CASE REPORTS

INNOVATIVE 3D-PRINTED PROSTHESIS IN A RARE CASE OF A HUGE MASS OF ANTERIOR THORACIC WALL – LOW GRADE FIBROMYXOID SARCOMA (LGFMS)

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Abstract

The need for complete resection of chest wall tumors creates a huge challenge in terms of reconstructing the complex dynamics of the thorax. We are reporting a case of a low-grade fibromyxoid sarcoma (LGFMS) diagnosed in a young male, where the complete resection of the mass, sternum and parcially the pericardium was performed. Subsequently, a composite porous high-density polyethylene StarPore® prosthesis of the sternum and costal arches was used and the latissimus dorsi muscle free flap with skin graft was implanted over the sternum.

Keywords: *: LGFMS, low-grade fibromyxoid sarcoma, soft tissue sarcoma, 3D printed prosthesis, StarPore, re-constructive surgery, chest reconstruction, sternal implant.*

INTRODUCTION

LGFMS is a rare tumor first described by Evans in 1987 and thus also known as Evans Tumor.

It is characterized by indolent nature, but not without the risk of metastases and recurrence.

CLINICAL CASE

An 18-year-old male without relevant medical history or current medication was evacuated from Guine-Bissau due to a diagnosis of a giant mass with 9 years of a progressive growth.

Chest CT described a bulky mass on the anterior surface of the chest, measuring approximately 17x17x12cm, originating from the body of the sternum at the level of the 3rd intercostal space The mass was heterogeneous with multiple images of calcifications, showing lysis and sclerosis to the body of the sternum and suggesting a chondroma as the first diagnostic hypothesis.

Morphological aspects and IHC profile of incisional biopsies favoured diagnosis of LGFMS.

A resection of the mass, sternum and costal arches with partial resection of the pericardium to secure the surgical margin free of tumor was performed. Subsequently a pericardium GoreTex patch was used to close the pericardial defect and the sternum and costal arch 3D-printed StarPore prosthesis was placed. Then the latissimus dorsi muscle free flap with skin graft was implanted over the sternum.

The surgery ran uneventfully and the patient was admitted to the ICU for the post-operative recovery.

In a final histopathological description of the resected mass, the diagnosis of LGFMS was made.

Currently, 16 months after the surgery, the patient's condition is good, and he has been under surveillance in the Outpatient Clinic.

Figure 1 *The giant thoracic mass.*

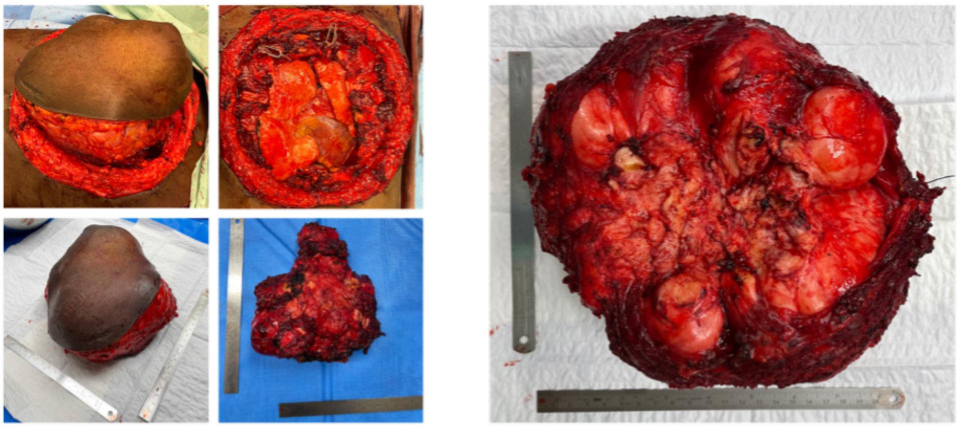

Figure 2 *A resection of the mass, sternum and costal arches with partial resection of the pericardium.*

DISCUSSION

Surgical resections of malignant tumors are the most frequent cause of thoracic wall defects[2]. Although the LGFMS tumors are rare and mainly indolent entities, their behaviour can be also marked by recurrences and a risk of distant metastases, thus a complete resection is the gold standard. This need for complete and frequently vast resections, commonly leaving patients with extensive and incapacitating chest wall defects, has created a huge challenge in terms of reconstructing the complex dynamics of the chest wall.[3] The necessity of finding a material which is rigid and durable enough to maintain thoracic stability, but sufficiently flexible to preserve its mechanics and respiratory function, has created a need for the quick development of innovative materials, especially in cases involving young active patients, whose thorax is still subjected to growth and remodelling.

The essential part of the successfull procedure is a close collaboration with Unit of Plastic and Recontructive Surgery which in this case enabled reestablishment of the muscular and cutaneos part of thoracic wall.[4]

The first report of sternocostal reconstruction by custom-made prosthesis after extensive resection of a chest wall sarcoma was resported by Aragón and collegues in 2015. The material they used though was a 3D-printed titanium prosthesis.[2] With the evolution in materials, the first polyethilen 3D-printed ribcage was implanted in May 2019 in Singapore. Since then, StarPore® prostheses have been successfully implanted in 24 patients worldwide.

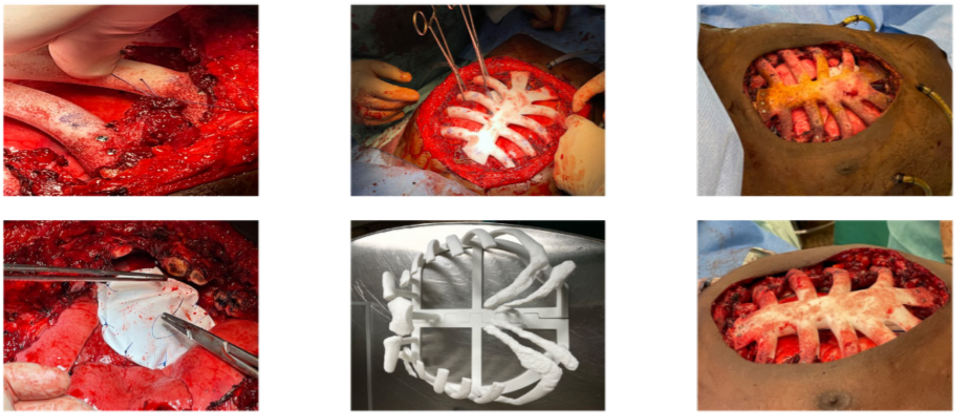

Figure 3 *Thoracic cage reconstruction with the composite porous high-density polyethylene StarPore® prosthesis of the sternum and costal arches.*

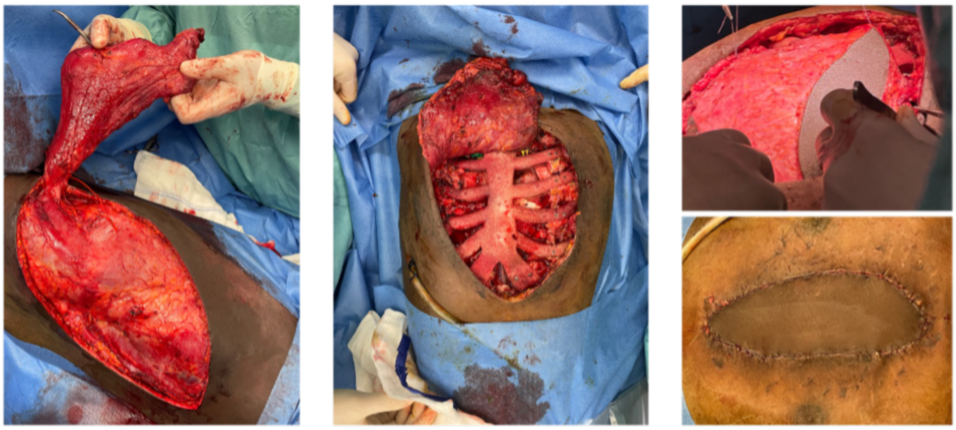

Figure 4 *Reconstruction with the latissimus dorsi muscle free flap with skin graft and the final effect.*

To the authors' knowledge, the presented procedure for implanting polyethylene custom-made prosthesis was the second one performed in Portugal.

We report the use of the innovative StarPore® prosthesis, which has clear advantages over the other custom-made prostheses. It is significantly lighter compared to PEEK or titanium, as well as much easier to manipulate during the implantation. 3D-printed specimens allow for a perfect fit and the creation of the most complex bone structures. Surgical margins and extension of resection are defined by the surgeon before the intervention, during pre-operative planning. A template was used, allowing to cut and intraoperatively modify the shape and size of the prosthesis without risking damaging the original material. Other innovations include the biocompatibility and high porosity, which is higher in StarPore samples in comparison to other materials, according to the study performed at University of Melbourne[5], stating that the porous characteristics of the material structure can facilitate the soft tissue and fibrovascular ingrowth and augment its integration, reducing infection and tissue erosion. Its properties include being a biologically neutral material which does not react with any tissue, bone or liquids and does not support growth of any organism.[6] Being a polyethylene, the material gives the possibility of soft tissue being sutured anywhere in the implant, as well as not causing imaging artefacts, an especially important feature for oncology cases and post-operative imaging.

The limiting factors are certainly the high costs of the production, which can significantly limit the access to these prostheses, as well as the time of printing and the complex logistics associated with production. For the oncologic cases, in which time is crucial and even the slight delay can have an impact on resecability and general outcome, it is an important limiting factor.

While we still lack long-term evaluation, the short-term effects, both cosmetic and in terms of respiratory function, are outstanding. We believe that with time and futher development of this technique, the accessibility, price and time of production will improve and the future will bring proper evaluation of long-term outcomes.

CONCLUSIONS

The LGFMS tumors are rare masses for which the first-line treatment is a surgical complete resection (R0), which, taking into consideration its dimensions, can cause important and debilitating chest wall defects.

The new promising method of chest wall reconstruction using the polyethylene StarPore® 3D-printed custom-made prosthesis seems to be of great value, but long-term evaluation of this method is necessary to fully assess its functionality and outcome.

The LGFMS are prone to recur both locally or as distant metastases, especially during the first two years after the resection, so a close follow-up is recommended.

Conflict of Interest:
The authors declare no conflict of interest.
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REFERENCES

1. Mir Ibrahim Sajid, Sidra Arshad, Jamshid Abdul-Ghafar, Saulat Hasnain Fatimi and Nasir Ud Din, Sajid et al.; Low-grade fi-bromyxoid sarcoma incidentally discovered as an asymptomat-ic mediastinal mass: a case report and review of the literatureJ Med Case Reports (2021) 15:50 https://doi.org/10.1186/s13256-020-02605-4
2. Aragón J, Pérez Méndez I. Dynamic 3D printed titanium copy prosthesis: a novel design for large chest wall resection and reconstruction. J Thorac Dis 2016;8(6):E385- E389. doi: 10.21037/jtd.2016.03.94
3. Novel Sternal Reconstruction With Custom Three-Dimensional–Printed Titanium PoreStar Prosthesis Minh D. Tran, MD, Jason A. Varzaly, MBBS, Justin C.Y. Chan, MBBS, Yugesh Caplash, MBBS,† and Michael G. Worthington, MBChB
4. João Nunes Pombo, Artur Nixon Martins, Catarina Paias Gouveia, Ágata Nawojowska, Samuel Mendes, Daniel Cabral, Francisco Félix, Bruno Rosa, Carlos Pinheiro, Miguel Andrade & Gaizka Saenz Ribeiro (2022) Rare case of low-grade fi-bromyxoid sarcoma of the thoracic wall with complete sternum reconstruction, Case Reports in Plastic Surgery and Hand Sur-gery, 9:1, 126-130, DOI: 10.1080/23320885.2022.2064290
5. Javad Jafari, Sheridan Mayo Abigail Augustine, Fatemeh Ma-lekipour, Philip M. Lewis, Daniel Heath, Andrea J. O'Connor The pore and wettability characteristics of porous polyethylene implants
6. Lipinska J, Kutwin L, Wawrzycki M, Olbrzymek L, Jabłonski S. Chest reconstruction using a custom-designed polyethylene 3D implant after resection of the sternal manubrium. Onco Targets Ther. 2017;10:4099-4103; https://doi.org/10.2147/OTT.S135681