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THE ROLE OF VIDEO-ASSISTED THORACIC SURGERY IN PATIENTS WITH LUNG CANCER

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Video-assisted thoracoscopic surgery has been introduced recently for the management of a variety of thoracic tumors. This study presents the most recent results, indications and limitation of this method in patients with lung cancer.

Unitermos: *Cirurgia torácica. Videoassistência. Neoplasia pulmonar.*
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Introduction

Lung cancer is a frequent malignancy with more than 170,000 new cases diagnosed in 1996, and 156,000 deaths from the disease during the same year. Most patients are still admitted to medical attention with advanced disease, locally or systemic. Recently, a new staging system was introduced to better define the extension of the disease, and direct in a more uniform and efficient way the strategies for treating every patient. A small percentage of patients are diagnosed to have early lung cancer (stage Ia, Ib, IIa, and IIb): those patients have the best outcome, and the more defined therapeutic approach. Most centers agree that patients with early disease are better treated by surgical resection. The standard operation for lung cancer is lobectomy (or pneumonectomy) with mediastinal lymph node dissection. Patients with locally advanced disease are treated with either operation and adjuvant therapy (chemo - or radiation), or by exclusive chemotherapy and radiation therapy. Systemic disease, as well as lung cancer with pleural dissemination, are usually treated with chemotherapy alone.

The introduction of minimally invasive surgery, with video-assisted technology, opened new horizons in the treatment of patients

Acta Oncol. Bras. Vol. 20 - nº 03, 110-113, jul-ago-set, 2000

with thoracic malignancies. The role of videothoracoscopy in the management of lung cancer patients has been evaluated and defined recently. Controversies are still encountered over specific situations and indications. Tumor biology, evolving technology and limitations of VATS are extensively discussed nowadays for thoracic oncology, and more specifically for lung cancer.

VATS has several likely indications in the management of lung cancer: diagnosis, staging, and resection.

Diagnosis

Most lung cancer patients present with extensive tumors, centrally located, producing a variety of symptoms. Few patients, however, are diagnosed with small peripheral tumors, usually asymptomatic. The proper diagnosis of solitary pulmonary nodules is crucial in order to offer the most effective treatment for individual patients. Estimated incidence of primary lung cancer in solitary nodules is 37%. The incidence increases with age and with smoking habits of the patient. On the other hand, patients with lung cancer diagnosed as a solitary peripheral lung nodule usually have the best outcomes following proper treatment. It becomes imperative to accurately determine the histology of the nodule while it is still small, and potentially curable. Several studies have evaluated the effectiveness of non-invasive methods to detect and diagnose malignancy in lung nodules. The best predictor of benign nodule is the comparison of previous chest radiograms, with the nodule remaining unchanged for more than two years. Computed tomography of the chest presents 40% false negative results for malignancy, by evaluating morphology and presence of calcification. Cytology can be determined by sputum analysis or bronchoscopy: accuracy ranges from 5% to 26%, and from 20% to 30%, respectively, for peripheral pulmonary nodules. In most cases, percutaneous transthoracic needle biopsy, guided by fluoroscopy or by CT scan, provides accurate diagnosis of the lesion, with high sensitivity (90%), but low specificity rates (77%). Nonspecific benign diagnosis indicating absence of malignant tumor cells is responsible for the majority of misleading and false negative results. Surgical resection is usually indicated for indeterminate nodules, as well as for malignant tumors. For that reason, most centers limit the indication of guided percutaneous needle biopsy to patients with high risk for operation, or in patients who are reluctant to be submitted to surgery. With the introduction of video endosurgery, with fewer trauma and postoperative complications, a more liberal indication for resection of a pulmonary nodule for diagnosis. Usually the lesions suitable for VATS resection are subpleural. The lung is deflated under general anesthesia, and three intercostal incisions are performed, with their exact location determined by the anatomical site of the nodule. The video camera is usually introduced through the seventh intercostal space, in the midaxillary line, which provides adequate visualization of most of the pulmonary parenchyma. The other ports are usually located on either sides of the imaginary line parallel to the thoracoscope. The instruments should be introduced in an angle of 90°, allowing for comfortable and adequate intracavitary manipulation and operative procedures. After thorough inspection of the lungs and of the pleural cavity, the lesion is visualized and excisional biopsy is performed. The parenchyma surrounding the nodule is secured and lifted with a grasping endosurgical instrument, and an endoscopic stapler is introduced. Resection of lung tissue including the nodule is performed by stapling a V or U shaped wedge fragment. The surgical specimen is placed in a protecting retrieval bag (or sterile surgical gloves) before removal through the intercostal incision. This maneuver would decrease the likelihood of contaminating the incision with tumor cells from the specimen. While the surgical pathologist is performing frozen section studies on the excised specimen, the surgeon should verify the integrity of the sutured pulmonary parenchyma, and the absence of significant bleeding or air leak from the suture line. The pleural cavity is drained with the placement of chest tube (usually a single tube attached to under-water seal), the lung is inflated, and the chest incisions are closed. Recently, a study evaluated 301 patients submitted to thoracoscopic excisional biopsy for the diagnosis of solitary lung nodule. The accuracy of VATS biopsy was 97%, with minimal postoperative pain, or significant complications.

Pulmonary nodules that are located deep in the pulmonary parenchyma, not visible from the surface, may present some difficulties for the endoscopic resection. Several techniques have been introduced to facilitate the localization of the lesions: 1) extending one of the port incisions in order to introduce a finger and palpate the lung. This maneuver could be performed also by pulling the lung towards the surgeon's finger by and endosurgical grasping clamp. 2) endoscopic ultrasound. 3) Dye injection into the parenchyma adjacent to the lesion (usually guided by CT scan). 4) J-wire hook placed in the lesion, with fluoroscopic or CT scan guidance.

Staging

Whenever a lung cancer is diagnosed, it is crucial to determine the extension of the disease, the resectability of the primary tumor, and the absence of occult tumor spread that would indicate a specific treatment strategy. Routine staging procedures vary considerably between medical centers around the world. Thorough clinical evaluation, with complete history and physical examination, along with CT scan of the chest and upper abdomen, are usually included in most standard evaluations, for asymptomatic patients. Brain CT scan and bone scintigraphy are still controversial, although some studies showed the advantage of performing those tests, for the potential avoidance of unnecessary operation. Even in centers that include all the above mentioned tests in their routine evaluation of lung cancer patients, 10% to 15% of operations are still incomplete resections due to intrathoracic spread of tumor cells, or to unsuspected tumor invasion of vital organs in the mediastinum. Every non-invasive method have been tested in order to reduce the rate of exploratory thoracotomy, with no significant impact. Mediastinoscopy and anterior mediastinotomy (Chamberlain) are usually performed to evaluate tumor extension into mediastinal lymph nodes (ipsilateral N2 or contralateral N3 disease). This procedure is limited in its capacity to evaluate direct mediastinal invasion by tumor.

Acta Oncol. Bras. Vol. 20 - nº 03, 110-113, jul-ago-set, 2000

Despite most extensive assessment modalities, some patients are still submitted to thoracotomy with unresectable or metastatic disease.

VATS was recently introduced in the evaluation and treatment of lung cancer patients. Small incisions, low trauma stress, good visualization of intrathoracic organs, capacity for surgical procedures and resection of virtually any organ in the chest, made this surgical technique very attractive for patients with lung cancer. VATS is a good staging option to thoroughly evaluate locoregional extension, as well as determine resectability in lung cancer. It allows for extensive evaluation of the pleura, parietal and visceral, the mediastinal lymph nodes, including pretracheal, subcarinal, and inferior paraesophageal lymph nodes (mediastinoscopy does not reach the latter nodes). Whenever there is a suspicion of mediastinal invasion, careful dissection of the hilum, and of the mediastinal structures provides important information about the resectability, as well as the feasibility of lobectomy. Tumor infiltration of the fissure, the main bronchus, or the pulmonary arteries would preclude patients unfit for pneumonectomy from an unnecessary thoracotomy. A recent study in 155 patients with lung cancer submitted initially to videothoracoscopic staging resulted in a significant decrease in exploratory thoracotomy rate (2,6%), compared to 12% with no VATS staging in the same institution.

Resection

The technological progress, recently witnessed by thoracic surgery, of videothoracoscopy has made it possible to perform most operations conventionally carried on through a formal thoracotomy, with direct visualization of the pleural cavity, the lungs and the mediastinum. A number of reports have been published recently describing cases of patients submitted to pulmonary resections, regardless of the underlying disease (benign or malignant processes), indicating the feasibility of lobectomy, pneumonectomy or segmentectomy, assisted by a videothoracoscope. Some authors advocate the advantages of lower morbidity when compared to open thoracotomy. It is clear now, that most, if not all operations usually performed by conventional thoracic surgery, are possible with video-assisted thoracic surgery, although technically more demanding, and time-consuming in some situations. The major question that remains unanswered is the clear correlation between feasibility of VATS resection of lung cancer, and adequacy of that resection related to oncologic principles and cure rates. Selection of patients candidates for each procedure is still being evaluated, with many controversies remaining in this field.

Most thoracic surgeons believe that videothoracoscopic major resections should be limited to patients staged preoperatively to have T1N0 and T2N0 tumors (Stages Ia and Ib). There is , however, controversy around the proper approach to the primary lung cancer and to mediastinal lymph nodes in those selected patients. Locally advanced tumors should not routinely be treated by VATS. Those opinions are usually discussed in all meetings dealing with lung cancer. Careful evaluation of the information available at the present time should orient the indication of VATS or open thoracotomy in every case, regardless of selection, until new evidence suggests other treatment strategies.

Stages I and II tumors are confined to lung parenchyma, with no mediastinal lymphatic or hematogenous spread, and with no evidence of invasion of adjacent organs. They represent a very localized disease, and consequently with the higher chances of cure form lung cancer. Surgical treatment is usually indicated for patients clinically fit for the operation. Lobectomy or pneumonectomy are the standard procedures for this stage. Complete treatment of lung cancer includes detailed assessment of margens, as well as status of mediastinal lymph nodes. Lymphadenectomy is indicated not only for complete removal of diseased lymph nodes, but also to completely stage regionally the patient. Complete mediastinal lymph node disection should be performed regardless of the extension of lung resection. The extent of ideal disection is still unclear. Few centers perform lymph node sampling, while others recommend thorough and complete mediastinal disection. Izbicki et al evaluated in a prospective study the role of systematic mediastinal lymphadenectomy in staging of lung cancer patients, compared to lymph node sampling. Identification of lymph node metastases at various levels was more efficient with complete disection, which correlates directly with prognosis. Patients admitted to the Department of Thoracic Surgery, Hospital AC Camargo are submitted to complete mediastinal lymph node dissection, regardless of the extent of lung resection. A retrospective study at our Department evaluated the role of lymphadenectomy on overall survival showed significant benefit, when compared with patients submitted to simple lung resection associated to sampling of suspicious mediastinal lymph nodes.

Patients with NSCLC submitted to complete resection and confirmed hisologically to be stage I have a good prognosis, with overall five-year survival rate of 65% to 87% (67% at Hospital AC Camargo). Martini et al evaluated the results of treatment of 598 patients with stage I NSCLC at Memorial Sloan-Kettering Cancer Center. T1 lesions were seen in 49% of cases. Overall survival rate was 82% for T1N0, and 68% in T2N0 ($p < 0,0004$). Recurrence rate was 27%, with 74% of all recurrences at distant sites. Extent of lung resection for the primary lesion was a significant factor for survival: 77% five-year survival rate with lobectomy or pneumonectomy, compared to 59% in wedge resection or segmentectomy.

Limited resection of lung primary tumors has been performed as a surgical option for patients with clinical limitation for lobectomy. Five-year survival rates vary between 33% and 52% (lower than lobectomy or pneumonectomy), and local recurrence rate increased to 12%-19%. Operative mortality rates ranged from 1% to 3%. Controversy persists when the patient presents with a small peripheral nodule, and is clinically fit for any operative procedure.

A study showed that tumors > 3 cm present with N1 disease in 38% of cases, while tumors 1,1 cm to 2 cm present with 17% N1. Patients with tumors < 1 cm have rarely identified intralobar N1. The authors suggest that tumors > 1 cm should be treated with wide resections (lobectomy or more), while minimal resections indicated only for the rare tumors < 1 cm (5% of all lung cancer cases).

A retrospective study in 308 patients with NSCLC tumors < 3 cm in diameter. Although they present with small tumors, 22 patients had N1 disease, 49 were pathologically IIIa, 15 IIIb, and 13 stage IV. Hilar lymph node involvement was identified in 30 patients.

Acta Oncol. Bras. Vol. 20 - nº 03, 110-113, jul-ago-set, 2000

A prospective randomized study recently published compared limited resection to lobectomy in 247 patients. Local recurrence rate was 6,6% following lobectomy, significantly lower than limited resection (16,8%). Table 1 shows the results of limited resection in NSCLC.

It becomes obvious, from the data presented, that limited resection for lung cancer is a compromise operation, only indicated for patients with limited health conditions that are not fit for a formal adequate complete resection, that includes nowadays lobectomy or pneumonectomy and mediastinal lymph node dissection. The issue of VATS resection of lung cancer should be addressed from the point of view of oncologic principles, and not from the technical difficulties eventually encountered during an operation. The thoracic oncologist should never sacrifice a complete and adequate (to our current standards) operation for a more fashionable or cosmetically attractive incision, mainly for patients with the most curable stages of lung cancer, stages I and II! If extensive lymph node dissection of the mediastinum is a more adequate operation (most medical reports worldwide indicate mediastinal lymphadenectomy as a superior operation, compared to lymph node sampling), the thoracic surgeon should not be tempted to perform a lesser operation (lymph node sampling), through a videothoracoscope, unless he routinely does the same operative procedure during a conventional open thoracotomy.

Table 1. Results of limited resection in the treatment of NSCLC - T1/T2

Author	year	n	Local recurrence rate (%)	Five-year survival rate (%)
Bennett	1978	44	40,0	36
McCormack	1980	53	19,3	35
Errett	1985	100	—	69
Miller	1987	32	6,2	31
Read	1990	107	4,4	70
Wain	1991	164	5,0	46
Temeck	1992	61	9,0	29
Warren	1993	74	21,6	50
Ginsberg	1994	123	17,5	70
Martini	1995	64	22,6	59

On the other hand, if the thoracic surgeon is capable and trained to perform lobectomy, and/or pneumonectomy, with mediastinal lymph node dissection, with the same meticulous technique as in open thoracotomy, by VATS techniques, he/she should indicate either operation, and there should be no significant differences between them in relation to outcome and recurrence rates. In fact, few studies have shown the feasibility of minithoracotomy, with no videothoracoscopic assistance, for lung cancer. The size of the incisions (or ports) is irrelevant as long as the surgeon performs a complete oncologic resection of the primary tumor. However, there are no long-term prospective randomized studies comparing VATS to open thoracotomy in adequately balanced lung cancer population, with adequate complete resection (not compromise surgery), to evaluate morbidity, mortality, local recurrence, and overall survival rate. Until we clearly show equal or superior results with VATS, thoracic surgeons should be very cautious whenever they indicate a videothoracoscopic resection for lung cancer.

Resumo

A videotoracoscopia tem sido indicada com freqüência progressivamente maior como abordagem cirúrgica em pacientes com tumores torácicos. O presente estudo apresenta o estado atual das indicações deste método, sua aplicação em câncer de pulmão, e os resultados obtidos até a presente data.

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