Egypt, J. Plast. Reconstr. Surg., Vol. 28, No. 1, January: 63-69, 2004

Chest Wall Tumour Resection and Different Reconstructive Modalities

NAHEDJ ATTIA, M.D.*; AHMAD ELMENSHAWY, M.D.*; YOUSSEF SALEH, M.D.** and SAMIR SHEHATA, M.D.***

The Departments of Cardiothoracic Surgery, Plastic & Reconstructive Surgery** and Radiation Oncology***, Faculty of Medicine, Assiut University.*

ABSTRACT

The incidence of malignancy in primary chest wall tumors varies and reported to be 50%-80%. Adequate resection and dependable reconstruction are the mandatory ingredients for successful management. This study was carried upon 35 patients presented by chest wall tumor. Twenty of them were primary chest wall tumors and the remaining fifteen patients were recurrent malignant chest wall ulcer following mastectomy. The number of ribs involved varied from 2-4 ribs. For all patients we did a standard excision including the involved ribs with wide safety margin. Chest wall stability was accomplished by use of proline mesh fixed in surrounding ribs. Immediate reconstruction was done using the available vascular zed myocutaneous flaps (20 by T.R.A.M. flap, 10 by L.D. flap and 5 by P.M. muscle flap). All cases had smooth postoperative course, smooth extubation, no need for mechanical ventilation and excellent chest wall stability excellent coverage, minimal donor site morbidity and early delivery of adjuvant therapy. The recurrence rate was small percentage and short hospital staying period (8-12 days).

INTRODUCTION

The importance of chest wall resections can be highlighted best by knowing that about 7% of all primary bone tumors are localized at the chest wall and 5% of all patients with bronchogenic carcinoma experience chest wall infiltration **[1]**.

Also the incidence of malignancy in primary chest wall neoplasms varies and has been reported to be in range of 50% to 80% **[2]**.

Chest wall resections are the procedures of long tradition, Parham's reported in 1899 comprises 48 cases with per operative mortality 30% **[3]**.

Continuous progress in anesthesia, intensive care and antisepsis as well as the development of alloplastics and elaboration of tissue transfer techniques have improved the mortality associated with these procedures **[4]**.

Availability of the chest wall reconstructive modalities allowed for more radical excision of some large malignant chest wall tumors **[5]**.

The most common techniques to reconstruct a full thickness defect are by the use of alloplastic material and filling the soft tissue defect with available myocutaneous flap **[6]**.

PATIENTS AND METHODS

This study was carried out upon 35 patients admitted in Assiut University Hospital in both cardiothoracic surgery department and plastic surgery department in a period from January 2000 to May 2003. Their age ranged from 22 to 72 years with a mean age 51 years, twenty were females and fifteen were males.

Primary chest wall tumor was present into 20 patients, their clinical criteria were the following:

1- Site: Five affecting the central segment of thoracic cage, another ten affecting the lateral segment and the last five affected the anterolateral part.
2- Size: their sizes ranged from 3 x 5 cm to 6 x 8 cm.
3- Rib invasion: number of ribs affected varied from 2-3 ribs.
4- Metastases: there were no lymphatic or distant metastases in any patient.

Fifteen patients presented either by malignant chest wall ulcer or fungating mass after mastectomy for breast cancer, their clinical criteria were as follows:

1- Site: they usually affect the antero-lateral segment in thoracic cage.
2- Size: their sizes varied from 4 x 3 cm to 5 x 7 cm.

3- Rib invasion: number of ribs affected varied from 2-3 ribs.
4- Metastases: there were no lymphatic or distant metastases.

Every patient was subjected to full medical history and thorough examination for all systems.

Chest examination: for mass (size, site, shape, mobility, consistency and invasion to underlying ribs).

Symmetry of chest wall, type of respiration and any scar in axilla or back. Abdomen examination for any surgical scar, muscle condition and any palpable organs.

For every patient the following investigations were done:

1- X ray chest p.a. and lat. view.
2- C.T. scan on chest to determine the depth of the tumor and M.R.I. if needed.
3- Preoperative biopsy from the mass or the ulcer.
4- Abdominal u/s and abdominal CT scan.
5- Laboratory investigation: including C.B.C.S. urea and creatine, blood sugar and liver functions.
6- Metastatic work to exclude any distant metastases as X ray, C.T. scan or bone scan.

Surgical technique: Under general anesthesia.

For all those patients wide surgical excision with safety margin including the affected ribs was done by senior cadiothoracic surgeon, the areas of excision varied in size from 300 cm to 400 cm and the number of ribs removed in this procedure varied from 2 to 4 ribs.

The chest wall stabilization was done using large proline mesh which was fixed in all directions by stainless steel wire no 1 in the surrounding ribs.

Immediate reconstruction of this large defect was achieved by plastic surgeon using the available well vascularized pedicled myocutaneous flap (rectus abdominis, latissmus dorsi or pectoralis major ms).

The choice of those different myocutaneous flaps depends on different factors:

1- size of the defect.
2- Site (central, lateral or antero-lateral).
3- Previous scars in back or abdomen.
4- History of radiation.

In this study we did reconstruction by using a contra lateral pedicled transverse rectus abdominis myocutaneous (T.R.A.M.) flap based on superior epigastric artery in twenty cases, they usually presented by large sized defects in anterolateral segment or previous history of radiation in axilla.

Also ten cases were reconstructed by using ipsilateral latissmus dorsi myocutaneous flap (L.D.) based on thoracodorsal artery usually presented by medium sized defects in the lateral region.

The last five cases were reconstructed by transposing of bilateral pectoralis major muscle flap (P.M.) usually in the central lesions.

Suction drains were inserted in both chest and axilla or abdomen according to the flap used, mean operative time was 2 $^{1}/_{2}$ hours.

Post-operative care:

The patient was extubated and transferred to the I.C.U. for one night under oxygen mask and strong pain killer till respiration became stabilized.

The patient was usually under cover of strong bactericidal antibiotic.

The patient was allowed to take oral feeding 2 to 3 hours postoperatively.

The patient preferred to be in semi sitting position.

Chest exercise and early mobilization was done from the second day post-op.

Suction drain was removed form fourth to fifth days.

Stitches were removed from 7 to 10 days.

Adjuvant therapy:

Chemotherapy: After complete healing of the scar in the presence of normal base-line laboratory investigations all patients received the adjuvant combination chemotherapy V.A.C. regimen (Vincristin 1.4 mg/m^2 i.v. dl, Adriamycin 50 mg/m^2 dl i.v. and Cyclophosphamide 750 mg/m^2 i.v. dl) with recycle every three weeks for six cycles.

Radiotherapy: All patients were planned for radiotherapy after completing six cycles of adjuvant chemotherapy by C.T. simulation, to insure accuracy, then received a tumor dose of 50 Gy to the chest wall. The radiation was delivered through linear-accelerator using 6 MV photon energy with application of wedges or filter to achieve a uniform dose distribution within the treatment volume. This is in

five weeks of treatment, five fractions per week from Saturday to Wednesday.

Follow up period: Varied from 34 months to 8 months, done in outpatient clinic for both clinical and radiological assement monthly in first 6 months and every 3 months in first year, every 6 months in later period.

RESULTS

Site of the chest wall lesion; the most common site was antero lateral (20 cases) and the least one was central area (5 cases) (Table 1).

Nature of primary chest wall lesion (20 cases): the most common was chondroma (10 cases) and the least one was rabdomyosarcoma (2 cases) (Table 2).

The remaining cases (15 cases) proved to be recurrent infiltrating duct carcinoma ulcer.

Modalities of coverage: The most common flap used was transverse rectus abdominis flap (20 cases) and the least one was pectoralis major muscle flap (5 cases) (Table 3).

Every patient was follwed up as the following:

A- Immediate follow up:

1- Smooth extubation.

2- Need for mechanical ventilation.

3- Duration in I.C.U.

4- Flap survival.

5- Hospital staying duration.

B- Late follow up:

1- Quality of coverage.

2- Response to radiation.

3- Recurrence rate.

4- Donor site morbidity.

All cases passed in smooth postoperative extubation with no need for mechanical ventilation and excellent chest wall stability (no paradoxical movement on respiration).

Also all cases stayed one day in postoperative I.C.U. with smooth postoperative course.

There were no case of mortality recorded during the period of study.

As regard flap survival: All cases were reconstructed by latissmus dorsi flap (10 cases) and pectoralis major flap (5 cases) were survived completely. As regard cases reconstructed by transverse abdominis flap (20 cases) all cases survived completely except two cases developed venous congestion in $^1/_4$ of the flap leading to partial fat necrosis and gangrene in this area of the flap, however, debridment and secondary closure was done in the eighth day.

Hospital staying period varied from 8 to 12 days.

An excellent quality of coverage was obtained in all cases.

Response to radiation: There were no major radiation complications reported in reconstructed flaps as gangrene or ulceration or flap loss, however, only 3 cases developed a small area of moist desquamation at the end of sitting which responded rapidly to local antibacterial cream.

Recurrence rate: The recurrences were reported into 3 cases (8.5%) out of 35 during the period of the study, two cases were aggressive huge rhabdomyosarcoma and the third one who did not complete his chemo and radiotherapy course.

Donor site morbidity:

As regard cases which were reconstructed by Pectoralis Major flap, they noticed minimal hollow in the parasternal area but can be camouflaged by our Islamic style clothes.

As regard cases which were reconstructed by Latissmus dorsi flap, all cases closed directly leaving nice scar in the back except two cases of large defect which required application of split thickness skin graft on the back.

As regard cases which were reconstructed by rectus abdominis flap, no case developed abdominal laxity or hernia due to use of unilateral muscle only and abdominal wall closure using proline mesh.

Table (1): Distribution of lesions in different sites of chest wall.

Site of lesion	No.
Antero-lateral	20
Lateral	10
Central	5
Total	35

Table (2): Different types of chest wall tumors.

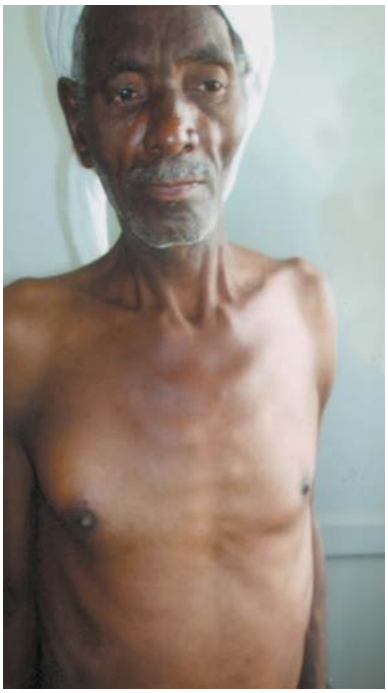
Natutre of the lesion	No.
Chondroma	10
Osteogenic sarcoma	3
Ewing sarcoma	5
Rabdomyosarcoma	2
Total	20

Table (3):Different flaps used in reconstruction.

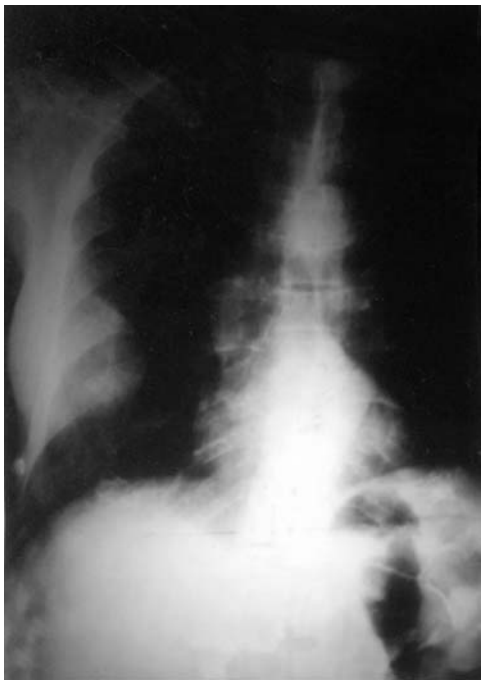
Flap used	No.
Transverse rectus myocutaneous flap	20
Latissmus dorsi myocutaneous flap	10
Pectoralis major ms. flap	5
Total	35

Case (1):

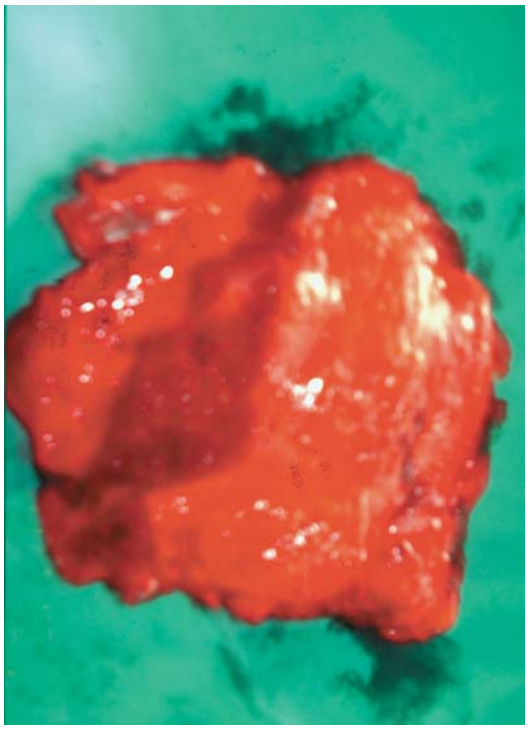
A- Pre-operative = right lateral chest wall mass.
B- X-ray pre-operative = showing mass in right side of chest.
C- Intra-operative = mass excision including 3 ribs.
D- Post-operative = ipsilateral L, D. myocutaneous flap for chest coverage.



(A)



(B)



(C)

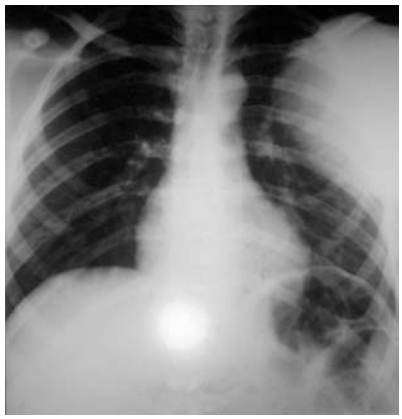
(D)

Case (2):

A- Pre-operative = left sided soft tissue rabdomyosarcoma.
B- X-ray pre-operative = showing left sided soft tissue shadow.
C- Intra-op. mass excision.
D- Post-operative = contra lateral T.R.A.M. flap for chest coverage.

(A)

(B)



(C)

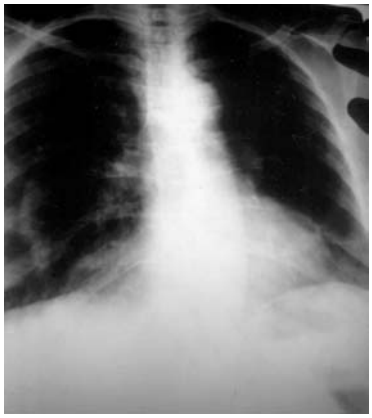
(D)

Case (3):

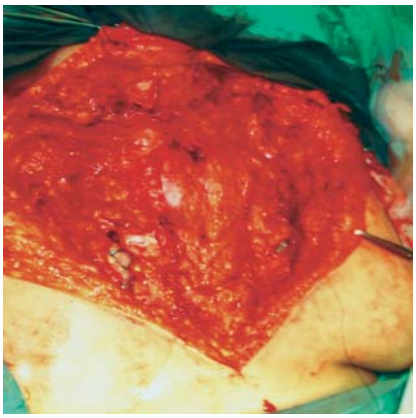
A- Pre-operative = sternal mass.
B- X-ray pre-operative = showing sternal shadow.
C- Intra-operative = bilateral transposing of P.M. flap for coverage.
D- Late post-operative = showing complete healing of wound.

(A)

(B)



(C)



(D)

DISCUSSION

The key to successful treatment of primary chest wall neoplasm remains early diagnosis and aggressive surgical management **[7]**.

Adequate resection and dependable reconstruction are the mandatory ingredients for successful treatment **[8]**.

The goals of reconstruction of the chest wall can be prioritized to:

1- Stabilization of the skeletal structure.
2- Obliteration of any underlying dead space or cavities.
3- Wound closure with well-vascularized soft tissue **[9]**.

Skeletal stabilization can be accomplished with autologous rib grafts or use of synthetic material such as mesh or gortex sheeting, however obliteration of dead space and wound closure can be accomplished by use of available myocutaneous flaps **[10]**.

This study was carried out upon 35 patients, twenty of them presented by primary chest wall neoplasms and the remaining fifteen cases presented by recurrent ulcer after mastectomy; they presented by different sizes and variable invasion to the underlying ribs with no distant or lymphatic metastases. All those patients underwent excision with safety margin and rib excision varied from two to four ribs. Immediate skeletal reconstruction using the synthetic mesh fixed by stainless steel wire on the surrounding ribs.

Immediate reconstruction was done using the available myocutaneous flap (T.R.A.M. flap in 20 cases, L.D. flap 10 cases and P.M. ms. Flap in 5 cases).

All cases had smooth postoperative course with early extubation, no mortality and no need for mechanical ventilation. Staying in I.C.U. was no more than one night in all of our cases. Our results are consistent with the results reported by Lampl **[3]** who worked upon 6 patients with chest wall tumor using alloplastic mesh fixed in the surrounding ribs by rib strut fixed through Parham steel band.

However, we differ with Lampl **[3]** in his method of chest stability by using mesh fixed through use of both rib strut and Parham steel band which were removed after 2 months under general anesthesia. However, in our method of chest wall fixation we obtained excellent results in chest stability without the need for such rib strut or Parham steel band which cost 160 Euro as he said, also the patient in his thesis required another operation after 2 months for removal of this Parham band. Lastly the use of those additional procedures may lengthen that risky operation.

Also we differ so much with Raffoul et al. **[11]** who worked upon 3 patients of chest wall tumor using only facial component of pedicled Latissmus Dorsi myocutaneous flap for chest wall stability after removal of more than 4 ribs, this is because removal of such number of ribs results in severe respiratory instability and paradoxical movement which needs rigid stabilization using rigid immobile materials as synthetic mesh fixed by wires on surrounding ribs.

The mean operative time in our study was 2 $^1/_2$ hours, which may be explained by combined work simultaneously between cardiothoracic and plastic surgeons.

There were excellent quality of coverage in all cases due to the use of appropriate myocutaneous flap according to site, size of defect and surrounding tissue.

Response to radiation: No case developed major radiological complications such as ulcer or flap loss, which was due to the use of linear accelerator technique which delivers a controlled computerized beam without affecting the adjacent structure.

Recurrence rate: The recurrence rate in our patients was 8.5%, which is lower than the thesis of Lampl **[3]** who recorded one case of recurrence out of 6 patients (16.5%), also it is lower than Pairlero & Arnold **[8]** who worked upon 100 chest wall tumors and recorded 17% recurrence rate with long follow up period (6 years). This may be explained by the aggressive resection, which was done in our cases and also the use of linear accelerator technique that delivers an appropriate dose of radiotherapy without affection of adjacent structure.

Donor site morbidity: It is accepted as regard all case of P.M. ms. Flap leaving a hollow in parasternal area, which can be camouflaged by Islamic style of those women.

As regard L.D. flap: All cases were closed primarily except two cases of large defect, which required a small piece of skin graft.

As regard T.R.A.M. flap: No case developed ms. weakness or hernia due to routine application of mesh in abdominal reconstruction.

Mean hospital stay varied from 8-12 days and was consistent with Lampl **[3]** and also due to smooth post-operative course with very nice healing of scar.

Conclusions:

1- The corner stone in management of chest wall tumor is early diagnosis and aggressive resection.

2- Chest stabilization is mandatory for all cases in which more than 3 ribs are involved in resection.

3- The use of synthetic proline mesh and fixation by stainless steel wire in surrounding ribs provides an excellent method for stability of chest wall.

4- The use of vacularized myocutaneous flaps for coverage of full thickness defect depends upon several factors as site, size and depth of the chest wall lesion.

5- The availability of chest wall reconstructive procedures has allowed for more radical excision of large chest wall tumors that carrying better prognosis.

6- Immediate reconstruction using myocutaneous flap provides an early delivery of adjuvant therapy that decreasing the incidence of recurrence.

7- The use of linear accelerator technique in radiotherapy course giving a controlled computerized beam without affection to the adjacent structures minimized markedly radiotherapy complications.

REFERENCES

1- El Tamper M., Chaglassian T. and Martin N.: Resection and debridment of chest wall tumors and general aspects of resection. Surg. Clin. North Am., 69: 947-964, 1989.

2- King R.M., Pairolero P.C. and Trastek V.F.: Primary chest wall tumors: factors affecting survival. Ann. Thorac. Surg., 41: 597-601, 1986.

3- L. Lampl: Chest wall resection: a new and simple method for stabilization of extended defects. Europ. J. Cardiothor. Surg., 20: 669-673, 2001.

4- Downey R.J., Rusch V. and Hus F.L.: Chest wall resection for locally recurrent breast cancer: is it worthwhile? J. Thorac. Cardiovasc. Surg., 119: 420-8, 2000.

5- Arnold P.G. and Pairolero P.C.: Chest wall reconstruction: an account of 500 consecutive patients. Plast. Reconstr. Surg., 98: 804-10, 1996.

6- Lardinois D., Muller M. and Furrer M.: Functional assessment of chest wall integrity after methylmethacrylate reconstruction. Ann. Thorac. Surg., 69: 19-23, 2000.

7- McAfee M.K., Pairolero P.C. and Bergstralh E.J.: Chondrosarcoma of the chest wall: factors affecting survival. Ann. Thorac. Surg., 40: 535-541, 1985.

8- Pairlero P.C. and Arnold P.G.: Chest wall tumors: experince with 100 consecutive patients. J. Thorac. Cardiovasc. Surg., 90: 367-372, 1985.

9- Pairolero P.C., Arnold P.G. and Harris J.B.: Long-term results of pectoralis major muscle transposition for infected sternotomy wounds. Ann. Surg., 213: 583-590, 1991.

10- Morgan R.F., Edgerton M.T., Wanebo H.J., Daniel T.M., Spotnitz W.D. and Kron I.L.: Reconstruction of full thickness chest wall defects. Ann. Surg., 207: 707-15, 1988.

11- Raffoul W., Dusmet M., Landry M. and Riss H.B.: A novel technique for the reconstruction of infected full thickness chest wall defects. Ann. Thorac. Surg., 72: 1720-4, 2001.