

Reconstruction by Pectoralis Major Myocutaneous (PMMC) Flap After Curative Resection of Chest Wall Malignancy: A Prospective Study of 18 Cases

Amit Kumar

Senior Resident, Department of Onco Surgery, Gujarat Cancer Research

Received: 15-06-2022 / Revised: 20-07-2022 / Accepted: 10-08-2022

Corresponding author: Dr. Amit kumar

Conflict of interest: Nil

Abstract

Aim: Pectoralis Major Myocutaneous (PMMC) flap is a very reliable and versatile flap for hTaeb-lae-d1 and neck oncologic reconstruction. Our study analyzed the versatility in chest wall reconstruction after curative resection of soft tissue malignancy.

Methods: We studied 18 cases of anterior chest wall tumours at Gujarat Cancer Research Centre & M. P. Shah Regional Cancer Centre, Ahmedabad, India between January – December 2015 who underwent curative resection followed by single stage PMMC only reconstruction. We analyzed our experience with minimum follow up of 1 year and reviewed the literature. Out of 18 patients, 15 were males and 03 females (M:F=5:1), average age was 39.5 years (range 16-65).

Results: The most common pathology was soft tissue sarcoma (72.2%, n=13) – Dermatofibrosarcoma Protuberans (50%, n=9), Fibrosarcoma (11%, n=2), Epitheloid sarcoma (5.5%, n=1) and Ewing's sarcoma (5.5%, n=1). The other pathologies were Squamous cell carcinoma (16.6%, n=3), Chondrosarcoma (5.5%, n=1) and Malignant melanoma (5.5%, n=1). Average size of the tumour was 57.11cm² (range 5×5 - 15×12 cm²). The location of the tumour over chest wall were – upper presternal (38%, n=7), parasternal (27.7%, n=5), lateral (27.7%, n=5) and shoulder (5.5%, n=1). Wide local excision with adequate margin in all directions done and thereafter average size of the defect was 106cm² (range 7×7-20×15cm²). All defects were reconstructed by single stage local PMMC only flap. Postoperative complications were minor: Infection and dehiscence (11.1%, n=2), marginal necrosis (5.5%, n=1) without any flap loss. One patient needed skin grafting for wound gap. After 12 months follow up, no recurrence noted and aesthetic outcome were excellent in 33% (n=6), moderate in 38.8%(n=7) and acceptable in 27.7%(n=5).

Conclusion: Pectoralis Major Myocutaneous Flap is an excellent reconstructive technique for oncological chest wall defect. It can cover large size defect at any location over the anterior and lateral chest wall with minimal complication and maximum aesthetic and oncological outcome.

Keywords: Pectoralis Major Myocutaneous (PMMC), Chest wall Tumours

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Chest wall defects are commonly caused by trauma, deep sternal wound infections, chronic empyema, congenital defects, and tumor resection. [1] Chest wall reconstruction can be divided into skeletal and soft tissue reconstructions. Skeletal support to prevent flail chest and subsequent respiratory failure is an important requirement for the successful management of chest wall tumors. [1-4] For reconstruction of the central area, a unilateral pectoralis major myocutaneous (PMMC) flap can be used for small defects, and bilateral PMMC flaps, bilateral pectoralis major turn-over flaps, a rectus abdominis muscle flap, a free flap, or other options can be used for large defects. [2-4]

SCC of the head and neck is treated by surgery, radiation, and chemotherapy individually or in combination. [5] However, its recurrence rate is between 60% and 70% for local recurrence or regional metastasis, and between 20% and 30% for distant metastasis. [6] Lung metastases (66%) are the most common form of distant metastases of SCC, followed by bone (22%) and liver (10%) metastases. Metastasis to the chest wall has been rarely reported. [7] Neoadjuvant or adjuvant radiotherapy is often performed for recurrent head and neck tumors, and 3 to 6 months after radiotherapy, reconstructive surgery should be performed carefully because the blood supply to tissues and fibroblast numbers decrease and delay wound healing. [8] During wide tumor resection, reconstructive surgeons should fill dead spaces in the chest cavity and prevent respiratory complications such as flail chest. For skeletal reconstruction, various types of prostheses and metal plates are used to secure skeletal structures. [1-4,9] With technical developments in microsurgery, free flaps have become the most important option for head and neck

reconstruction. However, local flaps, including pectoralis major flaps are also indicated for patients with a poor general condition (i.e., when complete tumor resection cannot be performed). Although salvage operations are inevitable, free flaps are not indicated for these patients. [10]

The reconstruction of soft tissue defects of the chest wall can be performed using local, PMMC, latissimus dorsi (LD), or vertical rectus abdominis muscle flaps depending on the defect size. PMMC flaps such as unilateral PMMC, bilateral PMMC, and PMMC turn-over flaps are used to reconstruct mid-sternal defects, and PMMC flaps based on the thoracoacromial pedicle are usually used as muscle advancement or rotation flaps. [2,3,11] PMMC rotation flaps provide a useful way of addressing sternal defects, but if a defect is too large to cover with a unilateral PMMC flap, bilateral PMMC flaps may provide an appropriate option. Additionally, detachment of the sternocostal head from the clavicular head of the pectoralis major muscle or separation of the insertion site of the pectoralis major muscle aids flap advancement. [3] For larger defect coverage, a rectus abdominis flap or a free flap may be used. In the described case, reconstruction was attempted using PMMC flaps rather than a free flap, because the patient was an elderly cancer patient in poor general condition with recurrence. If a patient's general condition is favorable, a free flap or omental flap is also considered a good choice for very large defect coverage. [2,7,10]

Our study analyzed the versatility in chest wall reconstruction after curative resection of soft tissue malignancy.

Materials and Methods

It was a prospective study of 18 cases of chest wall malignancy presented at Gujarat

Cancer Research Institute & M.P shah cancer hospital, Ahmedabad from January 2015 to December 2015. All patients evaluated clinically, radiologically and pathologically. Already diagnosed cases were rereviewed. Only the operable and nonmetastatic cases were included in study.

Methodology

All the patients underwent wide local excision with appropriate margins as per biopsy reports. The resection done was with curative intent by enbloc excision of all involved anatomy. The defect thus created was highly variable in size, site and depth. All the defects irrespective of

its site, size and depth were reconstructed with appropriately sized PMMC flap.

Postoperatively, patients managed conservatively and aspirin for at least 72 hours. Patients observed for any flap complications and discharged after 6-7 days when flap remain ok. Based on final histopathology report patients advised for adjuvant treatment.

Patients analyzed for the final outcome in terms of postoperative complications, oncological and cosmetic outcome.

Results

Table 1: Gender Distribution

Gender	N %
Male	15 (83.34%)
Female	3 (16.66%)

Out of 18 patients, 15 were males and 03 females (M:F=5:1) with average age of 39.5 years (range 16- 65).

Table 2: Type of tumors

Type of tumors	N %
Soft tissue sarcoma	13 (72%)
Recurrent dermatofibrosarcoma protuberans	9 (50%)
Fibrosarcoma	3 (16.66%)
Ewings sarcoma	1 (5.5%)
Squamous cell carcinoma	3 (16.66%)
Chondrosarcoma	1 (5.5%)
Malignant Melanoma	1 (5.5%)

The most common pathology was soft tissue sarcoma (72%, n=13) – on IHC, 50% (n=09) were recurrent dermatofibrosarcoma protuberans, 16.6% (n=03) were fibrosarcoma and 5.5% (n=01) were ewings sarcoma. The others were squamous cell carcinoma – 16.6% (n=03), chondrosarcoma 5.5% (n=01) and malignant melanoma 5.5% (n=01).

Table 3: Size and locations of tumour

Location of tumour	N %
Upper presternal	7 (38%)
Parasternal	5 (27.7%)
Anterolateral/lateral	5 (27.7%)
Over the shoulder	1 (5.5%)
Average size of the tumour	57.11 cm ²

Size and locations of tumour were highly variable. The average size of the tumour was 57.11 cm² (range 5×5- 15×12 cm²)

and location wise 38% (n=07) were upper presternal, 27.7% (n=05) were parasternal, 27.7% (n=05) anterolateral/lateral and

5.5% (n=01) were over the shoulder. Curative en bloc resection including biopsy sites done in all cases with adequate margins – 3 cm. in DFSP and >1cm. in rests. Average size of chest wall

defect noted was 106.72 cm² (range 7×7-20×15cm²). All the defects were closed by single stage ipsilateral or contralateral, unilateral or bilateral appropriately sized PMMC only flap.

Table 4: Postoperative complications and Aesthetic outcomes

Postoperative complications	N %
Infection and dehiscence	2 (11.1%)
Marginal necrosis	1 (5.5%)
Aesthetic outcomes	
Excellent	6 (33%)
Moderate	7 (37.7%)
Acceptable	5 (27.7%)

Postoperative complications were minor: Infection and dehiscence in 11.1% (n=02), marginal necrosis in 5.5% (n=01) without any flap loss or donor site complications. After minimum follow up of 12 months there was no any recurrence. Aesthetic outcomes were excellent in 33% (n=06), moderate in 37.7% (n=07) and acceptable in 27.7% (n=05) patients.

Discussion

Due to its versatility, the pedicled pectoralis major myocutaneous (PMMC) flap is extensively used for the treatment of surgical defects resulting from oral and maxillofacial cancer ablation. Despite the fact that microvascularized free-tissue transfer is increasingly becoming the main flap method for oral, head and neck cancer reconstruction, this method cannot be used effectively in certain situations, including recurrence following reconstruction (salvage), in the presence of poor systemic or local conditions, following full-dose radiotherapy, in patients with arteriosclerosis or in the elderly.

There are numerous literatures on PMMC reconstruction in head and neck oncology evaluating indications, technique, reliability, complications and functional & aesthetic outcomes but literatures over the chest wall oncological reconstruction by PMMC flap is limited. Traditionally, soft tissue defect was covered by skin flaps. However, with better understandings of

the pattern of blood supply to local musculocutaneous flap based on Mathes and Nahai classification system, these become the preferred by the 1970. [12] A large series of PMMC reconstruction of anterior chest wall defect was done by Jurkiewicz et al [13] and Asherman et al [14] in 114 cases but for benign infected condition after midline sternotomy.

PMMC flap proven to be versatile in anterior chest wall reconstruction mainly by Arnold and Pairolero who described soft tissue chest wall reconstruction by PMMC flap in 77 cases but again more than half of the cases were benign. [15] As per this study it can cover most defect in upper central region but also on lateral part. In our study, PMMC flap covered almost every part of the chest wall – anterior, lateral, anterolateral and shoulder.

Raman Chaos Mahabir et al described the preference of small to moderate defect (upto 5cm) closure by musculocutaneous flap and larger to be covered by prosthetic material. [16] In our study, PMMC flap covered the very large defect size upto 300 cm². In female patient with large breast, breast tissue flap along with musculocutaneous tissue of pectoralis major can cover the very large defect. [17]

Chang et al described 10-year experience of oncological chest wall reconstruction by myocutaneous flap at MSKCC of 106 patients. Only 4% of patients had partial

flap loss otherwise 85% of cases had stable healed chest wound without any complication and recurrence. [18] In Arnold et al study 83% had excellent results with a healed asymptomatic chest wall after average follow up of 57 months. The complications and results in our study almost similar to these studies. [13]

Massive chest wall resection with immediate reconstruction has been shown to be safe and aesthetically effective. [19] In our study aesthetic results are also effective. [20] Advances in research and microvascular technique will continuously add the free flap in the reconstruction of the chest wall but with high morbidity (~44%) and greater expenses. In our study, morbidity and expenses both are minimum.

Conclusion

For chest wall malignant reconstruction also, PMMC is highly versatile and reliable flap with excellent vascularity, wide arc of rotation, large flap dimension, easy harvest, economical and with least complications. It can cover very large size defect at any location with minimum complication and best aesthetic as well as oncological results.

References

1. Mansour KA, Thourani VH, Losken A, Reeves JG, Miller Jr JI, Carlson GW, Jones GE. Chest wall resections and reconstruction: a 25-year experience. *The Annals of thoracic surgery*. 2002 Jun 1;73(6):1720-6.
2. Novoa NM, Alcaide JA, Gomez Hernández MT, Fuentes M, Goñi E, Jimenez Lopez M. Chest wall-reconstruction: yesterday, today, and the future. *Shanghai Chest*. 2019; 3 (3):15.
3. Bakri K, Mardini S, Evans KK, Carlsen BT, Arnold PG. Workhorse flaps in chest wall reconstruction: the pectoralis major, latissimus dorsi, and rectus abdominis flaps. In *Seminars in plastic surgery* 2011 Feb (Vol. 25, No. 01, pp. 043-054). © Thieme Medical Publishers.
4. Weyant MJ, Bains MS, Venkatraman E, Downey RJ, Park BJ, Flores RM, Rizk N, Rusch VW. Results of chest wall resection and reconstruction with and without rigid prosthesis. *The Annals of thoracic surgery*. 2006 Jan 1;81(1):279-85.
5. Na SK, Cho HJ, Jeon JH, Park CH, Rho YS, Lim HJ. The value of salvage operation for recurrent head and neck cancer after surgery alone or surgery with radiotherapy. *Korean Journal of Otorhinolaryngology-Head and Neck Surgery*. 2001 Mar 1;44(3):301-4.
6. Armand JP, Cvitkovic E, Recondo G, Wibault P, Schwaab G, Domenge C, Tellez-Bernal E, Gandia D, Luboinski B, Eschwege F, de Forni M. Salvage chemotherapy in recurrent head and neck cancer: the Institut Gustave Roussy experience. *American journal of otolaryngology*. 1993 Sep 1;14 (5) :301-6.
7. Ferlito A, Shaha AR, Silver CE, Rinaldo A, Mondin V. Incidence and sites of distant metastases from head and neck cancer. *ORL*. 2001; 63 (4): 202-7.
8. Haubner F, Ohmann E, Pohl F, Strutz J, Gassner HG. Wound healing after radiation therapy: review of the literature. *Radiation Oncology*. 2012 Dec;7(1):1-9.
9. Turna A, Kavakli K, Sapmaz E, Arslan H, Caylak H, Gokce HS, Demirkaya A. Reconstruction with a patient-specific titanium implant after a wide anterior chest wall resection. *Interactive cardiovascular and thoracic surgery*. 2014 Feb 1;18(2):234-6.
10. You YS, Chung CH, Chang YJ, Kim KH, Jung SW, Rho YS. Analysis of 120 pectoralis major flaps for head and neck reconstruction. *Archives of plastic surgery*. 2012 Sep;39(05):522-7.
11. Solomon MP, Granick MS. Bipedicle muscle flaps in sternal wound repair.

- Plastic and reconstructive surgery. 1998 Feb 1;101(2):356-60.
12. Mathes SJ. classification of The Vascular anatomy of muscles: experimental and clinical correlation 1981. In 50 Studies Every Plastic Surgeon Should Know 2014 Oct 14 (pp. 57-62). CRC Press.
 13. Jurkiewicz MJ, Arnold PG. The omentum: an account of its use in the reconstruction of the chest wall. *Annals of surgery*. 1977 May;185 (5): 548.
 14. Ascherman JA, Patel SM, Malhotra SM, Smith CR. Management of sternal wounds with bilateral pectoralis major myocutaneous advancement flaps in 114 consecutively treated patients: refinements in technique and outcomes analysis. *Plastic and reconstructive surgery*. 2004 Sep 1;114(3):676-83.
 15. Arnold PG, Pairolero PC. Chest-wall reconstruction: an account of 500 consecutive patients. *Plastic and reconstructive surgery*. 1996 Oct 1;98 (5):804-10.
 16. Mahabir RC, Butler CE. Stabilization of the chest wall: autologous and alloplastic reconstructions. In *Seminars in plastic surgery*. Thieme Medical Publishers. 2011 Feb; 25(01): 034-042.
 17. Baek SM, Lawson W, Biller HF. An analysis of 133 pectoralis major myocutaneous flaps. *Plastic and reconstructive surgery*. 1982 Mar 1;69 (3):460-9.
 18. Chang RR, Mehrara BJ, Hu QY, Disa JJ, Cordeiro PG. Reconstruction of complex oncologic chest wall defects: a 10-year experience. *Annals of plastic surgery*. 2004 May 1;52(5):471-9.
 19. Mansour KA, Thourani VH, Losken A, Reeves JG, Miller Jr JI, Carlson GW, Jones GE. Chest wall resections and reconstruction: a 25-year experience. *The Annals of thoracic surgery*. 2002 Jun 1;73(6):1720-6.
 20. Abid Z., Ramzan M. A., Sheroze M. W., Jamal K., Batool R., & Mazher S. Prevalance of Depression and Its Association with Cigarette Smoking among Undergraduate Students; A Cross-Sectional Study from Karachi. *Journal of Medical Research and Health Sciences*. 2022; 5(2): 1786–1790.