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Omitting Chest Tube Drainage after Video Assisted Thoracoscopic Surgery

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ABSTRACT

Background: Drainless minimally invasive video-assisted thoracoscopic surgery (VATS) has improved perioperative outcomes and has become the standard of care for many thoracic procedures.

Objectives: This study aimed to assess safety and perioperative outcomes of omitting chest tube drainage after VATS among eligible selected patients

Methods: This study included 48 patients eligible for VATS and fulfilling the inclusion and exclusion criteria of omitting chest tube drain where, they were randomly allocated into two groups: Group–I (Drainless group) included 24 patients undergoing VATS with intra operative omitting of chest tube drains after an air leakage test and group-II (Drainage group) that included 24 patients undergoing VATS with conventional treatment using standard chest tube drainage.

Results: Omitting chest tube drainage improved the median of operation time (116.0 minutes), average post-operative pain score per day (1.66) and shortened median of postoperative duration of hospital stay (1.0 days) among patients in drainless group-I compared to 139 minutes, 4.8 and 3.5 days among patient in drainage group-II ($P<0.001$) respectively. Uniportal VATS procedure, VATS sympathectomy, male sex, younger age and non-smoking habits in eligible selected patients with omitting chest tube drainage among them expressed significantly the lowest postoperative pain score, shortest postoperative duration of hospital stay and the least operation time with minimal risk of perioperative complications compared to drainage group-II ($P<0.01$).

Conclusions: Omitting chest tube drainage after VATS is feasible in eligible selected patients and improved its efficacy, safety and perioperative outcomes (postoperative pain, hospital stay length, and the risk of perioperative complications).

Keywords: Omitting, Chest tube drainage, VATS.

INTRODUCTION

Minimally invasive surgical techniques, in particular, Video-assisted thoracoscopic (VATS) has advanced quickly over the past two decades, replacing the standard open thoracotomy procedure in simple thoracic surgeries. It also grown up as a choice for a complementary procedure in other more complex surgeries [1, 2].

Conventionally, following VATS, a chest tube is routinely inserted into the pleural cavity even in absence of air leak in the middle of operation. When there is no sign of an air leak and the daily pleural effusion has dropped to as little as 300 ml per day or less, the tubes are removed [3]. Chest drains are linked to discomfort, decreased pulmonary function, infectious complications, and an extended hospital stay [4]. Additionally, they may affect the postoperative course in a negative way and diminish the possible benefits of (VATS) [5].

Leaving chest drains in the pleural cavity following the VATS procedure is controversial. With the enormous development of (VATS) in recent decades, some surgeons are starting to apply a protocol of drainless VATS, especially in thoracic surgeries, in which the lung is left untouched [6, 7, 8] drainless techniques following VATS lung resection have been attempted, however the safety and feasibility are still controversial.

This study was to assess safety and perioperative outcomes of omitting chest tube drainage after video assisted thoracoscopic surgery (VATS) among eligible selected patients.

PATIENTS AND METHODS

This randomized-controlled-clinical trial was conducted on 48 randomly selected patients from those admitted to Cardiothoracic Surgery Department, Zagazig University Hospitals eligible for Video-assisted thoracic surgery (VATS) during the period, from the first of July 2022 to the end of February 2023.

Inclusion criteria:

Absence of cardiopulmonary insufficiency as coronary artery abnormalities, no associated co morbid diseases such as diabetes, coagulation issues, or cirrhosis of the liver, clearly unfavourable surgical indications, no metastatic tumors in any other organs by computed tomography (CT), no air leakage after VATS, no purulent pleural effusion, patient without lung atelectasis (with complete lung expansion), and absence of prolonged pleural effusion requiring postoperative chest drainage.

Exclusion criteria:

Changing surgical procedure during operation, existence of total pleural adhesion at time of the procedure, patients with cancerous tumors that have spread to the nearby organs, patients with high bleeding tendency and patient with underlying lung disease or traumatic pneumothorax).

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On the operation day, the included 48 patients after VATS and confirming no air leaks, were randomly allocated (assigned) into two groups: **Group-I** (drainless group) included 24 patients undergoing VATS with intra operative omitting of chest tube drainage after an air leakage test and **group-II** (Drainage group) that included 24 patients undergoing VATS with conventional treatment using standard chest tube drainage.

The study work was done over three stages (preoperative, intraoperative and postoperative stages) and every participant in this study, was subjected to the following:

a) -Pre-operative stage: It included**,** complete history taking (personal history, history of present illness, past history and family history), complete clinical examination (general examination, local examination, and recording of vital signs), a plain chest x-ray and CT chest. Routine hematologic tests (CBC, partial thromboplastin time, prothrombin time & concentration, liver function tests and kidney function tests).

b) -Intra-operative (interventional) stage: it included:

- Surgical procedures:

In a lateral decubitus and under general anesthesia, VATS procedure was performed usually by means of single-lung ventilation using either double lumen tubes (DLTs) or single lumen tubes (SLTs). The DLTs placement must be positioned and confirmed with the aid of a fiberoptic bronchoscope. Three to four triangular incisions were used as part of the standard VATS technique to aid in scoping and instrument insertion [(9)].

As an alternative, VATS with a single port has been described. [(10)]. Assessment was done using the video thoracoscope. Other surgical steps were carried out according to the specific procedure, and depending on the procedure, one or two chest tube drains connected to an underwater seal were implanted at the end of the operation.

- Intraoperative air leakage test:

After sealing any air leakages, the suitable chest tube was inserted through one of the ports. Then, all the three port sites were properly sealed with adhesive film sheets to simulate chest wall closure.

A suction device with a continuous suction pressure setting of -5 cmH_2O was attached to the chest tube. The ipsilateral remaining lung was simultaneously inflated with a continuous 10 cmH_2O airway pressure (Figure 1). The presence or absence of air leakages was then visually evaluated via the suction device [(5)].

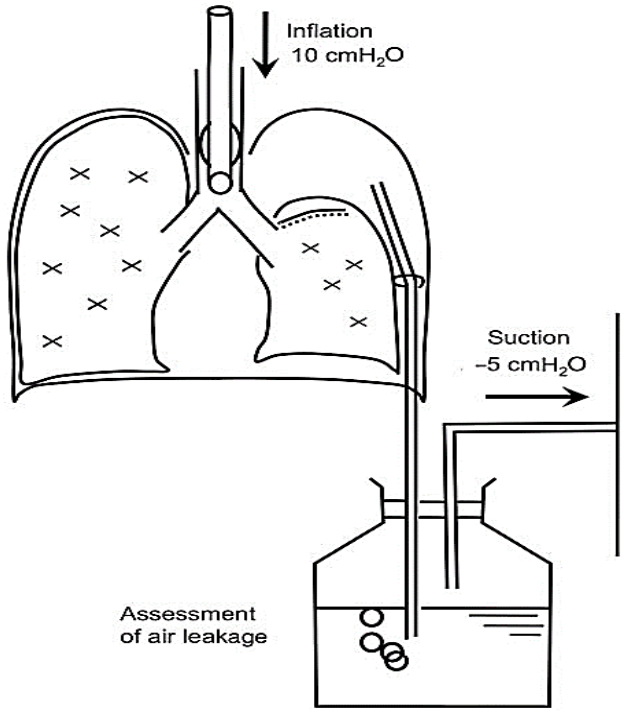

Figure (1): The thoracoscopic surgery suction-induced air leakage test [(5)].

After confirming the absence of air leakage from the treated lung, patients were randomly assigned to either **the drainless group** or **drainage group**. For patients allocated to the drainless group, the uniportal incision was closed immediately by a continuous sutures after removing the chest tube. Patients in the drainage group had a chest tube fixed through the uniportal incision before the wound was meticulously stitched up.

- Chest tube management:

In those with presence of air leaks while performing the suction-induced air leakage test, the suitable chest drain was inserted in the hemithorax postoperatively. Continuous suction unit at −5 cmH_2O was applied to the chest tube. If an air leak was discovered postoperatively, suction on the chest tube was decreased approaching zero (water seal). After disappearance of air leakage the chest tubes was removed the next day [(5)].

c) - Post-operative stage: Postoperative follow-up during the period of hospital stay and until complete recovery of the patient including:

- Assessment of post-operative pain by using numerical pain scale [(11)]. Pain score was recorded (at 9 am and 3 pm) on the first three days after operation and until complete recovery. Each day's mean score served as an indicator of pain severity, and based on that score, the pain intensity was classified as none, mild, moderate, or severe.
- Clinical examination, chest X-ray to estimate lung expansion, routine laboratory investigations (CBC, CRP, ESR & coagulation profile). Every morning at nine o'clock, individuals with chest tubes had their drained

pleural fluid volume recorded. In the drainless group, chest radiographs (CX-r) were taken at 4 to 6 hours and on the morning after surgery. The biggest distance on the CX-r between the pleural line and the chest wall is the magnitude of residual pneumothorax. If serial CX-r showed no evidence of a pneumothorax (less than 5 cm in diameter), the patient is considered to be fit for discharge. If CX-r showed significant pneumothorax (5cm or more) or progression of the remaining pneumothorax, or if the patient's respiratory condition clinically worsened a chest tube was placed or a needle aspiration was carried out, [12]. CX-r was done in the drainage group 4 to 6 hours after surgery and the morning following (POD1). If there is no air leak and the daily drainage volume is under 200 mL, the chest tube was withdrawn [11].

- Recording of postoperative complications (such as reoperation, lung infection, pleural effusion, or replacement of a chest tube). Additional issues such as subcutaneous emphysema, pneumothorax, unexplained chronic air leaking, and pneumonia affecting the duration of hospital stays. The requirement to keep the tube in place for more than three days is referred to as prolonged tube drainage. Subcutaneous emphysema is characterized by the presence of subcutaneous air on CX-r. Blunting of the costophrenic angle in the ipsilateral lung on CX-r is a defining characteristic of residual pleural effusions [12]. Postoperative hospital stay was reported until the patient recovered and leave the hospital. All methods was used to determine the sum of fluid in the pleural space after omitting chest tube postoperatively. A thoracocentesis is necessary to remove the accumulated fluid in each patient when the fluid in the pleural cavity fills the space by more than 10% to 30%. [13], which can degrade the patient's quality of life. Patients with pneumothorax and recurrent effusion were also detected by patient complaints, chest X-rays, and even CT scans.

Ethical consent: The study was approved by Zagazig University's Academic and Ethical Committee. A written informed consent form was signed by each patient to agree to participate in the study. This work has been carried out in compliance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Data were analysed using the Statistical Package for Social Science (SPSS) version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). Parametric data were expressed in terms of mean ± standard deviation (SD), non-parametric data as median and inter quartile range (IQR) and categorical data as number and percentage (%). Comparisons were carried out using independent student t-test for parametric data, Mann Whitney U test and Kruskall-Wallis test for non-parametric data, and Fischer exact test and Chi square test for categorical data. P value ≤ 0.05 was considered significant.

RESULTS

The differences between both groups regarding age, sex, smoking habits and final diagnosis were statistically non-significant ($P > 0.05$) respectively. The most frequent diagnosis among both groups was hyperhidrosis (Table 1).

Table (1): Characteristic features of the studied groups in the pre-interventional stage

Characteristics	Groups	Group (I) (Drainless group) (No=24)		Group (II) (Drainage group) (No=24)		Test of significance	P value
		No	%	No	%		
Age (Years)	(Mean ±SD)	32.16	±21.09	30.58	±20.69	t-test=0.262	0.794
Age groups (No & %)	<40 years	14	58.3	16	66.7	(X^2)* =0.356	0.766
	≥40 years	10	41.7	8	33.3		
Sex (No & %)	Male	16	66.7	14	58.3	(X^2)* =0.36	0.766
	Female	8	33.3	10	41.7		
Smoking habits (No & %)	Non-smoker	14	58.3%	12	50.0%	(X^2)* =1.87	0.502
	Passive smoker	6	25.0%	4	33.35%		
	Active smoker	4	16.7%	8	16.75%		
Final diagnosis (No & %)	Hyperhidrosis	14	58.3	12	50.0	(X^2)* =0.440	0.960
	Pleural thickening	2	8.30	2	8.30		
	Lung mass	6	25.0	8	33.3		
	Hilar mass	2	8.30	2	8.30		

- (X^2)*= Chi square test

The median & IQR of operation time in minutes among studied patients of both groups were shorter in drainless group-I (116.0 & 42.75) compared to that in drainage group-II (139.0 & 27.50) (P< 0.05). Drainless VATS sympathectomy and drainless Uniportal VATS procedure consumed the least operation time in minutes among studied patients in between both groups and within each separate group, (P <0.01) respectively (Table 2).

Table (2): Operation time in minutes (Median & IQR) among studied patients of both groups

Groups / Operation time(minutes)		Group (I) (Drainless group) (No=24)			Group (II) (Drainage group) (No=24)			Mann-Whitney U Test	P value
		No	Median	IQR	No	Median	IQR		
Operation time (minutes)		**24**	**116.0**	**42.75**	**24**	**139.0**	**27.5**	**444.0**	**.001***
Operation time per type of operation (minutes)	**(VATS) Sympathectomy**	**14**	**105.0**	**27.00**	**12**	**117.5**	**22.0**	**146.0**	**.001***
	(VATS) Pleural biopsy	**2**	**135.0**	**0.00**	**2**	**143.0**	**0.00**	**4.0**	**0.33**
	(VATS) Lung biopsy	**6**	**137.0**	**10.00**	**8**	**143.5**	**3.25**	**48.0**	**.001***
	(VATS) Hilar mass biopsy	**2**	**142.0**	**0.00**	**2**	**149.0**	**.00**	**4.0**	**0.33**
	K. W.Test ^^ P value	**17.807 .000**			**18.680 .000**				
Operation time per type of VATS Procedure(min.)	**(U-VATS)+**	**6**	**85.0**	**5**	**8**	**113.5**	**8.3**	**48.0**	**.001***
	(M-VATS) ++	**18**	**130.0**	**26.3**	**16**	**143.0**	**8.0**	**258.0**	**.000***
	M.W. Test ^ P-value	**108.00 .000**			**128.00 .000**				

- P<0.05* = significant - M.W. Test^ = Mann-Whitney U –Test , - K. W.Test^^ = Kruskal-Wallis Test,
- (U-VATS)+ = Uni-portal VATS, - (M-VATS)++ = Multi-portal VATS,

Minor complications were observed between both groups with no significance differences (P >0.05) (Table 3).

Table (3): Types of perioperative complications among studied groups

Groups / Types of Perioperative complications	Group (I) (Drainless group) (No=24)		Group (II) (Drainage group) (No=24)		Chi square test (X^2)	P value
	No	%	No	%		
No complication	**20**	**83.3%**	**16**	**66.7%**	**4.444**	**.398**
Residual pneumothorax	**2**	**8.3%**	**2**	**8.3%**		
Subcutaneous emphysema	**2**	**8.3%**	**2**	**8.3%**		
Pleural effusion	**0**	**0.0%**	**2**	**8.3%**		
Pneumonia/Empyema	**0**	**0.0%**	**2**	**8.3%**		

Omitting chest tube drainage among patients in the drainless group-I led to significant less average postoperative pain score in comparison to drainage group-II**.** Moreover, older age group (≥ 40 years) and female sex patients expressed a significant higher average post-operative pain score per day compared to younger age group (< 40 years) and male sex patients in between both groups and within each separate study group (P<0.05) respectively. Patients with drainless VATS sympathectomy and those with drainless Uniportal VATS procedure expressed the least average postoperative pain score in between both groups and within each separate group (P<0.01) respectively (Table 4)**.**

Table (4): Average post-operative pain score per day (Median & IQR) among studied patients of both groups according to age, sex, type of operation and type of VATS procedure

Groups/ post-operative pain score Parameters		Group (I) (Drainless group) (No=24)			Group (II) (Drainage group) (No=24)			Mann-Whitney U –Test	P value
		No.	Median	IQR	No.	Median	IQR		
Average post-operative pain score per day		**24**	**1.66**	**3.25**	**24**	**4.83**	**3.08**	**502.5**	**.000***
Average post-operative pain score /Age	**<40 years**	**14**	**1.0**	**0.3**	**16**	**3.9**	**1.6**	**224.00**	**.000***
	≥40 years	**10**	**4.7**	**2.0**	**8**	**6.5**	**1.5**	**80.00**	**.000***
	M.W. Test^ P-value	**138.00 .000**			**120.00 .000**				
Average post-operative pain score / Sex	**-Male**	**16**	**1.67**	**3.25**	**14**	**4.6**	**2.3**	**130.5**	**.000***
	-Female	**8**	**3.86**	**2.91**	**10**	**6.3**	**3.3**	**108.5**	**.000***
	M.W. Test ^ P-value	**98.000 0.002**			**75.000 0. 006**				
Average post-operative pain score / Type of operation	**(VATS) Sympathectomy**	**14**	**1.3**	**1.0**	**12**	**3.9**	**1.33**	**150.0**	**.000***
	(VATS) Pleural biopsy	**2**	**5,0**	**.00**	**2**	**6.6**	**.00**	**4.00**	**.330**
	(VATS) Lung biopsy	**6**	**2.0**	**3.6**	**8**	**5.8**	**3.84**	**44.0**	**.008***
	(VATS) Hilar mass biopsy	**2**	**3.0**	**.00**	**2**	**7.0**	**.00**	**4.0**	**.330**
	K. W.Test ^^ P value	**8.15 .043***			**9.78 .021***				
Average post-operative pain score / Type of (VATS) procedure	**(U-VATS)+**	**6**	**1.33**	**1.25**	**8**	**3.99**	**1.59**	**262.0**	**.000***
	(M-VATS) ++	**18**	**4.66**	**3.0**	**16**	**6.83**	**1.08**	**48.0**	**.002***
	M.W. Test^ P-value	**96.0 .003***			**128.0 .000***				

- M.W. Test^ = Mann-Whitney U –Test, - K. W.Test^^ = Kruskal-Wallis Test, - P<0.05* = significant
- (U-VATS)+ = Uni-portal VATS, - (M-VATS)++ = Multi-portal VATS

Drainless group I experienced a significant reduction in post-operative hospital stays in comparison with drainage group II (P<0.001)**.** The older age group (≥40 years) within the drainage group-II had the significant longest post-operative duration of hospital stay (P<0.001). Patients with drainless VATS sympathectomy and those with drainless Uniportal VATS procedure expressed the shortest postoperative hospital stay in between both groups and within each separate group, (P<0.01) respectively (Table 5)**.**

Table (5): Post-operative duration of hospital stay in days (Median &IQR) among studied groups according to age, type of operative intervention and type of VATS procedure

Groups/ post-operative pain score / Parameters		Group (I) (Drainless group) (No=24)			Group (II) (Drainage group) (No=24)			Mann-Whitney U –Test	P value
		No.	Median	IQR	No.	Median	IQR		
Post-operative hospital stay in days**		24	1.0	0.75	24	3.5	2.0	525.0	.000*
Hospital stay/Age groups	**<40 years**	14	1.0	.00	16	3.0	2.25	220.0	.000*
	≥40 years	10	1.20	1. 5	8	5.5	1.75	80.0	.000*
	M.W. Test ^ P-value	90.0 .259			115.0 .001*				
Hospital stay/ Type of operative intervention	**(VATS) Sympathectomy**	14	1.00	1.0	12	3.00	.00	164.00	.000*
	(VATS) Pleural biopsy	2	3.00	.00	2	5.00	.00	4.00	0.33
	(VATS) Lung biopsy	6	1.00	.00	8	4.50	3.25	48.00	.001*
	(VATS) Hilar mass biopsy	2	1.0	.00	2	6.00	.00	4.00	0.33
	K. W.Test ^^ P value	10.95 .012			8.84 0.32				
Hospital stay/ Type of (VATS) Procedure	**(U-VATS)+**	6	1.00	.00	8	3.00	2.25	284.0	.000*
	(M-VATS) ++	18	2.00	2.0	16	5.50	1.75	48.00	.001*
	M.W. Test^ P-value	86.00 .050*			116.0 .001*				

- M.W. Test^ = Mann-Whitney U –Test, - K. W.Test^^ = Kruskal-Wallis Test, - P<0.05* = significant
- (U-VATS)+ = Uni-portal VATS, - (M-VATS)++ = Multi-portal VATS,

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DISCUSSION

Recently, a lot of thoracic surgeons have tried to use the strategy of no routine draining chest tube drainage after VATS surgeries. In this study we assessed, the safety and feasibility of omitting chest tube after VATS.

Our results demonstrated that demographic data and smoking habits in the pre-interventional stage did not significantly differ between the two groups. The most frequent diagnosis among both groups were, Hyperhidrosis, lung mass, pleural thickening and hilar mass. **Imperatori *et al.*** [14] reported that, (VATS) is indicated for diagnostic and therapeutic purposes in different thoracic diseases. The most common procedures are wedge resection of the lung, mediastinal and pleural biopsy, pneumothorax treatment, sympathectomy, and pleurectomy.

According to this study, the operation time in minutes for the drainless group I was much less than for the drainage group II. An operation's typical duration can provide useful information about its complexity and ease of performance [15]. Also the current study illustrated that operation time with VATS sympathectomy was substantially shorter in the drainless group-I than in the drainage group-II. Moreover, the VATS sympathectomy consumed significantly less operation time than other VATS operative interventions within each separate group. However, time required for surgery from skin incision to wound closure as documented in the literature varied depending on the extent of the surgical operation [16, 17, 18, 19]. Also, it was found in this study that, omitting chest tube drainage accelerate the Uniportal and Multiportal operation times. VATS procedures were substantially shorter in the drainless group-I patients than in the drainage group-II patients. Moreover, drainless Uniportal VATS procedure consumed the least operation time in minutes among studied patients between both groups and within each separate group. Again, these findings concur with those of other studies. **Wang *et al.*** [20] and **Matsuura *et al*.** [21] reported that U-VATS had a significant shorter average operation time than M-VATS and concluded that compared to traditional M-VATS, U-

VATS reduced the length of the procedure and duration of stay in the hospital. **Matsuura *et al.*** [21] discovered in their research that U-VATS have always lowere operation time, and the reasons for this shorter operating time are related to: experience and technological differences. The camera's angle of view is focused straight at the operator's target, which has a similar field of view to a thoracotomy; and U-VATS, unlike M-VATS, does not necessitate the deployment by an assistant or grasping of tissue, and a rapid operation using identifiable forceps and energy gadgets can be conducted.

Post-operative outcomes among studied patients of both groups were estimated in this study, according to: the presence of perioperative complications, assessment of pain score and duration of postoperative hospital stay. This study revealed no complications among patients of drainless group-I (83.3%) compared to (66.7%) among patients in the drainage group-II without significant differences between both groups (P>0.05). The perioperative complications in drainless group-I included: residual pneumothorax 2/24 (8.3%) and subcutaneous emphysema 2/24 (8.3%), which resolved spontaneously without any further intervention. While the perioperative complications in drainage group-II included: Pleural effusion 2/24 (8.3%), residual pneumothorax 2/24 (8.3%), subcutaneous emphysema 2/24 (8.3%) which resolved spontaneously and pneumonia/empyema that developed in 2/24 (8.3%). The differences between the two groups were insignificant. However, in our patients, no more chest tubes were required. In addition, there were no in-hospital fatalities or infectious incidents among these individuals. A comprehensive systematic review and meta-analysis evaluating the effectiveness and safety of omitting chest drains after VATS was reported using data from ten studies (4 randomised controlled trials [RCTs] and 6 non-RCTs). Perioperative complications after VATS have been reported to range between 10% and 40%. The baseline patient characteristics and the techniques utilised to detect intraoperative air leakage differed slightly depending on the patient selection in these investigations. [4].

Post-operative pain among our studied patients revealed that omitting chest tube drainage led to significant less average postoperative pain score compared to that among patients in the drainage group-II. Similar results are published by **Ueda and colleagues** [5]. They provided that the location of the chest tube is mostly responsible for the postoperative chest pain. **Refai *et al*.**[6] noted that the duration of the pain associated with chest tube insertion, which is always present, is thought to be the primary factor affecting hospital stay and expenses. Early removal of the chest tube enables patients to breathe fully and comfortably, which makes chest physiotherapy easier, as shown by the parallel improvement in the patients' ventilatory functions. Reports demonstrated a reduction in postoperative pain scores with drainless VATS [22].

In relation to age, this study showed that, omitting chest tube drainage improved average post-operative pain score per day (Median & IQR) for both age groups (< 40 years & ≥ 40 years), being much lower in the drainless group-I patients than in the drainage group-II patients (P < 0.01). Moreover, the elderly (≥ 40 years) within each separate study group developed a significant higher average post-operative pain score per day than the younger age group (<40 years) (P<0.05)**.** This goes with **Halaszynski** [23] who reported that elderly patients exhibited more pain, especially in postoperative patients. The ageing process is linked to physiological decline and compromise as well as a decrease in the body's reserve capacity.

Regarding sex, this study displayed that omitting chest tube drainage improved average post-operative pain score per day for both sex groups, males and females being significantly lower among patients in the drainless group-I than in the drainage group-II (P<0.01). Moreover, female sex within each separate study group developed a significant higher average post-operative pain score per day than males (P <0.05)**. Bartley and Fillingim.** [24] reported that women are more sensitive and are liable to clinical pain post-VATS. Research have shown that women are more likely than men to suffer more intense pain and unpleasant sensations, have lower pain tolerances, and lower pain thresholds [25]. This phenomenon might result from gender differences in how neuroimmune factors interact to create and maintain pain hypersensitivity [26]**.**

This study demonstrated that average post-operative pain score per day among patient with VATS sympathectomy and VATS lung biopsy in the drainless group-I was substantially lower than in the drainage group-II. Moreover, patients with VATS sympathectomy expressed the least average post-operative pain score per day between both groups and within each separate group. **Lardionois and Ris** [27] reported that VATS sympathectomy with a single port approach for palmar hyperhidrosis demonstrated benefits in terms of reduced postoperative pain, which raised patient satisfaction. **Abdrabbo *et al.*** [28] found no patients in their study experienced severe pain following a VATS sympathectomy, and 35% of patients reported moderate pain that could be managed with oral analgesics after discharge.

This study illustrated that omitting chest tube drainage improved average post-operative pain score per day among patients with either Uniportal or Multiportal VATS procedure between studied groups. Also, patients with drainless Uniportal VATS procedure developed the least average post-operative pain score per day among studied patients in between both groups and within each

separate group. Uniportal VATS performed in a single incision produces much less trauma than the Multiportal VATS or open surgery. The most frequently mentioned advantage of uniportal VATS in lowering postoperative pain is probably its reduced invasiveness **(29).** Patients who received uniportal VATS operations experienced less post-operative pain than those who underwent Multiportal VATS treatments. A shorter hospital stay, which would result in lower expenditures, and a quicker healing time are further benefits that have been suggested **(30).**

In this study, the duration of hospital stay postoperatively was considerably shorter in the drainless group-I than in the drainage group-II (P<0.001). A randomised controlled study (RCT) of 60 patients receiving VATS wedge resection (31) showed that pleural drainage might be removed while the patient was still in the operating room, resulting in a median length of hospital stay of 1 day versus 3 days for the drainage group, with lower rates of complications. Chest drain removal could improve healing and lessen morbidity. Also, it might back up the idea of minimally invasive surgery, which increases the likelihood of outpatient thoracic day surgery **(32).**

The present study revealed that omitting chest tube drainage improved post-operative duration of hospital stay for both age groups (<40 years & ≥40 years) being significantly shorter among patients in drainless group-I compared to that among patients in drainage group–II. Moreover, the older age group (≥40 years) had the considerably longest post-operative hospital stay in both groups and within each individual group. Similarly **Agostini *et al.* (33)** in their observational concluded that age > 70 years is the major independent risk variables for the occurrence of major complications and prolonged duration of hospital stay.

This study showed that, patients with VATS sympathectomy and VATS lung biopsy in the drainless group–I was significantly of shorter duration of hospital stay than that among patients in the drainage group–II. Also, patients with VATS sympathectomy and omitting chest tube drainage, expressed the shortest postoperative duration of hospital stay than patients with other types of VATS operation. This corresponds to the findings of **Cui *et al.*(22),** who indicated that thoracic day surgery and avoiding the use of a chest tube can greatly reduce hospital stays and medical expenses. In addition, it is possible to anticipate a reduction in mental stress, higher patient satisfaction, and improvement of the use of available medical resources **(22)**. Currently, only thoracic sympathectomy on both sides, mediastinoscopy, bronchoscopy, and simple lung biopsy are performed during thoracic day surgery, and this technique has been made more complex by the use of a chest tube **(34).**

This study showed that, omitting chest tube drainage improved post-operative duration of hospital stay in days among patients with either Uniportal or Multiportal VATS procedure between studied groups. Also, patients with drainless Uniportal VATS procedure had the shortest post-operative hospital stay, measured in days, for patients in both groups and within each individual group. This is in agreement with, **Cui *et al.* (22)** who found that thoracic day surgery may become a reality with the use of Uniportal VATS with a lack of an indwelling chest tube and close postoperative monitoring. **Mineo *et al.* (30)** reported that drainless uniportal VATS are correlated with a quicker recovery time and a shorter hospital stay, which results in lower expenses

limitations of the study: Relatively small sample size providing low generalizability, short period of the study, so it was not available to discover the long-term postoperative outcomes among studied patients and since the study was an experience-based analysis of a single centre, we must work with multiple hospitals to get more data to support the validity of the results.

CONCLUSION

Omitting chest tube drainage after VATS is feasible in eligible selected patients and improved its efficacy, safety and perioperative outcomes (postoperative pain, hospital stay length, and the risk of perioperative complications).

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