Original Article

Role of medical thoracoscopy in the treatment of complicated parapneumonic effusions

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ABSTRACT

Objective: The role of medical thoracoscopy in the treatment of pleural infections is increasingly being recognized. This study was done to assess the role of medical thoracoscopy in the management of carefully selected subset of patients with complicated parapneumonic effusions (PPEs). **Materials and Methods:** We analyzed retrospective data of 164 thoracoscopic procedures performed at our center on patients with complicated PPE in the past 10 years. Patients were subjected to medical thoracoscopy based on ultrasonographic stratification and a computed tomography (CT) thorax. Medical thoracoscopy was performed after an intercostal block under conscious sedation with midazolam (2 mg) and fentanyl (50 mcg) and local anesthesia with lignocaine 2% (10–15 ml), through a single port 10 mm diameter thoracoscope. **Results:** A total of 164 patients (119 males and 45 females) underwent medical thoracoscopy during the study period. The mean age was 47.4 ± 15.9 (median, 50; range, 16–86). The final diagnosis by thoracoscopy was bacterial empyema in 93 patients and tuberculosis in 71 patients. Medical thoracoscopy was successful without subsequent intervention in 160 (97.5%) patients, two patients underwent a second procedure, in the form of decortication, and two patients died due to sepsis. There were no major procedure-related complications that required intervention. **Conclusion:** Early adhesiolysis and drainage of fluid using medical thoracoscopy should be considered in patients with multiloculated complicated PPE after careful radiological (ultrasonography and CT) stratification, as a more cost-effective and safe method of management.

KEY WORDS: Conscious sedation, loculations, medical thoracoscopy, parapneumonic effusions

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INTRODUCTION

Pleural effusions which develop secondary to pneumonia or lung abscess are referred to as parapneumonic effusions (PPEs). PPEs are classified into three stages, which form a continuous spectrum. The first stage is the exudative stage, which is characterized by a glucose level above 60 mg/dl, a pH above 7.20, and a lactic acid dehydrogenase (LDH) level of <3 times the upper normal

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limit of serum. This stage usually resolves with antibiotics alone. The second is the fibrinopurulent stage; in this stage, the pleural fluid may be positive for microbiological studies and usually shows a glucose level below 60 mg/dl, a pH below 7.20, and a pleural fluid LDH more than three times the upper normal limit for serum. Furthermore, the pleural fluid becomes loculated. Drainage becomes progressively more difficult as more loculations develop. Effective drainage prevents the organization and formation of a thick pleural peel referred to as an organized stage, which often requires surgical intervention for complete cure.[1]

A PPE is considered to be complicated if either the cultures of pleural fluid are positive, or an invasive procedure is required for its resolution. It is very difficult to identify the presence of a PPE, especially when associated with pneumonia, as the symptoms are not specific. A PPE should be strongly suspected when the response to the treatment of existing pneumonia is suboptimal.[2] It is of prime importance not only to identify a PPE but also to drain it completely because the association of a complicated PPE with pneumonia increases the risk of mortality by 3–6 times.[3,4]

While early drainage of infected pleural fluid is key to successful management,[5] septations and loculations prevent the complete evacuation of fluid by intercostal drains. Data on the role of intrapleural fibrinolytics use and the effective dose required are not consistent across the studies. Furthermore, the availability and cost are limiting factors in developing countries.[6,7] Video-assisted thoracic surgery (VATS) would be ideal for these cases, but it requires general anesthesia, and it is an expensive procedure.

The role of medical thoracoscopy in the treatment of pleural effusions is increasingly being recognized. Rigid thoracoscopy in particular helps breaking the loculations under direct vision, thereby facilitating complete clearance. In this study, we assessed the role of medical thoracoscopy in the management of patients presented with complicated PPE.

MATERIALS AND METHODS

This is a retrospective analysis conducted at a tertiary care referral hospital. Data of patients with complicated PPE who underwent rigid thoracoscopy over the past 10 years were collected and analyzed. The procedure was done in the Department of Pulmonary Medicine at Narayana Health City, Bangalore, India, between May 2010 and March 2020. The cases were selected for medical thoracoscopy based on chest ultrasound [Figure 1] and computed tomography (CT) thorax findings [Figure 2].

Patients with multiloculated effusions as suggested by ultrasonography and without significant mediastinal

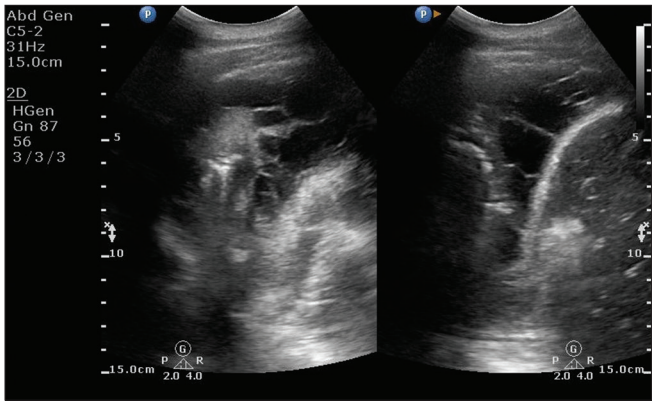

Figure 1: An ultrasonography showing loculated effusions

pleural involvement or visceral pleural thickening as indicated by the absence of "split pleura" on CT scan were selected for medical thoracoscopy.[8]

Medical thoracoscopy procedure

Intercostal block was administered as per anesthesia protocol to include one space above and below the anticipated site of entry identified by ultrasound. The medical thoracoscopy procedure was performed under conscious sedation with midazolam (2 mg) and fentanyl (50 mcg) and local anesthesia with lignocaine 2% (10–15 ml) administered at the site of entry. A rigid trocar was inserted carefully to avoid injury to underlying structures after blunt dissection through a 1.5 cm skin incision. A 10 mm diameter thoracoscope (Hopkins® Straight Forward Telescope 0°, Karl Storz SE & Co., KG., Germany) was then inserted to visualize the pleural cavity [Figure 3]. Rigid forceps were used to break the septations and loculations, carefully avoiding any injury to the lung. After adequate clearance was achieved, multiple pleural biopsies were taken for microbiologic and histopathologic studies [Figure 4]. An intercostal drain (ICD) was secured and connected to negative suction of −20 cm of H_2O. Completeness of pleural fluid drainage and lung expansion was confirmed by chest X-ray subsequently [Figure 5]. ICD was removed when the drainage was <50 ml for 2 consecutive days.

Statistical analysis

The data were analyzed by SPSS software version 15 for Windows, evaluation version (SPSS Inc., Chicago, IL, USA). Categorical variables are presented in terms of numbers or percentage, whereas continuous variables are presented as mean and standard deviation or median and interquartile range (IQR; 25th and 75th percentile values).

RESULTS

A total of 164 patients with complicated PPE were treated with medical thoracoscopy during the study period; of these, 119 (72.5%) were males and 45 (27.5%) were females. The mean age was 47.4 ± 15.9 and the median age was 50 (range: 16–86) years. The year-wise

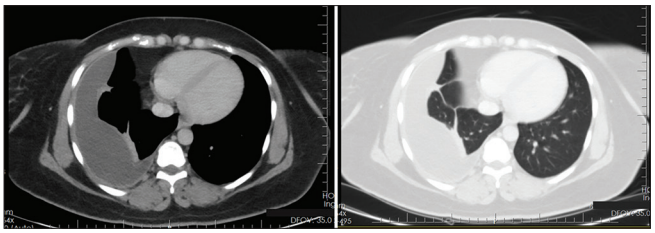

Figure 2: A computerized tomography of lung showing loculated effusions

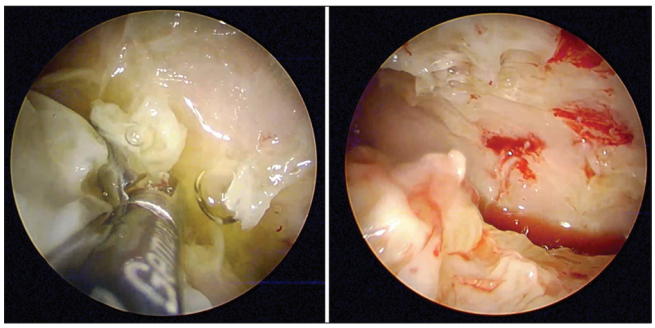

Figure 4: Thoracoscopic view showing pleural biopsy being taken after adhesiolysis

number of patients are presented in Table 1. The duration of symptoms was ≤2 weeks in 40% of the patients and >2 weeks in 60% of the patients. Sixty (36.5%) patients had a history of diabetes and 52 (31.7%) patients had hypertension. Other past histories included chronic kidney disease (n = 14; 8.5%), pulmonary tuberculosis (n = 2; 1.2%), asthma (n = 5; 3.04%), chronic obstructive pulmonary disease (n = 3; 1.8%), and coronary artery disease (n = 9; 5.5%). Clinical details and basic demographics of the study patients are summarized in Table 2.

Right-sided pleural effusion was seen in 57.9% (n = 95) of patients, left-sided pleural effusion was seen in 41.5% (n = 68) of patients, and only one patient (0.6%) had bilateral pleural effusion. The final diagnosis by thoracoscopy was bacterial empyema in 56.7% (n = 93) and tuberculosis in 43.2% (n = 71) of patients. The median day of ICD tube removal was day 4 (IQR; 3, 4); 86% of the patients had ICD removal within 5 days, and in 2 patients, the ICD tube remained in position for >10 days.

Medical thoracoscopy was successful without subsequent intervention in 160 of 164 patients (97.5%). Two patients underwent a second procedure with decortication. Two patients died during the study period due to sepsis

DISCUSSION

In patients with lower respiratory tract infection, the development of complicated PPE is associated with significant morbidity and mortality.[9] Stages of PPE include exudative, fibrinopurulent, and organizing phases. While the exudative phase can be managed with antibiotics

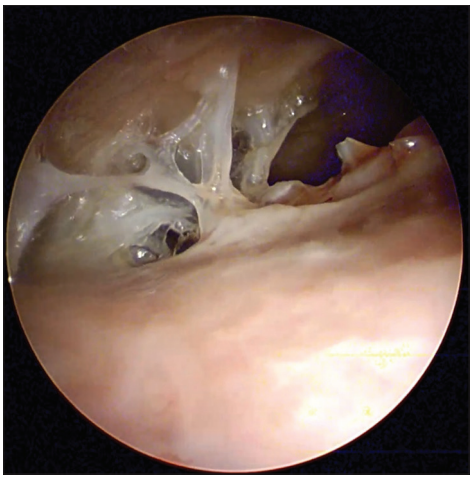

Figure 3: Thoracoscopic view showing thick adhesions

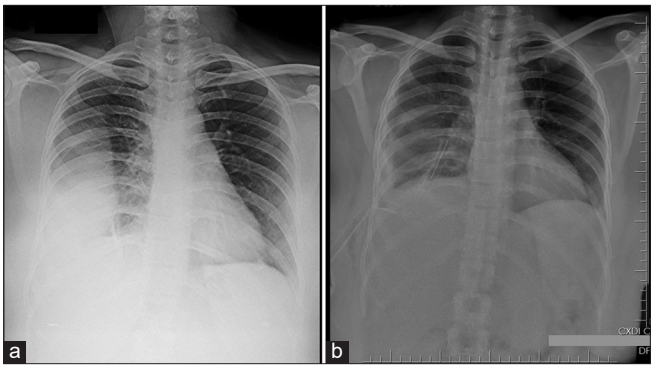

Figure 5: Chest X-ray showing pleural fluid drainage; (a) before and (b) after drainage

alone, the fibrinopurulent and organizing phases are often difficult to treat and always require fluid to be drained. The timing of intervention to mitigate complications is of paramount importance, and early intervention in a complicated PPEs leads to better outcomes.[4,10-12]

While the American College of Chest Physicians guidelines proposed a risk stratification scale, the British Thoracic Society guidelines proposed an algorithm for the management of PPE.[13,14] However, both fail to guide with clarity the timing of intervention in a complicated PPE. Imaging studies for stratification, which would suggest the timing or modality of intervention, have not been quoted in either guideline.

Ultrasound has now become a part of routine investigation before any pleural intervention as ultrasound can quantify and characterize pleural fluid and help to determine whether diagnostic or therapeutic drainage is required. Furthermore, it can guide the procedure of thoracentesis with minimal complications.[15] Chen *et al*. demonstrated that the presence of septations on ultrasonography was associated with a longer hospital stay due to prolonged intercostal tube drainage and was more likely to require surgical drainage.[16] Brutsche *et al*.

Table 1: Year-wise patients' distribution

Year	Number of patients
2010 (May-December)	6
2011	10
2012	11
2013	12
2014	11
2015	15
2016	16
2017	21
2018	25
2019	28
2020 (January-March)	9

Table 2: Basic demographics and clinical characteristics of the study patients

	n (%)
Total number of patients	164
Gender	
Male	119 (72.5)
Female	45 (27.5)
Age (years), median (range)	47.4±15.9, (50, 16-86)
Comorbidities	
Diabetes	60 (36.5)
Hypertension	52 (31.7)
Chronic kidney disease	14 (8.5)
Asthma	5 (3.0)
Past history of tuberculosis	2 (1.2)
Chronic obstructive pulmonary disease	3 (1.8)
Coronary artery disease	9 (5.5)
Chest X-ray	
Right-sided pleural effusions	95 (57.9)
Left-sided pleural effusions	68 (41.5)
Bilateral pleural effusions	1 (0.6)
Final diagnosis by thoracoscopy	
Bacterial empyema	91 (55.5)
Tuberculosis empyema	73 (44.5)
Thoracoscopy outcome	
Improved without subsequent procedure	160 (97.5)
Improved with subsequent procedure (decortication)	2 (1.2)
Mortality	2 (1.2)
Median day of ICD tube removal	4 (IQR; 3, 4)

IQR, 25th and 75th percentile. ICD: Intercostal drain, IQR: Interquartile range

in a similar study demonstrated that the outcomes in empyema stratified by ultrasound were good using medical thoracoscopic in terms of adhesiolysis and complete drainage of fluid.[17]

Ultrasound has the advantage of being available bedside, especially for the critically ill, lacks radiation exposure, and is low cost,[15] whereas CT chest helps in the identification of split pleura sign and mediastinal loculated collection and differentiates between empyemas and peripheral pulmonary abscesses.[18] In our study, all patients underwent both for obtaining optimal information about timing and choice of intervention.

The role of semirigid versus rigid thoracoscopy in the management of PPE is debatable, but both seem to have a role in their management.[19] Early in the course of the disease, with thin septations on ultrasound, semirigid thoracoscopy seems more appropriate. While thicker septations, loculations warrant adhesiolysis. Hence, a rigid thoracoscopy with rigid forceps is better suited to address these issues. Medical thoracoscopy is considered a minimally invasive approach, and the costs are much lower when compared to VATS. Although traditionally VATS has been the procedure of choice in such situations, a carefully selected subset of complicated PPEs does well with adhesiolysis and drainage using medical thoracoscopy, as in our study.[11] In this study, we achieved a success rate of 97.5%, defined as improvement in clinical and radiological parameters without requiring any further intervention. These success rates are similar to those reported in the literature.[17,20,21]

A VATS procedure is more invasive and mandates general anesthesia with single lung ventilation, both of which could be avoided with medical thoracoscopy. We suggest that patients with mediastinal loculations, thickened visceral pleura on contrast CTs, and those who fail medical thoracoscopy are more suitable for VATS or thoracotomy, and a careful stratification with imaging modalities helps guide these cases appropriately to medical or surgical approaches.[22]

Pain relief is of paramount importance during the procedure as this prevents inadvertent injury, especially to the lungs and mediastinal structures. Intercostal nerve blocks allow for adequate pain relief during thoracoscopy, especially as the instruments are rigid and manipulation causes significant pain during the procedure. As in the study by Sumalani *et al*., all patients in our study too received an intercostal nerve block, one space above and below the site of entry identified on ultrasound.[21]

Fibrinolytic use as an adjunct has also been extensively debated in the literature. Fibrinolytics were not used in our study as r-DNase, the only agent with some efficacy was not available in our country, and also the Cochrane review and meta-analysis by Tokuda *et al*. did not show any significant benefits.[6,23]

In our patients, medical thoracoscopic-guided adhesiolysis and drainage of fluid resulted in good clinical and radiological response; 160/164 patients had a good outcome, two patients required decortications subsequently, and two patients died due to sepsis. There were no major complications in our study [Table 3]. Our study strengthens the role of medical thoracoscopy in PPE with multiple thin loculations. We suggest that a careful stratification of patients with PPE using radiology may contribute to a more cost-effective way of managing PPE. The estimated average cost of VATS in our center is approximately 200,000 Indian rupees (2800 USD), whereas the average cost of medical thoracoscopy is around 50,000 Indian rupees (700 USD).

In our study, TB was seen in 44.5% of the patients suggesting that tuberculosis should also be kept as a differential in empyema as we are in an endemic area for

Table 3: List of complications recorded during the procedure in this study

Complications	Rigid thoracoscopy
Minimal subcutaneous emphysema	6
Persistent air leak	2
Persistent empyema	2
Ventricular arrhythmia	1
Re-expansion pulmonary edema	0

tuberculosis This is similar to the reports in other studies by Sumalani *et al*. and Patil *et al*.[21,24]

Limitations of the study

This is a retrospective and single-center study. Minor adverse events are less likely to have been recorded, and so it is possible that this may not give the complete picture. However, it is clear that all serious adverse events were captured, and that the results are not discordant with our overall impression of the safety and efficacy of medical thoracoscopy in this subset of complicated and radiologically stratified PPEs.

CONCLUSIONS

Medical thoracoscopy is a minimally invasive and cost-effective procedure in patients with multiloculated complicated PPE, who have been stratified carefully using radiological methods.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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