Evaluation of video-assisted thoracoscopic surgery lobectomy requiring emergency conversion to thoracotomy

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Abstract

Objective: Video-assisted thoracoscopic surgery (VATS) lobectomy has been employed for the treatment of lung cancer. Many investigators have reported that the outcomes of VATS lobectomy for lung cancer are comparable to those of thoracotomy; however, several controversial issues remain. One of the critical concerns is the safety. VATS lobectomy often requires an emergency conversion to thoracotomy, for example, in the event of massive bleeding. In this study, cases in which VATS lobectomy for lung cancer was converted to thoracotomy intra-operatively (converted VATS lobectomy) were identified. The safety of the converted VATS lobectomy was evaluated.

Methods: Between 2003 and 2007, VATS lobectomy was converted to thoracotomy in 24 out of 492 cases. Information regarding the patients’ characteristics, reasons for the conversion and perioperative complications as well as the recurrence and survival data were carefully reviewed. The reasons for the conversion were classified into two groups: (1) problems related to the VATS procedure (VATS-related problems) and (2) problems not related to the VATS procedure (non-VATS-related problems).

Results: Of the 24 converted cases, 19 (79%) had a history of smoking. Nine patients (38%) had a history of lung disease. Left upper lobectomy was the most frequently associated with conversion (11/24, 46%), followed by right lower lobectomy and right upper lobectomy. The most frequent reasons for the conversion were hilar lymphadenopathy and bleeding (seven patients each), followed by fused fissure. Eight of the conversions were considered to be attributable to VATS-related problems. Perioperative complications were observed in four patients, consisting of prolonged air leak in three patients and transient recurrent laryngeal nerve palsy in one patient. However, there were no life-threatening complications. The median follow-up period was 26 months. Recurrence occurred in two patients: pleural dissemination in one and bone metastasis in the other. Two deaths were observed during the follow-up period: one related to lung cancer and another related to other type of cancer.

Conclusions: The safety of the conversion was acceptable. Our findings suggest that VATS lobectomy for lung cancer is feasible from the viewpoint of safety, even after taking into account the potential need for conversion to thoracotomy in some patients.

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Keywords: Video-assisted thoracic surgery; Complication; Thoracotomy; Lung cancer

1. Introduction

Video-assisted thoracoscopic surgery (VATS) was introduced nearly 20 years ago. Since then, there has been a rapid development in VATS techniques, especially for the treatment of benign lung diseases [1]. With the accumulation of experience for the treatment of benign diseases, VATS has gradually begun to be employed for radical resection of lung cancer [2,3]. Several investigators have reported that the outcomes of VATS lobectomy for lung cancer are comparable to those of thoracotomy [4—7]. While no large, controlled studies have been conducted to compare VATS with thoracotomy, it is now generally accepted that the outcomes of VATS are not inferior to those of thoracotomy. Another concern is the safety of VATS lobectomy. Subsequent to VATS lobectomy, perioperative complications and mortality have been reported to occur at the rates of approximately 5—32% and 0—7%, respectively; these rates are also generally accepted to be comparable to those reported for thoracotomy [4,5,8,9]. However, VATS lobectomy sometimes requires, for a variety of reasons, emergency conversion to thoracotomy. Therefore, it is also important to determine the safety of converted VATS lobectomy. In this study, cases of VATS lobectomy for lung cancer requiring conversion to thoracotomy intra-operatively were identified, and the reasons for the conversion and the perioperative complications were determined to evaluate the safety of converted VATS lobectomy.

2. Patients and methods

This study was conducted with the approval of our hospital’s internal review board. Cases encountered between 2003 and 2007 in which VATS lobectomy for lung cancer was converted to thoracotomy were identified. Partial resections...
and segmentectomies were excluded from the study. Information regarding history of lung disease, smoking history, type of operation, operation time, amount of intra-operative bleeding and perioperative complications as well as the recurrence and survival data were carefully reviewed. The reasons for the conversion to thoracotomy were also carefully reviewed and classified into two groups: (1) problems related to the VATS procedure that could potentially be overcome by thoracotomy (VATS-related problems) and (2) problems not related to the VATS procedure (non-VATS-related problems). For example, vessel injury during VATS that necessitated conversion was classified as a VATS-related problem, whereas dense hilar lymphadenopathy that necessitated conversion was classified as a non-VATS-related problem. Recurrence and survival data were collected in February 2008.

3. VATS lobectomy technique

Patients with c-stage I non-small-cell lung cancer are considered to be suitable candidates for VATS lobectomy, except for those with tumours over 5 cm in diameter. One-lung ventilation is used and the patient is placed in a lateral decubitus position. Two or three trocars are introduced for the thoracoscope and the instruments. Thereafter, a 4—8-cm access thoracotomy is placed anteriorly from the edge of the latissimus dorsi muscle in the fourth intercostal space for upper or middle lobectomy, and in the fifth intercostal space in the middle axillary line for lower lobectomy. As in thoracotomy, anatomical lobectomy and mediastinal lymph-node dissection are performed. We do not use a rib spreader; a silicon rubber self-expanding instrument is applied to open the wound and prevent chest wall closure.

4. Results

In total, 492 patients underwent VATS lobectomy for lung cancer between 2003 and 2007. Of the 492 patients, 24 (5%) required emergency conversion to thoracotomy. The patient characteristics of the 24 patients are listed in Table 1. Of the 24 patients, 19 (79%) had a history of smoking and nine (38%) had a previous history of lung disease, including emphysema, silicosis or old tuberculosis. Left upper lobectomy was the most frequently associated with conversion (11/24, 46%), followed by right lower lobectomy and right upper lobectomy. The most frequent reasons for conversion were dense hilar lymphadenopathy and bleeding (seven patients each), followed by fused fissure and lymph node metastasis (Table 2). The median operation time and median amount of bleeding were 260 min and 420 ml, respectively. Perioperative complications were observed in four patients, consisting of prolonged air leak in three patients and transient recurrent laryngeal nerve palsy in one patient. However, there were no life-threatening perioperative complications or perioperative mortality. The median follow-up period was 26 months. Recurrence occurred in two patients: pleural dissemination in one and bone metastasis in the other. Two deaths were observed during the follow-up period: one related to lung cancer and another

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Patient characteristics.</th>
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<tbody>
<tr>
<td>Male/female</td>
<td>16/8</td>
</tr>
<tr>
<td>Age</td>
<td>Median 69 (53—80)</td>
</tr>
<tr>
<td>Smoking history</td>
<td>Yes 19 No 5</td>
</tr>
<tr>
<td>Coexistent lung disease</td>
<td>Emphysema 6 Silicosis 2 Old tuberculosis 1 No 15</td>
</tr>
<tr>
<td>Tumour size (cm)</td>
<td>Median (range) 2.0 (0.8—4.1)</td>
</tr>
<tr>
<td>c-stage</td>
<td>IA 17 IB 7</td>
</tr>
<tr>
<td>Surgery</td>
<td>Left upper lobectomy 11 Left lower lobectomy 2 Right upper lobectomy 4 Right middle lobectomy 1 Right lower lobectomy 6</td>
</tr>
<tr>
<td>Histology</td>
<td>Adenocarcinoma 18 Squamous cell carcinoma 6</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Table 2</th>
<th>Reasons and outcomes of the converted cases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for the conversion</td>
<td>Hilar lymphadenopathy 7 Bleeding 7 Fused fissure 4 Lymph node metastasis 1 Others 5</td>
</tr>
<tr>
<td>Operation time</td>
<td>Median (range, min) 260 (145—462)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Median (range, ml) 420 (75—1550)</td>
</tr>
<tr>
<td>Perioperative complication</td>
<td>No 20 Yes 4 Prolonged air leak 3 Recurrent laryngeal nerve palsy 1</td>
</tr>
<tr>
<td>Recurrence</td>
<td>No 22 Yes 2 Dissemination 1 Bone metastasis 1</td>
</tr>
<tr>
<td>Alive</td>
<td>22 Dead 2 Lung cancer-related 1 Other cancer-related 1</td>
</tr>
<tr>
<td>VATS-related problem</td>
<td>No 16 Yes 8 Vessel injury 7 Anatomic abnormality 1</td>
</tr>
</tbody>
</table>
related to other type of cancer. Of the 24 conversions, eight were attributable to VATS-related problems (seven with vessel injury and one with anatomical abnormality).

5. Discussion

We started VATS lobectomy for lung cancer in 1998. Since then, approximately 70% of all lobectomies have been performed by using VATS techniques. These techniques have gradually changed and improved over the years. In the first 5 years, the conversion rate was 8%, whereas over the next 5 years, the conversion rate decreased to 5%, which is presented in this study. These results suggest that the accumulation of experience improved the surgical team’s skill, allowing them to avoid and/or manage problems, resulting in a reduced conversion rate. On the other hand, these results also suggest that there remains a patient population in which VATS lobectomy is difficult to perform. It is generally accepted that dense hilar lymphadenopathy, pleural symphysis and fused fissure make VATS lobectomy difficult. In this study, 11 of the 24 conversions were necessitated by hilar lymphadenopathy or fused fissure. In all of the 11 cases, the results of the conversion were reasonably acceptable.

In this study, VATS-related problems were defined as those which might be overcome by thoracotomy. However, it was difficult to draw a clear line between VATS-related and non-VATS-related problems. Of the eight VATS-related problems, vessel injury accounted for seven; however, in most of these seven cases, there was also dense adhesion around vessels. In such cases, dissection of vessels was generally difficult and the risk of vessel injury and bleeding was high even by thoracotomy. It was very difficult to determine whether these vessel injuries were VATS-procedure-related problems; however, in the study, vessel injury was uniformly classified as a VATS-related problem without considering the patients’ background. Therefore, the risk of conversion of VATS lobectomy might be overestimated.

It remains controversial as to whether VATS lobectomy is justified for lung cancer patients with lymph node metastasis [10]. Watanabe et al. reported that the outcomes of VATS lobectomy were comparable to those of thoracotomy in clinical N0 but postoperative pathological N2 patients [11]. However, until now, it is generally considered that patients with lymph node metastasis are not suitable candidates for VATS lobectomy [12,13]. In one case, lymph node metastasis was suspected intra-operatively and VATS lobectomy was converted to thoracotomy.

One of the advantages of VATS lobectomy is the magnified visualisation it affords. Magnified visualisation is very useful for dissecting vessels or identifying small bleeders. However, this advantage could also turn into a disadvantage in some cases; in one of the left upper lobectomy cases, the left superior and inferior pulmonary vein formed a large common pulmonary vein. Where the superior pulmonary vein was supposed to branch off, the inferior pulmonary vein was ligated without noticing the common pulmonary vein. This case was converted to thoracotomy and the inferior pulmonary vein was reconstructed. With thoracotomy, such problems do not usually occur, since thoracotomy provides a wider-operation field of view and it would have probably been noticed in this case that the pulmonary veins formed a common trunk. VATS not only affords a different field of view, but also requires a different technique from thoracotomy. It is important to understand these differences of VATS and perform the surgery skilfully.

The decision for conversion is left to each surgeon’s skills and patience. It is difficult to establish any guideline for the conversion; however, our approximate timing of the decision for conversion is as follows. In cases with bleeding, a sponge stick is first applied for tamponade. Once the bleeding is controlled, a decision about whether or not the repair can be performed under VATS is made. When the bleeding cannot be controlled or repair seems to be difficult under VATS, conversion to thoracotomy is considered. In cases with fused fissure or dense hilar lymphadenopathy, if the pulmonary artery cannot be isolated, conversion is considered. Several investigators have reported conversion rates of 2—14% [5,14—16]. The reported conversion rates vary depending on the investigator. One explanation for this could be differences in the patients’ backgrounds. Some studies limited the application of VATS to stage I disease, while others extended it to more advanced disease. VATS lobectomy for advanced disease is more difficult and may be associated with a higher conversion rate. At our institution, VATS lobectomy is performed basically for c-stage I disease and our conversion rate was 5%, although there were no life-threatening perioperative complications or perioperative deaths. These results suggest that our conversion rate may be reasonable and acceptable, compared to other studies. We do not intend to attempt decreasing the conversion rate, as this might delay the timing of conversion and increase the risks. The first objective of the operation is to perform a safe and complete resection. Once problems appear, repair takes a longer time and the risks are increased. It is important not only to plan safe manoeuvres to avoid problems, but also to have the courage to convert, if there is any sense of discomfort experienced by the surgeon with VATS.

Long-term outcome is another important parameter to evaluate the safety and feasibility of converted VATS lobectomy. In this study, two patients had recurrence (pleural dissemination and bone metastasis), and one patient died of lung cancer. The number of patients in our study and the follow-up period were not sufficient to reasonably evaluate the long-term outcomes. Jones et al. recently reported that the long-term outcome of converted VATS lobectomy for lung cancer was equivalent to that of successful VATS lobectomy [17]. Although this was not described in this study, the median operation time, amount of bleeding and perioperative complication rate in successful cases of VATS lobectomy during this study period were 164 min, 144 ml and 6%, respectively. The operation time, amount of bleeding and perioperative complication rate in the converted VATS lobectomy cases were 260 min, 420 ml and 17% (4/24), respectively, all of the values greater than the corresponding values in the successful VATS lobectomy cases. However, there were no life-threatening perioperative complications (including pneumonia) or perioperative mortality. In addition, the mean postoperative duration of oxygen supplementation and postoperative hospital stay...
were 2 days and 12 days, respectively, in the converted VATS lobectomy cases, while they were 2 days and 10 days, respectively, in the successful VATS lobectomy cases. These results suggest that while the invasiveness of the surgery may be greater in the case of converted VATS lobectomy than in that of successful VATS lobectomy, it may have no influence on the short- and long-term outcomes.

In conclusion, in 24 patients (5%) out of a total of 492, VATS lobectomy was converted to thoracotomy. The most frequent indications for the conversion were hilar lymphadenopathy and bleeding. There were no life-threatening complications or perioperative mortality. VATS lobectomy is feasible for lung cancer surgery even from the viewpoint of the safety rate of converted VATS. This study suggests that VATS lobectomy is a safe procedure and a suitable alternative option for lung cancer surgery.

References