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Video-Assisted Thoracoscopic Surgery Versus Limited Posterolateral Thoracotomy for Management of Post Traumatic Clotted Hemothorax

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Abstract

Background: Hemothorax is collection of blood in pleural cavity caused by blunt or sharp trauma.Retained hemothorax is an undrained collection in pleura that can lead to fibro-thorax or empyema. Chest tube placement is described as a method of management. Now, video-assisted thoracoscopic surgery (VATS) has evolved to become a gold standard in the management of retained hemothorax. Our objective is to compare VATS with limited thoracotomy in treatment of traumatic retained hemothorax.

Patients and Methods: A prospective comparative study conducted on 60 patients with traumatic clotted hemothorax studied between January 2016 and December 2019. Patients were selected and classified into two groups each included 30 patients, Group I managed by open thoracotomy and group II managed by VATS.

Results: Our study revealed no difference between both groups regarding age, gender, side of affection or preoperative ICT period. There were a significant reduction in operative time (55.67 Vs 101.3; P = 0.001), post-operative pain (P = 0.001) and postoperative period of ICT insertion (1.2 vs 1.2 day, P = 0.021) and postoperative total hospital stay (3.03 vs. 5.53 day; P = 0.001) and the period needed for return to normal activity (1.03 vs. 2.2 days; P = 0.01) in VATS group versus open thoracotomy group.

Conclusion: We concluded that thoracoscopy is feasible, safe and tolerable method for management of retained traumatic hemothorax and so, we recommended it as a suitable method for this type of hemothorax.

Key words: VATS; retained hemothorax; limited thoracotomy

Introduction

Hemothorax is collection of blood in the pleural space. Retained hemothorax is often defined as residual pleural blood >500ml in volume or any residual blood that cannot be drained after 3 days of thoracostomy treatment [1].

The incidence of retained hemothorax after tube thoracostomy for trauma is uncertain. According to many studies, its incidence may vary from 4-20% of all chest tube insertions following trauma. Incomplete drainage of hemothorax might complicate by empyema, lung entrapment or fibro-thorax [2].

If the thoracostomy tube fails to drain the pleural blood, the next step would be inserting additional tubes without a major benefit or performing early thoracotomy. Although, early thoracotomy offers complete evacuation of the retained intrapleural blood clots and freeing the entrapped lung, it has the drawbacks of post-thoracotomy pain, prolonged hospital stays and the risk of wound infection[3].

Currently VATS has become an excellent treatment option for retained traumatic hemothorax. It is less invasive and faster than thoracotomy with the same benefit of early complete evacuation of pleural blood clots under direct vision[3].

Patients and Methods

This was a prospective comparative study that conducted on 60 patients with various amounts of traumatic retained hemothorax during the period from January 2016 to December 2019 in two separate centers according to availability of VATS system. A written informed consent was obtained from the patients prior to be enrolled in the study with full explanation of the methodology used.

Patients were selected and divided into two groups: Group I: Included 30 patients underwent limited Posterolateral thoracotomy for evacuation of the post-traumatic clotted hemothorax and Group II: Included 30 patients managed by VATS procedure for evacuation of the post-traumatic clotted hemothorax.

Adults of both sexes, with stable vital signs, without associated other organ injury, with only intercostal tube thoracostomy with evident retained hemothorax after chest tube insertion were included in the study.

Pediatrics patients, hemodynamically unstable patients, patients with disrupted mediastinal structure, patients with associated severe medical conditions or those with previous thoracotomy were excluded from our study. All patients were

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subjected to:

I. Preoperative Evaluation: Included

- Complete history taking including mechanism of trauma, special diseases that affect bleeding, surgical procedures done previously;
- Complete general and local examination of the patient;
- Investigations: in the form of Routine investigations to assess the general condition of the patients as CBC, coagulation profile, liver function tests and renal function tests and Specific investigations including radiological evaluation of the patients by a recent chest x-ray and CT scan.

II. Surgical Technique:

Limited Posterolateral Thoracotomy

- General anesthesia.
- Positioning in lateral decubitus, sterilization and toweling.
- The skin incision was performed approximately 1 cm below the tip of the scapula. It extends from the midpoint between the medial edge of the scapula and the thoracic spine posteriorly and the mid-axillary line anteriorly.
- After the skin incision, subcutaneous tissue and the latissimus dorsi muscle were divided using electrocautery with preservation of serratus anterior muscle.
- The entrance to the thoracic cavity is usually performed through the 5th intercostal space.
- A rib retractor is used to open the incision.
- Removal of the retained blood clots.
- Test for expansion of the lung following evacuation of the retained blood clots, then irrigation of the pleural cavity, one or two chest tubes are introduced.
- Closure of thoracotomy incision in layers.

VATS Procedure

- General anesthesia using single lung ventilation by double-lumen endo-tracheal tube and the patient was placed in lateral decubitus position.
- Sterilization and Toweling.
- Thoracoscopic instruments included a thoracoscope with a 0° or 30° angle lens, passed through thoracostomy site and the other two 10-mm ports made over the 4th intercostal space along the anterior and posterior axillary lines; this position of ports were made to meet the possibility of conversion to thoracotomy.
- After entrance of the thoracoscope; adhesions would be released by blunt dissection using either the sheath of the thoracoscope or endoscopically using electro-coagulated dissection.
- Removal of blood and blood clots by a suction instrument or a suction-irrigator system.
- One or two chest tubes were placed through the thoracoscopic port incisions.

III. Post-operative outcome Assessment

The primary assessment of patient's outcome was measured by immediate and early postoperative including:

(1) Measuring of the duration of thoracostomy tube drainage postoperatively (days);

(2) Total amount of tube drainage (ml);

(3) Post-operative pain;

(4) Post-operative complications;

(5) Hospital stay after performing each procedure.

During the follow-up period all patients were assessed by:

(1) Clinical evaluation by: physical examination; and

(2) Radiological evaluation by Chest X ray: immediately postoperative and at the time for removal of chest tubes when daily drainage amount≤100 cc and no air leakage are observed.

Statistical Analysis:

Data were analyzed using IBM SPSS software package version 20.0 (Belmont, Calf, 2013). Data were collected in tables then analyzed in regarding to Chi square (x2) and p value less than 0.05 were considered significant.

Results

Patients' age in group I (Thoracotomy group) ranged between 22-64 years with a mean age of 40.23±10.6 years while in group II (VATS group) ranged between 22-50 years with a mean age of 39.97±6 years and by the statistical analysis there was no difference between both groups of the study regarding age (P = 0.905) Table 1.

In group I, there were 19 males patients (19/30, 63.3%) and 11 female patients (11/30, 36.7%) with a male to female ratio of 1.73:1 while in group II, there were 17 males patients (17/30, 56.7%) and 13 female patients (13/30, 43.3%) with a male to female ratio of 1.31:1. By statistical analysis there was a significant increase in male affection than females (P = 0.01 and 0.03 respectively) without significant difference between both groups regarding sex affection (P = 0.435) Table 1.

In group I, there were 14 patients (14/30, 46.7%) had right side affection and 16 patients (16/30, 53.3%) had left side affection while in group II, there were 17 patients (17/30, 56.7%) had right side affection and 13 patients (13/30, 43.3%) had left side affection and by statistical analysis there was no significant difference either in each group (P = 0.231 and 0.333 respectively) or between both groups regarding side of affection (P = 0.385) Table 1.

Table 1: Demographic data of both studied groups					
Variable	**Group I (n = 30)**		**Group II (n = 30)**		**P value**
Age (years)					
Range	22-64		22-50		0.905
Mean±S. D	40.23±10.6		39.97±6		
Sex	No	%	No	%	P value
Male	19	63.30%	17	56.7%	0.01
Female	11	36.70%	13	43.3%	0.435
P	0.01		0.03		
Side of affection					
Right side	14	46.7%	17	556.7%	0.385
Left side	16	53.3%	13	43.3%	
P	0.231		0.333		
Type of trauma					
Blunt	21	70%	26	86.7%	0.287
Penetrating	9	30%	4	13.3%	
P	0.01		0.001		
P is significant if ≤0.05					

Table 2: Operative time in both studied groups			
Operative time (min)	**Group I (n = 30)**	**Group II (n = 30)**	**P value**
Range	80-150	40-70	0.001
Mean± S. D	101.3±18.6	55.67±8.98	

In group I, there were 21 patients (21/30, 70%) had blunt trauma and 9 patients (9/30, 30%) had penetrating trauma (stab trauma) while in group II, there were 26 patients (26/30, 86.7%) had blunt trauma and 4 patients (4/30, 13.3%) had penetrating trauma (stab trauma) and by statistical analysis there was significant increase in blunt trauma than penetrating trauma in each group (P = 0.01 and 0.001 respectively) while there was no difference between both groups regarding type of trauma (P = 0.287) Table 1.

In patients of group I, the intercostal tube thoracostomy insertion period was ranged between 4-8 days with a mean period of 5.9 ± 1.3 days while in group II, it was ranged between 3-7 days with a mean period of 5.35 ± 1.16 days and by statistical analysis there was no significant difference between both groups regarding preoperative ICT period (P = 0.221).

In patients of group I, the operative time ranged between 80-150 min with a mean time of 101.3 ± 18.6 min while in group II, it was ranged between 40-70 min with a mean time of 55.67 ± 8.98 min and the statistical analysis revealed that there was a significant increase in operative time in group I than in group II (P = 0.001) Table 2, Figure 1.

In group I, in 5 patients (5/30, 16.7%) during operation we found one case of lung laceration (1/5, 3.3%) and three cases of pleural adhesions (3/5, 10%) and one case of thick peel (1/5, 3.3%) while in group II, in 4 patients (4/30, 13.3%) we found two cases (6.7%) of pleural adhesions and one case (1/4, 3.3%) for each of lung laceration and thick peel and statistical analysis revealed that no significant difference between both groups regarding lung laceration, pleural adhesion, thick peel and total operative findings (P = 1.0, 0.221, 1.0, 0.869) Table 3.

In group I, there were 4 patients (4/30, 13.3%) had operative complications in the form of air leak in one case (1/4, 3.3%) and three cases of significant bleeding (3/4, 10%) while in group II, there were 3 patients (3/30, 10%) had operative complications in the form of air leak in one case (3.3%) and significant bleeding in two cases (6.7%) and by statistical analysis there is no significant difference between both groups regarding operative complications (air leak and significant bleeding; P = 0.324 and 0.222 respectively) or between both groups regarding the percentage of operative complications (P = 0.955) Table 4.

In group II, there were four cases (4/30, 13.3%) subjected to conversion to conventional open thoracotomy two due to excessive bleeding (2/30, 6.7%) and one case for lung injury and another case of dense pleural adhesions and thick peel (1/30, 3.3%).

n group I, there were 9 patients (9/30, 30%) experienced severe pain on VAS scale (7-10), 19 patients (63.3%) experienced moderate pain on VAS scale (3-6) and only two cases (2/30, 6.7%)

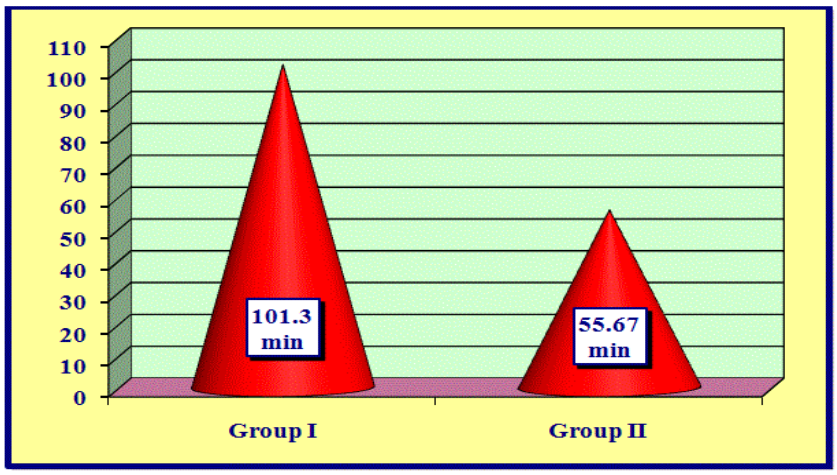

Figure 1: Operative time in both studied groups

Table 3: Operative findings in both studied groups					
Variable	**Group I (n = 30)**		**Group II (n = 30)**		**P value**
	No	**%**	**No**	**%**	
Lung laceration	1	3.30%	1	3.3%	1.0
Pleural adhesion	3	10%	2	6.7%	0.221
Thick peel	1	3.30%	1	3.3%	1.0
Lung free	25	83.3%	26	86.7%	0.869
P	P= 0.946				

Table 4: Operative complications in both groups					
Variable	Group I (n = 30)		Group II (n = 30)		P value
	No	%	No	%	
Complications	4	13.3%	3	10%	0.324
Air leak	1	3.3%	1	3.3%	0.222
Significant bleeding	3	10%	2	6.7%	
No complication	26	86.7%	27	90%	
P	P = 0.955				

experienced mild post-operative pain on VAS scale (1-2) while in group II, there were 3 patients (3/10, 10%) experienced severe pain on VAS scale (7-10), 8 patients (8/30, 26.7%) experienced moderate pain on VAS scale (3-6) and 19 cases (19/30, 63.3%) experienced mild post-operative pain on VAS scale (1-2) and statistical analysis revealed that there was a significant increase of post-operative pain in group I (P = 0.01, 0.001 and 0.01 respectively) Table 5, Figure 2.

Postoperatively the intercostals tube drainage in group I, ranged between 70-180 ml with a mean amount of drain of 116.16 ± 27.8 ml while in group II, it ranged between 30-100 ml with a mean drained amount of 50.33 ± 15.2 ml and the statistical analysis revealed that there was a significant increase in the drained amount in group I than in group II (P = 0.001) Table 6. In patients of group I, the postoperative ICT drainage time ranged between 2-3 days with a mean period of 2.2 ± 0.41 days while in group II, it was ranged between 1-2 days with a mean period of 1.2 ± 0.41 days and the statistical analysis revealed that there was a significant increase in duration of ICT drainage postoperatively in group I than group II (P = 0.021) Table 6.

In group I, there were 6 patients (6/30, 20%) had postoperative complications in the form of empyema in three cases (3/6, 10%), wound infection in one case (1/6, 3.3%) and two cases of bronchopleural fistula (air leak) (2/6, 6.7%) while in group II, there were two patients (2/30, 6.7%) had postoperative complications one of them (1/2, 3.3%) was empyema and the other one (1/2, 3.3%) was BPF (air leak) and by statistical analysis there was a significant increase in postoperative

Table 5: Post-operative pain on VAS in both groups

Variable	Group I (n =30)		Group II (n = 30)		P value
	No	%	No	%	
Mild pain (1-2)	2	6.7%	19	63.3%	0.01
Moderate pain (3-6)	19	63.3%	8	26.7%	0.001
Severe pain (7-10)	9	30%	3	10%	0.01

VAS, Visual Analogue scale; P is significant if ≤0.05

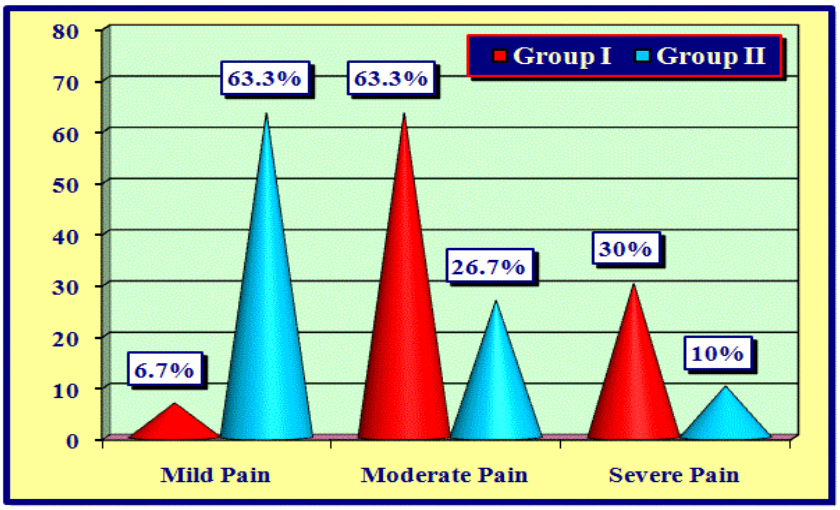

Figure 2: Post-operative pain on VAS in both groups

Table 6: Amount drained and duration of intercostals tube thoracostomy in both studied groups

Variable	Group I (n = 30)	Group II (n = 30)	P value
TICT drain			
Range	70-180	30-100	0.001
Mean±S. D.	116.16±27.8	50.33±15.2	
Duration of ICT drainage			
Range	2-3	1-2	0.021
Mean±S. D.	2.2±0.41	1.2±0.41	

complication as a whole in group I than in group II (P = 0.01) and also, there was a significant increase in difference complications (empyema, wound infection and BPF; P = 0.01, 0.021 and 0.03 respectively) Table 7.

In patients of group I, the total postoperative hospital stay ranged between 4-7 days with a mean period of 5.53 ±0.86 days while in group II, it was ranged between 2-5 days with a mean period of 3.03 ± 0.88 days and the statistical analysis revealed that there was a significant decrease in total postoperative hospital stay in group II than in group I (P = 0.001) Table 8.

In patients of group I, the total period to return to normal activity ranged between 1-3 weeks with a mean period of 2.2 ± 0.71 weeks while in group II, it was ranged between 1-2 weeks with a mean period of 1.03 ± 0.81 weeks and the statistical analysis revealed that there was a significant decrease in total postoperative period to return to normal activity in VATS group (group II) than in group I (P = 0.01) Table 8.

Cases of the study followed up for a period between 1-3 months postoperatively and the patients subjected to follow-up X-rays and CT; In group I, there were two cases (2/30, 6.7%) had empyema while in group II, all patients passed without complications during the period of follow-up and statistical analysis revealed that there was no significant difference in late complications in both groups (P = 0.769) while there was a significant increase of empymea in group I than in group II (P = 0.01) Table 9.

Table 7: Postoperative complications in both groups

Variable	Group I (n = 30)		Group II (n = 30)		Pvalue
	No	%	No	%	
Complications	6	20%	2	6.7%	
Empyema	3	10%	1	3.3%	0.01
Wound infection	1	3.3%	0	0.0%	0.021
BPF (air leak)	2	6.7%	1	3.3%	0.03
No complication	26	86.7%	26	86.7%	
P	P = 0.01				

Table 8: Postoperative total hospital stays and return to normal activity in both studied groups

Variable	Group I (n = 30)	Group II (n = 30)	P value
Postoperative total hospital stays (days)			
Range	4-7	2-5	0.001
Mean±S.D	5.53±0.86	3.03±0.88	
Return to normal activity (Weeks)			
Range	1-3	1-2	0.01
Mean±S.D	2.2±0.71	1.03±0.81	

Table 9: 1-3 months follow-up complications in both groups

Variable	Group I (n = 30)		Group II (n = 30)		P value
	No	%	No	%	
Complications	2	6.7%	0	0.0%	0.01
Empyema	2	6.7%	0	0.0%	
No complication	28	93.3%	30	100%	
P	P = 0.769				

Discussion

Our results revealed no difference between both groups regarding age while there was male predominance in each group without difference between both groups regarding gender; also, there was no difference regarding to side of affection. The same finding was reported by Fouly et al, 2018 and El-Khayat et al, 2018 [4, 5].

Our study revealed that blunt trauma was the most common cause of hemothorax without significance difference between groups. This finding is consistent with studies of Kaya et al, 2013, Neunaber et al, 2013 and El-Khayat et al, 2018[5-7].

El-Khayat and his colleagues, (2018), found in their study that the preoperative ICT period was 5.4 days and Lee and his coworkers, (2017), found that doing VATS procedure was after 5.8 days of indwelling the ICT which agrees with our results were we had interfered after 5 days[5, 8].However,Goodman and his colleagues, (2013), and Lin with his coworkers, (2014) concluded in their studies that early interference "in the first 3 post-trauma days" with VATS decreases the postoperative hospital stay and complications[9, 10].

The operative time was significantly longer in open group versus VATS group. This was also reported by Fouly and his colleagues, (2018)[4]. In contrast to reports of Lee and his coworkers, (2017), found in their study that the average VATS time was 139.7 min which disagrees with what our results and they explained that long time by the presence of multi-lesion and associated rib fixation[8].

Fouly and his colleagues, (2018), found in their study that the most common cases of conversion into open thoracotomy during VATS group was due to excessive bleeding and voluminous hematoma which run in line with our results[4].

El-Khayat and his colleagues, (2018), found in their study that the conversion rate to open thoracotomy from VATS was 6.25% which conflicting with our results but most commonly due to excessive adhesion which run in line with our results[5]. Yokobori and his coworkers, (2011), found in his study a conversion rate of about 13.8-31% to open thoracotomy which disagrees with what we found in our study[11].

In our study we found a significant decrease in postoperative pain in VATS group than open thoracotomy group in all forms. Wang, (2013), found in his study that the postoperative pain following VATS showed marked decline in intensity during the first three post-operative days which was in agreement with our study[12].

Wildgaard and his colleagues, (2012), reported in their study that there was no difference between postoperative pain syndrome and patients free of pin after VATS which conflicting with what we found in our study[13].Also, KoryllosansSoelben, (2017), found in their study that there was no difference between VATS and thoracotomy groups of surgery regarding pain but this in late follow-up[14].

The postoperative drained amount and period of ICT drainage were significantly reduced in group of VATS than in open thoracotomy group. In group B "VATS" the incidence of post-operative complications was significantly reduced than in open horacotomy group even in each complication its incidence in VATS group was significantly reduced than its incidence in open thoracotomy group. Also, after 3 months follow-up the VATS group showed significant reduction in complications. El-Khayat and his colleagues, (2018), found in their study that complications in open thoracotomy group was more common which was in agree with our results[5].

The total post-operative hospital stay was significantly reduced in VATS group than open thoracotomy group and also the return to normal activity was earlier in VATS group than thoracotomy group. Fouly and his colleagues, (2018), found in their study that the total postoperative hospital stay in thoracoscopy group was significantly shorter than in open thoracotomy group which run in line with our results[4].

Conclusion

We believe that thoracoscopy (VATS) is feasible, safe and tolerable method for evacuation and treatment of posttraumatic retained hemothorax. We recommend the use of thoracoscopy (VATS) for the management of retained hemothorax after chest trauma. Also, we recommend to train the junior staff to use this method and to confined the open method for special and complicated cases of retained hemothorax.

Limitations of the Study

The sample size is small.

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