Exploratory Thoracotomy for Nonresectable Lung Cancer*

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We sought to evaluate the effect of new diagnostic modalities on patients explored surgically for inoperable lung cancer. From July 1983 to February 1992, 335 patients underwent thoracotomy for lung cancer. Thirty-three of the 35 patients with nonresectable disease had sufficient data for analysis and underwent chest radiography (CXR), CT scan, and bronchoscopy. The study was terminated when video-assisted thoracoscopy (VAT) was introduced at the institution. Causes of nonresectability included significant N₂ disease not diagnosed preoperatively (n=11), tumor invasion of contiguous mediastinal structures (n=8), and insufficient pulmonary function (n=4). Four patients were left with unresected disease because of thoracic metastasis. Two patients had technically unresectable disease; three patients were explored surgically because diagnoses could be obtained by no other means. One patient was found to have small cell cancer. Data analysis demonstrated that 19 of 33 thoracotomies could potentially have been avoided or resulted in resection with current techniques. Refinement of imaging criteria, a judicious surgical approach to N₂ disease, and VAT may significantly reduce thoracotomies for nonresectable lung cancer.

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Key words: lung neoplasm; thoracoscopy; thoracotomy

Complete resection is the best therapy for non-small cell lung cancer, but many patients present with unresectable cancers. Five to 50% of patients are found to have a cancer that, due to extent of disease or magnitude of the procedure, is unresectable at thoracotomy.

Newer methods of preoperative evaluation of patients with lung cancer and improved imaging modalities have changed the population of patients undergoing surgical exploration for lung cancer. The impact of these methods on the patient population explored surgically for lung cancer and found to have unresectable disease is as yet unknown. To evaluate this question, we reviewed our patient population surgically explored for nonresectable lung cancer in the recent era.

**Material and Methods**

All patients undergoing exploratory thoracotomies for lung cancer between July 1983 and February 1992 were identified in the thoracic surgery operative records. The charts of those patients surgically explored without resection were examined for demographics, symptoms, and preoperative assessment (hematocrit, liver function studies, spirometric testing, chest radiograph [CXR], CT, bronchoscopy, cervical mediastinal exploration [CME], and anterior mediastinal exploration [AME]). Operative findings, reasons for unresectability, and postoperative morbidity and mortality were recorded. Additional therapy and long-term follow-up were also noted.

All patients had a CXR and chest CT. Chest radiography consisted of a posteroanterior and lateral chest film. The CT scan of the chest involved serial images through the chest, down through the adrenal glands at 1-cm intervals with intravenous contrast administration. Mediastinal lymph nodes were considered positive if they were greater than 1 cm in their short axis diameter. Cervical mediastinal exploration, AME, or both were performed when mediastinal lymph nodes larger than 1 cm were identified on CT scans or when otherwise clinically indicated by proximity of the tumor to the mediastinum. All radiologic studies were reviewed independently by a radiologist. Pulmonary clinic charts and phone calls provided follow-up data.

**Results**

During the study period, 335 patients underwent thoracotomy for primary lung cancer, of whom 300 (89.6%) proved to have resectable disease. Of the 35 patients with unresectable disease, 33 charts had sufficient data available for review and formed the database for our review.

The study comprised 28 men and 5 women ranging in ages from 45 to 72 years with a mean age of 58.5 years.

The most common symptoms were cough, hemoptysis, and pain. Five were asymptomatic, and 14 patients had multiple symptoms. The mean FEV₁ was
Table 1—Additional Studies

<table>
<thead>
<tr>
<th>Modalities Performed</th>
<th>No. of Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic resonance imaging*</td>
<td>4</td>
</tr>
<tr>
<td>Liver spleen scan</td>
<td>2</td>
</tr>
<tr>
<td>Abdominal CT</td>
<td>3</td>
</tr>
<tr>
<td>Ventilation perfusion scan</td>
<td>6</td>
</tr>
<tr>
<td>Bone scan</td>
<td>12</td>
</tr>
<tr>
<td>Exercise test</td>
<td>2</td>
</tr>
<tr>
<td>CME</td>
<td>13</td>
</tr>
<tr>
<td>AME</td>
<td>7</td>
</tr>
</tbody>
</table>

*No gadolinium enhancement.

2.31 ± 0.78 L.

All 33 patients underwent bronchoscopy. Erythema was found in three, endobronchial tumors in six, bleeding in one, and external compression in three patients. Tissue diagnosis was obtained in nine, either by brushings, washings, aspiration, or biopsy. In no patient did the bronchoscopic findings prove nonresectability. An additional 8 patients had needle biopsy diagnosis of cancer such that a total of 17 patients had a preoperative diagnosis of cancer. Additional studies are shown in Table 1. Causes for nonresectability are shown in Table 2.

N2 Disease

Eleven patients were found to have nonresectable disease at surgical exploration because of significant N2 disease. None of these 11 patients had a normal mediastinum on CXR. Computed tomography showed evidence of mediastinal adenopathy in six patients and no evidence of mediastinal adenopathy in five. All patients with a positive CT scan underwent CME or AME. In five cases, suspicious nodes were not found. In one, nodes were suspicious for malignancy, but no histologic diagnosis was obtained.

Local Invasion

Eight patients had nonresectable disease because of local tumor invasion. The tumor invaded the aorta in three, the superior vena cava in one, the esophagus in one, and the vertebral body in three patients. Chest radiography in the patients revealed potential nonresectability in five. Computed tomographic scan showed evidence of invasion of contiguous mediastinal structures in six, but the findings were insufficient to preclude surgical exploration.

Poor Pulmonary Function

Four patients had nonresectable disease because of poor pulmonary function. The extent of resection needed at surgery was greater than anticipated, and would have resulted in unacceptable residual pulmonary function. Their respective FEV1.5 were 1.32 L, 1.74 L, 1.89 L, and 2.00 L. These patients had ventilation perfusion scans prior to surgery. In the patient with an FEV1 of 1.89 L, the side of the pneumonectomy represented 60% of the ventilation and perfusion rendering the patient to have nonresectable disease. The patient with an FEV1 of 2.0 L was 72 years old with diffuse coronary artery disease and an ejection fraction of 27%. He had had two previous strokes and had chronic renal failure. It was believed that the patient would not survive a pneumonectomy. All four patients were explored surgically with the intent of performing a lobectomy. At surgery, a pneumonectomy would have been required to resect the tumor.

Intrathoracic Metastases

Four patients were left with unresected disease because of significant metastases in the thorax. These included one patient with metastasis on the diaphragm, two in the pleura, and one in the ribs. Chest radiography and CT scan showed no evidence of these metastases preoperatively. Magnetic resonance imaging in two patients did not reveal any evidence of these metastases.

Miscellaneous

Two patients had technically unresectable disease. The patients had significant adhesions from previous surgery. Hemorrhage was significant, and it was believed the patients would not survive continued surgical exploration. In three patients, preoperative evaluation showed that the patients had a nonresectable mass but a diagnosis could not be confirmed without thoracotomy. One patient suspected of having non-small cell cancer preoperatively was found to have a small cell cancer at surgical exploration.

Adjuvant Therapy

Three patients were treated with preoperative and postoperative chemotherapy. Twenty-seven patients had postoperative radiation therapy. Two patients had combined modality therapy, and one had no therapy.

Follow-up

There were no postoperative deaths. Postoperative morbidity is shown in Table 3. Twenty-six patients
had complete follow-up. Seven could not be located after their 6-week clinic visit. Survival ranged from 5 to 48 months. Six patients are still alive, two with local regional disease and four with distant metastases. Survival analysis is shown in Figure 1.

**DISCUSSION**

Exploratory thoracotomy for nonresectable cancer is a morbid procedure that yields no benefit to the patient in terms of longevity or palliation.\(^2\)\(^,\)\(^4\)\(^,\)\(^5\) The goal of thoracic surgeons should be to eliminate such procedures. It was hoped that improved imaging modalities such as CT and magnetic resonance imaging would contribute to this goal.\(^5\) The additional use of video-assisted thoracoscopy (VAT) and a more aggressive approach to positive mediastinal adenopathy found at surgery\(^6\)\(^,\)\(^7\) should further reduce the number of such patients.

Our study time frame was chosen such that, at its initiation, the institution had sufficient experience to use the CT reliably and frequently. The study was terminated just prior to the introduction of VAT as a diagnostic modality at our institution. In addition, in 1992, our department started to resect routinely lung cancers in patients with limited ipsilateral mediastinal nodal disease. Thus, this review should accurately demonstrate the effect of newer imaging modalities on the patient population with nonresectable lung cancer. Further, analysis of the causes of nonresectability should suggest the effect that the use of VAT and a more aggressive surgical approach will have on this population.

Our nonresectability rate was 10.4%. While the data are not available from previous years at our institution, this percentage is in concurrence with other series published in the literature.\(^2\)\(^,\)\(^6\) The major causes for nonresectability in our series, N2 disease, local invasion, poor pulmonary function, and intrathoracic metastases have also been reported by others.\(^2\)\(^,\)\(^6\)

N2 disease was the most common reason for nonresectability in our patients. This is not the case in other reports.\(^2\)\(^,\)\(^6\) This probably is due to our policy of not having patients with N2 disease undergo resection during the first 8 years of this study. Presently, we have started resections in patients with favorable N2 disease.\(^6\)\(^,\)\(^8\) This should result in a decrease of such patients who undergo surgical exploration but not resection. In this group, five patients had a normal findings from mediastinal exploration. One had a suspicious CME, but a malignant histologic diagnosis was not confirmed. Video-assisted thoracoscopy may serve to make a diagnosis in such patients.

Tumor invasion of local mediastinal structures was a cause for nonresectability in eight patients. The inability of CT to distinguish tumor invasion vs adhesions, inflammatory reaction, or necrosis is well documented in the chest and mediastinum in various structures.\(^6\) Inability to evaluate the extent of the tumor was also the cause of nonresectability in four patients whose pulmonary function could not support the greater than expected resection needed to remove the tumor. Based on our present experience with VAT, this modality could not have definitively ruled out resectability in these patients, and these thoracotomies were unavoidable with present-day technology.

Four patients did not have resectable disease because of intrathoracic metastases. While these metastases were not detectable by available CT, even in retrospect, they would clearly be found by thoracoscopy. Such thoracotomies should be eliminated in the future.

In our miscellaneous group, three patients had potentially diagnosable conditions without thoracotomy. Two of these patients had lesions too deep to diagnose with VAT and represent unavoidable thoracotomies.

There was no operative mortality in this series; however, the significant morbidity in this terminal population demonstrates the wisdom of avoiding such thoracotomies. Survival analysis shows no difference between our population from others reported with inoperable lung cancer.\(^9\)

Our analysis shows that with a more aggressive surgical approach to N2 disease and the use of VAT

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**Table 3—Morbidity**

<table>
<thead>
<tr>
<th>Cause</th>
<th>No. of Patients</th>
</tr>
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<tbody>
<tr>
<td>Hemoptysis</td>
<td>2</td>
</tr>
<tr>
<td>Collapsed lobe</td>
<td>1</td>
</tr>
<tr>
<td>Bronchial plug</td>
<td>1</td>
</tr>
<tr>
<td>Persistent air leak</td>
<td>1</td>
</tr>
<tr>
<td>Atypical chest pain requiring multiple visits to pain clinic</td>
<td>1</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 1.** Survival of patients with unresectable lung cancer.
in the diagnostic evaluation, up to 19 of our 33 thoracotomies could potentially have been avoided or resulted in resection. Clearly, at least 11 of our 33 would have fallen into this category. Based on the data in this study, we recommend that VAT be performed to avoid thoracotomy of nonresectable lung cancer in the following situations: (1) when the CXR and CT scan yield conflicting data on the mediastinum; (2) when CME and AME do not yield evidence of nonresectability despite a suspicious finding on radiographic examination; (3) when the extent of resection is unclear in a patient with limited pulmonary reserve; (4) when there is radiographic evidence of invasion of a nonvascular or nongastrointestinal adjacent structure in the chest; (5) when there is laboratory evidence of distant metastases without histologic confirmation; and (6) when there is radiologic evidence of nonresectability but a tissue biopsy specimen cannot be obtained.

By applying these criteria for using VAT, the burden of additional procedure will not increase substantially. Used with these guidelines, VAT will be a high-yield procedure to reduce thoracotomies for nonresectable lung cancer. To date, resectability rates and patterns of nonresectability have not been affected by new imaging modalities. However, with a more aggressive surgical approach to mediastinal adenopathy and appropriate use of VAT, a significant reduction of unnecessary thoracotomies may take place in the near future.

REFERENCES