www.jmscr.igmpublication.org
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v7i2.137

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Research Article

Chest Wall Tumor Resection and Reconstruction – Our Technique of Fixing the Prolene Mesh

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Abstract
The common indications for chest wall reconstruction include tumor, infection, congenital abnormalities, radiation injury, and trauma. The goals of successful reconstruction are to restore the chest wall rigidity, preserve pulmonary mechanics, protect intrathoracic organs, minimise the thoracic deformity. Large defects need synthetic, biologic or composite mesh reinforced by direct suture or flaps.
In last 10 years we have done 26 cases of chest wall tumor, of these 17 patients required reconstruction. We resected the tumor with margins as per oncological guidelines. To cover the defect Prolene mesh was used reinforced by muscle or myocutaneous flap. In our technique of reconstruction, we made a rim at resected margin to put the mesh. Preparation of rim around the margins taking all available tissue is of utmost importance. An average number of ribs resected were 3 per patient. All patients operated had uneventful recovery.
Keywords: *chest wall tumor, Rim, Prolene mesh.*

Introduction

The majority of chest wall defects requiring reconstruction results from tumor resections. Primary or metastatic chest wall neoplasms tend to infiltrate the external thoracic layers and need large resections to assure tumor free margins.[1] Other indications for chest wall reconstruction include infection, congenital abnormalities, radiation injury, and trauma.[2]

Proper history, clinical examination supported by radiological and histopathological reports help to diagnosed nature of tumor correctly. Surgery can be planned accordingly. About 50% to 80% of primary chest wall tumors are malignant[3] therefore aggressive management should be taken to treat the patient.

Defect created by such resection may need some kind of reconstructive procedure to stabilize chest

wall thereby minimizing paradoxical movement and to ensure adequate ventilatory mechanism to protect intra- thoracic structures and to preserve cosmetic integrity.

Our experience and technique

In last 10 years we have done 26 cases of chest wall tumor, out of these 17 patients required chest wall reconstruction. Our method of excision and reconstruction with placement of Prolene mesh is to be discussed here.

Site of tumor in our series-

1. Anterior chest wall - 05 cases
2. Anterolateral chest wall - 13 cases
3. Posterolateral chest wall - 08 cases

Types of tumor

In our study we found tumors of benign histopathology in 10 patients, malignant tumor was present in 16 patients, of these metastatic involvement of chest wall was found in 02 patients and in 01 case there was underlying tumor with chest wall involvement. Different histopathological types of tumors in our study are shown in Table no.1.

Of the sternal tumors 01 was giant cell tumor 01 was malignant fibrous histiocytoma and in 02 patients there were multiple tubercular sinuses involving the Manubrium sternii. Histopathologically, commonest benign and malignant tumors arising from anterolateral chest wall were chondroma and chondrosarcoma respectively. In one case of thoracic tumor with chest wall involvement we had to go for the lobectomy.

As two third of chest wall tumors are malignant, we treated these tumors aggressively by wide excision of tumor mass. To get a tumor free zone, we excised one rib above and one rib below the tumor and took a margin of 2 inches from grossly visible tumor margin in front and behind the tumor mass. The chest wall defect after the tumor resection was covered by prolene mesh which was reinforced by muscle flap or myocutaneous flap as needed.

There are various technique for closure of defect adopted by different surgeons. Usually the mesh fixing sutures are placed around the ribs in interrupted manner to obtain a secure closure.

In our technique of placement of the mesh, we made a rim at the resection margin, after excision of the tumor. This rim was prepared along the surgical margin. Prolene was used and continuous suturing was done taking all the tissue available at the site that is fascia, muscle & pleura in every suture bite (Fig.1).

Good hemostasis was achieved. Routinely, the cut margin is left as such without making any such type of rim. The advantage of this continuous sutured rim is that it makes the surgical margin strong and more defined for placement of the mesh and further reconstructive procedure. This rim provides a firm framework over which the Prolene mesh can be easily stretched. After making the rim, we stretch and hold the mesh over the defect using six to eight interrupted holding prolene sutures (Fig.2). While taking holding suture, care should be taken to stretch the mesh tightly without any lax and sag. Now, the mesh is fixed to the rim with continous prolene suture (Fig.3). The extra mesh at the margins is trimmed off to get a neat and clean coverage of the defect. (Fig.4) The Prolene mesh is then reinforced with muscle or myocutaneous flap as required. A drain was placed to prevent any collection at the operative site.

Result

All patients operated had uneventful recovery. An average number of ribs resected were 3 ribs per patient. All patients were extubated immediate postoperatively and none required any post operative ventilatory support. Out of 26 patients 4 patients lost in follow-up, in one patient there was local recurrence of tumor, 2 patients had late infection of these one required partial excision of prolene mesh.

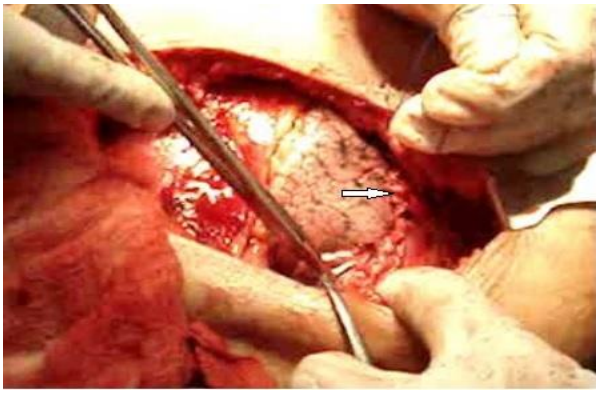

Fig 1: Making of prolene rim (White arrow)

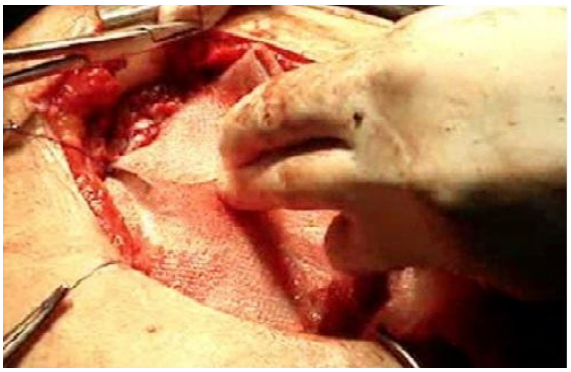

Fig 2: Stretching of mesh with interrupted sutures

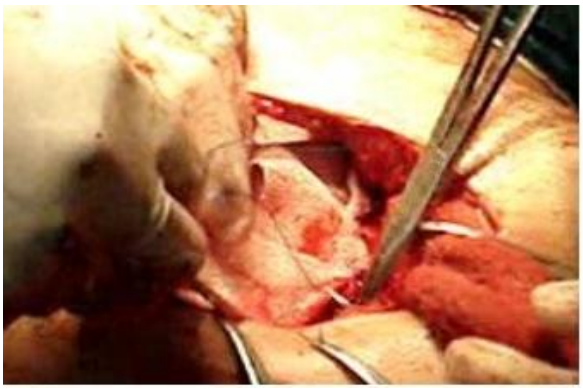

Fig 3: Fixing of mesh at rim with continuous prolene suture

Fig 4: Final appearance of mesh after stretching and fixing

Table 1: Histopathology of different tumors

BENING TUMORS	Number of cases
Bening chondroma	4
Osteochondroma	2
Tubercular involvement	2
Eosinophilic granuloma	1
Aneurysmal bone cyst	1
MALIGNANT TUMOURS	
Chondrosarcoma	7
Malignant histiocytoma	3
Osteochondrosarcoma	2
Giant cell tumor	2
Ewings sarcoma	1
Adenocarcinoma (chest wall involvement)	1

Discussion

The first chest wall reconstruction was described by Tensini in 1906 when a pedicaled Latissimus dorsi flap was used to cover an anterior chest wall defect.[4] Since that time, chest wall reconstruction has evolved significantly as surgical techniques have advanced and multiple prosthetic and bioprosthetic materials have become available.[5]

The goals of chest wall reconstruction are 1. Removal of all devitalized or tumor tissue 2. Restore integrity of chest wall, if the defect is large to prevent flail chest 3. Cover defect with healthy soft tissue to seal the pleural space, protect underlying organs and prevent infection.[5-7] There are several synthetic, biologic, and metallic materials available to reconstruct the chest wall defects, but each prosthetic material has its own advantages and disadvantages and none have proven to be clearly superior.[8,9]

It is not always necessary to perform reconstructive procedure after removal of portion of Bony chest wall. Decision of reconstruction depends on the size and location of the defect. Defect of less than 5 cm in diameter do not cause much physiological impairment of ventilation therefore if construction done it is for cosmetic purpose only. Small defect on posterior aspect covered by scapula do not require reconstruction.[10]

Rib resection involving as many as three or more ribs in anterior chest wall or four rib resection or more in the lateral chest wall or if the area of defect is greater than 100 cm square, chest wall reconstruction is indicated.[11]

To get good tumor free margin, ribs above and below the tumor should be resected. For high-grade malignancies, 4-cm margin is adequate, and for low-grade malignancies 1- 2 cm margin is good enough. Any involved soft tissue, skin, underlying pleura, or lung tissue should be resected with the tumor, provided pulmonary function permits resection.[10]

For reconstruction of resected bony chest wall autologous tissue (muscle or omentum), synthetic material (prolene or PTFE mesh) or both can be used. Today synthetic materials are the most commonly used object.[12] Best material is 2 mm thick expandable Polytetrafluoroethylene (PTFE) mesh or gore-Tex. Its advantage includes impermeability to water and air, strength and ease to suture. Major disadvantage is the cost. Single or double spaced knitted prolene mesh is another excellent material for repair. Little difference exists between prolene mesh and e-PTFE in terms of resistance to infection and rejection, however Prolene is more cost effective. Muscle or myocutaneous flaps are the tissue of choice to cover the wound, avoid and decrease the risk of infection, obliterate the space and cover the synthetic mesh.[13,14]

Irrespective of the patch used, non absorbable sutures (Prolene no. #0 or #1) should be used to securely attach the prosthetic material to the chest wall. Patch should be placed at the outer edge of the bony chest wall for the best cosmetic result.

Conclusion

To obtain good tumor free long term result in chest wall neoplasm, early diagnosis and aggressive surgical management with wide excision of tumor is necessary. Preparation of prolene rim around the excised margins taking all available tissue is of utmost important as prolene mesh can be stretched and fixed over it very nicely. This stabilizes the chest wall and prevents paradoxical movements. Cover of muscle or myocutaneous flap helps to seal the defect and protect the mesh from infection.

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