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# A Meta-Analysis Comparing Surgical Site Wound Infection following Single-Incision versus Multiple-Incision Video-Assisted Thoracoscopic Surgery Lobectomy for Patients with Lung Cancer

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CASE REPORT

# A Meta-Analysis Comparing Surgical Site Wound Infection following Single-Incision versus Multiple-Incision Video-Assisted Thoracoscopic Surgery Lobectomy for Patients with Lung Cancer

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## ABSTRACT

**Background:** A meta-analysis was conducted to evaluate the impact of single-incision (SI) versus multiple-incision (MI) video-assisted thoracoscopic surgery (VATS) lobectomy on surgical site wound length (SSWL) and surgical site wound infection (SSWI) in lung cancer (LC) patients.

**Methods:** Inclusive literature research till March 2023 was done and 598 interconnected researches were revised. The 8 picked researches, enclosed 1542 LC persons were in the utilized researches' starting point, 310 of them were utilizing SI, and 232 were utilizing MI. Odds ratio (OR) and 95% confidence intervals (CIs) were utilized to appraise the effect of SI compared to MI VATS lobectomy for LC subjects on SSWL and SSWI by the dichotomous, or contentious approaches and a fixed or random model.

**Results:** SI had significantly lower SSWL (MD, −1.53; 95% CI, −2.63–0.44, $p = 0.006$) compared to MI in LC persons. However, no significant difference was found between SI and MI in LC persons in SSWI (OR, 0.59; 95% CI, 0.21–1.66, $p = 0.32$).

**Conclusion:** SI had significantly lower SSWL, however, no significant difference was found in LC persons in SSWI compared to MI in LC persons. However, caution must be taken when interacting with its values since there was a low number of nominated research found for the comparisons in the meta-analysis.

**Keywords:** Lung cancer, Video-Assisted Thoracoscopic Surgery (VATS), Single-Incision (SI) surgery, Multiple-Incision (MI) surgery, Surgical Site Wound Infection (SSWI), Surgical Site Wound Length (SSWL), Lobectomy, Thoracic surgery

## 1. Introduction

Lung cancer (LC) has the highest occurrence and mortality rates among males globally, and the second highest rates among females [1]. Surgical resection is the main treatment for early stages of non-small cell lung cancer. Advancements in endoscopic instruments and surgical approaches have greatly contributed to the progress of novel minimally invasive surgical practices for the surgical therapy of LC throughout the past 20 years. Video-assisted thoracoscopic surgery (VATS) has been shown to yield superior postoperative outcomes in comparison to open thoracotomy. Multiple meta-analyses have demonstrated a reduction in issue rates, a decrease in the length of hospital admissions, and an enhancement in long-term survival [2–4]. Nevertheless, over 50% of patients who have undergone VATS report experiencing postoperative chest wall paresthesia specifically related to the portal sites [5]. The conventional VATS technique has been modified to employ a reduced number of smaller working ports throughout the surgical procedure in order to mitigate these issues. The single-incision (SI) approach

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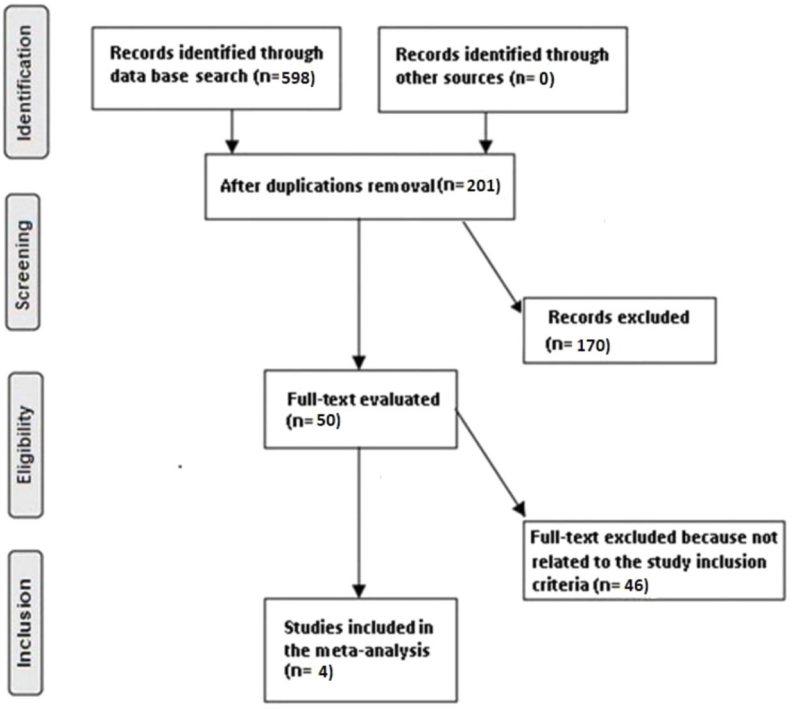


**Fig. 1.** A flowchart of the research process.

was first employed in 2005 to identify the kind of lung lesions [6]. Subsequently, the uniportal thoracoscopic method was employed to carry out more challenging thoracic procedures such as lobectomy, pneumonectomy, and bronchoplasty [7]. The uniportal technique has been reported to provide certain benefits compared to the multiport lobectomy. Advocates argue that having both the surgeon and the assistant surgeon positioned on the same side of the table provides improved ergonomics and training prospects. Nevertheless, alternative methods such as the Copenhagen three-port anterior approach offer similar benefits to this treatment. Superficially, it may appear to be a more complex technique compared to its two- to four-port counterpart. Introducing the camera and equipment through the same incision may provide a clearer and more direct view of the operative field [8]. Various institutional reviews have indicated some potential advantages of the uniportal VATS method, along with a reduction in the number of surgical incisions. These benefits encompassed enhanced patient satisfaction and a significant reduction in postoperative pain and paresthesia after 8 days [9]. Although these favorable results have been observed, the clinical performance of uniportal VATS compared to multiportal VATS remains uncertain [10]. In the context of lobectomy and sublobectomy for LC, this meta-analysis examined the impact of single-incision (SI) VATS lobectomy to multiple-incision (MI) VATS lobectomy on surgical site wound length (SSWL) and surgical site wound infection (SSWI) in LC individuals.

## 2. Methods

### 2.1. Eligibility criteria

The research selected aimed to provide an overview of the impact of single-incision (SI) VATS lobectomy compared to multiple-incision VATS lobectomy on short-stay wound length (SSWL) and short-stay wound infection (SSWI) in participants with lung cancer (LC) [11].

### 2.2. Information sources

Fig. 1 displays the complete research. The literature was incorporated into the research once the inclusion criteria were satisfied:

1. The study was conducted using observational, prospective, retrospective, or randomized controlled trial (RCT) research methods.
2. The individuals who were investigated were the ones with LC.
3. The intervention was self-instructional.
4. The study evaluated the results of SI versus MI VATS lobectomy for LC patients in terms of SSWL and SSWI.

**Table 1.** Search strategy for each database.

| Database | Search strategy |
|---|---|
| Pubmed | #1 "lung cancer" [MeSH Terms] OR "video-assisted thoracoscopic surgery" [MeSH Terms] [All Fields]<br>#2 "surgical site wound complication" [MeSH Terms] OR "single-incision" [MeSH Terms] OR "multiple-incision" [MeSH Terms] [All Fields]<br>#3 #1 AND #2 |
| Embase | 'lung cancer'/exp OR 'video-assisted thoracoscopic surgery'<br>#2 'surgical site wound complication'/exp OR 'single-incision'/exp OR 'multiple-incision'<br>#3 #1 AND #2 |
| Cochrane library | (lung cancer):ti,ab,kw (video-assisted thoracoscopic surgery):ti,ab,kw (Word variations have been searched)<br>#2 (surgical site wound complication):ti,ab,kw OR (single-incision):ti,ab,kw OR (multiple-incision):ti,ab,kw (Word variations have been searched)<br>#3 #1 AND #2 |

Studies that did not examine the features of the outcome of SI compared to MI VATS lobectomy for LC people on SSWL and SSWI, as well as studies on SSWL and SSWI in individuals without incision, were omitted from consideration.

### 2.3. Search strategy

The search protocol operations were identified and classified according to the PICOS framework. The term "population" refers to individuals with LC, P; SI represents the intervention or exposure, while the comparison was made between SI and MI; SSWL and SSWI were the outcomes, and the research design had no limitations [12].

We conducted a comprehensive search of Google Scholar, Embase, Cochrane Library, PubMed, and OVID databases up until March 2023. We used a combination of keywords and additional keywords to search for studies related to lung cancer, single-incision and multiple-incision surgical techniques, surgical site wound complications, and video-assisted thoracoscopic surgery. The details of the search terms used can be found in Table 1. In order to prevent an inquiry from being unsuccessful in establishing a link between the impact of SI and MI VATS lobectomy on SSWL and SSWl in LC participants, the paper replications were excluded. These replications were then organized into an EndNote file, and the titles and abstracts were reassessed.

### 2.4. Selection process

The subsequent phase involved the organization and analysis of data using the meta-analysis approach, following the epidemiological statement.

### 2.5. Data collection process

Criteria such as the author's name, research data, research year, country or area, population type, medical and treatment characteristics, categories, quantitative and qualitative estimation methods, data source, outcome estimation, and statistical analysis were used to collect data [13].

### 2.6. Data items

We collected the data independently, focusing on evaluating the impact of SI versus MI VATS lobectomy on SSWL and SSWl in LC patients, considering the different values found in previous studies.

### 2.7. Research risk of bias assessment

In order to assess the potential bias of each study, two writers conducted a separate evaluation of the technique employed in the selected papers. The procedural quality was assessed using the "risk of bias instrument" from the Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. Each research study was allocated one of the following bias risks based on the categorization determined by the appraisal criteria: Research that fulfilled all quality requirements was categorized as having a low risk of bias, whereas research that failed to meet or address one requirement was categorized as having a medium risk of bias. If many quality standards were not fully completed, the research was evaluated to have a significant risk of bias [14].

### 2.8. Effect estimates

Only studies that evaluated and detailed the effect of SI lobectomy in comparison to MI VATS lobectomy for LC participants on SSWL and SSWl were subjected to sensitivity analysis. An study of subclasses was carried out in order to compare the sensitivity of LC individuals to that of SI and MI.

### 2.9. Synthesis methods

The odds ratio (OR) and a 95% confidence interval (CI) were computed using either a random-effect or fixed-effect model and a dichotomous or contentious

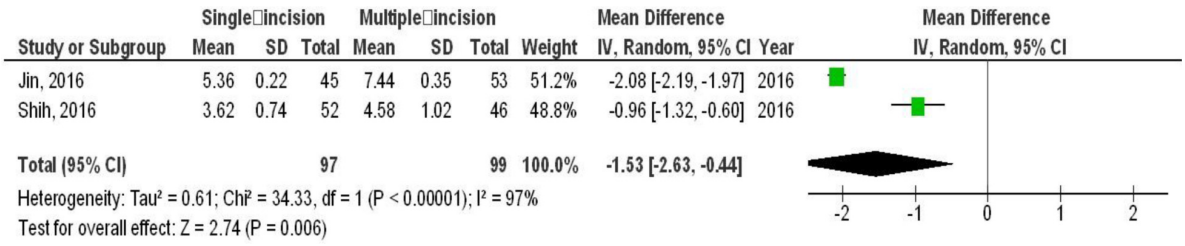


**Fig. 2.** The effect's forest plot of the SI compared to MI on SSWL in LC.

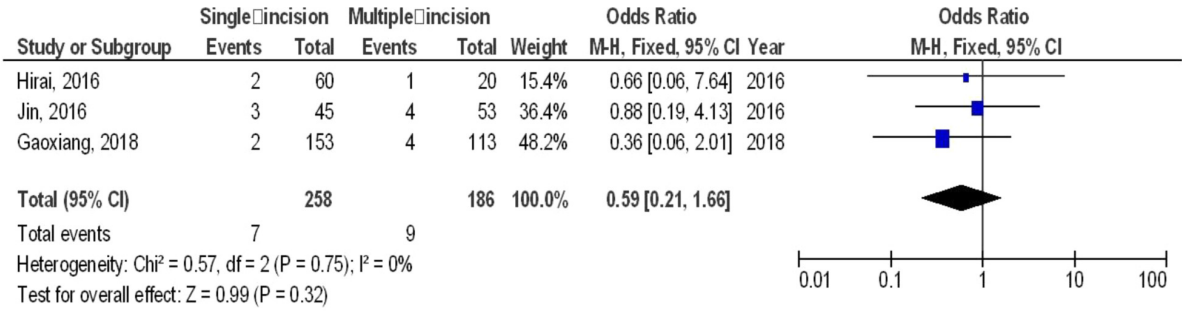


**Fig. 3.** The effect's forest plot of the SI compared to MI on SSWI in LC.

approach. The I2 index was computed on a scale ranging from 0 to 100%. There was heterogeneity observed at 0%, 25%, 50%, and 75% with varying degrees of intensity: none, low, moderate, and high, respectively. Fourteen Additional structures exhibiting a significant level of similarity in the linked inquiry were also examined to ensure the accurate model was employed. If the value of I2 was 50% or greater, the random effect was used. However, if I2 was less than 50%, the option of employing the fixed-effect was chosen. Fourteen A subclass analysis was conducted by dividing the initial estimation into the indicated consequence categories. The analysis employed a p-value of less than 0.05 to determine the statistical significance of differences among subgroups.

### 2.10. Reporting bias assessment

The Egger regression test and funnel plots were used to assess investigation bias, both quantitatively and qualitatively. The logarithm of the ORs was plotted against their standard errors to provide a comprehensive analysis. Investigations were deemed to have bias if $p \geq 0.05$ [15].

### 2.11. Certainty assessment

The p-values were examined using two-tailed testing. With the help of Reviewer Manager Version 5.3, we were able to generate graphs and perform statistical analyses. This software was developed by the Nordic Cochrane Centre in collaboration with the Cochrane Collaboration, based in Copenhagen, Denmark.

**Table 2.** Characteristics of the selected researches for the meta-analysis.

| Study | Country | Total | Single-incision | Multiple-incision |
|---|---|---|---|---|
| Shih, 2016 [16] | Taiwan | 98 | 52 | 46 |
| Hirai, 2016 [17] | Japan | 80 | 60 | 20 |
| Jin, 2016 [18] | China | 98 | 45 | 53 |
| Gaoxiang, 2018 [19] | China | 266 | 153 | 113 |
| | Total | 542 | 310 | 232 |

## 3. Results

4 papers, published between 2016 and 2018, from a total of 598 linked research that met the inclusion criteria were chosen for the research [16–19]. The consequences of these investigations are accessible in Table 2. 542 LC persons were in the utilized researchers' starting point, 310 of them were utilizing SI, and 232 were utilizing MI. The sample size was 80 to 266 persons.

SI had significantly lower SSWL (MD, −1.53; 95% CI, −2.63–0.44, $p = 0.006$) with high heterogeneity ($I^2 = 97\%$) compared to MI in LC persons as revealed in Fig. 2. However, no significant difference was found between SI and MI in LC persons in SSWI (OR, 0.59; 95% CI, 0.21–1.66, $p = 0.32$) with no heterogeneity ($I^2 = 0\%$) as revealed in Fig. 3.

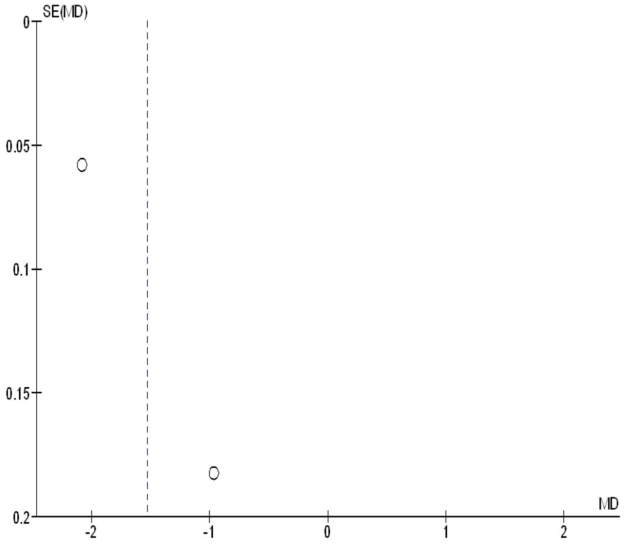


**Fig. 4.** The funnel plot of the SI compared to MI on SSWL in LC.

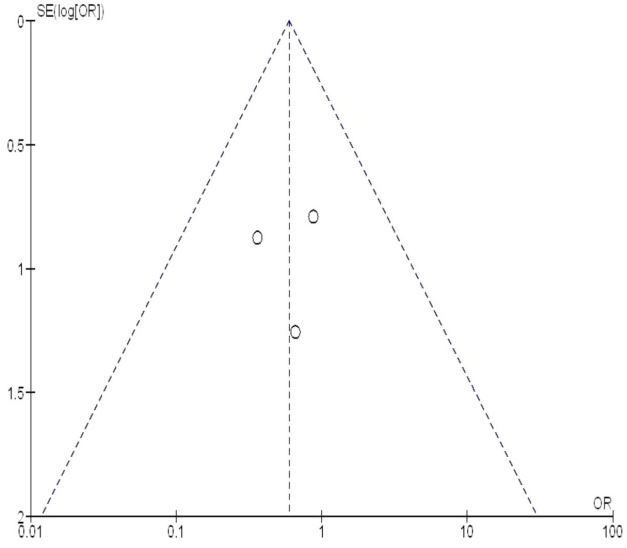


**Fig. 5.** The funnel plot of the SI compared to MI on SSWI in LC.

The utilization of stratified models to examine the effects of specific components was not possible due to a lack of data, e.g. age, gender, and ethnicity, on comparison outcomes. No evidence of research bias was found ($p = 0.89$) operating the quantitative Egger regression test and the visual interpretation of the funnel plot as shown in Figs. 4 and 5. Though, it was discovered that the mainstream of the implicated RCTs had poor procedural quality and no bias in selective reporting.

## 4. Discussion

The meta-analysis included a sample of 542 individuals with LC. Among these, 310 used SI and 232 used MI. Individuals with lower cognitive abilities (LC) between the ages of 16 and 19 had significantly lower social support and well-being (SSWL) compared to individuals with higher cognitive abilities (MI). Nevertheless, there was no notable disparity observed between SI and MI in those with LC in SSWI. Nevertheless, it is important to exercise caution when engaging with the values of the study, as the meta-analysis revealed a limited number of nominated researchers available for comparisons. That would impact the level of relevance of the evaluations, such as SSWI, that are being researched.

Lung cancer is the primary determinant of mortality in relation to cancer on a worldwide scale. VATS has largely supplanted conventional surgery in most institutions for the early treatment of LC. Due to recent advancements in surgical technology, Video-Assisted Thoracic Surgery (VATS) for Lung Cancer (LC) has rapidly gained popularity worldwide. The rapid growth of this procedure may be attributed to its low invasiveness, which takes into account the patient's pain tolerance, cosmetic outcomes, and health economic benefits, such as reduced hospital stays. Nevertheless, traditional VATS often leads to the development of allodynia and hypoesthesia, which are associated with intercostal nerve diseases and pose difficulties in postoperative treatment. This implies that performing surgery that involves techniques across several intercostal zones is more demanding and uncertain for surgeons. In certain countries, there have been recent advancements in the medical field that have allowed for the use of Video-Assisted Thoracic Surgery (VATS) for Lung Cancer (LC) with a single incision measuring 4 cm [20, 21]. This treatment is alternatively referred to as SI thoracoscopic surgery or uniportal VATS. Surgeons proficient in bullectomy/blebectomy and abrasion through SI thoracic surgery showed similar operative timeframes to those using MI for minor thoracic surgery. Furthermore, it is evident that single-port VATS necessitates a longer duration for the first stages when compared to multi-port VATS [22]. The single-port VATS has certain limitations, including as its inherent technical complexity during the first learning period and the potential lack of safety when performed by a less-experienced surgeon. The need for a skilled camera assistant is a result of the specific skill requirements of performing a single-port thoracoscopic lobectomy using uniportal VATS. The camera assistant must be qualified and knowledgeable about how to accommodate the geometrical changes involved in this procedure. Thus, we hypothesized that the duration of the treatment would decrease as a result of advancements in surgical equipment specifically designed for single-port surgeries and the accumulation

of more surgical expertise. Examining the mediastinal lymph nodes through dissection can enhance the classification of LC and thus impact statistical results [22]. The Single-Incision Video-Assisted Thoracic Surgery (SI VATS) typically results in a reduced duration of hospitalization. The implementation of SI VATS has led to a notable reduction in wound length, perhaps resulting in decreased postoperative pain, preserved pulmonary function, and a faster recovery time for patients, enabling them to resume activities sooner. Furthermore, the duration of the single-port chest tube is shorter compared to that of the numerous ports. Assessing these characteristics was difficult due to the absence of specific criteria for chest tube removal and duration of hospital stay [23]. Assessing the consistency of patient administration across all research studies and determining if various institutions followed distinct postoperative regimens is challenging. Implementing an alternative approach to managing chest tubes could greatly influence the results related to the time the chest tube is in place and the length of hospital stay. Concerns have been raised regarding potential drawbacks of the uniportal VATS treatment, including extended recovery time, more blood loss, reduced removal of lymph nodes during surgery, compromised safety outcomes, and a higher likelihood of converting to an open thoracotomy.

This meta-analysis examined the impact of SI and MI on the treatment of individuals with LC on SSWL and SSWI. Further examination is needed to shed light on these potential impacts. This point was also highlighted in previous research that used a connected meta-analysis approach and found similar results regarding the impact [24–27]. While the meta-analysis did not establish a direct link between these variables and the research results, it is important for well-conducted RCTs to consider these factors, along with the diverse range of ages, genders, and ethnicities of the participants. Overall, LC individuals showed a noticeable difference in SSWL between SI and MI. However, there was no notable distinction discovered between SI and MI in LC individuals in SSWI.

### 4.1. Limitations

It is possible that there was a bias in the selection of researchers for the meta-analysis, as some were excluded. However, the research that was excluded did not meet the criteria for inclusion in the meta-analysis. In addition, our understanding was limited when it came to evaluating how factors such as age, gender, and ethnicity influenced the results. The research aimed to investigate the impact of SI and MI on SSWL and SSWI in LC management. Due to the inclusion of inaccurate or missing data from previous research, there is a possibility that bias may have been magnified. Various factors, such as the individuals' nutritional state, race, gender, and age, likely contributed to the presence of bias. Missing data and unpublished work can inadvertently lead to distorted values.

## 5. Conclusions

LC individuals showed a noticeable decrease in SSWL when comparing SI to MI. However, there was no noticeable distinction discovered between SI and MI in LC individuals in SSWI. However, it is important to exercise caution when working with its values, as the meta-analysis revealed a limited number of nominated researchers available for comparisons. That would have an impact on the importance of the evaluations, such as SSWI.

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