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ORIGINAL ARTICLE

Where is the Video-Assisted Thoracic Surgery Truth In Making Decision?: Evaluation of 497 Cases

Video Yardımlı Göğüs Cerrahisi Cerrahi Karar Vermenin Neresinde?: 497 Olgunun Degerlendirilmesi

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ABSTRACT

Background: Video-assisted thoracic surgery (VATS) exploration is a frequently performed surgical intervention in thoracic surgery in cases such as pleural biopsy, mediastinal and hilar lymphadenopathy biopsies, hemothorax and air leak control. In this study, 497 patients were reviewed and extended indications of VATS exploration were revealed.
Methods: All of the patients with radiologically detected intrathoracic pathology between 2009-2019 were included in the study. Preoperative, intraoperative and postoperative findings were evaluated retrospectively.
Results: The clinical indications for VATS exploration were pleural effusion, intrapulmonary mass, cystic lesion, mediastinal lymphadenopathy or mass that has been investigated with a pre-diagnosis of malignancy or developed secondary to previously known malignancy, prolonged air leakage and / or lung expansion problems, mediastinal mass, hemothorax, pleural thickening or pleural nodule, chest wall tumor, pericardial cyst or effusion, chylothorax, and intrathoracic cavitary lesion. All patients with these indications were managed mainly with VATS exploration.
Conclusion: Evaluation of operability criteria, and subtype determination for targeted therapies in the diagnosed patient, definitive diagnosis can be made and over-treatments can be prevented due to the precise biopsies can be taken with VATS exploration. We recommend the VATS exploration as a key step for all intrathoracic pathologies.

Keywords: Exploration, intrathoracic pathology, video-assisted thoracic surgery

ÖZ

Giriş: Video yardımlı göğüs cerrahisi (VATS) eksplorasyonu, göğüs cerrahisinde plevral biyopsi, mediastinal ve hiler lenfadenopati biyopsileri, hemotoraks, hava kaçağı kontrolü gibi durumlarda sıklıkla uygulanan bir cerrahi girişimdir. Bu çalışmada 497 hasta gözden geçirildi ve VATS eksplorasyonunun genişletilmiş endikasyonları incelendi.
Yöntemler: 2009-2019 yılları arasında radyolojik olarak intratorasik patoloji saptanan hastaların tamamı çalışmaya dahil edildi. Preoperatif, intraoperatif ve postoperatif bulgular retrospektif olarak değerlendirildi.
Bulgular: VATS eksplorasyonu için klinik endikasyonlar plevral efüzyon, intrapulmoner kitle, kistik lezyon, mediastinal lenfadenopati veya malignite ön tanısı ile araştırılan veya önceden bilinen maligniteye sekonder gelişen kitle, uzamış hava kaçağı ve/veya akciğer ekspansiyon sorunlarıydı, mediastinal kitle, hemotoraks, plevral kalınlaşma veya plevral nodül, göğüs duvarı tümörü, perikardiyal kist veya efüzyon, şilotoraks ve intratorasik kaviter lezyon idi. Bu endikasyonları olan tüm hastalar esas olarak VATS eksplorasyonu ile tedavi edildi.
Sonuç: Tanı konulan hastada opere edilebilirlik kriterlerinin değerlendirilmesi ve hedefe yönelik tedaviler için alt tip belirlenmesi, VATS eksplorasyonu ile kesin biyopsi alınabilmesi nedeniyle kesin tanı konulabilir ve fazla tedavilerin önüne geçilebilir. VATS eksplorasyonunu tüm intratorasik patolojiler için önemli bir adım olarak öneriyoruz.

Anahtar Kelimeler: Explorasyon, intratoraksik patoloji, video yardımlı göğüs cerrahisi

Introduction

Videothoracoscopy (Video-Assisted Thoracic Surgery - VATS) is a method applied as a minimally invasive surgical intervention for intrathoracic pathologies. It has been used for more than a hundred years in both diagnosis and treatment of pleura, mediastinum, chest wall and lung pathologies, and is now a standard thoracic surgery technique. Many studies have proven that it has many advantages over the open surgical approach due to less pain, less hospital stay, less complications, and better cosmetic results [1-3]. In the nineties, besides anatomic lung and esophageal resections, wedge resections, parenchymal and pleural biopsies, mediastinal cyst and benign tumors, pericardial and pleural effusions, traumatic hemopneumothorax, and spontaneous pneumothoraxes were the indications, however, it has been developed with advanced technology and renewed endoscopy [4]. Since the exploration of thorax with VATS is minimally invasive, it is a feasible intervention in every case where it is needed. The main uses of VATS exploration are pleural biopsy, air leak control, mediastinal and hilar lymph node biopsy, debridement of pleural pouches, and traumatic hemothorax [5] Since the single port approach provides less pain and less hospitalization, it can be applied safely in cases requiring diagnosis and especially in staging. In fact, single-port incision can be performed under local anesthesia in cases with clinical status that cannot receive general anesthesia [6].

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In this study, it was aimed to review the indications in the selection of cases to undergo videothoracoscopic exploration.

Materials and Methods

497 patients who had been detected with an intrathoracic pathology radiologically and underwent VATS exploration between January 2009 and June 2019 were retrospectively reviewed and included in the study, according to approval of the ethic committee. Written informed consent was obtained from all patients. Patients who had clear indications for planned lung resections, diagnostic parenchymal biopsies, and patients who underwent tumor surgery after staging and diagnosing were excluded from the study.

In the majority of patients, thoracoscopy was performed under general anesthesia (94.2%; n=468). In a small group, it was performed under local anesthesia (5.8%; n=29). Surgical procedures were performed with local anesthesia in patients who were found to be at high risk ,e.g. older age, comorbid disease, poor general condition, in preoperative evaluation for general anesthesia.

In 257 (%51.7) cases single-port, in 181 (%36,4) cases two-port, in 58 (%11.7) cases three-port, and in 1 case four-port VATS exploration were performed. Thoracotomy was required rarely.

Age, gender, complaints, pre-diagnoses, intraoperative findings, postoperative follow-up and histopathological results of the cases were recorded.

Results

Of the 497 patients, 312 (62.8%) were male and 185 (37.2%) were female. The average age was 50.24 (2-85). The most common complaint in patients was dyspnea in 258 (51.9%) cases. There were cough in 112 (22.5%) cases, back and chest pain in 93 (18.7%) cases, fever in 15 (3%) cases and palpitations in 2 (0.04%) cases. Seventeen (3.4%) cases were asymptomatic. The most common clinical indication for videothoracoscopic exploration was pleural effusion in 198 (40%) cases (Table 1).

Table 1. Indications of VATS exploration.

Clinical manifestation	n (%)
Pleural effusion	198 (40%)
Intrapulmonary mass	78 (15.7%)
Cystic lesion	61 (12.2%)
Mediastinal lymphadenopathy or lesion	50 (10%)
Prolonged airleak/lung expansion **problem**	43 (8.7%)
Mediastinal mass	23 (4.6%)
Pleural lesion	20 (4%)
Hemothorax	15 (3%)
Pericardial cyst/effusion	5 (1%)
Chylothorax	4 (0.8%)
Total	497 (100%)

In this study, histopathological diagnoses could be obtained from all cases underwent VATS exploration and biopsy. A benign histopathological result was obtained from 229 cases (46%) without a diagnosis before the procedure, and a malignant histopathological result was obtained from 104 cases (20.9%). In 22 cases (4.4%) followed by a diagnosis of malignancy, a newly emerging intrathoracic lesion was benign.

The primary indication for patients who underwent VATS exploration due to pleural effusion was for diagnosis and treatment purposes. In all patients who underwent VATS for pleural effusion, the character of the fluid was exudate. The most common histopathology was pleuritis with 92 (46.4%) cases (Table 2).

Table 2. Histopathology results after VATS exploration due to pleural effusion.

Postoperative diagnosis	n (%)
Pleuritis	92 (46.4%)
Mesothelioma	28 (14.1%)
Adenocarcinoma	24 (12.1%)
Tuberculous pleuritis	10 (5%)
Metastasis of breast cancer	6 (3%)
Non-caseified granulomatous pleuritis	5 (2.5%)
Hematoma	5 (2.5%)
Hytatid cyst	4 (2%)
Lymphoma	3 (1.5%)
Metastasis of carcinoma	3 (1.5%)
Metastasis of endometrium cancer	3 (1.5%)
Nonsmall cell lung cancer (no-subtype)	2 (1%)
Fibrinoid necrosis	2 (1%)
Small cell lung cancer	1 (0.5%)
Ewing sarcoma	1 (0.5%)
Gossipoma	1 (0.5%)
Fat necrosis	1 (0.5%)
Diaphragm evantration	1 (0.5%)
Paraganglioma	1 (0.5%)
Malignant mesenchymal tumor	1 (0.5%)
Myxoid liposarcoma	1 (0.5%)
Metastasis of renal cell carcinoma	1 (0.5%)
Metastasis of serous papillary carcinoma	1 (0.5%)
Metastasis of neuroblastoma	1 (0.5%)
Total	**198 (100%)**

There were 78 cases diagnosed with intrapulmonary masses that underwent VATS exploration. The histopathological results of these intrapulmonary masses were lung squamous cell carcinomas (SCCs) in 22 (28.2%) cases, lung adenocarcinomas in 16 (20.5%) cases, hydatid cysts in 10 (12.8%) cases (Table 3).

Table 3. Postoperative diagnoses of cases that were detected by pulmonary mass and underwent VATS exploration.

Postoperative diagnosis	n (%)
Squamous cell carcinoma	22 (28.2%)
Adenocarcinoma	16 (20.5%)
Hydatid cyst	10 (12.8%)
Neuroendocrine tumor	6 (7.6%)
Pleuritis	5 (6.4%)
Schwannoma	3 (3.8%)
Anthracosis	3 (3.8%)
Granulomatous inflammation	2 (2.5%)
Metastasis of colon adenocarcinoma	2 (2.5%)
Metastasis of osteosarcoma	2 (2.5%)
Mesothelial cyst	1 (1.2%)
Small cell lung cancer	1 (1.2%)
Inflammatory myofibroblastic tumor	1 (1.2%)
Leimyosarcoma	1 (1.2%)
Metastasis of renal cell carcinoma	1 (1.2%)
Ganglion	1 (1.2%)
Inflammation	1 (1.2%)
Total	78 (100%)

Table 4. Results of patients with lymphadenopathy or intrathoracic lesions was detected by scanning.

Postoperative pathology	n (%)
Adenocarcinoma	12 (24%)
Non-caseified granulomatous inflammation	9 (18%)
Squamous cell carcinoma	7 (14%)
Caseified granulomatous inflammation	4 (8%)
Anthracosis	2 (4%)
Small cell lung cancer	2 (4%)
Lymphoid hiperplasia	2 (4%)
Chronical inflammation	1 (2%)
Atypical carcinoid tumor	1 (2%)
Mesothelioma	1 (2%)
Pleuritis	1 (2%)
Wegener's granulomatosis	1 (2%)
Necrosis	1 (2%)
Ewing sarcoma	1 (2%)
Metastasis of prostate carcinoma	1 (2%)
Lymphoma	1 (2%)
Castleman's disease	1 (2%)
Hydatid cyst	1 (2%)
Schwannoma	1 (2%)
Total	**50 (100%)**

There were 61 cases diagnosed radiologically with intrathoracic cystic lesions and underwent VATS exploration. Among these cases, 52 (85.2%) hydatid cysts, 3 (4.9%) pericardial cysts, 2 (3.2%) bronchogenic cysts, 2 (3.2%) schwannoma, 1 (1.6%) case of pleuritis and 1 (1.6%) case of necrosis/hemorrhage were detected.

There were 50 cases who had a lymphadenopathy detected during malignancy screening or underwent VATS exploration due to a newly developed intrathoracic lesion in a previously known malignancy follow-up. In 19 (38%) of these cases, there was a diagnosis of malignancy before the procedure (Table 4).

VATS exploration was performed in 43 cases followed up with spontaneous pneumothorax, trauma, and prolonged air leak problem or lung expansion defect postoperatively. It was observed that 37 (86%) of these cases had no intrathoracic pathology or parenchymal defects. There were bronchopleural fistulas in 3 (6.9%) cases, air leakage due to a hydatid cyst rupture in 2 (4.6%) cases, and a pulmonary contusion in 1 (2.3%) case.

VATS exploration was performed in 23 cases due to mediastinal mass, The detailed postoperative histopathology results are shown in Table 5. There were 20 cases underwent VATS due to extrapulmonary lesion located in the chest wall with pleural lesion. (Table 6).

Table 5. Histopathology results of the cases with mediastinal mass.

Postoperative diagnosis	n (%)
Thymoma	4 (17.3%)
Schwannoma	4 (17.3%)
Hodgkin lymphoma	3 (13%)
Mesothelial cyst	2 (8.6%)
Cystic teratoma	1 (4.3%)
Hytatid cyst	1 (4.3%)
Neurofibroma	1 (4.3%)
Ganglioneuroma	1 (4.3%)
Esophageal cyst	1 (4.3%)
Desmoid tumor	1 (4.3%)
Castleman's disease	1 (4.3%)
Adenosquamous carcinoma	1 (4.3%)
B-cell lymphoma	1 (4.3%)
Ectopic goiter	1 (4.3%)
Total	**23 (100%)**

Table 6. The histopathology results of the cases with pleural lesions.

Postoperative diagnosis	n (%)
Pleuritis	8 (40%)
Schwannoma	2 (10%)
Bone anomaly	2 (10%)
Abscess	2 (10%)
Breast carcinoma metastasis	1 (5%)
Lung adenocarcinoma	1 (5%)
Subplevral hemangioma	1 (5%)
Cavernous hemangioma	1 (5%)
Ewing's sarcoma	1 (5%)
Chronic cyst hydatid cavity	1 (5%)
Total	20 (100%)

There were 15 patients underwent VATS exploration with the diagnosis of hemothorax. Of the 10 post-traumatic hemothorax, 6 were penetrating and 4 were blunt injuries. One of the patients who had blunt trauma was using acetylsalicylic acid. In one of the cases with penetrating injury to the thorax, a diaphragmatic laceration was detected and repaired

with thoracotomy. In one case who applied with bilateral hemothorax, VATS was applied to the left hemithorax after bleeding control was achieved with right thoracotomy. VATS exploration was performed in 5 postoperative patients for hemothorax and bleeding control. It was found that one of these cases developed hemothorax after scoliosis surgery. All bleeding was controlled by VATS.

Pericardial cyst was detected in 3 (60%) of 5 cases and pericardial effusion in 2 (40%) of patients with pericardial pathology. Pericardial cysts were resected, a pericardial drain was placed in one case for pericardial effusion, and a pericardial window was opened in another case.

Of the 4 cases diagnosed as chylothorax, 2 cases were malignant. One case had primary familial cyhlothorax history and one case was iatrogenic. VATS was performed because conservative treatments were not beneficial. In 2 of the ductus thoracicus, duct repair was performed when a chile leak was seen. In two cases, pleural total decortication and adhesion were performed because no leak was detected.

Discussion

In thoracic surgery, VATS has been applied in diagnosis and treatment for many years. Although exploration was performed with mediastinoscopy in pleural diseases and pleural effusions, VATS has taken its place now [7].

It provides a clear view for both surgeon and surgical team as it is larger and more prominent than anatomical structures thanks to high resolution cameras and monitors. The degree of mass invasion of the mediastinum and chest wall, fissure involvement, lymph node sampling, presence of pleural and pulmonary nodules, and other intrathoracic pathologies are evaluated more closely and more specifically. However, the lack of depth perception, tactile feeling, and the need for endoscopic instruments can be disadvantages [8]. Contraindications of VATS include hemodynamically unstable patients, bleeding diathesis, patients who cannot tolerate single lung ventilation, and situations where there is no potential gap in the pleura [9].

Many studies have proven that VATS exploration is a gold standard procedure with high diagnostic value for pleural effusions [10-13]. We think that in all patients with symptomatic or recurrent fluid, VATS should be considered as a first-line approach to evaluate the pleural space and parenchyma. Because pleural effusions are often a clinical outcome secondary to another underlying disease [14]. Only 92 (46.4%) of pleural effusions were diagnosed with pleuritis. In the remaining case (53.6%; n = 106), the results of pathology were diagnosed separately, requiring completely different treatments. The cause of effusion in an oncology patient may be pleural metastasis, primary lung malignancy, primary pleural malignancy or inflammation. Even with these results, radical changes may be required in staging and treatment protocol. Tuberculosis pleuritis is the most common cause of pleural effusion after parapneumonic and malignant fluids [15]. In this study, the order by diagnosis number in pleural effusions is similar.

VATS exploration can be performed due to reasons such as malignancy suspicion, prior diagnosis of malignancy, targeted treatment planning despite being the diagnosis of malignancy and local invasion of the tumor [8]. Staging intrathoracic malignancies and evaluating the operability of a case is of great importance. Although computed tomography and PET scanning are appropriate scanning methods for tumor size and metastatic lesions, in some cases, they cannot make a clear distinction about the invasion or adhesion of the lesion to adjacent tissues [16]. In this study, some cases, diagnosed with lung cancer previously, were found to be inoperable by videothoracoscopic exploration because of mediastinum and fissure invasion and lack of enough lung capacity for pneumonectomy.

Hydatid cyst was detected in 10 of 78 intrapulmonary mass cases included in this study. This result shows that with VATS exploration, detection of benign disease and separation from malignant disease can prevent lobectomy.

Similar to pulmonary lesions, the size and location of mediastinal masses can be determined by radiological imaging, but discrimination the invasion or adhesion adjacent organ can be evaluated only during surgery in some cases. VATS exploration from a single port clearly ensures this. Those with a cystic structure in mediastinal lesions can also be detected by applying transillumination with VATS. All lesions in the mediastinum in this study were resected without the need for open surgery after VATS exploration. Biopsy or resections of thymoma and similar lesions were completed with VATS and there was no need for thoracotomy or sternotomy. VATS is recommended for surgery of thymoma complicated by myasthenia gravis and which is smaller than 6 cm and not showing adjacent organ invasion [17].

VATS has an important role in both diagnosis and treatment in cases with trauma or bleeding and air leak during postoperative follow-up. In the case of penetrating or blunt trauma, thoracotomy will not be required if an active bleeding focus is not detected thanks to a single port exploration in the evaluation of intrathoracic organs. This shortens the recovery and hospital stay of a patient with trauma stress. VATS can be applied at any stage in cases of trauma with early or delayed diagnosis. Organized hemothorax, empyema, chest wall or diaphragm injuries, lung expansion problem in trauma cases require VATS exploration [18].

Massive air leakage was not observed mostly in the patient group who had lung expansion defect and planned to have prolonged air leak control. However, "trapped lung" was prevented by pleurectomy of the thickened visceral pleura. Bronchopleural fistula was detected in three cases and utility incision was opened

to repair the fistula. Additional port incision may be opened for these procedures, or it may be necessary to switch to thoracotomy. But in any situation – VATS or thoracotomy, VATS exploration is the first step.

In cases with pericardial effusion, it allows opening a pericardial window with a single port. It also removes the additional thoracotomy stress in cases with pericardial effusion that may already be cardiac tamponade.

VATS exploration can often be made from a single port. However, if necessary, more than one additional port incision can be opened. In their studies comparing single-port and multi-port VATS resections, Ersen et al. [19] reported that there was no statistically significant difference in comparable parameters such as amount of blood loss, chest tube duration, post op drainage, postoperative pain other than operating time between the two groups, and also reported that the multiport VATS was completed in a shorter time. From this point of view, we recommend you not to hesitate to open an additional port. In this study, single port VATS was applied in 257 (51.7%) cases. An advantageous aspect of single port VATS is that it allows it to be applied under local anesthesia or with sedation. Twenty-nine (5.8%) cases were awake and VATS was performed by applying local anesthetic. All of them were explored for pleural effusion. None of them had intraoperative complications. VATS exploration is a comfortable and safe surgical procedure for both the patient and the surgical team.

The decision-making regarding the approach to intrathoracic pathologies begins with the patient's application and is completed as a whole with various radiological imaging and laboratory examinations. Decision making is a difficult process when including the cardiopulmonary functional capacities, sociocultural status and awareness of patients. Basic approaches and investigations are sufficient for decision making in most diseases. However, sometimes there is a need for additional resources and investigations. This varies according to the approach of thoracic surgery centers, the scope of specialist training and the role of patients in decision making [20]. VATS exploration shows its importance when additional resources are required. We think that it should be the first step in "decision making" as well as being used for diagnosis and treatment, especially in patients with malignancy or newly detected intrathoracic pathology. From this point of view, as well as in patients with pleural effusion that VATS exploration is widely accepted, VATS exploration can be performed as the first step in diagnosis, treatment and especially decision-making algorithm in each patient group and in each center for intrathoracic other pathologies. Some situations that were seen as disadvantages of VATS in previous years have disappeared. For example, the cost has decreased, experience has increased, the materials used have been diversified and available. All of these eliminated the tactile disadvantages of VATS relatively. Moreover, as our experience increased, we started using the endoscopic instruments as if we feel the tactile sensation. For example, the curvature and cavity of the ovarian clamp has been effective in locating the pulmonary nodules.

Performing thoracotomy has negative effects on postoperative morbidity and survival in patients who have undergone VATS exploration, who require surgery and whose disease has been staged and whose treatment has been planned previously. These situations were determined by VATS exploration and thoracotomy was planned for after neoadjuvant therapy. The patient was prevented from a second thoracotomy.

In conclusion, it should be kept in mind that VATS exploration can be used without any hesitation as the first step because of its effectiveness in diagnosis of intrathoracic pathologies in the thoracic surgery routine, staging in diagnosed lesions, and in the evaluation and conclusion of the disease.

Declaration of Conflicting Interest:

The Authors declare that there is no conflict of interest.

References

1.Santambrogio L, Nosotti M, Bellaviti N, Mezzetti M. Videothoracoscopy versus thoracotomy for the diagnosis of the indeterminate solitary pulmonary nodule. Ann Thorac Surg. 1995; 59(4): 868–71.

2.Pagès PB, Delpy JP, Falcoz PE, Thomas PA, Filaire M, Le Pimpec Barthes F, et al. Videothoracoscopy versus thoracotomy for the treatment of spontaneous pneumothorax: a propensity score analysis. Ann Thorac Surg. 2015; 99(1): 258–63.

3.Martín T, Larraga R, Badorrey I, Bello S, Hernandez A, de Andres JL, et al. La videotoracoscopia frente a la toracotomía en el diagnóstico de la enfermedad intersticial difusa [Videothoracoscopy versus thoracotomy in the diagnosis of diffuse interstitial disease]. Arch Bronconeumol. 1997; 33(7): 341–5.

4.Salo JA. The role of videothoracoscopy in the diagnosis and treatment of chest diseases. Ann Med. 1994; 26(6): 401–4.

5.Abbas AE. Surgical Management of Lung Cancer: History, Evolution, and Modern Advances. Curr Oncol Rep. 2018; 20(12): 98.

6.Kara M, Alzafer S, Okur E, Halezeroğlu S. The use of single incision thoracoscopic surgery in diagnostic and therapeutic thoracic surgical procedures. Acta Chir Belg. 2013; 113(1): 25–9.

7.Lee P, Colt HG. Pleuroscopy in 2013. Clin Chest Med. 2013; 34(1): 81–91.

8.Rusch VW, Bains MS, Burt ME, McCormack PM, Ginsberg RJ. Contribution of videothoracoscopy to the management of the cancer patient. Ann Surg Oncol. 1994; 1(2): 94–8.

9.Dieter RA Jr, Kuzyçz GB. Complications and contraindications of thoracoscopy. Int Surg. 1997; 82(3): 232-9.

10.Psallidas I, Kalomenidis I, Porcel JM, Robinson BW, Stathopoulos GT. Malignant pleural effusion: from bench to bedside [published correction appears in Eur Respir Rev. 2016 Sep; 25(141): 360] [published correction appears in Eur Respir Rev 2016 Sep; 25(141): 360]. Eur Respir Rev. 2016; 25(140): 189–98.

11.Pereira RR, Alvim CG, Andrade CR, Ibiapina CDC. Parapneumonic pleural effusion: early versus late thoracoscopy. J Bras Pneumol. 2017; 43(5): 344–50.

12.Aboudara M, Maldonado F. Update in the Management of Pleural Effusions. Med Clin North Am. 2019; 103(3): 475–85.

13.Wan YY, Zhai CC, Lin XS, Yao ZH, Liu QH, Zhu L, et al. Safety and complications of medical thoracoscopy in the management of pleural diseases. BMC Pulm Med. 2019; 19(1): 125.

14.Yalcin NG, Choong CK, Eizenberg N. Anatomy and pathophysiology of the pleura and pleural space. Thorac Surg Clin. 2013; 23(1): 1–10.

15.Cohen LA, Light RW. Tuberculous Pleural Effusion. Turk Thorac J. 2015; 16(1): 1–9.

16.Loscertales J, Jimenez-Merchan R, Congregado M, Ayarra FJ, Gallardo G, Triviño A. Video-assisted surgery for lung cancer. State of the art and personal experience. Asian Cardiovasc Thorac Ann. 2009; 17(3): 313–26.

17.Wang GW, Tao T, Li CK, Li QC, Duan GX, Sang HW, et al. Comparison between thoracoscopic and open approaches in thymoma resection. J Thorac Dis. 2019; 11(10): 4159–68.

18.Lang-Lazdunski L, Mouroux J, Pons F, Grosdidier G, Martinod E, Elkaïm D, et al. Role of videothoracoscopy in chest trauma. Ann Thorac Surg. 1997; 63(2): 327–33.

19.Erşen E, Kılıç B, Kara HV, Iscan M, Alizade N, Demirkaya A, et al. Uniportal versus multiport video-assisted thoracoscopic surgery for anatomical lung resections: a glance at a dilemma. Wideochir Inne Tech Maloinwazyjne. 2018; 13(2): 215□20.

20.Varghese Jr TK. Decision Making: The Surgeon's Perspective. In: Ferguson MK, editor. Difficult Decisions in Thoracic Surgery An Evidence-Based Approach. 3rd ed. London: Springer-Verlag, 2014. p. 47-57.