Laparoscopy: An Important Tool in the Staging of Malignant Pleural Mesothelioma

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Background: The current standard for the noninvasive staging of patients with malignant pleural mesothelioma is computed tomography (CT). However, CT often cannot determine whether a tumor is unresectable because of direct extension through the diaphragm to the peritoneal cavity. The aim of this prospective study was to determine whether laparoscopy detected transdiaphragmatic tumor extension when CT findings were equivocal.

Methods: From June 1993 to July 1994, 12 of 36 patients considered for possible thoracotomy and surgical resection had equivocal CT findings of diaphragmatic invasion. All underwent laparoscopy using a multiport technique with diaphragmatic and peritoneal biopsies.

Results: The mean operative time was 83 min. There were no perioperative complications. The median hospital stay was 1 day. Six patients had biopsy-proven transdiaphragmatic extension, or peritoneal studding of tumor. The other six patients subsequently underwent thoracotomy: three had a complete resection, and three had unresectable tumor due to chest wall (N = 2) or mediastinal (N = 1) invasion. In no case was transdiaphragmatic extension of a tumor seen.

Conclusions: This preliminary experience demonstrates that laparoscopy is a safe and accurate method for detecting transdiaphragmatic tumor extension when CT fails to do so. Laparoscopy should be considered a standard part of prethoracotomy staging in this subset of patients.

Key Words: Laparoscopy—Mesothelioma—Staging.

Malignant pleural mesothelioma (MPM) is an uncommon neoplasm with a poor prognosis (1). Approximately 2,000 new cases occur annually in the United States and most patients die within 2 years of diagnosis. However, during the past 10 years the incidence of this disease has increased and the natural history, biology, and treatment of MPM are now under active investigation (2). Accurate radiographic and clinical staging are essential to evaluating novel treatment strategies in prospective clinical trials, especially when surgical resection is being considered.

The current standard for the noninvasive staging of patients with MPM is contrast-enhanced, dynamic, computed tomography (CT) of the chest and abdomen (3,4). Compared with plain radiography, CT is more accurate in delineating the extent of disease (5,6). However, the low spatial resolution and relatively poor tissue characterization of CT limit the evaluation of chest wall or diaphragmatic invasion, mediastinal nodal involvement, and intraperitoneal disease (7). Reduced spatial resolution in the longitudinal axis is particularly problematic in evaluating transdiaphragmatic extension of tumor. Despite the ability to scan in the coronal and sagittal planes, magnetic resonance (MR) imaging has not proven better than CT in detecting the transdiaphragmatic extension of tumor (8).

In recent years, we have found laparoscopy to be highly accurate in staging upper gastrointestinal malignancies (9,10). For example, laparoscopy accurately determined resectability in 94% of patients with peripancreatic tumors, markedly decreasing
unnecessary exploratory laparotomies in this group (10). This experience prompted us to ask whether laparoscopy could assess transdiaphragmatic extension of MPM in patients in whom the CT findings of diaphragmatic extension were indeterminate.

**MATERIALS AND METHODS**

Patients who had biopsy-proven MPM and in whom a thoracotomy and resection was planned underwent laparoscopy if CT examination of the chest or abdomen did not clearly show the depth of diaphragmatic tumor, and extension into the peritoneal cavity could not be excluded.

Laparoscopy was performed with patients under general anesthesia, and with use of a multiport technique (Fig. 1). The patient was placed supine on the operating table. A warming blanket was used to maintain normal body temperature. An "open" surgical technique for carbon dioxide insufflation was used as described previously (10). A 30° angled telescope was used. Further metallic trocars (Surgiport, U.S. Surgical Corp., Norwalk, CT, USA) were inserted under direct vision. A 10-mm trocar was inserted in the midline below the xiphoid process. Depending on the site of the primary tumor, another 5-mm trocar was placed in the right or left upper quadrant. The peritoneal cavity was examined and, if present, adhesions were divided. The patient was placed in 40° of reverse Trendelenburg position with 10° of lateral tilt to the side opposite to the primary tumor. For right-sided tumors, a PEER retractor (Jarit Instruments, Hawthorne, NY, USA) was used to retract the liver, allowing exposure of the right hemidiaphragm. The spleen was mobilized by dividing lienophrenic ligament to obtain exposure for lesions on the left side. Peritoneal and diaphragmatic biopsies were obtained.

Demographic information, surgical and pathological findings, operative complications, and length of hospital stay were recorded in a prospective database. Comparisons between groups were made by log-rank analysis and the Fisher exact test.

**RESULTS**

Between June 1993 and July 1994, 36 patients with MPM were seen by a single surgeon (VWR) and were considered to have potentially resectable tumors. Of these, 12 had equivocal CT findings of diaphragmatic extension or intraabdominal disease and underwent laparoscopy.

All patients were male. The mean age was 66 years (range 51–78 years). The primary tumor was located in the right side of the chest in six cases and in the left in six cases. No patient had abdominal symptoms. Eight patients (67%) had previously undergone an abdominal operation for diseases unrelated to MPM.

All patients had contrast-enhanced, dynamic CT scans of the chest and abdomen. Transdiaphragmatic extension was suggested in five patients (Fig. 2A and B). The remaining patients had bulky tumor that involved the diaphragm to an indeterminate depth without clear indication of peritoneal spread (Fig. 3). MR imaging was performed in six cases (50%). Transdiaphragmatic extension was suspected in four of these cases (Fig. 4).

The mean operative time for laparoscopy was 83 min (range 35–160 min). This included the time for intraoperative frozen sections on the biopsies performed. All patients resumed a normal diet on the night of the operation. There were no perioperative complications and the median hospital stay was 1 day.

Six patients had either biopsy-proven, transdiaphragmatic extension of tumor or peritoneal seeding (Fig. 5). The remaining six patients subsequently underwent thoracotomy. Three had resection of

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**FIG. 1.** Schematic representation of port placement for staging laparoscopy in patients with MPM.