Am J Cancer Res 2026;16(7):3173-3182
www.ajcr.us /ISSN:2156-6976/ajcr0174584

Original Article

Comparison of perioperative hospital stay, postoperative chest tube retention, pain levels between uniportal and multiportal thoracoscopic lung cancer resection patients

Yong Gao, Zhanqiang Zhai, Lichao Huang, Youcai Zhu, Huafei Chen, Xiaofeng Li, Puen Chen, Yonghua Min, Gang Lan

Department of Thoracic Disease Diagnosis and Treatment Center, The Third Affiliated Hospital of Jiaxing University (Zhejiang Rongjun Hospital), Jiaxing 314000, Zhejiang, China

Received June 8, 2026; Accepted July 7, 2026; Epub July 15, 2026; Published July 30, 2026

Abstract: Purpose: To compare perioperative hospital stay, chest tube retention time, and postoperative pain intensity between uniportal video-assisted thoracoscopic surgery (UVATS) and multiportal VATS (MVATS) for anatomical lung resection in patients with non-small cell lung cancer (NSCLC). Methods: This retrospective cohort study enrolled 201 patients (83 in the UVATS group and 118 in the MVATS group) who underwent pulmonary lobectomy or segmentectomy. Daily postoperative chest drainage volume was recorded within the first three postoperative days. Postoperative pain intensity was assessed via the Visual Analog Scale (VAS) at 24 hours, 48 hours and 7 days after surgery. Opioid consumption, converted to morphine milligram equivalents (MME), was documented within the initial 48 postoperative hours. Chest tube retention time, postoperative length of stay and surgical complications were compared between groups. Results: The UVATS group yielded significantly lower daily drainage volumes on postoperative day (POD) 1 (284.56 vs. 338.92 mL, P = 0.007), POD 2 (197.34 vs. 236.48 mL, P = 0.009) and POD 3 (130.58 vs. 159.12 mL, P = 0.004), as well as lower cumulative 72-hour drainage volume (612.48 vs. 743.52 mL, P = 0.001). Patients in the UVATS group reported remarkably lower VAS scores at 24 h (3.52 vs. 5.08, P<0.001), 48 h (2.98 vs. 4.22, P<0.001) and postoperative day 7 (2.21 vs. 2.75, P = 0.002), alongside reduced 48-hour opioid consumption (28.46 vs. 42.73 mg, P<0.001). Moreover, the UVATS group had shorter chest tube indwelling time (3.47 vs. 4.85 days, P<0.001) and shorter postoperative hospitalization (5.63 vs. 6.76 days, P = 0.001). The overall complication rate was also markedly lower in the UVATS group (14.46% vs. 27.12%, P = 0.033). Conclusion: Compared with MVATS, UVATS for NSCLC anatomical resection is associated with decreased postoperative pleural drainage, alleviated surgical pain, shortened chest tube indwelling and hospitalization duration, as well as reduced perioperative complications.

Keywords: Uniportal VATS, multiportal VATS, non-small cell lung cancer, postoperative pain, chest tube retention

Introduction

Lung cancer ranks among the most prevalent and lethal malignancies worldwide, with NSCLC accounting for the majority of diagnosed cases. Surgical resection serves as the cornerstone of curative treatment for early-stage NSCLC, offering optimal long-term survival outcomes [1, 2]. Minimally invasive thoracoscopic surgery has gradually replaced conventional open thoracotomy, with well-documented advantages including attenuated postoperative pain, shortened hospitalization and accelerated postoperative recovery. With the iterative advancement of thoracoscopic techniques, two mainstream surgical modalities, multiportal VATS (MVATS) and uniportal VATS (UVATS), have been widely applied clinically. Clarifying the discrepancies between the two approaches is essential to optimize perioperative outcomes and standardize thoracic surgical practice [3, 4].

MVATS requires multiple small intercostal incisions for thoracoscope and surgical instrument placement to complete anatomical lung resection. Benefiting from satisfactory surgical field

https://doi.org/10.62347/QEPX4181

exposure and flexible instrument manipulation, this technique has gained global popularity. Standard MVATS adopts three or four separate ports: one dedicated to thoracoscope insertion, and the remaining ports for operative instrument placement. The multi-port design enables flexible instrument adjustment and clear surgical visualization, facilitating precise dissection and intraoperative hemostasis for thoracic surgeons [5-7]. Nevertheless, multiple cutaneous and intercostal incisions inevitably aggravate chest wall trauma, triggering intensified postoperative pain and prolonged chest tube indwelling. Cumulative incision-associated tissue damage may impair postoperative recovery and elevate complication risks. Even with such drawbacks, MVATS remains a mature and reliable procedure for lung cancer resection, supported by robust clinical evidence verifying its safety and efficacy [8, 9].

By contrast, UVATS represents a further optimized minimally invasive thoracic surgical modality. All endoscopic and operative devices are inserted via a single 3-4 cm intercostal incision, aiming to minimize chest wall and pleural trauma. The single-incision design reduces total surgical incision area and pleural disruption, thereby mitigating postoperative pain and promoting early patient ambulation. Additionally, direct instrument manipulation via a solitary incision improves surgical accuracy and intraoperative efficiency, while reduced pleural irritation alleviates postoperative inflammatory exudation and pleural drainage [10-12]. Given the rising clinical adoption of UVATS, evaluating its impacts on key recovery indicators including chest tube retention, hospital stay and postoperative pain is critical for surgical decision-making and individualized patient management.

Head-to-head comparison between MVATS and UVATS is conducive to individualized surgical selection for NSCLC patients undergoing anatomical lung resection. This study analyzed real-world perioperative data to systematically compare short-term surgical outcomes of the two modalities, focusing on recovery-related indicators closely linked to patient prognosis and satisfaction. The findings aim to elucidate the clinical value of the two techniques in contemporary thoracic surgery and provide evidence for patient-centered surgical decision-making.

Several previous studies have compared UVATS and MVATS, yet most available data originate from cohorts with heterogeneous healthcare systems and surgical protocols. High-quality real-world evidence based on standardized perioperative management in Chinese medical centers remains insufficient. The present single-center retrospective study adopted unified surgical procedures and rigorous data screening to eliminate confounding bias, reinforcing the generalizability of UVATS-related short-term benefits. We acknowledge that this study failed to evaluate long-term oncological outcomes and health economic benefits; nevertheless, standardized perioperative outcome analysis in this cohort provides credible real-world evidence to facilitate routine clinical decision-making.

Methods

Ethical approval and study protocol

This retrospective cohort study was conducted at Zhejiang Provincial Rongjun Hospital. The study protocol was approved by the Ethics Committee of the Third Affiliated Hospital of Jiaxing University (Zhejiang Rongjun Hospital). The requirement for written informed consent was waived by the IRB, given the negligible risk of this retrospective study and full anonymization of all extracted clinical data. All research procedures complied with institutional ethical regulations and the revised 1964 Helsinki Declaration.

Inclusion and exclusion criteria for patient enrollment

We retrospectively screened medical records of consecutive patients who underwent VATS for primary lung cancer at Zhejiang Provincial Rongjun Hospital from January 2021 to July 2025. Inclusion criteria: (1) age ≥18 years; (2) histopathologically confirmed primary NSCLC; (3) receipt of anatomical lung resection (lobectomy or segmentectomy) via either UVATS or MVATS; (4) complete perioperative clinical data.

Exclusion criteria: (1) emergency thoracic surgery; (2) intraoperative conversion to open thoracotomy; (3) administration of neoadjuvant chemoradiotherapy before surgery; (4) history of ipsilateral thoracic surgery; (5) pathologically confirmed metastatic lung cancer; (6)

incomplete clinical or follow-up data. Ultimately, 201 eligible patients were enrolled, including 83 cases in the UVATS group and 118 cases in the MVATS group.

Surgical approach definition and group allocation

All operations were performed by a fixed team of experienced attending thoracic surgeons. Consistent with the retrospective observational design, surgical modality selection depended on surgeon experience and individual thoracic anatomical characteristics, rather than random grouping.

UVATS group: A single 3.0-4.5 cm incision was made at the 4th or 5th intercostal space along the anterior axillary line. A wound protector was placed to reduce incision-related injury. A 30° 10-mm thoracoscope and all surgical instruments were inserted through the solitary incision. Standardized anatomical lung resection was performed. After radical tumor resection and meticulous hemostasis, a 24F chest tube was placed via the posterior aspect of the single incision and connected to a water-seal drainage system. The muscular layer was closed with 2-0 absorbable sutures using a continuous double-layer suture technique, the subcutaneous tissue was sutured with 3-0 absorbable sutures, and intradermal continuous horizontal mattress suture was applied for cutaneous closure to optimize postoperative cosmetic outcomes.

MVATS group: A 1.0-1.5 cm observation port was created at the 7th or 8th mid-axillary intercostal space for thoracoscope placement, and one to two additional 1.0-2.0 cm operative ports were made at the anterior axillary line for instrument insertion. Anatomical resection was performed following identical surgical standards as the UVATS group. Routine 24F chest tube placement and incision closure complied with institutional standard operating procedures. Additional Blake drain placement at the 7th or 8th intercostal space was permitted under specific clinical conditions, including anticipated persistent air leakage and extensive pleural dissection.

Data collection

Extracted baseline variables included age, sex, body mass index, smoking history, comorbidities (hypertension and diabetes mellitus), tumor location, maximum tumor diameter and pathological subtypes. Tumor staging was determined in accordance with the 8th edition of the American Joint Committee on Cancer (AJCC) staging system, combining preoperative radiological findings and postoperative pathological results.

Preoperative pulmonary function assessment

Preoperative pulmonary function tests were completed within two weeks before surgery, adopting two spirometry systems (MasterScreen Pneumo, CareFusion, Germany; BH-AX-MAPG, Resheal Technology, China) in accordance with joint guidelines issued by the American Thoracic Society and European Respiratory Society. Key indicators including percentage predicted forced expiratory volume in one second (FEV1%), FEV1/forced vital capacity (FVC) ratio and percentage predicted diffusion capacity of the lung for carbon monoxide (DLCO%) were collected. All predicted reference values were calculated based on Chinese population-specific equations.

Preoperative laboratory parameters

Peripheral venous blood samples were collected within 24 hours preoperatively for routine laboratory tests. Routine hematological indicators (hemoglobin, white blood cell count, platelet count) were detected via an XN-20[A1] automated hematology analyzer (Sysmex Corporation, Japan). Serum albumin levels were measured using a Hitachi 7020 automatic biochemical analyzer (Hitachi, Ltd., Japan). Serum C-reactive protein (CRP) concentration was quantified via immunoturbidimetric assays on the same biochemical analyzer.

Intraoperative outcome measures

Operative duration (time from skin incision to full cutaneous closure) and estimated intraoperative blood loss were extracted from official operative records. The number of dissected lymph nodes and lymph node stations were confirmed by postoperative pathological reports, and systematic lymph node dissection was implemented following unified institutional standards. Surgical procedures were classified as lobectomy or segmentectomy for subgroup analysis.

Postoperative chest drainage volume and chest tube management

Professional nursing staff recorded daily chest drainage volume at 8:00 a.m. every day using calibrated drainage containers. Daily drainage volume on postoperative day (POD) 1 to POD 3 was recorded, and cumulative 72-hour drainage volume was calculated by summing up three-day consecutive drainage data. Chest tube management complied with institutional standardized protocols. All 24F chest tubes were connected to single-chamber water-seal drainage systems without active suction, unless enhanced suction was clinically required. All patients were encouraged to perform early ambulation and postoperative respiratory rehabilitation exercises with indwelling chest tubes.

Chest tube removal was conducted only when all the following criteria were fully satisfied: (1) no visible air leakage for consecutive 24 hours, defined as absent air bubbles in the water-seal chamber during forced coughing and deep breathing; (2) 24-hour drainage volume less than 200 mL; (3) no radiological evidence of hemothorax, chylothorax or persistent pneumothorax on postoperative chest radiography. Chest tube indwelling time was defined as the interval from tube insertion to removal. All chest tube removal operations were performed by attending thoracic surgeons or supervised senior surgical residents.

Postoperative pain assessment

Postoperative pain intensity was evaluated using the validated 10-cm Visual Analog Scale (VAS), a gold-standard tool for postoperative pain evaluation [13]. The scale consists of a horizontal linear scale ranging from 0 to 10 points, with 0 representing no pain and 10 representing the worst unbearable pain. Patients were instructed to mark the corresponding position on the scale to reflect resting pain intensity over the past 24 hours.

All patients received intravenous patient-controlled analgesia (PCA) with morphine or fentanyl within the first 48 postoperative hours. Cumulative opioid consumption was extracted from PCA pump logs and electronic medication administration records. Opioid doses were uniformly converted to MME using internationally recognized conversion coefficients (1 mg intravenous morphine = 1 MME; 1 mcg intravenous fentanyl = 0.001 MME).

Postoperative complications and safety outcomes

Postoperative complications were monitored throughout index hospitalization and within 30 days after discharge. Complications were graded based on the Clavien-Dindo classification system (Grade I to Grade V): Grade I indicates mild postoperative adverse events without pharmacological or surgical intervention, whereas Grade V indicates in-hospital mortality. Targeted postoperative complications included prolonged air leakage (persistent air leakage exceeding POD 5 requiring prolonged chest tube drainage), arrhythmia (electrocardiogram-confirmed arrhythmia requiring medical or electrical cardioversion), postoperative pneumonia (new pulmonary infiltrates on chest imaging accompanied by fever over 38.0°C and leukocytosis requiring antibiotic therapy), extended subcutaneous emphysema, secondary hemothorax requiring surgical intervention, and surgical site complications (incisional infection or dehiscence). The occurrence of any above adverse event was defined as overall postoperative complications. Thirty-day unplanned readmission and 30-day all-cause mortality were recorded as secondary safety endpoints.

Statistical analysis

A priori sample size calculation was performed via G*Power v3.1.9.7. Based on moderate effect size (Cohen's d = 0.5) of primary outcomes, two-sided α of 0.05 and statistical power of 80% (1-β), a minimum of 64 cases per group was required for independent two-sample t-tests. The final sample size (83 UVATS vs. 118 MVATS) achieved sufficient statistical power to detect clinically intergroup differences.

All statistical analyses were performed using SPSS 29.0. The Shapiro-Wilk test was adopted to verify the normality of continuous variables. Normally distributed data were presented as mean ± standard deviation (SD), and intergroup comparison was conducted via independent samples t-test. Categorical variables were expressed as counts and proportions, with intergroup differences compared using the

Table 1. Baseline demographic and clinical features

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	t/χ^2	P
Age (years)	65.27 ± 8.93	64.82 ± 9.45	0.347	0.729
Sex (male/female)	47 (56.63%)/36 (43.37%)	69 (58.47%)/49 (41.53%)	0.068	0.794
Body mass index (kg/m^2)	23.45 ± 2.12	23.68 ± 2.25	0.705	0.481
Smoking history	33 (39.76%)	50 (42.37%)	0.137	0.711
Hypertension	35 (42.17%)	52 (44.07%)	0.072	0.789
Diabetes mellitus	12 (14.46%)	19 (16.1%)	0.101	0.751
Tumor stage			0.265	0.876
I	58 (69.88%)	85 (72.03%)		
II	17 (20.48%)	24 (20.34%)		
III	8 (9.64%)	9 (7.63%)		
Tumor location			0.102	0.999
RUL	28 (33.73%)	41 (34.75%)		
RML	9 (10.84%)	12 (10.17%)		
RLL	14 (16.87%)	21 (17.8%)		
LUL	18 (21.69%)	24 (20.34%)		
LLL	14 (16.87%)	20 (16.95%)		
Tumor maximum diameter (cm)	2.18 ± 0.84	2.24 ± 0.91	0.480	0.632
Histology			0.114	0.945
Adenocarcinoma	64 (77.11%)	93 (78.81%)		
Squamous	14 (16.87%)	19 (16.1%)		
Other	5 (6.02%)	6 (5.08%)		

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery; RUL: right upper lobe; RML: right middle lobe; RLL: right lower lobe; LUL: left upper lobe; LLL: left lower lobe.

chi-square test or Fisher's exact test (applied when expected cell frequency was less than 5). All statistical tests were two-tailed, and P<0.05 was defined as statistically significant. No multiple comparison correction was performed, given the descriptive and confirmatory nature of this clinical observational study.

Results

Baseline characteristics

As summarized in **Table 1**, baseline demographic and clinical characteristics were fully balanced between the UVATS and MVATS groups, with no significant intergroup differences detected (all P>0.05).

Preoperative pulmonary function

Preoperative pulmonary function indicators were comparable between the two cohorts, and no statistical difference was observed (all P>0.05) (**Table 2**).

Preoperative laboratory parameters

Routine preoperative hematological and biochemical indicators were well matched between groups, without significant baseline bias (all P>0.05) (**Table 3**).

Intraoperative outcomes

Intraoperative key outcomes, including operative duration, intraoperative blood loss, number of dissected lymph nodes and lymph node stations, as well as surgical procedure distribution, showed no significant discrepancy between the two groups (all P>0.05) (**Table 4**).

Postoperative drainage volume

As demonstrated in **Table 5**, the UVATS group exhibited significantly lower daily pleural drainage volume than the MVATS group on POD 1 (284.56 ± 128.43 vs. 338.92 ± 145.67 mL, P = 0.007), POD 2 (197.34 ± 94.52 vs. 236.48 ± 108.93 mL, P = 0.009) and POD 3 (130.58 ±

Table 2. Preoperative pulmonary function

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	t	P
FEV1% predicted	78.56 ± 12.34	77.93 ± 13.01	0.348	0.728
FEV1/FVC ratio (%)	72.48 ± 8.56	71.93 ± 8.91	0.436	0.663
DLCO% predicted	74.26 ± 11.48	73.81 ± 11.92	0.272	0.786

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery; FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; DLCO: Diffusing capacity of the lung for carbon monoxide.

Table 3. Preoperative laboratory parameters

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	t	P
Hemoglobin (g/L)	132.45 ± 13.28	131.87 ± 14.01	0.297	0.767
White blood cell count ($\times 10^9$/L)	6.42 ± 1.58	6.51 ± 1.67	0.384	0.702
Platelet count ($\times 10^9$/L)	241.36 ± 68.24	238.75 ± 71.43	0.259	0.796
Serum albumin (g/L)	41.28 ± 3.56	41.05 ± 3.72	0.442	0.659
C-reactive protein (mg/L)	5.24 ± 2.48	5.38 ± 2.62	0.377	0.707

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery.

Table 4. Intraoperative outcomes

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	t/χ^2	P
Operative time (min)	158.42 ± 34.56	154.37 ± 36.28	0.795	0.428
Intraoperative blood loss (mL)	88.56 ± 38.32	84.23 ± 39.17	0.779	0.437
Number of resected lymph nodes	14.28 ± 6.12	14.57 ± 5.98	0.334	0.739
Number of resected lymph node stations	5.14 ± 1.35	5.23 ± 1.41	0.437	0.663
Surgical procedure (lobectomy/segmentectomy)	67 (80.72%)/16 (19.28%)	98 (83.05%)/20 (16.95%)	0.180	0.672

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery.

Table 5. Postoperative drainage volume

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	t	P
Postoperative day 1 drainage (mL)	284.56 ± 128.43	338.92 ± 145.67	2.733	0.007
Postoperative day 2 drainage (mL)	197.34 ± 94.52	236.48 ± 108.93	2.647	0.009
Postoperative day 3 drainage (mL)	130.58 ± 62.46	159.12 ± 72.54	2.906	0.004
Total drainage at 72 h (mL)	612.48 ± 245.37	743.52 ± 298.65	3.291	0.001

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery.

62.46 vs. 159.12 ± 72.54 mL, P = 0.004). Correspondingly, the cumulative 72-hour drainage volume was markedly reduced in the UVATS group (612.48 ± 245.37 vs. 743.52 ± 298.65 mL, P = 0.001).

Postoperative pain outcomes

As illustrated in **Figure 1**, resting VAS pain scores at all postoperative time points were consistently lower in the UVATS group, including 24 hours (3.52 ± 1.23 vs. 5.08 ± 1.47, P<0.001), 48 hours (2.98 ± 1.08 vs. 4.22 ± 1.31, P<0.001) and postoperative day 7 (2.21 ± 1.19 vs. 2.75 ± 1.22, P = 0.002). In line with pain score changes, 48-hour cumulative opioid consumption was substantially decreased in UVATS patients (28.46 ± 12.35 vs. 42.73 ± 15.68, P<0.001).

Chest tube retention and hospital stay

As shown in **Figure 2**, patients receiving UVATS had remarkably shorter chest tube indwelling time (3.47 ± 1.54 vs. 4.85 ± 1.73 days, P<0.001) and shorter postoperative length of stay (5.63 ± 2.28 vs. 6.76 ± 2.54 days, P = 0.001) than those undergoing MVATS.

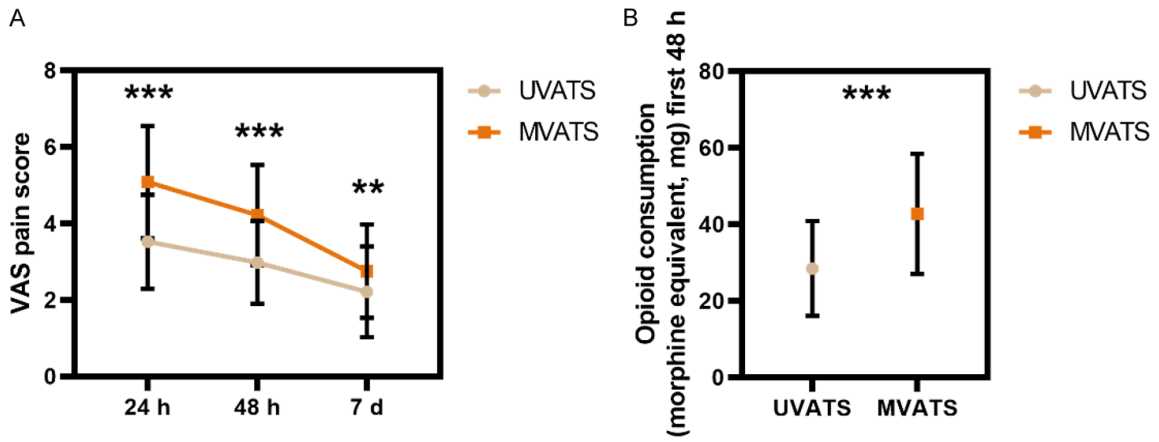

Figure 1. Postoperative pain and opioid consumption. A. VAS pain score at 24 hours, 48 hours, and 7 days postoperatively. VAS was measured on a 0-10 cm scale, with 0 representing "no pain" and 10 representing "worst imaginable pain"; B. Opioid consumption expressed as morphine milligram equivalents in the first 48 hours after surgery. Data are presented as mean ± SD. **: P<0.01; ***: P<0.001 UVATS versus MVATS group (independent-samples t-test). UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery; VAS: Visual Analogue Scale.

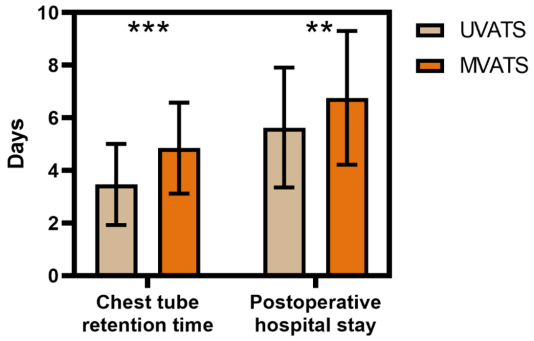

Figure 2. Chest tube retention and hospital stay. Duration of chest tube drainage (days) and length of postoperative hospital stay (days). Data are presented as mean ± SD. **: P<0.01; ***: P<0.001 UVATS versus MVATS group (independent-samples t-test). UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery.

Postoperative complications

The overall 30-day postoperative complication rate was significantly lower in the UVATS group (14.46% vs. 27.12%, P = 0.033) (**Table 6**). No statistically significant intergroup differences were found in individual complication incidence, 30-day unplanned readmission rate or 30-day all-cause mortality (all P>0.05).

Discussion

Our results verified reduced postoperative pleural drainage in the UVATS cohort. Such intergroup disparity is primarily attributed to divergent chest wall trauma severity. The single-port design of UVATS minimizes intercostal muscle and pleural disruption, alleviating postoperative pleural inflammatory exudation. Moreover, direct instrument manipulation via a solitary incision optimizes intraoperative visualization, reduces accidental visceral and vascular trauma, and mitigates intraoperative occult bleeding. Attenuated surgical trauma suppresses postoperative local inflammation, further cutting down pleural effusion production and reducing cumulative drainage volume [14-16].

Postoperative pain control is a core component of enhanced recovery after thoracic surgery. Our study confirmed that UVATS yielded lower dynamic and resting pain scores, alongside reduced perioperative opioid demand. The pain-relieving advantages of UVATS stem from reduced chest wall destruction: fewer intercostal incisions mitigate costal nerve compression and muscular injury, preserving thoracic wall biomechanical integrity. Optimized postoperative pain control not only improves patient comfort but also decreases opioid-related adverse events, including postoperative nausea, vomiting and respiratory depression, thereby smoothing postoperative rehabilitation [17-19].

Shorter chest tube indwelling time in the UVATS group can be explained by two major mechanisms. First, limited pleural irritation

Table 6. Postoperative complications

Parameter	UVATS Group (n = 83)	MVATS Group (n = 118)	χ^2/Fisher	P
Overall complications	12 (14.46%)	32 (27.12%)	4.568	0.033
Prolonged air leakage (>5 days)	7 (8.43%)	14 (11.86%)	0.613	0.434
Arrhythmia	3 (3.61%)	6 (5.08%)	0.022	0.881
Pneumonia	2 (2.41%)	5 (4.24%)	0.093	0.760
Subcutaneous emphysema	2 (2.41%)	4 (3.39%)	0	1
Hemothorax requiring intervention	1 (1.2%)	2 (1.69%)	0	1
Wound infection/dehiscence	0 (0%)	4 (3.39%)	1.396	0.237
30-day readmission	2 (2.41%)	5 (4.24%)	0.093	0.760
30-day mortality	0 (0%)	0 (0%)		

UVATS: uniportal video-assisted thoracoscopic surgery; MVATS: multiportal video-assisted thoracoscopic surgery.

reduces early postoperative effusion, rapidly meeting clinical chest tube removal criteria. Second, relieved intercostal pain enables patients to cooperate with respiratory rehabilitation and early ambulation, accelerating intrathoracic gas and fluid drainage. Early chest tube removal further reduces indwelling-related complications such as secondary incision infection and tube displacement, forming a virtuous cycle of postoperative recovery [20, 21]. By contrast, multiple intercostal ports in MVATS cause scattered pleural irritation and sustained inflammatory exudation, delaying chest tube removal and hindering functional recovery [5, 22, 23].

Shorter postoperative hospitalization in the UVATS group is a combined benefit of multiple improved perioperative indicators. Alleviated surgical pain removes barriers to early out-of-bed activity, lowering the incidence of immobilization-related complications such as nosocomial pneumonia and deep vein thrombosis. Meanwhile, reduced opioid consumption decreases sedation and gastrointestinal adverse reactions, eliminating common causes of delayed discharge. From the healthcare system perspective, shortened hospital stay optimizes bed resource turnover and cuts down in-hospital medical costs, delivering both clinical and socioeconomic benefits [24-28].

Although individual postoperative complications showed no statistical difference, the reduced overall complication rate of UVATS reflected its superior perioperative safety profile. The single-incision design cuts down skin invasion pathways of pathogenic bacteria, lowering surgical site infection risks. Meanwhile, centralized instrument operation improves intraoperative dissection accuracy, reducing iatrogenic visceral injury. Collectively, minimized surgical trauma and precise intraoperative manipulation contribute to better postoperative safety of UVATS [29-31].

Several limitations of this study require clarification. First, as a non-randomized retrospective observational study, surgical modality allocation depended on surgeon judgment and patient anatomical conditions, inevitably introducing selection bias. Although baseline characteristics were fully balanced to offset confounding effects, propensity score matching and other confounding adjustment methods were not adopted; thus, causal correlation between surgical modality and perioperative outcomes cannot be fully confirmed. Second, the sample size lacked sufficient statistical power to identify minor discrepancies in rare postoperative complications. Third, our follow-up period was restricted to the perioperative stage and 30 postoperative days, failing to evaluate long-term endpoints including chronic post-thoracotomy pain, thoracic deformity, tumor recurrence and long-term survival. Fourth, subgroup stratification based on tumor stage and surgeon seniority was not performed, due to insufficient cases in stratified subgroups leading to unstable statistical results. Accordingly, the study conclusions are only applicable to overall NSCLC surgical cohorts and should be generalized cautiously.

Consistent with existing Western studies, our real-world Chinese cohort validated the short-term perioperative superiority of UVATS. Nevertheless, we did not conduct postoperative quality-of-life assessment and health-economic evaluation, two critical indicators guiding clinical decision-making. We have launched a prospective, long-term follow-up cohort study to

integrate oncological survival, chronic pain evaluation and cost-benefit analysis, so as to provide comprehensive evidence for standardized UVATS clinical application.

Conclusion

UVATS yields superior short-term perioperative outcomes compared with MVATS for primary NSCLC anatomical lung resection. Specifically, UVATS reduces postoperative pleural drainage, alleviates surgical pain, shortens chest tube retention and postoperative hospitalization, and lowers overall perioperative complication risks. Such advantages are mainly attributed to minimized iatrogenic chest wall trauma, preserved thoracic integrity and enhanced surgical precision. UVATS possesses promising application prospects in minimally invasive thoracic surgery; further high-quality prospective studies with long-term follow-up are warranted to formulate unified clinical specifications and validate its long-term oncological safety.

Acknowledgements

This study was supported by the Jiaxing Science and Technology Program (No. 2024-AD30007).

Disclosure of conflict of interest

None.

Address correspondence to: Gang Lan, Department of Thoracic Disease Diagnosis and Treatment Center, The Third Affiliated Hospital of Jiaxing University (Zhejiang Rongjun Hospital), No. 309 Shuangyuan Road, Nanhu District, Jiaxing 314000, Zhejiang, China. E-mail: dr_langang@163.com

References

[1] Rudasill S and Farjah F. Surgical therapy for stage I lung cancer-lobar versus sublobar resection. Semin Respir Crit Care Med 2025; 46: 428-435.

[2] Rajaram R, Huang Q, Li RZ, Chandran U, Zhang Y, Amos TB, Wright GWJ, Ferko NC and Kalsekar I. Recurrence-free survival in patients with surgically resected non-small cell lung cancer: a systematic literature review and meta-analysis. Chest 2024; 165: 1260-1270.

[3] Kim SS, Cooke DT, Kidane B, Tapias LF, Lazar JF, Awori Hayanga JW, Patel JD, Neal JW, Abazeed ME, Willers H and Shrager JB. The Society of Thoracic Surgeons Expert Consensus on the multidisciplinary management and resectability of locally advanced non-small cell lung cancer. Ann Thorac Surg 2025; 119: 16-33.

[4] Bassiri A, Boutros C, Jiang B, Sinopoli J, Tapias Vargas L, Linden PA and Towe CW. Adoption of minimally invasive lung resection: a national cancer database study. J Surg Res 2024; 302: 166-174.

[5] Zhang K, Liu W, Zhao Y, Gao X, Dai W, Zhou X, Yu H, Shi Q, Li Q and Wei X. Comparison of early postoperative patient-reported outcomes after multiportal robotic-assisted thoracoscopic surgery and uniportal video-assisted thoracoscopic surgery for non-small cell lung cancer. Eur J Surg Oncol 2024; 50: 108481.

[6] Wei X, Yu H, Dai W, Huang L, Liu Y, Lei C, Yang D, Zhang K, Liao J, Wang Y, Tian B, Luo X, Xie S, Zhang Y, Liu X, Xu W, Hu B, Li Q and Shi Q. Long-term patient-reported outcomes after multiport robot-assisted surgery versus video-assisted surgery for lung cancer: an observational cohort study. Ann Surg Oncol 2026; 33: 4288-4300.

[7] Pajala FB, Tanadi C and Aribowo RH. The impact of the number of ports on perioperative outcomes following video-assisted thoracoscopic surgery for non-small-cell lung cancer: a systematic review and meta-analysis. J Chest Surg 2026; 59: 45-70.

[8] Zheng X, Wang W, Li X, He P and Wu X. Efficacy of uniportal versus multiportal video-assisted thoracoscopic lobectomy for non-small cell lung cancer: a retrospective analysis. Pak J Med Sci 2024; 40: 1135-1139.

[9] Wang X, Wang Y, Cao M, Fu Y, Pan W, Ye Q, Zhao X and Sun Z. Perioperative comparison of uniportal versus multiportal video-assisted thoracoscopic surgery for complex segmentectomy of the lower lung lobe. BMC Surg 2025; 25: 220.

[10] Watanabe T, Tanahashi M, Suzuki E, Yoshii N, Kohama T, Iguchi K and Endo T. Uniportal video-assisted thoracoscopic segmentectomy for early-stage non-small cell lung cancer: overview, indications, and techniques. Cancers (Basel) 2024; 16: 2343.

[11] Wang L, Cao J, Feng Y, Jia R and Ren Y. Application of uniportal video-assisted thoracoscopic surgery for segmentectomy in early-stage non-small cell lung cancer: a narrative review. Heliyon 2024; 10: e30735.

[12] Sudarma IW, Pertiwi PFK, Yasa KP and Harta IKAP. Outcomes of uniportal video-assisted thoracoscopic surgery in the management of lobectomy and segmentectomy for lung cancer: a systematic review and meta-analysis of propensity score-matched cohorts. Ann Thorac Cardiovasc Surg 2025; 31: 24-00137.

[13] Li L, Liu X and Herr K. Postoperative pain intensity assessment: a comparison of four scales

in Chinese adults. Pain Med 2007; 8: 223-234.
[14] Watanabe T, Doi T, Domen H, Handa Y, Igai H, Suzuki J, Taira A, Tanahashi M and Suda T. Uniportal video-assisted thoracoscopic surgery for lung cancer: the current opinions and future perspectives of thoracic surgeons in Japan. Gen Thorac Cardiovasc Surg 2025; 73: 845-854.
[15] Sachs E, Jackson V, Al-Ameri M and Sartipy U. Uniportal video-assisted thoracic surgery: segmentectomy versus lobectomy-early outcomes. Eur J Cardiothorac Surg 2024; 65: ezae127.
[16] Mikilps-Mikgelbs R, Bināns H, Gaidukova M and Siliņš I. Right uniportal video-assisted thoracoscopic surgery lung-sparing sleeve resection of the bronchus intermedius. Multimed Man Cardiothorac Surg 2024; 2024.
[17] Laven IEWG, Verkoulen KCHA, Franssen AJPM, Hulsewé KWE, Vissers YLJ, Štupnik T, Gonzalez-Rivas D and de Loos ER. Evolution of uniportal video-assisted thoracoscopic surgery: optimization and advancements. J Thorac Dis 2024; 16: 4839-4843.
[18] Ebana H. Uniportal video-assisted thoracoscopic surgery lobectomy. Kyobu Geka 2024; 77: 859-864.
[19] Andolfi M, Meacci E, Salati M, Xiumè F, Roncon A, Guiducci GM, Tiberi M, Nanto AC, Nachira D, Nocera A, Calabrese G, Congedo MT, Inchingolo R, Margaritora S and Refai M. Uniportal video-assisted thoracoscopic anatomic lung resection after neoadjuvant chemotherapy for lung cancer: a case-matched analysis. Cancers (Basel) 2024; 16: 2642.
[20] Ruan Y, Cao W, Xue H, You M and Zhao Z. Long-term outcome of uniport vs. multiport video-assisted thoracoscopic lobectomy for lung cancer. Sci Rep 2024; 14: 5316.
[21] Ahn S and Moon Y. Learning curve for complex segmentectomy via uniportal video-assisted thoracoscopic surgery for the treatment of early-stage lung cancer. J Thorac Dis 2024; 16: 1201-1211.
[22] Wu S, Chen X, Bai G, Liu Y, Yang Z and Gao S. Uniportal video-assisted thoracoscopic surgery does not increase recurrence rates following pneumonectomy in non-small cell lung cancer: a retrospective study from the National Cancer Center of China. Transl Lung Cancer Res 2025; 14: 1274-1289.
[23] Tokuishi K, Wakahara JI, Ueda Y, Miyahara S, Nakashima H, Masuda Y, Waseda R, Shiraishi T and Sato T. Comparison of postoperative pain between robotic and uniportal video-assisted thoracic surgery for anatomic lung resection in patients with stage I lung cancer. Gen Thorac Cardiovasc Surg 2025; 73: 692-699.
[24] Fu Z, Wang L, Hu W, Zhou Y and Zhou Q. Comparison of the efficacy of subxiphoid and intercostal uniportal video-assisted thoracoscopic surgery in patients with early-stage non-small cell lung cancer. Pak J Med Sci 2025; 41: 359-365.
[25] Congedo MT, Contegiacomo A, Nachira D, Chiappetta M, Calabrese G, Lippi M, Cina A, Lococo F, Meacci E, Vita ML, Ciavarella LP, Margaritora S and Iezzi R. Uniportal video-assisted thoracic surgery resection of subsolid or millimetric nodules using an innovative micro-coil technique: our experience. J Thorac Dis 2024; 16: 8424-8434.
[26] Shi Y and Xiao S. Effect of anatomical pulmonary segmentectomy and lobectomy under uniportal video-assisted thoracoscopic surgery on cardiopulmonary function and serum tumor markers in patients with early-stage non-small cell lung cancer. Ann Ital Chir 2024; 95: 593-602.
[27] Shahoud J, Weksler B, Williams B, Crist L and Fernando H. Initial outcomes with uniportal video-assisted lung resection. Interdiscip Cardiovasc Thorac Surg 2025; 40: ivaf111.
[28] Sassorossi C, Chiappetta M, Nachira D, Campanella A, Santoro G, Calabrese G, Scognamiglio C, Napolitano AG, Senatore A, Petracca Ciavarella L, Vita ML, Margaritora S and Lococo F. Uniportal laser-assisted video-assisted thoracoscopy (U-LA-VATS) for lung metastasectomy: technical description, peri-operative results and pertinent literature review. J Clin Med 2024; 13: 5346.
[29] Mizukami Y, Chiba Y, Sato K, Nakamura Y, Arai W, Maki R and Adachi H. Learning curve and outcomes of young surgeons in uniportal video-assisted thoracoscopic surgery lobectomy using bent-tip thoracoscopic forceps for lung cancer. J Thorac Dis 2025; 17: 9025-9038.
[30] Kuo YC, Wu CY, Hsieh MJ, Gonzalez-Rivas D, Yang TY and Wu CF. Early experience of uniportal robotic-assisted anatomic resection in lung cancer patients: is it safe and feasible for direct transition from uniportal video thoracoscopic-assisted surgery to uniportal robotic-assisted surgery? Asian J Endosc Surg 2025; 18: e70006.
[31] Goto H and Nakanishi K. Right upper lobectomy with mediastinal dissection under uniportal video-assisted thoracoscopic surgery for lung cancer in a patient with a right-sided aortic arch: a case report. J Cardiothorac Surg 2024; 19: 136.