



Research Article

## Comparison of Postoperative Pain and Recovery Following VATS and Open Thoracic Surgery.

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**Received:** 12-07-2026

**Revised:** 20-08-2026

**Accepted:** 16-09-2026

**Published:** 10-10-2026

**DOI:** 10.61336/ijmmas.22-04-04

**Abstract: Background:** Postoperative pain can limit coughing, mobilization and functional recovery after thoracic surgery. VATS may reduce access trauma compared with open thoracotomy, but comparative outcomes depend on procedure and perioperative care. **Aim:** To compare postoperative pain and recovery following VATS and open thoracic surgery. **Methods:** A prospective comparative observational study was planned among 120 adults undergoing eligible thoracic resections, with 60 participants in each approach group. Pain was assessed using a 0–10 numeric rating scale at 6, 24 and 48 hours. Opioid use, time to mobilization, chest-drain duration, hospital stay and 30-day complications were recorded. Continuous outcomes were compared using independent-samples tests and categorical outcomes using chi-square or Fisher exact tests, with 95% confidence intervals. **Results:** Illustrative simulated results showed lower 24-hour pain after VATS than open surgery ( $3.1 \pm 1.3$  vs  $4.6 \pm 1.5$ ; mean difference  $-1.50$ , 95% CI  $-2.00$  to  $-1.00$ ;  $p < 0.001$ ) and shorter hospital stay ( $4.9 \pm 1.8$  vs  $6.8 \pm 2.6$  days; mean difference  $-1.90$ , 95% CI  $-2.67$  to  $-1.13$ ;  $p < 0.001$ ). Any complication occurred in 21.7% versus 35.0%, respectively (risk difference  $-13.3$  percentage points, 95% CI  $-28.7$  to  $2.1$ ;  $p = 0.101$ ). These are fictional example values, not observed clinical results. **Conclusion:** The simulated example demonstrates how outcomes may be reported and cannot support a clinical conclusion. Actual patient data must be analysed before the manuscript is used for scientific dissemination.

**Keywords:** Video-assisted thoracoscopic surgery; Thoracotomy; Postoperative pain.

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## INTRODUCTION

Thoracic operations can cause substantial postoperative pain because the chest wall, intercostal nerves and pleura may be affected by incision, rib spreading, tissue retraction and chest drains. Pain can limit deep breathing, effective coughing and early mobilization, thereby interfering with pulmonary toilet and functional recovery. Persistent pain may also continue after discharge and affect quality of life. A planned multimodal analgesic pathway is therefore important regardless of surgical access. Contemporary recommendations support regular non-opioid analgesia and regional techniques, with opioids reserved for rescue when appropriate [3,4].

Video-assisted thoracoscopic surgery (VATS) provides intrathoracic visualization through small ports and avoids the rib spreading usually required for open thoracotomy. The smaller access trauma may reduce nociceptive input and facilitate earlier mobilization, chest drain removal and discharge. In a randomized trial of lobectomy for early-stage lung cancer, Bendixen et al. reported fewer episodes of clinically relevant pain after VATS and better EQ-5D quality of life over follow-up, although not every quality-of-life measure differed [1]. In the multicentre VIOLET trial, VATS was associated with better physical function at five weeks, less pain and shorter hospital stay, while its estimates also highlight that recovery differences may change over time [2].

The evidence is not uniform. Comparisons are affected by the extent of resection, surgeon experience, selection for open surgery, conversion, regional analgesia, chest-drain protocols and discharge practices. Systematic reviews generally report advantages in some recovery outcomes after VATS, but heterogeneity and limited direct randomized evidence constrain generalization, especially beyond lobectomy for lung cancer [5–8]. The current study was designed to compare postoperative pain and early recovery following VATS and open thoracic surgery in a defined hospital cohort, using the same perioperative

analgesia and outcome schedule in both groups. Its findings would help local teams assess whether the less invasive approach is associated with meaningful differences in pain, recovery milestones and short-term complications.

### AIM

To compare postoperative pain and recovery following video-assisted thoracoscopic surgery (VATS) and open thoracic surgery.

### OBJECTIVES

To compare postoperative pain intensity and analgesic requirement between patients undergoing VATS and open thoracic surgery.

To compare recovery milestones, including time to mobilization, chest-drain duration and postoperative hospital stay.

To compare the frequency of postoperative complications between the two surgical approaches.

## MATERIALS AND METHODS

### Source of data

Data were obtained from adult patients who underwent eligible thoracic procedures in the cardiothoracic surgery service at [name of institution]. Consecutive eligible patients were approached, and data were abstracted from perioperative records and direct postoperative assessments.

### Study design

A prospective comparative observational study was conducted. Patients were classified according to the surgical approach actually completed: VATS or open thoracotomy. Conversion from VATS to thoracotomy was documented and, for the primary comparison, analysed in the open group as-treated; a sensitivity analysis by intended approach was planned if conversions occurred.

### Study location

The study was conducted in the Department of Cardiovascular and Thoracic Surgery, Government Stanley Medical College and Hospital, Chennai.

### Study duration

Recruitment and follow-up were planned for 12 months, from January 2025 to December 2025, with each participant followed until 30 days after surgery. Replace these fields with the approved dates.

### Sample size

The planned sample size was 120 participants, with 60 in each group. For a comparison of two independent means, the sample size per group was estimated using:

$$n = \frac{2 (Z_{1-\alpha/2} + Z_{1-\beta})^2 \sigma^2}{\Delta^2}$$

Assuming a two-sided  $\alpha$  of 0.05, 80% power ( $Z\beta = 0.84$ ), a common standard deviation of 1.8 points for 24-hour pain on a 0–10 scale and a clinically relevant between-group difference ( $\Delta$ ) of 1.0 point,  $n = 2(1.96 + 0.84)^2(1.8)^2/(1.0)^2 = 50.8$ , rounded to 51 participants per group. Allowing approximately 15% for attrition or incomplete follow-up gave 60 per group, for a total of 120.

### Inclusion criteria

Adults aged 18 years or older undergoing elective anatomical pulmonary resection (segmentectomy or lobectomy) by VATS or open thoracotomy; judged eligible for either approach by the treating team; able to provide informed consent and report pain using a 0–10 numeric rating scale; and expected to receive the institution's standard postoperative analgesia pathway.

### Exclusion criteria

Emergency thoracic surgery; pneumonectomy, chest-wall resection or combined major procedures; VATS converted to open before completion (if analysed separately rather than as-treated); chronic opioid use or opioid-use disorder that would materially alter analgesic requirements; inability to provide reliable pain scores; severe cognitive impairment; known allergy or contraindication to core protocol analgesics; reoperation during the same admission; or refusal to participate.

## Procedure and methodology

Eligible patients were screened preoperatively and enrolled after written informed consent. The operating surgeon selected VATS or open thoracotomy on clinical grounds; the study did not assign the operation. The type and extent of resection, incision, operative duration, conversion, intraoperative blood loss and regional anaesthesia were recorded. Both groups followed the same documented multimodal analgesia pathway whenever clinically appropriate, including scheduled paracetamol and an NSAID or COX-2 inhibitor unless contraindicated, with regional analgesia according to the anaesthesia plan and opioid rescue for breakthrough pain. Pain was assessed on a 0–10 numeric rating scale at rest at 6, 24 and 48 hours after surgery; opioid administration was converted to oral morphine equivalents using a prespecified institutional conversion table. Patients were assessed daily for mobilization, chest-drain removal and discharge readiness. A 30-day follow-up was used to capture readmission and complications.

## Sample processing

No biological specimens were required for the study outcomes. Medication administration records were reviewed and opioid doses were converted to oral morphine equivalents. Procedure and complication data were checked against operative notes, progress notes and discharge summaries. Data were coded with a study identification number and stored without direct identifiers in a password-protected dataset.

## Data collection

A structured case-record form captured age, sex, body mass index, smoking status, ASA physical status, indication, procedure type, surgical approach, analgesia, pain scores, cumulative opioid exposure, time to first mobilization, chest-drain duration, length of stay, complications, 30-day readmission and missing observations. Data were entered by trained study staff and checked against source records. The assessor recording pain and milestones was not involved in choosing the surgical approach whenever staffing allowed.

## Statistical methods

Data were analysed using [software and version]. Continuous variables were summarized as mean (SD) when approximately normally distributed and as median (IQR) otherwise; categorical variables were summarized as n (%). Between-group mean differences with 95% confidence intervals were estimated using independent-samples t tests (Welch correction if variances differed); Mann–Whitney U tests were used for skewed outcomes. Categorical outcomes were compared using Pearson chi-square or Fisher exact tests, with risk differences or odds ratios and 95% CIs as appropriate. The primary pain comparison was the 24-hour NRS; repeated pain measurements would be analysed using a mixed-effects model with time, approach and their interaction. A multivariable model adjusting for age, ASA class, procedure type and analgesia technique was prespecified to address measured confounding. All tests were two-sided and  $p < 0.05$  was considered statistically significant. Missing data and conversions were to be reported transparently; no imputation was used for the illustrative tables below.

## Ethical considerations

The protocol was to be approved by the Institutional Ethics Committee of [institution] before recruitment (approval number: [insert]). Written informed consent was obtained from all participants. The study was conducted in accordance with applicable ethical standards and the Declaration of Helsinki.

## RESULTS

**Table 1. Baseline profile of participants by surgical approach (N=120)**

| Characteristic                     | VATS<br>(n=60) | Open<br>(n=60) | Test<br>statistic | 95% CI for contrast                | p<br>value |
|------------------------------------|----------------|----------------|-------------------|------------------------------------|------------|
| Age, years, mean (SD)              | 58.7 (10.2)    | 59.4 (9.8)     | $t = -0.39$       | –4.21 to 2.81                      | 0.697      |
| Male sex, n (%)                    | 34 (56.7)      | 37 (61.7)      | $\chi^2 = 0.31$   | –22.4 to 12.4 percentage<br>points | 0.577      |
| BMI, kg/m <sup>2</sup> , mean (SD) | 24.1 (3.6)     | 23.7 (3.8)     | $t = 0.59$        | –0.94 to 1.74                      | 0.556      |
| ASA physical status III, n<br>(%)  | 22 (36.7)      | 25 (41.7)      | $\chi^2 = 0.32$   | –21.3 to 11.3 percentage<br>points | 0.572      |
| Lobectomy, n (%)                   | 42 (70.0)      | 40 (66.7)      | $\chi^2 = 0.16$   | –13.2 to 19.9 percentage<br>points | 0.687      |
| Current/former smoker,<br>n (%)    | 29 (48.3)      | 32 (53.3)      | $\chi^2 = 0.30$   | –22.5 to 12.5 percentage<br>points | 0.580      |

The two illustrative groups were similar in age, sex distribution, body mass index, ASA physical status, lobectomy frequency and smoking status. None of the baseline comparisons was statistically significant (all  $p > 0.05$ ). These values are simulated and do not establish actual balance in a clinical cohort.

**Table 2. Postoperative pain and opioid use**

| Outcome                                                          | VATS (n=60) | Open (n=60) | Test statistic | Mean difference (95% CI) | p value |
|------------------------------------------------------------------|-------------|-------------|----------------|--------------------------|---------|
| Pain score at 6 h, mean (SD)                                     | 4.0 (1.4)   | 5.3 (1.6)   | t=-4.74        | -1.30 (-1.84 to -0.76)   | <0.001  |
| Pain score at 24 h, mean (SD)                                    | 3.1 (1.3)   | 4.6 (1.5)   | t=-5.85        | -1.50 (-2.01 to -0.99)   | <0.001  |
| Pain score at 48 h, mean (SD)                                    | 2.4 (1.1)   | 3.6 (1.4)   | t=-5.22        | -1.20 (-1.66 to -0.74)   | <0.001  |
| Opioid use in first 48 h, mg oral morphine equivalent, mean (SD) | 28.6 (12.4) | 39.8 (16.2) | t=-4.25        | -11.20 (-16.42 to -5.98) | <0.001  |

In the illustrative dataset, mean pain scores were lower after VATS at 6, 24 and 48 hours. At 24 hours, the simulated mean difference was -1.50 points (95% CI -2.01 to -0.99; p<0.001). Cumulative 48-hour opioid exposure was also lower in the VATS group, with a simulated mean difference of -11.20 mg oral morphine equivalent (95% CI -16.42 to -5.98; p<0.001).

**Table 3. Recovery milestones by surgical approach**

| Outcome                                      | VATS (n=60) | Open (n=60) | Test statistic | Mean difference (95% CI) | p value |
|----------------------------------------------|-------------|-------------|----------------|--------------------------|---------|
| Time to first mobilization, hours, mean (SD) | 15.8 (5.7)  | 23.6 (8.4)  | t=-5.95        | -7.80 (-10.40 to -5.20)  | <0.001  |
| Chest-drain duration, days, mean (SD)        | 2.7 (1.1)   | 3.8 (1.5)   | t=-4.58        | -1.10 (-1.58 to -0.62)   | <0.001  |
| Postoperative hospital stay, days, mean (SD) | 4.9 (1.8)   | 6.8 (2.6)   | t=-4.65        | -1.90 (-2.71 to -1.09)   | <0.001  |

The simulated VATS group mobilized earlier, had a shorter chest-drain duration and had a shorter postoperative stay. The illustrative mean differences were -7.80 hours for first mobilization (95% CI -10.40 to -5.20), -1.10 days for chest-drain duration (95% CI -1.58 to -0.62) and -1.90 days for length of stay (95% CI -2.71 to -1.09); all p<0.001.

**Table 4. Postoperative complications and 30-day readmission**

| Outcome                               | VATS (n=60) | Open (n=60) | Test statistic | Risk difference (95% CI) | p value |
|---------------------------------------|-------------|-------------|----------------|--------------------------|---------|
| Any postoperative complication, n (%) | 13 (21.7)   | 21 (35.0)   | $\chi^2=2.63$  | -13.3% (-29.3 to 2.6)    | 0.105   |
| Pulmonary complication, n (%)         | 7 (11.7)    | 13 (21.7)   | $\chi^2=2.16$  | -10.0% (-23.2 to 3.2)    | 0.142   |
| Prolonged air leak >5 days, n (%)     | 6 (10.0)    | 8 (13.3)    | $\chi^2=0.32$  | -3.3% (-14.8 to 8.1)     | 0.570   |
| Postoperative nausea/vomiting, n (%)  | 11 (18.3)   | 17 (28.3)   | $\chi^2=1.68$  | -10.0% (-25.0 to 5.0)    | 0.195   |
| Unplanned 30-day readmission, n (%)   | 3 (5.0)     | 6 (10.0)    | $\chi^2=1.08$  | -5.0% (-14.4 to 4.4)     | 0.298   |

Any postoperative complication was recorded in 13/60 (21.7%) illustrative VATS participants and 21/60 (35.0%) open participants. The simulated risk difference was -13.3 percentage points (95% CI -29.3 to 2.6; p=0.105), which was not statistically significant. Individual complication comparisons and 30-day readmission also did not reach statistical significance in this small illustrative sample.

## DISCUSSION

This illustrative comparison was structured to examine pain, recovery milestones and short-term complications after VATS and open thoracic surgery. The simulated results show lower pain scores and opioid use, earlier mobilization, shorter chest-drain duration and shorter hospital stay in the VATS group. These patterns are directionally consistent with several comparative studies, but the example values are not patient observations and should not be interpreted as evidence about a real hospital cohort.

### **Postoperative pain and analgesic requirement**

The simulated 24-hour pain score favoured VATS by 1.50 points. Bendixen et al. [1] reported moderate-to-severe pain in 38% of VATS participants versus 63% after anterolateral thoracotomy during the first 24 hours in their randomized lobectomy trial, with fewer pain episodes during follow-up. Ng et al. [8] also found lower early pain scores in pooled comparisons of multiport VATS and open lobectomy. In contrast, the VIOLET trial reported similar pain on postoperative day 1, with a modest advantage for VATS on day 2, emphasizing that an analgesia protocol and timing of assessment can affect observed group differences [2]. Palade et al. [9] found that adequate analgesia could achieve acceptable pain control in both groups, although the VATS group needed less medication during the early period. Van der Ploeg et al. [10] also evaluated pain after open, VATS and robotic lobectomy, reinforcing the need to distinguish surgical access when interpreting patient-reported pain. The simulated lower opioid requirement here is clinically plausible but would require confirmation using actual medication records and standardized opioid conversions.

### **Recovery milestones**

The illustrative results suggested earlier mobilization and reductions in drain duration and hospital stay after VATS. In VIOLET, VATS was associated with improved physical function at five weeks, shorter hospital stay and less pain, with recovery differences extending beyond discharge [2]. Wang et al. [7] reported shorter chest-drain duration and hospital stay for VATS compared with muscle-sparing thoracotomy in a meta-analysis, while Ng et al. [8] similarly summarized evidence favouring VATS for pain and function. Kim et al. [6], in a review of randomized trials, found a shorter hospital stay after minimally invasive surgery compared with thoracotomy, but cautioned that available trials and outcome reporting were limited. These outcomes are also affected by chest-drain policies, discharge criteria and enhanced recovery protocols; the ERAS Society and ESTS recommend early mobilization, opioid-sparing multimodal analgesia and minimally invasive surgery when appropriate [3].

### **Postoperative complications**

The illustrative composite complication rate was numerically lower after VATS, but the confidence interval crossed no difference. This is consistent with the need to avoid overinterpreting small samples. Lim et al. [2] reported fewer in-hospital complications overall after VATS in the VIOLET trial, although specific events such as air leak and bleeding require monitoring. Kim et al. [6] found no clear differences for several individual complications in pooled randomized comparisons, and Wang et al. [7] reported lower overall complications in VATS relative to muscle-sparing thoracotomy while some complications did not differ. In the ESTS propensity-matched cohort, Falcoz et al. [12] found shorter hospital stay and fewer overall and major cardiopulmonary complications after VATS, though residual confounding remains possible. Differences in case selection, complexity, conversion and definitions of complications can produce variable estimates across studies. Consequently, complication comparisons should be adjusted for procedural complexity and reported with absolute counts and confidence intervals.

### **Clinical interpretation**

The literature supports evaluating VATS as a less invasive access option for appropriately selected patients, while recognizing that surgical approach is determined by oncologic requirements, anatomy, patient fitness and surgical expertise. Evidence-based postoperative pain management remains necessary after either approach. Feray et al. [4] recommend basic non-opioid analgesia and regional techniques such as paravertebral or erector spinae plane block for VATS, with opioids reserved for rescue. Spaans et al. [5] reviewed analgesia after thoracoscopic lung resection and found substantial heterogeneity across regimens, making pooled comparisons difficult. Kosiński et al. [13] further examined early pain under multimodal analgesia across VATS port configurations, illustrating that technical details within minimally invasive surgery can also affect pain outcomes. This underscores why a local comparative study should record and, where feasible, standardize analgesia in both surgical groups.

### **Strengths and implications**

The proposed design uses prospective pain measurement, defined recovery milestones and 30-day follow-up. Reporting the mean differences and confidence intervals alongside p values would help distinguish clinical magnitude from statistical significance. In a completed study, multivariable adjustment for age, ASA class, procedure type, baseline pulmonary reserve, regional analgesia and conversion would be important because the approach was selected clinically rather than randomized. The four tables in this draft model a concise structure for presenting such results; all numbers presently shown are synthetic.

## **CONCLUSION**

In this illustrative dataset, VATS was associated with lower early postoperative pain and opioid use, earlier mobilization, shorter chest-drain duration and shorter hospital stay than open thoracic surgery. The numerical difference in overall complications was not statistically significant. Because all results in this draft are simulated, no clinical conclusion can be drawn until the analyses are repeated using the actual prospectively collected data. In practice, VATS may support faster

recovery in appropriately selected patients, while multimodal analgesia and individualized surgical decision-making remain important for both approaches.

### Limitations

- The tables contain simulated values because no patient-level data were supplied; they must not be reported as real findings.
- The proposed observational design is vulnerable to confounding by indication, because clinical factors and surgical complexity influence approach selection.
- The sample size of 120 may provide limited precision for uncommon complications and subgroup comparisons.
- Pain ratings and opioid conversion depend on assessment timing, patient reporting and local prescribing practice.
- Recovery outcomes such as drain removal and discharge are influenced by institutional protocols, staffing and social factors.
- The proposed follow-up is limited to 30 days for readmission and does not assess chronic post-thoracotomy pain, long-term function or quality of life.
- Generalizability may be limited if the cohort comes from a single centre or includes only selected anatomical resections.
- All institutional details, including location, study dates, ethical approval, analgesia specifics and software, remain placeholders that must be completed from the approved protocol.

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