Uniport versus Two-Port Video-Assisted Thoracoscopy in the Management of Retained Traumatic Hemothorax

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Abstract

Background: Traumatic hemothorax is the most common finding after chest trauma. Chest tube insertion is the primary management step. Retained hemothorax ranges from 5% to 30%. Various management strategies exist; observation is recommended for small amounts, whereas surgery is necessary for larger ones. Surgical intervention can be performed via thoracotomy or video-assisted thoracoscopy (VATS).

Objectives: This study aims to compare between uniport and two-port technique VATS evacuation of retained clotted blood regarding safety and effectiveness.

Patients and methods: This prospective study was performed in the Cardiothoracic Surgery Department at Menoufia University Hospital from June 2023 to December 2024. The study was conducted on 42 patients who presented with retained traumatic hemothorax managed by VATS.

Results: This study included 42 patients who underwent VATS evacuation of retained hemothorax: single-port VATS in 26 patients and two-port VATS in 16 patients. The chest X-ray showed improvement in 24 cases in the uniport group and 10 cases in the two-port group, while residual haziness was noted in two cases in the uniport group and six cases in the two-port group, with statistically significant difference (^{FE}p= 0.038).

Conclusion: Early evacuation of retained traumatic hemothorax via VATS is recommended. Both uniport and two-port VATS techniques yield mostly similar outcomes; however, we advocate for uniport VATS whenever possible, as it is less invasive for the patient.

Keywords: Traumatic hemothorax; Video-assisted thoracoscopy; VATS evacuation of retained hemothorax.

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Introduction

Trauma is considered the leading cause of death all over the world, with 25% of annual deaths due to morbidity and mortality related to poly-traumatized patients in American trauma centers (**Bruns and Diaz, 2015**). Chest trauma-related mortality is the second after head injury, with about two-thirds of the patients having thoracic trauma (**Ludwig and Koryllos, 2017**).

The most frequent complication after chest trauma is hemothorax. Chest trauma is responsible for 20%–25% of all trauma deaths in Egypt, according to a study conducted in 2017. In most cases, a chest tube will be sufficient for treatment, but in a minority of patients, more intervention will be needed to evacuate a retained hemothorax (**Elkhayat et al., 2018; Salama et al., 2017**).

Retained hemothorax varies between 5% and 30% in different studies. Different ways for management are present; observation for small amounts and surgery for larger ones (**Chou et al., 2015**).

Video-assisted thoracoscopic surgery (VATS) in the management of retained hemothorax is a well-established technique that ensures proper management with minimal surgical morbidity (**Elkhayat et al., 2018**).

This study aims to compare between uniport and two-port technique VATS evacuation of retained clotted blood regarding safety and effectiveness.

Patients and methods

This study was conducted in the Cardiothoracic Surgery Department at Menoufia University Hospital between June 2023 and December 2024. This study involved 42 patients who presented with retained traumatic hemothorax managed by VATS. Moreover, this research was approved by the local ethics committee of the Faculty of Medicine, Menoufia University (6/2023CARS3).

All patients aged 18 to 65 years, of both sexes, following an established radiological diagnosis, were included. Critically ill patients, those with pre-trauma effusion, or infected pleural effusion were excluded. Additionally, patients requiring urgent thoracotomy were also excluded from the study.

A full clinical and radiological evaluation was conducted after obtaining consent for participation in the study. A chest CT was performed to precisely assess the volume of retained hemothorax. VATS evacuation of the retained hemothorax was carried out under general anesthesia, with lung isolation using a double lumen endotracheal tube whenever possible. Two techniques were employed: either uniportal or two-port methods (**Elkhayat et al., 2018; Chou et al., 2015**).

After evacuation of hemothorax, a chest X-ray was obtained to be compared with the preoperative one. Patients were admitted for follow-up until drain removal. Outpatient follow-up for three months was done as follows: chest x-ray after one week, one month, and three months. A chest CT was done when needed.

Statistical analysis

Data were fed to the computer and analyzed using the IBM SPSS software package version 20.0. **(**Armonk, NY: IBM Corp, released 2011**)**. Categorical data were represented as numbers and percentages. The chi-square test was applied to compare two groups. Alternatively, Fisher's exact test or Monte Carlo correction was applied when more than 20% of the cells had an expected count less than 5. For continuous data, they were tested for normality by the Shapiro–Wilk test. Quantitative data were expressed as range (minimum and maximum), mean, standard deviation, and median. For normally distributed quantitative variables, the Student t-test was used to compare two groups**.** On the other hand, for not normally

distributed quantitative variables, Mann–Whitney test was used to compare two groups. The significance of the results was judged at the 5% level.

Results

This study included 42 patients who underwent VATS evacuation of retained hemothorax. A total of 26 patients underwent single-port VATS, while 16 patients needed an extra port, i.e., two-port VATS. The different parameters of both groups are presented in (**Table.1**), showing no significant difference. Blood transfusion needed preoperatively is presented in (**Table.2**).

Table 1.Comparison between both groups according to different parameters

Variables	**Total (n = 42)**	**VATS**		**Test of Sig.**	**P**
		Uniport (n = 26)	**two ports (n = 16)**		
Age (years)					
Mean ± SD	35.36 ± 11.69	34.81 ± 10.94	36.25 ± 13.13	U= 196.00	0.756
Sex					
Male	36 (85.7%)	24 (92.3%)	12 (75.0%)	χ^2= 2.423	^{FE}p= 0.180
Female	6 (14.3%)	2 (7.7%)	4 (25.0%)		
Smoking	18 (42.9%)	12 (46.2%)	6 (37.5%)	χ^2=0.303	0.582
Addiction	4 (9.5%)	2 (7.7%)	2 (12.5%)	χ^2=0.266	^{FE}p=0.628
Past history					
DM	12 (28.6%)	7 (26.9%)	5 (31.3%)	χ^2=0.091	^{FE}p=1.000
HTN	10 (23.8%)	7 (26.9%)	3 (18.8%)	χ^2=0.365	^{FE}p=0.715
CKD	4 (9.5%)	2 (7.7%)	2 (12.5%)	χ^2=0.266	^{FE}p=0.628
Liver disease	4 (9.5%)	2 (7.7%)	2 (12.5%)	χ^2=0.266	^{FE}p=0.628
Previous surgery	9 (21.4%)	4 (15.4%)	5 (31.3%)	χ^2=1.481	^{FE}p=0.265
Mode of injury					
RTA	25 (59.5%)	16 (61.5%)	9 (56.3%)	χ^2= 6.949	^{MC}p= 0.066
FFH	7 (16.7%)	3 (11.5%)	4 (25.0%)		
Stab	6 (14.3%)	6 (23.1%)	0 (0.0%)		
Gunshot	4 (9.5%)	1 (3.8%)	3 (18.8%)		
Side of hmthx					
Right	28 (66.7%)	17 (65.4%)	11 (68.8%)	χ^2= 0.050	0.822
Left	14 (33.3%)	9 (34.6%)	5 (31.3%)		
Rib fracture	14 (33.3%)	9 (34.6%)	5 (31.3%)	χ^2=0.050	0.822
Initial drainage Median (Min.–Max.)	450 (200–800)	450 (200–800)	425 (250–750)	U= 201.00	0.855
CXR					
Pleural effusion	15 (35.7%)	11 (42.3%)	4 (25.0%)	χ^2= 1.292	0.256
Opacity	27 (64.3%)	15 (57.7%)	12 (75.0%)		
CT chest					
Less 25%	17 (40.5%)	12 (46.2%)	5 (31.3%)	χ^2=	^{MC}p=

25%–50%	17 (40.5%)	9 (34.6%)	8 (50.0%)	1.173	0.708
More 50%	8 (19.0%)	5 (19.2%)	3 (18.8%)		

SD: Standard deviation; U: Mann–Whitney test; χ^2: Chi-square test; MC: Monte Carlo; FE: Fisher's exact; p p: p value for comparing the two studied groups. HTN: hypertension. DM: diabetes mellitus; CKD: chronic kidney disease. RTA: road traffic accident; FFH: falling from height; CXR: chest X-ray.

Table 2.Comparison between both groups regarding the amount of blood transfusion

Variables	**Total (n = 42)**	**VATS**		**Test of Sig.**	**P**
		Uniport (n = 26)	**two ports (n = 16)**		
Blood transfusion	**11 (26.2%)**	**7 (26.9%)**	**4 (25.0%)**	**χ^2=0.019**	**^{FE}p=1.000**
If Yes, no. of units					
1	1 (9.1%)	0 (0.0%)	1 (25.0%)	χ^2= 3.886	^{MC}p= 0.275
2	4 (36.4%)	3 (42.9%)	1 (25.0%)		
3	5 (45.5%)	4 (57.1%)	1 (25.0%)		
4	1 (9.1%)	0 (0.0%)	1 (25.0%)		
Mean ± SD	2.55 ± 0.82	2.57 ± 0.53	2.50 ± 1.29	t= 0.106	0.922

SD: Standard deviation; U: Mann–Whitney test; χ^2: Chi-square test; MC: Monte Carlo; FE: Fisher's exact ;t: Student *t*-test; p p: p value for comparing the two studied groups

The operative details, including the day of intervention and lung isolation, are shown in (**Table.3**), with no significant difference between the two groups. Postoperative drainage ranged from 100 to 500 ml in all patients, with no considerable difference between the groups. The chest X-ray showed improvement in 24 cases in the uniport group and 10 cases in the two-port group, while residual haziness was noted in two cases in the uniport group and six cases in the two-port group, with a statistically significant difference (^{FE}p= 0.038).

Table 3. Comparison between both groups regarding the day of intervention and lung isolation

Variables	**Total (n = 42)**	**Uniport**		**Test of Sig.**	**P**
		VATS (n = 26)	**2 ports (n = 16)**		
Day of intervention					
1st	3 (7.1%)	2 (7.7%)	1 (6.3%)	χ^2= 0.511	
2nd	11 (26.2%)	7 (26.9%)	4 (25.0%)		^{MC}p= 1.000
3rd	12 (28.6%)	7 (26.9%)	5 (31.3%)		
4th	10 (23.8%)	6 (23.1%)	4 (25.0%)		
5th	6 (14.3%)	4 (15.4%)	2 (12.5%)		
Lung isolation					
DETT	36 (85.7%)	23 (88.5%)	13 (81.3%)	χ^2= 0.421	^{FE}p= 0.658
S ETT	6 (14.3%)	3 (11.5%)	3 (18.8%)		

χ^2: Chi-square test; MC: Monte Carlo; FE: Fisher's exact

The outpatient follow-up continued for three months. The complete resolution detected by radiological examination is list in (**Table.4**) with insignificant difference between both techniques.

Table 4. Follow-up of both groups till resolution

Variables	Total (n = 42)	Uniport		Test of Sig.	p
		VATS (n = 26)	2 ports (n = 16)		
Outpatient follow-up till complete resolution					
1 week	19 (45.2%)	12 (46.2%)	7 (43.8%)	χ^2= 0.459	^{MC}p= 1.000
1 month	19 (45.2%)	11 (42.3%)	8 (50.0%)		
3 months	4 (9.5%)	3 (11.5%)	1 (6.3%)		

χ^2: Chi-square test; MC: Monte Carlo

Discussion

Traumatic hemothorax is the most frequent finding after chest trauma in poly-traumatized patients, and chest tube insertion is the primary step for management. Retained hemothorax after chest tube drainage varies between 5% and 30%. There are different techniques for management are present, including observation for small amounts and surgery for larger ones. Surgical intervention can be accomplished by thoracotomy or VATS (**DuBose et al., 2012; Khalil et al., 2025**).

Prior studies compared the use of intrapleural streptokinase and other drugs for retained hemothorax. Although this method shows some effectiveness, the comparison with VATS demonstrates its superiority (**Kumar et al., 2015; Abdrabo et al., 2023**).

VATS evacuation of retained hemothorax can be completed through either a single port or multiple ports. In the current study, we compared the results of uniport and two-port thoracoscopic drainage (**Goodman et al., 2013; Duggan et al., 2024**).

Our study included 42 patients who had retained hemothorax after initial drainage by chest tube.

Those patients were managed later by either uniport or two-port VATS for evacuation of retained hemothorax. The mean age was 35.36 years with no significant difference between the two groups.

Sex distribution of the included patients showed male predominance attributed to male liability to trauma, which coincides with other studies **(Elkhayat et al., 2018; Mahran et al., 2016**; **Huang et al., 2018)**. Moreover, 42.9% of patients were smokers and 9.5% were addicts, with insignificant differences in both groups. Diabetes mellitus and hypertension were the most common encountered chronic diseases in the study group.

Road traffic accidents were the most common form of trauma in both groups, followed by stab injuries in the uniport VATS group and falls from height in the two-port VATS group. Gunshot injuries were the least common, with no cases in the two-port VATS group. Additionally, there was no statistically significant difference between the two groups.

The mode of trauma in our group is consistent with the results of **Elkhayat et al. (2018)**, as blunt trauma is predominant, but **Mahran et al. (2016)** stated that falling from height was the most frequent mode of injury. **Debose et al. (2012)** and **Huang et al. (2018)** revealed that penetrating trauma was more frequent. This variation may be

attributed to the diverse societies included in later studies.

Rib fractures occurred in about one-third of patients with similar distribution in both groups. Right-sided injuries were more common than left-sided ones, in contrast to the findings of **Goodman et al. (2013)**. Initial drainage after chest tube insertion as initial management ranged between 200 and 800 ml. Chest X-ray is the standard radiological investigation performed after drainage when haziness or atypical opacity are more frequent, prompting a chest CT to be ordered for proper assessment of the retained blood amount.

Blood transfusion was required in about a quarter of cases, with similar distribution in both groups. One to four packs of blood were transfused to the patients preoperatively. Postoperatively, blood transfusions were less frequently required; only five cases needed one: one in the uniport group and four in the two-port group.

Early VATS evacuation is recommended to avoid fibrosis, which may lead to injury or necessitate thoracotomy (**Vassiliu et al., 2001; Meyer et al., 1997**). We operated on our cases within the first week after establishing a diagnosis of retained hemothorax, as shown in Table 3. Lung isolation using a double lumen tube was used whenever possible; in most cases, where it was not used, there was a left-sided hemothorax. Thereby, advancement of the tube to the right bronchus and intermittent apnea was applied.

Mostly, 26 cases (61.9%) underwent the operation with one port, which was the chest tube insertion opening for suction of the retained collection. The suction tip and saline irrigation were used to break down the clots, then a clamp was employed to grip the residual fragments. For the remaining cases, 16 (38.1%) needed adding one more opening to complete the evacuation. Fortunately, none of our cases needed conversion to thoracotomy, in contrast to other studies, for example, **Elkhayat et al. (2018)**. This is attributed to early intervention before pleural thickening and adhesion.

Postoperative chest X-ray demonstrated complete resolution in most cases, with a significant difference favoring the uniport group. The average hospital stay was one week, which is reasonable for such cases following early evacuation. This support aligns with other studies comparing VATS to alternative conservative management tools, such as reinsertion of a chest tube or streptokinase intrapleural injection. **(Elkhayat et al., 2018; Kumar et al., 2015; Abdrabo et al., 2023**).

Outpatient follow-up continued for three months after discharge. Most cases showed complete recovery within the first month. Antibiotics were administered for one week, and anti-inflammatory drugs were continued for one to three months, depending on the case.

Conclusion

Early VATS evacuation of retained traumatic hemothorax is recommended. Uniport and two-port VATS can be used with mostly similar outcomes; however, we recommend uniport VATS whenever possible as it is less traumatic to the patient. Further studies, including a larger patient group and more points of comparison, are warranted.

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