Video-Assisted Thoracic Surgery (VATS) for Children with Pulmonary Metastases from Osteosarcoma

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Background: Video-assisted thoracic surgery (VATS) may complement open thoracotomy in children with osteosarcoma requiring pulmonary metastasectomy.

Methods: The records of children with metastatic pulmonary osteosarcoma considered for initial VATS intervention (n = 9) were reviewed.

Results: Two children did not have VATS exploration: one child with multiple bilateral nodules and another child with a deep parenchymal nodule. VATS provided diagnostic biopsy material in all cases when used (n = 7). Two children had benign inflammatory lesions; four children had VATS-directed wedge resections of solitary malignant lesions; and one child had VATS biopsy of diffuse parenchymal and pleural pulmonary disease not amenable to resection. The mean operative time and hospital length of stay were 1.78 ± 0.54 h and 3.5 ± 1.8 days, respectively. There were two complications of VATS: bleeding in a child, requiring a transfusion, and a latent pneumothorax in a patient after removal of the chest tube.

Conclusion: VATS is safe, serves as an excellent diagnostic modality, complements the open thoracotomy, and may enable the surgeon to avoid more extensive procedures in selected cases.

Key Words: Thoracoscopy—Metastases—Lung—Children.

Improved chemotherapy and the resection of pulmonary metastasis have led to improved survival in children with osteosarcoma (1,2). Use of video-assisted thoracic surgery (VATS) in adults for lobectomy, pericardiectomy, resection of pulmonary metastases, and the removal of mediastinal tumors has been well documented (3-11). The initial experience with thoracoscopic techniques suggests that video-assisted endoscopic surgery may have a role in pediatric surgical oncology as a diagnostic, staging, and therapeutic tool (12). We hypothesize that VATS can be used as a complement to open thoracotomy (i.e., lateral thoracotomy or median sternotomy) in present combination protocols for treating children with metastatic osteosarcoma. Assessing its feasibility, we reviewed our early experience with VATS in the evaluation and treatment of children with pulmonary metastases from osteosarcoma.

METHODS

Patients

From August 1992 to January 1995, VATS was considered an initial diagnostic procedure in selected patients. The records of nine children with metastatic pulmonary osteosarcoma treated during this study period were reviewed (Table 1). The site of the primary tumor was femur (five), tibia (three), or humerus (one). The mean age was 15 years (range, 9 to 21 years); the gender distribution was five boys and four girls.

Initial management

Before a limb-sparing resection of the primary tumor, patients were treated with two cycles of in-
### TABLE 1. Procedures on patients with pulmonary metastases from osteosarcoma

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yr)</th>
<th>Pulmonary nodules</th>
<th>Disease-free interval (mo)²</th>
<th>Bilateral metastases</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>1 (left)/4 (right)</td>
<td>0</td>
<td>Yes</td>
<td>VATS/T</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>1</td>
<td>21</td>
<td>No</td>
<td>VATS</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>1</td>
<td>14</td>
<td>No</td>
<td>VATS</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>Diffuse³</td>
<td>2</td>
<td>Yes</td>
<td>VATS (pleural biopsy)</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>No</td>
<td>VATS</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>No</td>
<td>T</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>1</td>
<td>27</td>
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</tr>
<tr>
<td>8</td>
<td>18</td>
<td>15</td>
<td>0</td>
<td>Yes</td>
<td>MS</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>1</td>
<td>35</td>
<td>No</td>
<td>VATS</td>
</tr>
</tbody>
</table>

MS, median sternotomy; T, thoracotomy; VATS, video-assisted thoracic surgery.

² Interval (in months) from the time of the diagnosis of the primary tumor to the discovery of pulmonary metastases.

³ Lesions in the left and right hemithorax, respectively.

Diffuse parenchymal and pleural lesions.

traarterial cisplatin and intravenous doxorubicin (Adriamycin). After resection of the primary tumor, additional cycles of intravenous cisplatin and doxorubicin were administered for a total of six cycles of chemotherapy. Children were followed up by interval physical examination, radionuclide bone scan, and chest computed tomography (CT) for evidence of recurrence or metastatic spread.

Since 1992, children with pulmonary metastatic osteosarcoma in whom there was control of the primary disease without evidence of metastatic deposits were considered for initial VATS exploration or open thoracotomy. Indications for VATS included children with peripherally placed nodules, singular or few in number and amenable to biopsy; pleural-based CT findings; and the presence of atypical lesions. When nodules were deep in the pulmonary parenchyma or multiple and bilateral and thought unamenable to VATS exploration, an open thoracotomy was the initial procedure.

**VATS surgical technique**

Procedures were performed under general anesthesia with a double-lumen endotracheal tube or bilateral intermittent manual ventilation. CO₂ insufflation was not used to achieve pulmonary collapse in the performance of thoracoscopic procedures.

Patients were placed in a lateral decubitus position, prepped, and draped as for the standard open thoracotomy. Operative ports were chosen, based on the location of the principal nodule, to allow triangulation of the instrumentation and maintenance of in-line orientation with the surgeon, lesion, and video monitor.

Commonly, the camera port was placed at the midaxillary line at the level of the eighth intercostal space. Instrument ports were placed at the fifth intercostal space anterior axillary line and at the same level along the scapular line immediately caudal to the inferior angle of the scapula.

Intraoperatively, the presence of metastatic nodules was determined by local effacement of the pulmonary parenchyma. Digital palpation through a trocar site or through a limited thoracotomy (i.e., an incision <5 cm) provided confirmation of the presence of the nodule when the nodule was not visualized. Biopsies were performed by simple wedge resections by using an Endo-GIA 30 stapler. Hemostasis was obtained by using electrocautery. Specimens too large to extract through the trocar site were delivered through a limited thoracotomy. A chest tube was placed in selected patients after conclusion of the procedure if multiple biopsies were taken and an airleak was suspected. If no air leak was suspected, then the thoracic cavity was aspirated at the conclusion of the case through a trocar site, and a chest tube was not placed.

**RESULTS**

The mean disease-free interval, defined as the time from resection of the primary tumor to the identification of pulmonary metastases, was 8.6 ± 10 months (range, 0–35 months). The mean number of nodules in patients in the VATS study group was 3.1 ± 4.9 (range, 1–15). VATS-directed resection (n = 5), VATS-directed pleural biopsy (n = 1), lateral thoracotomy (n = 2), and median sternotomy (n = 1) were procedures used for diagnostic biopsy or pulmonary metastasectomy. Video-assisted thor-