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Value of Video-Assisted Thoracoscopic Surgery (VATS) in the Diagnosis and Treatment of Mediastinal and Pleuro-Pulmonary Diseases

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ABSTRACT

Objective: Thoracoscopy offers great advantages when compared with open surgery in terms of postoperative pain and pulmonary complications. Thoracoscopy is safe and feasible with minimal morbidity. The purpose of this study is to evaluate the indications, surgical procedures, complications, and failure rates of VATS in the diagnosis and treatment of intrathoracic diseases.

Materials and Methods: One hundred seventy consecutive patients, 112 men and 58 women, with age ranging from 17 to 75 years (mean 45.7 years), underwent one hundred seventy diagnostic, therapeutic and diagnostic & therapeutic VATS procedures. Indications included recurrent or persistent pneumothorax (n = 50 patients), empyema thoracis (20), solitary pulmonary nodules (23), diffuse lung disease (12), undiagnosed pleural effusions (40), mediastinal masses or cysts (20), bronchiectasis with hemoptysis (5).

Results: Of the 170 VATS procedures, 157 (92.4%) procedures were successfully performed. Thirteen patients (7.6%) required conversion to thoracotomy due to bleeding in 2 who had excision lung bleb, extensive adhesion in 2 with chronic empyema thoracis and unlocated lesion in 2 with solitary pulmonary nodule (SPN). There were 19 (11.2%)

nonfatal postoperative complications: prolonged air leak for more than 5 days was seen in 8 patients. This complication occurred in 3 patients with spontaneous pneumothorax and 3 patients with empyema. Wound infection occurred in 3 patients. VATS in diagnostic procedures were effective in 91% (40 of 44 patients) and the procedures were 17 wedge excision for interstitial lung disease & (SPN), 19 pleural biopsies, and 8 biopsies for mediastinal tumors. Seventy five therapeutic procedures were effective in 70 patients (93.3 %) (71 of 75 patients). The success rate of the diagnostic & therapeutic procedures was 92.2% (47 of 51 patients). Only small doses of analgesics were needed. There was no intraoperative mortality. The mean operative time was 71 minutes, The overall mean duration of chest tube drainage was 2.5 days and the average postoperative hospital stay was 5.1 days for successful VATS group.

Conclusions: VATS is a safe and effective method for diagnosis and treatment of intrathoracic diseases. Patients had benefit in reduced postoperative pain, short hospitalization, short recovery times and good cosmetic result.

Keywords: Video-assisted thoracoscopic surgery (VATS), Spontaneous pneumothorax, Empyema, Mediastinum, Thoracoscopy..

INTRODUCTION

Thoracoscopy offers great advantages when compared with open surgery in terms of postoperative pain and pulmonary complications.

Video-assisted thoracoscopic surgery (VATS) is recognized as an accepted approach for many intrathoracic diseases previously requiring a thoracotomy, for a definitive diagnosis or for appropriate therapeutic management⁽¹⁾.

Video-assisted thoracoscopic surgery permits good exposure of the entire thoracic cavity including the mediastinum and better evaluation

of the anatomic relationship. It provides adequate access and space for almost all maneuvers of dissection. Also, the surgical trauma is minimized⁽²⁾.

In these two decades VATS has developed very rapidly as minimally invasive tool and has replaced conventional open thoracotomy as a standard procedure for some simple thoracic operations as well as an option or a complementary procedure for some other more complex operations^(3,4).

Aim of the work:

To explore and evaluate the indications, operative procedures, efficacy, complications and technical difficulties (failure rates) of VATS in the diagnosis and treatment of intra-thoracic diseases.

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Patients and Methods:

In this study 170 consecutive patients (112 male and 58 female) with mean age of 45.7 years (range 17 y to 75 years), underwent diagnostic and or therapeutic VATS procedures for lung, pleural and mediastinal diseases under general anaesthesia in cardiothoracic surgery departments at Sohag university Hospital, Egypt. Each patient elected to try VATS first and was informed that a conversion to Thoracotomy might be necessary.

Information included Demographic data, indication, type of the procedure, incidence and aetiology of conversion to thoracotomy, Operative time, postoperative complications and 30 days mortality, final histopathological diagnosis, duration of chest drainage and length of hospital stay were collected and studied for the entire group.

Indications and Procedures:

Included wedge excision and pleurectomy for primary spontaneous pneumothorax in (50) patients, pleural biopsy for undiagnosed pleural effusion in (40), Decortication for Empyema thoracis (fibro purulent phase) in (20), wedge excision for in-determinate solitary pulmonary nodule (SPN) (peripheral <3cm) in (23) and for Diffuse interstitial lung disease in (12), Lobectomy for bronchiectasis in (5) and resection or biopsy of mediastinal mass or cyst in (20).

Exclusion criteria:

Included; Patients with coagulopathy, Patients can't tolerate one lung ventilation, extensive ipsilateral pleural adhesions, inability to tolerate general anesthesia, abnormal anatomy or pathology with expected technical difficulty and cases of a potentially curative surgical treatment for malignancy, the conventional thoracotomy was always performed.

All patients underwent the following investigations: full blood count, serum biochemistry, chest radiography (PA and Lateral), CT chest, PFT, arterial blood gases, PT and PTT.

Operative Technique:

All VATS procedures were performed under general anesthesia in the operating room using a double-lumen endotracheal tube with selective one lung ventilation. The position was accurately checked before and after the patient was turned to a lateral decubitus position. The patient is positioned on the operating table in the lateral decubitus position. Single dose of third generation cephalosporin was given for prophylaxis in all cases. A pulse oximeter was used to maintain O₂

saturation more than 90%. CO₂ insufflation was not used in all cases. The basic technique for VATS has been described by Landreneau et al⁽⁵⁾.

A rigid thoracoscope (Karl Storz, Tuttingen, Germany or Stryker, USA) was introduced through the fifth, six or seven intercostal space in the midaxillary line using a 10 mm thoracic port (ICS could be changed depend on the procedure). Zero or 30° is selected according to the requirement. The second and third incisions were made under vision of the endoscope in the third to the seventh intercostal space along the anterior and posterior axillary lines for manipulating instruments without placement of trocars.

Thoroscopic visualization of the lung, pleural cavity and mediastinum was then performed to identify the pathology before insertion of subsequent ports because this allowed accurate positioning of the ports towards the target lesion for dissection, excision or biopsy purposes and avoid injury to underline structures.

Spontaneous pneumothorax cases were operated to control source of air leak by excision or ligation bleb. Pleurodesis was achieved by partial pleurectomy for all cases. Decortication was done for patients with stage II Empyema (fibrino-purulent phase). Previous thoracic surgery, destroyed lung, diagnosed bronchopleural fistulas, the presence of a thickened visceral pleura peel, or a shrunken hemithorax on CT scan were exclusion criteria. Pleurodesis using talc in powder or bleomycin was done for patients with proved malignant effusion. The access thoracotomy incisions without rib spreading ranging from 3 to 6 cm were performed in cases of VATS lobectomy and decortications and sometimes in cases of SPN for digital localization. Lobectomy, wedge excision and biopsies were taken using a reload 35 and 45-mm Autosuture EndoGIA staplers.

In case of biopsy or excision of mediastinal tumor, wedge excision of pulmonary nodules, pulmonary resection and pleural biopsies, plastic bags were used to retrieve the specimen. The biopsy specimens sent for histopathology.

At the end of the procedure the chest was irrigated with NSS and the lung was allowed to inflate. The operative site was observed for bleeding and air leak. An intercostal (two in case of decortications) chest tube (28-32 F) was placed at the lowermost insertion site. The chest tube was connected to the water seal via a pleural collection device. All patients except two were extubated immediately after surgery in the operating room. Those two patients were elderly post decorticated

patients, were placed in the intensive care unit overnight for lung expansion. All incisions were infused with local anesthetic (bupivacaine 2%) for a better postoperative analgesic effect. Chest tubes were usually removed, when any parenchymal air leak that may have been present had resolved, when the lung was fully expanded, and when pleural drainage was less than 100 mL per 24 hours. Active and passive physiotherapy was started on postoperative day 1 and maintained for 1 month. Postoperative pain was controlled by PCA and NSAID. Patients were discharged after removal of the intercostal drain and following confirming chest radiography. All patients were seen in our outpatient clinic at 1 month

postoperatively. Most of them were also seen at 3 months, and then followed up by their referring physicians or pulmonologists.

Description statistics:

Range, number, percentage, mean $\pm$ SD were used to summarize the descriptive results.

RESULTS

Of 170 patients, having VATS procedures 65.9% were male (112 patients) and the remaining were females. The mean age was 45.7 $\pm$ years (range 17-75 years). The indications for VATS procedures reported in Table (1).

Table (1): Demographic Data of Patients subjected to VATS.

Indication	No. of patients	Age		Gender	
		range	mean	Male	Female
1-Pneumothorax	50	17-38	24.5	40	10
2-Undiagnosed Pleural effusion	40	23-74	51	25	15
3-Empyema thoracis	20	18-69	44	12	8
4-Solitary Pulmonary Nodule	23	27-73	49	12	11
5-Diffuse interstitial lung disease	12	36-71	46	6	6
6-Hemoptysis with bronchiectasis	5	46-58	52	5	0
7-mediastinal mass or cyst	20	29-71	51.6	12	8
Total	170	17-75	45.7	112	58
Percent	100 %	-----	-----	65.9%	34.1%

Table (2): The objectives of the procedures.

Procedures	No.	Percent	Type of procedures		
			D	T	D&T
1. Wedge resection and Pleurectomy	50	29.4%	-	50	-
2. Pleural Biopsy $\pm$ pleurodesis	40	23.5%	19	-	21
3. Decortication	20	11.8%	-	20	-
4. Wedge Excision only (23 SPN, 12 diffuse interstitial lung disease)	35	20.6%	17	-	18
5. VATS Lobectomy	5	2.9%	-	5	-
6. Excision or biopsy of mediastinal tumor	20	11.8%	8	-	12
Total	170	100%	44 (25.9%)	75 (44.1%)	51 (30%)

157 of 170 (92.4%) VATS procedures were successfully performed. 44 VATS procedures were used only for diagnostic procedures and included 19 pleural biopsies, 17 wedge excisions, 8 mediastinal biopsies. These procedures were effective in 91% (40 of 44 patients) four of them required thoracotomy because of failure of localization of the lung nodule in 2 cases and

pleural adhesion in other 2 cases. VATS procedures were used for therapeutic purpose in 75 patients. The procedures were effective in 70 patients (93.3 % 70 of 75 patients). The remaining 51 VATS procedures were used for diagnostic & therapeutic purposes in other 51 patients. These procedures were effective in 92.2% (47 of 51 patients) (Table 2).

Table (3): Summary of data in specific VATS procedures.

Procedure	No.	Conversion	Complication	Operative Time(min)		Duration of ICT drainage (days)		Post operative stay (days)	
				mean	range	mean	range	mean	range
1. Wedge resection and Pleurectomy	50	1	6	62.4	32-110	4.8	3-18	5.3	4-19
2. Pleural Biopsy ± pleurodesis	40	2	3	50.9	27-80	3.5	2-13	4.5	3-14
3. Decortication	20	3	3	82.3	61-142	6.8	4-21	8	5-21
4. Wedge Excision only (23 SPN , 12 DILD)	35	3	4	67.9	35-160	2.4	1-9	4.2	2-11
5. VATS Lobectomy	5	0	0	183.2	155-190	3.5	3-4	6.2	5-7
6. Excision or biopsy of mediastinal tumor	20	2	2	98.6	45-155	2.5	1-4	4	2-8
Total	170	13 7.6 %	19 (11.2%)	71	27-190	3.9	1-21	5.1	2-21

Table (4): causes of conversion in the VATS procedures..

Cause of Conversion	N
Massive adhesions	4
Failure of localization of pulmonary nodule	2
Bleeding	2
Stiff lung	2
Adhesion to Aorta	1
Deep lung laceration	1
Rupture of pericardial cyst	1
Total	1

The Mean operative time for all procedures was 78 minutes, (range 27 - 190 minutes). All of them were extubated of endotracheal tubes after operation except in two cases with decortications. Morphine was injected to the patients in 24 hours after the operation, Followed by oral analgesic.

The mean duration of chest tube drainage was 3.5 days (range 1-20). The mean post operative hospital stay for all patients was 5.1 days (range from 2 to 21days).

The conversion rate to thoracotomy was 7.6 % (13 of 170 patients) .the most common cause of conversion was massive adhesions which was reported in 4 patients followed by failure of localization of the pulmonary nodule in 2 patients. (table 3, 4).

Table (5): Post Operative Complications reported in Various VATS procedures

Complication	No.
Prolonged air leak > 5 days	8
Port site infection	3
Pneumonia	1
Hemorrhage	2
Subcutaneous Emphysema	2
Pleural Space infection	1
Post operative respiratory failure	1
Supraventricular arrhythmia	1
Total	19

The overall post operative complication rate was 11.2% (19 of 170 patients) the most common complications were persistent air leak (longer than 5 days) occurred in 8 patients and wound infection in 3 patients . There was no intraoperative mortality. (Table 5).

Table (6): Indications for Operation in pneumothorax patients (50 patients).

INDICATIONS	NO	(%)
First episode (@)	16	32%
First ipsilateral recurrence	18	36%
Second or third ipsilateral recurrence	10	20%
First contralateral recurrence	5	10%
Hemopneumothorax	1	2%
Total	50	100 %

@Associated with persistent air leak (> 7 days), incomplete lung re-expansion, or job restrictions.

1-Wedge Excision and Pleurectomy for spontaneous Pneumothorax (n=50 patients):

Of 50 patients with PSP who underwent VATS stapled wedge excision (incorporating the bleb) and partial pleurectomy (mechanical pleurodesis; 30 procedures were performed on the right side and 20 on the left side.

16 patients underwent VATS procedure in their first episode of Pneumothorax because of persistent air leak (> 7 days),incomplete lung re-expansion or job restrictions, 33 patients due to recurrent (ipsilateral or contralateral) Pneumothorax and one patient with hemo-pneumothorax.

48 (96%) VATS procedures in 50 patients were successfully done, two patients (4%) required conversion to open thoracotomy because of bleeding from intercostal artery which is accidentally damaged during pleurectomy,3 had persistent air leak > 5 days, one developed subcutaneous emphysema which was treated by

rest and oxygen therapy. The mean operative time was 62.4 minutes. Mean duration of pleural drainage was 4.8 days. The mean Postoperative hospital stay was 5.3 days. No recurrence was noted after a mean follow up of 11.4 month (range 2 to 22 month).

Table (7): The Histopathological results of VATS pleural Biopsy

Diagnosis	No. Of Patients	%
Benign:	19	47.5%
Tuberculous pleurisy	12	30%
Chronic nonspecific pleurisy	7	17.5%
Malignant:	21	52.5%
Mesothelioma	12	30%
Malignant lymphoma	1	2.5%
Metastatic cancer	8	20%
Breast (5)	5	
Bladder (1)	1	
Kidney (1)	1	
Rhabdomyosarcoma (1)	1	
Total	40	100

2-Pleural Biopsy for Undiagnosed pleural effusion (n= 40)

VATS was performed to obtain pleural biopsy specimens in 40 patients, the procedures were successful in 38 (95%) patients, Histopathological studies disclosed tuberculous pleurisy in 12 patients, chronic non specific pleuritis in 7, mesothelioma in 9, and metastatic carcinoma in 8 patients and malignant lymphoma in one patient. Of 40 undiagnosed pleural effusion, 21(52.5%) found to be malignant.

Pleurodesis by insufflations of 5 gm of sterile talc or chemical pleurodesis by bleomycin was performed for the patients with proved malignant effusion. The mean operating time was 50.9 minutes, The mean duration of chest tube duration was 3.5 days and the Mean length of hospital stay was 4.5 days. (table7)

3-VATS Lobectomy: (n= 5)

VATS lobectomy was performed in 5 patients with Hemoptysis from bronchiectasis. 3 had left lower lobectomy and 2 had right lower lobectomy.

Mean operative time was 183.2 minutes. Chest tube duration was 3-4 days with mean 3.5 days. The mean length of stay was 6.2 days (5-7). There was no complications or conversion to thoracotomy.

Table (8): Histopathological diagnosis of Patients subjected to wedge lung biopsy:

Histology	Number	%
<i>Solitary pulmonary nodules</i>	23	65.7
Primary malignancy	8	34.8
Adenocarcinoma	4	
Squamous carcinoma	2	
Bronchiolo-alveolar carcinoma	2	
Metastatic cancer	5	21.7
breast	2	
Kidney	1	
Colon	2	
Benign lesions	10	43.5
Pulmonary hamartoma	5	
Mycetoma	1	
Non specific granuloma	3	
Histoplasmosis	1	
Diffuse lung disease group	12	34.4%
Bronchiolitis obliterans	2	
Desquamative interstitial pneumonia	2	
Non-specific interstitial pneumonia	2	
Usual interstitial pneumonia	6	
Total	35	100

4-Wedge Pulmonary Excision: (n= 35)

Of the 35 patients that had wedge excision only (23 for single pulmonary nodules and 12 for diffuse interstitial lung disease, 32 were treated successfully, 3 required conversion to thoracotomy because of failure of localization of the nodule in 2 cases and stiff lung in one patient.

The pathological diagnoses of SPN revealed benign lesion in 10 (43.5%) cases and malignant in 13 cases (8 primary lung cancers and 5 metastatic cancers) and of interstitial disease revealed bronchiolitis obliterans in 2 patients, desquamative interstitial pneumonia in 2, and non-specific interstitial pneumonia in 2 and usual interstitial pneumonia in six (6 patient.(table 8). Mean operative time was 67.9 minutes, mean duration of chest drain was 2.4 days. The mean hospital stay was 4.2, days.

5-VATS Decortication:(n=20)

Of the 20 patients who underwent VTS decortications of empyema thoracis. Causes of empyema thoracis were parapneumonic in 18 patients and Tuberculous in two.

3 of 18 patients with parapneumonic Empyema, required conversion to thoracotomy, 2 because of massive adhesion to Empyema wall and one because of deep lung laceration .

Post operative complications reported in 3 patients in the form of post operative air leak more than 5 days, one of them is the tuberculous patient. Air leak stopped with conservative treatment after 12, 15 and 18 days .

The mean operative time was 82.3 minutes, range 61-142 minutes. The mean duration of chest tube drainage was 6.8 days. The mean LOS was 8 days.

Table (9): data of patients subjected to VATS procedures for mediastinal tumors.

Histology	Patients.No.	%	Location	procedure
Cystic	6	30		
Pericardial cyst	3		Middle	cRe+C, pRe
Thymic cyst	1		Anterior	pRe
Bronchogenic cyst	2		Posterior	cRe
Solid	14	70		
LN, sarcoidosis	2		Middle	Biopsy
LN, lymphoma	2		Middle	Biopsy
Parathyroid adenoma	1		Middle	cRe
Thymic hyperplasia	1		Anterior	cRe
Schwanoma	2		Posterior	cRe, cRe+C
Ganglioneuroma	1		Posterior	cRe
Neuroblastoma	1		Posterior	Biopsy
Malignant thymoma	1		Anterior	Biopsy
Malignant teratoma	1		Anterior	Biopsy
Seminoma	1		Anterior	Biopsy
Undifferentiated carcinoma	1		Posterior	Biopsy

+ C : conversion to thoracotomy, cRe: complete resection, P Re: partial resection

6- Mediastinum (n=20):

Of 20 patients subjected to VATS procedures for excision or biopsy of mediastinal tumors, 8 tumors located in the middle mediastinum, 7 in posterior mediastinum and 5 in anterior mediastinum. 6 tumors was cystic and 14 solid, the histological type of tumors was confirmed in all patients with solid lesions, lymphoma in 2, sarcoidosis in 2, Schwanoma in 2, Parathyroid adenoma in 1, Neuroblastoma in 1, Malignant teratoma in 1, Malignant thymoma in 1, and one case presented with back pain and mass located in the posterior mediastinum, biopsy confirmed the tumour as undifferentiated carcinoma of the lung.

Conversion to thoracotomy occurred in 2 of 20 patients (10%) (one case because of adhesion to the descending aorta and difficulty in dissection (one of neurogenic tumors with size 1.5 ×4 cm) and one case (huge pericardial cyst 6×8 cm), because of ruptue of the cyst). The mean operative time was 98.6 minutes. The mean duration of Chest tube drainage was 2.5 days and the mean postoperative hospital stay (LOS) was 4 days (range 2 to 8 days).

DISCUSSION

The application of VATS in thoracic surgery is becoming an accepted modality of treatment as

many procedures have been shown to be technically feasible^(8,9).

In our experience, VATS was useful for diagnosis of undiagnosed pleural effusion (pleural biopsy), indeterminate pulmonary nodules (wedge excision), diffuse pulmonary disease (wedge biopsy), and media-stinal Lymphadenopathy (biopsy). Additionally VATS was effective in treatment of recurrent or persistent spontaneous Pneumothorax, malignant pleural effusion (pleurodesis), stage II Empyema thoracis, mediastinal mass or cyst, and bronchiectasis (lobectomy). Similar indications were reported by many other authors^(7,8,9).

In this study the primary indication was Pneumothorax (29.4%) followed by Pleural biopsy (23.5%), and wedge excision of pulmonary nodules was the third indication. However, Daniel et al,⁽¹⁰⁾ reported that the most common indication was pleural biopsy for undiagnosed pleural effusion followed by treatment of Pneumothorax and excision of pulmo-nary nodules was the third indication.

In this study, thoracoscopy was successful in the majority (92.4%) of the patients in whom it was attempted and the preoperative goals of the procedure were satisfied in these patients. Similar success rates (85%, 87.3%) were reported by

Chanin and Wiroj & Adel K. and, Ayed Emad Al-Shawaf^(7,8).

The conversion rate has been reported to be between 4.1 and 33%, depending on the procedure^(7,11,12,13). These findings are consistent with our experience, where 7.6 % of patients required conversion to an open procedure. The reasons for conversion were failure of localization of the pulmonary nodule⁽²⁾, tight adhesions in the pleural space⁽²⁾, major bleeding due to accidental injury⁽²⁾, and/or a stiff lung⁽²⁾. These findings are consistent with findings of Chanin and Wiroj⁽⁷⁾. Although other series showed higher conversion rates than ours, because VATS was more frequently performed for malignant pulmonary nodules or masses, where conversion to open procedure is necessary to ensure adequate resection, keeping morbidity low^(14,15). In the present study, VATS was performed most commonly for spontaneous Pneumothorax and undiagnosed pleural effusion, for which conversion is very infrequent.

There was no operative deaths in our series. Kaiser LR and Bavaria JE, and Jancovici et al^(12,16), reported in-hospital mortality rates ranged between 0 and 5% with the deaths largely involving older patients in poor condition or with malignancy.

Most surgical series have reported an incidence of 4–11% of complications resulting from VATS^(7,8,13). Which are similar to those that occur after open procedures. In the present study, postoperative complications reported in 11.2% of cases (19 of 170 patients). With The most common complication, prolonged air leak, which occurred in 4.7 % (8 of 170 patients) of the patients in our series. The occurrence of air leak was related mainly to spontaneous Pneumothorax, decortications and lung biopsy. The cause of the air leak was from the raw edge of the stapler or from extensive dissection. Chanin & Wiroj and Adel et al^(7,8) reported 6% & 5.8% incidence of post operative air leak respectively in their series.

In the present study, the mean hospital stay for all patients was only 5 days (range 2–21 days). Only small doses of analgesics were needed, and most patients returned to preoperative levels of activity after only 2 weeks. Except for patients with decortications and prolonged air leak, the duration of chest tube use was short. In agreement with Chanin & Wiroj⁽⁷⁾ who reported that the mean hospital stay was only 5 days (1–18 days).

VATS for Pneumothorax

There is now compelling evidence that VATS is a viable alternative to limited lateral thoracotomy (LLT) for the treatment of primary spontaneous Pneumothorax⁽¹⁷⁾. In our series in terms of post operative complications, the recurrence rate is zero. Which is less than most reports (3–6 %) ^(7,18). On the other hand many other authors^(19,20,21) reported 0 % recurrence rate like our results when they used the same technique like us (stapled resection + pleurectomy), but they claim that they reserve this way of pleurodesis for only a selected group of patients with targeted 0 % recurrence such as aviators, scuba divers, or other military personnel with special professional requirements. Also we reported 3 cases from 50 (6%) with prolonged air leak > 5 days one case resolved after 11 days and the others after 14, 15 days in agreement with reports of air leak from other series ranged from 1.4 % to 6.9 % ^(22,23).

Undiagnosed Pleural effusion:

In our study this indication represents the next common indication after management of Pneumothorax. Igor et al⁽²⁴⁾ reported that Management of pleural fluid problems by Operative Thoracoscopy is a common indication.

Definitive histological diagnosis was established in all patients (100 %) by VATS pleural biopsy and pleurodesis done simultaneously when indicated.

Thoracoscopic pleurodesis, were performed in 18 patients, 1 patient necessitated repeated pleurodesis. Ohri et al⁽²⁵⁾ reported a 95.5% success with Thoracoscopic talc pleurodesis.

Indeterminate Solitary pulmonary nodule:

The importance of diagnosing a solitary pulmonary nodule derives from the high risk of malignancy⁽²⁶⁾.

A noninvasive approach of transbronchial biopsies provided a diagnosis in only 37 to 50% of cases⁽²⁷⁾ compared with VATS peripheral lung biopsy which was as effective as open lung biopsy and provided a diagnosis in 90 to 95% ^(28&7). In the present series VATS excisional lung biopsies were effective in 91.4%. Using CT scan for preoperative investigation of SPN, the potential to malignancy depended on old age, size of nodule, irregular surface, if growth pattern should undergo VATS excisional biopsy. Positron emission tomography (PET scan) is more accurate to detect the difference between benign and malignant SPN⁽²⁹⁾.

In the present study conversion to open thoracotomy was done in 8.7% of patients because of the inability to locate the lesions thoracoscopically. This is in agreement with findings of several authors who reported conversion to thoracotomy in 5.4% to 20% because of failure of localization^(10,30,31).

VATS in Diffuse lung disease:

Current guidelines recommend surgical lung biopsy for diagnosis of interstitial lung diseases (ILDs) in selected patients⁽³²⁾.

Bensard et al. and Mary et al. reported that VATS stapled wedge resection was as safe and as effective as open lung biopsy in the diagnosis of interstitial lung disease; the post operative recovery period, complications and hospital stay were substantially reduced in those undergoing VATS^(28,32).

The mean operative time in our cases was 67.9 min which is matched with Chanin and Wiroj and Adel et al^(7,8), and in both studies, it is shown that operative time is not more than that required for thoracotomy.

VATS Decortication:

In the present series, we include only patients in stage II Empyema (fibro-purulent phase) and if the clinical and radiological data are highly indicative of organized empyema, patients were scheduled for thoracotomy.

Chanin and Wiroj⁽⁷⁾, was found that VATS should be performed instantly in clot hemothorax while in cases of Empyema thoracis, it should be performed within 2-4 weeks after diagnosis.

15 % of patients required conversion to thoracotomy, in agreement with findings of other authors who report a conversion rate of 10% to 40%^(7,33-35). Contraindications to VATS decortication include the unsuitable general condition of patients with severe sepsis and significant parenchymal disease in the lung for decortications.

VATS for mediastinal Tumors:

Alberto et al⁽³⁶⁾ suggest that Well-circumscribed tumors smaller than 3 cm without evidence of chest wall or bony invasion can be approached thoracoscopically. On the other hand Akihiko et al⁽³⁷⁾ assumed that all small (probably under 6 cm) mediastinal neurogenic tumors not of the dumbbell type or without evidence of intraspinal invasion are good indications for VATS.

In the present study the 3 neurogenic tumors which were excised thoracoscopically were of

less than 3cm and the one which necessitated conversion to thoracotomy was 4 cm but conversion was needed because of adhesions rather than size.

The role of surgical thoracoscopy in diagnosis of mediastinal Lymphadenopathy is very clear and prescribed by many authors⁽¹⁾. In the present study four cases with mediastinal Lymphadenopathy were successfully diagnosed as sarcoidosis in 2 and lymphoma in 2 cases without complications.

Giacomo et al⁽³⁸⁾ reported that thoracoscopic excision of bronchogenic mediastinal cyst should be considered the primary therapeutic option.

VATS Lobectomy:

Published series of VATS lobectomy shows that the procedure is being performed around the world. However, less than 10% of lobectomies are currently performed with VATS, because most thoracic surgeons are still not comfortable with the technique⁽³⁹⁾.

Tomaszek et al⁽⁴⁰⁾ reported that VATS lobectomy is safe and feasible for pulmonary resection with shorter recovery times and hospital stays compared with conventional open thoracotomy.

In our series mean operative time was 183.2 minutes, chest tube duration was 3-4 days with mean 3.5 days and the mean length of stay was 6.2 days⁽⁵⁻⁷⁾. There were no complications or conversion to thoracotomy in agreement with the findings of other authors⁽⁴⁰⁻⁴³⁾.

CONCLUSION

The present study demonstrates that VATS has an effective and useful role in the diagnosis and/or treatment of many intrathoracic diseases including diseases of the pleura, lung, and mediastinum. The VATS procedure and use of a non trocar technique is safe with few complications. There was no operative mortality associated with VATS procedures. Patients had benefit in reduced postoperative pain, short hospitalization and short recovery times and good cosmetic results.

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