Video-assisted thoracoscopic major pulmonary resections

Technical aspects, personal series of 259 patients, and review of the literature

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Received: 5 February 2004/Accepted: 8 July 2004/Online publication: 13 October 2004

Abstract

Background: Although more than 10 years have passed since the first video-assisted thoracoscopic lobectomies, these procedures have not gained widespread acceptance. We discuss the technical aspects and major problems associated with these operations, focusing on their present status and future perspectives. The results of our clinical series are presented and the relevant literature is reviewed.

Methods: From October 1991 to June 2003, 344 patients were submitted to surgery for an intended video major pulmonary resection.

Results: Of the 344 patients, seven (2.0%) were deemed inoperable at video exploration; 78 (23.1%) required conversion, either for technical reasons (n = 3), anatomical problems (n = 49), oncological conditions (n = 20), or intraoperative complications (n = 6). We carried out 253 video-assisted lobectomies and six pneumonectomies (209 for primary lung tumor, 43 for benign disease, and seven for metastases). There were no intraoperative deaths. Two patients died postoperatively. Complications occurred in 20 patients (7.7%). Global survival at 3 and 5 years was 83.24% (± 6.9) and 68.87% (± 9.7), respectively. Patients with T1 N0 cancer had a better survival rate at 3 and 5 years (87.13 ± 8.3% and 75.12 ± 12.2%) than those with T2 N0 cancer (78.49 ± 11.2% and 61.2 ± 15%).

Conclusions: Based on our experience and a review of the literature, we conclude that video-assisted thoracoscopic surgery (VATS) - Lobectomy - Minimally invasive surgery - Lung cancer - Thoracoscopy

Major pulmonary resections (lobectomies and pneumonectomies) are still considered the most difficult operations that can be achieved thoracoscopically. The initial experiences were reported in the proceedings of a very crowded First International Symposium on Thoracoscopic Surgery, as published in the Annals of Thoracic Surgery [5, 17]. Ten years later, the technical difficulties, inadequate instrumentation, concern for intraoperative accidents and oncological radicality, as well as the difficulties inherent in teaching and learning these procedures, are the factors that still limit the acceptance of these operations. During these years, many surgeons have sporadically performed video-assisted thoracoscopic pulmonary resections; however, these operations are performed routinely only in few centers worldwide [3, 8, 9, 14, 17]. Do thoracoscopic lung resections have a scientific validity and consequently a future? or are they merely the experimental expression of advances in a new kind of technology that needed to show its utmost possibilities?

Every type of operation initially entails a range of learning and training stages. This is even more true in the case of pulmonary lung resections, which require long training and a wide experience in both conventional and thoracoscopic surgery. Technical difficulties, conversion rates, and complications during and after these operations gradually decrease as the operator's series increases.

The progressive increase in our clinical series, as well as that of other authors, has enabled us to review and evaluate the technical aspects and major problems encountered in the performance of video-assisted tho-
rascoscopic major pulmonary resections. The preliminary follow-up results for lung cancer and future possibilities for this kind of surgery are also evaluated.

Materials and methods

At our department, 2,534 video-assisted thoracoscopic operations were performed from October 1991 to June 2003. A total of 344 patients with pulmonary diseases underwent operation for an intended video-assisted thoracoscopic major pulmonary resection: 278 patients had a lung tumor, 68 patients had benign disease, and seven patients had lung metastasis. There were 259 males patients and 85 females patients. The average age was 68.5 years; the youngest was an 11-year-old girl and the eldest an 83-year-old man.

As for any open procedure, preoperative assessment of cardiorespiratory function, bronchoscopy, and precise conventional staging of the tumor is carried out. All candidates for a thoracic operation are always submitted to a video-assisted thoracoscopic inspection as the first step of the procedure. Through thoracoscopy the surgeon can decide whether the resection can be carried out entirely through a video-assisted thoracoscopic approach or whether a traditional open procedure is required. In case of cancer, video-assisted thoracoscopy also ensures a more precise staging.

Indications

Since the beginning of our experience, we have limited video endoscopic major pulmonary resections to patients with the following indications:

a. Primary lung neoplasm at cTNM stage I. The criteria for selecting these patients were as follows:

1. Peripheral T1 N0 and T2 N0 cancer < 3 cm in diameter;

2. No intrabronchial tumor or bronchoscopic evidence of infiltration of the lobar bronchi;

3. No atelectasis;

4. No evidence of infiltration of the parietal pleura during video-assisted thoracoscopic exploration.

b. Inflammatory disease (bronchiectasis, tuberculosis) and congenital anomalies (arteriovenous fistula, pulmonary sequestration).

c. Benign tumors (carcinoid, amartoma, bronchial adenoma).

d. Pulmonary metastasis that is located too deep within the parenchyma or too near the hilum to be removed by wedge resection.

Indications for thoracoscopic pneumonectomy have been limited to:

a. The presence of two simultaneous primary parenchymal tumors in different lobes of the same lung.

b. A parenchymal malignant tumor measuring < 3 cm that appears to infiltrate the fissure at high-resolution CT and at video-assisted thoracoscopic exploration.

In case of lung cancer, all enlarged or suspect lymph nodes discovered during the video operation are sent for immediate frozen-section examination. If the response is positive, the intervention is converted to an open procedure, no matter which phase of the operation had been reached.

Technique

Thoracoscopic resection follows the same surgical technique as a conventional pulmonary resection. The patient is intubated with a double-lumen Carlen's tube and is placed in lateral decubitus as for a classic posterolateral thoracotomy. Two monitors are placed on each side of the patient's head. A 10-mm trocar for the optics is inserted in the 7th or 8th intercostal space on the midaxillary line. Two—or exceptionally three—additional ports are usually inserted under video control, their position depending on the site of the lesion and the type of operation required.

Lysis of adhesions and a thorough exploration of the pleura cavity are carried out. Complete mobilization of the lung is essential to enable the assessment of the feasibility of an endoscopic resection. In lung cancer, these maneuvers accomplish a veritable surgical staging procedure to evaluate the feasibility of a thoracoscopic or thoracotomy resection [18].

The arteries, veins, and bronchi are then isolated and sectioned separately with a mechanical endoscopic stapler [16, 17, 22]. Isolation of vascular elements must be more accurate and extensive than in conventional surgery to enable the positioning of straight mechanical staplers.

Major pulmonary resections entail the creation of an additional incision to withdraw the specimen at the end of the operation. This small-3 to 5-cm incision is performed anteriorly between the midclavicular and anterior axillary lines. In female patients, the position of this incision is marked preoperatively along the inframammary fold for cosmetic reasons. The rib spreader is applied only during the retrieval of a particularly large specimen, thus preventing protracted pressure on the intercostal nerve, which often causes remarkable postoperative pain. The deflated specimen is usually easily extracted, provided that some precautions are taken. The specimen should not be extracted by grasping it at the hilum, because the bronchial branching with its dependent increase in size would wedge the removed parenchyma in the small thoracotomy incision. It is much better to grasp a lateral edge close to the tumor with a Duval forceps and extract the tumor first so that greater traction can be applied safely on the remaining parenchyma. The lung is then engaged and extracted with swinging movements. Neoplasms located deep within the parenchyma give no risk of seeding. On the contrary, when the tumor is superficial, protection of the edges of the wound is mandatory. We usually insert the specimen in a large plastic bag whose margins are extracted through the wound and opened to protect the incision. The resected parenchyma is then grasped within the bag and slipped simultaneously out of the bag and of the thorax.

Results

According to the indications criteria, of 344 patients who underwent surgery for an intended video-assisted thoracoscopic resection, in seven patients with lung cancer preoperatively staged as T1 N0 (four patients) and T2 N0 (three patients), thoracoscopy revealed unsuspected causes of inoperability; six patients had pleural carcinomatosis without pleural effusion; and one had mediastinal infiltration. Of the remaining 337 patients, 78 (23.1%) required conversion to open surgery. Conversion was due to technical or anatomical problems in 58 patients (74.4% of conversions) and to oncological problems in 18 (25.6%). The causes of conversion are detailed in Table 1. The operation was completed thoracoscopically in 259 cases. These consisted of 253 lobectomies and six pneumonectomies. The different operations performed are listed in Table 2. In 1996, we decided to discontinue the performance of thoracoscopic pneumonectomies, because acceptable indications are extremely rare and questionable [20].

Histology ascertained primary lung neoplasm in 209 patients (80.7%), benign pathologies in 43 patients (16.6%), and lung metastases in seven patients (2.7%) (Table 3). Histology of the operative specimen in patients with lung cancer confirmed preoperative stage I 174 patients (96 T1 N0 and 78 T2 N0), but it revealed unsuspected pathological lymph nodes in 35 patients (N1 in 28 and N2 in six cases).

We recorded two postoperative deaths (0.7%), which were due respectively, to rupture of the heart on the 15th postoperative day after a myocardial infarction and to contralateral pneumonia on the 33rd postoperative day.