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Role of Video Assisted Thoracoscopic Surgery (VATS) in Diagnosis & Treatment of diseases of thoracic cavity

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Abstract
Introduction:*VATS refers to the use of minimally invasive operative techniques employing endo-video guidance to accomplish thoracic surgical procedures previously requiring thoracotomy..*
Patients&Methods:*A prospective and retrospective analysis of 28 patients undergoing VATS for undiagnosed pleural effusion, empyema thoracis (post pneumonic or tubercular), bronchopleural fistula, ruptured liver abscess in pleural cavity, diaphragmatic hernia, eventration of diaphragm and lung cancer was done.*
Results:*All 28 patients who underwent diagnostic or therapeutic procedures using VATS, 89% of them achieved satisfactory outcomes with symptomatic relief during follow up period.*
Conclusion:*VATs is feasible and perhaps a better alternative for treatment of various diseases of thoracic cavity as compared to open thoracotomy.*
Keywords:*VATS-Video Assisted Thoracoscopic Surgery*

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I. Introduction

Thoracoscopy or the most commonly used term, video assisted thoracoscopic surgery (VATS), refers to the use of minimally invasive operative techniques employing endo-video guidance to accomplish thoracic surgical procedures previously requiring thoracotomy. The primary aim of this approach is to avoid the postoperative morbidity associated with open thoracotomy.

It was assumed that if patientscould be managed with "keyhole" surgery rather than thoracotomythey would experience less pain and shorter hospital stays.

The advantages of thoracoscopy over conventional thoracotomy are decreased postoperative impairment of pulmonary function, less postoperative pain, shorter hospital stay, and earlier return to full activity. Therefore, the method has gained rapid acceptance not only with surgeons, but especially with patients .Diagnostic as well as simple & advanced therapeutic procedures done by VATS are now well established and strongly recommended by most thoracic surgery societies. Many successful attempts have been cited in letearature at VATS to remove benign mediastinal tumors.[1-5]

VATS is useful for diagnosis and treatment of pleural effusion, for biopsy of diffuse pulmonary infiltrate, treatment of recurrent or persistent spontaneous pneumothorax and results in safe and effective sympathectomy. Therapeutic measures that can be done are such as breaking adhesions, drainage of loculated effusion, limited decortication for full expansion of lung, pleurodesis and excision of bullae & blebs.

II. Patient and Methods

From 2007-2009 a prospective and retrospective analysis of 28 patients undergoing VATS for undiagnosed pleural effusion, empyema thoracis (post pneumonic or tubercular), bronchopleural fistula, ruptured liver abscess in pleural cavity, diaphragmatic hernia, eventration of diaphragm and lung cancer was done in **Department Of Surgery in M.Y.Hospital,Indore**. Diagnosis was made using chest radiographs, thoracocentesis, pus culture, sonography, CT chest. In most case diagnosis was made with these methods. But in some cases diagnosis was not possible with all these methods like lung cancer so these patients were taken for VATS as a diagnostic purpose.

There were 15 males and 13 females , aged 15-60 years (median 37 years),The most common symptom with which the patient presented was chest pain(93% of cases) and fever(82% of cases).The complain of hemoptysis was present only in 6 patients(21% of cases) later diagnosed as lung cancer patients.

All patients underwent a general (hemogram, liver and kidney function,) ,blood sugar and electrolytes , respiratory (plain chest film & CT , arterial blood gas analysis) & cardiac (electrocardiogram) pre operative assessment.

In cases of empyema some patients were taken for VATS as primary therapeutic modality where as in most of the patients, persisting symptoms after tube thoracostomy was considered as indication for VATS. In cases of diaphragmatic hernia and eventration of diaphragm VATS was considered as primary therapeutic modality. In case of lung cancer VATS was done to take tissue biopsy only. The characteristics of these patients are listed in **TABLE 1**.

Thoracoscopy was performed using single lung ventilation in maximum cases, but the use of double lumen endotracheal tube especially in cases with collapsed lung has given no problem. The patients were placed in a lateral or semi lateral decubitus position. Based on preoperative imaging studies, suitable intercostals sites are selected for port placement between 3rd to 8th intercostal space. In many patients previous tube thoracostomy wound was used to insert trocar. 3, 5 and 10 mm instruments were utilized based on patient size. Low CO_2insuffulation pressures (e.g. 6 mm Hg) were maintained throughout the procedure. In some cases where we found collapsed lung there we use low pressure & zero pressure of CO_2.

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TABLE 1. Patient's characteristics,treatment and outcomes

Age in yrs (median)	15-60 yrs(37 yrs)
Male:Female ratio	3:2.5
Symptoms -Fever -Cough -Chest pain -Dyspnoea -Hemoptysis	 23(82%) 20(72%) 26(93%) 21(75%) 3(10%)
According to etiology -Empyema -Bronchopleural fistula -Diaphragmatic hernia -Eventration of diaphragm -Lung cancers -Lung Hydatid cyst -Rupture liver abscess in pleural cavity	 14 03 02 01 06 01 01
According to need of VATS -For diagnostic purpose -For therapeutic purpose -Both	 06 12 10
Operating time(median,range)	30-100 minutes(63.2 min)
Duration of tube drainage	3-10 days(7.1 days)
Length of Hospital stay	4-10 days(5.07 days)
Outcomes after VATS	25% converted to open thoracotomy ,75% were successful
Complication -Persistent air leak -Pus collection in ICD-most common	 Present in 26% of cases

In cases of empyema the pleural space was inspected and coagulum was removed. Interlobar collections were also sought and removed. Adherent peel was carefully removed from visceral and parietal pleural surfaces. Once the coagulum has been completely evacuated and the peel removed, the lung was inflated. The space was irrigated with antibiotic solution and a chest tube is placed via port site. A single chest tube was used commonly. In cases of diaphragmatic hernia bowel was reposited inside abdominal cavity and the defect in diaphragm was closed with non absorbable suture. A single chest tube was placed. In case of eventration of diaphragm placation of dome of diaphragm was done. In case of lung cancer pleural space and lung surface was inspected for nodules or growth, biopsy was taken from abnormal lung surface and sent for histopathology. The patients were managed in intensive care unit and thereafter in the general wards. Chest tubes were removed when there was cessation of air leak and minimal pleural drainage

III. Results

The treatment methods and outcome for our patients are shown in the table. All 28 patients underwent diagnostic and therapeutic procedures using VATs.

In those patients in which VATS failed to achieve satisfactory functional outcome either in form of persistent bronchopleural fistula, recurrent empyema, persisting symptoms, persistent collapsed lung as evident in imaging studies or clinical interpretation), open surgery was performed using standard posterolateral thoracotomy approach.

Seven patients were converted to open procedures,2 patient were of bronchopleural fistula and 5 patients were of empyema.There were no mortality or major morbidity intra or postoperatively.The operating time ranged from 30-100 minute(average 63.2 minute). 26% of patients were noted with complication in which

the most common was persistent pus collection in ICD.Other complication waspersistent air leak which recovered after conservative treatment.The chest tubes were successfully removed from 3-10 days(average 7.1 days) post-operatively.The post operative duration of hospital stay ranged from 4-10 days (median 5.07 days). During a follow up period of 3 months-2 years marked symptomatic relief were reported by 89% of patients.

IV. Discussion

In this series total 28 cases were included out of which 14 cases were of empyema, 3 cases of bronchopleural fistula, 6 cases of lung cancers and 2 cases of diaphragmatic hernia, and 1 case each of eventration of diaphragm, lung hydatid cyst and rupture liver abscess in rt. pleural cavity.

According to western literature, empyema most commonly occurs following pulmonary infection and in 1-3% cases of lung abscesses. The second most common cause is previous surgical procedures, including surgery of the lungs, oesophagus, or mediastinum. Empyema occurs in 2-12% of patients following these procedures. But in India half of the patients with empyema develop it as a complication of tuberculosis.

In, empyema pathological response may be divided in three phases that are not sharply distinct but gradually one phase merges into another with progression depending largely on the infecting organism. Exudative stage (1-3 days), fibrinopurulent stage (4-14 days), Organising stage (after 14 days).

In this series the main duration of presentation of empyema was 24 days (range 8-35 days). That indicates that majority of patients of empyema have been admitted when they are already in late fibrinopurulent (stage 2) or early fibrinous (stage 3) phase of empyema. The majority of patients of empyema in this series were of late stage disease at the time of presentation. In our series, out of 14 patients of empyema 9 patients recovered completely after VATS. In these patients the average duration of symptoms was 21 days (range 15-30 days).

The patients who didn't recovered after VATS were two cases of bronchopleural fistula and five cases of tubercular empyema.

As a tertiary referral centre we are mostly receiving the patients who had a failed trail of non surgical management of variable duration. Whether delay in referral for surgical intervention affects the likely hood of successful VATS treatment is an area of debate. In our series, in cases of empyema the mean duration between medical management and VATS was 17.7 days (range 1 - 80 days). This value reflects that most of the patients who have undergone VATS had organized empyema. The conversion rate to open decortication in our series is due to the late presentation of cases .In most of the patients, only suction irrigation with pleural debridement was possibly done. Patients in whom VATS was fully successful adhesiolysis with thorough pulmonary debridement was done.

Now a point which commands further discussion is the presence of tubercular empyema in our series. Tubercular empyema, because of its chronic nature requires decortication whether performed thoracoscopically or through a standard open thoracotomy. The use of VATS has not been routinely advocated for an organised empyema with an entrapped underlying lung where open decortication of lung by thoracotomy has been traditionally advocated. In a recent study by **Yu -Jen cheng et al** on the role of VATS in chronic empyema, patients with tubercular empyema were excluded from the series. Once chronic organizing empyema with thick fibrous peel is encountered, then' *open decortication of lung by thoracotomy* is considered as *gold standard* in all reports on chronic empyema therapy. Although a thoracoscopic evacuation of empyema can eradicate the pleural infections, as seen in the favourable result of VATS in treating the patients for fibropurulent empyema the addition of peel removal on lung surface in chronic empyema may sometimes cause lung damage which can aggravate the infection in these morbid patients. Since the removal of peel and sometimes a visceral pleurectomy are mandatory when using this procedure, patients with an uncontrolled current infection must be excluded from this protocol.

The main technical challenge of video assisted thoracoscopic surgery for decorticationS (VATD) depends on the degree to which surgeon can reduce pleural space and hence achieve maximal pulmonary expansion. The removal of dense pleural peel is a technical problem when performing VATD in stage 3 empyema. Meticulous dissection and time consuming piece by piece peeling are mandatory in the procedure which is why the surgeon takes the longer time.

The role of VATD in stage 3 empyema depends upon the available resources and experience of the operating team in video assisted surgery. When properly done it significantly reduce hospital stay and time of chest tube drainage. Open decortication is preferred in most of the institutions for the same.

In this series two cases of diaphragmatic hernia and one case of eventration of diaphragm are also included. One patient was operated for congenital diaphragmatic hernia and other patient was operated for diaphragmatic hernia after stab injury to the chest. **An article published in j*ournal of Pediatric Surgery*, by E.Yang, N.Allmendinger, S.Johnson, C.Chen, J.Wilson, S.Fishman** states that Neonatal thoracoscopic CDH repair is safe in selected patients who have good preoperative pulmonary function and anatomy amenable to primary diaphragmatic repair. In this patient bowel loops were pushed inside abdominal cavity and the defect was repaired. Patient recovered well after VATS without any complication and chest tube was removed on 3rd

post op. day. In case of eventration of diaphragm plication of the dome of diaphragm was done that patient also recovered fully.

In case of diaphragmatic tear due to stab injury combined laparoscopic and thoracoscopic approach was taken to reduce the contents of hernia and repair the rent.

One patient of solitary hydatid cyst of lung was also included in our series Surgical treatment has remained the standard option in the management of hydatid disease. Not much work is done about the thoracoscopic removal of hydatid cyst of lung. It is still a challenging job to remove the hydatid cyst of lung thoracoscopically.

Six cases of lung cancers were also included in this study. In all six patients diagnostic thoracoscopy was done. We succeeded in diagnosing all six patients by taking the biopsy of the abnormal lung tissue without much morbidity to the patient. Two cases were diagnosed as mesothelioma and four cases as adenocarcinoma after histopathology report. Pneumonectomy with open approach was performed in one patient who was having adenocarcinoma lung. Rests of the patients were in the advanced stage with metastases so they were given chemo-radiation according to the type of tumour..

V. Conclusion

The impetus to perform minimally invasive operations is occurring in all fields of surgery. The rationale for this lies in the belief that minimally invasive surgery will lead to less pain, faster recovery and less time in hospital and thus, potentially reduce healthcare costs.

Evidence is gradually accumulating indicating that video-assisted thoracoscopic surgery is a feasible and perhaps better alternative for the treatment of various diseases of thoracic cavity.

On comparing thoracoscopic and open method we see that incision scar mark of thoracotomy is very long and is painful to the patient than any other incision on the body due to the bony cage.

Laparoscopic and thoracoscopicoesophagectomy and thoracoscopicthymectomy is a standard procedure at many higher centres.

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