Suction versus non-suction drainage strategy after uniportal thoracoscopic lung surgery: a prospective cohort study

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Background: The postoperative outcomes of suction drainage versus non-suction drainage after uniportal video-assisted thoracoscopic surgery (UniVATS) come with little consensus. This study aimed to prospectively compare the postoperative outcomes of suction drainage versus non-suction drainage in patients who underwent UniVATS.

Methods: Between October 2022 and January 2023, patients undergoing UniVATS were prospectively enrolled. The choice of drainage strategy (suction or non-suction) was at the surgeon's discretion. The primary outcome was chest tube duration, with secondary outcomes including postoperative drainage volume, pain scores, postoperative complications, length of hospital stay, and hospitalization cost. Baseline characteristics and postoperative outcomes were compared. Univariable and multivariable analyses were used to identify risk factors for postoperative outcomes.

Results: A total of 206 patients were enrolled in this study, with 103 patients in each group. Baseline characteristics were well-balanced. The chest tube duration did not significantly differ between the two groups. However, suction drainage exhibited a significantly lower total drainage volume compared to non-suction drainage (280.00 *vs.* 400.00 mL, P=0.03). Suction drainage was associated with a significantly shorter postoperative hospital stay (3.00 *vs.* 4.00 days, P<0.001) and lower pain score on the second postoperative day (POD). Multivariable analyses also confirmed that suction drainage was significantly correlated with a lower total drainage volume and a shorter postoperative hospital stay.

Conclusions: These findings suggested that the suction drainage was superior to non-suction drainage in terms of postoperative drainage volume and length of hospital stay in patients undergoing UniVATS.

Keywords: Suction; drainage; uniportal; video-assisted thoracoscopic surgery (VATS)

Introduction

Chest drainage is a standard procedure following thoracic surgery, aiming to remove accumulated fluid and air from the chest cavity to promote lung re-expansion and maintains negative pressure (1). Common drainage procedures include simple water seal (non-suction drainage) and water seal with the addition of external suction (suction drainage). However, consensus in the clinical community regarding the preferred drainage strategy remains elusive (2). Previous studies have explored perioperative differences between the two procedures, such as air leak duration, chest tube duration, and length of hospital stay, but results have been divergent (2-6). In our prior research, we observed prolonged postoperative drainage duration

and reduced postoperative complications in the suction drainage group (5). Nevertheless, controversies persist due to heterogeneities in participant characteristics, study protocols, and surgical techniques, leaving the advantages of external suction still under debate.

With advancements in medical instruments and surgical techniques, thoracic surgery has been gradually transitioning towards minimally invasive procedures. In recent years, uniportal video-assisted thoracoscopic surgery (UniVATS), as an extension of the conventional multi-portal video-assisted thoracoscopic surgery (VATS), has gained increasing popularity in thoracic surgery (7-9). Previous studies have suggested that UniVATS may offer improved postoperative outcomes, such as reduced hospital stay and postoperative pain (10,11). However, investigations into the perioperative outcomes of adding external suction following UniVATS are scarce.

This study prospectively enrolled patients who underwent UniVATS lobectomy or segmentectomy to evaluate the necessity of water seal with the addition of external suction following UniVATS. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1852/rc).

Methods

Study design and participants

This prospective observational study was conducted at the Department of Thoracic Surgery, West China Hospital of Sichuan University from October 2022 to January 2023. We included patients who met the following criteria: (I) pathologically diagnosed with primary non-small cell lung cancer; (II) underwent UniVATS lobectomy or segmentectomy; (III) had lymph node dissection or sampling with at least three groups; and (IV) postoperative chest drainage using a 20-F chest tube. Exclusion criteria comprised patients receiving (I) neoadjuvant therapy; and (II) intraoperatively converting to thoracotomy.

Standard operating procedures

Detailed surgical procedures, as described in previous studies (6,12,13), were followed for all patients in this study. General anesthesia and double-lumen endobronchial intubation with single lung ventilation on the non-operated side were administered. A 3–5 cm incision was made in the fourth or fifth intercostal space between the anterior axillary line and middle axillary line. The extent of resection was determined appropriately. After exposing necessary tissues and structures, the targeted lung tissue was separated using an endoscopic stapler, and the resected tissue was extracted using a protective bag. Subsequently, systematic lymphadenectomy or sampling was conducted as appropriate. Water submersion was used to detect air leaks, and sutures were used if leaks were significant. Fibrin sealant was applied to the cut surface of the pulmonary parenchyma as needed. Before chest closure, a single 20-F chest tube was placed. The drainage tube was connected to either simple water seal (non-suction drainage) or water seal with the addition of external suction maintained at –10 to –15 cmH$_2$O (suction drainage). The surgeons experimentally added suction to the pleural drainage. External suction started postoperatively, continued for 2 days, and then transitioned to a simple water seal until chest tube removal. Chest tube removal criteria included fluid drainage less than 300 mL/24 h, no bubbles emerging for 12 hours, and complete lung expansion on chest radiography. Daily evaluations were conducted for air leakage and drainage, with a chest radiography on the first postoperative day (POD) to assess lung re-expansion. Patients were discharged the day following chest tube removal if no accident occurred.

Data collection and outcome

Baseline characteristics, including demographic characteristics [age, sex, and body mass index (BMI)],

smoking status, preoperative pulmonary function, comorbidities, intraoperative findings (intralobular fissure development and pleural adhesion), surgical information (resection extent and surgical procedure), and tumor information (tumor stage and histology), were collected. Postoperative outcomes were documented during the hospitalization period. The primary postoperative outcome was the chest tube duration. Secondary postoperative outcomes included postoperative drainage volume, pain scores on the first 6 postoperative hours (POH) and first 1–3 POD, incidence of pulmonary complications (pulmonary infection, persistent air leakage (PAL), pneumothorax, atelectasis, and subcutaneous emphysema), length of hospital stay, and hospitalization cost. Postoperative pain scores were assessed using the visual analog scale (VAS). PAL was defined as air leakage lasting more than 5 days after surgery (14).

Sample size

Based on a previous study (15), the sample size was determined using chest tube duration as the primary outcome. The chest tube duration was hypothesized to be 2.7±1.1 and 3.8±2.1 days in the non-suction and suction groups, respectively (15). To achieve a 5% type I error and 99% type II error, 87 patients were required in each group, as determined by G*Power (version 3.1). To account for a 10% dropout rate, the sample size was increased to 96 participants in each group.

Statistical analysis

We compared the baseline characteristics and postoperative outcomes between the non-suction and suction groups. The normality of continuous variables was assessed using the Shapiro-Wilk test. Normally distributed continuous variables were presented as means ± standard deviation (SD) and analyzed using Student's *t*-test. For non-normally distributed continuous variables, medians {interquartile ranges [IQRs]} were presented and analyzed using the Mann-Whitney *U* test. Categorical variables were expressed as frequency (percentage, %) and analyzed using Fisher's exact test. Additionally, we performed a sensitivity analysis of differential postoperative outcomes using univariable and multivariable regression analyses. A P value <0.05 was considered statistically significant, and all tests were two-tailed. R software (version 4.2.1; R Development Core Team, Vienna, Austria) was employed for all statistical analyses.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) (16). Ethical approval was granted by the Ethics Committee of West China Hospital of Sichuan University (No. 2022-544), and written informed consent was obtained from all patients enrolled in the study. The study protocol has been registered in Chinese Clinical Trial Registry (link: http://www.chictr.org.cn/, register ID: ChiCTR2200064605).

Results

Patient characteristics

Between October 2022 and January 2023, we prospectively screened 215 eligible patients who underwent UniVATS lung surgery and obtained informed consent from all patients. After surgery, 9 patients diagnosed with benign diseases by postoperative pathology were excluded. Consequently, 206 patients were enrolled, with 103 patients in each group (*Figure 1*). The mean age of the patients was 54.83±12.00 years old, with the majority being female (71.84%) and never smokers (88.35%). Most patients exhibited good physical status, with 90.78% of patients assessed with an American Society of Anesthesiologists (ASA) score of 2. The majority had pathological stage IA lung cancer (88.83%). Most patients had pleural adhesion (75.73%) and well developed interlobar fissure (99.03%). Among these patients, 4.85% underwent lymph node sampling, while 95.15% had lymph node dissection. On average, the number of lymph node and lymph node dissection stations were 4.60±1.53 and 4.65±1.47, respectively. Lobectomy was performed on 59.71% of patients, and 40.29% underwent segmentectomy. The mean surgery duration was 101.62±23.11 min. The baseline and surgical characteristics were well balanced between the two groups (*Table 1*).

Comparison of postoperative outcomes

Postoperative outcomes between the suction drainage and non-suction drainage groups are presented in *Table 2*. The chest tube duration was similar between the two groups. However, the drainage volume on the postoperative 5th day {115.00 [100.00, 127.50] *vs.* 230.00 [195.00, 260.00], P=0.01} and the total drainage volume {280.00 [200.00, 467.50] *vs.* 400.00 [221.00, 680.00], mL, P=0.03} were significantly lower in the suction drainage group than in the
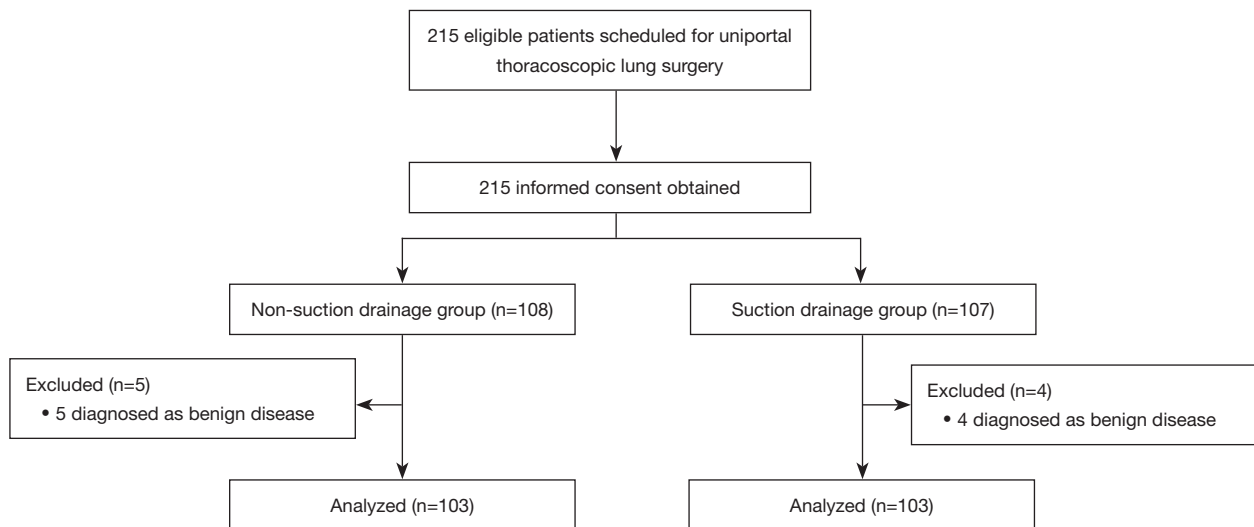
Figure 1 The flow chart of this study.

Table 1 Baseline and surgical characteristics between non-suction and suction groups

Characteristics	Total (n=206)	Non-suction (n=103)	Suction (n=103)	P value
Age, years	54.83±12.00	55.86±11.57	53.79±12.39	0.22
Sex				0.44
Male	58 (28.16)	32 (31.07)	26 (25.24)	
Female	148 (71.84)	71 (68.93)	77 (74.76)	
BMI, kg/m²	23.11±2.83	22.98±2.70	23.23±2.95	0.52
Smoking status				>0.99
Never	182 (88.35)	91 (88.35)	91 (88.35)	
Current/ever	24 (11.65)	12 (11.65)	12 (11.65)	
ASA				>0.99
2	187 (90.78)	93 (90.29)	94 (91.26)	
3	19 (9.22)	10 (9.71)	9 (8.74)	
Comorbidity				
Hypertension	32 (15.53)	21 (20.39)	11 (10.68)	0.08
History of cancer	21 (10.19)	11 (10.68)	10 (9.71)	>0.99
Pulmonary bullae	16 (7.77)	8 (7.77)	8 (7.77)	>0.99
Diabetes mellitus	9 (4.37)	7 (6.80)	2 (1.94)	0.17
COPD	1 (0.49)	0	1 (0.97)	>0.99
Pulmonary function test				
FEV_1, L	2.73±1.88	2.62±0.59	2.86±2.69	0.38
$FEV_1\%$	108.27±17.13	108.10±15.82	108.47±18.59	0.89
DLCO, mL/mmHg/min	22.56±4.74	22.47±4.99	22.66±4.47	0.79
DLCO%	97.55±14.45	96.69±14.98	98.54±13.84	0.38

Table 1 (*continued*)

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Characteristics	Total (n=206)	Non-suction (n=103)	Suction (n=103)	P value
Tumor location				0.11
Right upper lobe	54 (26.21)	29 (28.16)	25 (24.27)	
Right middle lobe	9 (4.37)	3 (2.91)	6 (5.83)	
Right lower lobe	36 (17.48)	22 (21.36)	14 (13.59)	
Left lower lobe	34 (16.50)	20 (19.42)	14 (13.59)	
Left upper lobe	42 (20.39)	14 (13.59)	28 (27.18)	
Multiple lobes	31 (15.05)	15 (14.56)	16 (15.53)	
Tumor size, cm	1.49±0.86	1.59±0.90	1.40±0.80	0.12
Pleural adhesion				0.07
No	50 (24.27)	31 (30.10)	19 (18.45)	
Yes	156 (75.73)	72 (69.90)	84 (81.55)	
Well-developed intralobular fissure				0.48
No	2 (0.97)	0	2 (1.94)	
Yes	204 (99.03)	103 (100.00)	101 (98.06)	
TNM stage				0.86
IA	183 (88.83)	91 (88.35)	92 (89.32)	
IB	10 (4.85)	6 (5.83)	4 (3.88)	
II+III+IV	10 (4.85)	5 (4.85)	5 (4.85)	
Missing	3 (1.46)	1 (0.97)	2 (1.94)	
Lymph				0.004
Sampling	10 (4.85)	10 (9.71)	0	
Dissection	196 (95.15)	93 (90.29)	103 (100.00)	
Number of lymph node	4.60±1.53	4.38±1.60	4.83±1.42	0.04
Number of lymph node dissection stations	4.65±1.47	4.41±1.57	4.88±1.34	0.02
Extent of resection				>0.99
Lobectomy	123 (59.71)	61 (59.22)	62 (60.19)	
Segmentectomy	83 (40.29)	42 (40.78)	41 (39.81)	
Histology				>0.99
Adenocarcinoma	201 (97.57)	101 (98.06)	100 (97.09)	
Squamous cell carcinoma	5 (2.43)	2 (1.94)	3 (2.91)	
Intraoperative blood loss, mL	14.43±6.91	15.00±6.29	13.95±7.40	0.34
Surgery duration, min	101.62±23.11	102.37±23.85	100.87±22.45	0.64

Normally/non-normally distributed continuous variables were presented as mean ± SD, and categorical variables were presented as n (%). BMI, body mass index; ASA, the American Society of Anaesthesiologists; COPD, chronic obstructive pulmonary disease; FEV$_1$, forced expiratory volume in one second; FEV$_1$%, predicted forced expiratory volume in one second; DLCO%, predicted diffusion capacity of carbon oxide; DLCO, diffusion lung capacity for carbon monoxide; TNM, tumor, node, metastasis; SD, standard deviation.

Table 2 Postoperative outcomes between non-suction and suction groups

Outcomes	Total (n=206)	Non-suction (n=103)	Suction (n=103)	P value
Chest tube duration, day	2.00 [1.83, 2.95]	2.58 [1.83, 3.56]	1.96 [1.83, 2.81]	0.08
Postoperative drainage volume, mL				
POD1	100.00 [51.25, 158.75]	110.00 [40.00, 160.00]	100.00 [62.50, 155.00]	0.88
POD2	170.00 [115.00, 260.00]	170.00 [120.00, 265.00]	167.50 [115.00, 240.00]	0.64
POD3	160.00 [110.00, 220.00]	160.00 [120.00, 222.50]	160.00 [100.00, 220.00]	0.87
POD4	170.00 [120.00, 240.00]	200.00 [125.00, 240.00]	160.00 [97.50, 220.00]	0.38
POD5	210.00 [120.00, 230.00]	230.00 [195.00, 260.00]	115.00 [100.00, 127.50]	0.01
POD6	140.00 [120.00, 190.00]	160.00 [87.50, 210.00]	120.00 [120.00, 155.00]	0.94
Total drainage volume, mL	330.00 [205.00, 540.00]	400.00 [221.00, 680.00]	280.00 [200.00, 467.50]	0.03
Postoperative length of hospital stays, days	3.00 [3.00, 4.00]	4.00 [3.00, 5.00]	3.00 [3.00, 4.00]	<0.001
Pain score				
POH6	2.00 [1.00, 2.00]	2.00 [1.00, 2.00]	2.00 [1.00, 2.00]	0.83
POD1	1.00 [1.00, 2.00]	1.00 [1.00, 2.00]	2.00 [1.00, 2.00]	0.27
POD2	1.00 [1.00, 2.00]	1.00 [1.00, 2.00]	1.00 [1.00, 1.00]	0.004
POD3	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	0.12
Hospitalization cost, CNY	49,957.99±32,894.61	51,016.55±45,802.44	48,899.44±8,636.72	0.65
Complications				
PAL	8 (3.88)	5 (4.85)	3 (2.91)	0.72
Subcutaneous emphysema	75 (36.41)	36 (34.95)	39 (37.86)	0.77

Normally/non-normally distributed continuous variables were presented as mean ± SD or median [IQR], respectively, and categorical variables were presented as n (%). POD, postoperative days; POH, postoperative hours; CNY, Chinese Yuan; PAL, persistent air leak; SD, standard deviation; IQR, interquartile range.

non-suction drainage group. Suction drainage also exhibited significantly decreased postoperative length of hospital stay compared with non-suction drainage {3.00 [3.00, 4.00] *vs.* 4.00 [3.00, 5.00], P<0.001}, as well as a lower pain score on POD2 {1.00 [1.00, 1.00] *vs.* 1.00 [1.00, 2.00], P=0.004}. No significant differences between the two groups were observed in drainage volume during the first 1–3 POD, pain scores on POH6, POD1 and POD3, hospitalisation cost, or the incidence of PAL and subcutaneous emphysema. No other postoperative complication events were observed in this study.

Regression analysis

We conducted univariable and multivariable regression analyses for significantly differential postoperative outcomes, including total drainage volume and length of

hospital stay. Multivariable analysis revealed that suction drainage [β, 95% confidence interval (CI): –137.651 (–232.773, –42.528), P=0.005] and segmentectomy [β, 95% CI: –115.638 (–221.023, –10.253), P=0.03] were associated with lower total drainage volume (*Table 3*). Regarding the length of hospital stay, we found that suction drainage [β, 95% CI: –0.605 (–1.02, –0.189), P=0.005], young age [β, 95% CI: 0.028 (0.008, 0.048), P=0.006], and higher predicted forced expiratory volume in one second ($FEV_1\%$) [β, 95% CI: –0.017 (–0.03, –0.005), P=0.006] were significantly associated with shorter hospital stay (*Table 4*).

Discussion

In this prospective cohort study, we aimed to evaluate the effectiveness of suction versus non-suction drainage strategies in patients undergoing UniVATS. Our findings

Table 3 Univariable and multivariable analyses for total drainage volume

Variable	Beta value [95% CI]	P value
Univariable analysis		
Suction (yes *vs.* no)	−117.311 [−213.442, −21.18]	0.02
Age, years	7.748 [3.818, 11.677]	<0.001
Sex (female *vs.* male)	−93.715 [−201.307, 13.877]	0.09
BMI, kg/m^2	3.792 [−13.488, 21.073]	0.67
Smoking status (current/ever *vs.* never)	63.587 [−88.065, 215.238]	0.41
ASA (3 *vs.* 2)	68.068 [−100.098, 236.235]	0.43
Morbidity (yes *vs.* no)	82.247 [−17.592, 182.085]	0.11
FEV$_1$%	−2.616 [−5.689, 0.457]	0.10
DLCO%	0.575 [−3.095, 4.244]	0.76
Pleural adhesion (yes *vs.* no)	105.438 [−7.311, 218.187]	0.07
Well-developed intralobular fissure (yes *vs.* no)	−133.24 [−629.927, 363.447]	0.60
Lymph (dissection *vs.* sampling)	−120.608 [−346.77, 105.554]	0.30
Number of lymph node	53.064 [20.338, 85.79]	0.002
Number of lymph node dissection stations	53.881 [22.732, 85.03]	0.001
Extent (seg *vs.* lob)	−173.726 [−270.185, −77.268]	0.001
Surgery duration, min	2.51 [0.425, 4.596]	0.02
Multivariable analysis		
Suction (yes *vs.* no)	−137.651 [−232.773, −42.528]	0.005
Surgery duration, min	1.865 [−0.189, 3.919]	0.08
Extent (seg *vs.* lob)	−115.638 [−221.023, −10.253]	0.03
Number of lymph node	118.752 [−359.023, 596.527]	0.63
Number of lymph node dissection stations	−77.807 [−556.619, 401.006]	0.75

CI, confidence interval; BMI, body mass index; ASA, the American Society of Anaesthesiologists; FEV$_1$%, predicted forced expiratory volume in one second; DLCO%, predicted diffusion capacity of carbon oxide.

demonstrated that suction drainage resulted in decreased total drainage volume, a shorter length of hospital stay, and less postoperative pain compared to non-suction drainage. These results were further supported by multivariable regression analyses. Notably, no potentially suction-related postoperative complications, such as postoperative pneumothorax, were observed in our study. These findings suggest that suction drainage is an effective strategy for managing postoperative drainage in patients undergoing UniVATS.

The optimal chest drainage strategy for patients after UniVATS has not been determined yet. A meta-analysis by our group previously reported that the suction drainage showed significantly longer chest tube duration, but reduced incidences of postoperative pneumothorax and cardiopulmonary complications (5). Similarly, a recent updated meta-analysis reported that suction drainage was associated with longer chest tube duration, but reduced postoperative pneumothorax (17). However, with the transition from multi-portal VATS to UniVATS, it remains unclear whether patients undergoing UniVATS could benefit from suction drainage. To address this gap, We retrospectively included patients receiving UniVATS and found longer chest tube duration, higher incidence of persistent air leak, but reduced drainage volume within first 3 POD in suction drainage group (6). To provide high-

2292

Qiu et al. A cohort study comparing outcomes of two drainage methods

Table 4 Univariable and multivariable analyses for length of hospital stay

Variable	Beta value [95% CI]	P value
Univariable analysis		
Suction (yes *vs.* no)	−0.816 [−1.213, −0.418]	<0.001
Age, years	0.03 [0.013, 0.047]	0.001
Sex (female *vs.* male)	−0.367 [−0.823, 0.089]	0.12
BMI, kg/m^2	−0.024 [−0.098, 0.049]	0.51
Smoking status (current/ever *vs.* never)	0.533 [−0.106, 1.172]	0.10
ASA (3 *vs.* 2)	0.838 [0.134, 1.541]	0.02
Morbidity (yes *vs.* no)	0.428 [0.006, 0.849]	0.05
FEV$_1$%	−0.016 [−0.029, −0.004]	0.01
DLCO%	−0.007 [−0.022, 0.008]	0.35
Pleural adhesion (yes *vs.* no)	0.012 [−0.469, 0.493]	0.96
Well-developed intralobular fissure (yes *vs.* no)	−0.534 [−2.638, 1.569]	0.62
Lymph (dissection *vs.* sampling)	−0.915 [−1.867, 0.037]	0.06
Number of lymph node	0.091 [−0.047, 0.228]	0.20
Number of lymph node dissection stations	0.053 [−0.082, 0.189]	0.44
Extent (seg *vs.* lob)	−0.271 [−0.69, 0.148]	0.21
Surgery duration, min	0.007 [−0.002, 0.016]	0.14
Multivariable analysis		
Suction (yes *vs.* no)	−0.605 [−1.02, −0.189]	0.005
Age, years	0.028 [0.008, 0.048]	0.006
ASA (3 *vs.* 2)	0.173 [−0.58, 0.926]	0.65
Morbidity (yes *vs.* no)	0.101 [−0.359, 0.561]	0.67
FEV$_1$%	−0.017 [−0.03, −0.005]	0.006

CI, confidence interval; BMI, body mass index; ASA, the American Society of Anaesthesiologists; FEV$_1$%, predicted forced expiratory volume in one second; DLCO%, predicted diffusion capacity of carbon oxide.

level evidence regarding the issue, the prospective study was conducted to investigate the effectiveness of suction drainage strategy in patients undergoing UniVATS.

This study found that suction drainage had comparable chest tube duration to non-suction drainage in patients receiving UniVATS. This contradicted a previous propensity score-matched study, which suggested that suction drainage led to a prolonged chest tube duration (6). The inconsistent conclusions might be attributed to that the retrospective study covered a duration of 10 years, and patients included received heterogeneous drainage management protocols, such as discharge with a chest tube (18) and the use of fibrin sealant (19). The current prospective study aimed

to address these issues. The criteria used for chest tube removal could also help explain the situation. The chest tube removal primarily relied on two criteria: minimal fluid drainage and the absence of air leakage. Correspondingly, similar incidence of persistent air leakage and the absence of postoperative pneumothorax events observed in this study might account for the comparable chest tube duration.

Despite the comparable chest tube duration, drainage volume on the postoperative 5th day and the total drainage volume in suction drainage group were significantly lower than that in non-suction drainage group. Moreover, non-suction drainage emerged as independent risk factor for higher total drainage volume in the multivariable analysis.

This finding aligns with our retrospective study, which also indicated significantly lower drainage volume within the first 3 POD with suction drainage (6). Conversely, randomized clinical studies enrolling patients undergoing multi-portal VATS or open surgery showed higher drainage volume in suction drainage (3,20). This discrepancy might be explained by the contradictory effects of suction drainage—the balance between fluid production and removal. On one hand, the application of external suction to a simple water seal increases negative pressure in the thoracic cavity, thereby promoting fluid exudation, potentially delaying the chest tube removal and increasing drainage volume. On the other hand, negative pressure may accelerate the fluid drainage, resulting in earlier chest tube removal. Based on our results, it appears that the equilibrium leans towards the latter scenario, leading to lower drainage volume when external suction is added in patients undergoing UniVATS.

We observed that suction drainage was associated with a shorter length of hospital stay compared with non-suction drainage. However, previous randomized clinical trials enrolling patients undergoing multi-portal VATS or thoracotomy found no significant difference in the length of hospital stay between the two drainage strategies (20-23). We considered two key factors that might contribute to the divergent conclusions. Firstly, shorter length of hospital stays corresponded to the numerically decreased chest tube duration and significantly lower drainage volume in suction drainage group in this study. Secondly, UniVATS, as a less invasive surgical approach compared with multi-portal VATS or thoracotomy, could significantly improve perioperative outcomes, such as lower incidence of postoperative complications and a shorter hospital stay (10,24,25). These findings suggest that suction drainage may offer greater benefits for patients undergoing less invasive surgical procedures. Additionally, hospitalization costs, corresponding with the length of hospital stay between the two drainage strategies, was numerically lower in the suction drainage group compared to the non-suction group.

Postoperative pain has emerged as a significant obstacle to enhanced recovery after surgery (ERAS), contributing to delayed mobilization and shortened duration of physical activity in the early stages of postoperative recovery (26). Effective pain management is crucial for optimizing patient outcomes within ERAS protocols. Our study revealed that suction drainage may be associated with lower postoperative pain scores compared to non-suction drainage. This finding can be attributed to several factors. Firstly, external suction reduces drainage volume and the duration of chest tube placement, facilitating early initiation of physical activity. Early mobilization has been shown to be beneficial for alleviating postoperative pain (27,28). Additionally, the relatively low pain scores observed in our study may be attributed to our institution's multimodal approach to postoperative pain management. This approach includes preoperative education, a comprehensive pain assessment system, multimodal analgesic protocols, and rehabilitation training. To our knowledge, this study is the first to compare the postoperative pain between suction drainage and non-suction drainage after lung surgery.

In addition, we found that external suction had a numerically lower incidence of PAL, which was similar to a previous study (4). However, the relationship between external suction and PAL remains controversial in the current literature (3,4,6), largely attributed to varying surgical types and the definition of PAL. Indeed, definitions of PAL vary widely, ranging from durations of over 3 to 10 days (29). The most widely accepted definition is a duration of over 5 days, primarily based on the average postoperative length of stay (14). PAL often results in delayed removal of the chest tube and prolonged hospital stays. Nonetheless, various clinical interventions, such as sterile compressed sponge, supportive treatment without special intervention, and endobronchial valves, can be employed to reduce the incidence of PAL (19,30,31).

Our study had apparent strengths, including a controlled drainage management protocol, strict sample size calculation, adequate statistical power, and a prospective design, which largely avoided selection biases and potential confounders. Several limitations should be also mentioned. Firstly, this was a single-center study, and the generalization of our findings should be interpreted with caution in heterogeneous patient populations or patients receiving different surgical techniques. Secondly, the possibility of unmeasured confounders influencing our results cannot be entirely ruled out. Future prospective randomized controlled trials are warranted to validate and further elucidate our findings. Finally, we did not evaluate long-term outcomes beyond the immediate postoperative period.

Conclusions

Altogether, this study provided real-world evidence that patients undergoing UniVATS could benefit more from suction drainage in postoperative outcome compared with non-suction drainage. Suction drainage strategy may be a

2294

Qiu et al. A cohort study comparing outcomes of two drainage methods

safe strategy for managing postoperative drainage.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1852/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1852/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Ethical approval was granted by the Ethics Committee of West China Hospital of Sichuan University (No. 2022-544), and written informed consent was obtained from all patients enrolled in the study.

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