Chest Wall Reconstruction using Gore-Tex® Dual Mesh

Tadashi Akiba, MD, PhD, FACS,1 Hideki Marushima, MD,1 Hiroko Nogi, MD, PhD,2 Noriki Kamiya, MD, PhD,2 Satoki Kinoshita, MD, PhD,1 Hiroshi Takeyama, MD, PhD, FACS,2 and Toshiaki Morikawa, MD, PhD2

Purpose: This study aimed to evaluate the clinical outcomes of chest wall reconstruction using a relatively new expanded polytetrafluoroethylene prosthesis Gore-Tex® dual mesh.

Methods: We reviewed charts of 11 patients who underwent bony chest wall resection from April 2006 to January 2011.

Results: Six patients underwent three ribs resection, three patients underwent two ribs resection, and the other two patients underwent sternal resection. Of six patients after three ribs resection, three underwent reconstruction using 2 mm Gore-Tex® dual mesh, one using Gore-Tex®, one using Bard composite E/X, and the remaining one used no prosthesis. Three patients who underwent two ribs resection underwent no chest wall reconstruction using prosthesis. Two patients who underwent sternal resection underwent chest wall reconstruction using dual mesh with or without a vascularized musculocutaneous pedicle flap. Immediate postoperative extubation was performed in all patients, except one who was extubated the following day. No postoperative deaths or cases with paradoxical respiration occurred.

Conclusion: Chest wall reconstruction using Gore-Tex® dual mesh demonstrated acceptable durability.

Keywords: dual mesh, chest wall tumor, sternal tumor

Introduction

Gore-Tex® dual mesh (Japan Gore-Tex Inc., Tokyo, Japan) has been successfully used in the repair and reconstruction of the abdominal wall, such as for a ventral incisional hernia or large hiatal hernia.1,2) In contrast, chest wall reconstruction using dual mesh has not been widely documented. Nagayasu et al. reported results of the reconstruction after rib resections by using dual mesh,3) and three reports describe the use of dual mesh after a sternal resection.3–5)

To evaluate the feasibility of dual mesh for reconstructing the chest wall, we reviewed our experience from patient charts. Our discussion particularly focused on the results of chest wall reconstruction using 2-mm Gore-Tex® dual mesh.

Patients and Methods

We reviewed eleven patients who underwent bony chest wall resection of more than two ribs or the sternum from April 2006 to January 2011 at Jikei University Kashiwa Hospital, Chiba, Japan.

The indication for resection was primary lung cancer in six patients; recurrent breast cancer in two patients; and primary chondrosarcoma, metastasis of clear cell...
carcinoma of unknown origin, and cholangiocarcinoma in each of the remaining three patients. Eight of the eleven patients underwent pulmonary resection, which included lobectomy in five patients and partial resection in three patients (Table 1).

Six patients underwent three ribs resection, three patients underwent two ribs resection, and the other two patients underwent sternal resection.

For the resection of three ribs, we used 2-mm Gore-Tex® dual mesh in 3 patients, Gore-Tex® in 1, Bard compositive E/X (Davol, Inc., Warwick, RI, USA), a composite of polypropylene and expanded polytetrafluoroethylene prosthesis (ePTFE) in 1, and no prosthesis in 1, because the resected rib was located posterior high (3,4,5th) beneath the right scapula. Three patients who underwent two ribs resection underwent no chest wall reconstruction using prosthesis. Two patients who underwent sternal resection underwent chest wall reconstruction using dual mesh with or without a vascularized musculocutaneous pedicle flap.

**Surgical technique**

Chest wall resection was performed through a posterolateral incision, and sternal resection was performed through an anterior chest circumferential incision. To prevent local recurrence, we maintained a sufficient tumor-free margin of at least 3 cm, except in patients whose tumor was located near a vertebra or the clavicle.

Sternal resections were performed for recurrent breast cancer using an electric saw for combined resection of the ribs, costal cartilages, skin, and chest wall muscles. One patient underwent resection of the lower four-fifths of the sternum for which we employed a musculocutaneous pedicle flap. In another patient who underwent resection of the upper four-fifths of the sternum, a vascularized 10th rib musculocutaneous pedicle flap was employed.

Before reconstruction using Gore-Tex® dual mesh and Bard Composix, holes were drilled in the rib and sternum adjacent to the chest wall defect. The prosthesis was carved to fit the defect and tightly sutured “tense as a drum” using 1-0 multiple SURGILON™ (Covidien, Japan) sutures; the dual mesh was placed with the patterned, indented surface upward. A chest tube was inserted into the pleural space, and suction drains were placed under the flap.

**Results**

Immediate postoperative extubation was performed in all patients, except one who was extubated the following day. No postoperative deaths or paradoxical respiration

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**Table 1 Patient details and outcomes**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Position</th>
<th>Number of resected ribs</th>
<th>Diagnosis</th>
<th>Additional procedure</th>
<th>Prosthesis</th>
<th>Complication</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>77</td>
<td>L</td>
<td>Cholangiocarcinoma</td>
<td>Partial resection of right diaphragm and lung</td>
<td>none</td>
<td>none</td>
<td>15 m alive</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>62</td>
<td>R</td>
<td>Chondrosarcoma</td>
<td>Partial resection of left lung</td>
<td>Gore-Tex</td>
<td>none</td>
<td>37 m alive</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>78</td>
<td>L</td>
<td>Unknown origin metastasis</td>
<td>none</td>
<td>Dual Mesh</td>
<td>Skin cellulitis, seroma</td>
<td>1 m alive</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>69</td>
<td>R</td>
<td>Lung cancer</td>
<td>Partial resection of left lung</td>
<td>none</td>
<td>Air leakage</td>
<td>18 m dead</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>75</td>
<td>L</td>
<td>Lung cancer</td>
<td>Left upper lobectomy</td>
<td>none</td>
<td>none</td>
<td>17 m alive</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>49</td>
<td>Supine</td>
<td>Breast cancer recurrence</td>
<td>none</td>
<td>Dual Mesh</td>
<td>Pleural effusion</td>
<td>14 m alive</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>71</td>
<td>L</td>
<td>Lung cancer, postesophagectomy</td>
<td>Right upper lobectomy</td>
<td>Dual Mesh</td>
<td>Pneumonia</td>
<td>11 m alive</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>80</td>
<td>R</td>
<td>Lung cancer</td>
<td>Left lower lobectomy</td>
<td>Bard composite</td>
<td>Seroma</td>
<td>11 m alive</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>77</td>
<td>L</td>
<td>Lung cancer</td>
<td>Right upper lobectomy</td>
<td>none</td>
<td>none</td>
<td>9 m alive</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>49</td>
<td>R</td>
<td>Lung cancer</td>
<td>Left upper lobectomy</td>
<td>Dual Mesh</td>
<td>none</td>
<td>8 m alive</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>54</td>
<td>Supine</td>
<td>Breast cancer recurrence</td>
<td>Partial resection of thymus</td>
<td>Dual Mesh</td>
<td>none</td>
<td>0 m alive</td>
</tr>
</tbody>
</table>
occurred. Three postoperative complications were reported in patients in whom dual mesh was used. In case number 3, the patient was readmitted to the hospital because of inflammation and swelling of the chest wall; the problem was diagnosed to be cellulitis of the skin and seroma. In case number 6, chest tube reinsertion was necessary to relieve pleural effusion. Case number 7, a patient who had undergone esophagectomy 11 years ago, needed reintubation because of contralateral pneumonia.

The mean observation period was 12.8 months. Follow-up chest computed tomography was performed routinely after each operation, and no dehiscence occurred in any case. In case number 10, chest computed tomography showed that the chest wall deformity was properly reconstructed with the dual mesh (Fig. 1).

Discussion

Reconstructing various locations of the chest wall is possible, and it is now widely accepted that bony chest wall reconstruction using polypropylene or ePTFE yields satisfactory results in most patients.3) However, only a few surgeons have reported lateral chest wall reconstruction using Gore-Tex® dual mesh, which is a pure and unique ePTFE and consists of two functionally distinct surfaces. The smoother surface is designed for minimal tissue attachment, whereas, the patterned, indented surface is designed for active tissue attachment.3)

Nagayasu et al. reported reconstruction with dual mesh after rib resection in ten cases and showed the usefulness of dual mesh.3) Gapany et al. reported reconstruction of lateral thoracic defects with dual mesh, covered by the latissimus dorsi muscle flap, in three pediatric patients with Ewing’s sarcoma.6) Infection of the patch did not occur in any of these patients despite chemo-induced immunosuppression and local radiotherapy in one case. Covering the Gore-Tex® patch with a muscle flap had the advantages of an organic, well-vascularized tissue that helps ensure its integration in the surrounding tissue while minimizing the risk of infection.6)

We had previously used a 2-mm ePTFE soft tissue (Gore-Tex®) patch; recently, we used dual mesh for this purpose.7) A muscle flap for coverage of the chest wall was not employed in any patient except for sternal resection because of breast cancer recurrence.

The diversity of techniques for chest wall reconstruction after sternal resection indicates that the ideal technique has not yet been agreed upon. Prosthetic materials are usually utilized for this purpose. However, these materials are either excessively rigid (methyl methacrylate) with subsequent limitation of chest wall movements and the risk of eroding adjacent structures or too weak (prolene mesh) to provide sufficient support for vital organs.3)

Only three reports describe sternal reconstruction using dual mesh. Nagayasu et al. reported reconstruction of an entire sternal body by using dual mesh and covering it with a latissimus dorsi musculocutaneous flap. The patient experienced transient paradoxical respiration; the authors speculated that this indicates that a pedicled muscle flap may be necessary if the subcutaneous tissue volume is inadequate to cover the dual mesh.3) Sunil et al. reported the use of a 2-mm Gore-Tex® dual mesh and multi-perforated titanium mandibular locking reconstruction plates.4) Hamad et al. reported that their patient was extubated immediately after surgery using titanium plates for support; they concluded that this could not be achieved solely by using the Gore-Tex® dual mesh.5) However, in our case, using a vascularized rib musculocutaneous flap, which was extubated immediately after surgery without using titanium plates. The rib supported the bilateral clavicles, and it may contribute to the prevention of respiratory problems.

In addition to these reports, one report describes using dual mesh for reconstructing the chest wall for support after pectus excavatum; Therefore, Gore-Tex® dual mesh seems to be the ideal material to support the sternum in its correct position.6) The advantages of dual mesh are its ability to stabilize the chest wall. In addition, it can be permanently left in place.
Seroma is the most common complication that occurs after prosthetic reconstruction. Use of a chest drain under negative pressure may prevent complications of seroma and infection; it also facilitates a high degree of adhesion between dual mesh and the adjacent tissues.

**Conclusion**

The use of Gore-Tex dual mesh provides a secure base for reconstruction of a chest wall defect after rib or sternal resection.

**Disclosure Statement**

We have no conflict of interest.

**References**