

Chest wall and diaphragm reconstruction; a technique not well established in literature

Riad Abdel Jalil (✉ da.06648@khcc.jo)

1. Department of Thoracic Oncology, King Hussein Cancer Center

Hanna Kakish

Jordanian Royal Medical Services

Mohamad K. Abou Chaar

King Hussein Cancer Center <https://orcid.org/0000-0002-9584-2184>

Obada Al-Qudah

King Hussein Cancer Center

Case report

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Abstract

Introduction: The treatment for most primary chest wall tumors is wide excision. After radical chest wall resection, skeletal reconstruction, when appropriate to preserve the reconstruction, is the essential element for successful management.

Case presentation: We describe a case of a 27-year-old male patient who had chest wall and diaphragm reconstruction for a recurrent chest wall tumor, using a single patch of Polytetrafluoroethylene (PTFE) mesh with diaphragm implanted into the middle of the mesh. There were no operative complications. The patient received post-operative radiotherapy with good functional and cosmetic results.

Conclusion: We present a novel and safe technique resulting in stable results after full-thickness multi-rib chest wall resections involving the diaphragm.

Introduction

Chest wall tumor is a generic term that includes primary neoplasm (both benign and malignant); chest wall metastases; neoplasms that invade the chest wall from nearby organs; and benign nonneoplastic conditions. Primary tumors of the chest wall are rare, heterogenous group of neoplasms with an incidence of 2% of the population ^[1] and arise from the bone, soft tissue or cartilage of the chest wall. These can be benign or malignant and radiological features of soft tissue involvement and cortical destruction are specific distinguishing features of malignancy. Here, we describe a technique of reconstructing a chest wall defect involving the lower costal margin and diaphragm.

Case Presentation

27-year-old male patient, with a history of left chest wall Ewing sarcoma ten years prior to his current presentation and on regular follow ups, presented to our clinic with a right chest pain of one-month duration. A right chest wall mass (about 5 centimeters, anterior to the anterior axillary line, firm, non-tender, fixed to the chest wall and without overlying skin changes) was found upon examination. Accordingly; a computed tomography (CT) scan of the chest with contrast was performed and showed right chest wall mass involving the right tenth rib laterally with large soft tissue component indenting the liver surface. A fluorodeoxyglucose positron electron tomography (FDG-PET) scan revealed a hypermetabolic mixed lytic/sclerotic bony lesion; which was consistent with the CT findings. There were no involvement of abdominal organs and no other hypermetabolic lesions. Ultrasound guided mass biopsy was done and showed tumor cells positive for Cluster of Differentiation 99 and Friend Leukemia Integration-1 suggestive of recurrent primitive neuroectodermal tumor (PNET)/Ewing Sarcoma. Patient received three cycles of neoadjuvant chemotherapy with mild regression of soft tissue component of the bony lesion from 5.5 cm to 3.5 cm. Then the patient underwent Open resection of right chest wall. The operation was performed in the left lateral position under general anesthesia. The surgery involved a wide local resection of the mass including the tenth rib with 4 cm margins anteriorly and posteriorly, plus

resection of part of the ninth and eleventh ribs and part of the diaphragm and abdominal wall. We used a single patch of Dulex/Polytetrafluoroethylene (PTFE) mesh for chest wall reconstruction. After placing the mesh into a satisfactory position, we reconstructed the diaphragm by suturing the diaphragm directly along the middle part of the inner surface of the mesh using continuous runs of ethibond (Fig. 1). The edges of the mesh were then secured with interrupted runs of prolene 0 to the eighth and 12th ribs (Fig. 2). Primary closure of the muscle over the mesh was done, then suturing of the subcutaneous tissue and skin. The operation had minimal blood loss, did not require any blood transfusion and the operation course was smooth. Chest tube was removed on post-operative day one; the post-operative (Post-op) course was smooth and the patient was discharged on day 3 post-op. Pathology of the specimen revealed tumor consistent with PNET/Ewing sarcoma. Patient then received adjuvant Chemotherapy and Radiotherapy. CT on his last follow up after completion of chemotherapy and radiotherapy showed no evidence of local recurrence or Lung/distant metastasis.

Discussion

All chest wall tumors should be considered malignant until proven otherwise. Wide resection with the achievement of microscopically negative margins should be the goal of surgical resection to improve local control and to prevent local recurrence in both benign and malignant lesions.

Wide Radical surgical resection is the treatment of choice for malignant chest wall tumors, and is exactly as the name implies, that is; no compromise should be made to reduce the size of the defect. Chest wall resection involves resection of the ribs, sternum, costal cartilages and the accompanying soft tissues. The reconstruction of the defect depends on the site and extent of the resected chest wall.

Diaphragm involvement by a tumor, which is mostly due to secondary tumors invading the diaphragm rather than primary tumors of the muscle itself, entails diaphragm reconstruction along with chest wall reconstruction. Reconstruction is done to prevent paradoxical movement of the chest (flail chest), provide support and to protect the underlying organs and prevent their herniation.

When possible, defects should be closed primarily by approximation of the muscle or skin. This is generally possible for defects less than 5 centimeters and high posterior defects less than 10 cm, as the scapula provides support. Large defects require reconstruction with either autologous tissue (flaps), prosthetic material or both. The advantage of using the autologous choice reduced risk of infection and no permanent foreign bodies are left in situ. The cons are all the potential complications related to the harvesting procedure (donor-site complication, graft failure, arm impaired mobility and prolonged operating time). Recently, with increased development of safe prosthetic options, the reconstruction is more often accomplished by meshes. For the most part, the choice of prosthetic material is based on surgeon's preference, different synthetic nets are now available, but none of them have proven to be significantly superior [2]. In our case, we use PTFE, which is an excellent material that proved the needed strength and is watertight. Not many reports are found discussing diaphragm reconstruction combined with chest wall reconstruction for chest wall tumors. Diaphragm is pulled to the original position and

sutured to the rib, without additional mesh usage. The common way for diaphragmatic reconstruction after resection is proposed by Sugarbaker and colleagues [3] using a synthetic mesh; where the patch is anchored in place by suturing it to the surrounding structures, following the natural course of the diaphragm with care taken to stretch the patch and place the sutures under some tension to avoid billowing of the patch [3, 5, 7]. Some studies discuss the use of fascia lata graft [4] and latissimus dorsi flap for diaphragmatic reconstruction [6, 8]. As mentioned above, in our patient we did a chest wall reconstruction using a PTFE mesh, then the diaphragm was pulled laterally and sutured to the middle part of the inner surface mesh (Fig. 1). As suturing the diaphragm to the 12th or eighth ribs would stretch the muscle and thus pose mechanical difficulties with the breathing process.

Abbreviations

PTFE

Polytetrafluoroethylene

CT

Computed tomography

FDG-PET

fluorodeoxyglucose positron electron tomography

PNET

Primitive Neuroectodermal tumor

Declarations

Ethics approval and consent to participate

NA

Consent for publication

We have obtained written informed consent from the patients to publish this report.

Availability of data and materials

NA

Competing interests

NA

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NA

Authors' Contributions:

HK performed the literature search and wrote the manuscript guided by RAJ. MKAC reviewed the manuscript, obtained consent from the patient, made some changes and oversaw the submission process. RAJ and OAQ oversaw the manuscript's inception, guided the literature search, counseled the patient, performed the procedure, wrote portions of the manuscript, and provided major revisions. All authors read and approved the final manuscript.

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Not applicable.

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Figures

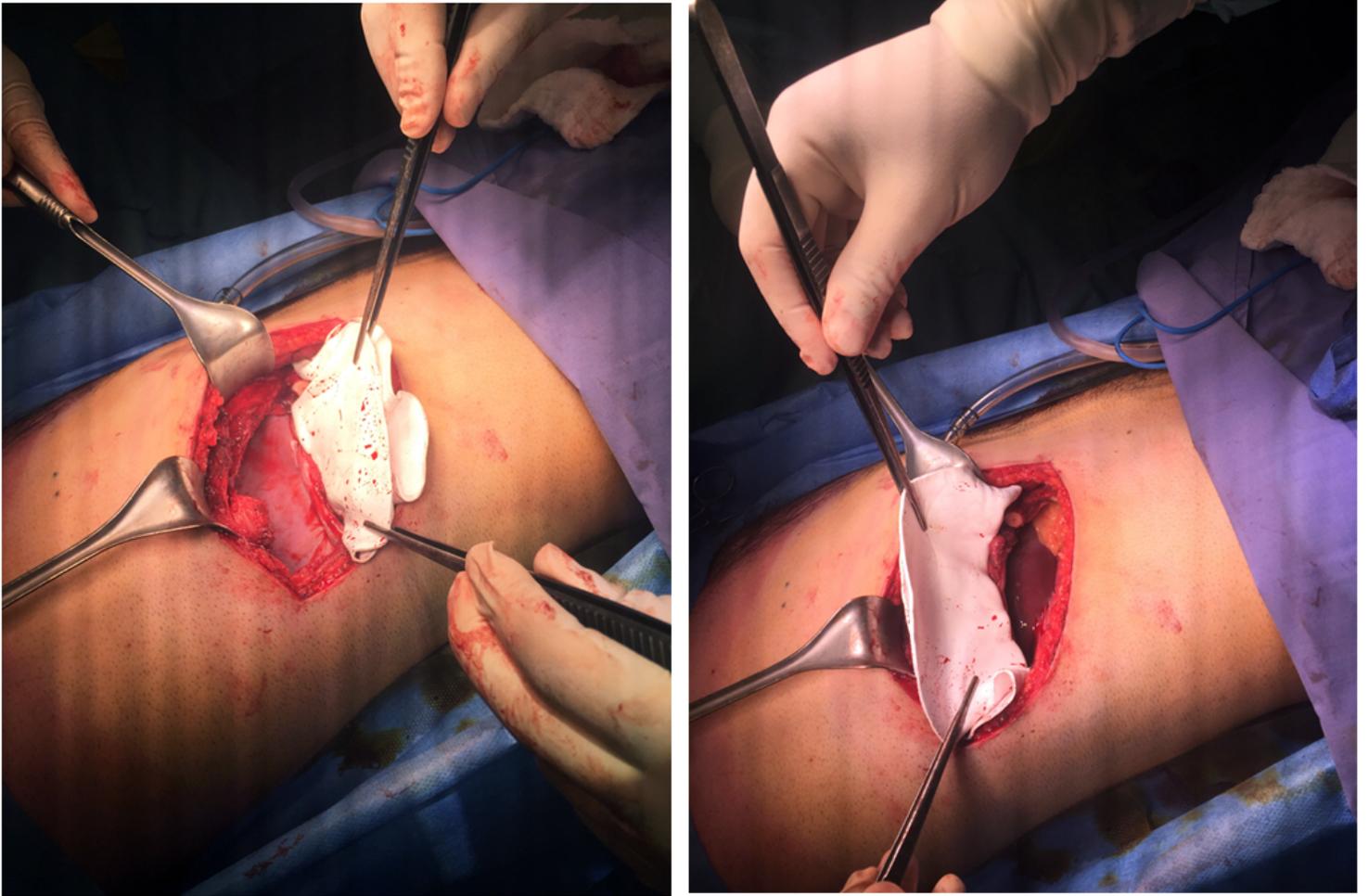


Figure 1

Intraoperative images showing the polytetrafluoroethylene mesh along the middle part of the inner surface being sutured to the edges of the diaphragm.



Figure 2

Intraoperative image showing the polytetrafluoroethylene mesh after it was sutured using Prolene size 0 suture to the eighth and eleventh ribs using interrupted suturing technique