achieves excellent results when tube thoracostomy conducts accurately and carefully.

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