DOI: https://doi.org/10.47391/JPMA.288

Video Assisted Thoracoscopy as a therapeutic modality in evacuating retained or clotted haemothoraces

Ambreen Abid[1], Tanveer Ahmad[2], Khalil Ahmed Shaikh[3], Shagufta Nasreen[4], Nazish Sikander[5], Misauq Mazcuri[6]

1,2,4-6 Department of Thoracic surgery, Jinnah Postgraduate Medical Centre, Karachi, Pakistan;

3 Jinnah Postgraduate Medical Centre, Karachi, Pakistan.

Correspondence: Ambreen Abid. **Email**: ambreenabid1234@gmail.com

Abstract

Objective: To determine the role of video-assisted thoracoscopy for evacuating retained / clotted haemothoraces to minimise the duration of chest tube drainage and length of hospital stay.

Methods: The prospective cohort study was conducted from July 2019 to February 2020 at the Department of Thoracic Surgery, Jinnah Postgraduate Medical Centre, Karachi, and comprised consecutive patients who underwent video-assisted thoracoscopy for retained or clotted haemothoraces. Outcome was measured as evacuation of retained haemothoraces resulting in partial or complete lung expansion and length of hospital stay. Data was analysed using SPSS 22.

Results: Of the 160 patients, 128(80%) were males and 32(20%) were females. The overall mean age was 36.08±11.91 years. Overall, 103(64.37%) patients underwent the procedure in within 4-7 days, and 57(35.63%) within 8-14 days. Complete lung expansion was achieved in 95(71.9%) patients when the procedure was performed in the first week, and in 37(28.1%) when performed in the second week (p=0.01). Within the first week, 87(84.4%) patients had shorter duration of stay compared to patients

having undergone the procedure in the second week (p=0.001). Relapse of collection was found in 21(13.7%) patients.

Conclusion: Video-assisted thoracoscopy was found to be a safe, reliable and effective technique for the evacuation of retained haemothorax in haemodynamically stable patients. Early intervention resulted in better outcome.

Key Words: VATS, Blunt trauma, Clotted haemothoraces, Hospital stay.

Introduction

Trauma is among the most common reasons of hospitalisation across the world [1]. As many as two-thirds of trauma patients have associated chest trauma. It may range from a rib fracture to life-threatening injuries. After head injury, thoracic trauma is the second leading cause of death [1]. In the United States, 35% of all trauma-related mortalities are a result of thoracic trauma alone or in association with other non-thoracic injuries [2].

Most haemodynamically stable patients with chest trauma are treated with a tube thoracostomy, but significant amount of residual blood might still remain in the pleural cavity after the procedure. In most cases, it takes 4-6 weeks for these haemorrhagic collections to entirely get resorbed, mostly without causing infection [3]. However, in some patients, due to malposition or poor drainage of pleural space, there may still be retained haemothorax [4]. Retained hemothorax can be defined as residual clots at least 500ml or larger, or in which at least one-third of the pleural space is occupied and cannot be drained by a chest tube after 72 hours of the initial treatment [3,5,6].

Extended hospitalisation and complications, such as empyema and fibrothorax, are adverse events associated with failure to properly evacuate blood from pleural space after thoracic trauma[7]. When thoracostomy tube placement fails to completely evacuate clots, methods such as additional thoracostomy tubes or early thoracotomy, in addition to adding low-pressure suctioning, are used to prevent the complications associated with inadequate evacuation of blood [8]. While adding additional chest tube

may be simple and inexpensive, it may still be ineffective, leading to more procedures and additional hospital stay. Other options include thoracotomy, which is effective, but is invasive and associated with potential morbidity. Video-assisted thoracoscopy (VATS) now provides an attractive option for evacuating retained haemothoraces. This technique is cost-effective and assists in a more thorough evacuation of traumatic haemothoraces, thereby reducing or preventing pleural space complications [8].

The current study was planned to evaluate the role of VATS in the management of chest trauma patients pertaining to retained or clotted haemothoraces in terms of reducing the duration of chest tube drainage and the length of hospital stay.

Patients and Methods

The prospective cohort study was conducted from July 2019 to February 2020 at the Department of Thoracic Surgery, Jinnah Postgraduate Medical Centre (JPMC), Karachi. After approval from the institutional ethics review board, the sample was raised using consecutive sampling technique from among the patients undergoing VATS for retained or clotted haemothoraces.

Those included were patients with continuous maroonish discharge from the chest tube, or clots in the tube and chest X-ray showing a post-traumatic retained haemothorax even 72 hours after the placement of the chest tube. Haemodynamically unstable patients with multiple organ injuries or those with a poor pulmonary reserve shown by a low partial pressure of oxygen (PO2) <80mmHg and oxygen saturation (SaO2) <94% were excluded. Also excluded were patients with associated major bronchial, oesophageal and / or vascular injuries as evidenced by continuous massive air leak, mediastinal air, or ongoing blood-loss.

A residual haemothorax with a volume of 500ml or more and / or occupying one-third or more of the haemithorax was defined as a retained haemothorax [1], clinically appreciated by persistent drainage of maroonish colour discharge from the chest tube [6]. VATS was carried out under general anaesthesia with a double lumen endotracheal tube. Clots were first washed with normal saline to break them. The

volume of normal saline was measured beforehand. All the fluid suctioned out was collected in a clear marked bottle, and the clot volume was calculated after subtracting the normal saline volume used. Clot removal was performed using a wide bore suction cannula appropriate for VATS. Size 36 French chest tubes were connected to under-water seal and were kept patent. Suction was applied uniformly for all patients. Daily measurement of the drainage and colour of the effluent was recorded. Chest tubes were removed when there was complete lung expansion with minimal (<50ml) light-coloured effluent in 24 hours without air leaks.

Data was analysed using SPSS 22. Descriptive data, like age, volume of blood after ultrasound, blood drained via VATS, length of hospital stay, day on which VATS was performed, and day on which the chest tube was removed, was presented as mean and standard deviation. Categorical data, such as gender, type of injury, rib fracture, side of trauma, outcome of VATS and complications, was presented as percentages and frequencies. Chi-square test was used to compare categorical data. $P \leq 0.05$ was taken as significant.

Results

Of the 160 patients, 128(80%) were males and 32(20%) were females. The overall mean age was 36.08±11.91 years. Overall, 102(63.75%) patients had blunt chest trauma and 58(36.25%) had penetrating chest trauma. The most common chest trauma was due to road traffic accidents (RTAs) 66(41.3%). Associated rib fractures were seen in 47(29.4%) patients. Sternal fractures were seen in 13(8%) patients. Overall, 103(64.37%) patients underwent the procedure in within 4-7 days (first week), and 57(35.63%) within 8-14 days (second week). Mean day of the procedure was 6.59± 3.36 days (range: 4-14 days). Mean operation duration was 66.78±1.23 minutes (range:35-90 minutes) (Table 1).

Mean blood volume calculated on ultrasound was 618.94±195.16mls (range: 400-1,250mls.). Mean volume of blood evacuated during VATS was 680.69±231.82 mls (range: 420-1,450mls.). Ultrasound underestimated the blood clot volume by 9.1%.

After VATS, complete lung expansion was seen in 132(82.5%) patients and partial lung expansion in 28(17.5%). Complications, such as conversion to thoracotomy, prolonged air leak, relapse of collection and pneumothorax, were seen in 13(8.1%), 21(13.1%), 22(13.8%) and 14(8.8%) patients, respectively. Ultrasound-guided drainage for all residual collections drained 274±49.41mls (Table 2).

Of the 132(82.5%) cases with complete lung expansion, 95(71.9%) were those who had VATS in the first week compared to 37(28.1%) among those who had it in the second week. Of the 28(17.5%) cases with partial expansion, 20(71%) had VATS in the second week. There was no difference in complications, such as relapse of collection and pneumothorax, when VATS was done early. Chest tube was removed in the first week in significantly more patients who had VATS in the first week compared to those who had it in the second week ($p<0.05$). Mean duration of hospital stay was 7.11±3.25 days when VATS was performed in the first week compared to 11.16±9.13 days for those who had it in the second week (Table 3).

Discussion

It has been documented that in up to 20% of patients, chest tubes fail to completely evacuate retained haemothoraces [7]. VATS, therefore, has been increasingly used during the last two decades in treating such haemothoraces. It is a reliable alternative to thoracotomy for accurately assessing and evacuating retained clots from the pleural cavity, hence reducing the chances of future complications, like empyema thoracis [4,9].

In the current study, 82.5%patients had complete lung expansion after VATS and 17.5% had partial lung expansion. This result was comparable with another local study[5]. An analysis of 8 studies found that clot evacuation was successful in 90% cases[10]. Another study showed 75% success rate with VATS7]. The success of VATS in terms of timing is also established, and the best results is expected when it is performed within 3-5 days[7,10]. The current study had similar findings. Early VATS is also associated with reduced conversion to thoracotomy. A study concluded that

VATS performed within 5 days was significantly associated with a lower conversion to open thoracotomy[11]. In another study conversion was higher when VATS was performed after seven days of trauma [7]. In the current study, all 13 conversions were in participants who had VATS in the second week. A study also stated that hospital length of stay (LOS) was significantly lower for patients having VATS within 5 days [11], which was also reflected in the current study. Early performance of VATS also allows early re-expansion of the lung capacity which can help in restoring lung function quickly and improving clinical outcomes [12].

Various reasons contribute to failure of VATS technique, including lung collapse, adhesions with the chest wall and organised clots. Failure of VATS is more likely if performed after six days of the injury. It is because as the days pass, loculation of retained contents advances, there are dense adhesions and higher risk of thoracic empyema. [5,7].

In the current study, ultrasound underestimated the clot volume by almost 9%. This was comparable to a local study which found that ultrasonography underestimated the clot volume by 15% [5]. Care should be taken when considering ultrasound as the only diagnostic modality to determine clot volume as it may underestimate the blood clot volume.

In the current study, the most common complication was prolonged air leakage 13.1% and relapse of collection 13.8%. A study in 2008 reported prolonged air leak as being the most common (4.7%) complication[13]. VATS performed after one week increases adhesions between the visceral and parietal pleura, hence increasing the chances of post-operative complications, such as retained collections or air leaks [1]. In the current study, air leakage was significantly higher in patients who had VATS in the second week compared to those who had VATS in the first week. Prolonged air leak can be managed conservatively, but it increases hospital stay [14]. The risk for post-operative air leak can be reduced by using staplers with pads [13]. In the current study, 3.12% patients had post-VATS subcutaneous emphysema which was

comparable to an earlier local study[5]. There was no mortality in the current study, and most patients (78.75%) came back for follow-up.

Lin et al. defined the benefits of early VATS in terms of decreased chances of infection, tube duration and shorter recovery time, all resulting in decreased hospital stay and morbidity[12]. Similar results were seen in the current study.

VATS is a well-tolerated, reliable and effective procedure that can be easily applied with negligible complications to manage retained haemothorax after a patient experiences chest trauma. As an alternative procedure to a thoracotomy, VATS is only slightly more invasive than a tube thoracostomy.

The current study has its limitations as it was a single-centre study and, as such, care should be taken when inferring its results to extrapolate to the entire population. Besides, the follow-up duration was not extended beyond a few days post-discharge which might have influenced or downplayed the complications of VATS that were noted.

Conclusion

VATS was found to be a safe procedure in hemodynamically stable patients for the removal of clots or retained hemothoraces. When performed within 7 days of sustaining chest trauma, VATS had favourable outcomes in terms of decreased morbidity, duration of hospital stay and intrathoracic complications.

Disclaimer: None.

Conflict of interest: None.

Source of Funding: None.

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Table 1: Characteristics of the participants.

Characteristics	N (%)
Gender	
Female	32 (20%)
Male	128 (80%)
Blunt Trauma	102 (63.8%)
Road traffic accident (RTA)	66 (41.3%)
Fall	24 (15.0%)
Direct	12 (7.5%)
Penetrating Trauma	58 (36.3%)
Gunshot	26 (16.3%)
Stab	32 (20.0%)
Associated Injury	
Fail Chest	23 (14.4%)
Ribs Fractured	47 (29.4%)
Location of Injury	
Right	106 (66.3%)
Left	54 (33.8%)
VATS Performed	
1st Week	103 (64.4%)
2nd Week	57 (35.6%)

VATS: Video-assisted thoracoscopy

Table 2: Outcome of video-assisted thoracoscopy.

Outcome	N (%)
Complete Lung Expansion	132 (82.5%)
Partial Lung Expansion	28 (17.5%)
Relapse of Collection	22 (13.8%)

Prolonged Air Leakage	21 (13.1%)
Pneumothorax	14 (8.8%)
Conversion to Thoracotomy	13 (8.1%)
Subcutaneous Emphysema	5 (3.12%)

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244 **Table 3: Difference in outcome based on timing of VATS procedure.**

Outcome		**VATS Performed [N (%)]**		**P value**
		1st Week	**2nd Week**	
Lung Expansion	Complete	95 (71.9%)	37 (28.1%)	0.01
	Partial	8 (28.5%)	20 (71.1%)	
	Yes	0	13 (100%)	
	No	103 (70%)	44 (30%)	
Prolonged Air Leak	Yes	8 (38.09%)	13 (61.90%)	0.007
	No	95 (68.34%)	44 (31.65%)	
Subcutaneous Emphysema	Yes	0	5 (100%)	0.002
	No	103 (66.45%)	52 (33.54%)	
Relapse of Collection	Yes	14 (63.6%)	8 (36.36%)	0.938
	No	89 (64.49%)	49 (35.5%)	
Pneumothorax	Yes	6 (42.85%)	8 (57.14%)	0.07
	No	97 (66.43%)	49 (33.56%)	
Chest Tube Removed	1st Week	75 (75.75%)	28 (45.90%)	<0.001
	2nd Week	24 (24.24%)	33 (54.09%)	
Hospital Stay	4-10 days	87 (84.4%)	24 (23.30%)	<0.001
	11-17 days	16 (29.07%)	33 (57.89%)	

245 VATS: Video-assisted thoracoscopy.

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