Resection And Reconstruction of Malignant Tumor Involving Sternum

W I Faisham*, M G Ziyadi**, W S Azman***, A S Halim***, W Zulmi*, Biswal B M****

*Orthopedic Department, **Cardiothorasic Unit, ***Reconstructive Sciences Unit, ****Oncology and radiotherapy, School of Medical Sciences Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia

SUMMARY
We present a series of four cases of chest wall tumor, which underwent sternum resection. The methods of resection and reconstruction chest wall defect are discussed and the final outcome highlighted.

INTRODUCTION
Primary sarcomas of the chest wall are uncommon 1. Sternum tumours or sarcomas in the lower neck or chest wall that infiltrate to the sternum pose surgical challenges for wide margin resection and reconstruction. We report 4 cases of chest wall tumors that involved the sternum, which required resection and reconstruction.

CASE REPORTS
The particulars of the four patients who underwent sternum resection are given in Table I. All patients presented with stage IIB disease with no evidence of distance metastases.

Surgical Technique
We performed upper sternum resection in three patients and anterior hemi-corpectomy of the sternum in the patient with squamous cell carcinoma. The upper sternum resection was done together with 1-3rd involved ribs and medial clavicle. The surgical technique included exploration of the subclavian artery by reflecting the pectoralis major and minor until the first ribs, which were then were protected and prepared for sternotomy. The sternal notch was freed from platysma, sternocleidomastoid and sternothyroid muscle. Single lung ventilation was employed and the subclavian vessels were protected before sternotomy was done according to surgical the margin needed. Two patients underwent upper sternal resection at the level of manubrium sternum and one patient underwent left hemi-sternum resection including the medial clavicle. Wide margin surgery was achieved by resection of the entire upper sternum, medial end of the clavicle, costal cartilage adjacent to the sternum, surrounding soft tissue and parietal pleural.

The chest wall defects were reconstructed with double layer prolate mesh and were tightened to the remaining sternum and ribs. Three patients with anterior chest soft tissue defects were covered with pedicle latissimus dorsi myocutaneous flap. One patient with rib chondrosarcoma had reconstruction with a pedicle pectoralis major myocutaneous flap.

The 76 year-old patient had post-operative complications, including pulmonary collapse and myocardial infarction, which required prolonged ventilation, but he subsequently recovered. Wide margin resections were achieved in three patients. A rib chondrosarcoma patient had a narrow soft tissue margin of 5 mm. The patient with synovial sarcoma and squamous cell carcinoma underwent 60 K Gray of radiation treatment. All patients survived surgery and had a median follow up of 14 months. There was no local recurrence.

DISCUSSION
The aims of surgical treatment of sternal sarcoma are to achieve adequate resection margins, maintenance of chest stability for lung function and acceptable cosmesis result 2. Restoration of chest wall stability and rigidity is important to prevent paradoxical chest motion. Furthermore a good vascularised soft tissue cover to seal the pleural space, protects visceral organs and minimizes infection 3.

Radical en-bloc resection and immediate reconstruction is the key to success in the management of malignant chest wall tumors. Wide margin surgery can be achieved by proper radiological evaluation of the tumor prior resection. The concept of resection of sternum tumor with the structure next to the part involved: - costochondral junction and the ribs, parietal pleural, medial clavicle and anterior soft tissue surrounding improves local control of the disease.

Wide margin surgery can create a massive chest wall defect. Stabilization of the chest wall is important for the patient to maintain post-operative pulmonary function and obviates the need for prolonged ventilation 1,2. Chest wall stability can be achieved by reconstruction of defect with synthetic mesh such as prolene or poly-tetrafluoroethylene (Marlex) with methyl methacrylate reinforcement. Other options includes transfer of floating ribs and stabilized with plate or rigid titanium bars and clips with methyl methacrylate (STRATOS) 2,3. The double Prolene mesh we used was able to achieve chest wall stability and rigidity in this series. In many cases primary closure is not possible after extensive anterior soft tissue resection. Local myocutaneous flap commonly used to cover anterior chest wall defect includes; latissimus dorsi, pectoralis major, serratus anterior and rectus abdominis. Their axial blood supply permits elevation and rotation to cover anterior defect. Latissimus dorsi myocutaneous flap is the most reliable option for reconstructions. It provide large...
amount of muscle and can be harvested with a skin paddle to allow primary closure, which is important for early adjuvant radiation treatment.

Long-term survival is closely dependent to the type of the tumor; overall 5 years survival achieved ranged from 50-65% \(^2,3\). Chondrosarcoma was reported to have the best survival result \(^2\).

### Cases of anterior chest wall tumor with sternal extension

<table>
<thead>
<tr>
<th>No</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Sternal extension</th>
<th>Bony resection</th>
<th>Chest wall reconstruction</th>
<th>Closure</th>
<th>Adjuvant</th>
<th>Outcome treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76</td>
<td>M</td>
<td>Chondrosarcoma</td>
<td>Entire upper to manubrium</td>
<td>Bilateral medial clavicle 2-4th ribs and upper sternum</td>
<td>Prolene mesh</td>
<td>Latissimus dorsi</td>
<td>-</td>
<td>DFS 18 months</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>F</td>
<td>Synovial sarcoma</td>
<td>Upper sternum</td>
<td>Left medial clavicle with upper clavicle and 1st-2nd ribs</td>
<td>-</td>
<td>Latissimus dorsi</td>
<td>Radiotherapy</td>
<td>DFS 12 months</td>
</tr>
<tr>
<td>3</td>
<td>64</td>
<td>M</td>
<td>Squamous cell carcinoma</td>
<td>Anterior cortex</td>
<td>Right clavicle with anterior hemicorticotomy 2-4th ribs with left hemisternal resection</td>
<td>-</td>
<td>Latissimus dorsi</td>
<td>Radiotherapy</td>
<td>DFS 6 months</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>M</td>
<td>Chondrosarcoma</td>
<td>2nd 3rd ribs and costosternal area</td>
<td>Prolene mesh</td>
<td>Latissimus dorsi</td>
<td>Pectoralis major flap</td>
<td>-</td>
<td>DFS 6 months</td>
</tr>
</tbody>
</table>

### REFERENCES