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Original Article

Bronchoscopic destruction of endobronchial lung tumors

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ABSTRACT

Background: Bronchoscopy is a safe and reliable intervention for the management of airway diseases. Airway patency is particularly important for patients with endobronchial tumors. The aim of this study was to report the effects of rigid bronchoscopy on the prognosis of endobronchial lung tumors causing bronchial obstruction.

Materials and Methods: The study included 38 patients who were referred to our clinic during 2009–2019 following radiological or bronchoscopic diagnosis of endobronchial lesions and who were at the stage of diagnosis and treatment for lung malignancy. Their demographic characteristics, clinical complaints, pathologic diagnoses, stages of primary lung cancer, preoperative and postoperative radiological findings, and bronchoscopy results were retrospectively evaluated and recorded.

Results: A total of 29 males and 9 females were included in the study. The most common complaints observed were cough in 16 patients (42.1%) and shortness of breath in 12 (31.5%). Overall, 28 patients (73.6%) had primary pulmonary malignancy, 6 (15.7%) had benign diseases, 2 (5.2%) had primary tracheal malignancy, and 2 (5.2%) had metastasis of non-pulmonary malignancy. Full endobronchial patency was achieved in 23 patients (60.5%), whereas partial patency was achieved in 10 (26.3%). Radiological regression of opacities was observed with symptomatic relief of clinical complaints in all patients who achieved partial or full patency.

Conclusion: Bronchoscopic destruction of an endobronchial lesion causing tracheobronchial obstruction is critical for improving acute respiratory distress, avoiding the development of lung damage, and preventing delayed treatment in malignant cases.

Keywords: dyspnea, obstruction, bronchus, trachea.

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Introduction

Bronchoscopy is a safe surgical method for the diagnosis, treatment, and management of airway diseases and has been practiced for more than a century [1]. It can be performed as a rigid or flexible procedure, but the advantageous aspects of flexible bronchoscopy is the reason why it is more commonly used in some areas. Nevertheless, rigid bronchoscopy is still the most reliable intervention for foreign body aspirations, central airway obstructions, and tracheobronchial stenting [2, 3].

Problems related to airway obstruction are encountered in approximately 30% of lung cancer patients [4]. In such patients, this obstruction occurs in three ways: as an endobronchial tumor plug, as external compression, or as a mixed type (Figure 1). The majority of lung cancer patients are at an advanced disease stage at the time of diagnosis [5]. However, the current use of targeted therapies, chemotherapy and radiotherapy protocols, and implementation of immunotherapy, has significantly improved the survival rate, even in patients whose tumors have not completely disappeared. Restoration of airway patency, which we consider as a part of these multimodal approaches, has therefore become obligatory in patients with endobronchial tumors.

In some cases, bronchial obstruction caused by systemic tumor metastasis is also encountered. These obstructions may occur as a result of external compression of the tumors on adjacent organs, or the tumors may have a direct endobronchial location. In addition, obstruction can occur due to benign lung pathologies, which constitute 2%–5% of all lung tumors and include adenomas, hamartomas, lipomas, and hemangiomas [6]. These benign tumors may be preliminarily diagnosed as a malignancy due to their presentation with similar clinical and radiological findings but may later be diagnosed correctly through bronchoscopy. The present study aimed to report the effects of rigid bronchoscopy on the prognosis of endobronchial lung tumors causing bronchial obstruction.

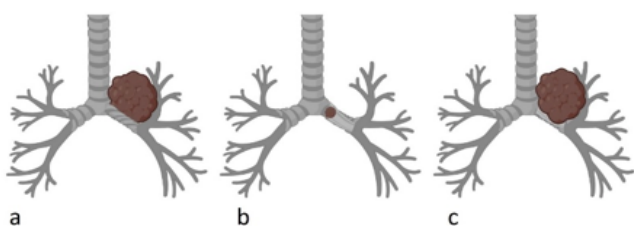


Figure 1. Illustration of types of obstruction; external compression (a), Endobronchial tumor plug (b), mixed type (c).

Materials and Methods

This study included 38 patients who were referred to our clinic during 2009-2019 following the diagnosis of endobronchial lesions radiologically or by bronchoscopy and who were at the diagnosis and treatment stage for lung malignancy. Patients who had post-intubation and post-tracheostomy stenoses, traumatic stenoses, and obstructions caused by external compression of the bronchus were excluded from the study.

Bronchoscopic tumor destruction

All bronchoscopic procedures were performed using a rigid bronchoscope (Karl Storz™, Germany), and all patients underwent rigid bronchoscopy under general anesthesia. If the structure of the tumor allowed its resection from the mucosa, mechanical destruction was performed with forceps. After determining localization and type of the tumor, forceps was used for direct tumor destruction. If the bronchial mucosa had cleavage next to the tumor, we aimed for luminal opening through it. If the tumor had a peduncle on the mucosa, it was excised completely due to tumor mobility. The bleeding control was done with endobronchial cold saline lavage and aspiration.

Cases where 100% of the airway became patent during bronchoscopy were considered to have achieved “full patency.” Cases provided with ventilation but with airway patency under 100% were considered to have achieved “partial patency” (Figure 2).

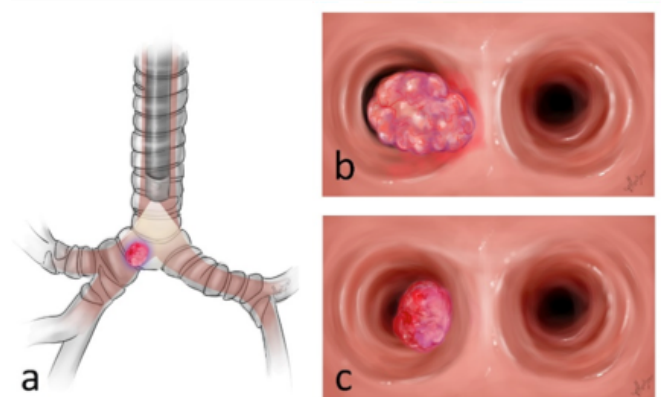


Figure 2. Demonstrative illustration of bronchoscopy; Illustration of tracheobronchial system and the endobronchial tumor located in the right main bronchus during bronchoscopy (a), illustrative view of the endobronchial tumor which caused near-total obstruction and located on the left main bronchus (b), illustrative view of partial airway patency after bronchoscopic tumor destruction (c).

Airway patency was checked through chest X-rays and computed tomography (CT) scans performed post-operatively.

The demographic characteristics, clinical complaints, previous diagnoses (if any), stages of cancer in primary lung cancer patients, preoperative and postoperative radiological findings, bronchoscopy results, and postoperative pathology diagnoses were retrospectively evaluated and recorded after approval by the Institutional Ethics Committee (Approval number: 2020/262).

Results

The 38 patients (29 males and 9 females) had a mean age of 58.89 ± 9.93 years (range 31-78 years). The most common complaints were cough in 16 patients (42.1%) and shortness of breath in 12 patients (31.6%) (Table 1).

Overall, 16 patients (42.1%) were undiagnosed prior to rigid bronchoscopy. Of the 38 patients, 28 had primary lung malignancy (Table 2).

Table 1. Complaints of patients

Complaints	n (%)
Cough	16 (42.1)
Dyspnea	12 (31.6)
Hemoptysis	3 (7.9)
Incidental	3 (7.9)
Chest pain	2 (5.3)
Fever	1 (2.6)
Sputum	1 (2.6)
Total	38 (100)

Table 2. Histopathological results of the lesions.

Diagnosis	n (%)
Squamous cell carcinoma	16 (42.1)
Adenoid cystic carcinoma	2 (5.3)
Typical carcinoid tumor	2 (5.3)
Atypical carcinoid tumor	2 (5.3)
Adenosquamous carcinoma	2 (5.3)
Chondroid hamartoma	2 (5.3)
Polyp	2 (5.3)
Adenocarcinoma	1 (2.6)
Small cell lung cancer	1 (2.6)
Malignant mesenchymal tumor	1 (2.6)
Plasmacytoma	1 (2.6)
Leiomyosarcoma	1 (2.6)
Renal cell carcinoma	1 (2.6)
Suspected malignancy	1 (2.6)
Necrosis	1 (2.6)
Chronical inflammation	1 (2.6)
Lipoma	1 (2.6)
Total	38 (100)

The staging of the primary lung cancer patients at the time of bronchoscopy was performed in accordance with the 8th edition of the Tumor, Node, and Metastasis staging system for lung cancer. Accordingly, 11 patients (39.3%) were classified as stage III, 8 (28.6%) as stage IV, 7 (25%) as stage I, and 2 (7.1%) as stage II (Table 3).

Thoracic CT scans performed preoperatively revealed an endobronchial lesion that did not negatively affect ventilation in the distal parenchyma but caused bronchial obstruction in 23 patients (60.5%). Six patients (15.8%) presented at our clinic with complete atelectasis of the right lung, three patients (7.9%) with complete atelectasis of the left lung, three patients (7.9%) with lobar and segmental atelectasis, two patients (5.3%) with increased aeration in the left lung, and one patient (2.6%) with increased aeration in the right lung.

Bronchoscopy revealed endobronchial-type bronchial obstruction in 27 patients (71%) and mixed-type bronchial obstruction in 11 patients (29%). The tumor localization in the CT was on the right in 25 patients (65.8%) and on the left in 13 patients (34.2%). Obstruction of the main bronchus was observed in 30 patients (78.9%); 19 of whom had obstruction on the right and 11 on the left main bronchus. Eight patients (21.1%) had lobar and segmental bronchial obstruction.

After bronchoscopy, full endobronchial patency was achieved in 23 patients (60.5%), whereas partial patency was achieved in 10 patients (26.3%) (Figures 3 and 4). In five patients, the distal endobronchial part of the tumor could not be observed safely (13.2%). All endobronchial hemorrhages were controlled locally after tumor resection, and no patient required thoracotomy. There were no intraoperative and postoperative complications. Radiological regression of opacities were observed with symptomatic relief of clinical complaints were established in all patients who achieved partial or full patency (Figure 5).

Table 3. Stages of the patients who were diagnosed with primary lung cancer.

Stage of primary lung cancer	n (%)
Stage I	7 (25)
Stage II	2 (7.1)
Stage III	11 (39.3)
Stage IV	8 (28.6)
Total	28 (100)

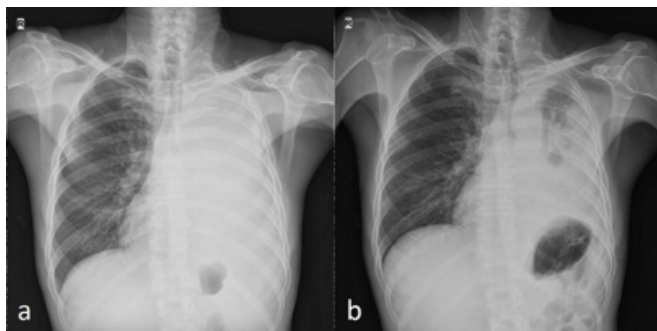


Figure 3. Chest X-ray showing the total atelectasis of the left lung (a), the partial ventilation was seen on the left lung after bronchoscopic tumor destruction (b).

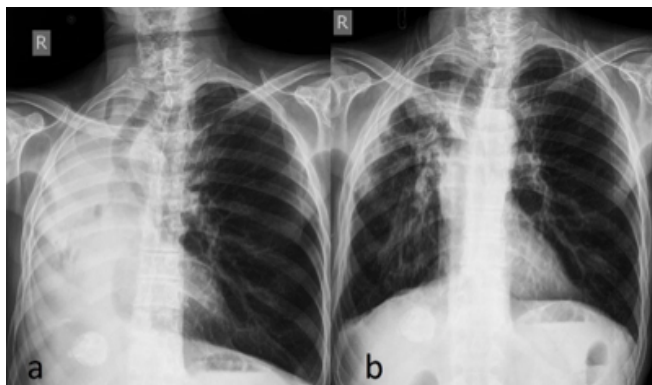


Figure 4. Chest X-ray showing the total atelectasis of the right lung due to main bronchus obstruction (a), the postoperative chest X-ray showed the lungs ventilated bilaterally (b).

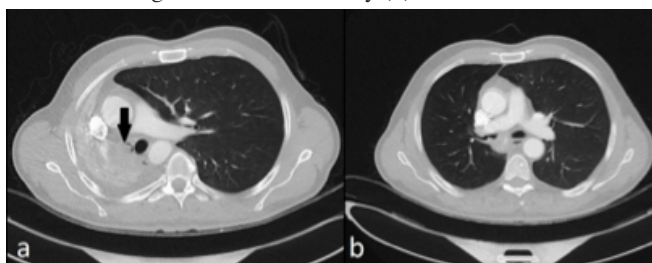


Figure 5. The total atelectasis of the right lung, mediastinal shifting and endobronchial tumor (black arrow) were seen in computed tomography (a), the ventilation of the right lung and partial patency of the right bronchus (b).

Obstruction occurred in three patients, and two patients underwent tracheobronchial stenting. In one patient, tumor destruction was completed with two rigid bronchoscopy procedures conducted at one-month intervals. In one patient with a hamartoma, an upper lobectomy was performed due to the development of bronchiectasis over time. Two patients with typical carcinoid tumors, one located in the lingula and the other in the left main bronchus, recovered following total bronchoscopic excision. Anatomical pulmonary resections were performed following bronchoscopy in three patients with malignant pathologies.

In two patients with atypical carcinoid tumor, left upper lobectomy was performed due to the continuity of the tumor in the bronchial wall in one, and bilobectomy inferior due to accompanying bronchiectasis in the other one. Additionally, one patient who had an adenoid cystic carcinoma located in the right main bronchus underwent pneumonectomy.

Death occurred within the first week in two patients diagnosed with stage IVA squamous cell carcinoma (SCC) and stage IVB adenosquamous carcinoma, respectively. Both these patients had total obstruction of the right main bronchus, and the distal endobronchial part of the tumor could not be observed safely. Three patients diagnosed with SCC who achieved full endobronchial patency also died due to acute renal failure during the course of chemotherapy in the first (stage IIB), sixth (stage IVB), and seventh month (stage IIIA), respectively. Four patients who achieved full patency and completed their treatment protocols had one- to three-year survivals (stage IIIB SCC, 1.5 years; stage IIA SCC, 2 years; stage IB SCC, 2.5 years; and stage IIIA SCC, 3 years, respectively). Follow-up and treatment of the other patients continued.

Discussion

Respiratory pathologies lead to serious morbidity and mortality, and early diagnosis plays a vital role in the course and control of these diseases [7]. The basic and most commonly practiced radiological examination is the chest X-ray, but low-dose thoracic CT is also used in screening programs and is now more commonly recommended [5]. If the radiological results detect an intrapulmonary pathology, the pathology is quickly diagnosed and treatment is commenced.

Patient complaints due to endobronchial pathologies are usually related to effects on the distal parenchyma and/or irritation of the airway. Symptoms include shortness of breath, cough, hemoptysis, sputum production, and wheezing. Patients presenting with these complaints should be screened for an intrapulmonary pathology upon their initial arrival at the clinic or during follow-up. The delayed diagnosis of an airway obstruction may lead to secondary effects, such as atelectasis, pneumonia, abscess, bronchiectasis, and tracheobronchial stricture in the affected lung, even if the tumor is diagnosed as benign [8].

The presence of airway obstruction in an oncologi-

cal patient may disrupt the patient's comfort and stable course and can cause delays in the administration of medical or surgical treatments required in the event of a possible secondary infection. The major airway obstruction associated with lung cancer is a life-threatening clinical condition that rapidly deteriorates. For example, Daneshvar et al have reported a prevalence of central airway obstruction of 13% and that the majority of lung cancer patients who developed airway obstruction were in the stage III and IV groups [9]. In our study, 67.9% of patients diagnosed with primary lung cancer were in stage III and IV. This prevalence can be explained by the large-sized masses that cause metastatic conglomerated lymph nodes. These nodes are centrally localized and close to the central airways, resulting in a more pronounced pressure effect and tumor invasion. Chemotherapy and radiotherapy treatments usually continue in these patients, leaving them with limited tolerance to complications secondary to bronchial obstruction due to their medical condition. Airway obstruction due to malignancy also increases mortality. Mechanical elimination of obstructions in the airway by bronchoscopy, therefore, improves the clinical course of the disease. For this reason, intervention with bronchoscopy should not be delayed in patients for whom it may be indicated.

In the present study, all patients who achieved full patency or partial patency by endobronchial intervention were able to continue their treatment protocols. However, in five patients, the distal part of the tumor could not be reached and luminal patency could not be achieved, and two of them with total obstruction of the right main bronchus died within the first week. We concluded that mechanical elimination of endobronchial obstruction through bronchoscopy reduces mortality.

The diagnosis and treatment of airway pathologies and tracheobronchial foreign body aspirations and the need for provision of airway safety in acute respiratory distress constitute the main indications for rigid bronchoscopy [1]. The wide lumen and fixed rigidity of this procedure permits surgical manipulations, such as those performed using an aspirator and various tools, while providing lung ventilation. The approach and treatment plan in malignancy-induced endobronchial obstruction should be decided by evaluating the characteristics of the lesion, the patient's medical condition, whether the obstruction is endobronchial or caused by external compression, and the stage of the treatment process. In

the case of a tumor that decreases or does not grow in size in response to chemotherapy or radiotherapy lung cancer treatments, the obstruction may not recur after mechanical destruction with bronchoscopy.

Additional options available for management of tumors causing endobronchial obstruction include cryo-canalization, brachytherapy, argon plasma coagulation, and laser and electro-cauterization, and these interventions can be successfully implemented with appropriate equipment [10,11]. The advantage of mechanical destruction with rigid bronchoscopy over these other procedures is that bronchoscopy does not require additional devices and equipment, making it less costly. Mechanical destruction can also be easily performed by a surgeon experienced in rigid bronchoscopy manipulations to provide quick and effective intervention in emergencies. In the case of external compression, tracheobronchial stents can be safely inserted to prevent recurrence of the obstruction by providing a mechanical barrier and ensuring airway patency [12]. Stent insertion is also an alternative for patients with recurrent obstruction. In the present study, a stent was inserted in two patients, but bronchoscopy had to be performed three times in a row in one patient. The waiting time to obtain supplies and the urgency of bronchoscopy were considered when repeated bronchoscopy was performed. The patient is not subjected to serious harm in repeating this procedure, as bronchoscopy can be considered a minimally invasive procedure. Furthermore, tumor destruction by bronchoscopy in malignancy-induced endobronchial obstruction to provide airway improves the survival and treatment compliance of patients [11]. This approach is also a palliative intervention for patients with advanced stage or technically unresectable clinical conditions.

In addition to primary lung cancers, metastatic lesions of the lung can also present with endobronchial obstruction. Thyroid, colon, breast, esophagus, and kidney cancers are among the malignancies that lead to endobronchial lung metastasis [13]. In the present study, two patients had an extrapulmonary malignancy (renal cell carcinoma and plasmacytoma). The bronchoscopic approach in these patients did not differ from primary lung malignancies in the other patients.

Benign lung tumors are less common when compared with all other lung tumors. Although hamartoma and adenoma are the most frequently occurring benign lung tumors, endobronchial polyps, inflammatory polyps, and,

more rarely, granulomas and lipomas are also considered benign lung tumors. Endobronchial presentation of benign lung tumors is quite rare, but rigid bronchoscopy is sufficient for the diagnosis and treatment of approximately 95% of patients with benign tumors [14]. Recurrence rarely occurs. In the present study, lesions having a benign pathology were excised using rigid bronchoscopy in six patients. In addition to being a palliative procedure, endobronchial tumor destruction by bronchoscopy is curative for low-grade tumors, such as typical carcinoids and benign lesions. Additional surgical treatment was not implemented in two patients diagnosed with typical carcinoids in this study, and their follow-up treatment continued.

In conclusion, bronchoscopic destruction of endobronchial lesions causing tracheobronchial obstruction is of critical significance in improving acute respiratory distress, preventing the development of lung damage, and preventing delayed treatment in malignant cases, regardless of the clinical course, stage, and diagnosis of the patient.

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Ethics Approval

The study was approved by the institutional ethical board of Selcuk University Medical Faculty (Approval number: 2020/262).

Authors' contributions

HY; collected the data, co-wrote the paper, performed the analysis, GSS; co-wrote the paper, conceived and designed the analysis, AC; collected the data, contributed data/analysis tools.

References

1. Batra H, Yarmus L. Indications and complications of rigid bronchoscopy. *Expert Rev Respir Med* 2018; 12: 509-20.
2. Sunam GS, Oncel M, Yildiran H. Bronchoscopy in Benign Tracheal Stenosis. *Ann Thorac Surg* 2016; 102: 2133.
3. Oncel M, Sunam GS, Ceran S. Tracheobronchial aspiration of foreign bodies and rigid bronchoscopy in children. *Pediatr Int* 2012; 54: 532-5.

4. Yarmus L, Feller-Kopman D. New Bronchoscopic Instrumentation: A review and update in Rigid Bronchoscopy. In: Beamis JF, Mathur PN, Mehta AC, editors. *Interventional pulmonary medicine. Lung biology in health and disease* 230. New York: Informa Healthcare; 2010. pp. 1-9.
5. Huang KL, Wang SY, Lu WC, Chang YH, Su J, Lu YT. Effects of low-dose computed tomography on lung cancer screening: a systematic review, meta-analysis, and trial sequential analysis. *BMC Pulm Med* 2019; 19: 126.
6. Madana K, Agarwala R, Bala A, Gupta D. Bronchoscopic management of a rare benign endobronchial tumor. *Rev Port Pneumol* 2012; 18: 251-4.
7. Jois DS, Mutreja D, Handa A, Moorchung N. Correlation between transbronchial lung biopsy and lung cytology. *Rev Esp Patol* 2020; 53: 75-8.
8. Lamprecht B, Hutarew G, Porsch P, Wegleitner B, Studnicka M. Successful bronchoscopic cryorecanalization in a case of endobronchial lipoma. *Diagn Ther Endosc* 2011; 2011: 845686.
9. Daneshvar C, Falconer WE, Ahmed M, Sibly A, Hindle M, Nicholson TW, et al. Prevalence and outcome of central airway obstruction in patients with lung cancer. *BMJ Open Respir Res* 2019;6:e000429. doi: 10.1136/bmjresp-2019-000429.
10. Schumann C, Hetzel M, Babiak AJ, Hetzel J, Merk T, Wibmer T, et al. Endobronchial tumor debulking with a flexible cryoprobe for immediate treatment of malignant stenosis. *J Thorac Cardiovasc Surg* 2010; 139: 997-1000.
11. Stanopoulos IT, Beamis JF Jr, Martinez FJ, Vergos K, Shapshay SM. Laser bronchoscopy in respiratory failure from malignant airway obstruction. *Crit Care Med* 1993; 21: 386-91.
12. Huang IA, Hsia SH, Wu CT, Jaing TH, Lai SH, Liu YH. Combined chemotherapy and tracheobronchial stenting for life-threatening airway obstruction in a child with endobronchial non-Hodgkin lymphoma. *Pediatr Hematol Oncol* 2004; 21: 725-9.
13. Ernst A, Feller-Kopman D, Becker HD, Mehta AC. Central airway obstruction. *Am J Respir Crit Care Med* 2004; 169: 1278-97.
14. Dalar L, Ozdemir C, Sokucu SN, Nur Urer H, Altin S. Bronchoscopic treatment of benign endoluminal lung tumors. *Can Respir J* 2019; 2019: 5269728. doi: 10.1155/2019/5269728.

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Original Article

Work-related strain and the prevalence of Burnout Syndrome in thoracic surgeons and research assistants in Turkey

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ABSTRACT

Background: Burnout syndrome (BS) is a slowly progressing clinical condition that can have negative effects on work life and cause serious social and economic losses. Our hypothesis in this study is that the working conditions of thoracic surgeons affect work-related stress and burnout levels (emotional exhaustion, depersonalization, personal success). The aim of our study is to determine work-related strain and the prevalence of BS among the thoracic surgeons and research assistants in our country.

Materials and Methods: Following the approval of the local ethics committee, 298 professionals were included in this cross-sectional survey study conducted between 01 December 2016 and 31 March, 2017. In addition to the 26 questions examining socio-demographic and work life sent via e-mail, participants were also sent the Work-Related Strain Inventory and the Maslach Burnout Inventory.

Results: 81.9% of the participants were male and the age average was found to be 42.0 ± 7.6 (26-63) years. Participants consisted of 112 specialist physicians, 47 research assistants, 29 doctor lecturers/chief assistants, 59 associate professors, 51 professors, while 40.9% were working in university hospitals. The study found that there is no difference in terms of gender in the subscales of Work-Related Strain Inventory and the Maslach Burnout Inventory ($p = 0.564, 0.760, 0.359$ and 0.579 respectively), and that the score from Work-Related Strain Inventory increased in line with increased academic status, while physicians working at the university got higher scores from Work-Related Strain Inventory ($p < 0.0001$). It was established that research assistants, and thoracic surgeons working in state hospitals and teaching hospitals had high scores in the emotional exhaustion ($p < 0.001$) and depersonalization subscales ($p < 0.001$) of the Maslach Burnout Inventory, while professors and those working in university hospitals had higher personal accomplishment scores ($p < 0.012$).

Conclusion: In the study, it was found that professors had higher point at Work-related Strain Inventory and personal accomplishment scores, whereas lower point at emotional burnout and depersonalization scores than in other academic titles. As a result, job-related strain was found to be significantly higher among academics with high workloads.

Keywords: burnout syndrome, specialist, thoracic surgeon, work-related strain

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Introduction

The most widely accepted definition of burnout today belongs to Christina Maslach, who also developed the Maslach Burnout Inventory (MBI). According to Maslach, burnout is defined as “emotional exhaustion (EE), depersonalization (DP) and low personal accomplishment (PA) seen in people who have intensive relations with people due to their job” [1]. Emotional exhaustion is the lack of energy and the feeling that one’s emotional resources have been drained, which emerges as a result of excessive psychological and emotional demands when helping people [2,3]. One who experiences such emotional intensity feels that they are unable to be as giving and responsible as they used to be towards the people they serve, and thus think they are not competent enough to provide the service [4]. DP is considered distancing from the recipient of the service; a strict and, in fact, inhumane approach. Increased distancing in the individual leads to an apathetic attitude towards the needs of others and the disregard of their feelings. This is usually due to the loss of idealism towards work, the rapidly increasing feeling of distancing, and the individual viewing the person they serve as an object [1,5]. Low PA defines the tendency of the individual to consider themselves negatively, as a result of which they feel inadequate, think they are not a competent individual and their motivation decreases [2]. As a result, they begin to feel a general inadequacy and failure in their work or in relationships with people whom they interact [6,7].

Burnout syndrome (BS) is as common in our country as it is around the world. BS is a clinical condition that starts quietly, progresses slowly with the impact of certain factors, affecting first the mental balance of the individual, and when it goes unnoticed, it paves the way for psychosomatic disorders, and significant issues in work-family and social life in the future. It is reported that 80% of employees face this syndrome at any time in their work life [4]. This commonly observed condition adversely affects work life with its undesirable personal and organizational results [8].

In their report, the International Labor Organization has reported that BS is seen more frequently in occupational groups such as doctors, nurses, teachers, police, lawyers, who work face to face with people, directly serve people, and which the human element has a very

important place in the quality of service [9]. In studies conducted in this area, it has been reported that there are many factors involved in the emergence of Burnout syndrome. In addition to individual characteristics such as age, gender, educational level, marital status, length of time in profession and seniority, the ability to use coping mechanisms, the effectiveness of organizational factors like workload, rewarding, control, belonging, justice, working time are also shown [9,10].

Medicine is an occupational group that manages the most sensitive periods of humans such as illness. Working face-to-face with people, tension caused by excessive patient load, uncertain and long working hours, insufficient hospital resources, problems in professional relations, dealing with chronic-fatal patients and patient relatives, economic concerns, inability to spare enough time for themselves and their private life lead to Burnout syndrome. In addition to these, the expectation from surgeons to think quickly and make critical decisions in the face of events, the pressure to avoid making mistakes increases the development of Burnout syndrome in this group [4].

Thoracic surgeons experience Burnout syndrome at equivalent rate to all surgeons (40% to 50%). Although more than 70% of thoracic surgeon members of The Society of Thoracic Surgeons report being satisfied with their career, surgeons are commonly affected by burnout (40%), though only a minority ever seek psychiatric or psychological help [11]. There are a few studies in the literature on burnout syndrome in thoracic surgeons [12,13]. Workforce Report from The Society of Thoracic Surgeons identified several characteristics common to thoracic surgeons at increased risk for burnout syndrome, including very long duration of residency training, high number of hours worked per week, frequent nights on call, and increasing caseload volumes [13].

Our hypothesis in this study is that the working conditions of thoracic surgeons affect work-related stress and burnout levels (emotional exhaustion, depersonalization, personal success). In this study, it was aimed to evaluate the work-related strain and burnout status of thoracic surgeons and research assistants working in our country.

Materials and Methods

Following the approval of the local ethics committee (No: 2016/388), this cross-sectional study was conducted between 01 December 2016 and 31 March 2017. The

study population was composed of 742 thoracic surgery research assistants and specialists who are members of the Turkish Society of Thoracic Surgery. Participants were provided detailed information about the study via e-mail. A questionnaire form consisting of three sections was sent, and 298 (40.2%) participants completed the questionnaire. The first section of the questionnaire consists of 26 questions containing socio-demographic information and the characteristics of work life, while the second section includes the 17-question Work-Related Strain Inventory (WRSI), and the third section includes the 22-question the Maslach Burnout Inventory.

Scales Used in the Study

Work-Related Strain Inventory is a 4-point Likert-type self-report scale consisting of 18 items that was developed by Revicki et al [14] in 1991 in order to determine work-related strain and stress in health workers. The scale was translated into Turkish and first applied to a nurse sample, and then to seven occupational groups working in the health field [15,16]. As item 15 significantly reduced the reliability coefficients in both studies, this item was removed from Aslan et al [8] study. In work-related strain inventory, the items are evaluated as “completely suitable for me”, “greatly suitable for me”, “partially suitable for me” and “not suitable for me at all”, and between 4-1 points. Items 2, 4, 8, 9, 11 and 15 are reverse scored. The lowest score on the scale is 18, and the highest score is 72. The strain increases as the score increases [8].

The Maslach Burnout Inventory was developed by Christina Maslach et al [1] and the reliability and validity of the Turkish version was prepared by Ergin et al [17]. It consists of 22 questions, with each question containing five-digit answer options. It has three components: Emotional Exhaustion, Personal Accomplishment and Depersonalization. The EE and DP scales contain negative responses, while low personal accomplishment scale contains positive responses. Scores are calculated separately for each scale. Since there is no cut-off value for the scores obtained from the subscales, there is no discrimination in the form of exhaustion is present or absent. Individuals experiencing burnout are expected to have high EE and DP, and low PA scores [1,17].

Statistical Analysis

SPSS v21 was used to evaluate the data. When the age and scale scores obtained as a result of the study were

evaluated using the Kolmogorov Smirnov Test in terms of suitability for normal distribution, it was found that they did not comply with normal distribution. Descriptive statistics were given as median (minimum-maximum), and the Mann Whitney U test was used to compare two groups to evaluate the data. The Kruskal Wallis Test was used in the comparison of more than two subgroups, and the significant parameters were compared with the Bonferroni corrected Mann Whitney U test. Statistical significance level was taken as $p < 0.05$, and after the Bonferroni correction, it was taken as $p < 0.01$.

Results

The median age of the 298 individuals who participated in the study was 43.2 (26.0-63.0) years, and 81.8% ($n = 244$) of them were male while 18.1% ($n = 54$) were female. In terms of positions at their institution of employment, 293 (98.4%) of the physicians stated they work as thoracic surgeons, 3 (1%) as deputy chief physicians, 1 (0.3%) as chief physician, and 1 (0.3%) as workplace doctor. 46.6% of the participants were academics, 37.6% were thoracic surgeons, and 40.9% ($n = 122$) worked at university hospitals, while 36.9% ($n = 110$) were working at teaching hospitals. The distribution of the socio-demographic characteristics of participants is presented in table 1. 90.3% of participants stated that they willingly chose the medical faculty and 86.6% stated they willingly chose the thoracic surgery residency. In the ranking of preferences in the Medicine Specialty Exam (MSE), thoracic surgery residency was among the top five choices for 47.7% of the participants. When participants were asked at the time of the study was conducted, “If you were given the chance to take the MSE again, would you prefer the thoracic surgery specialization again?”, 48.9% of the residents and 51% of the thoracic surgeons stated that they would choose thoracic surgery specialization again, while 51.1% of the residents stated that they were undecided and 49% of the thoracic surgeons would not choose thoracic surgery specialization again. Additionally, participants stated that they started their thoracic surgery residency median 3.0 (0-15.0) years after graduation from medical school, and residents stated that they have been working in this position for median 4.0 (1.0-6.0) years. Some work life-related characteristics of participants are presented in table 2.

Table 1. The demographic features of participants.

Variable	n	%
Sex		
Female	54	18.2
Male	244	81.8
Marital status		
Single	37	12.5
Married	248	83.5
Divorced	12	4.0
Spouse's working status		
Working	208	83.9
Not working	40	16.1
Region		
Marmara	107	36
Aegean	31	10.4
Mediterranean	17	5.7
Central Anatolia	78	26.3
Black Sea	32	10.8
Eastern Anatolia	16	5.4
South-eastern Anatolia	16	5.4
Institution		
State hospital	42	14.1
Training and research hospital	110	36.9
University hospital	122	40.9
Private hospital	21	7.1
Private clinic	1	0.3
Academic title		
Resident	47	15.8
Thoracic surgeon	112	37.6
Assistant professor	29	9.7
Associated professor	59	19.8
Professor	51	17.1

Table 2. Data on the participants' working life, earnings and time spent with their families.

	n=298	%
Faculty of medicine was preferred	269	90.3
Thoracic surgery residency was preferred	258	86.6
Thoracic surgery residency preference order in medical specialist exam		
1-5	142	47.7
6-10	90	30.2
≥11	66	22.1
Satisfaction with monthly income		
Sufficient	39	13.1
Partly	189	63.4
Insufficient	70	23.5
Time spending time with him-herself/their families		
Sufficient	40	13.4
Partly	94	31.5
Insufficient	164	55.1

In terms of personal monthly incomes, at the time the study was conducted, 62.1% of participants were in the 5.000-10.000 TL range, while the monthly family incomes for 41.5% of participants were stated to be in the 10.000-15.000 TL range. 63.3% (n = 189) of participants stated that their monthly income was partially sufficient, yet 23.6% (n = 70) stated that it was insufficient. Table 2 is shown that, 83.5% of participants are married and 80.5% stated that they have children. The median number of children is 2.0 (0-4.0), and 19.5% (n = 58) of participants stated that they have people who need constant care and for whom they are obliged to provide care. When participants were asked to consider the time they allocate to themselves or their families, while 55.1% stated that this time was insufficient, 31.6% stated that it was partially sufficient.

Hundred seven (36.0%) of the participants stated that they had watch duty, and 188 (63.3%) had on-call duty. While the number of median watch duty on weekdays and weekends is 3 (1-11) and 2 (1-7) per month, respectively, the number of median on-call duty on weekdays and weekends was found to be 7 (1-30) and 3 (1-8) per month, respectively. 30.2% (n = 90) of the thoracic surgeons who participated in the study stated that they had a diagnosed disease. These diseases are hypertension (n = 27), cardiovascular diseases (n = 14), diabetes (n = 16), bone and joint diseases (n = 15), anxiety (n = 8), malignancy (n = 6), endocrine diseases (n = 5), and others (n = 22). 13.8% (n = 41) of participants stated that they have been using antidepressant drugs for the last 6 months.

The study's scores for the subscales of WRSI and MBI according to some characteristics are shown in Table 3. While no statistically significant difference was found in the subscales of WRSI and MBI in terms of participants' gender, choice of medical faculty and thoracic surgery based on their own will, there was difference in terms of the spouse's employment status, their institution of employment, and title.

Work-Related Strain Inventory does not have a cut-off value, and the level of tension due to work increases in direct proportion to the score obtained from the scale. In the study, it was found that there was a difference between the hospital groups studied in terms of work-related strain score (p = 0.012), and the highest score was found in university hospital staff. In terms of the institution of employment, difference was found in Work-Related Strain Inventory between state hospital and training and research hospital staff (p = 0.006) and between state hospital and university hospital staff (p = 0.002). In terms of academic title, Work-Related Strain Inventory presented a difference between residents and professors (p = 0.011), thoracic surgeons and associate professors (p = 0.001), and thoracic surgeons and professors (p < 0.0001). As in the institution studied, those whose academic degrees are associate professors and professors were found to have higher work-related tension (Table 3).

Table 3. Scores of work-related strain scale and subtitles of and Maslach burnout inventory according to sex, spouse's working status, work place, academic title and career choice.

	Work-related Strain Inventory mean (min-max)	Emotional Ex- hausting mean (min-max)	Maslach Burnout Inventory Personal Accom- plishment mean (min-max)	Depersonalization mean (min-max)
Sex				
Female	44 (27-63)	18.5 (2-35)	20 (5-28)	6 (0-17)
Male	45 (21-64)	17 (0-37)	20 (7-28)	6 (0-19)
p	0.564	0.760	0.359	0.579
Spouse's working status				
Working	44.5 (23-62)	18.5 (2-35)	20 (7-28)	8 (0-18)
Not working	45 (21-64)	17 (0-37)	20 (5-28)	5 (0-19)
p	0.913	0.787	0.874	0.019
Watch duty				
Yes	46(21-64)	19(2-35)	20(5-28)	8(1-19)
No	43(23-63)	16(0-37)	20(7-28)	5(0-17)
p	0.086	0.042	0.047	0.001
On-call duty				
Yes	46(24-63)	18(0-37)	20(7-28)	6(0-17)
No	43.5(21-64)	16(1-35)	20(5-28)	6(0-19)
p	0.028	0.058	0.786	0.701
Institution				
State Hospital	40 (21-61) *, †	19 (0-35)	19 (7-28) ‡	5 (0-17)
Training and research hospital	45 (24-63)*	17 (2-37)	19 (5-28)	7 (0-19)
University hospital	46.5 (21-64) †	17 (0-36)	21 (7-28) ‡	5.5 (0-18)
Private hospital and clinic	42.5 (27-63)	17 (5-36)	20 (11-28)	5.5 (0-12)
p	0.012	0.382	0.030	0.206
Academic title				
Resident	43.5 (29-58)1,2	19 (7-35)4,5,6	19.5 (5-28)8	9 (1-19)9,10,11
Specialist physicians	43 (21-63)3	19 (0-36)7	19 (7-28)	6.5 (0-17)9
Assistant professor	42 (28-64)	17 (0-35)	21 (7-28)	6 (0-16)
Associated professor	47 (27-64)1,2	15 (0-37)4,6	21 (7-28)8	5 (0-15)10
Professor	50 (29-63)3	13 (1-35)5,7	21 (12-28)	4 (0-17)11
p	□0.0001	0.001	0.012	□0.0001
Faculty of medicine was preferred				
Yes	45 (21-64)	17 (0-37)	20 (5-28)	6 (0-19)
No	43 (23-64)	19 (0-35)	21 (7-28)	6.5 (0-14)
p	0.558	0.487	0.768	0.999
Thoracic surgeon residency was preferred				
Yes	44 (21-64)	18 (0-37)	20 (5-28)	6 (0-19)
No	46 (21-63)	16 (4-35)	21 (7-28)	5 (0-16)
p	0.663	0.518	0.248	0.185

* p=0.006; † p=0.002; ‡ p=0.005

1p=0.001; 2p=0.001; 3p=0.0001; 4p=0.001; 5p=0.002; 6p=0.002; 7p=0.002; 8p=0.002; 9p=0.004; 10p=0.0001; 11p=0.0001

As the burnout increases in the Maslach Burnout Inventory, the score of the emotional exhaustion and depersonalization sub-dimensions increases and the personal achievement score decreases. When the Maslach Burnout Inventory results are analysed in this study, a statistically significant difference was found in all subtitles of the scale between those who held watch duty and those who did not (respectively 0.042, 0.047 and 0.001). It is found that there is a difference in the academic title in the emotional exhaustion subtitle in residents and thoracic surgeons is higher than the other academic titles. This result shows that emotional exhaustion of residents and thoracic surgeons is higher than other academic titles. In terms of the academic titles, difference was found in emotional exhausting between residents and professors ($p = 0.011$), thoracic surgeons and associate professors ($p = 0.001$), and thoracic surgeons and professors ($p \leq 0.0001$); the emotional exhaustion subscale presented a difference between residents and associate professors ($p = 0.001$), residents and professors ($p = 0.002$), thoracic surgeons and associate professors ($p = 0.002$), and thoracic surgeons and professors ($p = 0.002$). The personal accomplishment subscale presented a difference between thoracic surgeons and associate professors; and the depersonalization subscale presented a difference between residents and thoracic surgeons ($p = 0.004$), residents and associate professors ($p \leq 0.0001$), and residents and professors ($p \leq 0.0001$). As in the institution studied, those whose academic degrees are associate professors and professors were found to have higher work-related tension (Table 3).

A difference was also found in personal accomplishment between institutions ($p = 0.030$). Personal accomplishment score of those working in state hospital and training and research hospital is lower than those working in other institutions ($p = 0.005$). The personal accomplishment subscale presented a difference between thoracic surgeons and associate professors; and the depersonalization subscale presented a difference between residents and thoracic surgeons ($p = 0.004$), residents and associate professors ($p \leq 0.0001$), and residents and professors ($p \leq 0.0001$). In the last title, depersonalization, there is a difference in spouse's working status and academic title, the score was found to be lower in participant that spouse not working and professors than in other groups (Table 3).

Discussion

Factors influencing the emergence of Burnout syndrome include individual characteristics such as professionals' gender, age, education, marital status, number of children, professional experiences, the psycho-social stressors they face in private life, and the ability to cope with them, as well as environmental factors such as the work environment, work order, workload, whether they have watch duty and overtime, insufficient wages [10,18]. The majority of the time on the job for surgeons, more particularly for thoracic surgeons who are the subject of this research, is spent in the operating room. Operating rooms are environments where surgeries are performed, the surgical team under the management of the surgeon utilize their knowledge, skills, and experience, the efficient use of time and appropriate use of skills are necessary, being quick to make the right decisions is critical, work hours are lengthy and their duration is generally unforeseeable, and where staff are subjected to numerous physical, psychological, and social distress. Over time, these working conditions cause burnout in employees [19]. In 2008, a survey of the American College of Surgeons (ACS) revealed a burnout rate of 40%. The most burnout prevalence was found in cardiothoracic surgery, trauma, transplant and urology [12,20].

Studies conducted in the world and in our country show that BS is a common problem among physicians. In a study conducted by Karamanova et al [21], the average EE and DP scores of healthcare workers from seven South and Southeast European countries were found to be 31.9% and 33.2%, respectively. In the same study, it was reported that Turkish healthcare workers had higher emotional exhaustion and depersonalization scores (53.8% and 58.9%, respectively). In a 2009 study conducted by Shanafelt et al [20] among surgeons, 7,905 members of the American Surgical Association participated in the study. It was found that 40% of the participants showed at least one of the symptoms of burnout, 32% scored high in EE, 26% scored high in DP, and 13% scored low in personal accomplishment. Similar results were found in other studies evaluating surgical branches. In a 2001 study evaluating 521 general surgeons and orthopaedic specialists established high burnout rate in both branches, and 32% of participants scored high in emotional exhaustion, 13% scored high in depersonalization, and 4% scored low in personal ac-

complishment [22]. In another study from our country, Bolat et al [23] reported that Burnout syndrome was common among urology specialists, that EE and DP, which are subscales of BS, were frequently observed, and that this had an adverse effect on the psychosocial condition of urologists.

In our study, it was found that there was no difference in terms of gender in the subscales of Work-Related Strain Inventory and the Maslach Burnout Inventory. Some studies in the literature have found that burnout is more prevalent in female physicians [24,25] while other studies found it was more prevalent in male physicians [26,27]. Similarly, in a study conducted by Özkula et al [18], no difference could be found between genders. The absence of a difference between genders may be due to the fact that the structure of today's health system and heavy working conditions cause similar burnout in both genders regardless of gender. On the other hand, thoracic surgery residency being chosen more by men, and the lower number of female surgeons in the study may have affected this result.

Burnout syndrome occurs more frequently due to reasons such as intense work pace, heavy workload, and excessive watch duty particularly during the assistantship period, which is the first year of medicine. However, believing that all physicians experience similar problems during their assistantship period leads to this situation being recognized as a normal. In the long run, though, this situation leads to decreased job satisfaction and psychological problems. It is known that the rate of burnout specifically in surgical branches increases more compared to other branches as the number of work years increase [4,24]. In this study, approximately 90% of participants stating that they willingly chose both the medical faculty and thoracic surgery, with almost half of them stating that thoracic surgery specialty was among the top five choices in their MSE preferences shows that they chose their profession willingly. However, the study determined that the problems faced by physicians in the later years of their duration of work and their preparedness to cope with these problems caused changes in their decisions. As a matter of fact, only 1/3 of them stating that they would prefer thoracic surgery once more if they had the right to choose again, shows that they are experiencing problems in terms of professional satisfaction and BS.

More than half of the participants stated that the time

they allocate to themselves or their family was insufficient. Moreover, 83% of the participants stated that they are married, 80% have children and 1/5 of them have family members who need constant health care and for whom they are obliged provide care. Physicians' intense work pace, the uninterrupted service provided to patients, as well as the excessive number of watch and on-call duties on both weekdays and weekends prevents them from allocating adequate time for themselves and their family. A number of studies have reported that young age, having children, weekly working hours, the number of on-call duties, and sufficient financial opportunities are the individual risk factors related to burnout. In the same publications, only 36% of surgeons stated that they had enough time for themselves and their families [20,22,24].

While only 13% of participants found the wages received sufficient, it was established that the depersonalization score is higher in those whose spouse was not working. This shows that physicians have economic concerns and that this increases depersonalization. Sleep deprivation leads to deterioration in cognitive performance, memory, reaction time, and variation in circadian rhythm. As a result of sleep deprivation, increases risk of human error related accidents and increases work-related strain and burnout [12]. In this study, a statistically significant difference was found in all sub-titles of the Maslach Burnout Inventory between those who were watch duty and did not. Burnout was more common in those who had a on-call duty.

In studies which professional status is associated with work-related strain and burnout, it has been determined that those who are professors, associate professors or specialists scored significantly lower than assistants in Work-Related Strain Inventory and the Maslach Burnout Inventory. This is thought to be due to the decrease in professional uncertainty and concern for the future as professional status increases [28-30]. When the findings obtained from our research were examined, in stark contrast to the literature, it was found that the scores from WRSI increased as the academic status increased. It must be kept in mind that the result determined in the study may be related to reasons such as the intense communication of academics with students, intense pressures on them to publish and be successful, as well as pressures caused by the health system and performance system. In support of this finding, it was found that the thoracic surgeons working at the university got higher

scores in WRSI. This result in the study group suggests that work-related strain may differ in studies conducted in different conditions and organizational structures.

In the study, it was found that research assistants, who have the lowest academic status, scored higher in the emotional exhaustion and depersonalization subscales of the MBI, in contrast to WRSI. Research assistants, who are in the early years of their specialty education, strive to cope with heavy working conditions on the one hand. While on the other hand, they are expected to take responsibility, make decisions and solve problems in patient management. When all these demands exceed one's coping capacity, it can lead to emotional exhaustion. This causes depersonalization towards patients and the loss of occupational idealism [5]. Similar to the results In WRSI, it was found that emotional exhaustion and depersonalization scores were high among staff working at state hospitals and teaching hospitals. It is considered that this situation is associated with the failure of the thoracic surgeons working in state hospitals in our country to fulfil their duties sufficiently, thus leading to their loss of moral motivation.

Low personal accomplishment defines the tendency of the individual to consider themselves negatively, as a result of which they feel inadequate, think they are not a competent individual and their motivation decreases [2]. In the study, the personal accomplishment score was found to be higher in professors and those working in university hospitals. Rewarding in various ways the contributions those with high academic titles make to their institutions, making presentations in congresses and symposiums, showing both material and moral appreciation make the individual feel more successful and valuable. This is an important motivation tool for individuals. On the other hand, individuals being more autonomous in their work compared to others as the academic title increases, their ability to make and implement their decisions more freely, having initiative regarding their work boosts the feeling of PA and reduces burnout [2].

In the study, it was found that one-third of participants have chronic diseases, primarily HT, and 13.8% of them had been using antidepressant drugs for the last 6 months. When BS is not detected and prevented at the appropriate time, besides intangible losses such as job loss, financial losses, family problems, difficulties in social relations, and loneliness, it can also often lead to numerous psychiatric illnesses ranging from somato-

form disorders with physiological and psychological symptoms to depression [5].

As a result, in terms of Burnout syndrome, health-care professionals, particularly surgeons, are among the risky occupational groups today. Burnout is a problem that needs to be emphasized in order to protect the mental health of the individual and to intervene early when necessary. At an institution where burnout is experienced less frequently and employee job satisfaction is high, the quality of the health service to be provided will also be high. The professional and social measures to be taken by authorized institutions, primarily the Turkish Society of Thoracic Surgery, can help increase psychosocial well-being, reduce the incidence of burnout in thoracic surgeons, and improve health care quality. Furthermore, in order to obtain sufficient data on this subject, studies are needed in our country particularly in relation to determining effective methods in preventing and dealing with Burnout syndrome.

Declaration of conflicting interests

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Ethics Approval

The study was approved by the institutional ethical board of Ondokuz Mayıs University, School of Medicine (No: 2016/388).

Authors' contributions

BÇ, SC; co-wrote the paper, collected the data, performed the analysis, contributed data/analysis tools, conceived and designed the analysis.

References

1. Maslach C, Jackson SE. The measurement of experienced burnout. *J Occup Behav* 1981; 2: 99-113.
2. Maslach C, Schaufeli WB, Leiter MP. Job Burnout. *Ann Rev Psychol* 2001; 52: 397-422.
3. Thomas AW, Douglas GB. The contribution of burnout to work performance. *J Organiz Behav* 1997; 18: 491-9.
4. Aslan H. Hekimlerde tükenme sendromu ve önleme yolları. *Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi Psikiyatri ABD Arşiv Dergisi* 2000; 9: 427-36.

5. Garden AM. Depersonalisation, a valid dimension of burnout? *Human Relations* 1987; 40: 545-60.
6. Leiter MP, Maslach C. The impact of interpersonal environment on burnout and organizational commitment. *J Organ Behav* 1988; 9: 297-308.
7. Maslach C. Job Burnout: New directions in research and intervention. *Curr Dir Psychol Sci* 2003; 12: 189-92.
8. Aslan H, Aslan RO, Kesepara C. Kocaeli'nde bir grup sağlık çalışanında işe bağlı gerginlik, tükenme ve iş doyumu. *Toplum ve Hekim Dergisi* 1997; 12: 24-9.
9. Chappell D, Di Martino V. Violence at work. International Labour Organization. ILO Report, 3rd Print Geneva: 2006.
10. Budak G, Sürgevil O. Tükenmişlik ve tükenmişliği etkileyen örgütsel faktörlerin analizine ilişkin akademik personel üzerinde bir uygulama. *DEÜİİBF Dergisi* 2005; 20: 95-108.
11. Squiers JJ, Lobdell KW, Fann JJ, DiMaio JM. Physician Burnout: are we treating the symptoms instead of the disease? *Ann Thorac Surg* 2017; 104: 1117-2.
12. Jaral OA, Baig K, Shetty K, Athanasiou T. Sleep deprivation leads to burnout and cardiothoracic surgeons have to deal with its consequences. *Int J Cardiol* 2015; 179: 70-2.
13. Williams D, Tricomi G, Gupta J, Janise A. Efficacy of burnout interventions in the medical education pipeline. *Acad Psychiatry* 2015; 39: 47-54.
14. Revicki DA, May HJ, Whitley TW. Reliability and validity of the work-related strain inventory among health professionals. *Behav Med* 1991; 17: 111-20.
15. Aslan SH, Gürkan SB, Girginer HU, Ünal M. İşe bağlı gerginlik ölçeğinin bir hemşire örnekleminde geçerlik ve güvenilirliği. *Psikiyatri Psikoloji Psikofarmakoloji (3P) Dergisi* 1996; 4: 276-84.
16. Aslan SH, Alparslan ZN, Aslan RO ve ark. İşe bağlı gerginlik ölçeğinin sağlık alanında çalışanlarda geçerlik ve güvenilirliği. *Düşünen Adam: Psikiyatri ve Nörolojik Bilimler Dergisi* 1998; 11: 4-8.
17. Ergin C. Doktor ve hemşirelerde tükenmişlik ve Maslach Tükenmişlik Ölçeğinin uyarlanması. VII. Ulusal Psikoloji Kongresi Bilimsel Çalışmaları, sayfa 143-154, Türk Psikologlar Derneği Yayınları, Ankara 1992.
18. Ozkula G, Durukan E. Burnout syndrome among physicians: the role of socio-demographic characteristics. *Dusunen Adam The Journal of Psychiatry and Neurological Sciences* 2017; 30: 136-44.
19. Koraş, K, Öcalan D, Solak O. Cerrahi hekimlerin ameliyathane-deki gergin davranışlarının hemşireler üzerindeki etkileri. *Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi* 2015; 4: 502-15.
20. Shanafelt T, Balch CM, Bechamps GJ, Russell T, Dyrbye L, Satele D et al. Burnout and career satisfaction among American surgeons. *Ann Surg* 2009; 250: 463-71.
21. Alexandrova-Karamanova AA, Todorova I, Montgomery A, Panagopoulou E, Costa P, Baban A et al. Burnout and health behaviors in health professionals from seven European countries. *Int Arch Occup Environ Health* 2016; 89: 1059-75.
22. Campbell DA Jr, Sonnad SS, Eckhauser FE, Campbell KK, Greenfield LJ. Burnout among American surgeons. *Surgery* 2001; 130: 696-702.
23. Bolat MS, Yürük E, Çınar Ö, Akdeniz E, Altunrende F, Özkuvancı Ü et al. The prevalence of Burnout Syndrome among Turkish urologists: results of a nationwide survey. *Turk J Urol* 2019; 45: 449-55.
24. Dimou FM, Eckelbarger D, Riall TS. Surgeon burnout: a systematic review. *J Am Coll Surg* 2016; 222: 1230-9.
25. Dyrbye LN, Shanafelt TD, Balch CM, Daniel Satele, Sloan J, Freischlag J. Relationship between emotional exhaustion in work-home conflicts and burnout among American surgeons: a comparison by sex. *Arch Surg* 2011; 146: 211-7.
26. Ozyurt A, Hayran O, Sur H. Predictors of burnout and job satisfaction among Turkish physicians. *QJM* 2006; 99: 161-9.
27. Soler JK, Yaman H, Esteva M, Dobbs F, Asanova RS, Katic M, Ozvacic Z, Desgranges JP, Moreau A, Lionis C, Kotanyi P, Carelli F, Nowak PR, de Aguiar Sá, Azeredo ZA, Marklund E, Churchill D, Ungan M; European General Practice Research Network Burnout Study Group. Burnout in European family doctors: the EGPRN study. *Fam Pract* 2008; 25: 245-65.
28. Dağdeviren N, Musaoğlu Z, Ömürlü İK, Öztora S. Akademisyenlerde iş doyumunu etkileyen faktörler. *Balkan Med J* 2011; 28: 69-74.
29. Çam O. The burnout in nursing academicians in Turkey. *Int J Nurs Stud* 2001; 38: 201-7.
30. Sünter AT, Canbaz S, Dabak Ş, Öz H, Pekşen Y. Pratisyen hekimlerde tükenmişlik, işe bağlı gerginlik ve iş doyumu düzeyleri. *Genel Tıp Derg* 2006; 16: 9-14.

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Original Article

The parenchyma-protecting effect of carvacrol in pulmonary contusion induced in rats

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ABSTRACT

Background: Pulmonary contusion is a potentially life-threatening clinical manifestation frequently seen in acute thoracic trauma. It can be life-threatening if diffuse in nature. This study investigated the tissue damage-reducing effect of carvacrol, an antioxidant, in rats with induced lung damage.

Materials and Methods: Twenty-one female Wistar Albino rats weighing 240-320 g were used in the study. Pulmonary contusion was induced with the application of 2.25 joules of energy with a modification of the isolated bilateral pulmonary contusion model. Lung tissues of rats administered two doses of oral 50 mg/kg carvacrol were then subjected to histopathologic examination.

Results: Congestion, alveolar destruction, alveolar hemorrhage, and leukocyte infiltration were subjected to histopathologic examination in all lung sections. The amount of alveolar hemorrhage was significantly lower in the carvacrol group compared with the control and trauma groups ($p = 0.033$). Congestion, leukocyte infiltration, and destruction also decreased, albeit statistically insignificantly, in the carvacrol group.

Conclusion: The antioxidant carvacrol significantly prevented alveolar hemorrhage in pulmonary contusion developing following trauma. Congestion decreased, and no leukocyte infiltration developed in the carvacrol group. However, it did not affect destruction.

Keywords: carvacrol, trauma, lung, pulmonary contusion

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Introduction

Pulmonary parenchyma damage can develop as a result of blunt or penetrating trauma. Pulmonary contusion is frequently seen following trauma and is responsible for 20-25% of post-traumatic adult deaths [1]. Pulmonary contusion is an independent risk factor for post-traumatic pneumonia, acute lung injury (ALI), acute respiratory distress syndrome (ARDS), ventilator-associated pneumonia, and respiratory distress [2]. Blood extravasation is linked to alveolar damage and the subsequent activation of a series of proinflammatory cells that occur following trauma. An increased blood leukocyte ratio and subsequent increase in tissue macrophage density initiate inflammatory processes, such as cytokine, proteolytic enzyme, and coagulation cascades. This process increases alveolar-capillary permeability, leading to edema, ventilation/perfusion mismatch, and loss of pulmonary compliance [3].

Edema and inflammation in the lungs in uncomplicated cases resolve in 48-72h in radiologic examinations. Apart from support therapies, there are no definite therapeutic methods for reducing complications in pulmonary contusion. Free oxygen radicals forming in tissue following trauma can further exacerbate tissue damage. Several previous studies have shown that antioxidant substances reduce complications in pulmonary contusion and exhibit positive effects on tissue healing. Carvacrol is a monoterpenoid phenolic compound (5-isopropyl-2-methylphenol) found in several essential oils. Studies are showing the antioxidant, antitumor, and antiinflammatory effects of carvacrol [4]. One meta-analysis of the in vitro effect of carvacrol identified antimicrobial, bactericidal, antifungal, anti-inflammatory, antioxidant, antidepressant, immunologic modulatory, and mutagenic activities [4].

Pulmonary contusion is a clinical manifestation frequently seen in acute thoracic trauma. This study investigated the tissue damage-reducing effect of carvacrol, an antioxidant substance, in rats with induced lung damage.

Materials and Methods

The research was conducted at the Bolu Abant İzzet Baysal University Experimental Animals Center Laboratory using 21 female Wistar Albino rats weighing 240-320 g. All rats were cared for in line with the Care and Use of Laboratory Animals Guideline published by the National Institutes of Health. Approval for the study was granted by the Bolu Abant İzzet Baysal University Medical Faculty Experimental Animals Ethical Committee, Turkey (2020/22).

Three groups were established: group 1, the control group, in which no contusion model was established. At the end of the experiment, the rats were sacrificed under general anesthesia, and their lung tissues were sent for histopathologic examination. Group 2: the contusion group, in which a contusion model was established, but in which no drug was administered. The rats were sacrificed under general anesthesia after 48 h, and their lung tissues were sent for histopathologic examination. Group 3: the contusion + carvacrol group. The first dose of carvacrol (50 mg/kg) was administered via the oral route 30 min after induction of contusion. A second dose was administered after 24 h. The rats were sacrificed under general anesthesia after 48 h, and their lung tissues were sent for histopathologic examination.

The doses of carvacrol (cas: 499-75-2) administered in the studies were in the range of 100-500 mg/kg [5,6]. In an animal study, carvacrol was shown to have a half-life of 1.84 to 2.05 hours in the digestive system. The same study also showed that unencapsulated carvacrol was almost completely absorbed in the stomach and proximal small intestine. Plasma levels peaked at 1.39 hours. In rats, the dose produced a toxic dose of 810 mg/kg when administered orally and 80 and 73 mg/kg when injected intravenously or intraperitoneally [6,7].

The trauma model

A bilateral pulmonary contusion model was used based on a modification of the isolated bilateral pulmonary contusion model described by Raghavendran et al [8]. Pulmonary contusion was induced by dropping a 230 g weight onto the thoracic anterior wall from a distance of one meter (Figure 1). The resulting energy was calculated at 2.25 joules using the formula $E = mgh$ (where E = energy, g = gravity, h = height – 100 cm, and the weight dropped = 0.23 kg). Pulmonary contusion was created by applying 2.25 joules of energy to the rats (Figure 1).

Anesthesia and the Surgical Procedure

Prior to the experimental procedure, rats received general anesthesia using ketamine HCl 40 mg/kg (Ketalar 500 mg flk; Zentiva Health Products San. Tic. A.Ş. Lüleburgaz- Kırklareli) and xylazine 5 mg/kg (Xylased 100 mg/mL; Bioveta medical Çankaya/Ankara/Turkey) via the intramuscular route. Rats continued to breathe spontaneously throughout the procedure. Rats developing no additional complications after the trauma were taken for surgery after 48 h. Sternotomy was performed through an incision over the sternum. Intracardiac access was provided with an injector and blood was drained. Both lung

tissues were then extracted by severing the points of attachment to the mediastinum. The lung tissue specimens were placed into formaldehyde solution and sent to the pathology department for histopathologic examination.

Histopathological Examination

Tissues sent for histopathologic examination were divided into five sections. In line with standard procedures, paraffin-embedded tissues were cut into 5- μ m sections. These were gradually deparaffinized and hydrated before staining with hematoxylin and eosin. Alveolar congestion, alveolar destruction, alveolar hemorrhage, and leukocyte infiltration in the vascular wall and alveolar space were evaluated in all lung tissue sections in the histopathologic examination. All these parameters were scored semi-quantitatively as none (0), mild (< 10%), moderate (10-45%), or severe (> 45%) (18) (Figure 2).

Statistical Analysis

Statistical analyses were performed using the SPSS software. The Kruskal-Wallis test was used to compare continuous data between the groups, and the Chi-square test for non-continuous data. P values of < 0.05 were regarded as statistically significant.

Results

Congestion, alveolar destruction, alveolar hemorrhage, and leukocyte infiltration were evaluated in each lung section in the histopathologic examination. The amount of alveolar hemorrhage was significantly lower in the carvacrol group compared with the control and trauma groups ($p = 0.033$). Moderate/severe hemorrhage was observed in four (57.1%) rats from the control group and in one (14.2%) from the carvacrol group.

Moderate/severe congestion was observed in four (57.1%) rats from the trauma group and one (14.2%) from the carvacrol group. Although the difference was not statistically significant ($p = 0.061$), noticeably less congestion was determined in the carvacrol group.

Moderate/severe destruction was observed in two

(28.5%) rats from the trauma group and one (14.2%) from the carvacrol group. No statistically significant difference was determined ($p = 0.31$).

The histopathologic examination revealed moderate/intense leukocyte infiltration in two (28.5%) rats from the trauma group. Mild leukocyte infiltration was observed in rats from the carvacrol group. No statistically significant difference was observed ($p = 0.11$) (Table 1).

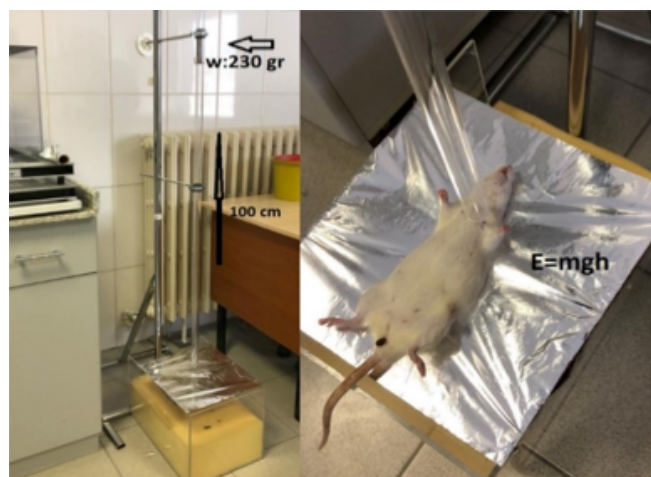


Figure 1. The induced trauma model.

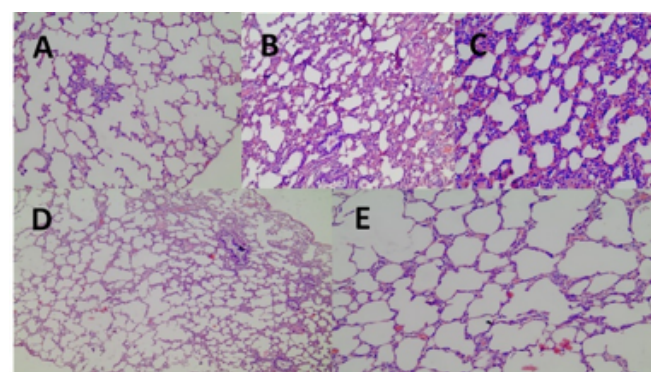


Figure 2. Lung tissue section exhibiting a normal appearance from the control group, HEx100 (A), fibrino-hemorrhagic exudate accumulation in the interstitial space and alveoli from the trauma group, HEx100, HEx200 (B, C), fibrino-hemorrhagic exudate decreased in the treatment group, and heterogeneous areas were observed together with normal-appearing lung tissue sections, HEx40 HEx100 (D, E).

Table 1. The study groups' histopathological data.

		Control	Trauma	Carvacrol	p
Hemorrhage	None/Mild	7	3	6	0.033
	Moderate/Severe	0	4	1	
Congestion	None/Mild	7	3	5	0.061
	Moderate/Severe	0	4	2	
Destruction	None/Mild	7	5	6	0.31
	Moderate/Severe		2	1	
Leukocyte infiltration	None/Mild	7	5	7	0.11
	Moderate/Severe	0	2	0	

Discussion

The results of this study showed a statistically significant decrease in hemorrhage caused by trauma-associated alveolar damage. Leukocyte infiltration, congestion, and destruction also decreased in damaged tissue, although not significantly. Based on these findings, we think that carvacrol exhibits a parenchyma-protecting effect in rats with induced pulmonary contusion. However, further experimental, laboratory, and clinical studies are now needed to confirm this.

Blunt chest wall trauma causes diffuse or segmental pulmonary contusion. Local and systemic inflammatory processes are initiated in association with tissue damage, leading to morbidity and mortality [9]. Approximately 25% of trauma-related deaths are caused by chest trauma [10]. Fluid accumulates in the alveolar or interstitial spaces in trauma-associated pulmonary contusion. Ventilation disorder, hypoxia, and hypercarbia develop in the alveoli as a result [9,10].

Free oxygen radicals emerge in association with tissue damage in cases of contusion in the lung. Free radicals are short-lived, unstable, low-molecular-weight, and highly active molecules with one or more unpaired electrons. Free radical production under most circumstances is a part of the pathomechanism, and several xenobiotic toxicities are associated with free radical production. The most important free radicals in the human body are oxygen-derived radicals. Oxygen is reduced to the superoxide group (O_2^-) through the effect of various iron-sulfur-containing oxidation-reduction enzymes and flavoproteins. The superoxide group is highly potent and leads to cell damage and is converted into hydrogen peroxide (H_2O_2) and oxygen by the copper enzyme superoxide dismutase [11,12]. Antioxidants are substances that directly and indirectly protect the cells against the undesirable effects of xenobiotics, carcinogens, and toxic radical reactions. This study investigated the tissue damage-preventing effect of the powerful antioxidant carvacrol.

In pulmonary contusion caused by blunt thoracic trauma, blood and fluid leak into the alveolar area and interstitial space due to oxidative stress, resulting in interstitial bleeding and edema within a few hours post-trauma [13]. Antioxidant agents reduce parenchymal changes characterized by leukocyte infiltration, excessive bleeding, alveolar impairment, congestion, and alveolar edema [13]. In our study, the decrease in fibrino-

hemorrhagic exudate accumulated in the alveolar area in the trauma group shows that the anti-inflammatory effect of carvacrol may be strong.

One study involving animal models reported that carvacrol contributed to the healing of acute pancreatitis through antioxidant mechanisms [14]. Recent research involving rats showed that carvacrol treatment healed oxidative stress injury in the brain, liver, and kidneys [15]. A randomized, double-blinded phase II clinical study from 2018 revealed that carvacrol possessed the ability to reduce inflammatory activity and symptoms in patients with asthma [16].

A meta-analysis of 31 publications investigating the in vitro effectiveness of carvacrol published in 2018 also revealed antimicrobial, bactericidal, antifungal, anti-inflammatory, antioxidant, antidepressant, immunomodulatory, and mutagenic activities [17].

Due to its antioxidant properties, carvacrol has also been shown to reduce DNA injury, prevent lipid peroxidation, and provide NO elimination [18]. In addition, its anti-inflammatory effect has also been proved to result from COX-2 suppression [19]. Significantly less hemorrhage was observed in rats administered carvacrol in the present study, and decreases were also observed in congestion and leukocyte infiltration, although these were not statistically significant.

In conclusion, hemorrhage resulting from trauma-related alveolar damage decreased significantly in rats receiving carvacrol in the present study. We also observed decreases in leukocyte infiltration and congestion in damaged tissue from rats given carvacrol, although these were not statistically significant. Based on these findings, we think that carvacrol protects the parenchyma in rats with induced pulmonary contusion, but further experimental, laboratory and clinical studies are needed to obtain more meaningful results.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Ethics Approval

The study was approved by the Bolu Abant İzzet Baysal University Medical Faculty Experimental Animals Ethical Committee, Turkey (2020/22).

Authors' contributions

OY; conceived of the presented idea and collected the data, SPÖ: developed the analysis. OY, SPÖ; verified the analytical methods, discussed the results and contributed to the final manuscript and co-wrote the paper.

References

1. Kao RL, Huang W, Martin CM, Rui T. The effect of aerosolized indomethacin on lung inflammation and injury in a rat model of blunt chest trauma. *Can J Surg* 2018; 61: S208-S218.
2. Sasser SM, Sattin RW, Hunt RC, Krohmer J. Blast lung injury. *Prehosp Emerg Care* 2006; 10: 165-72.
3. Türüt H, Ciralik H, Kilinc M, Ozbag D, Imrek SS. Effects of early administration of dexamethasone, N-acetylcysteine and aprotinin on inflammatory and oxidant-antioxidant status after lung contusion in rats. *Injury* 2009; 40: 521-7.
4. Feng X, Jia A. Protective effect of carvacrol on acute lung injury induced by lipopolysaccharide in mice. *Inflammation*. 2014 ; 37: 1091-101.
5. Guan X, Li X, Yang X, Yan J, Shi P, Ba L et al. The neuroprotective effects of carvacrol on ischemia/reperfusion-induced hippocampal neuronal impairment by ferroptosis mitigation. *Life Sci*. 2019; 235: 116795.
6. Michiels J, Missotten J, Van Hoorick A, Ovyne A, Fremaut D, De Smet S et al. Effects of dose and formulation of carvacrol and thymol on bacteria and some functional traits of the gut in piglets after weaning. *Arch Anim Nutr* 2010; 64: 136-54.
7. Suntres ZE, Coccimiglio J, Alipour M. The bioactivity and toxicological actions of carvacrol. *Crit Rev Food Sci Nutr* 2015; 55: 304-18.
8. Raghavendran K, Davidson BA, Helinski JD, Marschke CJ, Manderscheid P, Woytash JA et al. A rat model for isolated bilateral lung contusion from blunt chest trauma. *Anesth Analg* 2005; 101: 1482-9.
9. Miller PR., Croce MA, Kilgo PD, Scott J. Acute respiratory distress syndrome in blunt trauma: Identification of independent risk factors/discussion. *Am Surg* 2002; 68: 845.
10. Gündoğdu AG, Çamaş HE, Yazkan R. Blunt thoracic trauma. *Med J SDU* 2018; 25: 86-97.
11. Janciauskiene S. The beneficial effects of antioxidants in health and diseases. *Chronic Obstr Pulm Dis* 2020; 7: 182-202.
12. Matés JM. Effects of antioxidant enzymes in the molecular control of reactive oxygen species toxicology. *Toxicology* 2000; 153: 83-104.
13. Gavelli G, Canini R, Bertaccini P, Battista G, Bnà C, Fattori R. Traumatic injuries: imaging of thoracic injuries. *Eur Radiol* 2002; 12: 1273-94.
14. Bakır M, Geyikoglu F, Colak S, Turkez H, Bakır TO, Hosseini-gouzdagani M. The carvacrol ameliorates acute pancreatitis induced liver injury via antioxidant response. *Cytotechnology* 2016; 68: 1131-46.
15. Samarghandian S, Farkhondeh T, Samini F, Borji A. Protective Effects of Carvacrol against Oxidative Stress Induced by Chronic Stress in Rat's Brain, Liver, and Kidney. *Biochem Res Int* 2016, doi: 10.1155/2016/2645237.
16. Alavinezhad A, Khazdair MR, Boskabady MH. Possible therapeutic effect of carvacrol on asthmatic patients: A randomized, double blind, placebo-controlled, Phase II clinical trial. *Phytother Res* 2018; 32: 151-9.
17. Silva ER, de Carvalho FO, Teixeira LGB, Santos NGL, Felipe FA, Santana HSR et al. Pharmacological Effects of Carvacrol in In vitro Studies: A Review. *Curr Pharm Des* 2018; 24: 3454-65.
18. Guimarães AG, Oliveira GF, Melo MS, Cavalcanti S, Antoniolli AR, Bonjardim LR, et al. Bioassay-guided evaluation of antioxidant and antinociceptive activities of carvacrol. *Basic Clin Pharmacol Toxicol* 2010; 107: 949-57.
19. Landa P, Kokoska L, Pribylova M, Vanek T, Marsik P. In vitro anti-inflammatory activity of carvacrol: Inhibitory effect on COX-2 catalyzed prostaglandin E(2) biosynthesis. *Arch Pharm Res* 2009; 32: 75-8.

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Original Article

The importance of thoracic surgery clinics for emergency medicine: a retrospective analysis of consultations

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ABSTRACT

Background: Thoracic Surgery serves as a consultant for many specialties of medicine. In this study, we aimed to analyze the basic characteristics of the consultations requested by the Department of Emergency Medicine to the Department of Thoracic Surgery in a university hospital.

Materials and Methods: This study includes the retrospective analysis of emergency medicine consultations of patients over the age of 18 to the Thoracic Surgery Clinics of Çanakkale Onsekiz Mart University (COMU) Faculty of Medicine between 01/03/2014 and 01/03/2020. The cases were analyzed in two groups: the consultations requested with the initiative of the emergency medicine physician (Group A) and consultations requested as per recommendations of other physicians (Group B).

Results: Of 486 consultations that met the inclusion criteria, 434 (89.3%) consultations were requested as per the recommendations of the emergency medicine physicians (Group A) and 52 (11.7%) were requested as per the recommendations of other physicians (Group B). No thoracic surgical diagnosis was established in 107 (22%) consultations. When compared between the two groups, no thoracic surgical pathology was found in 55 (12.6%) consultations from Group A and 52 (100%) consultations from Group B ($p < 0.001$).

Conclusion: In our study, no thoracic surgical diagnosis was established in more than 20% of consultations requested by the emergency service. We believe that adding formal rotation training to thoracic surgery during the residency training of emergency medicine, which is the first specialty that meets emergency applications, will lead the diagnosis and treatment of thoracic surgical emergencies faster and more accurately.

Keywords: consultation, thoracic surgery, emergency medicine, thoracic trauma, residency training

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Introduction

Consultation can be defined as the request of a patient's responsible physician from another physician to evaluate the patient to seek the medical opinion regarding the diagnosis and treatment of a case [1,2]. Thoracic surgery serves as a consultant for many departments of medicine, mainly emergency medicine. Consultations constitute an important part of the routine workload of a thoracic surgeon. In this study, we aimed to analyze the basic characteristics of the consultations requested by the Department of Emergency Medicine to the Department of Thoracic Surgery in a university hospital and to determine how accurate the requested consultations are.

Materials and Methods

This study includes retrospective analysis of patients over the age of 18 who were consulted by the Emergency Department to the Department of Thoracic Surgery of the COMU Faculty of Medicine. Age, gender, and patient-specific medical record data were obtained anonymously. The cases were analyzed in two main groups: the consultations (Group A) requested as per the initiative of the Emergency medicine physician and the requested consultations as per the recommendations of other department physicians (Group B). Patients were also examined by dividing into various groups as causes of admission (traumatic, non-traumatic), types of trauma for patients with a history of trauma (penetrating and blunt thoracic trauma).

The study was approved by the Ethics Committee of Clinical Studies at Çanakkale Onsekiz Mart University (COMU) Faculty of Medicine with the approval number 2020-08. Our study was carried out following the ethical principles determined by the 1964 Helsinki Declaration and subsequent amendments. This study was supported by the Scientific Research Projects Unit of COMU with project number TSA-2020-3335.

Statistical Analysis

Mean, standard deviation, median, frequency, and percentage were used as descriptive statistics for demographic data such as age, gender and variables such as diagnosis, emergency intervention, termination of patients (emergency department, clinical hospitalization, intensive care unit hospitalization, referral, etc). The Chi-Square test was used to analyze categorical variables. p value less than 0.05 was considered significant.

The data obtained were analyzed using IBM SPSS for Windows version 19.

Results

A total of 1178 consultations were evaluated for this study. 666 of these were inpatient consultations requested from other clinics and 26 emergency room patients under the age of 18 were both excluded from the study. The consultation data of 486 patients who met the criteria for inclusion were analyzed within the scope of our study (Figure 1).

The mean age of the 486 consultation cases requested by the emergency department was 56.04 ± 19.2 . Of the cases included in our study, 383 (78.8%) patients were male and 103 (21.2%) were female (Table 1).

Ninety-nine (20.4%) consultations were requested for non-traumatic patients and 387 (79.6%) were requested for trauma-related admissions. The most common development mechanism of traumas was in-car traffic accidents with 152 (39.3%) and the second-most common mechanism was falls with 138 (35.7%) cases. As a result of the consultations of 387 traumatic cases, it was determined that the most common diagnosis was rib fracture with 106 (27.3%) cases. No pathological findings were detected in 104 (26.8%) of patients who were consulted with thoracic surgery because of trauma. As a result of the most frequent consultations, other traumatic and non-traumatic consultations and the diagnoses established by thoracic surgery are indicated in table 1.

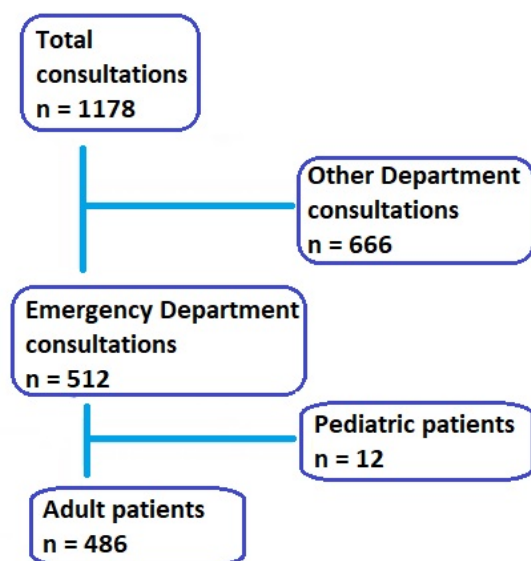


Figure 1. Flow diagram of the patients included in the study.

Table 1. Demographic data and general characteristics of the patients included in the study.

Age	Mean± std deviation 56.04±19.2
Gender	n (%)
Male	383 (78.8)
Female	103 (21.2)
Results of consultations	n (%)
<i>Non-traumatic</i>	99 (20.4)
Pneumothorax	37 (7.6)
Pleural effusion	34 (7.0)
Lung cancer	5 (1.0)
Empyema	5 (1.0)
Others	18 (3.8)
<i>Traumatic</i>	387 (79.6)
Rib Fracture	106 (21.8)
No pathology	104 (21.3)
Pneumothorax	54 (11.1)
Contusion	35 (7.2)
Hemo-pneumothorax	27 (5.6)
Hemothorax	27 (5.6)
Others	34 (7.0)
Cause of trauma	n (%)
<i>Blunt trauma</i>	361 (93.3)
MVA	152 (39.3)
Falls	138 (35.7)
Motorcycle accidents	35 (9.0)
MVAIP	15 (3.9)
Others	21 (5.4)
<i>Penetrating trauma</i>	26 (6.7)

Abbrev.: MVA; Motor vehicle accidents, MVAIP; Motor vehicle accidents involving pedestrians

A total of 434 (89.3%) of the consultations were requested with the initiative of the emergency medicine physician (Group A) and 52 (11.7%) with the recommendation of other department physicians (Group B). All consultations in Group B were requested for patients presenting due to trauma. Orthopedics (n = 21, 40.4%) and Neurosurgery (n = 14, 26.9%) recommended consultations were the top two departments that recommended Thoracic surgery consultation in Group B. No thoracic surgical diagnosis was established in 107 (22%) of the 486 consultations included in our study. When the percentage of the absence of thoracic surgical diagnoses as a result of the consultations were com-

pared among groups, no thoracic surgical diagnosis was established in 55 (12.6%) of the 434 consultations requested in Group A and all of the 52 consultations (100%) in Group B. And this difference was statistically significant ($p < 0.001$) (Table 2). It was determined that 104 (97.2%) of the 107 patients who did not have thoracic surgical pathology were traumatic admissions. All patients in Group B were found to have trauma-induced admissions. When the patients in Group A and Group B were examined in terms of chest surgery emergency intervention needs, 147 (33.9%) patients in Group A had undergone emergency thoracic surgical intervention, while no patients in Group B were treated by thoracic surgery and the difference was statistically significant ($p < 0.001$) (Table 2).

When the emergency thoracic surgical interventions applied to the patients included in our study were examined, it was determined that the most common intervention was chest tube thoracostomy with 120 (27.6%) cases (Table 2).

As a result of these 486 consultations, 152 (31.3%) patients were discharged from the emergency department, and physicians decided to treat 334 (68.7%) patients in the hospital. 255 (76.3%) of the 334 patients who were hospitalized were treated in inpatient clinics and 56 (16.8%) were hospitalized in the intensive care unit (ICU), and 23 (6.9%) were referred to other hospitals (Table 2). The indication of the referral of all 23 patients who were referred from our hospital was determined to be the lack of available beds in the ICU. Both groups were compared in terms of the patients who were discharged from the emergency department and hospitalized to other clinics, 141 (32.5%) patients in Group A were discharged from the emergency department and 49 (11.3%) patients were hospitalized in other clinics. In Group B, 11 (21.2%) patients were discharged from the emergency department, 33 (63.4%) patients were hospitalized to other clinics ($p = 0.220$). As a result of the consultations in Group B, there were no patients hospitalized in the thoracic surgery clinics whereas 173 (39.9%) patients were hospitalized in the thoracic surgery clinics in Group A ($p < 0.001$).

Table 2. Comparison of groups in terms of pathological findings, type of intervention, and hospitalization status.

Table 2: Comparison of groups in terms of pathological findings, type of intervention, and hospitalization status.			
	Group A n=434 (89.3%)	Group B n=52 (10.7%)	p
Pathological finding			
Yes	379 (87.4)	0 (0)	<0.001
No	55 (12.6)	52 (100)	
Intervention			
Yes	147 (33.9)	0 (0)	<0.001
No	287 (66.1)	52 (100)	
Intervention type			
Chest tube thoracostomy	120 (27.6)	0 (0)	
Thoracentesis	13 (3.0)	0 (0)	
Catheter thoracostomy	5 (1.2)	0 (0)	
Other	9 (2.1)	0 (0)	
No intervention	287 (66.1)	0 (0)	
Hospitalization status			
Discharged	141 (32.5)	11 (21.2)	=0.220
ICU	49 (11.3)	7 (13.4)	
Referred	22 (5.1)	1 (1.9)	
Inpatient clinics	222 (51.1)	33 (63.5)	<0.001
Thoracic surgery	173 (39.9)	0 (0)	
Other clinics	49 (11.3)	33 (63.5)	
Abbrev.: ICU; Intensive care unit, Ns; not significant			

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Discussion

Consultation means requesting the opinion of other physicians regarding the diagnosis and treatment of a patient for guiding the diagnosis and the treatment of the patient in line with these recommendations. It is a medical advisory system based on mutual communication between the primary physician and the consultant physician [1-3].

Thoracic surgery is a department that serves almost all departments of medicine, especially the emergency department, as a consultant physician [3,4]. Thoracic surgery is obliged to make an urgent diagnosis and treat a wide range of diseases such as blunt and penetrating thoracic trauma and related complications (rib fractures, traumatic hemothorax, and traumatic pneumothorax), spontaneous pneumothorax, pleural effusion, tracheobronchial foreign body aspirations. Especially for the consultations requested by emergency departments due to trauma, spontaneous pneumothorax, and tracheobronchial foreign body aspirations, prompt diagnosis and the application of emergency treatment are of great importance to prevent possible morbidity and mortality [5-7].

In the literature, it has been reported that the emergency medicine department requests the most frequent number of consultations from the department of thoracic surgery [3]. In our study, 512 of the 1178 consultations requested from our thoracic surgery clinic over 6 years were requested by the emergency department and 486 (41.3%) consultations were examined following the criteria of our study. In the light of this data, it can be concluded that the most frequently requested consultations from the thoracic surgery clinics are found to be consultations from emergency medicine.

The majority (78.8%) of the cases included in our study were male. In addition, it was determined that most of the applications of these patients in our study were traumatic applications (79.6%). It was determined that most applications for non-traumatic etiology were due to lung cancer and spontaneous pneumothorax. Considering that the majority of hospital admissions secondary to thoracic trauma and non-traumatic diseases such as lung cancer and spontaneous pneumothorax are more frequently detected in the male gender, it is expected that the vast majority of patients consulted in thoracic surgery are of male gender [8-10].

Chest tube thoracostomy is adequate in approximately 90% of patients who require emergency intervention [11]. In this case, it can be concluded that the most common type of emergency intervention as a result of the consultations requested by the emergency department from thoracic surgery is chest tube thoracostomy. In the results of our study, it was determined that the most common type of emergency intervention applied by thoracic surgery to patients construed by the Emergency Department was tube thoracostomy ($n = 120, 81.6\%$); which is compatible with the literature.

Of the 486 consultations included in our study, 434 (89.3%) were primarily requested by the emergency department on the initiative of the emergency medicine physician (Group A) and 52 (10.7%) were requested by the emergency department at the suggestion of other department physicians (Group B). While no thoracic surgical diagnosis was established in 55 (12.6%) of the consultations in Group A, no thoracic surgical diagnosis was established in any of the 52 consultations (100%) in Group B. All patients in Group B are traumatic admissions. Of the five main departments (Emergency Medicine, General Surgery, Thoracic Surgery, Neurosurgery, Orthopedics, and Traumatology) that deal with the vast majority of traumas in our country, thoracic surgery clinical rotation is available during the residency training only for general surgery. This situation may cause physicians who work in these departments the necessity to consult for the opinion of the thoracic surgery clinics, where they have not received any formal training to rule out a possible thoracic trauma in multi-traumatic applications. We think that it is practically not functional for each department to rotate with each other during their residency training. However, we believe that it is extremely necessary to establish a formal rotation training program during residency training to the thoracic surgery department from the department of emergency medicine, which primarily gives care to all traumas which are directly and indirectly responsible for 75% of trauma-related mortality [11,12]. In the future, this type of training program will be able to improve the knowledge and emergency response skills of emergency medicine specialists related to thoracic surgical emergencies and may prevent possible morbidity and mortality due to these conditions. In addition, patients who do not have any thoracic surgical pathology can be unnecessarily consulted, preventing the delay of the actual diagnosis and treatment of the patient, and ensuring that the time of the consult to thoracic surgeon can be

transferred to the patients who need care from their department. No study in the literature contained data similar to our study and therefore no comparison could be made. Thus we believe a randomized multicenter study on this subject may enlighten this need and proper changes in the guidelines of residency training can be made.

In conclusion thoracic surgery provides consultancy services to many departments and emergency medicine is the primary department to request a consultation from thoracic surgery. In our study, no pathological conditions were detected in approximately 25% of the consultations requested by the emergency department. Adding a formal thoracic surgery rotation program to the residency training of the departments that give care to trauma does not seem practical. But the addition of formal rotation training to thoracic surgery during the residency training of emergency medicine, which is the first specialist to meet emergency applications, might be more suitable. Thus, emergency department physicians can establish the diagnosis more promptly and accurately. And they may perform the treatment of thoracic surgical emergencies with self-confidence by performing chest tube thoracostomy in hospitals where there is no thoracic surgeon. In addition, we believe that thoracic surgeons will be able to transfer their time to patients who can benefit from their medical knowledge and skills.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Ethics Approval

This study was approved by the Clinical Studies Ethics Committee of Çanakkale Onsekiz Mart University Faculty of Medicine with the approval number of 2020-08 on 07 May 2020. Written informed consent was received from all participants of this study.

Authors' Contributions

İEG, OB, and TA: co-wrote the paper, collected the data, performed the analysis, contributed data/analysis tools, conceived and designed the analysis.

References

1. Kessler C, Kutka BM, Badillo C. Consultation in the emergency department: a qualitative analysis and review. *J Emerg Med* 2012; 42: 704-11.
2. "Consultation." Merriam-Webster.com Dictionary, Merriam-Webster, Available at: <https://www.merriam-webster.com/dictionary/consultation>. Accessed February 24, 2021.
3. Cobanoglu U. Evaluation of breast surgery construed cases in a university hospital. *Turk Toraks Der* 2009; 10: 117-21.
4. Tarrant C, Stokes T, Colman AM. Models of the medical consultation: opportunities and limitations of a game theory perspective. *Qual Saf Health Care* 2004; 13: 461-6.
5. Dennis BM, Bellister SA, Guillaumondegui OD. Thoracic Trauma. *Surg Clin North Am* 2017; 97: 1047-64.
6. Hewlett JC, Rickman OB, Lentz RJ, Prakash UB, Maldonado F. Foreign body aspiration in adult airways: therapeutic approach. *J Thorac Dis* 2017; 9: 3398-409.
7. Bintliffe O, Maskell N: Spontaneous pneumothorax. *BMJ* 2014; 348: g2928.
8. Dongel I, Coskun A, Ozbay S, Bayram M, Atli B. Management of thoracic trauma in emergency service: Analysis of 1139 cases. *Pak J Med Sci* 2013; 29: 58-63.
9. Hellyer JA, Patel MI. Sex disparities in lung cancer incidence: validation of a long-observed trend. *Transl Lung Cancer Res* 2019; 8: 543-5.
10. Bobbio A, Dechartres A, Bouam S, Damotte D, Rabbat A, Régnard JF et al. Epidemiology of spontaneous pneumothorax: gender-related differences. *Thorax* 2015; 70: 653-8.
11. Meredith JW, Hoth JJ. Thoracic trauma: when and how to intervene. *Surg Clin North Am* 2017; 87: 95-118.
12. Narayanan R, Kumar S, Gupta A, Bansal VK, Sagar S, Singhal M et al. An Analysis of Presentation, Pattern and Outcome of Chest Trauma Patients at an Urban Level 1 Trauma Center. *Indian J Surg* 2018; 80: 36-41.

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Original Article

The comparison of the Acute Physiology and Chronic Health Evaluation II, Sequential Organ Failure Assessment and American Society of Anesthesiologists physical status classification scores in the prediction of morbidity and mortality after lung surgery

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ABSTRACT

Background: This study compared three commonly used scoring systems, the Acute Physiology and Chronic Health Evaluation II (APACHE II), Sequential Organ Failure Assessment (SOFA), and American Society of Anesthesiologists physical status classification (ASA), in the prediction of post-operative mortality and morbidity after lung resection.

Materials and Methods: Adult patients admitted to the surgical intensive care unit (ICU) after lung resection between January 2018 and January 2020 were retrospectively evaluated.

Results: The study included 509 patients with a mean (SD) age of 59.9 (11.7) years; 421 of the patients were men (82.7%). The average ICU length of stay was 4.2 ± 6.9 days. Preoperative ASA scores were I-II in 73.5% and III-IV in 26.5% of the patients. The mean (SD) postoperative APACHE II score was 9.42 (4.23) and SOFA score was 1.04 (2.08). The area under the curve (AUC) in receiver operating characteristic analysis of postoperative complications was 0.772 for APACHE II and 0.690 for SOFA. The AUC values of APACHE II and SOFA scores for mortality were 0.925 and 0.944, respectively.

Conclusions: Our comparison of these scoring systems showed that SOFA was the best predictor of morbidity and mortality after lung resection. SOFA predicted the development of complications significantly better than both APACHE II and ASA. SOFA also predicted mortality better than ASA and APACHE II, although the difference was not significant for APACHE II. SOFA and APACHE II scores can be used to predict mortality and morbidity in patients lung resection surgery.

Keywords: Acute Physiology and Chronic Health Evaluation II Score, Sequential Organ Failure Assessment Score, complication, mortality, lung resection

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Introduction

Patients undergoing lung resection experience respiratory and cardiac problems that cause high perioperative morbidity and mortality. Despite advances in surgical technique and approach, the mortality rate ranges from 2% to 12%. The incidence of postoperative pulmonary complications is 19% to 59%, much higher than seen after upper abdominal (16-17%) or lower abdominal surgeries (0-5%). The total incidence of complications after thoracic surgery ranges between 15% and 37.5% [1-4].

Physiological scoring systems have been developed for various purposes, including evaluating patients scheduled for surgery or admitted to the intensive care unit (ICU), documenting clinical observations and data, estimating the risk of mortality and morbidity, and making comparisons between patients or different ICUs. Scoring systems can also guide patient monitoring and treatment [5]. The Acute Physiology and Chronic Health Evaluation II (APACHE II), Sequential Organ Failure Assessment (SOFA), and American Society of Anesthesiologists physical status classification (ASA) are among the most commonly used scoring systems today.

The APACHE II model was developed in ICUs and applied in research and risk stratification of critical patients [6,7]. It yields a score ranging from 0 to 71 based on 12 physiological variables. This score can easily be calculated using routine data obtained in the first 24 hours after hospitalization, and the model is widely used in ICU populations.

The SOFA is a measure of multi-organ failure based on daily assessment of 6 organ systems: the respiratory, cardiovascular, coagulatory, renal, liver, and nervous systems. Each organ is rated from 0 (normal function) to 4 (high dysfunction/failure) to give a score of 0 to 24 points for the past 24 hours. SOFA scores enable the evaluation of changes in organ dysfunction or failure over time and can also be used to assess postoperative mortality and mobility [8-10].

In this study, it was aimed to compare the roles of APACHE II, SOFA and ASA in predicting postoperative mortality and morbidity of patients and to investigate the reasons why these scores were high.

Materials and Methods

This retrospective study included 509 consecutive adult patients admitted to the ICU after lung resection (lobectomy, pneumonectomy) between January 2018 and January 2020. The study flow chart is shown in figure 1.

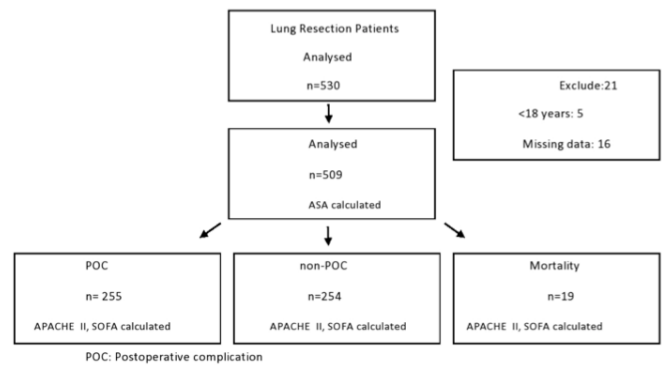


Figure 1. The study flow chart.

Indication for surgery was lung cancer in 453 (94.1%) of the patients and bronchiectasis in 56 (5.9%). A common general anesthesia protocol was used for all patients. Antibiotic prophylaxis was administered preoperatively. All surgical procedures were performed under general anesthesia after premedication with midazolam. Intravenous (IV) propofol 2-3 mg/kg and fentanyl 2 µg/kg were used for induction. As a muscle relaxant, 0.5 mg/kg IV rocuronium bromide was administered. A double-lumen endobronchial tube was placed on the right or left as appropriate and its position was confirmed by fiberoptic bronchoscopy (FBS). Anesthesia was maintained with 50% oxygen, 50% air, and 2% sevoflurane. Remifentanyl IV infusion was continued throughout the operation. The surgical procedure was determined according to current guidelines for pneumonectomy and lobectomy. Resections were performed via thoracotomy or video-assisted thoracoscopic surgery (VATS). Emergency cases and cases that did not undergo pneumonectomy or lobectomy were not included in the study. Cardiac and respiratory complications occurred in 254 of the patients, while the other 255 did not develop any complications. Cardiac complications included arrhythmia, angina, myocardial infarction, and mortality. Respiratory complications included pneumonia, pulmonary edema, prolonged air leak, acute respiratory failure, and need for mechanical ventilation. The patients' ASA scores were determined preoperatively and their APACHE II and SOFA scores were calculated based on the worst values recorded during their first day after admission to the ICU. The patients' demographic data and follow-up information were also noted. All patients were transferred directly from the operating room to the ICU, then moved to the ward after a sufficient postoperative monitoring period. Patients who developed complications during follow-up in the ward were re-admitted to the ICU. Patients between the ages of 18-85 were included in the study, and patients with missing data were not included in the study.

Statistical Analysis

The patients' demographic and clinical data were analyzed using IBM SPSS Statistics® version 23.0 (IBM Corp, Armonk, NY). Mean, standard deviation (SD), and minimum/maximum values were used as descriptive statistics for quantitative variables; frequency and percentage were used for qualitative variables. Normally distributed data were reported as mean (SD) and compared between groups using Student's t-test. Qualitative variables were analyzed using Pearson's chi-square test, or with Fisher's exact test for small groups. Nonnormally distributed continuous variables were expressed as median and interquartile range (25th-75th percentiles) and compared using Mann-Whitney U test. Results with p values less than 0.05 were accepted as statistically significant. Diagnostic performance of APACHE II, SOFA, and ASA scores in predicting postoperative complications (POC) and mortality was examined using receiver operating characteristic (ROC) curves and area under the curve (AUC). Statistical analysis was performed using MedCalc Software for Windows to determine the best predictor. Mul-

tivariate logistic regression analysis was conducted using only variables shown to have a significant effect on POC and postoperative mortality in univariate analyses to identify independent risk factors. Spearman correlation analysis was used degree of relation between length of stay (LOS) and APACHE II and SOFA scores.

Results

A total of 509 lung resection patients, 421 (82.7%) male and 88 (17.3%) female, were included in this study. The mean age was 59.9 years. 374 (73.5%) of the patients were ASA I-II, 135 (26.5%) were ASA III-IV; 479 (94.1%) were lung cancer, 30 (5.9%) were bronchiectasis. Lobectomy was performed in 372 (73.1%) patients, pneumonectomy was performed in 137 (26.9%) patients, thoracotomy was performed in 399 (78.4%) and VATS type surgery was performed in 110 (21.6%) patients. The mean intensive care unit stay was 1.9 ± 1.7 days. The preoperative, peroperative and postoperative data of the patients in the study are shown in table 1.

Table 1. Preoperative, peroperative and postoperative demographic and clinical pathological findings of the patients and their distribution in terms of postoperative complications (POC) and mortality.

Variables		Total (n=509)	Non-POC (n=254)	POC (n=255)	P value	Non-mortal- ity (n=490)	Mortality (n=19)	p value
Preoperative								
Age (years), mean±SD		59.9±11.7	57.3±13.0	62.5±9.7	<0.001	59.7±11.8	65.4±8.9	0.007
Gender, n (%)	Male	421 (82.7%)	192 (75.6%)	229 (89.8%)	<0.001	403 (82.2%)	18 (94.7%)	0.221
	Female	88 (17.3%)	62 (24.4%)	26 (10.2%)		87 (17.8%)	1 (5.3%)	
ASA score, n (%)	ASA I-II	374 (73.5%)	211 (83.1%)	163 (63.9%)	<0.001	361 (73.7%)	13 (68.4%)	0.611
	ASA III-IV	135 (26.5%)	43 (16.9%)	92 (36.1%)		129 (26.3%)	6 (31.6%)	
Diagnosis, n (%)	Lung cancer	479 (94.1%)	228 (89.8%)	251 (98.4%)	<0.001	461 (94.1%)	18 (94.7%)	
	Bronchiectasis	30 (5.9%)	26 (10.2%)	4 (1.6%)		29 (5.9%)	1 (5.3%)	
APACHE II, mean±SD		9.42±4.23	7.89±2.74	10.94±4.87	<0.001	9.02±3.60	19.63±6.19	<0.001
SOFA, mean±SD		1.04±2.08	0.25±0.64	1.82±2.65	<0.001	0.81±1.57	6.89±4.26	<0.001
SOFA, n (%)	<2	408 (80.2%)	244 (96.1%)	164 (64.3%)	<0.001	407 (83.1%)	1 (5.3%)	<0.001
	≥2	101 (19.8%)	10 (3.9%)	91 (35.7%)		83 (16.9%)	18 (94.7%)	
Intraoperative / postoperative								
Side, n (%)	Left	205 (40.3%)	108 (42.5%)	97 (38.0%)	0.303	201 (41.0%)	4 (21.1%)	0.097
	Right	304 (59.7%)	146 (57.5%)	158 (62.0%)		289 (59.0%)	15 (78.9%)	
Resection, n (%)	Lobectomy	372 (73.1%)	210 (82.7%)	162 (63.5%)	<0.001	365 (74.5%)	7 (36.8%)	<0.001
	Pnmc	137 (26.9%)	44 (17.3%)	93 (36.5%)		125 (25.5%)	12 (63.2%)	
Operation type, n (%)	Thoracotomy	399 (78.4%)	207 (81.5%)	192 (75.3%)	0.089	381 (77.8%)	18 (94.7%)	0.091
	VATS	110 (21.6%)	47 (18.5%)	63 (24.7%)		109 (22.2%)	1 (5.3%)	
LOS (days), mean±SD		1.9±1.7	1.0±0.0	2.9±2.0	<0.001	1.8±1.4	5.0±3.5	<0.001

Abbrev.: POC; Postoperative complications, ASA; American Society of Anesthesiologists physical status classification, SOFA; Sequential Organ Failure Assessment, LOS; Length of stay, Pnmc: Pneumonectomy, APACHE II; Acute Physiology and Chronic Health Evaluation.

POC were observed in 255 patients (50.0%). Cardiac and respiratory complications were observed more frequently in complications. The mean APACHE II score of these patients was 10.94 ± 4.87 and the SOFA score was 1.82 ± 2.65 . Of the 135 patients with SOFA score ≥ 2 and APACHE score ≥ 10 , cardiac complications predominated in 69 (51%) and respiratory complications in 66 (49%). While cardiac complications were observed in 123 (90%) arrhythmia, 9 (6.6%) heart failure, 8 (5.9%) angina and 5 (3.7%) myocardial infarction; respiratory complications were listed as acute respiratory failure 44 (35%), pneumonia 62 (50%), pulmonary edema 10 (7%) and pulmonary embolism 4 (6%). Of the patients who developed PC, 31.5% ($n = 39$) required invasive mechanical intervention and 40.3% ($n = 50$) underwent CPAP.

The mean age was 62.5 ± 9.7 years in patients who developed POC, and 65.4 ± 8.9 years in those who developed mortality. Factors associated with POC development were male sex, advanced age, high ASA (III/IV), APACHE II, and SOFA scores, resection due to lung cancer, and pneumonectomy ($p < 0.001$ for all). The other variables did not differ significantly between patients with and without POC. Patients with POC had statistically longer ICU LOS (mean 2.9 ± 2.0 days vs. 1.0 ± 0.0 day, $p < 0.001$).

Of the 19 patients who died during the study period, 12 had respiratory complications and 7 had cardiac complications. The mean APACHE II score of these patients was 19.63 and the SOFA score was 6.89. Mortality was associated with advanced age ($p = 0.007$), high APACHE II and SOFA scores ($p < 0.001$ for both), and pneumonectomy ($p < 0.001$). The other variables showed no significant differences between surviving and ex patients. ICU LOS was statistically longer among nonsurvivors (mean 5.0 days versus 1.8 days, $p < 0.001$).

ROC analysis of SOFA, APACHE II, and ASA scores' relationship with POC and mortality revealed that all three scoring systems were significantly effective in predicting POC. However, only SOFA and APACHE II scores were significant predictors of mortality (Table 2). The ROC curves for SOFA and APACHE are shown in figures 2 and 3.

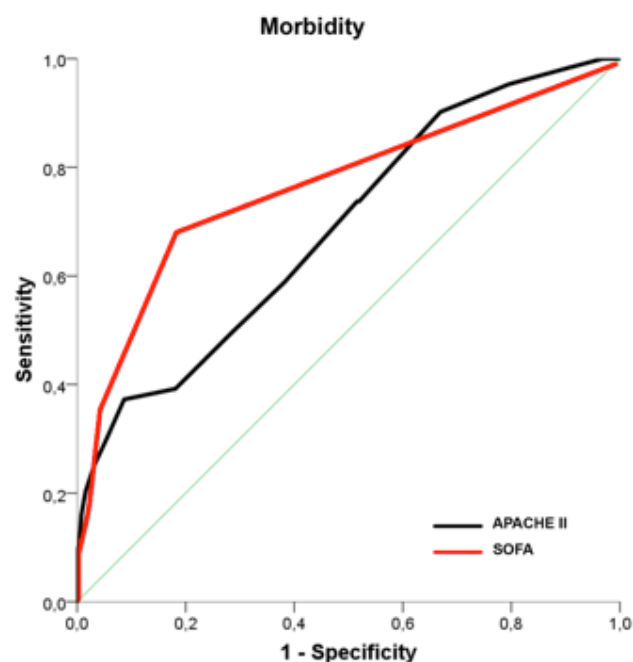


Figure 2. Receiver operating characteristic (ROC) curve of APACHE II and SOFA score for morbidity. The APACHE II score achieved area under the curve of 0.690 (95% confidence interval: 0.647-0.730) for predicting major complications. The SOFA score achieved area under the curve of 0.772 (95% confidence interval: 0.733-0.808) for predicting major complications.

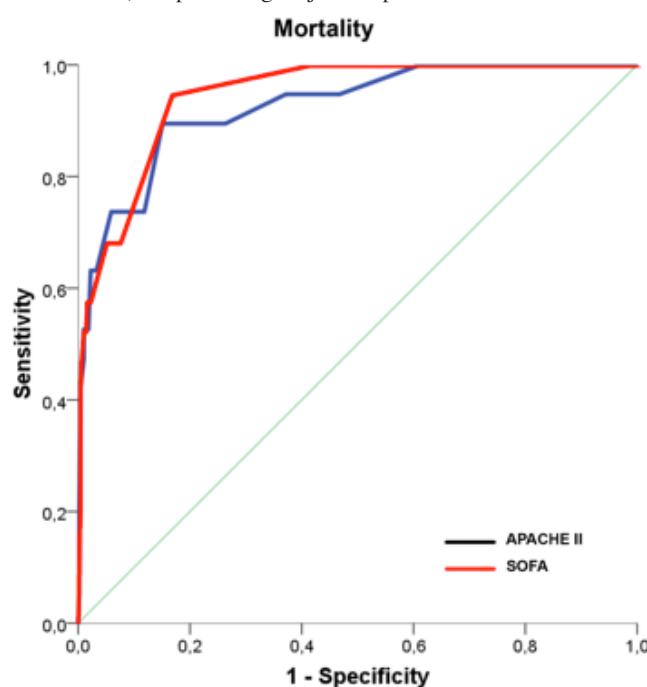


Figure 3. Receiver operating characteristic (ROC) curve of APACHE II and SOFA score for mortality. The APACHE II score achieved area under the curve of 0.925 (95% confidence interval: 0.898-0.946) for predicting mortality. The SOFA score achieved area under the curve of 0.944 (95% confidence interval: 0.920-0.962) for predicting death.

Comparison among the scoring systems showed that SOFA was the best predictor of POC and mortality (Table 2).

Table 2. The results obtained after examining the reliability of SOFA, APACHE and ASA in predicting POC and mortality with ROC curves and comparison between tests.

	AUC	95% CI	Cutoff (n)	Sensitivity (%)	Specificity (%)	P value
For POC						
SOFA	0.772 [#]	0.733-0.808	0	68.63	81.89	<0.001
APACHE	0.690	0.647-0.730	11	37.25	91.34	<0.001
ASA	0.662	0.619-0.703	1	92.94	29.13	<0.001
For postoperative mortality						
SOFA	0.944	0.920-0.962	1	94.74	83.06	<0.001
APACHE	0.925	0.898-0.946	12	89.47	84.90	<0.001
ASA	0.574 ^{&}	0.530-0.618	1	94.74	18.57	0.173

Abbrev.: AUC; Area Under Curve, CI; Confidence interval, ASA; American society of anesthesiologists score, APACHE II; The Acute Physiology and Chronic Health Evaluation

[#]: Different from both APACHE and ASA ($p=0.002$ and $p<0.001$, respectively)

[&]: Different from both SOFA and APACHE ($p<0.001$ and $p<0.001$, respectively)

SOFA predicted POC development significantly better than both APACHE II ($p = 0.002$) and ASA ($p < 0.001$). While SOFA predicted mortality better than APACHE II, this difference was not significant ($p = 0.502$). APACHE II also predicted POC development better than ASA, but not significantly ($p = 0.318$). However, APACHE II predicted mortality significantly better than ASA ($p < 0.001$).

In ROC analysis, a SOFA score of 1 was identified as the optimal cut-off for prediction of POC. Comparison of patients with $\text{SOFA} \geq 1$ ($n = 221$) and those with SOFA scores <1 ($n = 288$) revealed that the high SOFA group had a statistically significantly higher rate of POC than the low SOFA group (79.2% vs. 27.8%, $p < 0.0001$; odds ratio [OR]: 9.891, 95% CI: 6.534-14.974).

For postoperative mortality, the optimal SOFA cut-off was 2. Comparison of patients with $\text{SOFA} \geq 2$ ($n = 408$) and low $\text{SOFA} < 2$ ($n = 101$) showed that the high SOFA group had statistically higher postoperative mor-

tality (17.8% vs. 0.2%, $p < 0.0001$; OR: 88.265, 95% CI: 11.622-670.353).

The cut-off score for APACHE II in the prediction of POC was 12. Patients with $\text{APACHE II} \geq 12$ ($n = 392$) had a significantly higher POC rate compared to patients with APACHE II score < 12 ($n = 117$) (81.2% vs. 40.8%, $p = 0.0001$; OR: 6.261, 95% CI: 3.777-10.381).

An APACHE II score of 13 was the optimal cut-off for postoperative mortality. The mortality rate was significantly higher among patients with APACHE II scores ≥ 13 ($n = 91$) than those with APACHE II score < 13 ($n = 418$) (18.7% vs. 0.5%, $p < 0.0001$; OR: 47.784, 95% CI: 10.814-211.150).

In multivariate analysis using the independent variables that were significantly associated with POC development (Table 1) and the $\text{SOFA} \geq 1$ and $\text{APACHE II} \geq 12$ groups, we found that sex, ASA III/IV, resection type, high APACHE II, and high SOFA were found to be independent risk factors for POC (Table 3).

Table 3. Multivariate Logistic Regression Analysis for Postoperative Complications.

Variables	Multivariate analysis 1			Multivariate analysis 2		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Age	1.014	0.994-1.035	0.157	1.008	0.986-1.030	0.443
Gender	0.442	0.250-0.780	0.004	0.456	0.250-0.834	0.01
ASA III-IV	1.514	1.200-1.909	0.0005	1.545	1.203-1.984	0.0007
Diagnosis	0.886	0.762-1.029	0.114	0.906	0.774-1.060	0.223
Resection type	1.488	1.118-1.863	0.0005	1.436	1.127-1.829	0.003
APACHE ≥ 12	5.328	3.133-9.052	<0.001	--	--	--
SOFA ≥ 1	--	--	--	8.386	5.423-12.968	<0.001

Abbrev.: ASA; American Society of Anesthesiologists physical status classification, APACHE II; Acute Physiology and Chronic Health Evaluation II, SOFA; Sequential Organ Failure Assessment

In the multivariate analysis including independent variables associated with mortality (Table 1) and the $\text{SOFA} \geq 2$ and $\text{APACHE} \geq 13$ groups identified in ROC analysis, we determined that resection type, high APACHE II, and high SOFA were independent risk factors for postoperative mortality (Table 4).

There was a strong positive correlation between LOS and SOFA score ($r = 0.530$, $p < 0.001$) and a moderate positive correlation between LOS and APACHE II score ($r = 0.330$, $p < 0.001$).

Discussion

In this study, we evaluated the ability of the SOFA and APACHE II scoring systems to predict mortality and morbidity after lung resection. The SOFA and APACHE scores are the most commonly used tools for the assessment of mortality and morbidity in non-surgical ICUs [11]. According to our study results, APACHE II and SOFA may be acceptable scoring systems for predicting hospital mortality and morbidity after lung resection.

In a study of 600 patients admitted to the ICU after cardiac surgery, APACHE II score was found to be a useful method for predicting mortality, with the best predictive ability at scores above 9 ($\text{AUC} = 0.743$) [6]. In our study, both SOFA and APACHE II scores significantly predicted mortality. We found that the APACHE II was a good predictor of mortality in patients undergoing lung surgery, with an AUC of 0.925 and an optimal cut-off of ≥ 12 . Similarly, SOFA score had an AUC of 0.944 and a cut-off of > 1 . In our study population, the median APACHE II score was 10.94 in those with POC and 7.78 in those without POC. The prevalence of POC among patients with high APACHE II scores (≥ 12) was 81.2%, compared to 40.8% in those with low scores (< 12). In other words, APACHE II scores above the cut-off value were associated with a two-fold increase in morbidity.

High APACHE II scores are an indicator of higher

mortality. In a study of 8515 ICU patients, Knaus et al reported that APACHE II scores were between 20 and 35 for all nonsurgical patients, while mortality was 40% to 75% [12]. Ulus et al reported an ICU mortality rate of 44.8% among patients whose APACHE II scores were 20 to 35 at ICU admission [13]. APACHE II score was found to be useful in predicting post-ICU mortality and readmission in surgical patients [14]. In our study, the mortality rate was 0.5% in patients with APACHE II < 13 , while it was 13% in patients with > 13 .

In their study of 1190 intensive care patients, Lee et al stated that the APACHE II score is a useful scoring system for both admission to intensive care and discharge [13]. In our study, the duration of intensive care hospitalization (LOS) was 1 day in the group that did not develop complications, while the average in the group that developed complications was 2.9 days. In the group that developed mortality, the average duration of hospitalization was observed as 5 days. Mortality with LOS was statistically increased in those who developed it (5.0 days versus 1.8 days on average). Again, a statistically significant association was observed between the high SOFA score and LOS.

The SOFA system was developed at a consensus meeting of the European Society of Intensive Care Medicine in 1994 and further revised in 1996 [15]. A study evaluating BNP, Euroscore, and SOFA scores in cardiac surgery patients showed that SOFA score was useful in predicting mortality [16]. In a study including 272 lung transplant patients, the mean SOFA and APACHE II scores of the 244 surviving patients were 17.4 and 4.9, while those of the nonsurviving 28 patients were 24.2 and 7.1, respectively [17]. In our study, there was a difference between SOFA score ≥ 2 and SOFA score < 2 in terms of postoperative mortality in terms of 17.8% versus 0.2%. An increase in mortality was observed as the SOFA score increased.

In the present study, we observed that SOFA was better able to predict POC and mortality compared to ASA

Table 4. Multivariate logistic regression analysis for postoperative mortality.

Variables	Multivariate analysis 1			Multivariate analysis 2		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Age	1.027	0.972-1.086	0.332	1.043	0.986-1.102	0.135
Resection type	1.832	1.092-3.073	0.02	1.883	1.109-3.196	0.01
APACHE ≥ 13	36.095	7.994-162.974	< 0.001	--	--	--
SOFA ≥ 2	--	--	--	68.306	8.916-523.289	< 0.001

Abbrev.: APACHE II; Acute Physiology and Chronic Health Evaluation II, SOFA; Sequential Organ Failure Assessment

and APACHE II. Mortality prediction was better with SOFA than APACHE II, although the difference was not statistically significant. Furthermore, the rate of POC was 79.2% among patients with SOFA scores ≥ 1 , compared to 27.8% at values < 1 . In other words, patients with a SOFA score of 1 or higher had a 9.8-fold higher risk of developing POC compared to those with a score below 1. SOFA predicted POC development significantly better than both APACHE II and ASA. APACHE II predicted mortality development significantly better than ASA.

ASA score is used for preoperative patient assessment and is useful in determining the anesthetic approach, especially in terms of monitoring methods. It is widely accepted and applied worldwide. The system was endorsed by the American Society of Anesthesiologists in 1940 to determine surgical risk. Higher scores are associated with increased perioperative mortality and morbidity. We observed that ASA III-IV was a significant predictor of POC compared to ASA I-II, consistent with the results of similar studies [18,19].

Despite advances in lung surgery, mortality and morbidity rates are still high [20-22]. The frequency of POC is affected by factors such as resection type, patient demographic characteristics, procedure duration, and intraoperative bleeding. Age, gender, renal dysfunction, hypertension, chronic obstructive pulmonary disease (COPD), and lymph node dissection are considered risk precursors for cardiopulmonary complications [5,6]. In our study, male sex, advanced age, high ASA (ASA III/IV) score, lung cancer-induced resection, high APACHE II and SOFA score, and pneumonectomy were negatively affected by the development of complications. Markers of mortality after lung cancer resection are listed as BMI, male sex, renal dysfunction, chemotherapy, pneumonectomy, bilobectomy, and emergency surgery [3,11]. In our study, advanced age, high APACHE II and SOFA scores, and pneumonectomy were negatively affected the development of mortality. In the study of factors affecting APACHE II and SOFA scores higher than their normal levels, arrhythmias in cardiac complications, pneumonia and acute respiratory failure were observed to be prominent in respiratory complications.

The main limitations of this study are the small patient group and its retrospective design. Furthermore, although it was a single-center study, the surgeries were performed by different surgeons.

In conclusion comparison of these three scoring systems demonstrated that SOFA was the best predictor of morbidity and mortality after lung resection. SOFA predicted both complications and mortality significantly better than ASA and predicted complications significantly better than APACHE II. Prediction of mortality was also better compared to APACHE II, but the difference was not significant.

Scoring systems are an important tool in pulmonary surgery practice that evaluate operative mortality and morbidity. Validation studies are needed to predict and evaluate complications and mortality observed after lung resection. According to the findings of this study, SOFA and APACHE II scores had high AUC values for predicting mortality (0.944 and 0.925, respectively) and moderate AUC values for predicting morbidity (0.772 and 0.690, respectively). These results indicate that patients with high APACHE II and SOFA scores should be monitored more closely to reduce the incidence of mortality and morbidity. However, our study was conducted with a limited number of patients and the results should be confirmed in larger studies.

Declaration of conflicting interests

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Ethics Approval

The study was approved by the institutional ethical board of Health Sciences University, Istanbul Yedikule Chest Disease and Thoracic Surgery Training and Research Hospital (No: 271-05/23.08.2020).

Authors' contributions

YÖ, CA; co-wrote the paper, collected the data, performed the analysis, contributed data/analysis tools, conceived and designed the analysis.

References

1. Stéphan F, Boucheseiche S, Hollande J, Flahault A, Cheffi A, Bazelly B et al. Pulmonary complications following lung resection: a comprehensive analysis of incidence and possible risk factors. *Chest* 2000; 118:1263-70.

2. De Decker K, Jorens PG, Van Schil P. Cardiac complications after noncardiac thoracic surgery: an evidence-based current review. *Ann Thorac Surg* 2003; 75: 1340-8.
3. Rena O, Papalia E, Oliaro A, Casadio C, Ruffini E, Filosso PL et al. Supraventricular arrhythmias after resection surgery of the lung. *Eur J Cardiothorac Surg* 2001; 20: 688-93.
4. Algar FJ, Alvarez A, Salvatierra A, Baamonde C, Aranda JL, López-Pujol FJ. Predicting pulmonary complications after pneumonectomy for lung cancer. *Eur J Cardiothorac Surg* 2003; 23: 201-8.
5. Cakir E, Sari E, Bindal A, Çiftçi A, Özkoçak Turan I. Comparison of the Effectiveness of Acute Physiology and Chronic Health Evaluation II and Modified Early Warning Score Scoring Systems in Predicting Mortality in Patients in the Intensive Care Unit. *Yoğun Bakım Derg* 2019; 10: 75-9.
6. Yalçın M, Gödekmerdan E, Tayfur K, Yazman S, Ürkmez M, Ata Y. The APACHE II Score as a Predictor of Mortality After Open Heart Surgery. *Turk J Anaesthesiol Reanim* 2019; 47: 41-7.
7. Wang L, Chen R, Mo Z, Dong J, Sun Z, Xiao F et al. Predictive value of SOFA score combined AGI grading system in elderly patients with sepsis: a retrospective analysis with 91 patients. *Zhonghua Wei Zhong Bing Ji Jiu Yi Xue* 2017; 29: 145-9.
8. Aldrich JM, Gropper MA. Can we predict pulmonary complications after thoracic surgery? *Anesth Analg* 2010; 110: 1261-3.
9. Pätälä T, Kukkonen S, Vento A, Pettilä V, Suojäranta-Ylinen R. Relation of the Sequential Organ Failure Assessment score to morbidity and mortality after cardiac surgery. *Ann Thorac Surg* 2006; 82: 2072-8.
10. Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. *Intensive Care Med* 1996; 22: 707-10.
11. Geyik FD, Altun GT, Çitak N. A Comparison Of Apache II And Apache IV Scoring Systems in Patients Admitted to an Intensive Care Unit. *Journal of Anesthesia – Jarss* 2013; 21: 182-6.
12. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. *Crit Care Med* 1985; 13: 818-29.
13. Ulus F, Kokulu S, Savkılıoğlu E. Survival Analysis Of The Elderly Patients Treated In The Respiratory Intensive Care Unit *Turkish Journal Of Geriatrics* 2010; 13: 231-7.
14. Lee H, Lim CW, Hong HP, Ju JW, Jeon YT, Hwang JW et al. Efficacy of the APACHE II score at ICU discharge in predicting post-ICU mortality and ICU readmission in critically ill surgical patients. *Anaesth Intensive Care* 2015; 43: 175-86.
15. Jones AE, Trzeciak S, Kline JA. The Sequential Organ Failure Assessment score for predicting outcome in patients with severe sepsis and evidence of hypoperfusion at the time of emergency department presentation. *Crit Care Med* 2009; 37: 1649-54.
16. Kartufan F, Karaoğlu K. Mortality after Cardiac Surgery; a Comparison of BNP, EuroSCORE and SOFA Score. *GKDA* 2018; 24: 111-7.
17. Rello J, Bello I, de Vicente R, Hermira Anchuelo A, Ballesteros MÁ, Iranzo R et al. EMPRET Study investigators. Risk Factors for Mortality in 272 Patients With Lung Transplant: A Multi-center Analysis of 7 Intensive Care Units. *Arch Bronconeumol* 2017; 53: 421-6.
18. Curatolo C, Goldberg A, Maerz D, Lin HM, Shah H, Trinh M. ASA physical status assignment by non-anesthesia providers: Do surgeons consistently downgrade the ASA score preoperatively? *J Clin Anesth* 2017; 38: 123-8.
19. Ozkan E, Fersahoğlu MM, Dulundu E, Ozel Y, Yıldız MK, Topaloğlu U. Factors affecting mortality and morbidity in emergency abdominal surgery in geriatric patients. *Ulus Travma Acil Cerrahi Derg* 2010; 16: 439-44.
20. Çınar HU, Kocatürk C, Cansever L, Ceyhan S, Bedirhan MA. Morbidity, mortality and survival rates of non-small cell lung cancer patients who underwent lobectomy with pulmonary artery reconstruction compared to those of the patients who underwent pneumonectomy. *Curr Thorac Surg* 2020; 5: 1-9.
21. Aker C, Sezen CB, Ceritoglu A, Dogru MV, Aksoy Y, Kalafat CE et al. Prognostic value of Glasgow Prognostic Score in patients with non-small cell lung cancers undergoing pN2 pneumonectomy. *Curr Thorac Surg* 202; 16: 7-13.
22. Sezen AI, Sezen CB, Sokulmez Yildirim S, Dizbay M, Ulutan F. Cost analysis and evaluation of risk factors for postoperative pneumonia after thoracic and cardiovascular surgery: a single-center study. *Curr Thorac Surg* 2019; 4: 56-62.

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Case Report

An inappropriate localization of a zoonotic disease: infraclavicular, infrapectoral hydatid cyst

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ABSTRACT

Hydatid cyst is a zoonotic disease that is common worldwide. Turkey is an endemic region for hydatid cyst due to the widespread farming and animal husbandry. *Echinococcus granulosus* is the most common infestation species in humans, and humans are the incidental intermediate host. The cyst formed by this zoonotic cause is expected to be localized in either lungs or the liver, depending on the part of the life cycle in humans. Soft tissue or intramuscular presence of the cyst is rare. Herein, we present a hydatid cyst case with an unusual localization.

Keywords: hydatid cyst, parasitosis, thorax, surgical treatment, echinococcoses

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Introduction

Hydatid cyst is a commonly seen zoonotic disease. Turkey is an endemic region for hydatid cyst due to the widespread farming and animal husbandry [1]. *Echinococcus granulosus* is the most common infestation species in humans, and humans are the incidental intermediate host [2]. The cyst formed by this zoonotic cause is expected to be localized in either lungs or the liver, depending on its life cycle. Soft tissue or intramuscular presence of the cyst is rare, and differential diagnoses include soft tissue tumors. Herein, we present a hydatid cyst case located out of the thoracic cavity.

Case Report

A 39-year-old male patient presented to our clinic with swelling, redness, and pain under his clavicular region. He had a history of a mass excision from the same area two years ago. He did not have a discharge report from the previous intervention but according to the patient's statement 'a cyst was removed'. When the patient was questioned about his postoperative medical treatment after the surgery he stated that he was given a prescription but he did not use any medication other than pain killers. He mentioned that during the last three months the swelling increased progressively. The previous incision scar was visible under the clavicle bone and the mass was round and palpable with well circumscription right under the clavicle bone during the physical examination.

The ultrasound examination revealed a 55x42 mm lesion containing multiloculated cysts at the right infraclavicular region. Thorax computed tomography showed the cystic lesion located under the pectoral muscle, adjacent to the clavicle's lower border and not related to the thoracic cavity (Figure 1). The reported multiloculation dominantly suggested the recurrence of hydatid cyst disease.



Figure 1. Thorax CT showing the cystic lesion under the pectoral muscle.



Figure 2. Extracted cysts.

Surgical excision was planned. It was observed that the cystic structure was in the pectoral muscle during the anatomical dissection. The pericystic structure was taut and thin, and punctured during the procedure and all round cysts filled with clear fluid meticulously enucleated (Figure 2). The macroscopic appearance was compatible with hydatid cyst.

The cavity was lavaged with a 20% hypertonic solution to achieve a scolicalid affect. No complications occurred postoperatively. The patient was discharged on the 1st postoperative day uneventfully. Histopathologic examination reported the presence of germinative membrane, eosinophilic stained nuclei, acellular lamellar cuticle layer and outermost fibrous tissue, in addition to inflammatory granulation tissue, and scolex in the cyst lumen, which was compatible with the diagnosis of hydatid cyst.

Albendazole treatment with a dose of 15 mg/kg/day, was initiated in the postoperative first outpatient clinic follow-up, which was advised for 6 months. No additional lesion was detected in the postoperative 3rd-month follow-up control.

Written informed consent was obtained from the patient for publication of his data.

Discussion

Humans are intermediate hosts for hydatid cyst. Orally taken parasite embryos due to contaminated food or water pass into the blood from the duodenal mucosa and can spread to all body tissues. The most common site of localization is liver (50-70%) and lung (11-17%). Whereas pericardium (5%), soft tissues (2.4-5.3%), heart (0.5-3%), and muscle and subcutaneous tissues (0.5-4.7%) are affected less frequently [3]. Extrahepatic

localization of a hydatid cyst may be primary or secondary. Secondary involvement is mostly seen as a direct spread to proximal tissues due to the cyst's rupture in the liver and lungs. In our case, the patient had a cystic lesion located under the clavicle bone region which was confirmed with CT imaging and superficial tissue ultrasound. No cystic lesion was detected in lungs and liver.

In cases of muscular and subcutaneous hydatid cysts, the main symptom is localized palpable swelling. It is one of the options that should be considered in the differential diagnosis in endemic areas. Although some serological tests such as IHA and indirect immunofluorescence test may help diagnose hydatid cysts in the muscles, the diagnosis of muscular and subcutaneous hydatid cysts is usually made by the presence of scolex during the operation [3]. In cases where muscular cyst hydatid is suspected, diagnostic biopsy or aspiration should be avoided to prevent the disease's rupture and spread [4,5]. In our case, patient had a history of surgery from the same area and multiple cysts suggesting recurrence infection.

The primary treatment method in cases diagnosed with muscular cyst hydatid is total excision of the cyst [4-6]. The measures taken to prevent contamination during excision are very important. In our case, the patient who had a second hydatid cyst operation from the same site was thought to have recurrence due to contamination in the first operation in addition to patient's statement that he did not use the prescribed medication. Failure of the patient to use the treatment as recommended could lead to much more serious consequences and present with a clinically disseminated infection [7].

Scolicidal agents that can be used to destroy intracyst daughter vesicles are ethanol, 20-30% hypertonic saline, formaldehyde, 0.5% cetrimide, 0.5% silver nitrate and hydrogen peroxide solutions. The most commonly used scolicidal substance in thoracic surgery operations is hypertonic saline solution with a rate of 20-30%, due to its minimal toxicity. It can be used in the lavage of the cyst content as well as a barrier to prevent the cyst content from contaminating the surrounding tissues after an uncontrolled cyst puncture. As in our case, it is very important to prevent contamination during surgery and postoperative medical treatment to prevent recurrent infections.

Albendazole treatment was started for the patient after excision. Medical treatment with benzimidazole compounds (albendazole-mebendazole) seems to be far

from curative treatment. However, these agents can be used for prophylactic purposes to prevent spread and recurrence at least for six months.

In conclusion, the atypical location should not be forgotten in the areas that are considered as endemic for cyst hydatid. Cyst hydatid should not be forgotten in the differential diagnosis of cystic mass lesions in muscle and subcutaneous tissues. Attention should be paid to perioperative contamination, and postoperative medical treatment support should be provided to prevent the recurrence.

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Authors' contributions

FC, CH: conceived and designed the current case report, co-wrote the paper, FC: collected the clinical data. The authors discussed the case under the literature data together and constituted the final manuscript.

References

1. Sayır F, Çobanoğlu U. Yöremizin Endemik Paraziter Hastalığı: Kist Hidatik. *Van Tıp Dergisi* 2013; 20: 288-93.
2. Morar R, Feldman C. Pulmonary echinococcosis. *Eur Respir J* 2003; 21: 1069-77.
3. Di Gesu G, Picone A, La Bianca A, Massaro M, Vetri G. Muscular and subcutaneous hydatidosis. *Minerva Med* 1987; 30: 835-40.
4. Tatari H, Baran O, Sanlidag T, Gore O, Ak D, Manisalı M, et al. Primary intramuscular hydatidosis of supraspinatus muscle. *Arch Orthop Trauma Surg* 2001; 121: 93-4.
5. Duncan GJ, Tooke SM. Echinococcosis infestation of biceps brachii. *Clin Orthop* 1990; 261: 247-50.
6. Casero RD, Costas MG, Menso E. An unusual case of hydatid disease: Localisation to the gluteus muscle. *Clin Infect Disease* 1996; 23:395-6.
7. Özpolat B, Sayın M, Doğan OV, Doğan Y. Simultaneous traumatic rupture of bilateral pulmonary hydatid cysts. *J Thorac Cardiovasc Surg* 2005; 130: 908-9.

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Case Report

Catamenial pneumothorax with liver herniation

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ABSTRACT

Catamenial pneumothorax (CP) is a special type of pneumothorax occurring in women of reproductive age related with the menstrual cycles. In most cases patients are misdiagnosed as primary spontaneous pneumothorax and are admitted to the hospital with recurrences. CP is mostly associated with thoracic endometriosis. Characteristic lesions of the disease include diaphragmatic perforations and also diaphragmatic or pleural spots or nodules in addition to bullae or blebs. There are a few cases in the literature with partial liver herniation from diaphragmatic defects in patients with catamenial pneumothorax. In this study, we present a 45-year-old female patient with the diagnosis of catamenial pneumothorax and herniation of liver from diaphragmatic defects.

Keywords: catamenial pneumothorax, thoracic endometriosis, diaphragmatic defects, liver herniation, video assisted thoracoscopic surgery

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Introduction

P Catamenial pneumothorax (CP) is defined as spontaneous recurrent pneumothorax occurring in women of reproductive age with a correlation with the menstrual cycles [1]. The most common clinical presentation of CP is typical chest pain, dyspnea and cough before or simultaneously with menstruation [2]. In most cases patients are misdiagnosed as primary spontaneous pneumothorax and admit to the hospital with recurrences. In this study, we present a 45-year-old female patient with liver herniation from diaphragmatic defects.

Case Report

A 45-year-old non-smoker woman was hospitalized for right side pneumothorax (Figure 1) and she was treated with tube thoracostomy.

A thoracic computed tomography (CT) scan taken after the treatment of first attack showed no evidence of intrathoracic abnormalities (Figure 2).

One week after the treatment she admitted to our clinic again with recurrent pneumothorax then she underwent right-sided video-assisted thoracoscopic surgery (VATS). Apical wedge resection and partial pleurectomy were performed. During VATS no diaphragmatic pores were detected.

The patient admitted to the hospital with dyspnea and chest pain 1.5 years later. Partial right sided pneumothorax was observed on the posteroanterior chest x-ray. After nasal oxygen therapy the pneumothorax was completely resolved within three days. In the detailed medical history, the relationship between cyclic chest pains and pneumothorax attacks with the menstrual cycle was noticed. Serum CA125 levels were increased moderately (45 U/mL^{-1}). The patient was consulted to the gynecology clinic and GnRH analog treatment was initiated.

During 1-year follow-up with hormone therapy, there was no chest pain or pneumothorax. Two months after the end of hormonal treatment, the patient complained of chest pain again. The x-ray showed a right pneumothorax thereupon thorax CT was performed. Thorax CT showed a lesion with a size of $22 \times 14 \text{ mm}$ adjacent to the right hemidiaphragm suspicious for endometriosis focus or liver parenchyma herniated from diaphragmatic defects (Figure 3).



Figure 1. Posteroanterior chest x-ray of the patient with right sided pneumothorax.

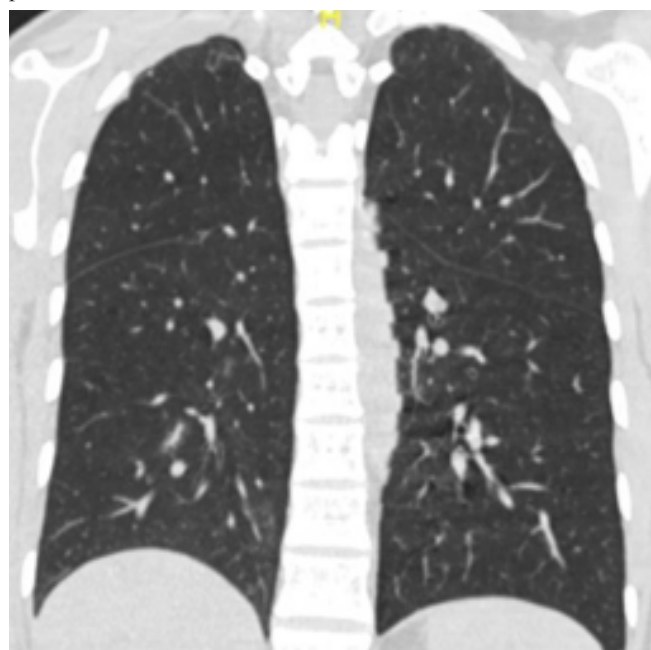


Figure 2. Thoracic CT coronal section image taken after the treatment of first attack.

Thoracic magnetic resonance imaging (MRI) was performed for detailed evaluation. Focal herniation of the right lobe of the liver from the diaphragmatic defect was reported in thorax MRI. A new intervention was planned and the patient underwent video-assisted thoracoscopic surgery. Multiple pores were observed in the central tendinous portion of the diaphragm where the right lobe of the liver was herniated from the largest one (Figures 4a-c). The defective area was partially resected and sent for pathologic examination. The diaphragm was repaired with nonabsorbable interrupted sutures (Figure 4d).

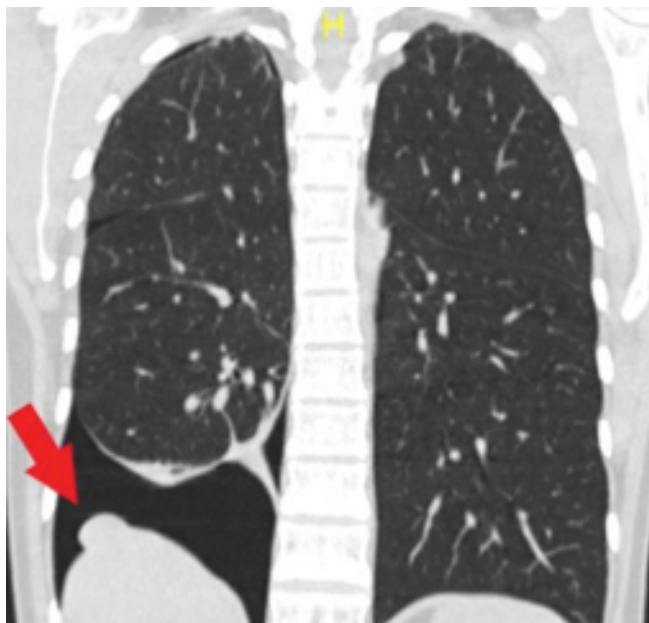


Figure 3. Thoracic CT coronal section image showed focal herniation of the right lobe of the liver from the diaphragmatic defect.

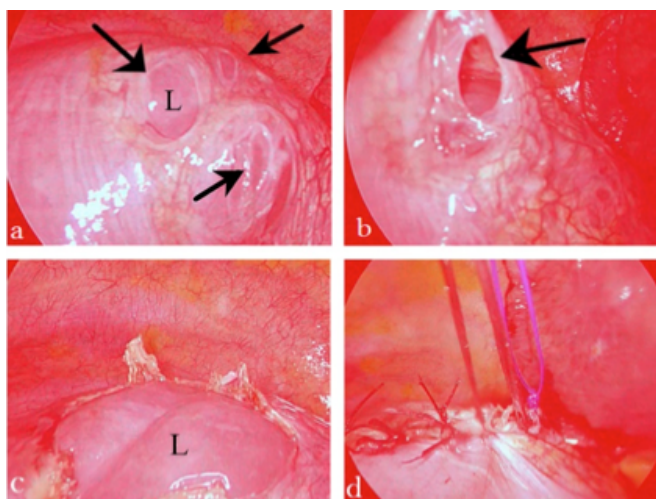


Figure 4. Intraoperative view of the diaphragmatic pores (arrows) and liver herniation from bigger defect (a), view of one of the pores after elevation of the diaphragm (b), image of liver after resection of the diaphragmatic pores (c), diaphragm was repaired with non-absorbable interrupted sutures (d). (L: Liver)

There was no evidence of endometriosis reported on the pathologic examination. The patient was evaluated with gynecology clinic and hormonal therapy (dienogest) was initiated after the surgery. In the postoperative 9 months follow up, the patient had no symptom and no pneumothorax was observed in the chest x-rays.

Written informed consent was obtained from the patient for publication of her data.

Discussion

CP is a recurrent clinical condition that usually occurs one day before or 72 hours after menstruation in

premenopausal women. The diagnosis is mostly made clinically and most patients have complaints of typical shortness of breath, and recurrent chest pain at times associated with menstruation [2].

CP is mostly associated with thoracic endometriosis. Thoracic endometriosis is defined as the migration of ectopic endometrial tissue into the thoracic cavity, which is the most common extra pelvic location of endometriosis [3]. However positive histopathologic confirmation of thoracic endometriosis is not possible in most of the cases and that is thought to be related to the place where the biopsy was taken randomly [2].

There are a few hypotheses for the pathogenesis of CP. When there is no mucus plug between the atmosphere and the peritoneal cavity during menstruation, the air can pass through the genital system and from the diaphragmatic defects to the thoracic cavity [1]. These diaphragmatic defects may be congenital or acquired and play an important role in pathogenesis. Increased prostaglandin levels during menstruation leading to bronchoconstriction and alveolar rupture or air leakage from endometrial implants on the pleural surface are among other theories [4].

While CP is predominantly on the right side, left-sided and bilateral cases have also been described [1]. Peritoneal fluid containing air and endometrial tissue mainly flows into the right suprahepatic space because of the anatomical difference between the right and left abdominal cavity. This fluid and air pass through the lymphatic pores or existing diaphragmatic defects to the thoracic cavity during respiration. The common occurrence of CP on the right side is explained by this theory [2].

Characteristic lesions of the disease include diaphragmatic perforations and also diaphragmatic or pleural spots or nodules in addition to bullae or blebs. In our case there was no diaphragmatic defect that could be observed in the first operation, however years later more than one defect developed and the liver became herniated. There are only seven cases in the literature with partial liver herniation from diaphragmatic defects and most of them had herniation after recurrence as in our case [5]. The appearance of apical bulla/bleb during the operation may cause the clinicians to approach treatment with the diagnosis of primary spontaneous pneumothorax. A study by Shrestha et al [4] stated that most of the female patients of reproductive age who applied

with spontaneous pneumothorax were not questioned about menstrual history at the time of admission to the hospital, all of the patients applied with more than two episodes of pneumothorax, and even two patients had a history of unsuccessful pleurodesis and the diagnosis of catamenial pneumothorax was made mostly retrospectively with intraoperative or histologic findings.

The sensitivity of serum CA 125 level in diagnosis is not clear, Bagan et al [3] emphasized that an increase in serum CA 125 level may be an indicator of endometriosis and may support the indication of videothoracoscopy and hormonal therapy in the early stage.

There is still no clear treatment algorithm for catamenial pneumothorax. Cases with mild symptoms are usually managed with observation, simple thoracentesis or chest tube, while thoracoscopy, bulla/bleb resection, and pleurodesis are mostly preferred in recurrent pneumothorax [2]. There is no clear consensus regarding the extent of intervention in diaphragmatic lesions [4]. To prevent recurrence and obtain a histological sample, we recommend resection in diaphragm repair and using mesh/graft if necessary. Due to the possibility of recurrence, medical treatment such as GnRH analogs, oral contraceptives and, dienogest are recommended after surgery [6].

In conclusion, with this case, we aim to emphasize that the diagnosis of catamenial pneumothorax should be suspected in patients with recurrent and right-sided pneumothorax, in premenopausal female patients. The entire chest cavity and diaphragm should be fully examined in thoracoscopic examination. Patients with catamenial pneumothorax must be evaluated for endometriosis and a multidisciplinary approach should be provided to the management of the disease, including a thoracic surgeon, gynecologist and, endocrinologist.

Declaration of conflicting interests

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Authors' contributions

GK,BBK; Conceived and designed the analysis, BBK; Collected the data, HK,SGG,BMY; Contributed data or analysis tools, BBK; Performed the analysis GK,BBK; co-wrote the paper.

References

1. Bagan P, Le Pimpec Barthes F, Assouad J, Souillamas R, Riquet M. Catamenial pneumothorax: retrospective study of surgical treatment. *Ann Thorac Surg* 2003; 75: 378-81.
2. Gil Y, Tulandi T. Diagnosis and treatment of catamenial pneumothorax: a systematic review. *J Minim Invasive Gynecol* 2020; 27: 48-53.
3. Bagan P, Berna P, Assouad J, Hupertan V, Le Pimpec Barthes F, Riquet M. Value of cancer antigen 125 for diagnosis of pleural endometriosis in females with recurrent pneumothorax. *Eur Respir J* 2008; 31: 140-2.
4. Shrestha B, Shrestha S, Peters P, Ura M, Windsor M, Naidoo R. Catamenial Pneumothorax, a Commonly Misdiagnosed Thoracic Condition: Multicentre Experience and Audit of a Small Case Series With Review of the Literature. *Heart Lung Circ* 2019; 28: 850-7.
5. Bobbio A, Carbognani P, Ampollini L, Rusca M. Diaphragmatic laceration, partial liver herniation and catamenial pneumothorax. *Asian Cardiovasc Thorac Ann* 2007; 15: 249-51.
6. Alar T, Uysal A, Gedik İ. Catamenial pneumothorax: a case report of recurrent spontaneous pneumothorax. *Curr Thorac Surg* 2016; 1: 35-7.

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Case Report

Periosteal chondroma of rib at adulthood

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ABSTRACT

Periosteal chondroma is a rare, benign, slowly growing cartilaginous tumors. They are found in long and tubular bones, mostly. It occurs in second and third decades of life. Rib is an rare location to found periosteal chondroma. We demonstrates a case report of periosteal chondroma founded in the rib that belongs 44-year-old man. We also examine isocitrate dehydrogenase 1 (IDH-1) mutation of this unusually located periosteal chondroma immunohistochemically and IDH-1 mutation was determined as negative. This article is aimed to present 44 years old man's periosteal chondroma developed at rib that is an unusual location and age for periosteal chondromas.

Keywords: rib, periosteal chondroma, juxtacortical chondroma,

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Introduction

Periosteal chondroma, also defined as juxtacortical chondroma, benign cartilaginous lesion which arises on cortex beneath periosteum. Periosteal chondromas are relatively uncommon tumors which form less than %2 of all chondromas. Although it can develop at any age, most of the patients in 2nd and 3rd decade of life [1]. Their common presentations include palpable, mostly painful masses and swelling [2,3]. The most common sites for periosteal chondroma are phalanges of the hands and feet and the proximal humerus [4]. This article is aimed to present 44 years old man's periosteal chondroma developed at rib that is an unusual location and age for periosteal chondromas [5].

Case Report

A 44-year-old man who presented with palpable and painful mass which appeared recently at his rib referred to our clinic. He stated that his pain at the location of mass had gradually increased and does not relieve by nonsteroidal anti-inflammatory drug (NSAIDs) which prescribed for his fibromyalgia previously. He does not have any hospital admission for this mass at his rib before. He does not have any chronic disease other than fibromyalgia that is diagnosed 2 years ago. His drug history was duloxetine and etodolac for his fibromyalgia. In his family history there is no malignancies, genetically inherited disease. The patient has a history of traffic accident in 2014 when he involved in a car accident and was brought to the emergency room. In his physical examination after trauma, pain at the right hemi-thorax was noted. Any other physical examination abnormalities were detected. He did not receive any surgical intervention; complete blood count follow-up was performed, and he was discharged from hospital after adequate period of observation. In his physical examination in our clinic, swollen and tender mass was found at his 6th rib of costal arch. His biochemical tests were in the normal range. Chest radiography was performed, and no significant change was noticed. Subsequent thorax tomography revealed a mass lesion at 6th costochondral junction arised on the surface of rib (Figure 1).

Partial rib resection surgery was successfully performed to the patient. The resection material of the right 6th costa-chondral region was sent to pathology. They

are bone tissue in the size of 3.5x1.5x2 cm and associated tissue in the size of 2.5x1.5x1 cm and tissues in the size of 3x3x0.5 cm, which were sent as a multiple fragment. Histopathological investigation of lesion was compatible with periosteal chondroma (Figure 2). Margins of resected tumor material which was send to the pathology laboratory was reported as tumor free. During his post-operative fallow up no complication was occurred, and the patient was discharged 3 days after his surgery. After partial rib resection surgery, patient's symptoms were regressed, and patient had reduced pain. By the time this article was written, 3 months later of patient's surgery, no recurrence of periosteal chondroma was encountered.

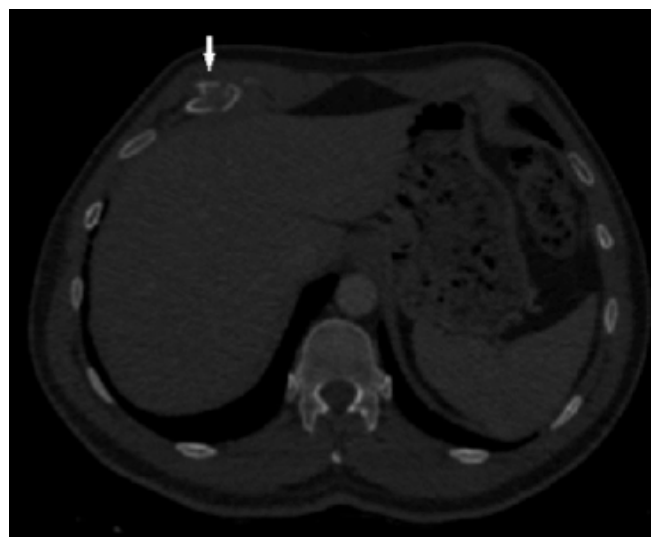


Figure 1. Axial reformation, mediastinal window of CT scan shows a lesion on the surface of rib. This lesion is radiolucent at partial places and in some regions calcification and lobules which have cartilaginous density can be seen. Note the asymmetry of bone and surrounding soft tissue relative to same rib level alignment of opposite sight. Calcification can be seen in the medullary cavities of lesion.

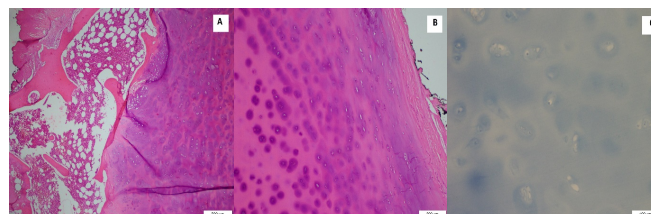


Figure 2. Low-power view showing well differentiated hyaline cartilaginous tumoral mass associated with the bone cortex (H-EX40) (A), low - power showing lobules of hyaline cartilage surrounded by a periost (H-EX100) (B), immunohistochemical IDH-1 showing negativity in chondroid tumor cells. (X200) (C).

Written informed consent was obtained from the patient for publication of his data.

Discussion

Periosteal chondromas are benign hyaline cartilage neoplasm of bone surface that arises beneath of periosteum. According to WHO they are forming less than two percent of all chondromas, and they occur with males outnumbering females by three to two. They are commonly seen in long bones. Typical location for periosteal chondroma is proximal humerus [6]. Since our case was found in unusual location and age, this case report is about to provide unique contribution to literature.

Clinically, periosteal chondromas present as palpable mass generally induce pain and swelling around [3]. Radiological findings of periosteal chondromas are scalloping of adjacent bony cortex, presence of cartilaginous matrix appearing as small dots of calcification and possible soft tissue mass component [7]. Mass caused by periosteal chondroma leads to erosion over the cortical bone seen with radiodensities. Medullary extension is not seen [8]. Gross features include encapsulated, solid masses of glistening white tissue. Periosteum overlay the tumor on its boundaries. The cortex underlies the tumor may thickened, eroded. Size of tumor is generally less than 3 cm in diameter. Histopathologically, periosteal chondroma has a well-defined border with cortex underlies. Matrix is composed of hyaline cartilage. Atypia can be seen in neoplastic cortex from mild to moderate. Although histological features resemble to other chondromas, periosteal chondromas are more cellular [2,3,8].

IDH-1 (isocitrate dehydrogenase 1) mutation has described recently in a wide variety of benign and malignant cartilaginous tumors [9]. Periosteal chondromas have high frequency rate for IDH-1 gene mutation [6]. IDH-1 mutations were detected with a high percentage (6 out of 8) in the study of Amary et al. The overall frequency of IDH1/IDH2 mutations in conventional central and periosteal cartilaginous neoplasms was found to be 56%. Mutation-positive central and periosteal cartilaginous tumors occurred more frequently in the tubular bones of the hands and feet than at other anatomical 90% of the acral-based tumors revealed a mutation, compared to 53.2% of tumors in the long bones of the appendicular skeleton, and 35.1% of those in the flat bones [10]. Other study also support the finding of IDH-1 mutation in periosteal chondromas [11]. When we re-

viewed the literature it has been seen that this mutation status does not have any effect on prognosis. However, IDH-1 inhibitors may have a part in the treatment, since this mutation has a role during tumorigenesis, in the future. In this case immunohistochemical staining studies was performed towards IDH-1 mutation and result was negative.

During differential diagnosis procedure; periosteal chondrosarcoma, periosteal osteosarcoma should be considered by clinicians. Histopathological evaluation and radiography are important to distinguish and clarify final diagnosis. Periosteal osteosarcoma generally has periosteal neoplastic bone formation covering lesion and demonstrates more cytological atypia. Periosteal chondrosarcomas are larger and more cellular, also have more cytological atypia [3]. While evaluating radiology; there are obvious differences that can help us to differentiate periosteal chondroma from periosteal osteosarcomas and periosteal chondrosarcomas. Periosteal chondrosarcomas demonstrate popcorn calcification on radiography whereas periosteal osteosarcoma demonstrates perpendicular spicules of calcification [12]. Since our specimen had well defined border with hyalinized matrix which has no myxoid changes within it and had no hyperchromasia, binucleation or double cells within lacune our final diagnosis was periosteal chondroma, though immunohistochemical staining towards IDH-1 mutation was negative. In addition to that, no invasion to adjacent structures and less cytological atypia supports our diagnosis of periosteal chondroma.

Treatment options for periosteal chondromas are partial resection, total resection and intralesional resection of the lesion. These treatment options seem to be effective and have low recurrence rates [13].

In conclusion, this case report reveals clinical symptoms, histopathological and radiological characteristics, as well as differential diagnosis of periosteal chondroma which was founded at unusual location. For clinicians, while evaluating mass or bone tumor on radiography, considering periosteal chondroma as one of the preliminary diagnosis leads to early and proper surgical treatment for patients. Even though more data are needed, as an etiological factor, blunt trauma to the thorax region may be associated with subsequent periosteal chondroma. Moreover, we believe that our study is about to have unique contribution to current literature by exam-

ining IDH-1 mutation in periosteal chondroma which is found in rare location and unusual age.

Declaration of conflicting interests

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Authors' contributions

CBK, TUK, HS, FECS, EA: conceived and designed the current case report, co-wrote the paper, collected the clinical data. The authors discussed the case under the literature data together and constituted the final manuscript.

References

1. Singh AP, Singh AP, Mahajan S. Periosteal chondroma of the sacrum. *Can J Surg* 2008; 51: E105-6.
2. Greenspan A, Borys D. Radiology and Pathology Correlation of Bone Tumors: A Quick Reference and Review, Wolters Kluwer, 2015 pp 379.
3. Nielsen GP, Rosenberg AE. Diagnostic Pathology: Bone, Elsevier, 2nd ed. 2017 pp 116-119.
4. Anderson MW, Smith SE. Musculoskeletal Imaging Cases. Oxford University Press, Incorporated, 2013 pp 114.
5. Karabakhtsian R, Heller D, Hameed M, Bethel C. Periosteal chondroma of the rib--report of a case and literature review. *J Pediatr Surg* 2005; 40: 1505-7.
6. Bridge JA, Hogendoorn P. WHO Classification of Tumours of Soft Tissue and Bone. Eds: Fletcher CDM, Bridge JA, Hogendoorn PCW. IARC 4th Ed, Vol 5 2013 pp 254.
7. Imura, Y, Shigi A, Outani H, Hamada K, Tamura H, Morii E et al. A giant periosteal chondroma of the distal femur successfully reconstructed with synthetic bone grafts and a bioresorbable plate: a case report. *W J Surg Onchol* 2014; 12: 354.
8. Vigorita VJ, Ghelman B, Mintz D. Orthopaedic Pathology. Wolters Kluwer, 2nd ed, 2015; Chr 7, pp 459.
9. Bleda R, Vasudevaraja V, Patel S, Stafford J, Serrano J, Esposito G et al. Functional and topographic effects on DNA methylation in IDH1/2 mutant cancers. *Sci Rep* 2019; 9: 16830.
10. Amary MF, Bacsí K, Maggiani F, Damato S, Halai D, Berisha F et al. IDH1 and IDH2 mutations are frequent events in central chondrosarcoma and central and periosteal chondromas but not in other mesenchymal tumours. *J Pathol* 2011; 224: 334-43.
11. Panagopoulos I, Gorunova L, Taksdal I, Bjerkehaugen B, Heim S. Recurrent 12q13-15 chromosomal aberrations, high frequency of isocitrate dehydrogenase 1 mutations, and absence of high mobility group AT-hook 2 expression in periosteal chondromas. *Oncol Lett* 2015; 10: 163-7.
12. Inoue S, Fujino S, Kontani K, Sawai S, Tezuka N, Hanaoka J. Periosteal chondroma of the rib: report of two cases. *Surg Today* 2001; 31: 1074-8.
13. Lewis MM, Kenan S, Yabut SM, Norman A, Steiner G. Periosteal chondroma. A report of ten cases and review of the literature. *Clin Orthop Relat Res* 1990; 256: 185-92.

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Case Report

A successfully treated patient with bronchial atresia and tracheal stenosis

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ABSTRACT

Bronchial atresia is one of the rare congenital bronchopulmonary malformations. The affected bronchus is atresic and usually the upper lobe of the left lung is involved and is not connected to the central airways. In this case report, we present the treatment process of a patient with post-intubation tracheal stenosis, left main bronchial stenosis, and an agenesis of left upper lobe bronchus.

Keywords: tracheal stenosis, bronchial stenosis, bronchial atresia

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Introduction

Bronchial atresia is one of the rare congenital bronchopulmonary malformations. Usually, the upper lobe of the left lung is involved and is not connected to the central airways. The affected bronchial system gets filled with mucocoele. Atelectasis, hyperlucency, and hypervascularity are observed on CT of the affected lung [1-3]. In this case report, we would like to present the treatment process of a patient with post-intubation tracheal stenosis, left main bronchial stenosis, and an agenesis left upper lobe bronchus.

Case Report

A 33-year-old female patient was admitted to our clinic with a pre-diagnosis of tracheal stenosis and left lung mass. The patient had been hospitalized in an intensive care unit for nearly a year and was treated for tuberculosis. However, no laboratory data of tuberculosis were found in the patient's file examination. Tracheostomy and bronchoscopy had been performed upon detection of a mass in the upper lobe of the left lung in the examinations of the patient who had developed respiratory distress. Bronchoscopy had showed stenosis in the trachea and a mass lesion that obstructed the left main bronchus almost completely. Biopsy had been performed. No malignancy had been found as a result of biopsy and tuberculosis examination.

When the patient was admitted, she had severe stridor and orthopnea. Thorax CT revealed stenosis in the trachea, total obstruction of the left main bronchus, left upper lobe atelectasis, and adjacent partial pneumothorax (Figure 1).

PET-CT was performed on the patient due to suspicion of malignancy. No abnormal FDG uptake was observed in PET-CT. The stenosis in the trachea area was dilated with rigid bronchoscopy. There was a 4 mm opening through which distal left main bronchus could not be reached. It was dilated by performing balloon dilatation in the left main bronchus. Then, when the distal was reached with bronchoscope, it was observed that there was no left upper lobe bronchus. Biopsies were taken from the left main bronchus and the pathology test result was negative again for malignancy (Figure 2).

Then, in different sessions, rigid bronchoscopy and balloon dilatations were performed on the patient for

4 more times, and the trachea and left main bronchus were dilated. The left upper lobe bronchial orifice was never observed, and it was decided to perform left upper lobectomy on the patient since it was considered to be atretic. During lobectomy, it was observed that the left upper lobe bronchus was atresic and in the form of a band, just as it was observed in bronchoscopy. A mucocoele-like gelatinized liquid was observed to flow through the removed left upper lobe. After thoracotomy, rigid bronchoscopy was performed on the patient again and a stent was placed in the trachea and left main bronchus in the same session (Figure 3). No malignancy was found in the pathological examination of the left upper lobe. The result showed alveolar proteinosis.

After a post-op follow-up for about 12 months with stent, the stents were removed and the patient has no problem as of the 24th month follow-up at present (Figure 4).

Written informed consent was obtained from the patient for publication of her data.

Discussion

Most tracheal stenosis cases are due to intubation, tracheostomy, and chemical or traumatic injuries. It has been reported that it may be due to other inflammatory diseases such as Wegener granulomatosis, connective tissue diseases, sarcoidosis, and tuberculosis. Idiopathic subglottic stenosis commonly seen in women is among the rare causes of tracheal stenosis [1].

Bronchial stenosis together with tracheal stenosis is usually seen in childhood and it is congenital. It is often seen together with additional deformities such as pulmonary artery anomaly, ventricular septal defect, lung hypoplasia, lung agenesis, musculoskeletal anomalies, central nervous system anomalies, genitourinary system anomalies, and gastrointestinal defects [2-4]. There are publications stating that congenital bronchial atresia is the result of bronchial artery occlusion that develops during the fetal period [5]. In this case, there was atresia in the left upper lobe bronchus, stenosis in the left main bronchus, and post-intubation tracheal stenosis. In the history of our patient, there was a treatment in intensive care unit with a pre-diagnosis of tuberculosis for a period of approximately one year. However, no evidence of tuberculosis was found in any specimen taken after the operation. In addition, none of the other anomalies

accompanied by bronchial stenosis and agenesis were seen in our patient.

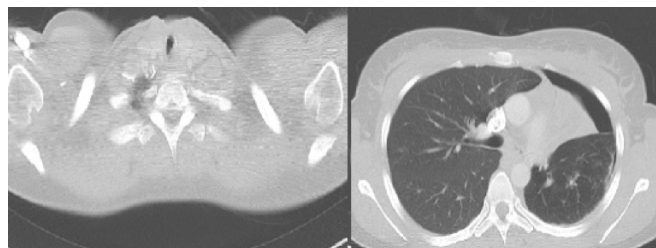


Figure 1. Thorax CT images showing the post-intubation stenosis in the trachea, stenosis in the left main bronchus, total atelectasis in the left upper lobe, and partial pneumothorax.



Figure 2. The stenosis in the left main bronchus, balloon dilatation, and the image after dilatation.

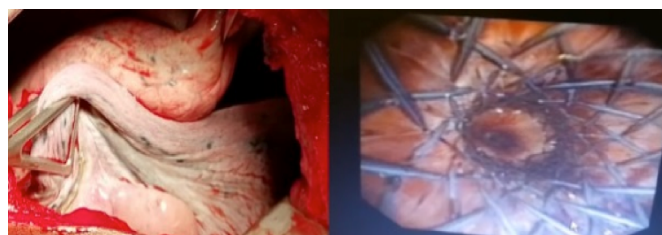


Figure 3. The image of hepatization in the left upper lobe and the stent.

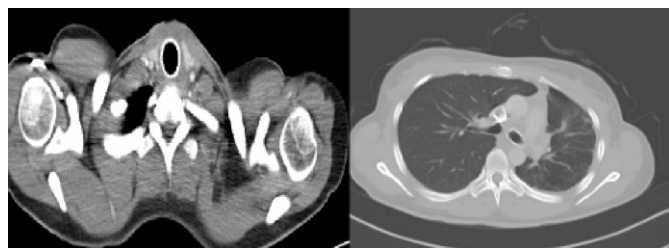


Figure 4. The image taken after surgery and stent procedure. The metal cuffed stent is observed in the left main bronchus and trachea.

Congenital bronchial atresia was first reported by Ramsay in 1953 [6]. Pulmonary agenesis is morphologically categorized according to the presence or absence of bronchial, alveolar, and vascular structures and whether their agenesis is bilateral or unilateral [3]. While the absence of bronchus, lung parenchyma, and vascular structures together is called pulmonary agenesis, the absence of lung parenchyma with rudimentary bronchus is called aplasia, and the presence of a rudimentary lung tissue with rudimentary bronchus is

called pulmonary hypoplasia [7,8]. In our case, besides left main bronchial stenosis, endoscopic and postoperative evaluation did not show a luminal left upper lobe bronchus, but there was an atelectasis lung tissue. As such, it does not comply with the description of the current classifications.

In the evaluation of bronchial malformations, thorax CT angiography and bronchoscopy are the basic diagnostic tests. Sometimes, accompanying cardiac anomalies and anatomical anomalies of pulmonary vascular structures can be clearly identified with angiography performed with cardiac catheterization [3]. In bronchial atresia, air retention due to collateral circulation and a cystic area (bronchocele) distal to the obstructed bronchus may be observed in tomography. Sometimes the parenchyma cannot be observed in cases where the lobe bronchus and parenchyma structure did not develop at all, or it may be the absence of a sequestered parenchymal structure or bronchial and vascular structures [9]. It has been reported that bronchial atresia is mostly seen in the left upper lobe and especially the segmental ones are seen in the apicoposterior segment. PET-CT was performed in one patient with a suspicion of mass and no pathological FDG uptake was observed. It was stated that the appearance of mass in the patient was due to the mucocoele accumulated in the ectatic bronchus in the diaphragm of the atresia bronchus [10]. Common long-term complications seen in bronchial atresia are pneumothorax, recurrent pneumonia, and pulmonary parenchymal deterioration [9]. In this case, the right upper lobe was in total atelectasis. There was a partial pneumothorax adjacent to the atelectatic upper lobe and no pathological FDG uptake was observed on PET-CT due to the appearance of the mass. In our case, the inside of the removed upper lobe was completely filled with mucus accumulation, and a result of alveolar proteinosis was reported after the pathological examination.

Among the causes of acquired bronchial stenosis, reasons such as selective main bronchial intubation, repeated intrathoracic vascular interventions, and cardiovascular stent compression have been stated [2]. In the literature, a patient who developed stricture completely occluding the right main bronchus despite treatment after tuberculosis has been presented. It is stated that with serial balloon dilatations, the total atelectasis of the patient's right lung was opened and the clinical course

improved rapidly [11]. Andrews stated that after tuberculosis, the left bronchial system was totally obstructed by fibrosis due to tuberculosis in one of two cases, and in the other case, the right upper lobe bronchus was obstructed by tuberculosis-related fibrosis [12]. Since this case had a history of tuberculosis treatment in the past, it was the first etiology that came to mind that there might be atresia developing after tuberculosis, however, no microbiological evidence of tuberculosis was found in the past file examination of our case, and no data on tuberculosis was found as a result of the pathological examination of the specimens we obtained.

In conclusion, bronchial atresia is a rare condition. The coexistence of bronchial atresia and stenosis in the trachea and bronchi has not been encountered in the literature. In this case, it is interesting that both lobar bronchial atresia, tracheal stenosis, and stenosis in the left main bronchus were together, and there was no evidence of anomaly in any other accompanying organs and vascular structures in terms of etiopathology. We present this case since the present findings are different from the cases with bronchial anomalies discussed in the literature.

Declaration of conflicting interests

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Authors' contributions

BM, MT: conceived and designed the current case report, co-wrote the paper, collected the clinical data. The authors discussed the case under the literature data together and constituted the final manuscript.

References

1. Aydoğmuş Ü, Yuncu G, Türk F. A case of idiopathic subglottic and bilateral bronchial stenosis. *Turk Thorac J* 2016; 7: 28-31.
2. Schweiger C, Cohen AP, Rutter MJ. Tracheal and bronchial stenoses and other obstructive conditions. *J Thorac Dis* 2016; 8: 3369-78.
3. Joo CU, Song GY, Kim JS. Lobar agenesis of the left upper lung. *J Korean Med Sci* 1990; 5: 233-5.
4. Al-Qadi MO, Reddy DRS, Larsen BT, Iyer VN. Chronic pulmonary aspergillosis complicating bronchial atresia. *Case Rep Med* 2014; doi: 10.1155/2014/208963.
5. Murata S, Oguri T, Sasada S, Tsuchiya Y, Ishioka K, Takahashi S et al. A case of congenital bronchial atresia patient with sub-clinical infection who underwent lung resection. *Resp Med Case Rep* 2020; 30: 101076.
6. Ramsay BH. Mucocoele of the lung due to congenital obstruction of a segmental bronchus. *Dis Chest* 1953; 24: 96-103.
7. Ghaye B, Szapire D, Fanchamps JM, Dondelinger RF. Congenital bronchial abnormalities revisited. *Radiographics* 2001; 21: 105-19.
8. Gupta K, Taneja D, Aggarwal M, Gupta R. Left upper lobar agenesis of lung: a rare case report. *Lung India* 2017; 34: 302-4.
9. Traibi A, Seguin-Givelet A, Grigoriu M, Brain E, Gossot D. Congenital bronchial atresia in adults: thoracoscopic resection. *J Vis Surg* 2017; 3: 174.
10. Demir M, Taylan M, Yılmaz S, Dursun E, Sezgi C, Işık R. Bronchial atresia in an adult misdiagnosed as pulmonary mass. *Tuberk Toraks* 2017; 65: 351-3.
11. Tan GP, Abisheganaden JA, Goh SK, Verma A. Reversible platypnoea-orthodeoxia syndrome in post-tuberculosis bronchial stenosis. *Respirol Case Rep* 2018; 6: e00303.
12. Andrews CH. Bronchial stenosis in pulmonary tuberculosis. *Can Med Assoc J* 1935; 33: 36-41.

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Case Report

Metastatic tracheal tumor palliated with rigid bronchoscopy and argon plasma coagulation: a case report with video presentation

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ABSTRACT

Metastasis of tracheobronchial tree is an infrequent and life-threatening condition. Endobronchial metastasis is rare while endotracheal metastasis is extremely rare entity. Renal cell carcinoma (RCC) constitutes approximately 3% of all adult malignancies and metastasizes 30% cases to organs during the course of the disease. Lung is the most common target organ of RCC metastasis and usually bilateral parenchymal metastases are seen as well as tracheobronchial system. Hemoptysis may be the first manifestation and bronchoscopy is useful for both diagnosis and therapy. Argon plasma coagulation (APC) is a choice of current therapeutic techniques to achieve hemostasis from bleeding endobronchial lesions. Here we report a case of 72-year-old man was suffering hemoptysis due to endotracheal metastasis of RCC diagnosed via rigid bronchoscopy and palliated with APC successfully.

Keywords: tracheal metastasis, tracheobronchial metastases, renal cell carcinoma, argon plasma coagulation, rigid bronchoscopy, hemoptysis

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Introduction

Metastasis of tracheobronchial tree, which originates from either primary bronchogenic carcinoma or a non-pulmonary tumor, is a rare but life-threatening condition. Endobronchial metastasis is rare while endotracheal metastasis is extremely rare entity [1]. Renal cell carcinoma (RCC) constitutes approximately 3% of all adult malignancies and metastasizes to regions such as lungs, liver, bone, brain, adrenals and lymph nodes by hematogenous route in approximately 30% of cases during the course of the disease. Lung is the most common organ of RCC metastasis and usually bilateral parenchymal metastases are seen as well as endobronchial metastases [2]. Hemoptysis may be the first manifestation. Bronchoscopy is useful for both diagnosis and therapy. Argon plasma coagulation (APC) is a choice of current therapeutic techniques to achieve hemostasis from bleeding endobronchial lesions.

Here we report a case of a patient with complaints of hemoptysis, with an endotracheal metastasis from RCC, diagnosed by rigid bronchoscopy and palliated with APC.

Case Report

A 72-year-old man was referred to our clinic due hemoptysis with a history of one month. He had a nephrectomy for renal cell carcinoma, 5 years' ago. He used to smoke for 45 years and stopped for 5 years. Thorax CT showed metastatic masses in both lungs and a round mass in mid-trachea obstructing 3/4 of the lumen (**Video 1**).

The lobulated and fragile endotracheal mass was resected via rigid bronchoscopy for biopsy and lumen opening under general anesthesia (**Video 2**). A catheter was inserted through a fiberoptic bronchoscope and APC is applied for palliation of hemoptysis. During processing, FiO₂ was reduced to 21% for short periods of time (**Video 3**). The patient was discharged the next day with more comfortable breathing and ceased hemoptysis.

Microscopically, the tumor cells were large, the appearance of the cytoplasm clear with sharply outlined boundaries infiltrating the squamous epithelium of trachea. Immunohistochemical examination of the tumor cells showed moderate vimentin, CD10 and PAX 8 staining, and absent for TTF-1 and CK antigen staining. The morphologic and immunohistochemical features were consistent with metastatic clear type renal cell carcinoma (Figures 1,2). He was referred to the oncology clinic for appropriate systemic treatment.

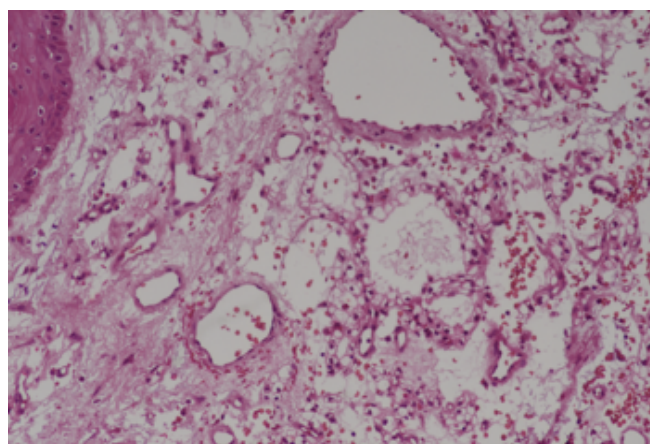


Figure 1. Invasion of clear cell carcinoma cells in the trachea lined with squamous epithelium (HEX10).

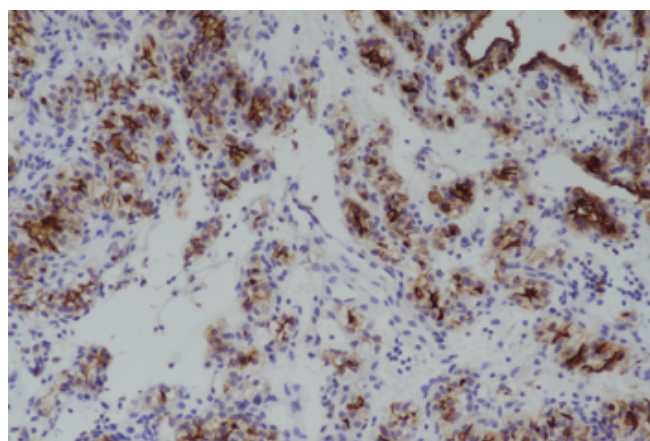


Figure 2. Positive staining with CD10 in tumor cells in immunohistochemical examination.

Written informed consent was obtained from the patient for publication of his data.

Discussion

The lungs are the second most common site for solid tumor metastasis with parenchyma and pleura usually being involved. Metastasis of tracheobronchial tree is rather less common and often overlooked [1,3]. Sorenson et al. reported that the trachea was involved in only 5% of all tumors in the respiratory tree [3]. The origin of endotracheal or endobronchial metastasis may be various solid tumors. In a series of 83 metastatic tracheobronchial tumor patients, thyroid, kidney, esophagus and lymphoma are common primary tumors [3]. Tracheal metastatic lesions were mostly originated by intrathoracic tumors (i.e., thyroid and esophagus). Lung cancer can also be seen as endotracheal synchronous/metachronous metastasis, except for direct invasion [3-5]. In a review which published a 39-year series of 2242

secondary tracheal tumors, 92.6% (n = 1.853) were tracheal invasion of adjacent intrathoracic organs, and only 17.4% (n = 389) of cases were distant organ metastasis with hematogenous spread.

The most common primary sites of tumor were thyroid, esophagus and lung in the intrathoracic group whereas colorectal carcinoma, breast and melanoma metastasis were widely seen in the distant metastatic group [1,3-6]. Shavit et al reported a case of RCC metastasis of trachea the first time in 2002 [7]. In the series of 550 interventional bronchoscopic cases published by Tsuboi et al in 2016, 9 cases were RCC tracheobronchial metastases, and tracheal metastases were reported in 4 of them [8].

Renal cell carcinoma is the ninth most common cancer worldwide and accounts for 2% to 3% of all malignant tumors in adults. During the course of the disease, it metastasizes to regions such as lungs, liver, bone, brain, adrenals and lymph nodes by hematogenous route in approximately 30% of cases. Lungs are the most common target organ of RCC metastasis [2]. Although it is generally seen as bilateral parenchymal metastasis, it could be also seen as tracheobronchial metastasis in a less common way [1,3,7].

Presenting symptoms of tracheal metastases are dyspnea, stridor, cough, and hemoptysis [1,3,9]. In our patient hemoptysis was the only symptom despite the stenosis in the trachea.

Contrast-enhanced computed tomography (CT) and/or magnetic resonance imaging are important in diagnosis as they emphasize the vascular nature of the metastatic tumor. However, a small endoluminal lesion may be confused with phlegm accumulation and overlooked. Sometimes it can only be diagnosed as a metabolic activity on PET/CT, even if there is no image on CT [10].

Biopsy from the lesion provides more accurate diagnosis while risk of bleeding and airway obstruction must be kept in mind during bronchoscopy. RCC and its endobronchial metastases are frequently hypervascular and hemorrhagic tumors. Rigid bronchoscopy should be a priority in tracheal lesions because of its large working hole, allowing the use of interventional instruments, opening the tracheal lumen by taking off larger pieces, and the possibility of powerful aspiration. However, flexible bronchoscopy may also be necessary for detailed images, cleaning of the distal airways, and

the use of instruments such as cryotherapy and APC. Despite all these precautions in case of abundant bleeding, it is a life-threatening situation; a surgical team and a thoracotomy set should be prepared for further operations. Inflating the cuff of the endobronchial tube over the lesion can provide a valid airway and will be a time-saving maneuver. Classical methods (ice sludge, adrenaline saline, cryotherapy, cautery, etc.) may be useful in milder hemorrhages. APC is a technique that can control bleeding instantly without penetrating into deep tissues. The coagulation is achieved with shots made without touching which also has the ability to kill tumor cells [9,11].

Since renal cell carcinoma has traditionally been defined as a radio resistant tumor, surgical excision or other methods are rather beneficial in cases of endobronchial or endotracheal metastasis. New immunotherapy agents are also applied in the treatment of metastatic renal cell carcinoma with promising perspectives [12].

In conclusion, a variety of solid malignancies may metastasize to the tracheobronchial tree. Tracheal metastasis is rare but life-threatening conditions due to tracheal stenosis and hemoptysis. Rigid and flexible bronchoscopy should be used together while the patient is under general anesthesia, and be prepared for the risk of massive bleeding. APC provides a safe hemostasis in bleeding endobronchial tumors when performed by experienced hands. Therapeutic bronchoscopy in such cases can contribute to the quality of life and may impact survival.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Authors' contributions

ABK, ANK: conceived and designed the current case report, co-wrote the paper, collected the clinical data. The authors discussed the case under the literature data together and constituted the final manuscript.

References

1. Madariaga ML, Gaissert HA. Secondary tracheal tumors: a systematic review. *Ann Cardiothorac Surg* 2018; 7:183-196.

2. Arora RD, Limaïem F. Renal clear cell cancer. 2021. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. PMID: 33085377.
3. Sorensen J.B. Endobronchial metastases from extrapulmonary solid tumors. *Acta Oncol* 2004; 43: 73-9.
4. Karakattu S, Yorke J, Hoskere T, Stewart L, ElMinaoui W. A rare case of multiple secondary endotracheal metastasis from early stage small cell cancer. *Respir Med Case Rep* 2020; 30: 101103.
5. Zhang Z, Mao Y, Chen H, Dong J, Yang L, Zhang L et al. Endotracheal and endobronchial metastases in a patient with stage I lung adenocarcinoma. *Ann Thorac Surg* 2014; 97: e135-7.
6. Choi IY, Lee KY, Lee JH, Je BK, Shin JS, Um JW et al. Tracheal metastasis from rectal cancer: a case report and review of the literature. *Balkan Med J* 2013; 30: 120-2.
7. Shavit L, Maly B, Rosenbaum E, Grenader T. Endotracheal metastases in renal cell carcinoma: A life-threatening but treatable complication. *Eur J Intern Med* 2007; 18: 161-3.
8. Tsuboi R, Oki M, Saka H, Kogure Y, Oka S, Nakahata M et al. Rigid bronchoscopic intervention for endobronchial metastasis of renal cell carcinoma *Respir Investig* 2016; 54: 250-4.
9. Chousein EGU, Turan D, Özgül MA, Çetinkaya E. Secondary pulmonary malignancies requiring interventional bronchoscopic procedures. *Turk Gogus Kalp Dama* 2021; 29: 360-9.
10. Park CM, Goo JM, Lee HJ, Kim MA, Lee CH, Kang MJ. Tumors in the tracheobronchial tree: CT and FDG PET features. *Radiographics* 2009; 29: 55-71.
11. Sancho-Chust JN., Viedma EC, Tomas RM, Vives EC. Argon plasma coagulation for management of hemoptysis in endobronchial metastasis from soft-tissue sarcoma. *Respir Med Case Rep* 2019; 28: 100919.
12. Hoshal SG, Wickwire PC, Gandour-Edwards RF, Rajappa P, Cates DJ. Metastatic renal cell carcinoma presenting as a rapidly enlarging endotracheal mass due to hyperprogression on Anti-PD1 Immunotherapy. *Ear Nose Throat J* 2020. doi: 10.1177/0145561320931215.

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whether individual deidentified participant data (including data dictionaries) will be shared,

what data in particular will be shared,

whether additional, related documents will be available (e.g., study protocol, statistical analysis plan, etc.),

when the data will become available and for how long,

by what access criteria data will be shared (including with whom, for what types of analyses, and by what mechanism).

Authors must provide a data-sharing statement at submission to indicate whether data will be shared according to the statements written above.

Please visit <http://www.icmje.org/icmje-recommendations.pdf> that provides illustrative examples of data sharing statements that would meet these requirements.

Authors of secondary analyses using shared data must attest that their use was in accordance with the terms (if any) agreed to upon their receipt. They must also reference the source of the data using its unique, persistent identifier to provide appropriate credit to those who generated it and allow searching for the studies it has supported. Authors of secondary analyses must explain completely how theirs differ from previous analyses. In addition, those who generate and then share clinical trial data sets deserve substantial credit for their efforts. Those using data collected by others should seek collaboration with those who collected the data. As collaboration will not always be possible, practical, or desired, the efforts of those who generated the data must be recognized.

Statistical Knowledge

The statistical method used should be reported in a way that a reader whoever could reach the original data could understand the results. The terms used, abbreviations, symbols, the pc programme used and the statistical method should all be defined.

When reporting the results, especially when giving means and percentages, two digits should be given after the comma (112.20 or 112.21 instead of 112.2). P, t, Z values are exceptional and three digits should be given after the comma ($p = 0.001$, instead of $p < 0.05$).

Submission Process

Briefly, except whole numbers, two digits after the comma should be given, but for statistical values like p,t,z,F,Chi-square, three digits after the comma should be given. When presenting p values, the exact p value together with the test statistics should be given, except for the case when this value is smaller than one percent or one per thousand (this time $p < 0.01$ or $p < 0.001$, respectively should be given).

Preparation of Manuscript

Cover Letter

The Current Thoracic Surgery requires authors to disclose in the “cover letter” any commercial association (eg, employment, direct payments, stock holdings, retainers, consultantship, patent licensing arrangements, or honoraria) that might pose a conflict of interest issue concerning the manuscript. All funding sources supporting the work should be acknowledged in a footnote. Also authors should mention that none of the material in the manuscript has been published previously, and that none of this material is currently under consideration for publication elsewhere. This includes symposia, transactions, books, articles published by invitation, and preliminary publications of any kind except an abstract of 400 words or fewer.

Style and Format

Manuscripts should be double-spaced with 3-cm margins on all sides of the page, in Times New Roman font. Every page of the manuscript, including the title page, references, tables, etc., should be numbered. All copies of the manuscript should also have line numbers starting with 1 on each consecutive page.

Symbols, Units and Abbreviations

In general, the journal follows the conventions of Scientific Style and Format, The CSE Manual for Authors, Editors, and Publishers, Council of Science Editors, Reston, VA, USA (7th ed.). If symbols such as $\times$, μ , η , or v are used, they should be added using the Symbols menu of Word. Degree symbols ($^{\circ}$) must be used from the Symbol menu, not superscripted letter o or number 0. Multiplication symbols must be used ($\times$), not the letter x. Spaces must be inserted between numbers and units (e.g., 3 kg) and between numbers and mathematical symbols (+, -, $\times$, =, <, >), but not between numbers and percent symbols (e.g., 45%). Please use SI units. All abbreviations and acronyms should be defined at first mention. Latin terms such as *et al.*, *in vitro*, or *in situ* should not be italicized.

Manuscript Content

Research articles should be divided into the following sections. Principal sections should be Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References sections. Please see below for information about other types of manuscripts.

Title and Contact Information

The first page should contain the full title in sentence case, the full names (last names fully capitalized) and affiliations (in English) of all authors (University, Faculty, Department, City, Country), and the contact address and e-mail for the clearly identified corresponding author.

Abstract

An informative abstract of not more than 250 words must accompany each manuscript. The abstract must be structured to include the study's background, materials and methods, results, and conclusions and key words under 5 separate headings. Abstracts of review articles should be a brief overview of the main points from the review.

Keywords

Please provide at least 3 key words or phrases to enable retrieval and indexing. Acronyms should be avoided.

Always try to use terms from the Medical Subjects Headings (MeSH) list from PubMed <https://www.ncbi.nlm.nih.gov/pubmed>.

Introduction

This should argue the case for your study, outlining only essential background, and should not include the findings or the conclusions. It should not be a review of the subject area, but should finish with a clear statement of the question being addressed.

Materials and Methods

Explain clearly but concisely your clinical, technical, or experimental procedures. Previously published papers related to the methods should be cited with appropriate references. Brand names and company locations should be supplied for all mentioned equipment, instruments, chemicals, etc.

Results

Findings must be described without comment. The same data or information given in a Table must not be repeated in a Figure and vice versa. It is not acceptable to repeat extensively the numbers from Tables in the text or to give lengthy explanations of Tables or Figures.

Discussion

Statements from the Introduction and Results sections should not be repeated here. The final paragraph should highlight the main conclusions of the study. Names of funding organizations should be written in full.

References

In the text, references should be identified using numbers in square brackets in which they appear consecutively. The titles of journals should be abbreviated according to the style used in Index Medicus. A general guide limit the number of references to 25 for original articles, to 6 for case reports and to 85 for reviews. For articles with 1 to 6 authors, list all authors. For articles more than 6 authors, list the first 6 authors followed by “et al.”. Do not use individual sets of parentheses for citation numbers that appear together, e.g., [2,3,5-9], not [2],[3],[5]–[9]. For other styles of publication or Internet articles, see [http:// www. nlm.nih.gov/ bsd/ uniform_ requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html) References should be formatted as follows (please note the punctuation and capitalization)

Journal titles should be abbreviated according to ISI Web of Science abbreviations. Authors are solely responsible for the accuracy and completeness of references.

Articles in Journals

Özpolat B, Gürpınar ÖA, Ayva EŞ, Gazyağcı S, Niyaz M. The effect of Basic Fibroblast Growth Factor and adipose tissue derived mesenchymal stem cells on wound healing, epithelization and angiogenesis in a tracheal resection and end to end anastomosis rat model. *Türk Gogus Kalp Dama* 2013; 21: 1010-9.

For other styles of publication or Internet articles, see [http:// www.nlm.nih.gov/bsd/uniform_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)

Tables and Figures

All illustrations (photographs, drawings, graphs, etc.), not including tables, must be labeled “Figure.” Figures must be submitted both in the manuscript and as separate files.

All tables and figures must have a caption and/or legend and be numbered (e.g., Table 1, Figure 2), unless there is only one table or figure, in which case it should be labeled “Table” or “Figure” with no numbering. Captions must be written in sentence case (e.g., Macroscopic appearance of the samples.). The font used in the figures should be Times New Roman. If symbols such as $\times$, μ , η , or v are used, they should be added using the Symbols menu of Word.

All tables and figures must be numbered consecutively as they are referred to in the text. Please refer to tables and figures with capitalization and unabbreviated (e.g., “As shown in Figure 2...”, and not “Fig. 2” or “figure 2”). The tables and figures themselves should be given at the end of the text only, after the references, not in the running text.

The resolution of images should not be less than 118 pixels/cm when width is set to 16 cm. Images must be scanned at 1200 dpi resolution and submitted in jpeg or tiff format. Graphs and diagrams must be drawn with a line weight between 0.5 and 1 point.

Graphs and diagrams with a line weight of less than 0.5 point or more than 1 point are not accepted. Scanned or photocopied graphs and diagrams are not accepted.

Charts must be prepared in 2 dimensions unless required by the data used. Charts unnecessarily prepared in 3 dimensions are not accepted.

Figures that are charts, diagrams, or drawings must be submitted in a modifiable format, i.e. our graphics personnel should be able to modify them. Therefore, if the program with which the figure is drawn has a “save as” option, it must be saved as *.ai or *.pdf. If the “save as” option does not include these extensions, the figure must be copied and pasted into a blank Microsoft Word document as an editable object. It must not be pasted as an image file (tiff, jpeg, or eps) unless it is a photograph.

Tables and figures, including caption, title, column heads, and footnotes, must not exceed 16×20 cm and should be no smaller than 8 cm in width. For all tables, please use Word’s “Create Table” feature, with no tabbed text or tables created with spaces and drawn lines. Please do not duplicate information that is already presented in the figures.

Tables must be clearly typed, each on a separate sheet, and double-spaced. Tables may be continued on another sheet if necessary, but the dimensions stated above still apply.

Instruction to Reviewers

The Current Thoracic Surgery is a current periodical, peer-reviewed and open access official e- journal of the Turkish Society of Thoracic Surgery which its funded and published three times annually. In April, August and December.

The language of the journal is English.

The Current Thoracic Surgery is dedicated to publishing clinical research, clinical analysis, laboratory and experimental studies, editorials, invited current reviews, case reports, interesting images and “How to Do It” papers.

The journal is based on independent and unbiased double-blinded peer-reviewed principles. Only unpublished papers that are not under review for publication elsewhere can be submitted. Current Thoracic Surgery does not accept multiple submission and duplicate submission even though the previous one was published in a different language. The authors are responsible for the scientific content of the material to be published. The Current Thoracic Surgery reserves the right to request any research materials on which the paper is based.

The Current Thoracic Surgery encourages and enables academicians, researchers, specialists to publish their valuable research in branches of general thoracic surgery, thoracic disease and thoracic surgery anesthesia. The primary aim of the journal is to publish original articles with high scientific and ethical quality and serve as a good example of medical publications in the World.

The Editorial Board of the Current Thoracic Surgery and the Publisher adheres to the principles of the International Council of Medical Journal Editors (ICMJE), the World Association of Medical Editors (WAME), the Council of Science Editors (CSE), the Committee on Publication Ethics (COPE), the US National Library of Medicine (NLM), the World Medical Association (WMA), the US Office of Research Integrity (ORI), the European Association of Science Editors (EASE), and the International Society of Managing and Technical Editors (ISMTE).

All articles are available in PDF format on our website ([www.http://cts.tgcd.org.tr/](http://cts.tgcd.org.tr/)) and can be downloaded free of charge.

All articles submitted for publication are strictly reviewed for their originality,
methodology,
importance,
quality,
ethical nature and,
suitability for the journal

The Current Thoracic Surgery uses a well-constructed scheme for the evaluation process.

The overall rejection rate of the Current Thoracic Surgery is 29%.

The average time during which the preliminary assessment of manuscripts is conducted is 4 days.

The average time during which the reviews of manuscripts are conducted is 41 days.

The average time in which the article is accepted for publication is 59 days.

The entire submission process for a manuscript is completed online through the self-explanatory online submission system.. The reviewers can reach their personal pages from the same address with their own passwords.

Manuscripts that comply with the main rules of the journal are sent to at least two external reviewers, and the reviewers are asked for their opinion about the suitability of the paper for publication. The reviewed manuscripts are then re-reviewed by the Editor in Chief and the Editorial Board and a decision of rejection or acceptance is shaped.

If the reviewers have any **potential competing interests**, they must notify the editor before agreeing to review a submission.

The Current Thoracic Surgery is committed to the highest standards of **research and publication ethics**. Editors will act in accordance with the relevant international rules of publication ethics (i.e., COPE guidelines, ICMJE Recommendations, CSE White Paper on Publication Ethics, CSE White Paper on Publication Ethics, WAME resources, WMA policies and ORI) if any ethical misconduct is suspected. The Editorial Board of the Current Thoracic Surgery encourages reviewers to comment on possible research or publication misconduct such as unethical research design, duplication, plagiarism, etc.

Plagiarism is a serious problem and the most common ethical issue afflicting medical writing. Current Thoracic Surgery does not allow any form of plagiarism. In accordance with our journal policy, submitted manuscripts are screened with plagiarism software to detect instances of overlapping and similar text (iThenticate and others) at least two times (during the evaluation process and after acceptance). If the reviewers have any suspect, the editors can provide them information obtained by plagiarism screening tools.

An **approval of research protocols by an ethics committee** in accordance with international agreements (“WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects (last updated: October 2013, Fortaleza, Brazil)”, “Guide for the care and use of laboratory ani-

mals (8th edition, 2011)” and/or “International Guiding Principles for Biomedical Research Involving Animals (2012)” is required for all research studies. If the submitted manuscript does not include ethics committee approval, it will be reviewed according to COPE’s guideline (Guidance for Editors: Research, Audit and Service Evaluations). If the study should have ethical approval, authors will be asked to provide ethical approval. If they cannot provide ethical approval, their manuscript will be rejected and also their institutions and when needed, the related bodies in their country will be informed that such studies must have ethics committee approval. If the study does not need ethics committee approval after the editorial board’s review, the authors will be asked to provide an ethics committee approval or a document given by a related independent committee that indicates the study does not need ethics committee approval according to the research integrity rules in their country. If the authors provide either an approval or a document showing that ethics approval is not needed, the review process will continue. If the authors cannot provide either documents, the manuscript will be rejected. For articles concerning experimental research on humans, a statement should be included that shows informed consent of patients and volunteers was obtained following a detailed explanation of the procedures that they may undergo.

Informed consent must also be obtained for case reports.

All recognizable photographs of a patient must be accompanied by written permission from the patient for reproduction. Procedures that were performed to eliminate any pain, harm and distress in subjects/animals should clearly be stated. The authors should clearly state their compliance with internationally accepted guidelines and the guidelines issued by the relevant authority of their country. The journal requests a copy of the Ethics Committee Approval received from the relevant authority.

The Current Thoracic Surgery wants reviewers to treat the manuscripts in confidence. The material of the manuscripts must not be used or shared in any way until they have been published. The Current Thoracic Surgery follows the COPE flowchart in cases of suspected reviewer misconduct. Please refer to COPE ethical guidelines for peer reviewers for “Basic principles to which peer reviewers should adhere” and “Expectations from reviewers”

Our reviewers are expected to check that the articles comply with the SAGER guidelines and encourage authors to do so. Authors should use the terms sex (biological attribute) and gender (shaped by social and cultural circumstances) carefully in order to avoid confusing both terms. Article titles and/

or abstracts should indicate clearly what sex(es) the study applies to. Authors should also describe in the background, whether sex and/or gender differences may be expected; report how sex and/or gender were accounted for in the design of the study; provide disaggregated data by sex and/or gender, where appropriate; and discuss respective results. If a sex and/or gender analysis was not conducted, the rationale should be given in the discussion.

The Current Thoracic Surgery uses bibliographic databases and also accepts authors’ suggestions to find new reviewers. The journal thanks to the reviewers and publishes the reviewer list every year in the last issue.

Besides the routine questions given at the reviewers’ comment page, the reviewers can also use the questions below, when reviewing the manuscripts:

1. Please do state if any conflict(s) of interest is present to review this manuscript.
2. Do you suspect any research or publication misconduct?
3. Does the manuscript contain significant information to justify publication?
4. Is the title of the article appropriate?
5. Does the abstract clearly and accurately describe the content of the article?
6. Is the problem significantly and concisely stated?
7. Are the methods of the study described comprehensively?
8. Is the results section clear and satisfactory?
9. Are the interpretations and conclusions justified by the results?
10. If adequate and current references were given?
11. Is the terminology used in the text appropriate for a medical writing?
12. Are the figure/table legends satisfactory?
13. Is it necessary to shorten/elongate the article sections?

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