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Case report - Thoracic oncologic

Vascularized rib support for chest wall reconstruction using Gore-Tex® dual mesh after wide sternochondral resection

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Abstract

Only a few reports describe chest wall reconstruction after sternal resection using Gore-Tex dual mesh, and very few reports describe the use of a vascularized rib to support the thoracic cage. We present a case of a breast cancer patient who underwent anterior chest wall resection for recurrent sternal cancer. Her sternoclavicular joints bilaterally and lower sternum were divided using an electric saw. The bony chest wall was reconstructed using Gore-Tex dual mesh, and a vascularized rib was used to bridge the space between the clavicular heads to support the thoracic cage. The patient’s postoperative course was uneventful, without complications, such as paradoxical respiration or pneumonia.

Keywords: Chest wall tumor; Gore-Tex dual mesh; Sternum; Vascularized rib

1. Introduction

Gore-Tex dual mesh (Japan Gore-Tex, Inc, Tokyo, Japan), which is a pure and unique expanded polytetrafluoroethylene prosthesis, consists of two functionally distinct surfaces. The smoother surface is designed for minimal tissue attachment, and the patterned, indented surface is designed for active tissue attachment [1].

Only a few reports describe chest wall reconstruction after sternal resection using Gore-Tex dual mesh [1–3], and few reports describe using a vascularized rib for thoracic cage support [4]. We present here, the initial results of our technique using Gore-Tex dual mesh and a vascularized osteomusculocutaneous flap with rib and latissimus dorsi for reconstruction of an anterior chest wall defect after wide sternochondral resection.

2. Case report

A 54-year-old female with an anterior chest wall tumor (Fig. 1a) was referred from a regional hospital to our hospital for surgical intervention in August 2010. She had undergone bilateral breast cancer surgery on the right and left breasts in 1997 and 1998, respectively. The right and left breasts had been reconstructed using a transverse rectus abdominis muscle flap and a silicone prosthesis, respectively.

In November 2010, transverse chest computed tomography revealed a sternal tumor, expanding into the anterior mediastinum; the diagnosis was compatible with a metastasis from the previous breast cancer (Fig. 1b). Pulmonary function tests showed a forced expiratory volume in one second of 1.76 l (78% of predicted) and a forced vital capacity of 1.96 l (78% of predicted).

Chest wall resection was performed in the supine position. A skin incision was made leaving a 2–3-cm tumor-free margin. After bilateral dissection of the second to fourth ribs and costal cartilages with a 2–3-cm tumor margin, the fifth cartilage and lower sternum were divided with an electric saw, and the sternum was elevated so that the retrosternal space could be seen. Because the tumor had invaded the thymus, the lower portion of the thymus was resected along with the chest wall.

After the internal mammary vessels had been divided bilaterally, the adhesion between the right innominate vein and the sternum was separated. The resection was completed with division of the first rib and sternoclavicular joints bilaterally with an electric saw. An upper four-fifths sternectomy was performed through all layers including the patient’s skin, subcutaneous tissues, pectoral major muscles, costal cartilages and ribs.

Under strictly aseptic conditions, a dual mesh was placed very tightly over an 11×10 cm bony defect between the ribs, and anchored to the lateral tip of all the divided ribs or costal cartilages using multiple 1-0 Surgilon sutures (Covidien, Tokyo, Japan), with the patterned, indented surface of the mesh placed upward. This provided a very secure base upon which the free flap could be placed.
The patient's position was then changed from supine to lateral. A right latissimus dorsi musculocutaneous flap including the 10th rib, based on the right thoracodorsal vessel, was harvested. The muscle origin of the latissimus dorsi muscle on the 10th rib and its periosteum were carefully preserved and harvested with the 10th rib, which was 12 cm in size. The intercostal muscles were preserved. The musculocutaneous flap was separated from vertebral origins and humerus insertions, and the latissimus dorsi musculocutaneous flap with the 10th rib was transferred to the anterior chest without rotation through underneath the skin as a pedicle flap.

The bone defect was covered with the preserved intercostal muscles, and the skin was closed directly. The two ends of the harvested 10th rib were placed on the two ends of the clavicles. The clavicles and the 10th rib were fixed with cortical bone screws. The grafted 10th rib was then covered with the latissimus dorsi musculocutaneous flap. The dual mesh was covered with the grafted latissimus dorsi muscle, and the split thickness of skin was grafted onto the muscle. A chest tube was inserted into the right pleural space, and suction drains were placed under the flap.

Postoperative extubation was performed immediately after surgery, and no flail chest was observed. The patient's postoperative course was uneventful. The objective findings of normal healing and structural stability were confirmed by postoperative chest computed tomography (Fig. 2), and the patient's chest wall mobility showed excellent recovery.

3. Discussion

Large central composite chest wall defects present a challenge, particularly in association with tumor recurrence [5]. The diversity of techniques for chest wall reconstruction after sternal resection indicates that the ideal technique has not yet been identified [3]. The key to a successful outcome in these complex cases is a coordinated effort by the surgical team to individualize treatment for these patients, using total resection of the disease process, reconstruction of chest wall integrity and soft tissue coverage of the defect [6].

Prosthetic materials are generally used for this purpose [3]. However, they are either excessively rigid (methyl methacrylate) with subsequent limitation of chest wall movement and a danger of erosion of adjacent structures, or too weak (Prolene mesh) to provide sufficient support for the vital organs [3]. Therefore, we used a 2-mm polytetrafluoroethylene soft tissue (Gore-Tex) patch for this purpose, and recently, we have been using a dual mesh for this purpose [7].

There are only three reports of sternal reconstruction using dual mesh [1–3]. Nagayasu et al. reported a case with resection of the sternal body for treatment of sternal osteomyelitis, but the patient had postoperative complications, with paradoxical respiration [1]. Sunil et al. reported the use of a 2-mm dual mesh and multiperforated titanium mandibular locking reconstruction plates in a child, and insisted that no postoperative ventilation was required [2]. Hamad et al. reported that their patient was extubated...
immediately after surgery using titanium plates for support; they found that this could not be achieved with the Gore-Tex mesh alone, and emphasized the vital role of the transverse plates in chest wall stabilization [3].

We adopted a dual mesh in our case and bridged the gap between the clavicular heads using a vascularized rib without using plates. Thus, our patient also did not need immediate mechanical ventilation after surgery. Only a few reports describe the use of vascularized ribs for reconstruction of the chest wall. Davaraj et al. reported one case in a child who underwent replacement of an excised clavicle and overlying skin with a thoracodorsal system using the latissimus dorsi and serratus anterior with a vascularized rib, with good postoperative function [4].

4. Conclusion

Dual mesh supported the chest wall and provided a very secure base upon which the free flap could be placed. Also, vascularized rib without using plate bridged the bilateral clavicular heads. These procedures did not need immediate mechanical ventilation after surgery. Surgical repair of wide sternochondral resection using both a dual mesh and a vascularized rib can be recommended as a successful procedure.

References