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Comparative Study between Video Assisted Thoracoscopic Decortication versus Conventional Thoracotomy for Chronic Empyema in Adults

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ABSTRACT

Background: Empyema is the presence of purulent material inside the pleural cavity.

Objective: This work aimed to compare the outcomes of video assisted thoracoscopic decortication versus conventional thoracotomy for chronic empyema in adults.

Methods: This prospective randomized comparative clinical study included 40 patients suffering from chronic empyema underwent decortication by video assisted thoracoscopic surgery (VATS) or conventional thoracotomy at the Department of Cardiothoracic Surgery, Tanta University Hospital. Studied cases were randomized into 2 equal groups in a parallel manner by computer generated numbers & their allocation code was kept in a closed opaque envelope: Group A underwent VATS and group B underwent lung decortication via conventional postero-lateral thoracotomy.

Results: Duration of surgery was significantly higher in group A than in group B (P value<0.001). Intraoperative blood loss was significantly lower in group A than in group B (P value<0.05). Hospital stays, visual analogue scale (VAS) were significantly lower in patients in group A than in group B .

Conclusions: VATS offers significant advantages in terms of reducing intraoperative blood loss, blood transfusion requirements, hospital stay, postoperative thoracic drainage, pain score, inflammatory markers, and higher hemoglobin level. Conventional thoracotomy showed reduced operative time and provided effective lung decortication in cases with severe adhesions to achieve the optimum results and to decrease the duration and the complications of the surgery. Sliding score by dynamic CT provided valuable preoperative insights into grade of pleural adhesions, aiding surgical planning and guiding the decision to proceed with VATS or convert to open thoracotomy.

Keywords: Conventional thoracotomy, Video assisted thoracoscopic decortication, Chronic empyema, Adults.

INTRODUCTION

Empyema is the existence of purulent material inside the pleural cavity.The most common causes of development of empyema are lung infection (pneumonia) or rupture of lung abscess [1, 2].

Empyema is an aggressive clinical condition associated with significant morbidity that requires proper management. Empyema undergoes three stages of development. The first stage, known as the exudative stage, is distinguished by the presence of exudate fluid as a result of extravasation and an increase in capillary permeability following the release of inflammatory markers. The second stage (fibrin-purulent stage) is characterized by development of purulent material with formation of septations and loculations due to stimulation of fibroblast. The third stage (peel stage) is characterized by development of pleural thickening and rinds that prevent full lung expansion, known as chronic empyema. Proper management of empyema uses intercostal tube drainage, antibiotic administration according to culture and sensitivity and preventing development of third stage in which lung decortication is the only known intervention [3].

Lung decortication aims to remove partial pleural thickening, removal of fibrous peel, rectifying lung infoldings, debridement of any purulent tissue or material to eradicate the source of infection, and achieve full lung expansion. Lung decortication is conventionally performed via postero-lateral thoracotomy incision, which is very painful, causing restricted clearance of secretions that leads to respiratory distress [4].

Therefore, some promising studies advocate the use of thoracoscopic procedure for lung decortication owing to its less painful and better cosmetic results [5]. However, other studies are against thoracoscopy in decortication as they showed that thoracoscopy is less efficient in the proper removal of the pleural thickening or fibrous peel, which is one of the main objectives in lung decortication. Therefore, this study compared the results of video-assisted thoracoscopic (VATS) decortication versus conventional thoracotomy for chronic empyema in adults.

PATIENTS AND METHODS

This was a prospective randomized comparative clinical study that was conducted on 40 studied cases who suffer from chronic empyema and underwent decortication by VATS or conventional thoracotomy at the Department of Cardiothoracic Surgery, Tanta University Hospital from 1st of July 2023 to 30th of September 2024.

Inclusion criteria: Cases above eighteen years old, both genders & who underwent lung decortication for chronic empyema. Chronic empyema was diagnosed as failure of complete lung expansion after complete and proper evacuation by intercostal tube or due to presence of thickened pleural rinds that render proper lung expansion [6].

Exclusion criteria: Patients who were unable or refused to provide written informed consent, patients

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who were participating in other clinical trials, patients who used intrapleural fibrinolysis in the management of empyema, and patients with malignant effusion or tuberculous effusion complicated by empyema.

Randomization: Studied cases were randomized into 2 equal groups in a parallel manner by computer-generated numbers, & their allocation code was kept in a closed opaque envelope: Group A (n=20): Patients underwent video-assisted thoracoscopic decortication and group B (n=20): studied cases underwent lung decortication via conventional postero-lateral thoracotomy.

Pre-operative evaluation: All studied cases were subjected to full history taking (age, sex, symptoms duration as fever (in days) and history of comorbidities or previous surgeries), full clinical examination including vital signs, full laboratory investigations [Complete blood count, liver function tests, renal function tests, prothrombin time, international normalized ratio, Na, K, arterial blood gas, and C-reactive protein (CRP)], full radiological investigations [computed tomography (CT) of the chest , chest X-ray and sliding score for detection of pleural adhesions through dynamic CT chest [7]], scans and other investigations if indicated in the form of electrocardiogram and pelviabdominal ultrasound. Chest tube insertion was done as initial treatment and fluid removed were subjected to the following:

Fluid analysis: The fluid collected was subjected to physical and chemical analysis (e.g., appearance, pH, glucose, protein levels) to assess the nature of the effusion, and to help differentiate between types of pleural effusions, such as exudates or transudates.

Fluid culture and sensitivity testing: Pleural fluid samples were sent for microbiological analysis (Aerobic and anaerobic), including culture and sensitivity to identify any bacterial or fungal pathogens. Cultures were performed to isolate and identify causative organisms. The bacteriology was categorized based on the identification of pathogens from culture results. The study tracked the most common bacteria isolated, including Gram-positive organisms (e.g., Streptococcus pneumoniae, Staphylococcus aureus), Gram-negative organisms (e.g., Klebsiella pneumoniae , Escherichia coli), and anaerobes, which are frequently implicated in chronic empyema cases.

Antibiotic duration: The duration of antibiotic therapy was recorded in days and adjusted according to the sensitivity results from the culture. tuberculosis (TB) screening techniques to exclude TB, such as polymerase chain reaction for Mycobacterium TB deoxyribonucleic acid and acid-fast bacillus smear. Also, cultures were performed on pleural fluid samples.

Intraoperative data including side of surgical approach, duration of operation, estimation of intraoperative blood loss through the calculation of the quantity of sponges that are completely soaked and the quantity of blood in the suction container, severity of adhesions and blood transfusion and number of units needed.

SURGICAL TECHNIQUE

VATS using multi-port: The patient was initially placed under general anesthesia, which is typically administered using double-lumen endotracheal intubation. The optimal separation of both lungs was confirmed through fiber-optic bronchoscopy as part of the procedure. Patient was placed in the posterolateral decubitus position. Selected as the principal access site along the mid-axillary line were either the sixth or seventh intercostal space. A small incision was made, and a trocar was inserted to create the entry point for the thoracoscope. Additional ports (usually 2 to 4) were then placed under direct thoracoscopic vision, ensuring precise placement, and minimizing the risk of injury to surrounding structures. These secondary ports facilitated the introduction of surgical instruments for dissection, drainage, and pleural decortication.

Once access to the pleural cavity was established, thorough drainage of the empyema was performed. This involved gentle blunt dissection of the pleural adhesions using specialized thoracoscopic instruments, which allowed for the removal of the thick, fibrous pleural peel, or decortication. The cavity was repeatedly irrigated with warm saline to help clear any remaining pus and debris, ensuring the thoracic cavity was clean before further intervention.

Endo staplers were employed to excise necrotic lung tissue & seal any air leaks that may be present. These staplers ensured secure tissue resection and were essential for minimizing post-operative air leaks and preventing complications. Chest tubes were inserted through one or more of the intercostal access sites, underneath direct visualization, to facilitate the removal of any remaining fluid or air from the pleural space after the decortication was completed and hemostasis was accomplished. The thoracic cavity was carefully closed in layers following the procedure to prevent the presence of any leaks or potential infection-causing spaces. An aseptic dressing was applied over the incision sites, and the patient was closely monitored postoperatively for any complications, such as bleeding or respiratory distress.

Conventional surgical technique of thoracotomy: The studied case was placed in the posterolateral decubitus position and underwent a thoracotomy through a posterolateral thoracotomy incision while under general anesthesia. The rib spreader was employed to obtain access to the thoracic cavity, while the serratus anterior muscle was spared. The pleural cavity was subsequently routinely invaded through the 5th intercostal space. Exposure was facilitated by the use of a Finochietto retractor. The operation aimed to free the lung completely by dissecting adhesions of diaphragmatic, apical, and mediastinal surface of the lung. Opening the lung fissures. Removing the pleural peel covering the lung with drainage of the empyema fluid. After all of that we ensure complete lung expansion by ask the anesthesiologist to inflate the lung. Close any air leak if significant by sutures. 1 or 2 chest tubes were inserted at suitable locations after the thoracic cavity was washed with warm saline following complete hemostasis. Ribs were sutured together on both sides. After that, an aseptic dressing was applied after the chest wall was closed in layers with skin sutures/stapler.

Postoperative data including length of hospital stay in days, full clinical examination including vital signs as fever, postoperative chest radiography (CXR) (Residual collection, complete lung expansion), postoperative CBC, CRP before discharge, blood transfusion and number of units needed and postoperative pain scale from (1-10) were all recorded.

During the first week following the operation, the visual analogue scale was employed to evaluate postoperative pain. The scale is represented as a 10-centimeter straight line that represents the extremes of "no pain" and "worst pain".

Nonsteroidal anti-inflammatory drugs and opioids were employed to ensure adequate postoperative pain management. Additionally, the total dose & duration of each of the analgesics required were recorded. Air leakage that persisted for more than five days, pulmonary atelectasis, excessive bleeding, & the necessity of a blood transfusion were all documented as complications. It was recorded whether deaths occurred during the hospitalization. In order to search for any residual or long-term complications, serial chest X-rays were conducted [8].

Additionally recording of duration in days till discharge from the hospital and amount of thoracic drainage. Post operative complications (Prolonged air leak, bleeding, re-collection and need for re-exploration). Extended chest tube drainage was the primary method of treatment for prolonged air leaks, which are defined as air leaks that persist for more than five days. If the air leak persisted beyond the expected time frame, additional interventions like the application of fibrin glue or surgical reinforcement were considered [9]. Bleeding was managed with close monitoring of chest tube output, typically assessed by the amount of drainage every hour. If there was a significant increase in drainage (e.g., > 200 mL/hr) for two consecutive hours, it indicated a possible ongoing hemorrhage, and re-exploration was considered [10].

Hemoglobin levels were also monitored closely to guide the need for transfusions or further interventions based on the clinical situation [11]. In cases where there was ongoing fluid collection or signs of infection (e.g., fever, increased inflammatory markers), need for re-exploration and drainage were indicated. Patients were followed up at our Outpatient Clinic after two weeks then after one month then after two months. Follow up was performed using CXR, CBC, CRP, and new development of fever.

Ethical approval: An Informed written consent was acquired from the patients. The study was carried out after approval from the Ethics Committee of the Faculty of Medicine, Tanta University Hospital (approval code:36264MS249/7/23). The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis

The statistical analysis was performed using SPSS version 26 (IBM Inc., ARMONK, NY, USA). Histograms & the Shapiro-Wilks test were used to evaluate the data distribution's normality. An unpaired Student's T-test was used to compare the 2 groups' means & standard deviations (SD) of quantitative parametric variables. Quantitative non-parametric data were presented using the median & interquartile range, & the Mann-Whitney U test was employed to analyse the data. Qualitative variables were expressed as frequency & percentage (%) & analysed using the Chi-square test. A two-tailed P value ≤ 0.05 was considered statistically significant.

RESULTS

Mean age in group A was 40 ± 7 and 41± 6.6 years in group B. Both groups had a male predominance (75% males in group A and 70% in group B). No significant differences were observed in preoperative comorbidities (Diabetes, hypertension, chronic obstructive pulmonary disease (COPD) & coronary artery disease (CAD)) , radiological investigation, sliding score to assess the pleural adhesion detected by dynamic CT, CRP, total leukocyte count (TLC), hemoglobin, bacteriology, duration of antibiotic use and need for preoperative intercostal tube insertion among the groups (**Table 1).**

Table (1): Demographic data, risk factors, preoperative radiological investigation, sliding score to assess the pleural adhesion detected by dynamic CT, CRP, TLC, hemoglobin, bacteriology, duration of antibiotic use and need for preoperative intercostal tube insertion of the studied groups

		Group A (n=20)	Group B (n=20)	P value
Age (years)		40.1 ± 7	41.4 ± 6.6	0.549
Gender	**Male**	15 (75%)	14 (70%)	0.999
	Female	5 (25%)	6 (30%)	
Risk factors	**Diabetes mellitus**	4 (20%)	3 (15%)	0.998
	Hypertension	7 (35%)	6 (30%)	0.735
	COPD	2 (10%)	4 (20%)	0.661
	CAD	4 (20%)	3 (15%)	0.998
Radiological investigation	**Pleural thickening**	16 (80%)	18 (90%)	0.659
	Pleural Pouch	8 (40%)	6 (30%)	
	Collection	3 (15%)	5 (25%)	
Sliding score by dynamic CT	**Grade 0**	5 (25%)	5 (25%)	0.801
	Grade 1	5 (25%)	3 (15%)	
	Grade 2	3 (15%)	5 (25%)	
	Grade 3	7 (35%)	7 (35%)	
CRP (mg/L)		42.05 ± 15.55	47.15 ± 13.04	0.268
TLC (109/L)		16.95 ± 1.57	17.55 ± 1.05	0.164
Hemoglobin (g/dL)		10.23 ± 0.43	9.95 ± 0.67	0.133
Bacteriology	**Staphylococcus aureus**	6 (30%)	7 (35%)	0.935
	Streptococcus pneumoniae	4 (20%)	3 (15%)	
	Escherichia coli	6 (30%)	5 (25%)	
	Klebsiella pneumoniae	4 (20%)	5 (25%)	
Duration of antibiotic use (day)		8.2 ± 4.24	7.25 ± 4.54	0.498
Need for preoperative intercostal tube insertion		11 (55%)	9 (45%)	0.527

Data are presented as mean ± SD or frequency (%). **COPD:** Chronic Obstructive Pulmonary Disease, **CAD:** Coronary artery disease. **Grade 0:** Totally fixed reflecting sever adhesion. **Grade 1:** Sliding within same intercostal or the same rib reflecting moderate adhesion. **Grade2:** Sliding under one Intercostal space reflecting mild adhesion. **Grade3:** Sliding over more than one space so reflecting no adhesion.Sliding score by dynamic CT was insignificantly different between both groups**. CRP:** C-reactive protein, **TLC:** Total leukocyte count.

Side of surgical approach was insignificantly different among the 2 groups. The duration of surgery was significantly longer in group A than in group B (P value<0.001). Group A exhibited a significantly lower intraoperative blood loss than group B (P value<0.05). The intraoperative blood transfusion was insignificantly different between both groups demonstrating that group B needed more blood intraoperatively (**Table 2).**

Table (2): Side of surgical approach, duration of surgery, intraoperative blood loss & blood transfusion of the studied groups

		Group A (n=20)	Group B (n=20)	P value
Side of surgical approach	**Right**	11 (55%)	7 (35%)	0.203
	Left	9 (45%)	13 (65%)	
Duration of surgery (h)		3.5 ± 0.51	1.6 ± 0.5	**<0.001***
Intraoperative blood loss (ml)		204.15 ± 30.3	725.35 ± 16.52	**<0.001***
Intraoperative blood transfusion (units)		3 (15%)	7 (35%)	0.273

Data are presented as mean ± SD or frequency (%). * significant as P-value ≤ 0.05.

Sliding score by dynamic CT was significantly lower in patients converted to open than patients not converted to open (P value 0.001) (**Table 3).**

Table (3): Relation among conversion & sliding score by dynamic CT

		Converted to open (n=10)	Not converted to open (n=10)	P value
Sliding score by dynamic CT	**Grade 0**	5 (50%)	0 (0%)	**0.001***
	Grade 1	5 (50%)	0 (0%)	
	Grade 2	0 (0%)	3 (30%)	
	Grade 3	0 (0%)	7 (70%)	

Data are presented as frequency (%). CT : computed tomography * Significant as P-value ≤ 0.05.

Hospital stays were significantly lower in group A than in group B (P value<0.001). Duration, amount of thoracic drainage and total amount drainage during stay was significantly lower in group A than in group B (P value <0.05). The physical nature of fluid was insignificantly different among both groups. Visual analogue scale (VAS) was significantly lower in group A than in group B (P value <0.001) (**Table 4).**

Table (4): Hospital stay, duration, amount of thoracic drainage and physical nature of fluid and VAS of the studied groups

		Group A (n=10)	Group B (n=20)	P value
Hospital stays (day)		3.2 ± 0.79	7.35 ± 1.79	**<0.001***
Duration of thoracic drainage (days)		2.9 ± 0.88	5.95 ± 1.32	**<0.001***
Amount of thoracic drainage (ml/day)		100 ± 40.82	130 ± 25.13	**0.019***
Total amount drainage during stay (ml)		270 ± 103.28	757.5 ± 139.81	**<0.001***
Physical nature of fluid	**Bloody**	0 (0%)	5 (25%)	0.140
	Serosanguineous	10 (100%)	15 (75%)	
	Turbid serosanguineous	0 (0%)	0 (0%)	
VAS		2.5 (2 - 3.75)	5 (2 - 3.75)	**<0.001***

Data are presented as mean ± SD or frequency (%). VAS: Visual Analogue Scale.

Lung expansion occurred at postoperative before discharge, 2 weeks, 1 month and 2 months in all patients in both groups. Residual collection occurred in 1 (10%) patient in group A and 1 (5%) patient in group B. Prolonged air leaks, surgical bleeding, residual collection and need for re-exploration were insignificantly different between both groups (**Table 5).**

Table (5): Postoperative radiological investigation and complication in hospital of the studied groups

			Group A (n=10)	Group B (n=20)	P value
Radiological investigation	**Postoperative before discharge**	**Lung expansion**	10 (100%)	20 (100%)	**--**
		Residual collection	1 (10%)	1 (5%)	
	2 weeks	**Lung expansion**	10 (100%)	20 (100%)	**--**
		Residual collection	0 (0%)	0 (0%)	
	1 month	**Lung expansion**	10 (100%)	20 (100%)	**--**
		Residual collection	0 (0%)	0 (0%)	
	2 months	**Lung expansion**	10 (100%)	20 (100%)	**--**
		Residual collection	0 (0%)	0 (0%)	
Complication	**Prolonged air leak**		0 (0%)	2 (10%)	0.540
	Surgical bleeding		0 (0%)	1 (5%)	1
	Residual collection		1 (10%)	1 (5%)	1
	Need for re-exploration		0 (0%)	1 (5%)	1

Data are presented as mean ± SD or frequency (%).

Hemoglobin was significantly higher at postoperative in group A than in group B (P value<0.001) and was insignificantly different at 2 weeks, at 1 months and at 2 months between both groups. Postoperative blood transfusion was insignificantly different between both groups. CRP was significantly lower at postoperative in group A than in group B (P value=0.022) and was insignificantly different at 2 weeks, at 1 months and at 2 months between both groups. Total leukocyte count was significantly lower at postoperative in group A than in group B (P value<0.001) and was insignificantly different at 2 weeks, at 1 months and at 2 months between both groups. Fever was insignificantly different at postoperative between both groups. Fever didn’t occur at 2 weeks, 1 month and 2 months in any patients in both groups (**Table 6).**

Table (6): Hemoglobin, postoperative blood transfusion, CRP and fever of the studied groups

		Group A (n=10)	Group B (n=20)	P value
Hemoglobin	Postoperative	9.78±0.22	8.7±0.09	**<0.001***
	2 weeks	9.35±1.11	9.03±0.24	0.220
	1 month	9.32±0.78	9.04±0.22	0.134
	2 months	9.78±0.16	9.7±0.16	0.213
Postoperative blood transfusion		0 (0%)	5 (25%)	0.140
CRP	Postoperative	41.2±15.25	54.15±13.04	**0.022***
	2 weeks	35.2±15.16	43.9±10.06	0.070
	1 month	18.6±12.42	27.3±12.88	0.089
	2 months	1.9±0.88	2.2±0.89	0.391
Total leukocyte count	Postoperative	16.8±1.23	18.95±0.76	**<0.001***
	2 weeks	13.9±1.73	13.35±1.6	0.394
	1 month	11.4±2.27	10.9±2.25	0.571
	2 months	9.9±0.74	10.15±0.75	0.392
Fever	Postoperative	2 (20%)	3 (15%)	0.999
	2 weeks	0 (0%)	0 (0%)	---
	1 month	0 (0%)	0 (0%)	---
	2 months	0 (0%)	0 (0%)	---

Data are presented as mean ± SD or frequency (%). *: Significantly different as P value ≤0.05. CRP: C-reactive protein.

DISCUSSION

Thoracotomy has traditionally been a standard method for evacuating the pleural space, with a reported success rate exceeding 90% [12, 13]. Decortication with open thoracotomy remains the gold standard surgical technique for chronic empyema [14].

We found that surgical duration was significantly longer in group A (VATS) (3.5 ± 0.51 h.) (210 ± 30.6 min) than in group B (1.6 ± 0.5 h.) (96 ± 30 min). This may reflect the technical complexity of VATS in cases with dense pleural adhesions, delayed diagnosis, limited surgical space, and the learning curve associated with VATS [15]. Conversion from VATS to open thoracotomy further prolonged operative time. In disagreement with our results**, Dokhan *et al.*** [16] found that the duration of surgery was significantly higher in open thoracotomy group (336.0 ± 67.60 min) compared to VATS group (291.07 ± 56.66 min).

In the present study, intraoperative blood loss was significantly lower in group A (204.15 ± 30.3 ml) than in group B (725.35 ± 16.52 ml). Intraoperative blood transfusion was lower in group A (15%) than in group B (35%) but without significant difference between both groups. As VATS group could be attributed to the fact that VATS is a less invasive procedure with small incision than open thoracotomy, leading to reduced tissue trauma and blood loss. Comparable with our findings, **Jindal *et al.*** [17] found that intraoperative blood loss was significantly lower in VATS group in comparison with the group of open thoracotomy. **Irani *et al.*** [18] reported that blood transfusion was lower in the VATS group (46 cases) compared to the thoracotomy group (53 cases) without significant difference.

In our study, sliding score by dynamic CT was significantly lower in patients converted to open than in patients not converted to open. Notably, 10 (50%) patients in VATS group converted from VATS to open thoracotomy because of dense adhesions and their sliding score was grade 0 to 1. This findings suggests that a lower preoperative sliding score may predict the need for conversion due to more severe adhesions or restricted lung mobility [19]. Conversion aimed to achieve optimum results and decrease complications and duration. In accordance with our findings, **Sokouti *et al.*** [20] found that the conversion of 252 patients to open traditional thoracotomy occurred during VATS. Open thoracotomy decortication was performed when VATS failed, with these failures most commonly occurring in the late stages of empyema.

In our study, duration of thoracic drainage, amount of thoracic drainage and total amount drainage were significantly lower in group A than in group B, during stay. In line with our findings, **Steen *et al.*** [21] concluded that VATS has fewer days with tube drainage compared to open thoracotomy. Likewise, **Podbielski *et al.*** [22] carried out a study on 30 patients with empyema thoracis. They were allocated into 2 groups: The open thoracotomy group (n=14) and VATS group (n=16). They found that drainage duration was significantly lower in VATS group (4.7 ± 2.8 days) compared to open thoracotomy group (8.3 ± 4.6 days).

In our study, hemoglobin was significantly higher at postoperative in group A than in group B while CRP & TLC were significantly lower postoperatively in group A than in group B. VATS is less invasive compared to open thoracotomy. It involves smaller incisions and minimizes disruption of tissues, muscles, and blood vessels. This leads to less intraoperative blood loss, preserving hemoglobin levels better in the VATS group. Conversely, open thoracotomy allows for more extensive clearance but is associated with greater surgical trauma and tissue damage, leading to higher postoperative CRP levels compared to VATS [17, 23].

In the current study, postoperative blood transfusion was lower in group A (0%) than in group B (5%) without significant difference between both groups. Supporting our findings, **Elbasiouny *et al.*** [24] found that postoperative blood transfusion was lower in the group of VATS (10 cases) in comparison with the group of open thoracotomy (15 cases) without significant difference. (total 60 cases 30 cases in each group).

In the present study, VAS was significantly lower in group A (2-3) than in group B (4-6). As VATS is a less invasive procedure with small incision than open thoracotomy, leading to reduced pain and tissue damage. In agreement with our results, **Steen *et al.*** [21] concluded that pain score was significantly lower in VATS compared to open thoracotomy.

In the present study, regarding complications in hospital, prolonged air leaks, surgical bleeding, residual collection, and need for re-exploration were insignificantly different between both groups. Supporting our findings, **Elbasiouny *et al.*** [24] found that air leaks was insignificantly different between both VATS decortication group (10 cases) and open decortication group (15 cases) of total 60 cases 30 case in each group. Likewise, **Jindal *et al.*** [17] found that post-operative complications were insignificantly different among both open thoracotomy group & VATS group.

In our study, Lung expansion in CXR occurred at postoperative before discharge in all patients in both groups. Residual collection occurred in 1 (10%) patient in group A & 1 (5%) patient in group B, which managed medically by using proper antibiotic according to culture and sensitivity taken from the infected pleural tissue. In a research by **Andrade-Alegre *et al.*** [25], they stated that VATS claimed similar clinical results as open thoracotomy which support our findings regarding residual collection. Similarly, **Chan *et al.*** [26] found that decortication using both approaches gave similar degrees of postoperative functional improvements.

LIMITATIONS of the study were single center study, small sample size and short period of follow-up.

CONCLUSION

Both VATS and open thoracotomy allowed equally effective decortication for chronic empyema. However, VATS offered significant advantages in terms of reducing intraoperative blood loss, blood transfusion requirements, hospital stay, postoperative thoracic drainage, pain score, inflammatory markers, and higher hemoglobin level. On the other hand, conventional thoracotomy showed reduced operative time and provided effective lung decortication in cases with severe adhesions to achieve the optimum results and decreased the duration and the complications of the surgery. Sliding score by dynamic CT provided valuable preoperative insights into grade of pleural adhesions, aiding surgical planning and guiding the decision to proceed with VATS or convert to open thoracotomy.

RECOMMENDATIONS

we recommend both VATS and conventional thoracotomy as safe and effective procedures for patients with chronic empyema, further prospective multicenter studies with larger sample size, further studies are needed with a longer period of follow-up, further studies are needed to compare with robotic surgery & to compare with patients who received intra-pleural fibrinolysis. More efforts should be focused on improving VATS surgical expertise to minimize conversion rates and further to enhance its potential benefits.

ABBREVIATIONS

CAD	Coronary artery disease
CBC	Complete blood count
COPD	Chronic obstructive pulmonary disease
CRP	C-reactive protein
CT	Computed tomography
CXR	Chest radiography
DNA	Deoxyribonucleic acid
ECG	Electrocardiogram
SD	Standard deviation
TB	Tuberculosis
TLC	Total leukocyte count.
VATS	Video assisted thoracoscopic surgery

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