In patients with resectable non-small-cell lung cancer, is video-assisted thoracoscopic segmentectomy a suitable alternative to thoracotomy and segmentectomy in terms of morbidity and equivalence of resection?

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Abstract

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was ‘In patients with resectable non-small-cell lung cancer, is video-assisted thoracoscopic segmentectomy a suitable alternative to thoracotomy and segmentectomy in terms of morbidity and equivalence of resection?’ Altogether 232 papers were found as a result of the reported search, of which 7 represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. Only one study compared the survival rates of video-assisted thoracoscopic surgery (VATS) and open surgery and found no significant difference in overall (P = 0.605) and disease-free (P = 0.996) survival between these groups. The mean length of hospital stay was reported as shorter following VATS when compared with open surgery in all of the studies looking at this outcome. The greatest difference in length of hospital stay reported was 4.8 days (VATS 3.5 days and open 8.3 days). The duration of chest tube placement was also universally reported as shorter in patients having VATS procedures when compared with open procedures. Two studies compared the number of lymph nodes that could be sampled when completing this operation by VATS using an open approach and neither found there to be a significant difference between these numbers. Using the evidence collected, we conclude that anatomical segmentectomy performed by VATS is a safe and effective alternative to conventional techniques in the surgical management of non-small-cell lung cancer. We are aware that the current evidence is limited and existing studies all examine small numbers of patients. Unfortunately, at present there is no blinded randomized control trial comparing these two surgical methods. There is also no study comparing the utility of each method for differing anatomical locations of segments. This should be kept in mind when interpreting the results of the studies presented.

Keywords: Thoracic surgery • Video-assisted thoracoscopic surgery • Segmentectomy • Non-small-cell lung cancer

INTRODUCTION

A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

THREE-PART QUESTION

In [patients with resectable NSCLC], is [VATS segmentectomy] a suitable alternative to [thoracotomy and segmentectomy] in terms of [morbidity and equivalence of resection]?

CLINICAL SCENARIO

You are a cardiothoracic registrar attending a local multidisciplinary team meeting. The case of a 76-year old lady with a peripheral, 1.5-cm right upper lobe tumour (T1aN0M0) is presented.

In consideration of her coexisting chronic obstructive pulmonary disease, your consultant proposes sublobar resection using an open thoracotomy approach. You are aware of evidence supporting the use of video-assisted thoracoscopic surgery (VATS) segmentectomy in early non-small-cell lung cancer (NSCLC) and that this minimally invasive technique may reduce surgical morbidity. You discuss this with your consultant who explains that the oncological efficacy and feasibility of a VATS approach for sublobar resection requires further evaluation. He asks you to review the literature on this topic.

SEARCH STRATEGY

Medline 1950 to January 2012 using the OVIDPubmed interface with results limited to English language articles: (Video-Assisted Thoracic Surgery OR VATS) AND (Sublobar resection OR segmentectomy OR limited resection) AND (Non-Small-Cell Lung Cancer
### Table 1: Best evidence papers

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schuchert et al. (2009), J Thorac Cardiovasc Surg [2] Retrospective cohort study (level 3)</td>
<td></td>
<td>225 patients with Stage 1 NSCLC (138 1A and 87 1B) underwent segmentectomy (104 VATS and 121 open)</td>
<td>Mean follow-up (months) (VATS 16.2 and open 28.2)</td>
<td>Overall recurrence (VATS 16.3% Open 24%)</td>
<td>Retrospective analysis may introduce a bias. Study performed at an institution with extensive VATS experience may limit general applicability. Longer mean follow-up in the open group. 2 perioperative deaths in the open group (0 VATS deaths).</td>
</tr>
<tr>
<td>Leshnower et al. (2010), Ann Thorac Surg, [3] Retrospective cohort study (level 3)</td>
<td></td>
<td>41 patients underwent segmentectomy (15 VATS and 26 open)</td>
<td></td>
<td>Length of stay (days) (VATS 3.5 ± 1.4 Open 8.3 ± 6.1)</td>
<td>Limitations: retrospective study, small numbers. Surgery performed for metastatic disease in 12 patients and benign disease in 4 patients. Inclusion of non-oncological diseases (i.e. aspergilloma and Wegner’s granulomatosis). There were two 30-day mortalities in the open group (0 VATS deaths).</td>
</tr>
<tr>
<td>Atkins et al. (2010), Ann Thorac Surg [4] Retrospective cohort study (level 3)</td>
<td></td>
<td>77 patients underwent segmentectomy (48 VATS and 29 open)</td>
<td></td>
<td>Length of stay (days) (VATS 4.3 ± 3 Open 6.8 ± 6)</td>
<td>Reduced length of hospital stay. Small study size. Retrospective analysis. Within the open thoracotomy group, 25% of cases were Stage 2B or greater.</td>
</tr>
<tr>
<td>Shiraiishi et al. (2004), Surg Endosc, [5] Retrospective cohort study (level 3)</td>
<td></td>
<td>59 patients underwent segmentectomy (34 VATS and 25 open)</td>
<td></td>
<td>Length of stay (days) (VATS 12.7 ± 3.6 Open 16.7 ± 7.7)</td>
<td>Operative time was significantly longer in the VATS group. Reduced length of stay for VATS group.</td>
</tr>
</tbody>
</table>
OR NSCLC OR lung cancer). Finally, a manual search was used to follow up on references from the retrieved studies.

**SEARCH OUTCOME**

Two hundred and thirty-two papers were returned using the reported search. From these, six papers were identified that provided the best evidence to answer the question. Manual searches of the reference lists permitted the inclusion of one more article. These are presented in Table 1.

**RESULTS**

Schuchert et al. [2] performed a retrospective analysis of 225 segmentectomy cases comparing VATS (n = 104) with open thoracotomy (n = 121) for Stage 1 NSCLC. Both groups were comparable for age, gender, disease staging and pulmonary function. Perioperative outcomes were similar in terms of operative time and blood loss; however, there were two mortalities in the thoracotomy group. The median hospital stay was significantly shorter for VATS patients (5 vs 7 days; P = 0.001) with a lower incidence of postoperative pulmonary complications in the VATS group (15.4 vs 29.8%; P = 0.012).

Levels of recurrence for the VATS and open groups were similar (16.3 vs 24%; P = 0.10) with no difference in recurrence-free (P = 0.996) or overall (P = 0.605) survival.

In 2010, Leshnower et al. [3] retrospectively reviewed 41 segmentectomy cases (15 VATS and 26 open). There were 9 NSCLC VATS resections and 14 NSCLC resections in the thoracotomy group. The patients were well matched for age, tumour size, comorbidity and pulmonary function. The authors report 0% morbidity within the VATS cohort, while 34.6% of the thoracotomy cases suffered postoperative complications. Length of stay was significantly shorter for thoracoscopic cases (VATS 2.8 ± 1.3 vs open 8.3 ± 6 days, P = 0.01) as was the duration of chest tube placement (VATS 2.8 ± 1.3 vs open 5.2 ± 3 days, P = 0.001). The authors have not published recurrence/survival data.

Atkins et al. [4] retrospectively reviewed 77 patients who underwent thoracoscopic segmentectomy (n = 48) and open thoracotomy (n = 29). Within the thoracoscopic group, 27 patients were treated for primary lung cancer compared with 12 from the thoracotomy group. These NSCLC groups were similar regarding age, smoking history and pulmonary function; however, they differed in their preoperative staging in that 95% of the VATS group were Stage 1, while 25% of the thoracotomy group were Stage 2B/3A (16.7 Stage 2B and 8.3% Stage 3A). The incidence of loco-regional recurrence was similar (VATS 7.7 vs open 8.3%, P = 1.0). Hospital

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**Table 1:** (Continued)

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospective, single-centre observational study (level 4)</td>
<td></td>
<td>Chest tube duration (days)</td>
<td>6 (3–21 days)</td>
<td>VATS feasible with low morbidity, 20% conversion to thoracotomy. No mortality</td>
</tr>
<tr>
<td></td>
<td>Highly selected cases</td>
<td>Postoperative complications</td>
<td>No complication: 15 Complication(s): 5</td>
<td>No thoracotomy group for comparison</td>
</tr>
<tr>
<td></td>
<td>Inclusion: proven/suspected clinical Stage 1 lung carcinoma</td>
<td></td>
<td></td>
<td>Highly selected cases</td>
</tr>
<tr>
<td></td>
<td>At least one strong argument against lobectomy and oncological dilemma</td>
<td>Conversion rate (%)</td>
<td>20% (to open) and 10% (to lobectomy)</td>
<td></td>
</tr>
<tr>
<td>Watanabe et al. (2009), Eur J Cardiothorac Surg [8]</td>
<td>41 patients underwent VATS segmentectomy</td>
<td>5-year survival</td>
<td>74.5 ± 9.3% (for all cases) 89.9 ± 7.1% (for Stage 1A cases)</td>
<td>Small retrospective study</td>
</tr>
<tr>
<td>Retrospective cohort study (level 4)</td>
<td>T1N0M0 peripheral NSCLC &lt;2 cm (n = 38)</td>
<td>Recurrence</td>
<td>No local recurrences</td>
<td>VATS segmentectomy is safe and efficacious. Lung function is preserved</td>
</tr>
<tr>
<td></td>
<td>NSCLC with interlobar invasion (n = 3)</td>
<td>4 cases of distant metastasis following VATS segmentectomy</td>
<td></td>
<td>Length of stay (days) not stated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chest tube duration (days)</td>
<td>3 (1–9)</td>
<td>Complications: atrial fibrillation (n = 2) and air leak (n = 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lymph nodes sampled</td>
<td>8 ± 2 (nodal stations dissected)</td>
<td>Mean follow-up 70 months. No local recurrence. Survival is not compromised</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conversion rate (%)</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

NSCLC: non-small-cell lung cancer; VATS: video-assisted thoracoscopic surgery; TT: totally thoracoscopic.
stay was significantly reduced for patients who underwent thoracoscopic rather than open surgery (4.3 ± 3 vs 6.8 ± 6 days; P = 0.03). The perioperative outcomes were comparable in terms of operative time, bleeding, lymph node sampling or duration of chest tube placement. There were two mortalities (6.9%) within 30 days of surgery in the thoracotomy group. Follow-up for ~30 months demonstrated increased overall survival for patients who underwent VATS segmentectomy.

In 2004, Shiraishi et al. [5] conducted a retrospectively study of the feasibility of VATS segmentectomy in comparison with standard thoracotomy. The operative time was significantly longer for VATS cases; however, the perioperative and postoperative outcomes were otherwise equivalent. The length of hospital stay was significantly reduced for VATS patients (~4 days). There was 100% recurrence-free survival in both cohorts; however, the follow-up period was relatively short.

Gossot et al. [6] demonstrated the efficacy of totally thoracoscopic anatomical segmentectomy in a group of 50 patients requiring sublobar resection. The cases included 25 clinically N0 NSCLC lesions, 16 benign and 9 metastatic lesions. The mean length of stay was 5.6 days (±2.4). Five patients experienced minor complications including mucous plugging (n = 2), air leak (n = 1), pneumothorax requiring chest drain insertion (n = 1) and ‘neurological disorder’ (n = 1). Witte et al. [7] performed an observational study demonstrating that VATS segmentectomy is a safe and efficacious procedure. The cases (n = 20) were proved or suspected Stage 1 lung cancer and all experienced an unremarkable postoperative course.

Watanabe et al. [8] studied 41 sublobar resection cases demonstrating the feasibility of VATS segmentectomy as a treatment for selected NSCLC patients. The cases included T1N0M0 peripheral NSCLC <2 cm (n = 38) and NSCLC with interlobar invasion (n = 3). The 5-year survival of the entire cohort and the Stage 1A group were reported as 74.5 (±9.3) and 89.9% (±7.1%), respectively. There were no cases of loco-regional recurrence; however, the authors report 4 cases of distant metastasis following VATS segmentectomy, brain (n = 2), lung (n = 1) and liver (n = 1).

**CLINICAL BOTTOM LINE**

We reviewed the available literature regarding VATS segmentectomy for Stage 1 NSCLC. A total of seven papers were chosen including four retrospective studies comparing VATS versus thoracotomy and three studies regarding the feasibility of VATS segmentectomy. Unfortunately, the anatomical locations of the segments removed were not available. For this reason, outcomes for VATS and open thoracotomy could not be examined by segment removed. The studies demonstrated that thoracoscopic segmentectomy is a feasible technique with at least equivalent levels of morbidity, recurrence and survival compared with open segmentectomy. Furthermore, several studies report significant differences in the length of hospital stay, postoperative complications and duration of chest tube placement, suggesting that in selected cases thoracoscopic segmentectomy may confer additional benefit to patients postoperatively compared with open segmentectomy.

**Conflict of interest:** none declared.

**REFERENCES**