

Surgery for Early-Stage Non-Small Cell Lung Cancer: A Systematic Review of the Video-Assisted Thoracoscopic Surgery Versus Thoracotomy Approaches to Lobectomy

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Video-assisted thoracoscopic surgery (VATS) for lobectomy has been touted to provide superior outcomes, compared with thoracotomy, for patients with early-stage non-small-cell lung cancer (NSCLC). However, supporting data are limited to case series and small observational studies. We hypothesized that a systematic review of the literature would enable a more objective evaluation of the evidence in order to determine the potential superiority of the VATS approach, compared with thoracotomy, in terms of short-term morbidity and long-term survival. To identify relevant articles for inclusion in our analysis, we performed a systematic review of the MEDLINE database. We looked for randomized controlled trials, observational studies, and case series that reported outcomes after VATS or thoracotomy lobectomy for NSCLC. For statistical testing, we used a two-sided approach ($\alpha = 0.05$) under the hypothesis that VATS lobectomy is

superior to thoracotomy lobectomy. We screened 17,923 studies. After independent review of the abstracts by 2 reviewers, we included 39 studies (only one randomized controlled trial) in our analysis. In aggregate, these 39 studies involved 3256 thoracotomy and 3114 VATS patients. The characteristics of the two groups were not significantly different. Compared with thoracotomy, VATS lobectomy was associated with shorter chest tube duration, shorter length of hospital stay, and improved survival (at 4 years after resection), all statistically significant. Compared with lobectomy performed by thoracotomy, VATS lobectomy for patients with early-stage NSCLC appears to favor lower morbidity and improved survival rates.

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The variety of procedures that can be performed using minimally invasive surgical approaches is expanding. In the 1990s, surgeons began using video-assisted thoracoscopic surgery (VATS) to perform lobectomies. As experience grew, VATS lobectomy began to be used to treat patients with early-stage (ie, stage I and II) non-small cell lung cancer (NSCLC). Proponents of the VATS approach have touted several potential advantages compared with a thoracotomy: less morbidity, shorter convalescence, and superior survival rates. Critics of the VATS approach have argued that it may not be an equivalent oncologic operation. Unfortunately, prospective multi-institutional randomized trials have not been performed; the evidence in the literature to guide surgical management of early-stage NSCLC is limited to single institution case series and small observational studies.

We used a systematic review of the literature to enable a more objective assessment of the published evidence available and permit a more accurate comparison of VATS vs thoracotomy lobectomy for early-stage NSCLC in terms of short-term morbidity and long-term survival rates. This was intended to help resolve uncertainty and efficacy between the two approaches. We formulated four hypotheses: compared with open lobectomy, patients who undergo VATS lobectomy have (1) a lower overall complication rate, (2) a shorter duration of chest tube drainage, (3) a shorter length of stay, and (4) a superior overall survival rate during the first 5 years after NSCLC resection.

Material and Methods

Data Collection

To identify relevant articles for inclusion in our analysis, we performed a structured literature retrieval of the MEDLINE database. We looked for randomized controlled, trials, observational studies, and case series that reported outcomes after either VATS or thoracotomy

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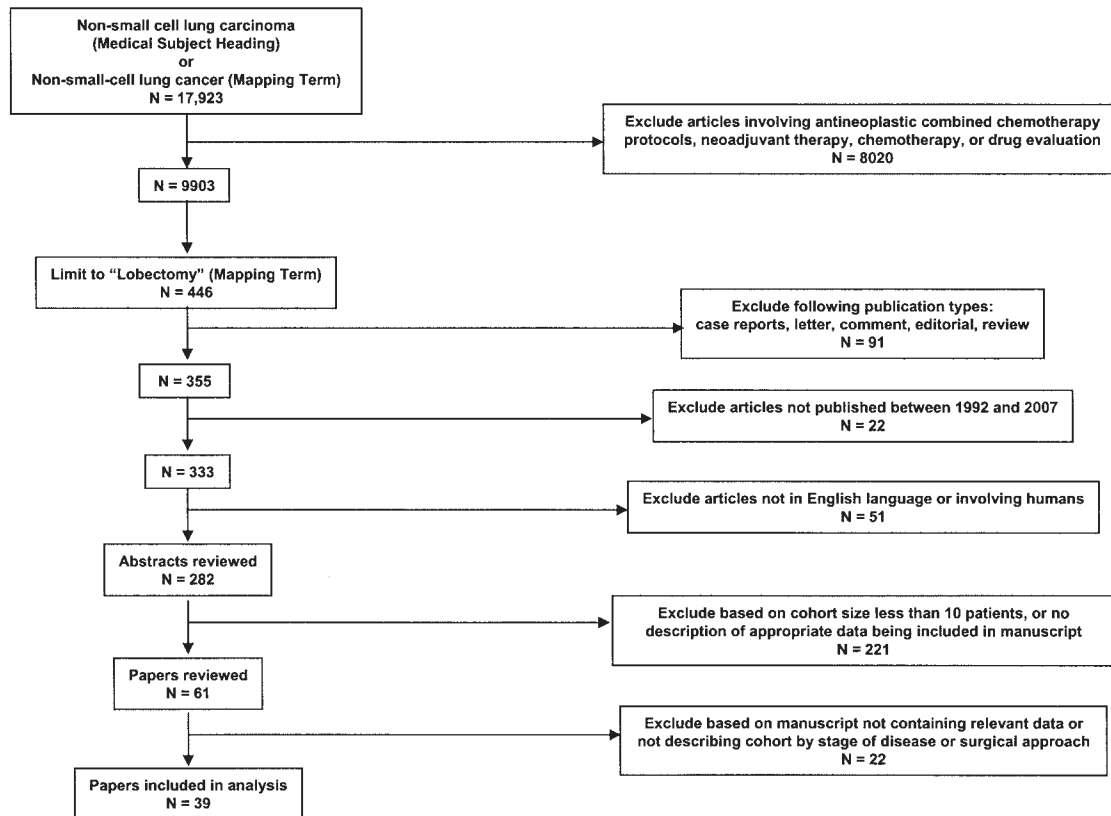


Fig 1. The algorithm of the systematic review's MEDLINE search schema demonstrates the criteria for limiting and excluding articles as well as the number of articles identified at each step.

lobectomy for NSCLC. Our MEDLINE search algorithm (Fig 1) began by querying for non-small cell lung carcinoma (medical subject heading) and for non-small cell lung cancer (mapping term). This query yielded article abstracts from 17,923 studies. We excluded articles with the medical subject headings of antineoplastic combined chemotherapy protocols, neoadjuvant therapy, chemotherapy, and drug evaluation. Of the remaining articles, we included only those containing lobectomy as a mapping term, leaving 446. We then excluded case reports, letters, comments, editorials, and reviews. Finally, we limited our final analysis to articles written in English, involving humans, and published from January 1, 1992 (the year the first VATS lobectomy was performed), through April 30, 2007.

Using these search criteria, we identified 282 potential articles for inclusion in our analysis. The abstracts of these articles were reviewed by 2 independent reviewers, using the inclusion criteria of (1) at least 10 patients in the study underwent either VATS or open lobectomy and (2) the abstract specifically indicated that the article contained data on complication rates, chest tube duration, length of hospital stay, or survival rates. After independent review of the abstracts, 61 articles were included. After we reviewed those 61 articles, we included 39 in our analysis. The other 22 articles were excluded because they did not contain the specific data mentioned in the

abstract or because they did not subdivide their results by disease stage or by surgical approach (ie, they only presented aggregate data). For our analysis, we looked at articles which reported data for clinical stage I and those that reported data on pathologic stage I.

Statistical Analysis

Because variability of continuous outcomes (length of stay and chest tube duration) from individual studies was typically unavailable, pooled estimates were calculated by weighting according to the sample size of the study from which they were taken. Proportions were transformed to the logit scale before pooling. Statistical comparison of the two surgical approaches was performed using a random effects meta-regression model with surgical approach as the covariate. Heterogeneity was assessed with I^2 [1]. In studies where the complication rate was not reported, we calculated it as the sum of the individual complication rates. If the overall survival rates were not explicitly stated, we extracted them from survival curves (when provided). Results are reported as mean and 95% confidence interval. Data on length of stay and complications from McKenna (1998) [2], which potentially were duplicated in a subsequent publication [3], were excluded from the analysis. All statistical analyses were performed using Stata 10.0 software

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