New Method

A Case Report on a Full-Thickness Chest Wall Reconstruction with Polypropylene Mesh and Stainless Steel Mesh Concurrently Using a Transverse Rectus Abdominis Myocutaneous Flap

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A full-thickness chest wall resection requires subsequent chest wall reconstruction. A chest wall resection and reconstruction was performed using a transverse rectus abdominis myocutaneous (TRAM) flap, together with polypropylene mesh (Marlex mesh) and stainless steel mesh (SSM). A 71-year-old man was diagnosed as having recurrent lung cancer in the chest wall, and underwent surgical resection. Marlex mesh was sutured to the posterior wall of the surgical defect. A portion of the SSM was adjusted to the size of the defect and cut out. Its edges were folded to make the portion into a plate. This SSM plate was placed anteriorly to the Marlex mesh and sutured to the ribs. The Marlex mesh was folded back on the SSM plate by 2 cm and fixed. After the above procedures, a left-sided TRAM flap was raised through a subcutaneous tunnel up to the defect and sutured to the region. The patient was discharged from hospital 19 days postoperatively. The wound was fine and he had no flail chest or dyspnea, and carcinomatous pain resolved. (Ann Thorac Cardiovasc Surg 2006; 12: 445–8)

Key words: chest wall reconstruction, transverse rectus abdominis myocutaneous flap, polypropylene mesh, stainless steel mesh

Introduction

There are various methods of reconstruction when chest wall resection is performed primarily for the treatment of tumors of the chest wall. We need to choose an appropriate method according to the disease, location of the disease, and features of the case.[1)] We report on a case in which the bone structure of the thorax was reconstructed with polypropylene mesh (Marlex mesh) and stainless steel mesh (SSM), and the soft tissue of the thorax was reconstructed with a transverse rectus abdominis myocutaneous (TRAM) flap.

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Case Report

A 71-year-old man was diagnosed with carcinoma of the right lung. In May 2001 he underwent pneumonectomy of the right lung and mediastinal lymph node resection. In January 2002, he began to complain of pain in the right precordia, and a tumor of 3 cm in size was detected in the right precordia between the third and fourth ribs in March of the same year. A fine needle biopsy revealed a class-V adenocarcinoma. A diagnosis of recurrent lung cancer arising in the right chest wall was made. There were no recurrent lesions in any other region. He was admitted to the hospital for surgery.

A computed tomography (CT) scan of the chest revealed a mass measuring slightly less than 3 cm in diameter located in the parasternal region at the right third

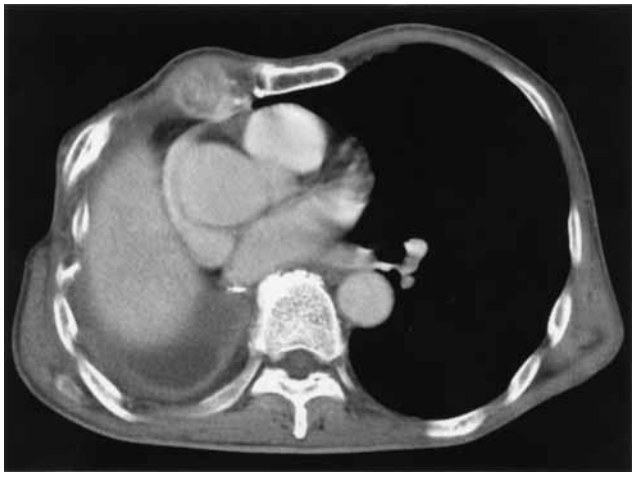

Fig. 1. A CT scan revealed a mass lesion of slightly less than 3 cm in diameter in the parasternal region at the right third intercostal space. The mediastinum organ was deviated on the right-hand side, and the heart had deviated to directly under the tumor exactly.

Fig. 2. An incision was made in the skin for chest wall resection and for collecting a TRAM flap.
Arrow, the skin immediately above the tumor is resected; arrow heads, a skin flap grafted into the defect was harvested transversely.

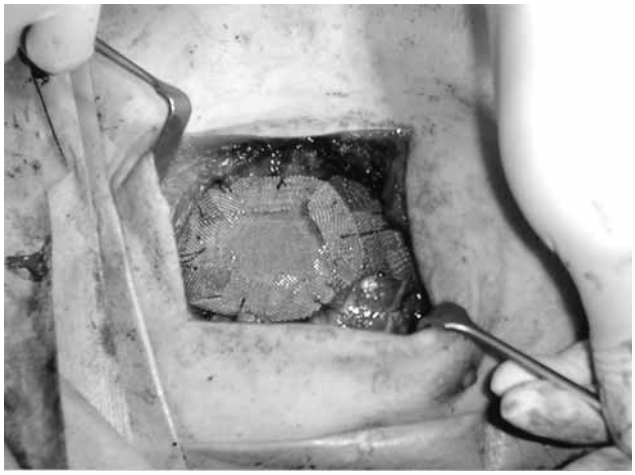

Fig. 3. Stainless steel mesh backed with Marlex mesh sheet was sutured to the ribs.

Fig. 4. Marlex mesh backing stainless steel mesh was folded back by 2 cm and sutured to the ribs.

intercostal space. The mediastinum organ was deviated on the right-hand side, and the heart had deviated to directly under the tumor exactly. Therefore, a positive reconstruction of the bony thorax was needed to protect the mediastinum organs, such as the heart (Fig. 1). The surgical procedure of Hisayoshi et al. was used.[1)] An incision was made in the skin, and the skin immediately above the tumor was resected (Fig. 2). A portion of the chest wall containing the tumor in the center and the adjacent areas of 1.5 cm or more in width, including the third and fourth ribs, were resected. The defect was approximately 7×5 cm in size. A Marlex mesh sheet was sutured to the posterior wall of the defect. A portion of SSM, which was adjusted to the defect in size, was cut and the edges of the portion were folded to a plate. This plate of SSM was placed anteriorly to the Marlex mesh sheet and sutured to the ribs (Fig. 3). The sheet of Marlex mesh was folded back by 2 cm on the SSM plate and sutured (Fig. 4). After the above procedures, a left-sided TRAM flap was raised through a subcutaneous tunnel up to the site of reconstruction and sutured to the region of the defect. Drains were left in the defect and the site where the

Fig. 5. A photograph of the wound taken 3 months postoperatively.

myocutaneous flap was obtained has completed reconstruction.

The patient was discharged 19 days postoperatively. The wound was fine and he had no flail chest or dyspnea, and was free from carcinomatous pain (Fig. 5). However, bone metastases were detected 6 months later, and he died 9 months postoperatively.

Discussion

After radical en bloc chest wall resection, skeletal reconstruction when appropriate and adequate skin coverage to preserve the reconstruction are the essential elements for successful management of these complex chest wall defects.[2] Reconstruction of these defects is important to maintain adequate ventilation, to protect the heart and great vessels from infections and trauma, and to maintain cosmetic integrity.[3] The method of reconstruction should be chosen according to the size of defects, the thickness of chest wall resected, location of defects, and the disease, sex, age, and respiratory function of patients. Among the above items, the location and size of defects are the most important.[1]

Reconstruction materials are required to have the following properties: (1) fulfill the objective function; (2) not induce foreign body response or allergic reaction; (3) provide smooth wound healing and unification with the surrounding tissue; (4) be resistant to infection; (5) be easy to handle; (6) be inexpensive; and (7) not degenerate in the long term.[3] In general, artificial materials tend to be used for chest wall stabilization, mainly because of their convenience. However, they carry the risk of a foreign body reaction and infection. Should infection occur while artificial materials are being used in a full-thickness chest wall reconstruction, these materials must be removed.[4]

Several materials have been used including metal plates and strips, tantalum mesh, polytetrafluoroethylene, and polypropylene mesh (Marlex mesh).[3] Marlex mesh, which has high affinity for a living body, is a material suitable for chest wall reconstruction.[1] SSM has a grid structure made of metal fibers, and therefore has slight elasticity with appropriate hardness and softness.[1]

In the present case, the defect was not especially large: 7×5 cm in diameter. However, as the defect was located just above the heart, concerns were raised about the consequences of chest wall reconstruction using only a musculocutaneous flap and Marlex mesh. We therefore used Marlex mesh and SSM for reconstruction as described by Hisayoshi et al.[1]

The major problem in using metal mesh for chest wall reconstruction is variation and separation of the material in long-term outcomes. Injuries to the adjacent lungs and major blood vessels may have grave consequences. Therefore, we folded the edges of SSM, fixed the mesh to the ribs, and covered it with Marlex mesh in a form of sandwich.

We believe that the use of this method increases graft survival rate and all the above problems are resolved. Moreover, Marlex mesh can provide softness and flexibility for the chest wall.[1] Hisayoshi et al. showed that in an autopsied case, the SSM graft survived well and the reconstructed area was almost identical to the surrounding normal skin, involving none of the described above.[1] Therefore, we also think that sufficient time to engraft would result in less possibility of SSM detachment.

Artificial materials are prone to infection and induce foreign body reactions. As a result, autologous tissues have been used.[5] Because these tissues are autologous and contain blood flow, there is no concern about infection or allergic reaction, and wound healing is uneventful. However, the surgical procedure is complex and requires technical skill.[5] A TRAM flap, based on the superior epigastric artery, is one of the most elegantly designed musculocutaneous flaps. It has become the mainstay of autog-

enous tissue breast reconstruction. Since its initial description for breast reconstruction, this flap has been used additionally for reconstructive problems of the chest wall such as sternal wound infections, chest wall ulcers after irradiation, and defects after tumor extirpation.[6] The advantage of the TRAM flap is that the patient does not need to be moved throughout the procedure.[7] To obtain a large volume of tissue for the purpose of reconstructing the chest wall, we employed a left-sided TRAM flap.

In the present patient, who underwent pneumonectomy of the right lung, the protection of intramediastinal organs is more important than the maintenance of respiratory function in reconstructing the bone structure of the thorax. Since the patient was thin preoperatively, we thought that if the skin is resected, grafting of a skin flap from another region would be necessary. Since the tumor was located in the precordia, surgery was performed with the patient in a supine position, and therefore a TRAM flap, which can be collected while the patient is being kept in the same supine position, was used. Consequently, the wound healed well, and pain in the precordia was controlled. We believe excellent palliation can be achieved even in patients who are not potentially curable. Chest wall resection with reconstruction utilizing SSM, Marlex mesh, and TRAM flap can be performed as a safe, effective one-stage surgical procedure for a variety of major chest wall defects.

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