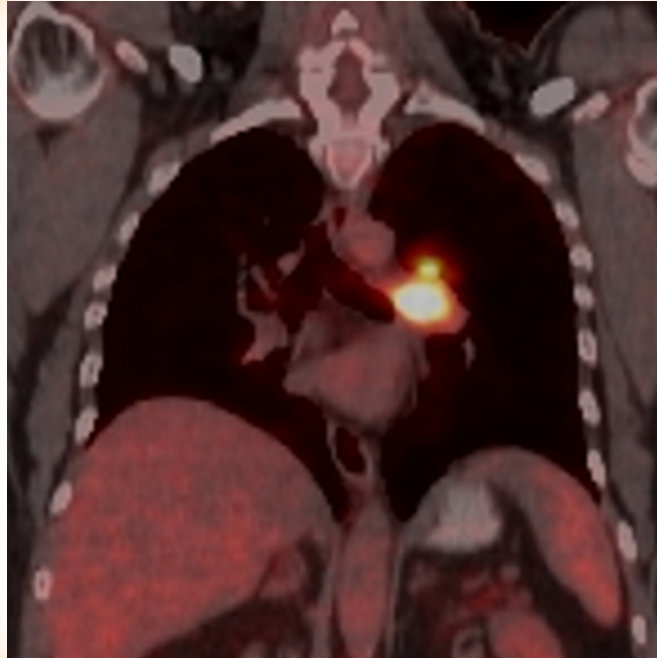


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Original Article

Uniport VATS versus biport VATS in treatment of spontaneous pneumothorax

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ABSTRACT

Background: To enhance postoperative outcomes in patients having video- assisted thoracic surgery (VATS) for spontaneous pneumothorax, it is necessary to determine the difference between the uses of each VATS treatment in such patients. Previous studies have revealed a discussion over the preference of one technique over the other.

Materials and Methods: A comparative study was conducted on spontaneous pneumothorax patients (primary or secondary) undergoing VATS in Assiut University Heart Hospital from January 2017 till April 2019. Patients included in our study were prominent bullous forms in PSP pneumothorax lines, recurrent pneumothorax, bilateral pneumothorax, previous history of contralateral pneumothorax, and spontaneous hemothorax, air leakage more than five days with drainage catheter for first-episode patients. Patients were divided into two groups as group A patients who underwent uniport VATS procedure, and group B patients who underwent biport VATS procedure.

Results: The study included 32 patients, 22 were primary spontaneous pneumothorax (PSP), while 10 were secondary spontaneous pneumothorax (SSP). The male to female ratio (MF ratio) was 3.2:1. The mean $\pm$ SD for age was 30.04 ± 10.245 in PSP and was 50.43 ± 9.071 in SSP. Eighteen patients underwent uniport VATS, and 14 underwent biport VATS. The mean time for operation was 81.5 ± 33.74 in uniport VATS versus 109.79 ± 25.37 in biport VATS ($p = 0.014$). No significant statistical difference was found between uniport and biport VATS regarding pain, air leak, complications, hospital stay, recurrence, and mortality. Despite no statistical difference regarding mortality ($p = 0.492$), there were two mortalities in the uniport VATS group known as interstitial pulmonary fibrosis.

Conclusions: We concluded that there are no differences between both techniques except for operative time.

Keywords: pneumothorax, video- assisted thoracic surgery, uniport, multiport

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Introduction

Pneumothorax is a collection of air within the pleural sac; the incidence was reported to be 37 per 100,000 population per year in the United Kingdom. The incidence differs between men and women, being lower in women due to the 6:1 male to female ratio. The primary issue is a recurrence, which occurs at a rate of between 20% and 50%. The majority of recurrences occur during the first year [1,2].

Pneumothorax can be classified into spontaneous and non-spontaneous. The spontaneous type is classified into primary (PSP) and secondary (SSP) [3]. The PSP is usually diagnosed in young males, smokers, and tall with no underlying lung disease, while the secondary type is usually diagnosed in older males with a previous history of lung diseases, mostly chronic obstructive pulmonary diseases (COPD). However, PSP occurrence in patients without underlying lung diseases, there are pathological changes in the lung known as emphysema-like changes (bullae/ blebs) [4].

Management of pneumothorax focuses on evacuating air from the pleural space to restore lung function and prevent further recurrences. Management options range from less invasive methods as simple observation, simple aspiration (with a catheter, with immediate removal of the catheter after pleural air is evacuated), insertion of a chest tube, and pleurodesis to more invasiveness, including video- assisted thoracic surgery (VATS) and thoracotomy. The approach selection depends on the size of the pneumothorax, the severity of symptoms, whether there is a persistent air leak, and whether the pneumothorax is primary or secondary [5-7]. The choice of surgical approach is a debate despite the statement of ERS (European Respiratory Society) for pneumothorax, which stated that VATS is the gold standard for surgery, yet the choice of VATS approaches, whether uniportal or multiport, fails to have a consensus. We assume that using uniportal VATS will encourage more patients to have their surgery performed as incision will be the chest tube size only and will get them the same clinical outcomes.

Material and Methods

This is a comparative study included a total coverage of all patients who are presented to our hospital for surgery for spontaneous pneumothorax, whether primary or secondary starting from January 2017 to April 2019,

and who fulfilled the inclusion criteria after filling the informed consent and ethical committee approval of Assiut University, Faculty of Medicine (No:17200669). Patients with evident bullous forms in PSP pneumothorax lines, recurrent pneumothorax, bilateral pneumothorax, previous history of contralateral pneumothorax, and air leakage for more than five days with drainage catheter for first-episode patients are all eligible. Patients who met the inclusion criteria will be divided into two groups: group (A) patients underwent uniport VATS procedure, and group (B) patients underwent multiport VATS procedure. Exclusion criteria included the patient's refusal or reoperation case (for other thoracic diseases rather than pneumothorax).

Preoperative variables include age, gender, smoking history, associated comorbidities, addiction history, the indication of surgery, the presence of morbidities (e.g., diabetes mellitus, systemic steroid intake, collagen, and autoimmune diseases and/or cardiac diseases), chest tube insertion (either applied or not before operation), duration of air leakage in patients with the intercostal tube. Intervention variables include date and time of surgical intervention, the procedure performed (uniport VATS, multiport VATS), intraoperative findings (i.e., pleural adhesions visible bleb, site of the bleb, clotted hemothorax etc.), surgical technique used, i.e., staplers, conventional sutures or ligation, operative time (from port opening/ trocar insertion to skin closure), and method of pleurodesis (apical pleurectomy, pleural abrasions, or chemical pleurodesis). Post-intervention variables include post-operative pain score and need for opioid analgesics, duration of air leakage, complications (wound infection, recurrence, and need for intensive care unit admission), hospital stay, and morbidity and mortality.

Statistical Analysis

Data were collected from operative notes on the institutional data base on excel sheath. IBM SPSS version 22.0 (IBM Corporation -<http://www.spss.com>) was used for data analysis. Mean, standard deviation, median, frequency, and percentage were used as descriptive statistics for demographic data such as age, gender and other variables as smoking, diagnosis, and addiction history. Mann Whitney-test was used as non-parametric test of significance for comparison between two sample means. Fisher's exact and Monte Carlo exact tests were used to analyze categorical variables. P-value was considered statistically significant when it was less than 0.05.

Results

During the study time frame, about 121 patients diagnosed with pneumothorax were admitted to our university hospital. Around 79 of them were treated conservatively via aspiration and/or chest tube, and 42 patients underwent surgery for pneumothorax. We found that 32 patients during the period of the study were eligible for inclusion criteria and underwent VATS wedge resection and mechanical pleurodesis for spontaneous pneumothorax (Primary spontaneous pneumothorax PSP ($n = 22$) and Secondary spontaneous pneumothorax SSP ($n = 10$) by uniport or multiport technique according to surgeon preference (Figure 1).

The male to female ratio (MF ratio) was 3.2:1. The mean $\pm$ SD for age was 30.04 ± 10.25 in PSP and was 50.43 ± 9.07 in SSP. While 75% were smokers, all of them were males, and 25% were nonsmokers. We encountered that 31.2% had associated comorbidities (eight cases have chronic obstructive pulmonary diseases (COPD) (25%), and two cases with interstitial pulmonary fibrosis (6.3%) (Table 1). Thirty cases were unilateral (21 cases right, and nine cases left), and two were bilateral.

Uniport VATS technique was performed in 56.3%, while the multiport technique was performed in 43.8%. In cases that performed in the uniport group, three cases were addicted, while no cases were addicted in multiport technique, the addicted cases were using tramadol (one case), hashish (one case), and both opiate and tramadol (one case).

All cases underwent stapling at the base of bleb or bullae, with two cases need the addition of suture to the stapler line due to stapler failure, which was complete or partial (6.3%). The resection was for apical bleb/bullae in all cases (100%), with one case needed resection for another posterior segmental bleb in the upper lobe (3.1%), and one case with superior segmental blebs in the lower lobe (3.1%). Surgical pleurodesis was performed in all cases with two different methods, first was pleurectomy (43.8%) which was performed at the beginning of the experience with the VATS technique, and the second pleural abrasion was performed by brushing the parietal pleura (56.3%).

The mean operative time (minutes) was 81.5 ± 33.74 in uniport technique versus 109.79 ± 25.37 in multiport technique with a significant statistical difference ($p = 0.014$).

Postoperative complications were reported in 15.6% of all cases. Complications were reported in three cases in the uniport technique versus two cases in the multiport

technique with no statistical significance ($p = 0.672$). The complicated cases in uniport technique were SVT (supraventricular tachycardia) ($n = 1$, 5.6%) which need intensive care unit admission for two days, recurrence ($n = 1$, 5.6%), wound dehiscence ($n = 1$, 5.6%). The recurrence was reported in patients with bilateral pneumothorax, which occurred after seven days of discharge and was managed conservatively with no need for another intervention. The wound dehiscence was noticed in patients with interstitial pulmonary fibrosis (IPF) on corticosteroids treatment perioperatively. In the multiport group, complications were prolonged air leak ($n = 1$, 7.1%) and conversion to open thoracotomy due to complete stapler failure ($n = 1$, 7.1%).

Regarding pain scores, it was found that there was an insignificant relationship ($p = 0.386$) between both groups. Moreover, it was found that the mean duration (in days) of air leak was (3.50 ± 1.80) in the uniport technique, while it was (3.64 ± 3.59) days, in multiport technique, which was statistically insignificant ($p = 0.289$). Relatively, the mean duration of the intercostal tube was (4.22 ± 1.48) days, after the uniport technique compared to multiport technique (4.79 ± 3.47) days, which also statistically insignificant as $p = 0.538$ (Table 2).

The postoperative stay was measured in days, and the mean was statistically insignificant among the compared groups ($p = 0.466$). Mortality was reported in two patients among the group of uniport VATS technique (11.1%), while no mortality was reported in multiport technique, which indicated no statistically significant difference ($p = 0.492$). The two mortality patients were patients with interstitial pulmonary fibrosis (IPF).

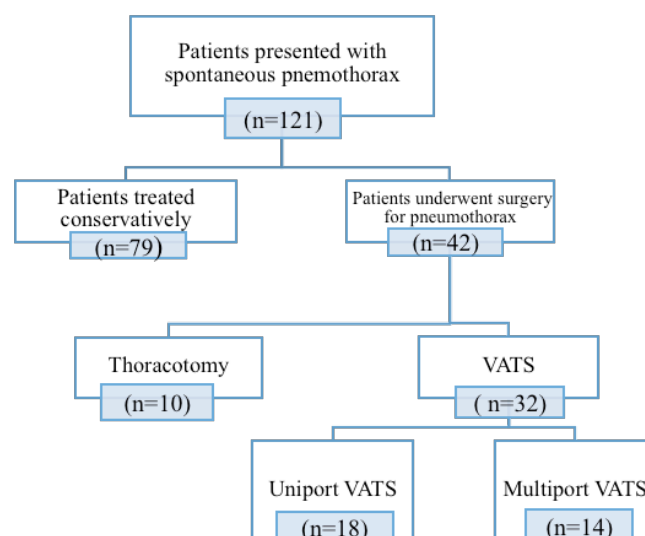


Figure 1. Algorithm for the number of studied patients.

Table 1. Demographic data distribution in uniport and multiport VATS techniques.

Variable	Uniport (n= 18)		Multiport (n=14)		p
Age (Mean ± SD)	31.6±11.6		38.93±13.89		0.123
Diagnosis					
Primary spontaneous pneumothorax	14	77.8	8	57.1	0.267
Secondary spontaneous pneumothorax	4	22.2	6	42.9	
Smoking					
Yes	12	66.7	12	85.7	0.412
No	6	33.3	2	14.3	
Addiction					
Yes	3	16.7	0	0.0	0.238
No	15	83.3	14	100.0	

Table 2. Postoperative outcomes.

Variable	Uniport (n= 18)		Multiport (n=14)		p
Operative time(minutes) Mean $\pm$ SD	81.5	33.74	109.79	25.37	0.014
Complication					
Converted (stapler failure)	0	0.0	1	7.1	0.745
SVT and ICU	1	5.6	0	0.0	
Recurrence	1	5.6	0	0.0	
Prolonged air leak (15)	0	0.0	1	7.1	
Wound dehiscence	1	5.6	0	0.0	
No	15	83.2	12	85.8	
Pain score Mean $\pm$ SD	4.44	1.72	3.93	1.54	0.386
Air leak duration (days) Mean $\pm$ SD	3.50	1.80	3.64	3.59	0.289
Intercostal tube duration (days) Mean $\pm$ SD	4.22	1.48	4.79	3.47	0.538
Post-operative stay (days) Mean $\pm$ SD	5.56	2.01	5	2.18	0.466
Mortality	2	11.1	0	0.0	0.492

Discussion

There is a notable evolution in the surgery for pneumothorax over the last years. The open thoracotomy and pleural abrasion were the main surgery for pneumothorax described by Tyson and Crandall in 1941 [8]. Re-

cently, VATS has offered more advantages over open thoracotomy regarding postoperative stay, operative time, chest tube duration, and postoperative pain [9].

Rocco et al introduced single-incision thoracoscopic surgery in 2004 [10]. At that time, the single incision laparoscopic surgery (SILS) port was not in use. One of the biggest reasons for the lack of progress of such technique is that surgeons found the process difficult without a specialized port. It was not easy to insert a 5-mm scope, an endograsper, and a stapler at the same time through a 2.5 cm incision. Incompatibility among instruments, the limited endoscopic field of view, and angulation management of staplers were added to the difficulty.

Chen et al published similar results on 40 patients over 6 months who underwent surgery for primary spontaneous pneumothorax comparing uniport VATS with triport VATS where he uses single incision laparoscopic port (SILS) in Uniportal cases while we don't use (SILS) as we work from the port incision directly [11].

The wide range of patient's ages in our study was explained by that we included patients with SSP (ten patients in our study, which have a mean age of 50.43 ± 9.071). Despite that, there was no difference in the mean age between both study groups (uniport group and multiport group). Most studies did not have such a wide range of age as they studied only patient with PSP [9,12-14].

We found significantly lower operative time among the uniport group than the multiport group ($p = 0.014$). Despite many reports clarify that there was no significant difference between the two groups [14], Kutluk et al also reported less operative time among the uniport group [12].

There was no significant difference between the studied groups regarding postoperative complications. A result which coincided with the result of a study conducted by Nachira et al in 2018 [9].

Several studies hypothesized that patients who underwent uniport VATS for pneumothorax had reduced postoperative pain than multiport VATS [9,15]. This was thought as a result of reduced number of intercostal spaces involved, and, in turn, intercostal nerves affected [16]. Moreover, Yang et al proposed that the cause of pain is mechanical pleurodesis [14]. However, we found no difference in the pain score of the patients in both groups regardless the number of ports and method of pleurodesis.

In a study by Nachira et al, it was reported that there was a significantly lower duration of air leak and chest tube duration in uniport VATS compared to multiport

VATS ($p < 0.001$) [9]. In another study by Kutluk et al, who were comparing uniport, biport, and triport VATS, they reported no difference among the three procedures as regards the air leak and chest tube duration ($p = 0.378$) [12]. We reported no statistically significant difference between the two groups, which is consistent with Kutluk et al as our multiport procedure was biport VATS.

The overall hospital stay in both groups in our study was found 5.56 ± 2.01 for the uniport group and 5 ± 2.18 for the multiport group. Also, Kutluk et al reported 3.73 ± 0.22 for uniport, 3.78 ± 0.20 for biport, and 4.48 ± 0.36 for triport [12]. The diagnosis of secondary spontaneous pneumothorax was reported in 10 cases in our study (4 cases underwent uniport VATS and 6 cases underwent biport VATS) as many studies reported a higher incidence of prolonged air leak and complication due to associated COPD and increased number of blebs/bullae in SSP [15,19-21]. Another reason in our study is that the patient stays for another day after removing the chest tube because of our postoperative nursing care institutional protocol.

Regarding recurrence in comparing uniport VATS with multiport VATS, Nachira et al, also reported no significant differences between the two procedures [9]. In a study by Kutluk et al, they compared uniport VATS with biport and triport VATS, the overall recurrence rate was 5%, and it found no significant difference among the three groups [12]. The recurrence was reported in only one case in our study, with an overall recurrence rate of 3.13%. The recurrent case was within the uniport group with no recurrence reported within the multiport group with no significant difference between both procedures.

Notably, the recurrent case underwent pleural abrasion as surgical pleurodesis and did not need another intervention and was managed conservatively. Caecilian et al, in a study of 107 patients, showed a significant reduction in pneumothorax recurrence after pleural pleurectomy (PP) compared to pleural abrasion (PA) [21]. Even though both techniques were performed via the VATS approach. However, Ling et al compared the effects of pleural abrasion with other PSP treatment interventions in 2015 [22]. It was concluded that pleural abrasion and pleurectomy result in the same recurrence rates, but pleurectomy shows greater postoperative pain and more frequent complications, such as acute postoperative bleeding. Another explanation for recurrence in our case was that this case was operated for bilateral pneumothorax on the same session; while the patient in the supine position, the surgeon might be unable to

do pleural abrasion for the whole circumference of the apical pleura in this position in comparison to lateral decubitus where lung drop to the mediastinum and the whole circumference of the pleural can be abraded.

Compared to the multiport-port VATS group, Nachira et al reported that there was no significant difference in the uniport VATS group in terms of mortality, with an overall mortality of 0% [9]. Consistently, we reported no significant difference between both multiport and uniport regarding mortality. However, we reported mortality in two cases among the uniport group with an overall mortality rate of 6%. The preoperative comorbid status of the two cases reported as fatal should be considered because both had IPF and suffered postoperative respiratory failure, raising the question of surgery's suitability in IPF patients.

Nishimoto et al revealed that treatment of IPF patients complicated by pneumothorax is complicated as the lung is stiffer due to parenchymal fibrosis and associated with a high recurrence rate (70%) [23]. A common procedure is VATS which the intervention is advocated to treat prolonged air leaks in some patients and prevent recurrences in all patients with direct closure of the air leak, stapling/resection of any visible bleb, and mechanical pleurodesis (e.g., abrasion with dry gauze). However, it was concluded that surgical treatment for IPF patients complicated by pneumothorax has a dismal prognosis with high morbidity [23].

In conclusion, VATS is a milestone approach for surgery for pneumothorax with approved safety. In comparison between uniport VATS and multiport VATS, there was no clear evidence about which is superior to another and there were no differences between both techniques in most points that were studied except for operative time.

Declaration of conflicting interests

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Ethics approval

The study was approved by the institutional review board of Assiut University, Faculty of Medicine, Egypt (No: 17200669).

Authors' contribution

MS; collected all literatures and wrote the whole review, HE; helped in collecting the literatures and drafted the review, AE; helped in the discussion and drafting the review. All authors have read and approved the manuscript.

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Original Article

Do we need a small catheter drainage with chest tube after uniportal video-assisted thoracoscopic surgery for better drainage?

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ABSTRACT

Background: Some of the residual effusion cannot be drained by the chest tube due to the high port position of the uniportal video-assisted thoracoscopic surgery (VATS) which theoretically leads to prolonged hospital stay. Hypothesis that putting an additional small catheter drain at the most depended part of the hemi-thorax together with chest tube after uniportal VATS to evaluate value of small catheter drainage with chest tube after uniportal VATS in hospital stay, pain score and chest x-ray.

Materials and Methods: It represents a pilot prospective study randomized trial from August 2019 to August 2020 who had undergone uniportal VATS procedures were divided into two groups as group A (chest tube with small catheter) and group B (chest tube only).

Results: Fifty-three patients underwent uniportal VATS only 30 where eligible to the study divided into two equal groups (18 males, 12 females). The mean age of patients in the small catheter with chest tube was 42.07 ± 12.85 years, compared to 34.93 ± 10.73 years in the chest tube only. Six different types of operation was done. Postoperative pain and hospital stays was nearly equal in both groups ($p > 0.05$). Postoperative residual effusion in immediate chest x-ray in small catheter with chest tube was managed by aspiration from small catheter and show improvement in follow up chest x-ray next morning ($p < 0.05$) but in chest tube only was management conservatively didn't show improvement in follow up chest x-ray next morning ($p > 0.05$).

Conclusions: Small catheter with chest tube didn't add more pain. Although more than half of the cases get aspiration from small catheter and show improvement in follow up chest x-ray next morning, this does not statically affect hospital stay.

Keywords: chest tube, uniportal VATS, small catheter drainage.

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Introduction

Video-assisted thoracoscopic surgery (VATS) is now considered a minimally invasive technique among thoracic surgeons. VATS surgeons attributed the origin of thoracoscopic therapy to the Swedish physician Hans Christian Jacobaeus 1912 [1]. VATS causes less pain, postoperative complications and shortened hospital stay due to the decreased trauma to the chest wall. It has become superior to many diagnostic and therapeutic procedures that require traditional thoracotomy [2,3]. Thoracotomy is considered as one of the most painful surgical procedures. Increase postoperative pain lead to complications such as retained secretion, limited physical activity, atelectasis and pneumonia [4]. Most of the progress in these areas was accomplished by Gaetano Rocco's group at the National Cancer Institute, Italy. In June 2010, a significant milestone in this approach occurred with the world's first uniportal VATS lobectomy, which was reported in 2011 by Gonzalez Rivas's group in Coruna, Spain. Ever since, uniportal VATS has been successfully used to perform complex lung resection procedures involving pneumonectomy, segmentectomy, bronchoplastic and chest wall resection. There are promising initial clinical outcomes and short term results, and further data is awaited in the long run [5,6]. Recent systematic reviews report that VATS increases survival in early-stage lung cancer [7].

An intercostal tube is applied intra-operative following traditional VATS procedures to drain the remaining pneumothorax and residual effusion, traditionally via two chest tubes, one to air drainage directed up and another for fluid drainage directed downward. In uniportal VATS, surgeons almost always put one chest tube with subsequent outstanding possibility of ineffective drainage due to the high position of the chest tube at 5th and sometimes 4th intercostal space [8]. If no suction is applied, some of the residual effusion can't drain through the intercostal tube, resulting in a prolonged hospital stay.

The hypothesis is that placing additional small catheter drainage at the most depended part of the hemithorax in conjunction with the chest tube can result in the chest tube being removed earlier without causing the additional patient pain, hospital stay, or additional incision for another chest tube .

Material and Methods

This work was conducted in Cardiothoracic Surgery Department of Assiut University Heart Hospital. It is a pilot prospective study randomized trial (coin tossing) in which patients admitted to the service between August 2019 and August 2020 who underwent uniportal VATS procedures. Fifty-three patients underwent uniportal VATS only 30 where eligible to the study were divided into two equal groups as group A: chest tube with small catheter drainage and group B: chest tube only (Figure 1).

The inclusion criteria for the study are; patients who underwent uniportal video-assisted thoracoscopic surgery at our hospital and require postoperative chest drainage. The exclusion criteria are; patients who did not require the insertion of an intercostal tube post-operatively and refused to be in research. Perioperative management is achieved by the same team of surgeons who performed all the operations that was decortication, lung resection (lobectomy or sublobar resection), drainage and sympathectomy nearly same on both groups. The incision was created in the fourth or fifth intercostal space between the anterior axillary line and the midaxillary line. The chest tube was inserted into the fourth or fifth anterior axillary line and placed anteriorly to the apex of the chest, and the chest tube was connected to water sealed bottles. A guide-wire was used to guide the insertion of a small-bore drain. Central veins catheter was used as small catheter drainage, we use 4, 5, or 7 Fr size depending on the patient's weight and age. A needle and syringe were used to localize the insertion position for the video thoracoscope [9]. After passing a guide-wire through the needle's hub, the needle was removed and the tract was enlarged with a dilator. A small-bore tube can then be passed into the thoracic cavity along the wire (Figure 2).

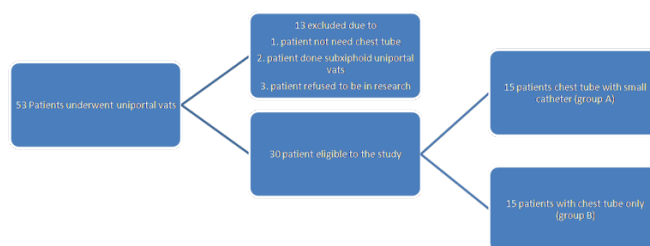


Figure 1. Flow diagram of number of patients.



Figure 2. Small catheter drainage in the most dependent part.

Operative time from the skin incision to skin closure was calculated by min. The severity of pain was quantified using numerical rating scales. The score ranged from zero to 10; no pain results in a zero on the numerical rating scale (NRS), whereas severe pain results in a ten on the NRS. Hospital stays mean from the day of surgery to the day of discharge. After removing the chest tube; the chest drains less than 50 mL per day with no air leak and minimal osculation. Small catheter should be removed following chest tube removal if the lung is fully expanded and there is no residual effusion in chest x-ray and aspiration from the small catheter is less than 10 mL and aspiration done by using syringe 50 mL. Chest x-rays was performed at 4 hour post-operatively and following morning. Complications were based on postoperative persistence air leak, subcutaneous surgical emphysema, bleeding and wound infection. Ethical consideration is based on risk/benefit assessment. The data gathered in this study may aid in increasing the number of patients undergoing VATS, including those who participate in this study. On the other hand, patients would benefit from the clinical and radiological follow-up. Patients undergoing VATS would benefit from significant impact of early postoperative discharge, resulting in reducing pain and lowering morbidity and mortality percentage. There are no known risks associated with participation in this study except for risk of exposure to anesthesia in the operative procedures. No alteration will be made the patients' treatment or follow-up. Dealing with data and data dissemination should be confidential. The investigators reviewed the charts to determine patients' eligibility, and collect necessary variables in a private area at the cardiothoracic department to ensure confidentiality. The data from the

eligible charts were kept in locked cabinets. Each patient was assigned a specific study number, which was used to enter the data into the computers for analysis and statistical purposes. The computers were password protected, and no one except the investigators would have access to the cabinets, study coding numbers or computers. Identifiable data were accessed only by the investigators and were not shared with any other doctors. An informed written consent will be obtained from those patients who will participate in the study mentioning the risk of the procedure and associated anesthesia. We ask also the consent as if they will undergo any specific intervention and their management will be the usual management of patient with VATS. A small catheter drainage with chest tube after VATS not done before and we will inform the patient about this.

The committee of medical ethics of faculty of medicine approved our research (No: 17100559).

Statistical Analysis

The data were tested for normality using the Kolmogorov-Smirnov test and for homogeneity variances prior to further statistical analysis. Categorical variables were described by number and percent, where continuous variables described by mean and standard deviation. Differences between the groups for categorical variables were analyzed using Chi Square test or Fisher's Exact test. Student's t test was used to assess difference between two groups in terms of and continuous variables. A two-tailed $p < 0.05$ was considered statistically significant. All analyses were performed with the IBM SPSS 20.0 software.

Results

Fifty-three patients underwent uniportal VATS only 30 where eligible to the study divided into two equal groups (18 males, 12 females). The mean age of patients in the small catheter with chest tube (Figure 3) was 42.07 ± 12.85 years, compared to 34.93 ± 10.73 years in the chest tube only. The small catheter with chest tube showed a male dominance by 66.7%, while chest tube only had a nearly equal distribution regarding the male to female ratio (Table 1).

Table 1. Demographic data of patient in both groups.

	Small catheter with chest tube (n=15)		Chest tube only (n=15)		p
	No.	%	No.	%	
Sex					
Male	10	66.7	8	53.3	0.456
Female	5	33.3	7	46.7	
Age					
Mean±SD	42.07±12.85		34.93±10.73		0.110

Six different type of operation includes decortication, lung resection (lobectomy or sublobar resection), drainage and sympathectomy nearly same on both groups ($p > 0.05$).

Post-operative pain mean score immediately following operation: the small catheter with chest tube scored 4.46 ± 1.27 while the chest tube only 4.79 ± 0.58 . The mean pain score for the 6-hour in small catheter with chest tube was 3.46 ± 1.33 while chest tube only had a mean 3.86 ± 0.77 . Pain score next morning small catheter with chest tube has a mean 3 ± 1.58 , while the chest tube only mean was 3.21 ± 0.7 . Mean duration of air leak in the small catheter with chest tube was 2.01 ± 1.94 days, while in the chest tube only was 2.33 ± 2.42 days. Mean duration of chest tube in the small catheter with chest tube was 4.58 ± 3.75 days, while in the chest tube only was 2.93 ± 2.79 days. The number of patients in the small catheter with chest tube who had a postoperative pneumothorax on an immediate chest x-ray was 7 (46%); the number of patients in the small catheter with chest tube who had a next morning pneumothorax on a chest x-ray in small catheter with chest tube was 4 (26%). In chest tube only postoperative pneumothorax in immediate chest x-ray was 4(26%) next morning pneumothorax in chest x-ray was 3(20%). No significant difference between two groups in duration of air leak ($p > 0.05$).

The number of patients in the small catheter with chest tube that showed postoperative residual effusion in immediate chest x-ray in the small catheter with chest tube was 10 patients, all of which were managed by aspiration from small catheter. The following day residual effusion in chest x-ray in the small catheter with chest tube was 4 patients ($p = 0.028$). In the chest tube only postoperative residual effusion in immediate chest x-ray was 3 patients next morning residual effusion in chest x-ray is the same 3 patients ($p = 1.000$).



Figure 3. Postoperative chest x-ray show small catheter with chest tube.

There was no need for another chest tube during period of admission in both groups. There was no additional complication such as wound infection and chest infection reported in either groups. Only one case required surgical emphysema management conservative ($p = 0.309$).

Small catheter with chest tube patients stayed a mean of 4.38 ± 1.8 days in the hospital following surgery, while those in the chest tube only spent a mean of 3.33 ± 2.77 days ($p > 0.05$).

There were no statically difference between two groups regarding: pain score, hospital stay or post-operative complications; However there was statically difference regarding post-operative pleural effusion, small catheter with chest tube was superior in management of post-operative pleural effusion ($p = 0.028$) in comparison to chest tube only which showed no statically significant in management of pleural effusion ($p = 1.000$).

Follow-up chest x-rays performed ten days after patient were discharged revealed no difference between two groups. There were four patients in the study and group B, two patients in each group, had an obliteration of the costophrenic angle on chest x-rays.

Table 2. Comparison between small catheter with chest tube and chest tube only in pain score, chest x-ray and hospital stay.

	Small catheter with chest tube (n=15)		Chest tube only (n=15)		p
	No	%	No	%	
Pain score					
Immediate					
Mean±SD	4.46±1.27		4.79±0.58		0.394
Next 6 hour					
Mean±SD	3.46±1.33		3.86±0.77		0.349
Next morning					
Mean±SD	3±1.58		3.21±0.7		0.649
Duration at air leak (days)					
Mean±SD	2.01±1.94		2.33±2.42		0.722
Duration at small catheter and chest tube (days)					
Mean±SD	4.58±3.75		2.93±2.79		0.202
Chest x-ray (4 hours postoperative)					
Residual pneumothorax					
Immediate					
Yes	7	46.7	4	26.7	0.256
No	8	53.3	11	73.3	
Next morning					
Yes	4	26.7	3	20.0	0.666
No	11	73.3	12	80.0	
P-value	0.256		0.666		
Residual effusion					
Immediate					
Yes	10	66.7	3	20.0	0.010*
No	5	33.3	12	80.0	
Next morning					
Yes	4	26.7	3	20.0	0.666
No	11	73.3	12	80.0	
P-value	0.028*		1.000		
Need for another chest tube during the period of admission					
No	15	100.0	15	100.0	-
Other complication					
Chest infection					
No	15	100.0	15	100.0	-
Wound infection					
No	15	100.0	15	100.0	-
Subcutaneous emphysema					
Yes	1	6.7	0	0.0	0.309
No	14	93.3	15	100.0	
Hospital stay (days)					
Mean±SD	4.38±1.8		3.33±2.77		0.253

Discussion

The study set out to investigate the significance of small catheter drainage with chest tube protocol in patients undergoing VATS surgery vs. Chest tube only, by comparing the patients' postoperative pain grade, hospital stay, and postoperative chest x-rays as well as their need for re-insertion of an intercostal tube or any additional management.

Video-assisted thoracoscopic surgery is a diagnostic and therapeutic tool used in the management of pleural, parenchyma, and mediastinal diseases [10]. The small catheter drain is inserted easily, and the procedure is painless if it performed alone for effusion drainage. However, using the small catheter alone may have adverse consequences as severe subcutaneous emphysema and might become blocked by blood clots which is a risk factor, mainly if postoperative bleeding occurs [11].

Yang Z et al concluded that attaching a pigtail catheter to the chest drain through a single incision VATS lobectomy appears to be a safe and promising technique for reducing pain, decreasing air leak time, shortening hospital stay and detecting postoperative bleeding early [12].

It has been demonstrated that patients in the pigtail tube group had a significant more volume drained in a short amount of time on the first 2 days than those in the larger drain group. There were no significant differences between the two groups in the air leak time, subcutaneous emphysema or wound healing same as demonstrated in the present study [12].

In our study, post discharge pleural effusion occurred in two patients in the group A and two patients in the group B who developed an obliteration of the costophrenic angle on follow-up chest x-ray 10 days after discharge. All patients were managed conservatively without the need to insert another chest tube. According to Yang et al report, the percentage of patients that developed pleural effusion after two weeks was two patients in the smaller pigtail group and eleven patients in the larger drain group [12]. All patients were managed conservatively except three in the larger drain group who required chest tube re-insertion.

The pigtail used as small catheter in the Yang Z study had a diameter of 8 Fr [12]. We used central vein catheter as small catheter drainage 4, 5, 7 Fr in size in our study.

Our study's overall mean length of stay was 4.3 days in the group A and 3.3 days in the group B, which was nearly identical in both groups. Yang et al found that the mean hospital stays was 5 days in pigtail group and 6 days in large drain group [12]. This difference was because of some of minor procedure in our study, such as uniportal VATS biopsy, were performed as a one-day procedure and early discharge from the hospital was the standard. Ismail et al [13]. Reported an average hospital stay of 8.3 days, which differs from our study because Ismail reported a major uniportal VATS operation that requires post-operative physiotherapy and management to fully expand the lung, not to mention the fact that his series' mean age was also higher than ours.

In our study, the main post-operative pain score was 3 in the group A and 3.3 in the group B on the second day, which was nearly identical in both groups. Yang et al found that pain scores were 3 in the pigtail group and 3 in the large drain group on the second day. These results are consistent with our study, which found no difference in pain scores on the second day, but Yang's report found that the smaller pigtail group's pain score decreased significantly on the third day following surgery compared to the larger drain group ($p < 0.001$).

There is no significant difference between the two groups in terms of sex and age. Small catheters with chest tubes did not add more pain to the patient compared to the chest tube only.

The group A had ten patients (67%) with post-operative residual effusion on immediate chest x-ray, all of whom were managed with aspiration from a small catheter. The following morning, the group A had a residual effusion on chest x-ray was 4 (27%). In the group B, post-operative residual effusion in the immediate chest x-ray was 3 (20%) and in the following day, residual effusion in the chest x-ray was the same 3 (20%) with p-values of 0.028 and 1.000 in the study and group B, respectively. Although some cases were aspirated from a small catheter and showed improvement on the following morning's chest x-ray, this had no effect on the length of hospital stay for the two groups.

There was no need for another chest tube during the admission period in either the small catheter with chest tube or the chest tube only, except for one case that required conservative surgical emphysema management. The length of stay in the hospital following surgery is nearly identical in both groups.

Limitations of the study

Our study had a limited number of patients, which can be attributed back to the decreased number of cases presented to our center that matched the criteria of the study during the time of the study. Although our study managed to involve many varieties regarding VATS procedures the number of patients in each category didn't allow for separate comparison of each of the different categories. Lack of publication in the English literature regarding the topic of the study didn't allow the possibility of comparing our results.

In conclusion a small catheter with a chest tube did not add more pain to the patient comparing to a chest tube only. Although more than half of the cases get aspiration from the small catheter and show improvement in follow-up chest x-ray the following day, this does not statically affect hospital stay.

Declaration of conflicting interests

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Ethics approval

The study was approved by the Ethics Committee of Assiut University, Faculty of Medicine, Egypt (RIBno: 17100559).

Authors' contribution

AA; Data collection, HE; analysis of data, performing surgery, MO; revising the manuscript, AE; writing the overall manuscript. All authors have read and approved the manuscript.

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Original Article

Evaluation of the change in pain, dyspnea perception, and pulmonary function values with pain tape application in patients undergoing thoracotomy

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ABSTRACT

Background: We aimed to evaluate the changes in pain, dyspnea perception and respiratory functions by applying pain tape in the postoperative period in patients who underwent thoracotomy.

Materials and Methods: 55 patients were included in the prospective, randomized study with local ethics committee approval. The patients were divided into two groups, and on the postoperative 1st day, pain tape was applied to group I patient and placebo tape similar to pain tape was applied to group II patient. Visual Analogue Scale (VAS) was used for pain assessment, Modified Borg Scale (MBS) for dyspnea assessment, pulmonary function test and six-minute walking test (6 MWT) were used to evaluate pulmonary functions in the preoperative and postoperative periods.

Results: There were 29 patients in group I and 26 patients in group II, with mean age of 59.2 ± 10.4 (18-75) years. According to the statistical analysis, no difference was found between the groups in terms of age, gender, height, weight, BMI, 6 MWT, MBS, FEV1, FVC, FEV1/FVC values ($p > 0.05$). There was a difference between the groups in terms of VAS values measured on the 3rd postoperative day (4.65 ± 1.79 vs. 6.57 ± 1.74 ; $p > 0.001$). In addition, the postoperative complication rate was different in group I compared to group II (17.2% vs. 30.7%; $p = 0.003$).

Conclusion: Pain tape application is a reliable and simple method for pain control in the postoperative period in patients undergoing thoracotomy. It can be applied to patients for pain control in the early period, and in this way, the development of postoperative complications can be prevented.

Keywords: pain, dyspnea, pain tape, complication, thoracotomy

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Introduction

Thoracotomy pain is an acute traumatic pain that occurs due to iatrogenic causes such as soft tissue, muscle and visceral damage, bone and joint trauma, inflammation. Insufficient breathing and coughing, atelectasis, hypoxia and lung infections due to this pain are important causes of postoperative morbidity [1,2]. Effective analgesia provides early postoperative mobilization and reduces morbidity. Today, there are a wide variety of methods and drugs used to relieve pain after thoracotomy. These are; systemic narcotic analgesic or nonsteroidal anti-inflammatory drug use, patient-controlled analgesia, thoracic epidural analgesia, cryoanalgesia, transcutaneous nerve stimulation, paravertebral block, intercostal nerve block, and administration of local anesthetic agents to the intrapleural and extrapleural space [3-5].

Integration of all these analgesia techniques with the pulmonary rehabilitation program can accelerate recovery, prevent postoperative pulmonary complications, and shorten the hospital stay [6,7]. New ones are added to the classical respiratory physiotherapy techniques applied today. One of these new techniques is the application of pain tape, which is known to help in pain management. Pain tape; kinesiology taping technique was developed in the 1970s by Dr. Kenzo Kase to prevent limitations in joint movements and functional activities, which are an undesirable effect in standard tape and tape applications. This tape contains polymer fibers, which has a 60% stretching share, is used to integrate the inflamed areas for any reason, reduce edema, and support circulation. Due to the absence of any pharmacological agents in the tape and its hypoallergenic feature, it provides ease of use in all patients from the pediatric group to the geriatric group [8].

The aim of our study is to investigate the effect of pain tape application on postoperative pain, dyspnea level, and respiratory functions in addition to routine analgesic treatment in patients undergoing thoracotomy.

Materials and Methods

Fifty five patients who underwent thoracotomy were included in our prospective, randomized, double-blind and placebo-controlled study, which was approved by Ondokuz Mayıs University Medical Research Ethics Committee. All cases were operated by the same thoracic surgery team under the supervision of an experienced

anesthesiologist. Similar surgical indications and anesthesia management were used. All cases were approached with posterolateral or lateral thoracotomy, depending on the surgeon's preference. A single dose of cefuroxime axetil administered as a prophylactic intravenous (IV) antibiotic regimen (Cefaks© 1.5 g/flk, Deva, Istanbul, Turkey) and an additional dose was administered at the 4th hour when the surgery was prolonged. At the end of the operation, a chest tube was placed in the 7th or 8th intercostal space accordingly. All patients were extubated in the operating room and transferred to the intensive care unit. In the absence of any obstacle, the patients were transferred to the service on the first postoperative day.

For postoperative analgesia, dexketoprofen (Arveles© 50 mg, UFSA İlaç, İstanbul, Turkey) in 2x1 doses and paracetamol (Parol© 10 mg/mL, Atabay İlaç Fabrika A.Ş., Istanbul, Turkey) 3x500 mg IV was given for all patients. Tramadol hydrochloride IV (Contramal© 100 mg/2 mL, Abdi İbrahim, Istanbul, Turkey) and pethidine hydrochloride IM (Aldolan© 100 mg/2 mL, LIBA laboratories A.Ş., Istanbul, Turkey) were administered when necessary.

The patients who were taken to the service on the 1st postoperative day were divided into two groups, and pain tape (Kinesio Taping Association International, Albuquerque, NM, USA) was applied to group I (n = 29) patients and a placebo tape similar to pain tape was applied to group II (n = 26) patients. Pain tape taping was applied to the patients on the 1st postoperative day together with the dressing by a physiotherapist who is an expert in the field. The application to be made in the placebo control group was applied by the same specialist physiotherapist to the same areas with the clothing tape in a way that mimics the application of the pain tape. The physiotherapist applying taping did not know whether the tapes were placebos or real tapes. Tape application was made in standardized length, tension, and shape. Three skin areas designated for application, the pain trigger point, were found on the patient by palpation. Y-shaped deltoid/trapezius inhibition on the ipsilateral deltoid/trapezoid and Y- and I-shaped tapings were made on the diaphragm for relaxation and facilitation [9] (Figure 1). The tapes were removed on the day the patient was discharged.

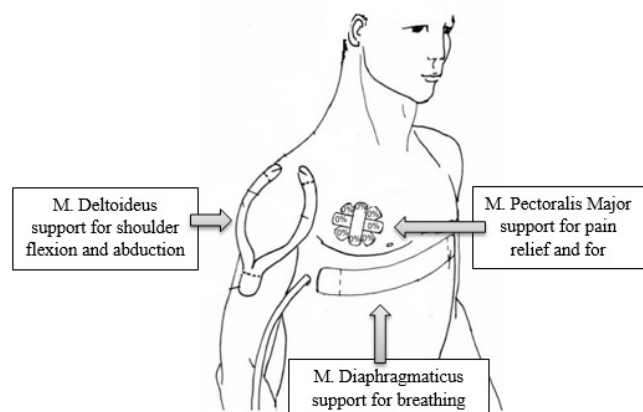


Figure 1. Pain tape areas that we apply to our patients in the postoperative period and the muscles they affect.

In the study, Visual Analogue Scale (VAS) [10] was used for pain assessment, Modified Borg Scale (MBS) [11] for dyspnea assessment, six-minute walk test (6 MWT) [12] and pulmonary function test (PFT) were used to assess pulmonary functions in the preoperative and postoperative periods. VAS and MBS were applied preoperatively and postoperatively on the 1st and 3rd days, 6 MWTs were performed preoperatively and postoperatively on the 3rd day, and PFT was performed at the preoperative and postoperative 3rd month. The specialist physiotherapist and patients who made these evaluations did not know which group they were in.

The inclusion criteria for the study are; patients who have undergone thoracotomy, patients who have not applied a pain tape before the surgical procedure, patients who can cooperate in the postoperative period, patients who give voluntary consent and patients between the ages of 18-80. The exclusion criteria for the study are; patients staying in the intensive care unit for more than 24 hours after surgery, patients with previous thoracic trauma, thoracotomy, or tube thoracostomy, patients who receive psychiatric treatment and cannot cooperate due to the drugs they use, patients who cannot give their own voluntary consent, patients under 18 years of age and patients who develop allergies to the applied pain tape.

Statistical Analysis

Whether the data met the normality assumption was checked using the Shapiro-Wilk test. Mann-Whitney U test was used to test the difference between two groups in terms of ordinal or non-normally distributed continuous variables. Results are expressed as mean value $\pm$ SD, or median value and interquartile range (IQR). Bonferroni correction was applied for multiple tests. Number and

% values were given for categorical variables. Since the data to be obtained from the study will be subjected to the t-test, considering the power and sample size test based on previous studies in this area, the sample size was calculated as $\alpha=0.05$ and the power of the test was 90%, with a minimum of 25 patients per group. SPSS Windows version 24.0 (Chicago, IL, USA) package program was used for statistical analysis and $p < 0.05$ was considered statistically significant.

Results

Of the 55 patients included in the study, 46 were male and 9 were female, with mean age of 59.2 ± 10.4 (18-75) years. It was determined that 74.54% ($n = 41$) of the patients were active smokers. The most common type of surgery was lobectomy in 27 patients and segmentectomy/wedge resection in 12 patients. In the study, the mean hospital stay was 7.12 ± 3.2 days and no mortality was observed for thirty days. There was no statistical difference between the groups in terms of age, gender, weight, height, BMI, ASA score, PFT values, smoking status, types of surgery, duration of chest tube stay and duration of hospitalization. Demographic and preoperative data of the patients are shown in Table 1.

There was no significant difference between the groups in terms of FVC, FEV1, FEV1/FVC and PEF values according to the pulmonary function test results performed in the preoperative and postoperative period. Again, although MBS and 6 MWT values performed in the postoperative period were better in group I patients, no statistical difference were found between the groups. When VAS values were evaluated, there was no significant difference between preoperative ($1.0 \pm 0.88/1(2)$ vs. $0.92 \pm 0.97/1(2)$; $p = 0.762$) and postoperative 1st day values ($6.62 \pm 1.84/7(3)$ vs. $7.07 \pm 1.54/7(2)$; $p = 0.323$), while VAS values were significantly lower on the 3rd postoperative day in group I patients ($4.65 \pm 1.79/4(3)$ vs. $6.57 \pm 1.74/6.5(3)$; $p < 0.001$) (Table 2).

Although hospitalization time (6.5 ± 3.01 days vs. 7.8 ± 3.8 days; $p = 0.167$) and chest tube removal time (4.9 ± 1.81 days vs. 5.2 ± 2.08 days; $p = 0.354$) were shorter in Group I, no statistical difference was found. When compared in terms of postoperative complications, it was found to be 17.2% ($n = 5$) in group I and 30.7% ($n = 8$) in group II, which was statistically significant ($p = 0.003$) and the most common complication was atelectasis. (Table 1).

Table 1. General characteristics and data of the patients.

	Group I (n=29)		Group II (n=26)		p
	Mean±SD/median (IQR)/ n (%)		Mean±SD/median (IQR)/ n (%)		
Age (years)	58.3±11.3/59 (18.5)		60.2±12.2/62.5 (10)		0.542
Gender					0.412
Male	24	82.8	22	84.6	
Female	5	17.2	4	15.4	
Weight (kg)	78.9±18.1/74.5 (21.5)		77.2±11.4/77.5 (14.7)		0.686
Height (cm)	165.1±8.01/165 (8.7)		160±31.3/166.5 (8.25)		0.447
Body Mass Index (kg/m²)	29.2±7.73/27.3 (6.8)		28.9±4.6/27.3 (6.2)		0.440
ASA score					0.728
I	4	13.8	2	7.7	
II	17	58.6	20	76.9	
III	8	27.6	4	15.4	
Preoperative pulmonary function test					
FVC (L)	3.23±0.85/3.1 (0.8)		3.44±0.82/3.3 (1.3)		0.376
FVC %	93.9±21.93/92 (27.2)		98.7±20.94/100 (28.5)		0.439
FEV1 (L)	2.58±0.77/2.4 (0.7)		2.69±0.70/2.6 (1)		0.606
FEV1%	93.1±23.06/90 (28.7)		95.3±21.68/97.5 (33.7)		0.722
FEV1/FVC	79±8.57/79.7 (12.1)		80.9±7.42/82.5 (7.7)		0.391
PEF (L)	6.72±2.73/6.2 (3)		6.96±2.49/6.7 (3.2)		0.758
PEF%	89.7±27.5/84 (34.5)		93.9±25.7/99 (43.5)		0.599
Smoking					0.352
Yes	21	72.4	20	76.9	
No	8	27.6	6	23.1	
Type of operation					0.481
Segmentectomy/wedge resection	8	27.6	4	15.4	
Lobectomy	12	41.4	15	57.7	
Pneumonectomy	-		2	7.7	
Decortication	3	10.3	3	11.5	
Mediastinal mass resection	6	20.7	2	7.7	
Complication	5 (17.2)		8 (30.7)		0.003
Air leakage	2		2		
Atelectasis	1		3		
Subcutaneous emphysema	2		2		
Wound infection	-		1		
Median chest tube duration, days	4.9±1.81		5.2±2.08		0.354
Hospitalization (days)	6.5±3.01		7.8±3.8		0.167

Abbrev.: SD: standard deviation; ASA: American Society of Anesthesiologists; FVC: Forced vital capacity, FEV1: Forced expiratory volume 1st second, PEF: Peak expiratory flow.

Table 2. Comparison of the groups in terms of preoperative and postoperative data.

		Group I mean±SD/median (IQR)	Group II mean±SD/median (IQR)	P
FVC (L)	Preoperative	3.23±0.85/3.1 (0.8)	3.44±0.82/3.3 (1.3)	0.376
	Postoperative	3.11±0.91/2.98 (1.05)	2.9±0.65/2.99 (0.9)	0.373
FVC%	Preoperative	93.9±21.93/92 (27.2)	98.7±20.94/100 (28.5)	0.439
	Postoperative	89.4±20.45/87.5 (25)	86.7±19.32/87 (22.5)	0.638
FEV1 (L)	Preoperative	2.58±0.77/2.4 (0.7)	2.69±0.70/2.6 (1)	0.606
	Postoperative	2.52±0.88/2.14 (0.8)	2.33±0.58/2.4 (0.75)	0.392
FEV1%	Preoperative	93.1±23.06/90 (28.7)	95.3±21.68/97.5 (33.7)	0.722
	Postoperative	88.8±22.35/84.5 (27.7)	84.3±18.8/86 (24.05)	0.453
FEV1/FVC	Preoperative	79±8.57/79.7 (12.1)	80.9±7.42/82.5 (7.7)	0.391
	Postoperative	77.7±7.58/79 (13.8)	77.8±8.13/79.6 (11.7)	0.953
PEF (L)	Preoperative	6.72±2.73/6.2 (3)	6.96±2.49/6.7 (3.2)	0.758
	Postoperative	6.0±2.33/5.8 (1.7)	6.28±2.05/5.6 (2.13)	0.725
PEF%	Preoperative	89.7±27.5/84 (34.5)	93.9±25.7/99 (43.5)	0.599
	Postoperative	84.5±26.16/81 (37)	87.6±21.14/94 (30.5)	0.658
VAS (0-10)	Preoperative	1.0±0.88/1 (2)	0.92±0.97/1 (2)	0.254
	Postoperative 1st day	6.62±1.84/7 (3)	7.07±1.54/7 (2)	0.107
	Postoperative 3rd day	4.65±1.79/4 (3)	6.57±1.74/6.5 (3)	<0.001
6MWT (m)	Preoperative	367.9±94.9/400 (82.5)	361.7±84.24/362.5 (75.2)	0.432
	Postoperative	205.2±62.71/205 (75)	197.6±68.46/185 (110)	0.684
MBS (0-10)	Preoperative	2.20±1.85/2 (2)	2.15±1.40/2 (1.25)	0.301
	Postoperative 1st day	4.51±2.45/4 (3)	4.65±2.15/4 (4)	0.275
	Postoperative 3rd day	5.86±2.50/6 (4)	6.73±1.97/7 (3)	0.540

Abbrev.: SD: standard deviation; FVC: Forced vital capacity, FEV1: Forced expiratory volume 1st second, MBS: Modified Borg Scale, PEF: Peak expiratory flow, VAS: Visual analog scale, 6MWT: Six minute walk test.

Discussion

According to the results of this prospective, randomized, double-blinded and placebo-controlled study, it is seen that pain tape application is effective in pain control in the early postoperative period. In our study, in which we evaluated the perception of pain in patients with VAS, it was observed that while VAS was significantly lower in group I patients on the postoperative 3rd day than in group II patients, this value was the same in both groups on the postoperative 1st day. We attribute this situation to the intensive analgesic administration in the intensive care unit before the first postoperative day. In addition, the complication rate observed in the early postoperative period was lower in group I patients, indicating that patients had good pain control in the early postoperative period.

In the postoperative period, as after many surgeries, severe pain occurs in approximately 70% of patients

after thoracotomy. Pain after thoracotomy is an acute traumatic pain and occurs as a result of stretching of the costovertebral, costotransverse joint ligaments, and posterior spinal muscles [1,2]. After all thoracotomy operations, whether pulmonary resection is performed or not, respiratory muscle strength decreases and respiratory reserve decreases due to the deteriorated respiratory physiology due to the surgical procedure. In addition, postoperative pain restricts diaphragmatic movements by creating phrenic nerve inhibition and causes a decrease in its strength [13]. As a result, breathing becomes shallow, lung volume and capacity decreases, coughing reflex is impaired, causing sputum retention, atelectasis, hypoxemia, hypercapnia and respiratory failure. In addition, age, cardiopulmonary comorbidities, smoking history, variable and low pulmonary function test results, and low exercise capacity increase the risk of postoperative pulmonary complications (PPC) [14-16].

Although developments in postoperative pain management, innovations in anesthesia, and surgery in the last 20 years have reduced general postoperative complications, the most important cause of mortality and morbidity in thoracic surgery is still postoperative pulmonary complications. Factors such as the operation performed, the type of incision and the size of the tissue removed may affect the result, and the rate of PPC can reach 36% [17,18]. In addition, PPC increases the length of stay of patients in the intensive care unit and hospital, and health expenditures [7,19].

To date, various treatment strategies and methods have been developed to reduce the incidence of PPC, such as the detection and prevention of risk factors, improvement of preoperative condition and patient education, intraoperative applications, and postoperative pulmonary care [16-18]. Among these, respiratory physiotherapy has been accepted as a useful practice in preventing pulmonary complications and it has been recommended to be routinely applied by the European Respiratory Society (ERS), European Society of Thoracic Surgeons (ESTS) [20] and American College of Chest physicians (ACCP) [21] due to its functional benefits.

According to the current literature, postoperative pulmonary rehabilitation applied in the early period after thoracic surgery aims; to increase alveolar ventilation, to increase lung volume and capacity, to ensure effective coughing, and to prevent areas under mechanical pressure from going into atelectasis during surgery [13,18]. Although it is stated in the literature that postoperative physiotherapy is necessary and beneficial, there is no standard information about which program should be applied to which patient. The rehabilitation program to be implemented should be planned individually according to the patient's clinic and needs [7,18]. In our study, we applied the pain tape taping technique, which is a pulmonary rehabilitation application method that has not been investigated and mentioned much in patients who underwent thoracotomy.

The pain tape taping technique is a rehabilitation method that was developed in the 1970s and consists of application. A specially designed elastic tape (Kinesio®) is applied to the patient's skin to replace the underlying soft tissue areas and achieve therapeutic effects [8]. By causing the skin to rise in the area where the pain patch is applied, it increases the skin and subcutaneous inter-

stitial area, thus increasing circulation and movement in this area. The increase in circulation and movement directs the exudate to the lymphatic pathways, reducing the edema and inflammation and reducing the pain. In addition, the pain tape provides stimulation of mechanoreceptors through the skin, thereby activating the central nervous system [8,22]. In our study, we also used the pain tape taping method, which is easy to apply and does not cause any discomfort to the patient, and we found that the patients in the group in which we applied the pain tape had less pain in the early postoperative period and accordingly, the postoperative complication rate was lower.

The modified Borg scale was developed by the Borg in 1970 to measure the effort expended during physical exercise. It is a scale that is frequently used to evaluate the severity of dyspnea on exertion and the severity of dyspnea at rest [11]. Studies have reported that MBS is a reliable scale for determining the severity of resting and exertional dyspnea and is correlated with respiratory rate and pulmonary function tests. In addition, it is emphasized that MBS is superior to other scales in terms of long-term reproducibility and can be used to predict respiratory reserves of patients. In a study conducted by Akkoca et al, it was found that there was a relationship between the mean dyspnea severity evaluated by patients with MBS and pulmonary function test parameters. In another study conducted by Güneş et al [23,24], it was determined that there was a relationship between the mean dyspnea severity evaluated by patients with MBS and lung functional parameter values. In our study, we used MBS in our patients in the preoperative and postoperative periods to evaluate the perception of dyspnea. Accordingly, we did not observe a statistical difference between the groups, although the MBS values were lower, especially on the postoperative 3rd day, in our patients who were applied pain tape.

Respiratory system functions are always affected during and after surgery. After pulmonary resection, there is an increase in residual volume as a result of both removal of the lung parenchyma tissue and decreased diaphragm and chest wall mobility. While the FEV1 value shows a rapid decrease in the early period; general anesthesia applications cause a decrease in functional residual capacity. This depends on the anaesthetic agents and muscle relaxants used during surgery [20,21]. When the findings related to pulmonary func-

tion tests were examined in our study, we found a decrease in the FVC, FEV1, FEV1/FVC, and PEF values measured in both groups of patients in the postoperative period. This decrease was less in group I patients than in group II patients, but we did not observe a statistical difference between the two groups.

The six-minute walk test, developed by Balke in 1963 to measure functional exercise capacity, is a submaximal, indirect cardiovascular physical fitness test. The parameter it tries to measure indirectly is the maximal oxygen consumption, and it measures the distance the person takes in 6 minutes in meters [12]. 6 MWT is easy to perform and evaluate, it does not require equipment. A normal person's walking distance is 400-700 meters during this time. The six-minute walk test is a widely used approach to evaluate the change in functional exercise capacity of patients in the pulmonary area [13,25]. In a related study in the literature, it was reported that the exercise capacity measured by the 6 MWT improved significantly more than the control group in the 4-week pulmonary rehabilitation program applied to lung cancer patients after resection [13]. In another study conducted by Spruit et al [26] with patients who underwent resection for lung cancer, it was reported that the 6-minute walking distance of the 8-week pulmonary rehabilitation program was significantly better than the control group. Since it was an easily applicable test in our study, we applied 6 MWT to our patients preoperatively and postoperatively. Accordingly, although postoperative 6 MWT values were better in group I patients to whom we applied pain tape, compared to group II patients, we did not detect a statistical difference between the groups.

In conclusion, there is a need for well-programmed and fully implemented pulmonary rehabilitation programs to reduce pain after thoracotomy operations, eliminate pulmonary complications, and return the patient to their preoperative functional life as soon as possible. Considering the clinical benefits, giving importance to simple, cost-effective and low-risk PR practices in thoracic surgery clinics will be important in terms of the success of the surgery, health costs and patient benefits. In this study, we applied pain tape in addition to routine postoperative pain treatment in patients who underwent thoracotomy, and we found that patients felt less pain in

the early postoperative period. From this point of view, pain tape seems to be an easy to apply, inexpensive and effective method, and we recommend it to be applied as a part of the pulmonary rehabilitation program in addition to routine pain treatment in patients.

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 Medical Research Ethics Committee of Ondokuz Mayıs University, Faculty of Medicine (KA EK/383).

Authors' contribution

SGT, BÇ; Conceived and designed the analysis, collected the data, contributed data/analysis tools, performed the analysis, co-wrote the paper, HKÇ; Conceived and designed the analysis, performed the analysis, co-wrote the paper, ZA; Collected the data, co-wrote the paper.

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Original Article

What COVID-19 brings with: incidental solitary pulmonary nodules

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ABSTRACT

Background: Thoracic computed tomography (CT) scans for preliminary diagnosis of COVID-19 can be used as a tool to detect solitary pulmonary nodules (SPNs).

Materials and Methods: We retrospectively evaluated the thoracic CT reports of 5416 patients, aged 45-75, who presented to our hospital with a preliminary diagnosis of COVID-19 in 2020.

Results: Pulmonary nodules/masses were detected in 85 patients. 56 of these were male, and 29 female. 63 patients (74%) had SPNs, 11 (13%) masses, and 11 (13%) multiple nodules. 5 patients were in follow-up for malignancy, and 21 (21%) arrived for follow-up after the detection of nodule/mass. 11 patients died due to pulmonary pathologies.

Conclusions: COVID-19-related concerns have seriously disrupted the follow-up of pulmonary nodules. However, the widespread use of CT serves as a kind of lung cancer screening.

Keywords: COVID, CO-RADS, solitary pulmonary nodules, incidental

Introduction

The SARS-CoV-2 epidemic, which started in China's Wuhan province at the end of 2019, spread worldwide and was declared a pandemic by the World Health Organization, affecting all countries and causing thousands of deaths and hospitalizations every day [1].

The most common clinical presentation in COVID-19 is respiratory distress, and as in other viral diseases, pulmonary involvement manifests as ground-glass opacity (GGO), rendering chest x-ray insufficient. Therefore, computed tomography (CT) has become standard in COVID-19 diagnosis [2].

During the pandemic, frequent thoracic CT scans have almost proved to be a screening program for detecting parenchymal nodules and masses since lung cancer requires early treatment for favorable outcomes but usually progresses asymptotically in the early stage and is detected incidentally [3-5].

In the present study, we reassessed the thoracic CT scans taken for preliminary diagnosis of COVID-19 in our clinic and investigated the cases with solitary pulmonary nodules (SPNs) and masses.

Materials and Methods

We evaluated patients aged 45-75 with thoracic CT scans taken for preliminary diagnosis of COVID-19 in our hospital, between March and December 2020. We retrospectively assessed their thoracic CT reports to detect non-COVID-19 findings.

Our hospital database enabled us to refer to both the previous and later scans of the patients with non-COVID-19 findings. We included patients with pulmonary nodule on the CT reports and nodule sized > 5 mm and excluded extraparenchymal pathologies. Besides, nodules < 5 mm in size remained outside our investigation since they required no further evaluation [6].

We retrospectively evaluated the patients' age, gender, tumor size and location, previous and later CT findings, history of malignancy, and survival.

Ministry of Health and local ethics committee of Omer Halisdemir University approved the study. Informed consent was taken from all participants.

Results

We evaluated the CT reports of 5416 patients conforming to the inclusion criteria. It was observed that all patients had low-dose CT and the reporting was mixed by 4 separate radiologists working in our hospital and from a private center through external reporting.

Intraparenchymal nodule (>5 mm) or mass was detected in 85 patients (0.15%). The mean size of SPNs was 21.7 mm, and masses 49.1 mm (Figures 1,2).

General characteristics of the patients and information about the nodule are given in table 1. Three patients had a history of lung malignancy, 1 breast, and 1 rectal malignancy, and all were in follow-up. Twenty one (24%) patients had previous CT scans for other reasons, and 18 (21%) had a control CT scan following the detection of a lesion.

It was determined that 11 patients (13%) died during the research. Since patients with a diagnosis of metastatic disease also had additional comorbidities like history of coronary artery disease and the causes of death were not clear, a clear interpretation of death due to the disease could not be made.

Table 1. General information about patients and nodules.

	n	%
Sex		
Male	56	66
Female	29	34
Lesion		
Solitary pulmonary nodule	63	74
Multiple/bilateral	11	13
Mass	11	13
Solitary pulmonary nodule		
Ground-glass opacity	12	19
Calcified	7	11
Cavitary	1	1.5
Semisolid	10	16
Solid	33	51
Location		
Right lower lobe	21	34
Left lower lobe	15	24
Right upper lobe	13	20
Left upper lobe	7	11
Right middle lobe	7	11

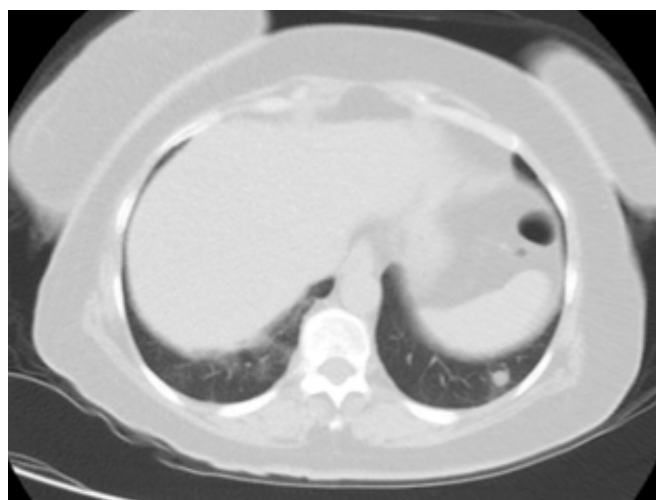


Figure 1. Thorax CT of a COVID-19 patient showing an incidental solitary pulmonary nodule.

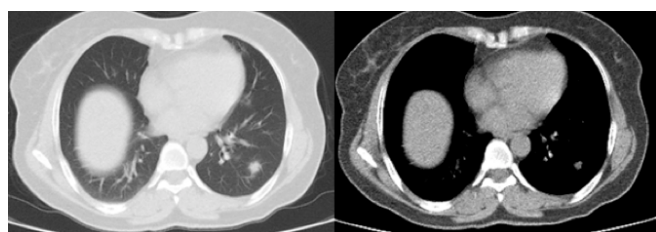


Figure 2. Thorax CT of a COVID-19 suspected patient showing a semisolid nodule.

Discussion

The COVID-19 pandemic established the routine of thoracic CT scans to assess viral pneumonia findings [2]. In this regard, the number of thoracic CT scans ($n = 5416$) performed in our center last year for a preliminary diagnosis of COVID-19 only in patients aged 45-75 is remarkable by itself. However, these procedures, along with the regular ones, burdened radiology units with an enormous reporting workload, inevitably prompting efforts at standardization and the development of assessment tools, such as the COVID-19 Reporting and Data System (CO-RADS) [7].

Although we evaluated the age range of 45-75 years in our study, patients aged 55-74 years and with a smoking history of more than 30 packs/year are considered high-risk in the NCCN guideline, while patients under the age of 50 and with a smoking history of less than 20 packs/year are considered low-risk [8]. Since we included patients who were evaluated in the emergency room and during the diagnosis of COVID-19, we could not reach the smoking history retrospectively, therefore,

we determined the upper limit as 75 years old in accordance with the guideline, while the lower limit was 45 years old. However, since this study aims to screen for pulmonary nodules and lung cancer in the general population of the population only through a specific sample, different evaluations that will be made independent of the age factor will also contribute to the literature.

At our center, we constantly review the effectiveness of CO-RADS and similar classification systems in the prognosis and decision process. However, all this endeavor concerning COVID-19 causes additional pathologies in thoracic CT scans to be overlooked during evaluations. This fact also constitutes a primary limitation in our study since we conducted our investigation based on CT reports retrospectively, not confirming additional pathologies. Nevertheless, reports inconsistent with tomographic images are not rare in clinical practice. A general literature review, coupled with the knowledge that a previous study had indicated the incidental pulmonary nodule frequency in Turkey as 21.8% for patients aged > 55 and nodules > 6 mm, implies that solely evaluating pulmonary involvement COVID-19 can be a limiting factor in detecting incidental nodules [9]. In addition, nodule rates were found to be 10-20% in studies conducted on CT report reading programs in 2014 and 2017 [10]. In another study, the rate of new nodules was observed to be 10% in the evaluation made in the follow-up of patients with cancer [11].

Another limitation is the patients' reluctance to observe the recommended follow-up program for nodules detected on their initial CT scans because of the COVID pandemic [12]. Most of our patients ($n = 52$) did not re-present to our hospital for follow-up, probably due to COVID-19-related fears. In addition, since there was no PET/CT and thoracic surgeon in our hospital at the time period for which the study is planned, it was possible for patients to apply to an external center and these data could not be accessed, so there is no data on the cases followed up in a further center. For this reason, although our study has value in terms of instant nodule detection, more efficient results can be obtained by conducting it in a center where all follow-ups are planned in terms of follow-up strategy and results. This study should be seen as a milestone at this point. According to the Fleischner 2017 guideline for solitary pulmonary nodules, while routine follow-up is not recommended

for nodules smaller than 6 mm, 6-12 months follow-up for 6-8 mm, CT or PET/CT and biopsy is recommended 3 months later for solid nodules larger than 8 mm. Routine follow-up is not recommended for subsolid and GGO nodules with sizes smaller than 6 mm too, and for subsolid nodules larger than 6 mm, 3-6 month CT controls are required, and for GGO nodules 3 to 5 years follow-up at 6-12 month interval [13]. Nodule follow-up and advanced imaging and diagnostic procedures to be performed under necessary conditions will increase the diagnosis of early-stage lung cancer [14].

The current literature mainly covers the common challenges and proposed solutions in pulmonary nodule screening during the COVID-19 pandemic and comprehends various cases thought to be nodules at first but later diagnosed with COVID-19 [15,16]. However, to our best knowledge, the present study is the first to evaluate thoracic CT scans taken for COVID-19 preliminary diagnosis in terms of additional pathologies.

Our study focused on the value of CT as a lung cancer screening program rather than the malignancy rates and clinical outcomes of the findings. Lung cancers typically have high survival rates and favorable surgical outcomes if diagnosed early. Early-stage lesions, particularly SPNs, do not cause clinical manifestations in the patient and are usually detected incidentally [17]. This fact increases the diagnostic value of thoracic CTs taken for other reasons [18].

In conclusion, the COVID-19 pandemic has significantly disrupted nodule screening. However, retrospective reassessment of scans and reports may potentially restore the effectiveness of pulmonary nodule screening programs. Any potential the pandemic presents for early diagnosis of lung cancer should be utilized. Our study also emphasized the importance of a holistic evaluation of imaging. Scrutinizing the thoracic CT scans taken for COVID-19 independent of their accompanying reports will offer benefits in detecting additional pathologies. We plan and suggest further studies to support this proposition.

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 institutional review board of Omer Halisdemir University, Faculty of Medicine (No: E-95860085_050.02.04-123708).

Authors' contribution

MÇ; conceptualized and designed the study, HT; collected and analyzed data. MÇ,HT; revised the final version of the manuscript and co-wrote the paper. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Original Article

The role of video-thoroscopic sympathectomy in Buerger and Raynaud

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ABSTRACT

Background: Buerger and Raynaud diseases are peripheral circulatory disorders that cause ulcers at fingers and affect the quality of life. The aim of this study is to detect the role of sympathectomy via video-assisted thoracoscopic surgery (VATS) in Buerger and Raynaud for an effective treatment.

Materials and Methods: Study was designed retrospectively on prospective data. Sympathectomy via VATS, was applied to 45 patients who were diagnosed as Buerger or Raynaud disease in a 6-years period. Patients were followed with 6 months intervals. Age, gender, initial symptoms, smoking habit, quality of life with the operation type, duration and hospital stay were recorded. After surgery all datas related to the patient were also noted at follow-up period.

Results: Ten of 45 patients were in Buerger disease group and 35 in Raynaud. After VATS, existing finger ulcers were regressed 100% and regression in symptoms was more than 70% for both diseases. For overall, progression in life quality was noted as more than 95% of patients. Median hospital-stay was 2 days. There was no mortality and serious complication. Pneumothorax was the most common complication.

Conclusions: In order to increase the life quality of the patients and prevent the tissue loss, sympathectomy seems the only satisfactory surgical method of treatment for Buerger and Raynaud diseases especially for the circularity disorders of upper extremities.

Keywords: Raynaud, Buerger, ulcerations, thoracoscopic sympathectomy

Introduction

Thromboangiitis obliterans (Buerger), is an inflammatory disease of mid-sized arteries that hold the vessels of upper and lower extremities and it is strongly associated with smoking. The diagnosis depends on angiography, doppler ultrasonography and tissue biopsy, the inflammation occludes all the layers as panarteritis and panphlebitis. Atherosclerosis is not observed in the occluded arteries. Although it was Leo Buerger [1] in 1908, who published a detailed description of the pathological findings on 11 amputated limbs and named the disease, Winiwarter [2] had mentioned the disease as endarteritis obliterans far before that date. Males between the ages of 25 and 40 are under a higher risk. The upper extremities have a risk ratio of 45%. The disease progresses through recurrences and exacerbations. Protecting the extremities from severe hot and cold weather etc., quitting use of tobacco products are the main factors for an effective treatment.

Raynaud's phenomenon is characterized by recurring vasospasm of the fingers and toes by paleness, redness after bruising-cyanosis, after being exposed to cold or emotional stress. It has been proven that blood does not enter the capillaries when this condition is observed with a microscope [3]. The diagnosis is based on the identification of the attacks. Raynaud phenomenon is classified as primary (Raynaud's disease) if there is not an underlying disease and secondary (Raynaud's syndrome) if another disease has been confirmed. This phenomenon was first described by Maurice Raynaud in 1862 and later studied by Thomas Lewis in 1930 [4].

In response to the effective factor, faintness develops in the fingers and hands; when the effective factor disappears, cyanosis evolves in 8-10 minutes, then chilblains are observed and spread to the whole hand within an hour. Paresthesia, sensation of tingling, trophic changes on the skin and the bones in the advanced stages, even a clinical picture progressing towards gangrene. Digital skin temperature measurement, plethysmography and capillary microscopy methods can be used for the local blood flow. The cold pressor test is also an easy diagnostic test [4-6]. Raynaud phenomena occurs more frequently in women (20-30%), particularly in younger age populations (teens to 20s) [7]. The objective of the treatment is to decrease the number and the severity of the attacks, to prevent the amputations and tissue damage. Lewis [4] claimed that the primary pathology of the disease existed

in the epitome of digital arteries which were affected by the sympathetic system. Hughes (8), described the endoscopic thoracic sympathectomy for the first time.

Handling with diseases includes preservation of the body temperature, using gloves and stockings, quitting smoking, decreasing emotional stress and exercising, vasodilators, antiaggregant agents, in some cases hyperbaric oxygen therapy as medical approaches [3,9]. However, sympathectomy seems the major surgical aspect. It should be applied in the case of vasospastic symptoms and superficial trophic disorders [10,11]. Despite the fact that the description of Buerger and Raynaud diseases has existed for almost 150 years, so far no consensus has been reached in respect to the classification, etiology, pathogenesis, diagnosis criteria and treatment methodology. There is an instability between the medical and surgical treatment that brings about a loss of time, the disenchantment of the patient's faith in receiving treatment, worse still the formation of irreversible pathologies.

Due to the role of vasospasticity and increase in sympathetic tone in etiopathogenesis of both diseases, we thought it would be appropriate to examine the results and effectiveness of sympathectomy in treatment in both groups of patients. In our study, we planned to demonstrate effects of surgery in the treatment of Raynaud and Buerger, including short and long-term results, side effects, and recurrence rates, on the basis of patient satisfaction.

Material and Methods

Study Group and Design

During the six-year period between 2005 and 2011, 45 patients, diagnosed with Raynaud and Buerger, were applied 75 thoracic sympathectomies with VATS. The study was planned retrospectively through prospective data. Patients were evaluated based on age, gender, smoking, duration of surgery, duration of hospitalization, treatment success, complications, follow-up and patient verbal reported satisfaction information.

In terminology for both Raynaud and Buerger, there is diversity in the naming that has come from the past and continues to the present day. We chose to define them as Raynaud and Buerger for the sake of consistency throughout our article, and to add a 'phenomenon' where appropriate, since it is considered a sign/symptom rather than a disease.

Although cold protection, sedatives, peripheral vasodilator drugs such as calcium channel blockers and pentoxifylline and nicotine stopped medical treatment, severe symptoms, ulcer development and risk of amputation were considered as criteria for inclusion in the study, with the definition of lack of response to medical treatment. While Raynaud patients were diagnosed with clinical history and cold application testing, Buerger patients were diagnosed with Doppler ultrasonography and angiography, while operation indication was determined according to the symptoms and findings of the patients. Our patients' hand temperatures during the preoperative period were measured. In the postoperative period, values were also measured and compared with preoperative values. Detection of complete drying and temperature increase in the hands at an early postoperative period was considered an indicator that sympathetic ganglia were effectively cauterized and sympathectomy was successful.

Follow-up period for patients was 1- 60 months. The patient was called for a check-up a week after sympathectomy. Long-term follow-up was either by control or by calling for re-changes in quality of life by the questionnaire in scoring between 0-5, before and after the surgery (reached a value of 0 is very distressed, very good with a value of 5 patient satisfaction). Surgeries were performed in the same thoracic surgery clinic and the author was the main or second surgeon. Study was approved by Ethic Committee of Vakıf Gureba Training and Research Hospital, registered by 2010-68/22. The work was carried out in accordance with the principles of the Helsinki Declaration, detailed information was given to all patients before ETS and informed consent forms were signed by patients.

Surgery

Under double-lumen intubated general anesthesia, all patients were administered a single-session endoscopic thoracoscopic sympathectomy (ETS) operation. In Raynaud 30 were bilaterally and surgery was started firstly with the right side, In Buerger patients the symptomatic side was the incision side. By a single port, with a 30-degree videothoracoscope, cauterization was used for T2-3-4, and rarely T5 ganglions. The efficacy of ETS is tested intraoperatively with the presence of dryness and increased heat in the hands just after the

sympathectomy. Both lungs were expanded under a high pressure by the anesthesiologist at the end of the operation, the air was taken out, and without placing a chest tube, the incisions were sutured. Postoperative chest x-ray was in routine.

Statistical Analysis

The data obtained was analyzed statistically by using the SPSS for Windows® (V.11.0; SPSS, Inc., Chicago, Illinois, USA). Descriptive data of the effects of the same post-treatment (sympathectomy) data in two specific close-up diseases between certain years are shared. The entire universe that came to our clinic in the specified years was taken. Power was not calculated because there was no two-group comparison. Mean time to relapse was evaluated by Kaplan-Meier survival analysis. In descriptive analyses, the continuous variables were given as mean-standard deviation and categorical ones indicated as percentages and counts. Differences between the groups for categorical variables were analyzed using Chi Square test or Fisher's Exact test. Difference between two dependent groups was evaluated by paired t test. P value less than 0.05 was considered significant.

Results

The age-range of 45 patients who did not response to medical treatment, was 15-76, the mean was 39.5 ± 18.5 . While the age-range in the Buerger group was 26-76, with a mean of 47.4 ± 21.3 , the age-range in the Raynaud group was 15-62 and mean of 36.7 ± 14.6 . Thirty-five patients were Raynaud and 10 were Buerger patients. In total, 29 patients (64.4%) were male. In separately examining of the groups, the male sex was also seen more. It was noted that 27 out of 45 patients smoked an average of 15 ± 10 packs/year, between 2-35 packs. All 10 patients with Buerger and 17 of Raynaud patients were smoking (Table 1).

Table 1. Sex and smoking data of Buerger and Raynaud patients.

Sex	Disease		
	Buerger n=10 (22.2%)	Raynaud n=35 (77.8%)	n=45
Male	8 (80%)	21 (60%)	29 (64.4%)
Female	2 (20%)	14 (40%)	16 (35.6%)
Smoking	10 (100%)	17 (48.5%)	27 (60%)
<i>p = 0.29 Fisher's Exact Test</i>			

It was realized that 42 of 45 (93.3%) patients had an increase in complaints about cold-contact. When symptoms are evaluated, there was redness in the 31 (68.9%) of the patients, in addition to this, there was excessive sweating complaints in 14 of them (31.1%). A total of 45 patients were applied 75 sympathectomies, including 30 patients with Raynaud bilaterally, the rest 5 patients and 10 patients with Buerger unilaterally. The left sympathectomy was applied to 10 patients (22.2%) applied to a single-sided operation (22.2%), the right of it was applied to 5 patients (11.1%). In 27 patients (60%) T2-3-4 level ganglions, in 18 patients (40%) T2-3-4-5 levels were cauterized (up to 4 cm to eliminate the fibers of Kuntz).

The surgery period was between 15-70 minutes, meanly 41 ± 15 . As a surgical complication; in 16 cases (21.3%) of pneumothorax developed of 14 of needed tube thoracostomy. In 1 patient (2.2%) bronchospasm and respiratory-failure developed and improved with 16 hours of mechanical ventilation support. Mortality wasn't observed. Duration of staying in hospital was 1-18 days and it was noted as a mean of 2 days. The five fingers' temperatures on the diseased side were measured separately pre and postoperatively. The average values were compared. The hand temperature was measured as a mean of preoperative 34 ± 0.86 , as postoperative 35.3 ± 0.87 . The 1.3°C increase in heat was found to be significant. This has shown that sympathectomy is effective at the applied levels (Figure 1).

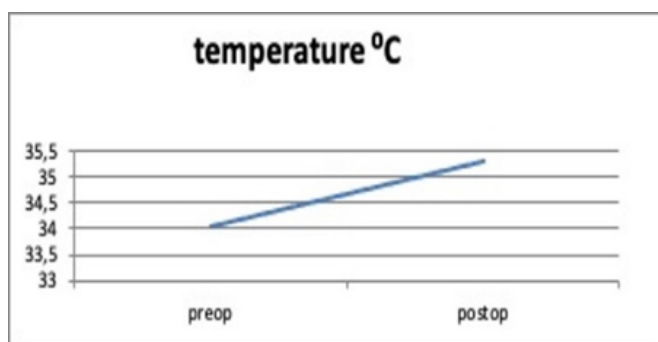


Figure 1. Distal temperature difference. In all of the patients, the temperature values of all fingers on the symptomatic side were measured in the preoperative. Mean values were compared with the measurement of postoperative 1-2 hours. The preoperative hand temperature was 34 ± 0.86 meanly, while the postoperative hand temperature was measured 35.3 ± 0.87 . The increase in temperature was found statistically significant ($p = 0.003$) ($p = 0.003$, paired samples test).

In the follow-up of 45 patients, when preoperative and postoperative-life quality surveys were compared, it was stated that life quality of 15 patients (33.3%) was bad before surgery, 30 patients (66.6%) of life quality were worse, besides, one of the postoperative patients (2.2%) declared he hadn't got any benefit of surgery, another 1 patient (2.2%) was worse compared to before. Regarding these cases, it was found that all patients with the disease of Buerger and Raynaud are 95.6% successful in improving the quality of life after sympathectomy.

In the preoperative period, 22 patients (48.9%) with ulcer complaint (48.9%) of 11 (24.4%) only in one finger, of 6 (13.3%) on two fingers, of 4 (4%) on three fingers and 1 patient (2.2%) more than four ulcers on both hands had diagnosed. In postoperative follow-up, 22 patients' ulcers which existed before sympathectomy healed of all (100%); however, due to both the patient's exposure to external factors (hot- cold difference, smoking) and the clinical progress of the disease, it was observed that ulcers developed on the other fingers which didn't exist beforehand. New ulcer development was observed in 6 (60%) of 10 Buerger and 8 (66.6%) of 12 Raynaud patients with ulcers. While 14 (63.6%) of the 22 ulcerated patients in our study group had recurrent ulcers in new localizations, 8 (36.4%) patients had no recurrence. If the remaining 8 patients become completely non-ulcerative is accepted as complete recovery, our success rate is 36.4% (Table 2, Figure 2).

Table 2. Results of Raynaud and Buerger patients with ulcer signs, after sympathectomy.

Ulcer		Buerger	Raynaud	Total
Preoperative (+)		10	12	22
Postoperative (-)		0	0	0*
Same finger				
Postoperative (+)	n	6	8	14
Different finger	%	60	66.7	63.6**
Ulcer healing rate	n	4	4	8
	%	40	33	36.4***

*Can not say whether there is statistical significance or not, ** $p = 0.89$ Pearson Chi Square Test, *** $p = 0.57$ Fisher's Exact Test

In this table, we show statistically that the Buerger and Raynaud groups are similar and there is no difference between the groups

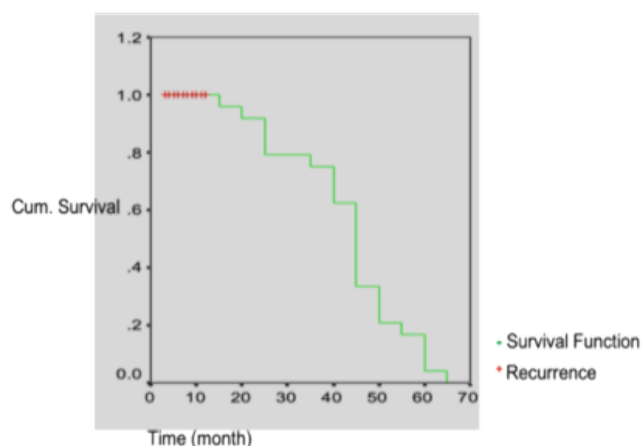


Figure 2. Graph of the development time of recurrent symptoms in patients without ulcers.

This non-mortal procedure has more than 70% complete symptom improvement in Raynaud's patients and 100% success in target finger improvement in ulcerated patients. In addition, in terms of improving quality of life, our overall success is above 95%, even a subjective assessment.

A whole recovery and progress have been succeeded in the patients of 33% with ulcer and Raynaud's. As for the patients with no ulcer, the perfect success in the form of recovery and improvement of the symptoms has been 70% and whereas the partial success is 30%. In the survey of quality of life, 95.6% of the patients have indicated that they feel better and gave a higher score. The complete success of sympathectomy in the patients with Buerger's has been assessed as 40% for the cases with ulcers (Figures 3-5). The symptom recovery rate could not be determined as there were no cases without ulcer and according to the survey of quality of life, success was again 95.6%.



Figure 3. Healing process of a Buerger's patient with ulcer is shown preoperatively.

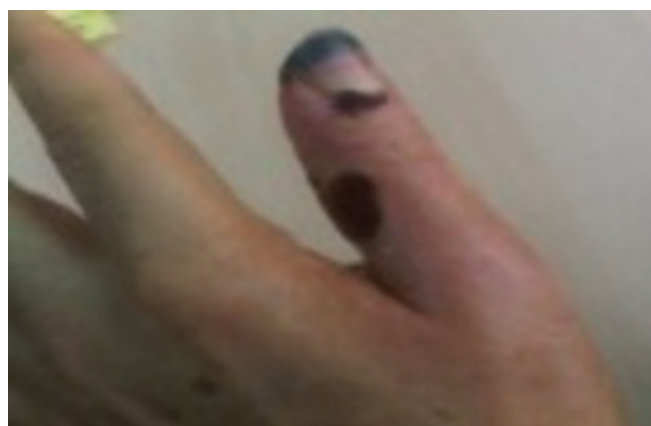


Figure 4. Healing process of a Buerger's patient on day 10 postoperatively.



Figure 5. Healing process of a Buerger's patient at 3rd year after sympathectomy.

Discussion

Due to the role of vasospasticity and increase in sympathetic tone in etiopathogenesis of both and the fact that they are known to be effective in their treatment, we examined the results of sympathectomy with VATS, which is considered the most effective option in surgery in both groups of patients. During an attack, radial and ulnar pulses are clearly received. It is accepted by all authorities that the main pathology begins with vasoconstriction in arterioles and metarterioles [3,8,9]. In Buerger patients, histopathological disorders are constantly present. In the clinic, it is in a state of attacks, often starting at the tip of the nail and can deepen to gangrene. Doppler and angiography are important in diagnosis, especially in differentiation with atherosclerosis. In addition, a positive cold test indicates the place of sympathetic activity in both diseases and sympathectomy in treatment [10-12]. In our study, Raynaud patients were diagnosed with cold water testing technique and Buerger patients were diagnosed with angiography.

In studies, 2% of Buerger patients were women, and in Raynaud patients, this ratio was 85% [3,9]. In contrast to the literature in our study, 21 (60%) of the 35 patients with Raynaud's were male and 14 (40%) were female. Of the 10 patients with Buerger, 8 (80%) were male and 2 (20%) were female. Buerger patients were often 25-40 years old, and Raynaud was of asthenic, anemic types under the age of 40 [3,9] while the mean age in our group was 39.5 years old.

The main factor in treatment is the cessation of smoking. In his study, Van Damme [6] showed the importance of quitting smoking before treatment, 16 of 29 Buerger patients had good postoperative results, and 9 of these patients stopped smoking. In our study, the return symptoms were accelerated in both Raynaud and Buerger patients who continued to smoke. In our series, 27 patients smoked a mean of 15 packs/year, and 11 patients quit smoking. In follow-up, we noted that 4/10 (40%) of Buerger patients and 12/35 (33%) of Raynaud patients continued to smoke.

In the medical treatment of Raynaud's and Buerger diseases, cold protection consists of sedatives, peripheral vasodilator drugs, such as calcium channel blockers and pentoxifylline, and the cessation of nicotine [3,9]. We performed 75 endoscopic thoracic sympathectomies (ETS) on a total of 45 patients who did not respond to medical treatment. We performed bilateral sympathectomy on 30 of the 35 patients with Raynaud's. The rest of 5 patients and 10 patients with Buerger had sympathectomy on the side of the symptom and/or ulcer. In the first sympathectomy session, bilateral sympathectomy can be performed, considering progression and continuity of sympathetic hyperactivity, as well as the operation can be performed only on the side of the findings. Thoracoscopic technique shows differences. In the use of clips compared to the cauterization method, there may be a dislocation of the clip, a incomplete clipping of the chain, and inappropriate ganglion localization. In patients, the goal is complete sympathetic blockade and the risk that the clip may fail by sliding should not be taken. Although it is not in routine use, there are reports about chemical sympathectomy [13], in our study, we applied thoracic sympathectomy to all of our patients with cauterizing via thoracoscope.

In different publications, authors have reported that

they cauterize T2-4 level ganglia and considered them appropriate when evaluating their results [12-15]. In our study, 27 (60%) of 45 patients had T2-3-4 ganglia, and 18 patients (40%) had T2-3-4-5 the ganglia were cauterized, and at these levels it was found that complete sympathetic blockade of the upper extremities could be achieved. In our study, a mean value was found by measuring heat on the diseased side, preoperative five fingers of each hand separately, and this value was compared with the postoperative one. The increase in temperature of 1.3°C was found to be significant. This suggests that sympathectomy is effective at the levels administered.

The most common complication associated with the procedure was minimal pneumothorax, was also top in our study with 16 patients (21.3%). In one patient developed bronchospasm and respiratory failure and required 16 hours of mechanical ventilation support (2.2%). Looking at the duration of hospital stays, it was recorded as the shortest 1 and the longest 18 days. The mean was 3.4 days. Eleven patients (24.4%) were discharged on the first day of postoperative and 7 patients were discharged on the second day. We believe that patients who have not trouble checking after the procedure can be discharged on the day of surgery, so VATS sympathectomy can be performed in the form of daily surgery.

A study by Lorenzo et al [14], found no satisfactory results after sympathectomy of patients with Buerger. In contrast, success in ulcer healing was rated at 85% and in symptom improvement at 14% in a literature survey involving 30 years in the publications of Coveliers et al [16]. In the early period after sympathectomy, local blood flow increases by 8 times and provides an increase in heat, and the O₂ gradient increases due to the opening of shunts. But after 2-3 months, when the late effects are examined, they fall to the preactive level and relapse occurs [12]. The 100% recovery rate of initial ulcers should also not be decimated. Our follow-up period is between 1 and 60, a median of 32 months, and the return of symptoms is meanly 8 months. This non-mortal procedure has more than 70% complete symptom improvement in Raynaud's patients and 100% success in target finger improvement in ulcerated patients. In addition, in terms of improving quality of life, our overall success is above 95%, even a subjective assessment.

In conclusion bilateral or one-sided blockage of the thoracic ganglia is achieved fully via thoracoscopic sympathectomy technique. It can be proved that the ganglia have been deactivated (sympathectomy) by digital temperature measurement. The changes in the temperature clearly show the circulation of the skin. Although the symptoms of some patients with Raynaud's disease return after the VATS sympathectomy, there is a considerable decrease in their intensity and frequency; the success of the treatment is; 70% full and 30% partial recovery in the symptoms, 100% recovery in the chronic ulcers and 33% recovery in the overall ulcers. Thoracoscopic sympathectomy can be advised for all of the Raynaud cases. The success of VATS sympathectomy for Buerger's is 100% recovery of chronic ulcers and 40% recovery of the overall ulcers. VATS sympathectomy is suitable for the Buerger's patients with ulcer. Referring to our study we can say that among 30-40% of the patients with Buerger's and Raynaud's, the patients can be free of disease and saved from amputation with the help of VATS sympathectomy. Cauterization of T2-3-4 ganglia seems enough for a satisfying result.

Sympathectomy via VATS increases the quality of life considerably in Buerger's and Raynaud's and should be considered a final choice for those who are resistant to medical treatment and have severe symptoms and/or serious complications with an impaired quality of life. Although the possibility of the recurrence especially in symptoms must be kept in mind, VATS sympathectomy is a harmless surgical operation without mortality and with tolerable minor complications, short hospitalization after a short and minimally invasive surgery, it is a comfortable treatment period and does not exhaust the patient.

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Ethics approval

The study was approved by the Ethic Committee of Vakıf Gureba Training and Research Hospital, registered by 2010-68/22.

Authors' contribution

UT; collected/analysed data, and wrote the whole manuscript.

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Original Article

Factors affecting survival after resection of stage IIB non-small cell lung cancer

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ABSTRACT

Background: Our aim in this study was to evaluate prognostic factors affecting survival and disease-free survival (DFS) in the subgroups of stage IIB NSCLCs.

Materials and Methods: Patients with stage IIB NSCLC who underwent surgery in our hospital between January 2006 and December 2015 were included in the study. The patients were evaluated in two groups: T3N0 patients staged as IIB due to pN0 (Group A) and T1N1/T2N1 patients (Group B).

Results: Of the 192 patients were included in the study. There were 47 patients in group A (24.5%) and 145 patients in group B (75.5%). 5-year survival rates was 58.2%. There was no statistically significant difference in survival according to T stage. The 5-year survival rates in the T1, T2, and T3 groups were 69%, 55.3%, and 54.6%, respectively ($p = 0.34$). The main prognostic factors affecting survival were advanced age ($p = 0.02$). The mean DFS was 72 months and the 5-year DFS rate was 54%. Advanced age and male sex, were identified as poor prognostic factors for DFS ($p < 0.005$).

Conclusions: The stage IIB category remains heterogeneous despite the updated eighth edition IASCL staging system. The results of our study indicate that age was the main prognostic factors affecting survival in stage IIB NSCLC. However, the effect of visceral pleural invasion and lymph node involvement on survival in stage IIB subgroups was not detected, more comprehensive multicenter studies are still needed.

Keywords: lung cancer, stage IIB, survival, prognostic factors, pleural invasion

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Introduction

Lung cancer currently ranks first in cancer-related deaths [1,2]. Surgical resection is the main treatment method for early non-small cell lung cancer (NSCLC). However, stage IIB NSCLC represents a heterogeneous group of tumors. One of the biggest changes in the eighth edition of the International Association for the Study of Lung Cancer (IASLC) classification for lung cancer was moving the group labeled stage IIA in the seventh edition to stage IIB, while the classification of TIIB (> 5 cm) in the seventh edition is regarded as T3 in the new staging. However, the other T3 factors of a second tumor in the same lobe and parietal pleural invasion remained unchanged. Therefore, patients who were previously considered stage IIA (TIIBN0M0) were included in stage IIB (T3N0M0). This resulted in considerable heterogeneity in the stage IIB group in the eighth edition of the staging system [3]. According to the eighth edition of the IASLC TNM classification, stage IIB includes 3 different subgroups: T1N1, T2N1, and T3N0 [4]. Due to this heterogeneity, there have been publications suggesting that the factors of T stage and N stage have different effects on survival [5]. The present study aimed to evaluate factors affecting survival and prognosis in this heterogeneous group.

Our objective was to evaluate prognostic factors associated with survival and disease-free survival (DFS) in the subgroups constituting stage IIB NSCLC.

Materials and Methods

Patients who underwent surgical resection of stage IIB NSCLC in our hospital between January 2006 and December 2015 were included in the study. The study was designed retrospectively. Patients who did not receive adjuvant therapy (poor general condition or refused treatment), who received neoadjuvant therapy and were down-staged, or who underwent nonanatomical resection and incomplete resection were excluded from the study. Patients who underwent sleeve resection and had invasion of the chest wall were classified as extended resections. The included patients were evaluated in 2 groups. The first group consisted of pT3N0 patients staged as IIB due to pN0 (group A), while the second group comprised pT1N1 and pT2N1 patients (group B). Sufficient sample size calculated as 88 patients (44 for each group), alpha value was 0.05, Beta value was 0.02 and the power value of the study calculated as 0.8. The

study was approved by the institutional review board and conducted in accordance with the principles of the Declaration of Helsinki (2020-62).

Patient Selection

Preoperatively, all patients underwent thoracic computed tomography (CT) evaluation as well as positron emission tomography (PET/CT) and cranial magnetic resonance imaging (MRI) for the evaluation of distant metastases. Pulmonary function testing was performed for assessment of pulmonary reserve. Echocardiographic examination was done and the cardiology department was consulted for patients who were > 60 years of age or had a history of cardiac disease. Fiberoptic bronchoscopy was also performed preoperatively to evaluate endobronchial lesions.

The patients underwent curative lobectomy or pneumonectomy. Preoperative mediastinal staging was performed with endobronchial ultrasound bronchoscopy with transbronchial needle aspiration or mediastinoscopy in patients who had mediastinal lymph nodes greater than 1 cm on thorax CT and/or mediastinal hilar pathological uptake of 18-FDG on PET/CT during preoperative period.

Mediastinal lymph node dissection including at least 3 stations was performed. Routine sampling of the paratracheal and subcarinal lymph nodes was done in right-side operations, while the subaortic, paraaortic, and subcarinal lymph nodes together with the other mediastinal and hilar lymph nodes were sampled in left-side operations. Pathologic staging was based on the eighth edition of the IASLC classification [6].

Follow-up information was obtained from all patients through office visits or from their primary physicians. In collaboration with the oncology team, patients were followed by chest CT and physical examination every 3 months for the first 2 years, every 6 months from 2 to 5 years, and once a year thereafter. All patients had postoperative consultation with the oncology department and received adjuvant chemotherapy. Because the study was retrospective and molecular testing is not covered by social insurance, this analysis was not done for all adenocarcinoma patients.

Statistical Analysis

Descriptive statistics were used to summarize demographic and clinical data, and relationships between

categorical data were evaluated using chi-square (χ^2) or Fisher's exact test. Student's t and Mann–Whitney U tests were used for continuous variables. Overall and disease-free survival were evaluated by Kaplan–Meier analysis and factors were compared using log-rank analysis. P values less than 0.05 were considered statistically significant. All analyses were done using SPSS (version 22, IBM Corp., Armonk, NY, USA) package software.

Results

A total of 192 patients were included in the study. Of these, 8 (4.2%) were women and 184 (95.8%) were men. The mean age of the patients was 59.3 ± 8.4 years. There were 47 patients in group A (24.5%) and 145 patients in group B (75.5%). In terms of operative characteristics, 87 patients (45.3%) had right-side resections and 105 patients (54.7%) had left-side resections; 147 patients (76.6%) underwent lobectomy and 45 (23.4%) underwent pneumonectomy. Chest wall resection was performed in 6 patients (3.1%) and sleeve resection in 17 patients (8.9%). The mean tumor diameter determined after resection was 4.1 ± 1.5 cm. Postoperative pathologic

diagnosis was adenocarcinoma in 67 patients (34.9%), squamous cell carcinoma in 123 patients (64.1%), and adenosquamous cell carcinoma in 2 patients (1%). Comparison of demographic characteristics between groups A and B revealed statistically significant differences in age, visceral pleural invasion, and histopathology ($p < 0.05$). The demographic and operative characteristics of the patient groups are shown in table 1.

Median survival time was 89 months; 5- and 10-year survival rates were 58.2% and 43%, respectively. Median follow-up time was 68 months. There was no statistically significant difference in survival according to T stage. The 5-year survival rates in the T1, T2, and T3 groups were 69%, 55.3%, and 54.6%, respectively ($p = 0.34$). The main prognostic factors affecting survival were advanced age ($p = 0.02$). Table 2 shows prognostic factors associated with survival.

The mean DFS was 72 months and the 5-year DFS rate was 54%. Advanced age and male sex, were identified as poor prognostic factors for DFS ($p < 0.005$). Prognostic factors affecting DFS are shown in table 3.

Table 1. Comparison of demographic and histopathological characteristics between the groups.

Variable		Group A		Group B		p value
		n	%	n	%	
Age (years), mean $\pm$ SD		61.6 $\pm$ 7.3		58.5 $\pm$ 8.6		0.019
Age (years)	<65	28	59.6	107	73.8	0.064
	$\geq$ 65	19	40.4	38	26.2	
Sex	Male	46	97.9	138	95.2	0.682
	Female	1	2.1	7	4.8	
Side	Right	24	51.1	63	43.4	0.362
	Left	23	48.9	82	56.6	
Operation	Lobectomy	47	100	100	69	<0.001
	Pneumonectomy	0	0	45	31	
Resection type	Standard	40	85.1	129	89	0.479
	Extended	7	14.9	16	11	
Histopathology	Adenocarcinoma	28	59.6	39	26.9	<0.001
	Squamous cell ca	19	40.4	104	71.7	
	Adenosquamous cell ca	0	0	2	1.4	
Visceral pleural invasion	No	22	46.8	103	71	0.002
	Yes	25	53.2	42	29.5	

Bold values indicate statistical significance ($p < 0.05$)

Table 2. Factors associated with survival.

Variables		5-Year Survival (%)	Median survival	Univariate (months)	Multivariate HR (95% CI)	p
Age (years)	<65					
	≥65	47.7	59	0.019	1.5 (1.0-2.3)	0.028
Sex	Male	56.4	85			
	Female	100	106	0.035		
Side	Right	59.5	94			
	Left	57.1	85	0.829		
Histopathology	Squamous cell ca	50.3	74			
	Adenocarcinoma	62.6	91	0.299		
Stage	Group A	54.6	67			
		59.3	91	0.885		
T Stage	1	69	99			
	2	55.3	88			
	3	54.6	67	0.347		
Visceral pleural invasion	No	58.6	101			
	Yes	47.8	71	0.039		
N1 status	Single-station N1	63.3	99			
	Multi-station N1	51.1	73	0.138		
Operation	Lobectomy	59.7	91			
	Pneumonectomy	53.3	73	0.316		
Resection Type	Standard	56.1	92			
		73.9	96	0.172		

Bold values indicate statistical significance (p < 0.05)

Table 3. Factors associated with DFS.

Variables		5-Year Survival (%)	Median Survival (months)	Univariate p	Multivariate HR (95% CI)	p
Age (years)	<65	58.3	91			
	≥65	40.4	48	0.007	1.6 (1.1-2.4)	0.010
Sex	Male	52	84			
	Female	100	105	0.024		
Side	Right	44.7	64			
	Left	57.1	74	0.983		
Histopathology	Squamous cell ca	61	42			
	Adenocarcinoma	38.9	90	0.125		
Stage	Group A	52.5	61			
	Group B	54.5	78	0.815		
T Stage	1	61.9	85			
	2	51.5	74			
	3	52.5	61	0.540		
Visceral pleural invasion	No	55.7	90			
	Yes	46.3	47	0.045		
N1 status	Single-station N1	57.1	90			
	Multi-station N1	48.9	60	0.265		
Operation	Lobectomy	56.3	78			
	Pneumonectomy	46.7	57	0.225		
Resection Type	Standard	51.3	84			
		73.9	90	0.185		

Bold values indicate statistical significance (p < 0.05)

Discussion

Stage IIB tumors have always been controversial in lung cancer staging due to the heterogeneity of this group. In particular, factors affecting survival and recurrence prognosis vary [5,7]. Of these factors, the most controversial are older age, pleural involvement, and T and N status.

Especially in lung cancers, age is among the most important prognostic factors for survival [8,9]. Liu et al [10] showed that the survival rate decreased with higher age in patients with pathological stage N1 disease. In contrast, Sayan et al [5] reported that age was not a prognostic factor in overall survival in stage IIB patients. In our study, the 5-year overall survival rate was 62.8% in patients under 65 years of age and 47.7% in patients aged 65 and older. Similarly, DFS was significantly shorter in patients over 65 and advanced age was identified as a significant prognostic factor in multivariate analyses.

Visceral pleural invasion is one of the most heterogeneous factors in the prognosis of stage IIB tumors. Some studies have indicated it to be a significant prognostic factor even in early-stage lung cancer [11-15]. Jiwangga et al [16] also showed that bilateral pleural seeding metastasis was the most common recurrence pattern in stage I lung cancer patients with visceral pleural invasion. In 2019, Shin et al [3] determined that visceral pleural invasion was a poor prognostic factor for recurrence and survival in their study of 122 patients diagnosed with stage IIB (hazard ratio: 1.940). Endo et al [17] reported the DFS rate as 48.6% in stage IIB disease and showed that the most important cause of recurrence was visceral pleural invasion. Van Velzen et al [18,19] and Yin et al [18,19] similarly concluded that visceral pleural invasion is a poor prognostic factor for stage IIB NSCLC. In the present study, the 5-year DFS rate was 46.3% in patients with visceral pleural invasion compared to 55.7% in patients without visceral pleural invasion ($p < 0.05$). Visceral pleural invasion was also found to be the most important factor in terms of recurrence, as in previous studies [5,18]. Consequently, the detection of visceral pleural invasion in stage IIB patients emerged as the most important factor in terms of recurrence follow-up. However, when multivariate analysis was performed, it was found that visceral pleural invasion did not affect survival.

Deterbeck et al [4] reported a survival rate of 56% among patients with pathological stage IIB as in their eighth edition staging system study. In a study comparing the differences between seventh and eighth edition TNM classifications, Goldstraw et al [6] determined the respective 5-year survival rates as 47% and 53% for the stage IIB subgroup. In their comparison of stage IIB subgroups, Asamura et al [20] observed 50% survival of T1N1M0 patients and 38% survival of T3N0M0 patients and reported that tumor diameter was the most important prognostic factor for survival. Dai et al [21] also stated that N status is an important factor for survival and the presence of ≥ 3 N1 lymph nodes is a poor prognostic criterion. However, Maniwa et al [22] did not detect any effect of metastatic lymph node count on survival in N1 patients. In the present study, 5-year overall survival rates were 58.2% among all patients and 69.0%, 55.3%, and 54.6% for T1N1, T2N1, and T3N0 patients, respectively ($p = 0.34$).

Cerfolio et al [23] reported that patients with histopathological diagnosis of adenocarcinoma had higher survival rates compared to other histopathological types. Survival was also longer for squamous cell carcinoma patients than adenocarcinoma patients in the present study (50.3% vs. 62.6%) but the difference was not a statistically significant ($p = 0.29$).

There are differing views on the association between extent of resection and survival in the literature. Patients who undergo pneumonectomy were reported to have poorer survival outcomes [5,24-26]. Sayan et al [5] determined that stage IIB patients who underwent lobectomy and segmentectomy had better survival outcomes compared to those who had pneumonectomy and chest wall resections ($p < 0.05$). Alexiou et al [27] emphasized that although pneumonectomy was associated with worse operative mortality compared to lobectomy, there was a favorable impact on survival. Unlike other publications, Dai et al [21] observed no survival difference between lobectomy patients and pneumonectomy patients ($p = 0.399$). Sezen et al [28] also reported no prognostic relationship between extent of resection and survival in geriatric patients. In contrast to many studies in the literature, resection type was not found to have an effect on survival in the present study. We attribute this to patient selection and believe that patients' performance status influences their survival outcomes.

The main limitation of the study is that attempting to generalize results obtained from a small patient group creates bias. In addition, the retrospective nature of the study, underrepresentation of the female sex, and the inclusion of operations performed by different surgeons.

In conclusion the stage IIB category remains heterogeneous despite the updated eighth edition IASCL staging system. The results of our study indicate that age was the main prognostic factors affecting survival in stage IIB NSCLC. However, the effect of visceral pleural invasion and lymph node involvement on survival in stage IIB subgroups was not detected, more comprehensive multicenter studies are still needed.

Declaration of conflicting interests

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Ethics approval

The study was approved by the institutional review board of Health Sciences University Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital (No: 2020-62).

Authors' contribution

CA; performed the analysis, co-wrote the paper, contributed data or analysis tools, CBS; conceived and designed the analysis, performed the analysis, co-wrote the paper. MVD, LC, MM, MAB; contributed data, co-wrote the paper, NY, VE; collected the data.

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Original Article

The importance of N1 lymph node dissection in non-small cell lung cancer

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ABSTRACT

Background: Not all of the N1 lymph nodes are routinely dissected during surgical resection of non-small cell lung cancer (NSCLC). The aim of our study is to determine the risk factors for N1 lymph node metastasis in NSCLC with peroperative dissection.

Materials and Methods: Patients who underwent lung resection in our hospital between September 2014 and April 2016 were retrospectively included in this study. Resected specimens were dissected in the operating room by the surgeon before being put into formaldehyde solution. Patients were divided into three groups: with a single positive N1 node (Group 1), with multiple positive N1 nodes (Group 2), and with single or multiple positive N1 nodes and incidentally positive N2 nodes (Group 3).

Results: Fifty patients were included (46 males, 4 females). Univariate analysis showed significant correlation between N1 positivity and left-sided tumor, left central mass, squamous cell carcinoma, maximum standardized uptake (SUVmax) on positron emission tomography (PET/CT), pneumonectomy, and tumor size ($p < 0.05$). Logistic regression showed that the risk of N1 involvement was higher for squamous cell carcinoma compared to adenocarcinoma in all three groups.

Conclusions: Left central mass, squamous cell carcinoma, SUVmax ≥ 10 , uptake in hilar lymph nodes on PET-CT, and tumor diameter > 3.5 cm correlated with single or multiple positive N1 nodes in our study. Specimen dissection in patients with such preoperative findings could improve the accuracy of pathological nodal staging, thus refining the assessment of prognosis and selection of patients who would benefit from adjuvant therapy.

Keywords: lymph node dissection, lymphatic metastasis, non-small-cell lung carcinoma, surgical pathology, thoracic surgery

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Introduction

In the 8th edition of the TNM Staging System for lung cancer, there are changes in the classification of T and M groups. The changes in these two groups affect prognosis [1]. However, one of the most reliable factors in the prognosis of lung cancer patients and in determining optimal treatment options is the lymph node status. A publication, which is also mentioned in the 8th TNM edition manual, propose changes to N classifications [2].

In the surgical treatment of non-small cell lung cancer (NSCLC), mediastinal lymph node dissection is performed after resection. However, not all of the N1 lymph node stations are routinely dissected during surgery. In order to determine the correct stage, immediately after the surgery, the N1 lymph nodes on the lesion may be dissected by the surgeon before the specimens are put into formaldehyde solution and sent to pathology. Dissection of all N1 lymph nodes during an operation is inconvenient, because this may extend the duration of the operation and jeopardize the surgery. The idea behind dissecting the specimens before placing them into formaldehyde solution is that formaldehyde may affect the structure of lobes, reduce their volume, and cause possible false negative results in N1 lymph nodes. For this reason, we believe that the dissection of N1 nodes of the peripheral zone (stations 12-14) should be performed by the surgeon, not the pathologist.

This study aimed to determine the risk factors for involvement of one or more N1 lymph nodes of the hilar/interlobar (stations 10 and 11) as well as peripheral (stations 12, 13 and 14) zone acquired by dissection of fresh specimens prior to formaldehyde fixation.

Materials and Methods

Patient selection

After giving informed consent, patients who underwent pulmonary resection for NSCLC with thoracotomy or video-assisted thoracoscopic surgery (VATS) between September 2014 and April 2016 were retrospectively included in the study. All patients had positron emission tomography (PET / CT) scans before the operations. All patients were also diagnosed with NSCLC before the surgery. Patients with known N2, synchronous tumor, distant organ metastasis; who had undergone sublobar resection, neoadjuvant chemotherapy, and/or radiotherapy; who had wedge resection during the lobectomy; or who had a T4 tumor and/or those on whom a complete resection could not be performed were not included in the study. Approval was obtained from scientific

research committee of University of Health Sciences, Istanbul Sureyyapasa Chest Diseases and Thoracic Surgery Research and Training Hospital.

Technique

Mediastinoscopy was performed at the time of resection on patients suspected to be N2-positive. These include patients who have a ≥ 2.5 maximum standard uptake value (SUVmax) at mediastinal lymph nodes on PET/CT or centrally located tumors. Pulmonary resection was performed via VATS or thoracotomy in patients who had no clinical evidence of N2 disease. After the resection, the lobectomy or pneumonectomy specimens were dissected in another area in the operating room without being placed in the formaldehyde solution. Care was taken to preserve the integrity of the lesion and total removal of the N1 lymph nodes. The dissection was performed from the center to the periphery. The parenchyma over the bronchus was opened by beginning with the bronchus located in the most central duct (right or left main bronchus for pneumonectomy, lobar bronchus for lobectomy) to the periphery. The bronchus was not cut during any dissection. The N1 lymph nodes located between the bifurcation regions of the bronchi were dissected. The Mountain-Dressler nodal map was used to identify lymph node stations and assign the individual resected nodes [3]. All of the lymph nodes were dissected one by one and put into separate containers filled with formaldehyde to send to pathology.

Patient groups

The patients were evaluated in three groups. The first group included patients who were identified by the dissection as being positive for only a single N1 node. The second group included patients identified by the dissection as having more than one N1-positive node. The third group included the patients with single or multiple positive N1 nodes and incidentally positive N2 nodes. The numbers of patients in each group was determined according to the distribution of lymph node status during the study period.

The following parameters were included in the analysis: Age, sex, side, systemic disease, history of previous surgeries, history of smoking, forced expiratory volume (FEV1), tumor localization and diameter on computed tomography (CT), tumor uptake and hilar lymph node involvement on PET/CT (SUVmax ≥ 2.5), tumor type, tumor differentiation, tumor grade, invasion of visceral pleura, mediastinoscopy result, N1 dissection, N1 positivity status, N2 positivity status, N1 positivity accord-

ing to different resected segments and centrally located tumors, resection type, duration of operation, duration of dissection, tumor stage according to the 8th TNM Staging System, morbidity, 30-day mortality [1].

In tumors involving more than one lung segment, the segment where the tumor occupies a larger proportion was chosen. Masses the origin of which could not be precisely determined due to the centralization of the mass were named central masses. Tumor SUVmax cut-off value was determined as 10 and above, vs. below 10 according to the median value of SUVmax. Plus tumor diameter cut-off value was determined as 3.5 cm according to the median value of the tumor.

From the perspective of localization, it was observed that N1 positivity was more frequent in the left upper lobe apicoposterior segment, as well as in cancers involving both the left upper lobe apicoposterior and anterior segments, those involving a left central mass, and those involving central masses (left and right) than any other groups. Therefore, these four groups were evaluated separately.

In the evaluation of dissected N1 lymph node results, the number of positive N1 lymph nodes (LNs) was determined and the lymph node ratio (LNR: Positive lymph nodes/sampled lymph nodes) was calculated [4].

Statistical Analysis

The data obtained in the study were analyzed using SPSS (Statistical Package for Social Sciences) for Windows 22.0 software. Number, percentage, mean, and standard deviation were used as descriptive statistics. Logistic regression analysis was applied to examine the association of independent variables (predictors) with our dichotomous dependent variable (N1 positivity). Any variable whose univariable test has a p-value less than 0.20 or 0.25 along with all variables of known clinical importance was included in the multivariable model. The findings were evaluated with a 95% confidence interval and a 5% significance level.

Results

Fifty patients were included in the study. Forty-six of the patients were male and four were female. Demographic information about the patients is given in table 1.

PET/CT scans showed that 13 patients had hilar lymph node involvement, seven patients had mediastinal lymph node involvement, eight patients had both types, and 22 patients had none of these. In patients with hilar lymph node involvement on PET/CT, the false

negative rate for N1 was 27.5%, and the false positive rate was 57.1%. Six patients underwent resection with VATS, while two patients had en-bloc chest wall resection. Sleeve resection was performed in three patients. Of the 24 patients who underwent right-sided intervention, there were patients with upper left lobectomy (46%), right lower lobectomy (21%), middle lobectomy (17%), superior bilobectomy (8%), inferior bilobectomy (4%), and pneumonectomy (4%). Of the 26 patients that underwent left-sided intervention, there were patients with upper lobectomy (46%), pneumonectomy (31%), and lower lobectomy (23%).

The average age of the participants was 61.7 ± 8.8 years (Table 2).

Mediastinoscopy was performed in 31 patients. The mean duration of operation, including the duration of mediastinoscopy during the same anesthesia, was 234.2 ± 77.6 min, and the mean duration of nodal dissection of the resected specimen was 12.1 ± 3.6 min. The average duration of hospital stay was 6.5 ± 3.33 days (range 1-18 days). Five patients (10%) had prolonged air leakage, one patient (2%) had pneumonia, one patient (2%) had chylothorax, and one patient (2%) had bronchopleural fistula. Two patients (4%) underwent re-thoracotomy due to hemorrhage. There was no postoperative mortality. When evaluated in terms of tumor type, 24 patients were identified as having squamous cell carcinoma (SCC), 24 had adenocarcinoma, one had large cell carcinoma, and one had adenosquamous carcinoma.

Four hundred and eighty-eight N1 lymph node stations (10-14) were dissected in the study. Fifty-three of them had N1 lymph node metastasis (Table 3). The average number of N1 lymph node stations dissected from resected specimens was 9.76 ± 3.32 (range 5-19), while the LNs were 2.73 ± 1.59 (range 0-6). The LNR was 0.10. Seventy percent of N1 positive patients had direct lymph node invasion.

Fifteen patients were in group 1, while 15 were in group 2, and 20 were in group 3. Tables 4-6 show the relationships of statistically significant variables prior to logistic regression analysis to determine the risk factors for N1 positive in all three groups. Logistic regression analysis showed that likelihood of N1 positivity in cases with SCC was higher than in cases with adenocarcinomas separately for each group ($p = 0.007, 0.004, 0.003$; OR: 10.587, 11.000, 13.472; 95%CI: 1.90-58.92, 2.10-57.50, 2.35-76.95 respectively) and for the whole study group ($p = 0.001$; OR: 9.167; 95% CI: 2.38-35.30).

Table 1. Patient characteristics.

	Groups	Frequency (n)	Percent (%)
Sex	Female	4	8.0
	Male	46	92.0
Side	Right	24	48.0
	Left	26	52.0
Systemic disease history	-	14	28.0
	+	36	72.0
Former operation history	-	20	40.0
	+	30	60.0
SUVmax of the tumor on PET/CT	<10	15	30.0
	≥10	35	70.0
Hilar lymph node uptake on PET/CT	-	29	58.0
	+	21	42.0
Central mass	-	42	84.0
	+	8	16.0
Central mass (left side only)	-	45	90.0
	+	5	10.0
Apicoposterior segment (left upper lobe)	-	42	84.0
	+	8	16.0
Apicoposterior + anterior segment (left upper lobe)	-	38	76.0
	+	12	24.0
Pneumonectomy	-	41	82.0
	+	9	18.0
Tumor visceral invasion	-	35	70.0
	+	15	30.0
Postoperatively found N2	-	43	86.0
	+	7	14.0
Tumor type	Adenocarcinoma	24	48.0
	Squamous cell carcinoma	24	48.0
	Other	2	4.0
Tumor differentiation	Poor	3	6.2
	Moderate	42	87.5
	Well	3	6.2
Tumor grade	G1	3	6.0
	G2	37	74.0
	G2-3	6	12.0
	G3	3	6.0
	G4	1	2.0

Abbrev.; SUVmax: Maximum standardized uptake value, PET/CT: Positron emission tomography

Table 2. Descriptive statistics.

	n	Mean	SD	Minimum	Maximum
Age (years)	50	61.7	8.8	31	79
Cigarette consumption (package/year)	50	38.0	22.7	0	120
FEV1 (ml)	50	2233	558.1	1290	3490
FEV1 (%)	50	77.5	17.7	40	114
Clinical tumor size (mm)	50	36.3	16.4	10.0	71.0
Pathological tumor size (mm)	50	36.5	17.0	10.0	80.0

Abbrev.; SD: Standard deviation, FEV1: Forced expiratory volume in one second

Table 3. N1 positive lymph node stations.

	Right		Left	
	Station	Positive (n)	Station	Positive (n)
Upper lobe	10		10	3
	11 superior	1	11 superior	3
	11 inferior	1	11 inferior	1
	12 superior	2	12 superior	2
	12 inferior	1	12 inferior	2
	13 apical	1	13 apicoposterior	5
	14 apical		14 apicoposterior	4
	13 posterior	2	13 anterior	5
	14 posterior	1	14 anterior	2
	13 anterior		13 lingula (superior)	2
	14 anterior		14 lingula (superior)	
			13 lingula (inferior)	1
Middle lobe			14 lingula (inferior)	
	13 lateral	1		
	14 lateral	1		
	13 medial			
Lower lobe	14 medial			
	13 superior	1	13 superior	1
	14 superior	1	14 superior	
	13 mediobasal		13 anteromedial	4
	14 mediobasal	1	14 anteromedial	
	13 anterobasal		13 laterobasal	1
	14 anterobasal		14 laterobasal	
	13 laterobasal	1	13 posterobasal	1
	14 laterobasal		14 posterobasal	
	13 posterobasal			
	14 posterobasal	1		

Table 4. Univariate analysis in group 1.

		Negative		Positive		P
		n	%	n	%	
SUVmax of the tumor in PET/CT	<10	14	40.0	1	6.7	0.017
	≥10	21	60.0	14	93.3	
Hilar lymph node uptake in PET/CT	-	24	68.6	5	33.3	0.023
	+	11	31.4	10	66.7	
Central mass	-	33	94.3	9	60.0	0.006
	+	2	5.7	6	40.0	
Pneumonectomy	-	32	91.4	9	60.0	0.015
	+	3	8.6	6	40.0	
Tumor type	AC	22	66.7	2	13.3	0.001
		11	33.3	13	86.7	
Clinical tumor size (mm) (Mean±SD)		32.14±15.84		46.07±13.65		0.005

Abbrev.; SUVmax: Maximum standardized uptake value, PET/CT: Positron emission tomography, SD: Standard deviation, AC: Adenocarcinoma, SCC: Squamous cell carcinoma

Table 5. Univariate analysis in group 2.

		Single		Multiple		P
		n	%	n	%	
Central mass	-	33	94.3	9	60.0	0.006
	+	2	5.7	6	40.0	
Central mass (left side only)	-	34	97.1	11	73.3	0.024
	+	1	2.9	4	26.7	
Pneumonectomy	-	32	91.4	9	60.0	0.015
	+	3	8.6	6	40.0	
Tumor type	AC	22	64.7	2	14.3	0.002
		12	35.3	12	85.7	

Abbrev.; AC: Adenocarcinoma, SCC: Squamous cell carcinoma

Table 6. Univariate analysis in group 3.

		Negative		Positive		P
		n	%	n	%	
Side	Right	18	60.0	6	30.0	0.036
	Left	12	40.0	14	70.0	
SUVmax of the tumor on PET/CT	<10	13	43.3	2	10.0	0.011
	≥10	17	56.7	18	90.0	
Hilar lymph node uptake on PET/CT	-	21	70.0	8	40.0	0.035
	+	9	30.0	12	60.0	
Central mass	-	30	100.0	12	60.0	<0.001
	+	0	0.0	8	40.0	
Central mass (left side only)	-	30	100.0	15	75.0	0.007
	+	0	0.0	5	25.0	
Pneumonectomy	-	30	100.0	11	55.0	<0.001
	+	0	0.0	9	45.0	
Tumor type	AC	21	72.4	3	15.8	<0.001
		8	27.6	16	84.2	
Clinical tumor size (mm) (Mean±SD)		30.93±14.91		44.40±15.48		0.003
Pathological tumor size (mm) (Mean±SD)		32.00±15.26		43.45±17.57		0.018

Abbrev.; SUVmax: Maximum standardized uptake value, PET/CT: Positron emission tomography, SD: Standard deviation, AC: Adenocarcinoma, SCC: Squamous cell carcinoma

According to the results of our study, a typical PET/CT image example of a patient who may benefit from lymph node dissection is shown in figure 1.

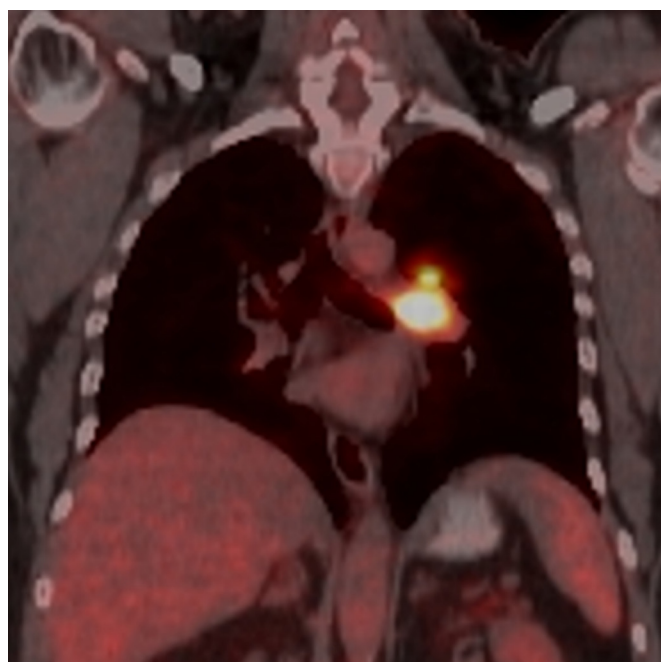


Figure 1. The coronal image of a positron emission tomography symbolizing the results of our study.

Discussion

The debate over the prognostic significance of N1 involvement is ongoing, and the variability of survival in these patients indicates the need to include a more detailed N1 status in predicting prognosis. It is most likely that the varied number of N1 positive lymph nodes causes this inconsistency. Therefore in our time, careful N1 lymph node dissection is becoming more important to better predict prognosis and understand the disease, plus it may affect the stage in upcoming TNM classifications [2].

In a study by Maeshima et al, the researchers suggested routinely sampling lymph nodes 13 and 14 [5]. Another study indicating the prognostic significance of LNs in N1 disease is described by Jonnalagadda et al [6]. They showed that a greater number of N1 LNs was associated with worse lung cancer-specific ($P < 0.0001$) and overall ($P < 0.0001$) survival. As the number of positive N1 lymph nodes increase, survival decreases, and as a result, N1 positivity was suggested to be an independent prognostic factor.

Although LNs appear to be important in prognosis, some authors have emphasized that LNR is more critical than LNs in determining prognosis [7-9]. In the study of Matsuguma et al, the 5-year survival rate for N1 disease was 52.2%, 54.3% according to LNs, and 58.8% accord-

ing to LNR [7]. In the same study, they reported that LNR is superior to LNs, both are more significant than N1 in the TNM classification, and both may be present in future TNM classifications. Results of a meta-analysis of 6130 diseases, which was published in 2016, showed that LNR is an important determinant in survival and cancer relapse [8]. All of these studies agree that a higher LNR was associated with a worse survival. Plus, it was shown that patients with a ≤ 0.15 LNR had the best survival, whereas in patients with a LNR > 5 survival was the worst [4]. In our study LNR was calculated as 0.10. It seems that by increasing the number of lymph nodes dissected, LNR is better calculated.

As an outcome, the significant differences in the survival of patients without N2 disease may arise from LNs and LNR factors. Therefore, N1 lymph nodes should be carefully dissected to calculate LNs and LNR correctly in patients with NSCLC.

In the literature, N1 lymph node metastasis has been reported to be more frequent in adenocarcinomas than in SCC [10,11]. Nakao et al reported that N1 lymph node involvement was seen more frequently in adenocarcinomas than in SCC [11]. In another study LNs was significantly higher, and tumors recurred more frequently in adenocarcinoma cases than in SCC cases. This applies to tumor metastases to N1 lymph nodes, not direct invasion.

However, for direct invasion the situation seems to be different. In a study, it is stated that SCC prefer a direct invasion as it arises more frequently in the wall of the lobar bronchi and is associated with a higher incidence of direct lymph node involvement compared with the usually peripherally located adenocarcinoma [12]. In another study by Varlotta et al investigating the effect of resection in patients with NSCLC on relapse and general survival, N1 lymph node involvement was higher in SCC than in adenocarcinoma [13]. In our study, the probability of N1 lymph node metastasis in SCC was higher than in adenocarcinoma. This difference can too be explained by the fact that a higher number of our patients with direct lymph node invasion had SCC.

In left-sided stage 1 NSCLC patients, survival rate is not adequate [14]. Particularly, survival of patients with left lower lobe cancers is lower than that of patients with other lobe cancers [15]. It has been suggested in the literature that this may be due to the presence of right paratracheal lymph node involvement in left-sided lung cancers [16]. High involvement of the N1 lymph nodes in left-sided NSCLC may also contribute to this situation

[17]. In a study it is stated that left-sided tumors tend to directly invade or reach the hilar nodes more easily [12]. In our study, the likelihood of having N1 positivity in left-sided tumors was higher than in the right.

Tumor location may affect pN1 upstaging during operations in patients with NSCLC [18]. Central tumors tend to have more positive N1 lymph nodes along with them, plus they may have retrograde lymphatic spread to other lobes. In our study, N1 positivity was seen in all patients who underwent pneumonectomy (n = 9). Four of these patients (44.4%) were found to have N1 positivity in a different lobe from where the tumor exists. These cases were a patient with a left lower lobe tumor and N1 positivity at the left upper lobe apicoposterior segment, a patient with a right upper lobe tumor and N1 positivity at the right middle lobe lateral segment, a patient with a left upper lobe tumor and N1 positivity at the left lower lobe in an anterobasal segment, and a patient with a left upper lobe tumor and N1 positivity at the left lower lobe laterobasal segment.

PET/CT scanning during the preoperative period has great importance. This method is especially highly sensitive and specific in detecting mediastinal lymph node metastasis. In a recent study, the value of PET/CT in detecting prognosis was emphasized; however, the requirement for pathological diagnosis was still described [19]. The benefits of PET/CT are much lower in the N1 lymph nodes. The method is useful in detecting hilar lymph nodes, but its value in detecting interlobar, lobar, segmental, and subsegmental lymph nodes is low. In our study, PET/CT scans showed that a mass SUVmax value greater than 10 and hilar lymph node involvement in the N1+ and N1+, N2- groups was significant.

Tumor localization is also an important factor in evaluating the presence of N1 in the preoperative period. In a previous study, unexpected N1 disease-related progression of stage occurred in 1/3 of central tumor patients, and tumor localization was found to be the only independent variable in pathological N1 stage increase [20]. In our study, central tumor presence for all three groups was significant in terms of N1 positivity.

There are publications in the literature about the relationship between tumor diameter and N1 positivity. In a study by Zhang et al., the researchers investigated the determinants of lymph node involvement in small and peripheral NSCLC patients [21]. In our study, multivariate analysis showed that the probability of lymph node metastasis in patients with a tumor diameter greater than

10 mm was significantly higher than in other patients. In our study, the clinical and pathological tumor size was significantly higher in groups 1 and 2.

There are different practices about specimen handling throughout the globe. In some institutions the specimens are put into formaldehyde solution and sent to pathology while in others they are sent fresh. The reason why the dissection was done by a surgeon instead of a pathologist is that in our institution the specimens are not sent fresh to pathology but are put into formaldehyde solution first.

Limitations of the study

No significant survival study could be performed due to the short study period. Parameters such as 5-year survival rate, disease-free survival, and tumor relapse have not been investigated. Plus, due to the many criteria that reduce the sample size, dissection could be performed only on a limited number of lesions. However, this article contains only preliminary results and studies are still continuing. This study contains only one clinical center. However, our hospital is a reference center for lung cancer, accepting patients from many different places.

In conclusion preliminary results show that dissection of lymph nodes may be useful for both lung sides but especially for left central masses. In cases with SCC, involvement on PET/CT with mass SUVmax above 10, hilar LAP involvement on PET/CT, and tumor diameters over 3.5 cm, performing dissection may be useful for improved detection of N1 and multi-N1 positivity and may provide prognostic information.

Declaration of conflicting interests

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Ethics approval

The study was approved by the scientific research committee of University of Health Sciences, Istanbul Sureyyapasa Chest Diseases and Thoracic Surgery Research and Training Hospital (2021/223).

Authors' contributions

TD; Conceived and designed the analysis, collected the data, contributed data/analysis tools, VB; Conceived and designed the analysis, co-wrote the paper, SC; Contribut-

ed data, co-wrote the paper, SD; Performed the analysis, co-wrote the paper, AM; Contributed data, SK; Contributed data, LA; Contributed data, CT; Contributed data.

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Case Report

Surgeon powered robotic lobectomy: first case performed in Turkey

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ABSTRACT

In this case report, the case of non-small cell lung cancer resection performed with surgeon-powered robotic surgery (sPRS) was evaluated in light of the literature. A 62-year-old male patient applied to our clinic with the complaint of non-specific chest pain. On the tomography of the patient, a mass of approximately 1 cm in the lower lobe of the right lung was detected, and there was no distant metastasis. A transthoracic needle biopsy was performed on the patient. Right lower lobectomy operation was performed using wristed instruments (Artisential® Wristed Instruments) in this non-small cell lung cancer patient. sPRS provides more mobility than VATS and we think that it is a more cost effective surgical instrument than robotic surgery. We think that surgeons should embrace new technologies in order to provide more benefits to patients.

Key words: Non-small cell lung cancer, robotic surgery, surgeon powered robotic surgery, lobectomy, VATS

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Introduction

With developing technologies, lung cancer surgeries have been changing from video thoracoscopic surgery (VATS) to robotic-assisted thoracic surgery (RATS). Robotic surgery has developed due to the lack of flexibility and maneuverability in VATS [1]. However, it is still not widely preferred today in terms of cost and effectiveness. For this reason, different technologies have been developed in which VATS has been combined with robotic technology.

Nowadays, the results of robotic surgeries and VATS operations are frequently compared. However, publications have stated that robotic surgical procedures have been more successful than VATS in the early postoperative results [2-4]. On the other hand, one of the main limitations in VATS surgery is limited freedom, since the surgical instruments do not have sufficient angles during the surgery. Wristed VATS instruments are a new technology introduced as an alternative to robotic surgery. Trevis et al. [2] were the first in the literature to define the technology of these instruments as surgeon-powered robotic surgery (sPRS). Today, it is becoming increasingly popular due to the possibility of movement with sPRS technology that is the same as with RATS technology. However, only two studies in the literature used these instruments in thoracic surgery operations [2,3].

In this case report, a case of non-small cell lung cancer resection performed with sPRS technology was evaluated with the literature.

Case Report

A 62-year-old male patient applied to our clinic with the complaint of non-specific chest pain. A mass of approximately 1 cm was detected in the lower lobe of the right lung on the tomography of the patient, who had a history of smoking 30 packs of cigarettes/year and also had diabetes mellitus. Surgery was planned for the patient, who did not have distant metastases on positron emission computed tomography (PET-CT) and was found to have non-small cell lung cancer via transthoracic fine-needle aspiration biopsy. In the patient, who was operated on with sPRS, a thoracoport was opened for an instrument of 2 cm from the 4th mid-axillary intercostal space and the 7th posterior axillary line. A 3-cm utility incision was made in the subcostal space. Thoracic pathologies, adhesions, and the diaphragm level were evaluated using a 30° 10-mm thoracoscope (Logic HD, Storz, Germany)

using a subcostal incision. During the exploration, a mass was detected in the lower lobe of the right lung. Articulated thoracoscopic precise dissector (38-cm shaft, Artisential) were used for dissection of the pulmonary veins and arteries. A precise dissector wristed instrument was used from the 4th midaxillary incision. Articulated thoracoscopic forcep (38-cm shaft, Artisential) were used for traction of the lung. A forcep wristed instrument was used from 7th posterior axillary incision. Pleural adhesions were severed using robotic arm bipolar cautery. The pulmonary arteries, veins, and bronchus were ligated with endoscopic closure devices (endoGIA, Covidien plc, Norwalk, USA). Right lower lobectomy operation was performed on the patient using wristed instruments (Artisential Wristed Instruments) (Figures 1,2). Specimens were removed using endoscopic specimen bags. Systematic lymph node resection was done from stations 2, 4, 7, 8, 9, and 11. The patient, whose postoperative pathology was reported as squamous cell carcinoma, was discharged three days postoperatively. Informed consent was obtained from the patient.

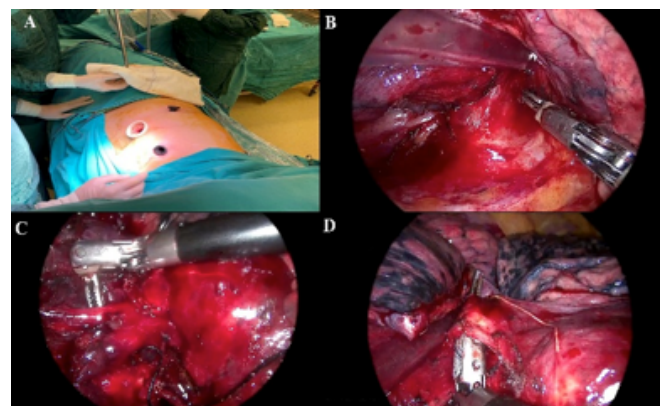


Figure 1. Intraoperative View. The port locations used in the operation (A), dissection of the inferior pulmonary vein (B), dissection of the common basal artery (C), dissection of the superior pulmonary artery (D).



Figure 2. Intraoperative view; use of the instruments.

Discussion

Video thoracoscopic surgeries have become increasingly common nowadays. The rigidity of the instruments sometimes makes it difficult to perform operations. On the other hand, wristed laparoscopic instruments have begun to be used as an alternative today, in terms of both cost-effectiveness and safety.

Especially in publications that have been made with regard to robotic surgery, it has been stated that it is oncologically similar to VATS. However, the operation time is very long due to docking. In their series of 103 cases, Novellis et al [4] found that the length of stay in RATS was more successful when compared to open surgery and VATS. Oncologically, they stated that lymph node dissection could be performed as much as open surgery. In addition, it was stated in the literature that pain in RATS is less than in other techniques. Similarly, Alhan et al [5] stated that the pain was less in the operations performed with RATS. Trevis et al [2] reported on a case series in the literature on sPRS and stated that when compared to RATS, it had similar motion advantages and was more advantageous in terms of cost-effectiveness. In addition, Fianan et al [6] stated in their study that technical problems in robotic technologies were observed at a rate of 8.2%. They mentioned that these technical problems would be improved with future technological developments. In sPRS technology, on the other hand, it is believed that these technical problems have been eliminated due to the absence of a computer systems.

In the current case, the most important reason for preferring these instruments for surgical resection is the possibility of 360° movement. Since one of the most important problems in VATS surgery is the limitation of movement, it is believed that resections will be easier with these instruments. In addition, it is believed that it provides an advantage in the dissection of vascular structures, because it has a tactile impulse that is similar to VATS. With these instruments, it is believed that the minimally invasive technique will evolve into a micro-invasive technique in the coming years.

In the current case, subcostal incision was preferred over utility incision, which is used in VATS. During the tumor removal, the specimen could be removed from the subcostal area more easily than the intercostal area, which is much more rigid than the subcostal area. Especially in recent years, subcostal approaches have been more preferred in thoracic surgery because they are less

painful [7]. On the other hand, this case was the first case performed in Turkey using sPRS technology.

One of the disadvantages of robotic surgery is that it does not have a tactile impulse in the most important surgeries. The absence of palpation or tissue sensation of the tumor may create additional difficulty in the operation. Robotic operations require experience in a certain number of simulations [8]. Since sPRS has a similar structure to VATS, it is believed that the learning period of the instruments is much faster.

The fact that the surgeon is positioned at the operating table during the operation is among the advantages of VATS and sPRS. In addition, CO2 insufflation after the operation also prevents enlargement of the incision.

In conclusion, sPRS provides more mobility than VATS and it is believed that it is a more cost-effective surgical instrument than RATS. It is believed that there will be serious changes in thoracic surgery in the following decades, and that the developments in robotic surgery and minimally invasive approaches will allow surgeons to more easily perform microscopic operations in the future. It is believed that surgeons should embrace new technologies in order to provide more benefits to patients.

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Authors' contributions

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

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Case Report

Parkinson and atraumatic sternum fracture: a case report

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ABSTRACT

Although sternum fractures are more common after direct and impact trauma, they are rarely caused by pathological reasons. Sternum insufficiency fractures have been reported rarely in elderly patients. In the literature, sternum fracture after low-energy indirect trauma has been rarely reported. Our aim in this case is to present a 79-year-old female patient with chest pain after indirect trauma and a sternum fracture on admission to the emergency department. The patient with previously known Parkinson's disease had a manubrium sternum fracture on computed tomography, and no additional pathology was found.

Key words: sternum, atraumatic, insufficiency fracture, Parkinson's disease

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Introduction

Insufficiency fractures are common in the spine, pelvis, and lower extremities [1]. Insufficiency fractures are rarely seen in the medial femoral condyle, talus, sternum, first rib, and sacrum [2]. Sternum insufficiency fractures are often seen in the body of the sternum and rarely in the manubrium [3]. Insufficiency fracture can be seen secondary to recurrent minor traumas, lymphoma, metastatic involvement, corticosteroid use, osteoporosis [3]. Sternum insufficiency fractures may be associated with dorsal kyphosis or without kyphosis, may be symptomatic or asymptomatic, and may be confused with pathological fractures [4].

Parkinson's disease is one of the most common neurodegenerative diseases [5]. The incidence of Parkinson's disease is increasing due to reasons such as prolongation of life span and industrialization. It is predicted that the number of Parkinson's patients will exceed 12 million worldwide by 2040 [6]. Postural instability is an important symptom of Parkinson's disease and may be present at the time of diagnosis; resulting in an increased risk of falling, loss of independence, and impaired quality of life [7]. Postural control is impaired in more than 75% of Parkinson's patients, so the postural instability and the risk of falling increases [8].

In this case, we aim to emphasize that sternum insufficiency fractures may develop due to thoracic vertebral kyphosis in Parkinson's patients.

Case report

A 79-year-old female patient admitted to the emergency department in January 2021 due to anterior chest pain. It is known that the patient fell on the right shoulder at her height on the day of admission, and pain developed in the anterior rib cage after falling. She had no comorbid disease other than the known Parkinson's disease and no history of previous trauma. There was no cardiac or pulmonary finding in her system query. She did not smoke or drink alcohol. She had tremors and localized chest pain on physical examination. No skin infection and emphysematous changes, ecchymosis, or crepitation on the chest wall were found. No fracture was observed in the right shoulder joint examination and imaging. Hemoglobin was 13.3 g/dL, Troponin T was 5.48, and CK-Mb was 1.39 (ref value < 4.88) on admission to the emergency department. No pathology was found on

electrocardiography at the first admission. Cardiac and pulmonary pathologies were ruled out. A fracture in the manubrium sternum was detected in the lateral graphy (Figure 1a) and computed tomography (CT) of the patient (Figure 1b). Cobb angle and kyphotic angle (< 45°) were measured on lateral radiography (Figure 1a).

Since the patient did not require surgical treatment, she was followed up in the thoracic surgery service for conservative treatment and follow-up. Bone mineral density (BMD) measurement was requested in terms of osteoporotic fracture exclusion due to the presence of kyphotic changes in T11 and L1 in the sagittal CT section (Figure 1b). The T-score in the left femur/total hip region was found to be -1.9 while the BMD value was found to be -1.7 in the lumbar region, and it was considered osteopenic. Blood D-vitamin level was 5.80, calcium was 9.05 mg/dL, alkaline phosphatase was 66 U/L and primary vitamin D deficiency was detected.

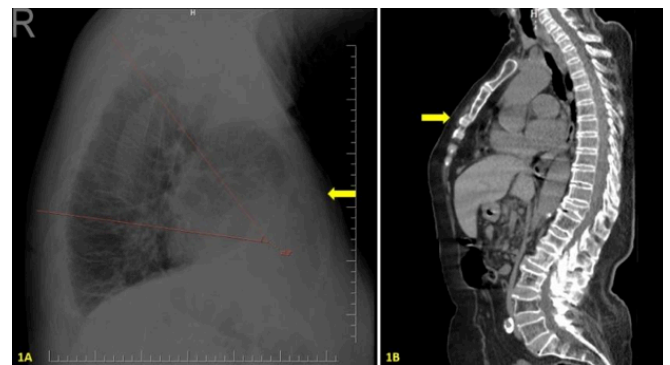


Figure 1. Kyphosis angle and sternum fracture on lateral radiography (A), sagittal CT view of L1 and T11 compression fracture and sternum fracture (B).

In the retrospective anamnesis of the patient, it was learned that the patient had Parkinson's disease for 12 years and had been using pramipexole 1mg (parkipex, Generica İlaç San. ve Tic A.Ş.), domperidone 10 mg (Motilium, Johnson& Johnson), benserazide hydrochloride 125 mg (Deva Holding A.Ş.) and rasagiline 1 mg (Rasalas, Abdi Ibrahim). During the follow-up of the patient, when her tremors continued at the current drug doses, dose changes were made in consultation with the neurology and the tremors regressed. The patient was discharged with a daily dose of 1200 IU vitamin D and an appropriate analgesic treatment. She recovered without sequelae after 3 months in her follow-up. The case review was conducted according to all guidelines outlined in the Declaration of Helsinki. Written informed

consent for publication was obtained from the patient and patient's nearest relative.

Discussion

Musculoskeletal pathologies are common in patients with Parkinson's. Age, female gender, disease severity and advanced age are predisposing factors for musculoskeletal pathologies [9]. Postural instability and tremor are major findings in Parkinson's disease; besides, postural abnormalities, gait disorders, speech disorders, hypomimia, changes in eye movements are among other motor findings [9]. After postural instability, patients develop kyphosis to maintain balance. Osteopenia and osteoporosis is a common finding in Parkinson's patients [10]. Compression fractures seen after extensive osteopenia in elderly patients also cause dorsal kyphosis. Our case had osteopenia, compression fracture, and dorsal kyphosis developed due to Parkinson's disease. Kyphosis creates flexion-compression stress in the sternum, resulting in sternum insufficiency fractures. In elderly patients, the osteopenic structure of bones and loss of elasticity of cartilage tissue are predisposing to insufficiency fractures [4].

In a review published in France in 2015, it was reported that falling alone was not a risk factor for fracture in Parkinson patients. Decrease in physical activities due to loss of neuromuscular function, malnutrition, low body mass index, high parathyroid hormone, low vitamin D level, and especially the use of antiparkinsonian drugs such as L-dopa cause weakening of bone quality and atraumatic fractures [9].

Sternum fractures are more common after high-energy traumas, but they are rare. Insufficiency fractures most commonly occur in lower extremities, vertebra and pelvic bones. Sternum insufficiency fractures are extremely rare, more common in elderly patients. It is often in the manubrium zone of the sternum [3]. Our case has a manubrium sternum insufficiency fracture.

The thorax is stabilized by the ribs, sternum, and vertebrae. Insufficiency of one of these structures creates additional stress to other structures. According to Fowlers' flexion-extension compression theory: after multiple osteoporotic thoracic vertebra compression fractures, secondary sternum insufficiency fracture may develop against flexion and compression stresses caused by chronic thoracic kyphotic deformity [1,3]. In

this case, the patient had no history of previous vertebral trauma, but she had thoracic kyphosis on T11 and L1 due to compression fractures. It is thought that the patient developed secondary insufficiency fracture due to thoracic kyphosis deformity.

Sternum insufficiency fractures are divided into two as buckling or non-buckling. Buckling fractures are associated with thoracic kyphosis, while non-buckling fractures may or may not be associated with thoracic kyphosis. Our case had a buckling type sternum insufficiency fracture. With lateral chest radiographs, the localization of the sternum fracture can be determined, as well as thoracic kyphosis. CT can be used to exclude infection and malignancy [1].

In conclusion, thoracic kyphosis and sternum insufficiency fractures are associated, they are not very common. Over this rare situation, it should be considered that sternum insufficiency fracture may occur in patients with thoracic kyphosis and osteopenia after urgent cardiac and pulmonary causes are ruled out in patients admitting with anterior chest pain. Insufficiency fractures cause significant morbidity and mortality in the elderly group. Future insufficiency fractures and complications can be prevented, hospital stay times and costs can be reduced with osteoporosis treatment.

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Authors contributions

ÖÖ,FC; 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.

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All papers reporting animal experiments should include a statement in "Materials and Methods" section giving assurance that all animals have received humane care in compliance with the Guide for the Care and Use of Laboratory Animals and indicating for the approval by the institutional ethical review board. If necessary, a copy of the form could be required by the editor. Similarly include the date and number of approval by the local institutional animal research committee and the ethical guidelines that were followed by the investigators.

Informed consent

Patients have a right to privacy that should not be infringed without informed consent. Identifying information, including patients' names, initials, or hospital numbers, should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives written informed consent for publication. Informed consent for this purpose requires that a patient who is identifiable be shown the manuscript to be published. Authors should identify Individuals who provide writing assistance and disclose the funding source for this assistance.

Identifying details should be omitted if they are not essential. Complete anonymity is difficult to achieve, however, and informed consent should be obtained if there is any doubt. For example, masking the eye region in photographs of patients is inadequate protection of anonymity. If identifying characteristics are altered to protect anonymity, such as in genetic

pedigrees, authors should provide assurance that alterations do not distort scientific meaning and editors should so note.

Publication Ethics and Malpractice Statement

The Current Thoracic Surgery is electronic peer reviewed international journal committed to upholding the possible highest standards of publication ethics. In order to provide our readers with a journal of highest quality we state the following principles of Publication Ethics and Malpractice Statement. All articles not in accordance with these standards, will be removed from the publication if malpractice is discovered at any time even after the publication. The Current Thoracic Surgery is checking all papers in a double-blind peer review process. We also check for plagiats and research fabrication (making up research data); falsification (manipulation of existing research data, tables, or images) and improper use of humans or animals in research. In accordance with the code of conduct we will report any cases of suspected plagiarism or duplicate publishing. The Current Thoracic Surgery reserves the right to use plagiarism detecting software to screen submitted papers at all times.

Authors must ensure that they have written original works. In addition they must ensure that the manuscript has not been issued elsewhere. Any work or words of other authors, contributors, or sources should be appropriately credited and referenced. Authors are also responsible for language editing before submitting the article. Authors submitting their works to the journal for publication as original articles confirm that the submitted works represent their authors' contributions and have not been copied or plagiarized in whole or in part from other works without clearly citing. Any work or words of other authors, contributors, or sources (including online sites) should be appropriately credited and referenced. All authors should disclose financial or other conflict of interest that might influence the results or interpretation of their manuscript (financial support for the project should be disclosed). When an author discovers a significant error or inaccuracy in his/her own published work, it is the author's obligation to promptly notify the journal editor and cooperate with the editor to retract or correct the paper. An author agrees to the license agreement before submitting the article. All articles must be submitted using online submission procedure. Submitting a paper simultaneously to more than one publication at a time is a breach of publications ethics. Before publication of an accepted manuscript, each author will be required to certify that he or she has participated sufficiently in the work to take responsibility for a meaningful share of the content of the manuscript, and that this participation included:

1. Conception or design of the experiment(s), or collection and analysis or interpretation of data;
2. Drafting the manuscript or revising its intellectual content; and
3. Approval of the final version of the manuscript to be published.

Editors must ensure a fair double-blind peer-review of the submitted articles for publication. They will strive to prevent any potential conflict of interests between the author and editorial and review personnel. Editors will also ensure that all the information related to submitted manuscripts is kept as confidential before publishing. Editor-in-Chief will coordinate the work of the editors.

Reviewers evaluate manuscripts based on content without regard to ethnic origin, gender, sexual orientation, citizenship, religious belief or political philosophy of the authors. They must ensure that all the information related to submitted manuscripts is kept as confidential and must report to the Editor-in-Chief if they are aware of copyright infringement and plagiarism on the author's side. They must evaluate the submitted works objectively as well as present clearly their opinions on the works in a clear way in the review form. A reviewer who feels unqualified to review the research reported in a manuscript or knows that its prompt review will be impossible should notify the Editor-in-Chief and excuse himself from the review process.

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The use of someone else's ideas or words in their original form or slightly changed without a proper citation is considered plagiarism and will not be tolerated. Even if a citation is given, if quotation marks are not placed around words taken directly from another author's work, the author is still guilty of plagiarism. Reuse of the author's own previously published words, with or without a citation, is regarded as self-plagiarism. All manuscripts received are submitted to iThenticate®, a plagiarism checking system, which compares the content of the manuscript with a vast database of web pages and academic publications. Manuscripts judged to be plagiarized or self-plagiarized, based on the iThenticate® report or any other source of information, will not be considered for publication.

Conflict of Interest Statement

Public trust in the peer review process and the credibility of published articles depend in part on how well conflict of interest is handled during writing, peer review, and editorial decision making. Conflict of interest exists when an author (or the author's institution), reviewer, or editor has financial or personal relationships that inappropriately influence (bias) his or her actions (such relationships are also known as dual commitments, competing interests, or competing loyalties). These relationships vary from those with negligible potential to those with great potential to influence judgment, and not all relationships represent true conflict of interest. The potential for conflict of interest can exist whether or not an individual believes that the relationship affects his or her scientific judgment. Financial relationships (such as employment, consultancies, stock ownership, honoraria, paid expert testimony) are the most easily identifiable conflicts of interest and the most likely to undermine the credibility of the journal, the authors, and of science itself. However, conflicts can occur for other reasons, such as personal relationships, academic competition, and intellectual passion.

So authors should declare that there is no conflict of interest and also, if there is any, the status for their financial support should be clear in the cover letter and within article.

Declaration of sponsorship

The authors should describe the role of the study's sponsors in the following areas: a. designing the study, b. collecting, analyzing, and interpreting the data, c. writing the report.

Corrections, Retractions and Expression of Concern

It is presumed that manuscripts report on work based on honest observations. However occasionally information becomes available which may contradict this. In such situations CTS apply Committee on Publication Ethics guidelines on corrections, retractions and expressions of concern.

Corrections

Errors in published papers may be identified requiring publication of a correction in the form of a corrigendum or erratum. Because articles can be read and cited as soon as they are published, any changes thereafter could potentially impact those who read and cited the earlier version. CTS provides authors with an opportunity to review article proofs prior to publication with the express goal of ensuring accuracy of the content. Publishing an erratum or corrigendum increases the likelihood readers will find out about the change and also explains the specifics of the change.

Corrigenda and Errata will be published on a numbered page and will contain the original article's citation. Cases where these corrections are insufficient to address an error will be dealt with on a case-by-case basis by the Editor in Chief. Inadequacies arising from the normal course of new scientific research are not within the scope of this and will require no correction or withdrawal.

Article retraction

Infringements of professional ethical codes, such as multiple submission, bogus claims of authorship, plagiarism, fraudulent use of data or the like. Occasionally a retraction will be used to correct errors in submission or publication. The retraction of an article by its authors or the editor under the advice of members of the scholarly community has long been an occasional feature of the learned world. Standards for dealing with retractions have been developed by a number of library and scholarly bodies, and this best practice is adopted for article retraction by CTS:

A retraction note titled "Retraction: [article title]" signed by the authors and/or the editor will be published in the paginated part of a subsequent issue of the journal and listed in the contents list. In the electronic version, a link will be made to the original article. The online article will be preceded by a screen containing the retraction note. It is to this screen that the link resolves; the reader can then proceed to the article itself. The original article will be retained unchanged save for a watermark on the .pdf indicating on each page that it is "retracted."

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In an extremely limited number of cases, it may be necessary to remove an article from the online database. This will only occur where the article is clearly defamatory, or infringes others' legal rights, or where the article is, or we have good reason to expect it will be, the subject of a court order, or where the article, if acted upon, might pose a serious health risk. In these circumstances, while the metadata (Title and Authors) will be retained, the text will be replaced with a screen indicating the article has been removed for legal reasons.

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In cases where the article, if acted upon, might pose a serious health risk, the authors of the original article may wish to retract the flawed original and replace it with a corrected version. In these circumstances the procedures for retraction will be followed with the difference that the database retraction notice will publish a link to the corrected re-published article and a history of the document.

Expressions of concern

Where substantial doubt arises as to the honesty or integrity of a submitted or published article it is the Editor in Chief's responsibility to ensure that the matter is adequately addressed, usually by the authors' sponsoring institution. It is not normally the Editor in Chief's responsibility to carry out the investigation or make a determination. The Editor in Chief should be promptly informed of the decision of the sponsoring institution and a retraction printed should it be determined that a fraudulent paper was published. Alternatively, the Editor in Chief may choose to publish an expression of concern over aspects of the conduct or integrity of the work.

Withdrawal

Articles may be withdrawn by corresponding author before accepting for publication. If it is accepted, it could be used only for Articles in Press which represent early versions of articles and sometimes contain errors, or may have been accidentally submitted twice. Occasionally, but less frequently, the articles may represent infringements of professional ethical codes, such as multiple submission, bogus claims of authorship, plagiarism, fraudulent use of data or the like. Articles in Press (articles that have been accepted for publication but which have not been formally published and will not yet have the complete volume/issue/page information) that include errors, or are discovered to be accidental duplicates of other published article(s), or are determined to violate our journal publishing ethics guidelines in the view of the editors (such as multiple submission, bogus claims of authorship, plagiarism, fraudulent use of data or the like), may be "Withdrawn" from CTS. Articles which have been published under an issue could not be withdrawn.

Responding to Allegations of Possible Misconduct (Explicit Policy)

All allegations of misconduct will be referred to the Editor-In-Chief, who will review the circumstances in consultation with the deputy editors. Initial fact-finding will usually include a request to all the involved parties to state their case, and explain the circumstances, in writing. In questions of research misconduct centring on methods or technical issues, the Editor-In-Chief may confidentially consult experts who are blinded to the identity of the individuals, or if the allegation is against an editor, an outside editor expert. The Editor-In-Chief and deputy editors will arrive at a conclusion as to whether there is enough evidence to lead a reasonable person to believe there is a possibility of misconduct. Their goal is not to determine if actual misconduct occurred, or the precise details of that misconduct.

When allegations concern authors, the peer review and publication process for the manuscript in question will be halted

while the process above is carried out. The investigation described above will be completed even if the authors withdraw their paper, and the responses below will still be considered. In the case of allegations against reviewers or editors, they will be replaced in the review process while the matter is investigated. For further information visit "Useful links".

Data Sharing Policy

Current Thoracic Surgery requires authors to submit a data-sharing statement form and register a data-sharing plan when registering a clinical trial. The ICMJE's data sharing statement policy asks authors to submit a data-sharing statement for randomized clinical trials. The ICMJE's policy regarding trial registration is explained at (<http://www.icmje.org/icmje-recommendations.pdf>).

Accordingly, the data sharing statements must indicate the following:

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 ν 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 limits 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. 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

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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