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Complete video-assisted thoracoscopic surgery lobectomy and its learning curve. A single center study introducing the technique in The Netherlands

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Abstract

Data regarding the benefits for the complete video-assisted thoracic surgery (c-VATS) lobectomy over the open lobectomy are numerous. This article describes the experience of introducing this technique in a training hospital, the first reported cohort in The Netherlands. From March 2006 to November 2008, all patients operated on for proven or suspected lung cancer were analyzed. Prospective data from these patients were evaluated. A subgroup analysis for the c-VATS lobectomy is presented. A total of 184 operations were performed on 172 patients. In 122 (66.3%) of the operations the resection ended in a lobectomy of which 70 were done by complete thoracoscopic procedure. For the c-VATS lobectomy the mean operating time was 179 min, with a mean blood loss of 444 ml. The median hospital stay was four days. Complications were present in 10% of c-VATS lobectomies. No mortality was seen in the c-VATS group. After thorough evaluation and training, c-VATS lobectomy is a safe procedure that can be performed in a relatively low volume hospital. It has exceptional short-term benefits. For training purposes all operations must start thoracoscopically. All patients must be operated according the intention to treat method.

Keywords: Thoracoscopy/VATS; Lobectomy; Lung cancer surgery; Education

1. Introduction

Complete video-assisted thoracic surgery (c-VATS) lobectomy has not yet been widely accepted. Due to the positive results known from published data the c-VATS lobectomy was introduced in our hospital [1–4]. On 9 March 2006, the first c-VATS was performed. It was also the first reported c-VATS lobectomy in The Netherlands [5].

The purpose of this article is to share this experience with other surgeons who want to perform the c-VATS lobectomy. The learning process and curve, the selection criteria, suitability rate and the results of the first 70 cases of c-VATS lobectomy are described.

2. Material and methods

2.1. Learning and training

After thorough preparation, 10 open chest thoracoscopic lobectomies were performed. Gradually the procedure was performed completely thoracoscopically.

All patients were operated on by the same team of two dedicated surgeons.

2.2. Indications

All consecutive patients operated upon in the period March 2006 until November 2008 with proven or suspected lung cancer were included. The data are collected prospectively.

The type of resections were wedge resection, (bi) lobectomy and pneumonectomy. Each patient was categorized preoperatively as a possible candidate for the c-VATS lobectomy. Our criteria were tumor size > 5 cm, central location and/or growth into surrounding tissue. If a patient was suitable for c-VATS, we labeled this situation intention to VATS (IV), in order to distinguish them from the intention to thoracotomy (IT). The latter patients were started thoracoscopically solely for instructive reasons, and a conversion was anticipated.

2.3. Procedure

The complete thoracoscopic lobectomy is performed in the manner that is described by Demmy et al. [6]. An epidural catheter is placed. After double lumen intubation the patient is positioned in lateral position. A 30° thoroscope is placed in the 8th midaxillary intercostal space, two trocars are placed anteriorly and posteriorly. A 4–5 cm utility incision in the ventral axillary line above the specific
lobe is made. Spreading of the ribs is not performed. Dissection starts with lobe specific lymph node sampling. An anatomic dissection is performed with individual stapling of the pulmonary vein, artery, bronchus and fissure by using a 45-mm long, six rows linear endostapler with tissue specific fillings (Ethicon Endo-Surgery, Norderstedt, Germany). The specimen is extracted in an endobag. In the first 20 patients we used the Endo Catch (Autosuture, Covidien, Mansfield, UK) which was replaced by the Lapsac endobag (Lapsac, Cook Medical, Limerick, Ireland). The bronchus staple line is examined for leakage. Afterwards the dissection site is sprayed with a fibrin sealant (Tissucol, Baxter AB, Vienna, Austria). A single 20 Ch chest tube is inserted. Postoperatively all patients are admitted at the ICU for overnight observation. The chest tube is removed the next morning. The Visual Analogue Scale (VAS) scores are documented for the first four days.

3. Results

3.1. Patients

In the study period from March 2006 to November 2008, 172 patients underwent surgery. The total number of operations was 184 (Table 1). Wedge resections were performed because of metastatic disease (n=22), for diagnostic purposes in suspicious lesions (n=21), or for non-small cell lung cancer (NSCLC) in patients with limited pulmonary function (n=5).

The reasons that the operation started primarily by thoracotomy were: large or centrally located tumor (n=14), prior surgery (n=2), invasion in adjacent structures (n=11), pancoast tumor (n=1), urgent surgery (n=2), expected thoracoscopically undetectable tumor (n=1) and the c-VATS team was not complete (n=4). In two cases the tumor was not resectable.

In 96 patients the operation was started thoracoscopically (Fig. 1). Of these, 69 patients were categorized as IV and 27 patients as IT.

In eight (29.6%) patients of the IT group a c-VATS lobectomy unexpectedly could be performed. These eight patients were categorized as not suitable for c-VATS because of size of the tumor > 6 cm (n=4), central location (n=2), suspected growth into adherent lobe (n=1) and lymph node dissection (n=1).

3.2. Conversion to thoracotomy

Seven IV patients (10.1%) had to be converted to an open thoracotomy. These patients represent the ‘real’ conversions. In one patient the reason for conversion was due to an unexpected positive mediastinal lymph node in station 8. A radical lymph node dissection had to be performed.

Table 1

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of procedures (172 patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>184 (100%)</td>
</tr>
<tr>
<td>Wedge resection</td>
<td>48 (26.1%)</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>122 (66.3%)</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>12 (6.5%)</td>
</tr>
<tr>
<td>Open and shut thoracotomy</td>
<td>2 (1.1%)</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Lobe</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right upper</td>
<td>17</td>
</tr>
<tr>
<td>Right middle</td>
<td>3</td>
</tr>
<tr>
<td>Right lower</td>
<td>16</td>
</tr>
<tr>
<td>Left upper</td>
<td>20</td>
</tr>
<tr>
<td>Left lower</td>
<td>12</td>
</tr>
<tr>
<td>Right middle and lower</td>
<td>1</td>
</tr>
<tr>
<td>Right middle and upper</td>
<td>1</td>
</tr>
</tbody>
</table>

Two patients could not tolerate single lung ventilation. On three occasions the hilus could not be visualized safely. Finally, in one patient there was bleeding that could not be controlled thoracoscopically.

3.3. The c-VATS patients

In 70 patients a c-VATS lobectomy was performed. Thus, from all our lobectomies done in the study period 57.4% (70 out of 122) were suitable for c-VATS. There was an increase in suitability rate for the last 20 operations compared to the first 50 c-VATS lobectomies (74.1% vs. 52.3%). There were 42 men (60%) and the mean age of the patients was 65.6 years (range: 41–85).

The locations of the tumors are presented in Table 2. Postoperative specimens showed in 63 patients (90%) NSCLC, in one patient (0.7%) small cell lung cancer (SCLC), in three patients (4.3%) a metastasis of colorectal origin and in three patients (4.3%) a benign tumor. Postoperative staging for the NSCLC group is presented in Table 3. Intra-operative bloodloss of these patients ranged from 50 to 2500 ml with a mean of 444 ml and a median of 400 ml. The amount of blood loss in rank of the consecutive c-VATS lobectomies is represented with a trendline in Fig. 2.

The mean operating time for the c-VATS group was 179 min (range: 60–540 min) with a median of 150 min. The operating time in rank of the consecutive c-VATS lobectomies is depicted in Fig. 3. The last 20 lobectomies included 122 patients. In 48 patients (26.1%) a wedge resection was performed. In 122 patients (66.3%) a lobectomy was performed. In 12 patients (6.5%) a pneumonectomy was performed. In 2 patients (1.1%) an open and shut thoracotomy was performed.
Table 3
Staging c-VATS lobectomy postoperatively

<table>
<thead>
<tr>
<th>Stage</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>31</td>
</tr>
<tr>
<td>IB</td>
<td>26</td>
</tr>
<tr>
<td>IIA</td>
<td>1</td>
</tr>
<tr>
<td>IIB</td>
<td>2</td>
</tr>
<tr>
<td>IIIA</td>
<td>2</td>
</tr>
<tr>
<td>IIIB</td>
<td>1</td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
</tr>
<tr>
<td>M1 (colorectal)</td>
<td>3</td>
</tr>
<tr>
<td>Benign</td>
<td>3</td>
</tr>
</tbody>
</table>

c-VATS, complete video-assisted thoracic surgery.

were performed with a mean operating time of 142 min (range: 60–210) and a median of 141 min.

The VAS score was mistakenly not documented in four patients. The first postoperative day, 84.8% (56 out of 66) of the patients scored no to very slight pain (0–2 score). On day 3, when 79% of all patients did not receive an epidural anymore, 95.5% of these patients scored 0–2 points.

The median hospital stay was 4.0 days with a mean of 5.7 (range: 1–18). Thirty-nine (55.7%) were discharged within 5 days postoperatively and 10 (14.3%) on day 5. The median hospital stay for the open lobectomies was 8 days (range: 4–68 days) with a mean of 12 days.

3.4. Mortality

From all 184 operations, five patients died in the hospital of which three patients died within 30 days postoperatively. One patient died on day 10 due to asystoly and two patients due to a myocardial infarction (23 days after an IT lobectomy and 25 days after a primary open bi-lobectomy).

There were no mortalities in the c-VATS patients, including the converted IV patients.

3.5. Morbidity

In the c-VATS group the following intra-operative complications are noted. In three patients there was tumor spill, one due to rupture of the endobag and one while putting the lobe into the endobag. In the third patient manipulation of the lobe was the reason for tumor spill. Another problem was rib fractures occurring due to specimen extraction and manipulation of the trocars.

The seven early postoperative complications are shown in Table 4.

4. Discussion

The term video-assisted thoracic surgery lobectomy may lead to confusion as described by Shigemura [7]. Even then there is a wide variability of practice [8]. We therefore
prefer to use the adjective complete. A c-VATS means that the whole procedure is done under indirect vision by looking on the monitor without rib spreading.

In c-VATS lobectomy the procedure is often new for most lung surgeons. It will be valuable for the surgical team if there is experience in conventional lobectomies as in minimal invasive surgery. Of all preparations, (re)visiting a specialized center has proven to be most valuable. In the beginning the operations are physically and psychologically demanding. The operation time ranged from 6 to 8 h.

From a technical point of view a striking difference between open and c-VATS resections is that in c-VATS the whole procedure runs from anterior to posterior. Besides, in open surgery the vascular structures are identified and controlled often before the fissure is transected. However, in c-VATS, dissection of the fissure by the endostapler is part of the identification and controlling of the other structures.

The most feared intra-operative complication is uncontrollable bleeding. Although on one occasion significant bleeding forced us to conversion, five others could be controlled thoracoscopically. Simple compression with a sponge stick is often sufficient. In contrast to the generally practiced minithoracotomy, in c-VATS the ports are placed on different strategic places. This makes introduction of instruments and bleeding control relatively easy. Several publications show significant intra-operative bleeding only occurring in <1% of cases [2].

A critical point widely discussed in publications is the oncological efficacy of the c-VATS procedure. There are many studies showing the same or even better long-term results for patients with stage I and II NSCLC operated with c-VATS compared to historical data [2, 4, 9–11]. Trocar site recurrence has been reported, but in a large study by McKenna et al. he observed this in 0.2% of cases [2]. There is no difference in loco-regional control as shown by Shiraiishi et al. [12].

The lymph nodes can easily be removed. Only dissection of the subcarinal lymph nodes in upper and middle lobe resections remains challenging. One of the advantages of c-VATS is that suspected mediastinal lymph nodes can be assessed, indicating neo-adjuvant therapy. Our real conversion rate of 10.1% corresponds with published data [13].

Several studies demonstrated that c-VATS lobectomy is associated with less postoperative pain and a faster recovery after the operation leading to fewer complications [14]. Again, although we did not have a control group, this study confirmed these observations. Both the short hospital stay as well as the low VAS pain scores were impressive.

By performing 25–30 c-VATS lobectomies yearly we demonstrated that it is possible to learn the technique and to reproduce the favorable results known from earlier publications [15].

Data from The Netherlands Cancer Registry show that in The Netherlands in the period 2001–2005 a total of 4353 lobectomies, thus, 911 yearly, were performed. With a suitability rate of 57.4% this means that every year ~500 patients are suitable for c-VATS resections. These patients are treated in one of the 80 hospitals certified to perform lung surgery. A minimal amount of hospitals will have enough patients yearly to learn and to uphold the skills for this technique.

5. Conclusions

In performing 70 c-VATS lobectomies in a 31-month period we were able to learn the technique and to confirm the beneficial short-term outcomes mentioned in literature.

Although c-VATS lobectomy is, in our opinion, suitable for every dedicated lung surgeon, the learning curve is substantial. The reason is not primarily the alleged problems such as, control of intra-operative bleeding and proper oncological care, but because the technique is new for all the surgeons involved. It is challenging to learn the correct sequence of the resection. Every operation for operable lung cancer must start thoracoscopically. The reason is three-fold. Extra training is obtained, information of the tumor and the extent is gathered during the scopic part of the operation. And finally, certain patients might unexpectedly be suitable for c-VATS.

As can be concluded from these data, the number of lobectomies needed yearly to learn and uphold the skills can be obtained by a minimal amount of specified hospitals in The Netherlands. Therefore, concentrating patients in certain hospitals is crucial so that more patients can benefit from this technique.

References


