

Is Video Assisted Thoracoscopy (VATS) Satisfactory Tool for Evacuation of Post-Traumatic Hemothorax?

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Abstract

Objectives: To evaluate the rule and efficacy of thoracoscopy in the management of retained post-traumatic hemothorax, the evaluation includes the feasibility of the procedure, the success rate and the best time for doing it.

Patients and Methods: This is a prospective study conducted in 4 tertiary centers in Egypt since August 2006 till January 2016. All patients complained from either blunt or sharp trauma. Patients with incomplete drainage of hemothorax by chest tube underwent thoracoscopic evacuation of the retained hemothorax. VATS procedure was done through three ports which were made along the thoracotomy line for conversion to thoracotomy in case of failure of the VATS procedure.

Results: The study included 1226 patients; with isolated unilateral traumatic hemothorax. The cause of hemothorax was blunt trauma in 56% of patients, gunshot in 17% of patients and stab wound in 27% of patients. Total success rate of VATS intervention was 77.1% in all cases. Success rate was 100% for those operated by the 3rd day, 79.9% for those operated by the 4th day, 77.6% for those operated by the 5th day, 57.1% for those operated by the 6th day and 50% for those operated by the 7th day. There was no intraoperative, no postoperative mortality in patients operated thoracoscopically or those converted to open thoracotomy.

Conclusion: Thoracoscopic evacuation of post-traumatic hemothorax is not a complicated procedure and carries high success rates if done early.

Keywords: VATS; Retained Hemothorax; Traumatic; Thoracotomy

Introduction

Chest injuries occur in about 60% of polytrauma cases; therefore, a rough estimate of the occurrence of hemothorax related to trauma in the United States approaches 300,000 cases per year [1,2]. Seventy percent of the thoracic traumas are blunt and the remaining are penetrating injuries [2,3,14].

Hemothorax should be suspected in any patient arriving at the emergency department following blunt or penetrating thoracic trauma as it is a common complication of chest injuries [3,4]. Post-traumatic hemothorax is a consequence of parenchymal injury, injuries of intercostal vessel, chest wall, bronchial artery, major thoracic vessels or/and the heart [5].

Post-traumatic hemothorax diagnosed radiologically by chest x-ray, chest ultrasound and chest-CT which is the most accurate radiological tool as it can measure density of blood which is between 30 and 50 Hounsfield Units (HU), and differentiate blood from blood clots that have density of is 50 - 90 HU [6-8]. The diagnosis can confirmed by needle aspiration of the pleural cavity which reviles blood, but this method carries a potential risk of infection [9].

Currently, several options are available for the management of retained hemothoraces; the following strategies are commonly used: observation; image-guided percutaneous decompression; placement of a second chest tube (2nd Chest Tube); intrapleural thrombolytic therapy; video-assisted thoracoscopy (VATS); thoracotomy; and pleurostomy [1-3,10,14]. The role of VATS in the management of thoracic injuries is expanding; and has been associated with decreased postoperative wound and pulmonary complications, reduced pleural drainage duration and hospital length of stay, improves pain control and postoperative quality of life in comparison to thoracotomy [11-14].

Patients and Methods

This is a prospective study conducted at Department of Cardiothoracic Surgery at 4 tertiary Cardiothoracic Surgery centers in Egypt (Benha, Tanta, Alazhar and Assiut university hospitals) from August 2006 till January 2016. All patients complained from either blunt or sharp trauma. Chest x-ray was done for all patients, all patients had collection in the affected hemithorax which proved to be blood by aspiration, and chest tube was initially inserted to all patients for evacuation of the hemothorax in 5th intercostals space at mid axillary line.

Exclusion criteria include: patients with initial drainage of ≥ 1500 cc of fresh blood as they were operated by emergency thoracotomy, patients with bilateral haemothorax and patients with cardiac or major vessels or diaphragmatic injuries and other system injury e.g. head injury, spine injury or abdominal injury that required urgent or emergent surgical intervention are also excluded.

All patients were admitted to cardiothoracic surgery department, and the daily drainage is recorded, patients with residual hemothorax that proved by drainage and chest x-ray for ≥ 3 days and ≤ 7 days for whom a trial of thoracoscopic evacuation was done, are enrolled in this study. All these patients were investigated preoperatively by Chest X-Ray, Ultrasound pleura, and CT chest. Also complete laboratory assessment in the form of CBC, complete coagulation profile, liver function tests and kidney function tests. Chest-CT was done for all cases and it is the most reliable tool for precise diagnosis of the amount of the retained hemothorax. ECG and Echocardiography were done for selected cases.

Operative technique

All patients received general anesthesia with insertion of a single-lumen endotracheal tube, the chest tube removed and the patient was turned to the lateral decubitus with the affected side up, a 10-mm camera port inserted through the site of the removed chest tube, which is usually at the 5th or 6th intercostal space in the mid-axillary line. VAT camera is passed through that port and connected to the video and the interior of the thoracic cavity is inspected, another two 10-mm ports inserted and all ports were made to meet the possibility of conversion to thoracotomy. CO₂ insufflated at rate of 0.5 L/min for sustained intrathoracic pressure of 6 - 8 mmHg, this offers better visualization of the thoracic cavity by increasing the lung collapse.

The retained blood clots were removed, then the pleural cavity was irrigated with warm saline then the anesthetist asked to inflate the lungs manually with pressure of 35 - 40 Cm H₂O to assess expansion of the lung then ports were removed and two chest tubes were inserted through the site of the removed anterior and middle ports, then the chest tubes were secured in place by stiches and connected to under-water seal (Figure 1, 2).



Figure 1: -10 mm camera port inserted through the site of the removed chest tube, which is usually at the 5th or 6th intercostal space in the mid-axillary line.

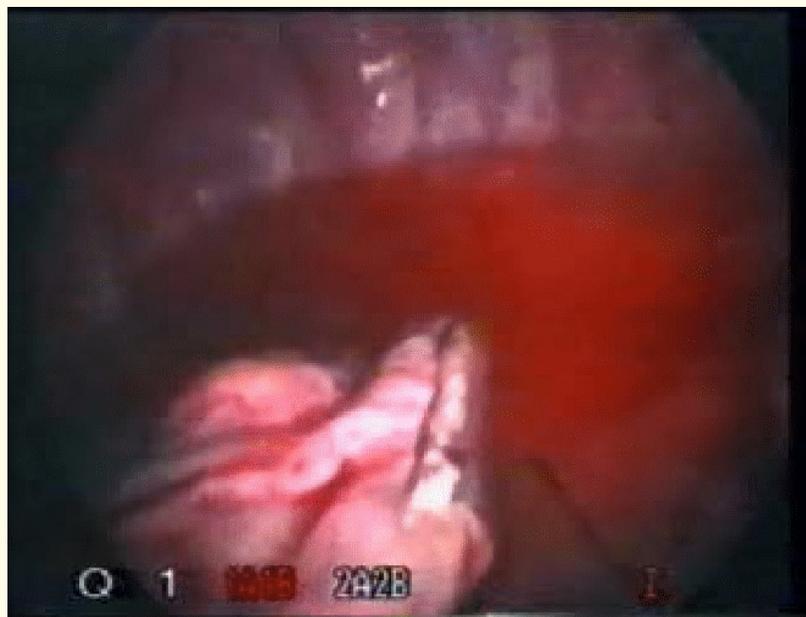


Figure 2: Pleural blood collection as seen through VATS.

In patients with still trapped lung and organized haematomas were present, conversion to thoracotomy was done in the same setting. All the patients were extubated in the operating room with no hemodynamic or respiratory compromise.

After complete recovery from anesthesia, all patients sent to the ward and followed for daily drainage, when drainage became serous and less than 100 cc/day, chest tubes were removed and the patients observed for another 24 to 48 hours before discharge.

Statistical analysis

Patients were divided in two groups, Group A (patients with successful VATS) and Group B (patients who converted to thoracotomy). All data were collected, organized, tabulated and statistically analyzed using SPSS software statistical computer package version 13. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison between two groups and more was done using Chi-square test. Correlation between variables was evaluated. Significance was adopted at $p < 0.05$ for interpretation of results of tests of significance.

Results

The study included 1226 patients; 1042 (85%) males and 184 (15%) females with mean age of 28.72 ± 13.94 ; ranged from 14 to 67 years. The cause of hemothorax was blunt trauma in 56% (n = 686) of patients, stab wound in 27% (n = 331) of patients and gunshot in 17% (n = 209) of patients (Table 1).

Age (in years)	Range: 14 - 67	Mean: 28.72 ± 13.94
Gender	Male	1101 (85%)
	Female	195 (15%)
Affected Hemithorax	Right	855 (66%)
	Left	441(34%)
Type of Trauma	Blunt Trauma	726 (56%)
	Stab wound	350 (27%)
	Gunshot	220 (17%)

Table 1: Preoperative patient characteristics.

Operative time ranged from 40 to 150 minutes with mean of 105.65 ± 18.51 minutes, in whom VATS was successful operative time ranged from 40 to 95 minutes with mean of 55.36 ± 12.64 minutes, and in whom thoracotomy was done the operative time calculated from the skin incision of thoracotomy till the last stitch of skin closure, and it ranged from 85 to 150 minutes with mean of 109 ± 19.87 minutes.

In this study the overall success rate was 77.1% (n = 947). Success rate was 100% (n = 80/80) for those operated by the 3rd day, 79.9% (n = 465/582) for those operated by the 4th day, 77.6% (n = 312/402) for those operated by the 5th day, 57.1% (n = 72/126) for those operated by the 6th day and 50% (n = 18/36) for those operated by the 7th day.

Conversion to thoracotomy was done in 23% (n = 282) of patients, the cause of conversion was incomplete lung expansion in 222 patients and tear of the lung that could not managed by stapler in 60 patients; that necessitates suturing in 47 cases and wedge resection in 13 cases.

The amount of intraoperative drainage in all patients ranged from 500 to 1100 ml with mean of 752.59 ± 131.55 ml, in cases of successful VATS drainage ranged from 500 to 1000 ml with mean of 739.02 ± 121.71 ml and in those converted to thoracotomy; drainage ranged from 600 to 1100 ml with mean of 795.38 ± 156.34 ml.

Overall postoperative chest tube stay ranged from 3 to 14 days with mean of 7.56 ± 2.27 days; (in 944 patients in whom VATS was successful the chest tube stay ranged from 3 to 10 days with mean of 6.88 ± 1.91 days, and in whom converted to thoracotomy chest tube stayed from 7 to 14 days with mean of 9.69 ± 2.22 days).

Postoperative hospital stay in all patients ranged from 5 to 15 days with mean of 8.91 ± 2.27 days, in cases with successful VATS ranged from 5 to 14 days with mean of 7.32 ± 1.99 days, while the postoperative hospital stay in cases that converted to open thoracotomy ranged from 8 to 15 days with mean of 10.77 ± 2.13 days (Table 2, 3).

Variables	Number	Percentage
Successful complete evacuation	944	77%
Conversion to thoracotomy	282	23%
Mean postoperative hospital stay	8.91 ± 2.27 days	
Mean postoperative chest tube stay	7.56 ± 2.27 days	
The mean amount of intra operative drainage	752.59 ± 131.55 ml	
Mean operative time	105.65 ± 18.51 minutes	
Mean postoperative chest tube output	564 ± 194 mL	

Table 2: Operative and postoperative patient characteristics.

Variables	Group A (successful VATS)	Group B (converted to thoracotomy)	P Value
Mean operative time (minutes)	55.36 ± 12.64	109 ± 19.87	0.002*
Timing of VATS and success rate	Up to 5 th day(n = 1064)	207 (19.5%)	0.004*
	After 5 th day(n = 162)	72 (44.4%)	
The mean amount of intraoperative drainage	739.02 ± 121.71 ml	795.38 ± 156.34 ml.	0.083
Mean postoperative chest tube stay	6.88 ± 1.91 days	9.69 ± 2.22 days	0.103
Mean postoperative hospital stay	7.32 ± 1.99 days	10.77 ± 2.13 days	0.034*

Table 3: Operative and postoperative patient characteristics in both groups.
Significant ($P < 0.05$)

There was no significant postoperative complications, no intraoperative or postoperative mortality.

Discussion

Retained hemothorax and infected thoracic collections after trauma can be seen in up to 20% of patients initially treated with tube thoracostomy and have traditionally been treated nonoperatively, often with prolonged hospital stays [15,16].

Since the first performed thoracoscopy in 1910 by The Swedish internist H.C. Jacobsen, the rule of thoracoscopy is expanding and its use in trauma for evacuation of post-traumatic collection is well established in many institutions [17,18].

The study included 1226 patients with retained hemothorax, The cause of hemothorax was blunt trauma in 56% (n = 686) of patients, stab wound in 27% (n = 331) of patients and gunshot in 17% (n = 209) of patients; Karmy-Jones, *et al.* [19] in a similar study included 102 patients also showed the predominance of blunt trauma which was the cause of retained hemothorax in 77% of patients, gunshot in 9.8% and stab wound in 14.7% of patients.

In this study Operative time ranged from 40 to 150 minutes with mean of 105.65 ± 18.51 minutes, in whom VATS was successful operative time ranged from 40 to 95 minutes with mean of 55.36 ± 12.64 minutes, and in whom thoracotomy was done the operative time calculated from the skin incision of thoracotomy till the last stitch of skin closure, and it ranged from 85 to 150 minutes with mean of 109 ± 19.87 minutes., and these results are much better than that obtained by Kurimoto., *et al.* [20] who reported a mean operative time of 108.5 ± 36.4 minutes in the VATS group, and 143.0 ± 65.3 minutes in the thoracotomy group.

In this study the overall success rate was 77.1% (n = 947). Success rate was 100% (n = 80/80) for those operated by the 3rd day, 79.9% (n = 465/582) for those operated by the 4th day, 77.6% (n = 312/402) for those operated by the 5th day, 57.1% (n = 72/126) for those operated by the 6th day and 50% (n = 18/36) for those operated by the 7th day. These results goes with that of Morales-Uribe., *et al.* [21] who stated that best results are obtained when drainage is performed within the first five days after trauma, and close to that obtained by Darlong [22], who suggested the intervention from 2nd to 10th day, on the contrary DuBose., *et al.* [23] found that there is no relationship between timing of VATS and success rate.

Conversion to thoracotomy was done in 23% (n = 282) of patients, this percent is much higher than that obtained by Lowdermilk and Naunheim [24] as they reported conversion to thoracotomy in only 10% of patients in a similar study. The cause of conversion in our study was incomplete lung expansion in 222 patients and tear of the lung in 60 patients; that necessitates suturing in 47 cases and wedge resection in 13 cases.

In our study amount of intraoperative drainage in cases of successful VATS showed no significant difference from those converted to thoracotomy with mean of 739 ml, and 795 ml for both respectively, and these amounts are higher than that obtained by Navsaria *et al.* [25] who reported 650 ml evacuated thoroscopically.

Postoperative chest tube stay ranged from 3 to 14 days with mean of 7.56 ± 2.27 days, in 944 patients in whom VATS was successful the chest tube stay ranged from 3 to 10 days with mean of 6.88 ± 1.91 days, and regarding this point our results are almost as those obtained by Ahmed., *et al.* [26] who reported removal of chest tubes within the first week in 90.9% of patients in a study included 110 patients.

Postoperative hospital stay in all patients ranged from 5 to 15 days with mean of 8.91 ± 2.27 days, in cases with successful VATS ranged from 5 to 12 days with mean of 7.32 ± 1.99 days, these result was much higher than that obtained by Abolhoda., *et al.* [27] who reported a median post-operative hospital stay following successful video assisted thoracic surgery of 3.5 days in a study included 16 patients, also regarding this point our result was higher than that obtained by Manlulu., *et al.* [28,29] who reported a mean postoperative length of stay of 5.86 days in a study included 19 patients.

In this study the postoperative hospital stay in cases with successful VATS ranged from 5 to 12 days with mean of 7.32 ± 1.99 days, while the postoperative hospital stay in cases that converted to open thoracotomy ranged from 8 to 15 days with mean of 10.77 ± 2.13 days, and the p-value was significant between both, as it was < 0.05 which is statistically significant.

In this study there was no intraoperative, no postoperative mortality and this result goes with that by Milanchi., *et al.* [30] and Meyer., *et al.* [31] who reported no mortalities in their studies.

Conclusion

Thoracoscopic evacuation of post-traumatic hemothorax is not a complicated procedure that can be easily don by experienced thoracic surgeons in an experienced centers. VATS has less intraoperative time and less postoperative complications than conventional thoracotomy, it carries high success rates if done early, and should be considered from the 3rd day after trauma to evacuate the retained hemothorax.

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