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CASE REPORT

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Complete resection of a giant costal chondrosarcoma with reconstruction of the thoraco-abdominal wall: a case report

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Abstract

Background Chondrosarcoma primarily occurs in the pelvis and femur, with occasional cases in the ribs. Surgical resection remains the main treatment method for costal chondrosarcoma. However, complete resection often leads to a large range of chest wall defects and a challenging reconstruction.

Case presentation A 49-year-old female patient presented with progressive swelling of the right chest and abdominal wall over 15 years. Chest CT revealed a 20.1 × 15.6 × 13.7 cm multilocular cystic-solid mass with internal calcification, encircling the 8th to 12th ribs and causing elevation of the right diaphragm. Compression of the liver resulting in a significant reduction in volume. Based on an ultrasound-guided biopsy, chondrosarcoma Grade I was diagnosed. After a multi-disciplinary discussion, we performed a complete resection of the tumor, including the 8th to 12th anterolateral ribs and part of the diaphragm. The diaphragm was then reconstructed by suturing it to the ribs and intercostal muscles at the resection margin. The thoraco-abdominal wall defects were reconstructed with a polypropylene mesh. Finally, we excised the excess skin and then closed the incision. Histopathologic diagnosis was chondrosarcoma Grade II. The postoperative course was uneventful. At the 3-month postoperative follow-up, no signs of recurrence were observed.

Conclusions Wide en-bloc resection followed by reconstruction using polypropylene mesh is feasible and cost-effective for costal chondrosarcoma with limited invasion. This case illustrates the importance of meticulous preoperative planning and multi-disciplinary discussion.

Keywords Chondrosarcoma, Thoraco-abdominal wall, Reconstruction, Case report

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Background

Chondrosarcoma, a rare type of solid tumor, primarily occurs in the pelvis and femur, with occasional cases in flat bones like the sternum and ribs [1]. Costal chondrosarcoma accounts for merely 5−15% of all chondrosarcoma cases [2] and tends to reach a significant size before symptoms begin to manifest. The effects of radiotherapy and chemotherapy on chondrosarcoma are quite limited [3]; prognosis mainly depends on the tumor grade and the completeness of surgical resection. Although surgical resection remains the main treatment method, it faces some challenges. A giant costal chondrosarcoma may invade the chest and abdominal wall simultaneously, and has close connections with surrounding tissues; complete resection often leads to a large range of chest wall defects and a challenging reconstruction, especially when it involves the sternum, spine, or multiple consecutive ribs [4]. Therefore, multi-disciplinary discussion and developing a meticulous preoperative plan which includes a way of reconstruction are important. Here, we present a case study involving surgical resection and thoraco-abdominal wall reconstruction for a patient suffering from a giant costal chondrosarcoma.

Case presentation

A 49-year-old female patient presented with progressive swelling of the right chest and abdominal wall over 15 years. There was no associated fever, coughing, shortness of breath, pain, chills, or night sweats. Her body mass index was 16.82. The physical examination revealed a giant well-circumscribed mass located at the junction of the right chest and abdominal wall, between the anterior axillary line and the posterior axillary line (Fig. 1A). Upon palpation, the tumor was hard and fixed to the chest and abdominal wall. The skin was not involved, and no tenderness was observed.

Her laboratory test results were all normal. Preoperative cardiopulmonary exercise test indicated that the patient's cardiopulmonary function was good. Chest CT showed a 20.1×15.6×13.7 cm multilocular cystic-solid mass with internal calcification encircling the 8th to 12th ribs (Fig. 1B). The mass elevated the right diaphragm. Muscles and skin of the right abdominal wall were displaced. The liver and right kidney were compressed, resulting in a significant reduction in liver volume (Fig. 1C). Three-dimensional reconstruction showed that the mass had suspicious invasion of the liver and was merely adjacent to the right kidney (Fig. 1D). Based on an ultrasound-guided biopsy performed on this site, chondrosarcoma Grade I was diagnosed.

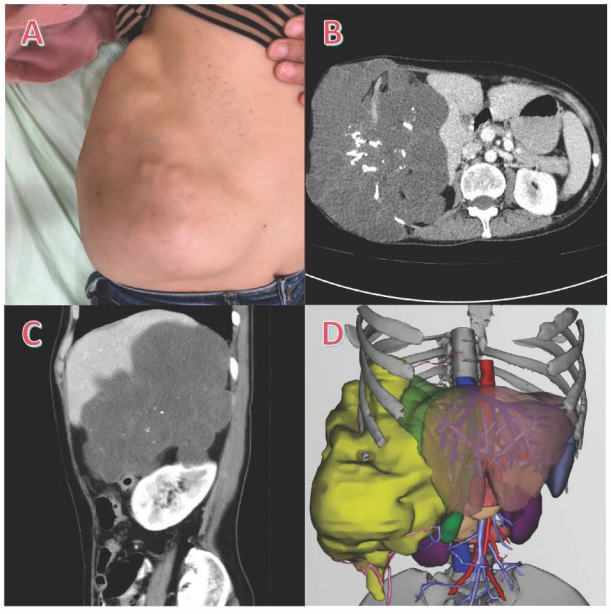

Fig. 1 **A**: A giant mass located at the junction of the right chest and abdominal wall, between the anterior axillary line and the posterior axillary line. **B**: CT showed a 20.1×15.6×13.7 cm multilocular cystic-solid mass with internal calcification compressed the liver, resulting in a significant reduction in volume. **C**: CT Showed the relationship between the tumor and the liver and right kidney in the sagittal plane. **D**:Three-dimensional reconstruction visually illustrated the relationship between the tumor and its surrounding tissues

Due to the tumor's adjacency to several organs and the relatively large resection area, we conducted a multidisciplinary discussion before the surgery, involving a radiologist, oncologist, pathologist, thoracic surgeon, hepatobiliary surgeon, and urological surgeon. The focus of the discussion was on: (1) diagnosis; (2) preparations for partial resection of the liver and right kidney if invaded by the tumor; and (3) reconstruction of the chest and abdominal wall after resection. Following the multidisciplinary discussion, we concluded that the diagnosis of chondrosarcoma was established. The surgery required collaboration between hepatobiliary and thoracic surgeons, with the primary focus of tumor resection on achieving sufficient margins. Reconstruction aimed to be as simple and effective as possible while restoring the integrity and function of thoracic wall and abdominal wall.

Using standard anesthesia and bilateral lung ventilation, a 25 cm fusiform incision was made on the surface of the tumor (Fig. 2A), and the superior and inferior skin flaps were freed to a sufficient distance to fully expose the tumor on the chest. The 8th to 12th anterolateral

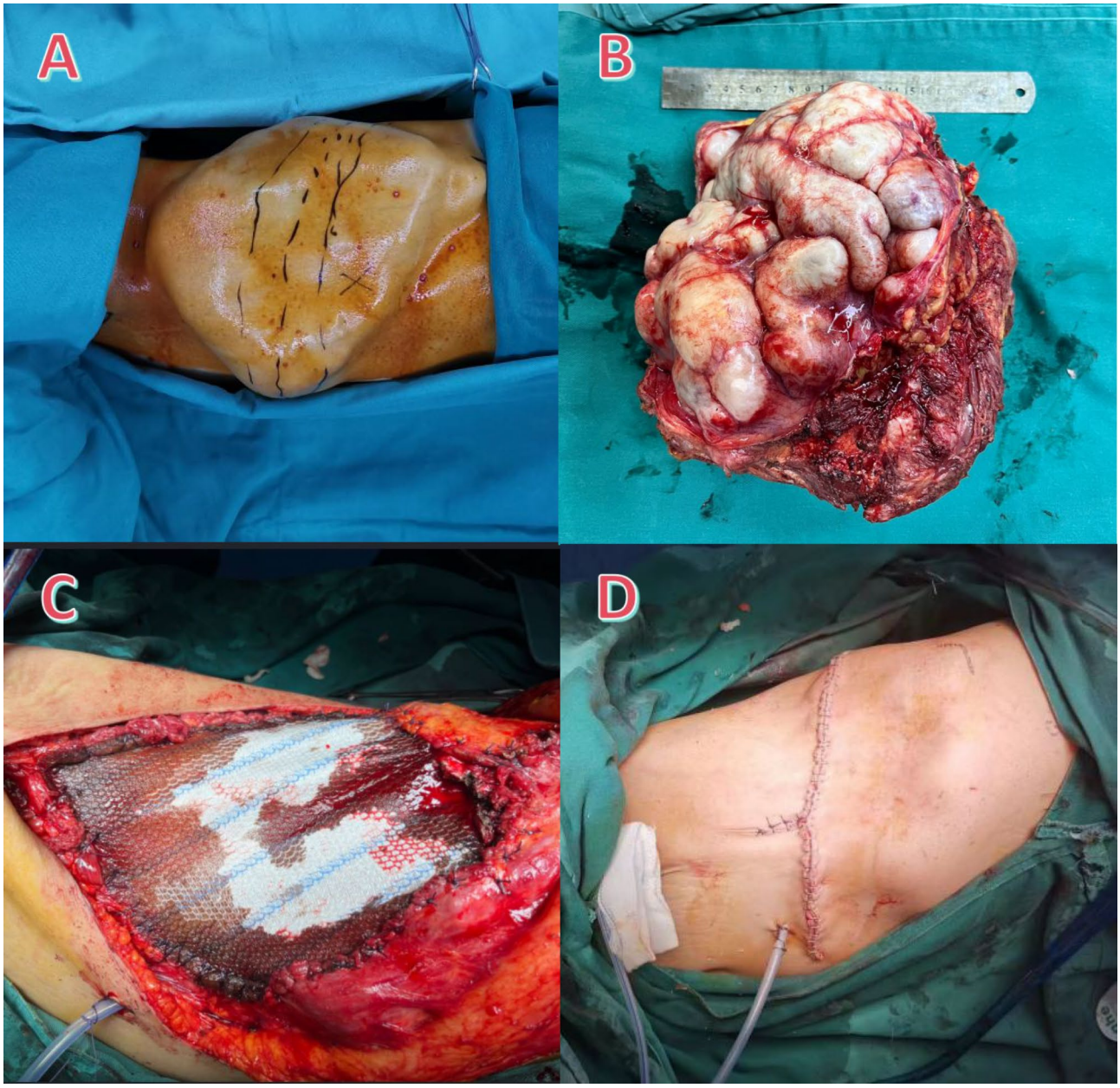

Fig. 2 A: A 25 cm fusiform incision was made on the surface of the tumor. B: Display of the completely excised tumor. C: Costal chondrosarcoma was removed and thoraco-abdominal wall defects were reconstructed with a polypropylene mesh. D: The excess skin was excised, and the incision was closed. Drainage tubes were placed in both the abdominal cavity and subcutaneous cavity

ribs and intercostal muscles were resected to expose the tumor in the thoracic and abdominal cavities, maintaining a margin of more than 2 cm around the tumor [5]. We found the tumor invaded the diaphragm, compressed the liver and the right kidney, and had partial adhesion to the mesentery. Therefore, we dissected the adhesion, resected part of the diaphragm, and removed a portion of the skin, including the skin at the biopsy site, along with the tumor entirely. (Fig. 2B). And then, the diaphragm was reconstructed by suturing it to the ribs and intercostal muscles at the resection margin, the thoraco-abdominal wall defects were reconstructed with a 15 cm × 15 cm single layer polypropylene mesh which had good biocompatibility and high strength (Fig. 2C). Drainage tubes were placed in both the abdominal cavity and subcutaneous cavity. Finally, we made an inverted triangular incision on the inferior skin flap, excising the excess skin and closing the incision (Fig. 2D). The surgical area was compressed and bandaged to ensure that the skin and mesh remain firmly attached. The abdominal and subcutaneous drainage tubes were removed on the fifth day after surgery. Postoperative histopathology confirmed chondrosarcoma Grade II with negative margins (Fig. 3A). The postoperative course was uneventful, and the patient

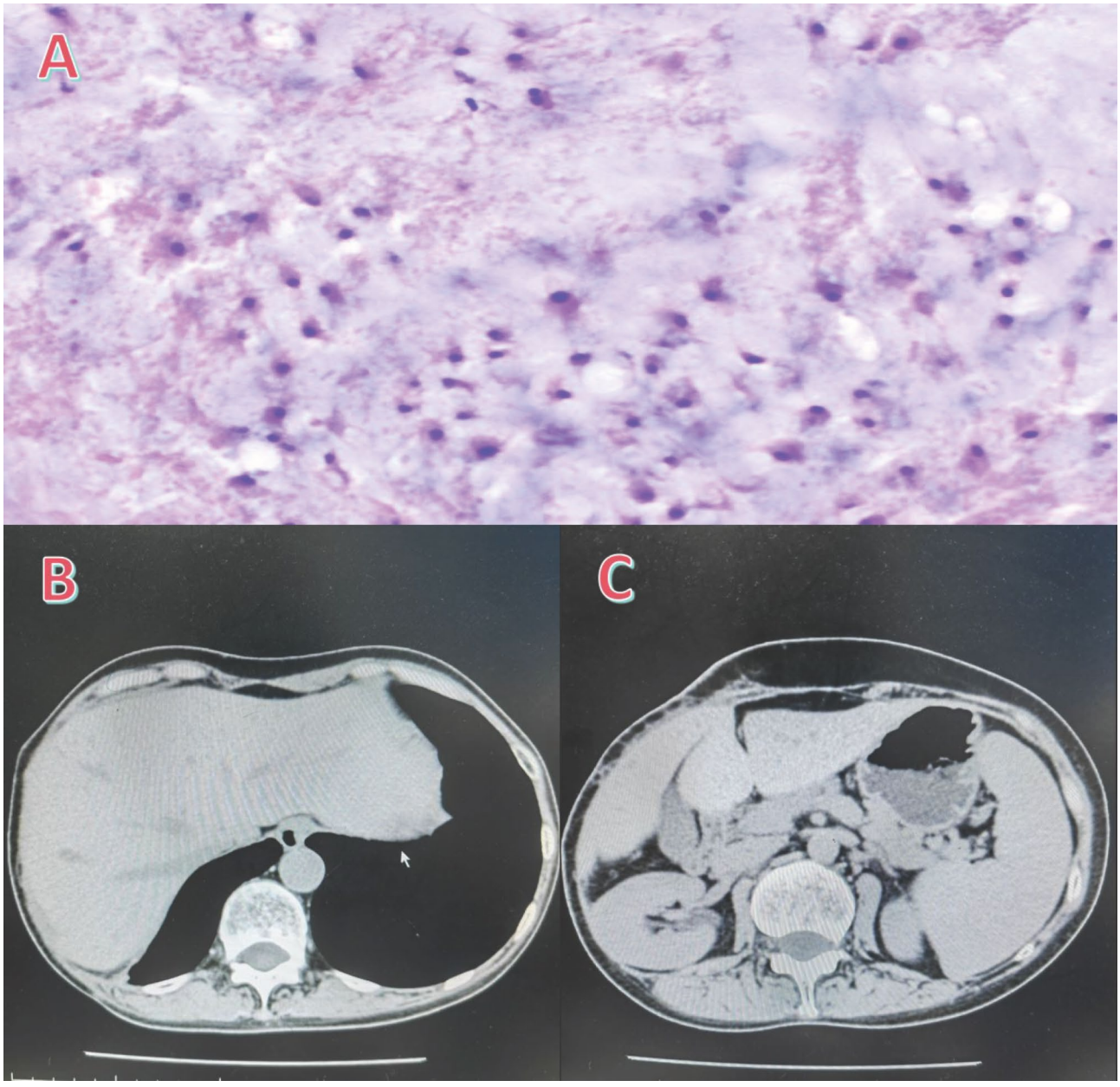

Fig. 3 **A**: A few mitotic figures were visible, with extensive myxoid degeneration in the cartilaginous matrix, suggesting a chondrosarcoma Grade II (HE × 200). **B**: The chest CT image from the follow-up three months after surgery. **C**: The abdominal CT image from the follow-up three months after surgery

was discharged on postoperative day 10. At the 3-month postoperative follow-up, no signs of recurrence were observed (Fig. 3B and C).

Discussion

Chondrosarcoma is a relatively rare malignant bone tumor with an incidence of approximately 1–2 cases per million people per year in the general population. It originates from cartilage or chondrogenic connective tissue, and is characterized by their production of chondroid (cartilage-like) matrix [6, 7]. The World Health Organization categorizes chondrosarcoma into Grades I to III, depending on their histological characteristics, making it valuable not only as a prognostic indicator but also as a guideline for their management [8]. Chondrosarcoma exhibits low responsiveness to chemoradiotherapy, therefore, R0 resection with a guaranteed negative margin is the preferred treatment.

Costal chondrosarcoma is extremely rare and is mostly reported as individual cases. Only around 40 case reports were found by searching the PubMed and the vast majority of tumors reported were confined to the chest. Dantis et al. [9] reported a similar case with simultaneous involvement of the chest and abdominal wall and emphasized the unique advantages of 3D-composite mesh in reconstructing large-area defects of the chest and abdominal wall. However the clinical challenge was to prevent recurrence and to find better treatment options. Multi-disciplinary discussion, essential for personalized care, ensures a thorough approach to complex cases by facilitating detailed tumor evaluation, critical structure identification, tailored surgical planning, and improves decision-making, outcomes, and surgical safety.

In our case, preoperative multi-disciplinary discussion revolved around diagnosis and detailed surgical planning was conducted. The pathological diagnosis of the tumor was crucial for formulating the surgical plan. Chondrosarcoma was both invasive and metastatic, with its invasiveness and metastatic potential increasing with higher grades. Therefore, surgery must achieve adequate margins and be prepared to excise any invaded tissues. As detailed in the case presentation, an ultrasound-guided biopsy revealed a diagnosis of chondrosarcoma Grade I. Pathologists generally believed that it was impossible to accurately distinguish between benign enchondroma and well-differentiated chondrosarcoma based solely on pathological morphology, whether through needle biopsy or surgical biopsy, because the two shared significant morphological similarities [10]. The differentiation between benign and malignant tumors largely depended on the tumor location, patient age, clinical symptoms, and imaging characteristics. Chondrogenic tumors occurring in long bones, flat bones, vertebrae, and craniofacial bones should be highly suspected of being chondrosarcoma, even in the absence of atypical chondrocytes, if they exhibit the following characteristics: (1) enlargement of the tumor after age 40; (2) pain at rest; (3) a maximum diameter exceeding 5 cm; (4) imaging evidence of bone cortex changes; and (5) MRI detection of periosteal or peritumoral edema [11]. After multi-disciplinary discussions, we unanimously concluded that the diagnosis of costal chondrosarcoma was established, and we speculated that the right kidney might simply be compressed by the tumor. The relationship between the liver and tumor was difficult to judge solely based on imaging data, therefore, collaborative surgery with hepatobiliary surgeons was a necessary condition to ensure complete tumor resection and the integrity of thoraco-abdominal wall reconstruction.

The main purpose of reconstruction is to restore the integrity and stability of the chest wall, to avoid chest wall softening and abnormal breathing, and to ensure the stability of respiratory circulation. Several techniques are commonly employed, each suited to different types of defects. Autologous tissue transplantation is one method used by surgeons to repair defects by utilizing the patient's own tissues [12, 13]. This method provides a good blood supply to the graft, which reduces the risk of rejection and promotes healing. However, it can increase the risk of damage to the patient during the tissue harvesting process. In cases that require structural support, synthetic materials like titanium mesh or plates are frequently used [14]. These materials offer strong, durable support and possess good biocompatibility, thereby minimizing the risks of infection and displacement. Furthermore, advancements in 3D printing technology [15] have facilitated the creation of customized implants tailored to the patient's anatomical structure. For more complex defects, a combination of autologous tissue and synthetic materials may be utilized [16]. This composite reconstruction approach balances the need for soft tissue coverage with the requirement for rigid structural support, making it particularly suitable for large or functionally significant defects. The choice of reconstruction technique depends on various factors, including the size and location of the defect, and the functional and aesthetic goals of the surgery. Literature emphasizes the importance of selecting the appropriate reconstruction method to achieve optimal outcomes [14].

In the present case, the 8th to 12th anterolateral ribs were removed, however, we believed that this patient was not suitable for reconstruction using any form of rigid structural support. Firstly, the 8th to 12th ribs were false ribs, the removed ribs had little impact on respiratory movement. Secondly, most of the defects were located on the abdominal wall. Finally, it was challenging to form a stable connection between the ribs, the support structure, and the diaphragm. Repeating friction might

cause patient discomfort, displacement or dislodgement, and even damage to surrounding organs. So we sutured the diaphragm to the ribs and intercostal muscles at the resection margin, using a polypropylene mesh to reconstruct the defects. Although this may lead to a little reduction in the chest cavity volume and make the reconstructed area essentially become part of the abdominal wall, it nonetheless guarantees the stability of the chest wall and minimizes the likelihood of complications stemming from complex reconstruction. Moreover, the combination of the mesh and a relatively thick flap fully meets the reconstruction requirements of the"abdominal wall". If resource constraints and cost-effectiveness are not considered, replacing polypropylene mesh with advanced ones would result in a more perfect reconstruction outcome.

The patient's postoperative course was uneventful, and was discharged without any complications. Histopathological analysis confirmed the complete removal of the tumor with negative margins. We did not recommend any further treatment for this patient because, on the one hand, the tumor was of low malignancy grade, and on the other hand, we achieved complete R0 resection. According to guidelines [17] and literatures [7, 18–20], treatments such as radiotherapy, chemotherapy, checkpoint inhibitors, and targeted drugs are primarily used when tumors are inoperable, metastatic, or recurrent. However, there is still insufficient data to support their routine use as adjuvant therapy following surgery in cases of chondrosarcoma Grade I-II. However, we require the patient to undergo a chest X-ray or CT scan every six months for the first five years, and then annually thereafter.

Conclusions

Wide en-bloc resection followed by reconstruction using polypropylene mesh is feasible and cost-effective for costal chondrosarcoma with limited invasion. The successful management of giant costal chondrosarcomas hinges on multi-disciplinary discussion, meticulous preoperative planning, and suitable surgical and reconstructive techniques. This case contributes valuable insights into the complex interplay of these factors, reinforcing the need for tailored strategies to optimize patient outcomes in similar scenarios.

Abbreviations

CT Computed tomography
MRI Magnetic Resonance Imaging

Acknowledgements

None.

Author contributions

Caiyang Liu, Qinyan Yang, and Deyuan Zhong performed the literature review and drafted the manuscript.Hongtao Yan, Hang Gu, and Xiaozun Yang participated in the diagnosis and treatment of the case and provided expertise in clinical knowledge.Xiaojun Yang, Qiang Li, and Xiaolun Huang provided important academic and language advice and critically revised the manuscript.Wei Dai supervised and guided the research, and contributed to significant decisions throughout the study.All authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Our study was approved by the Ethics Committee for Medical Research and New Medical Technology of Sichuan Cancer Hospital (No. SCCHEC-02-2024-138).

Consent for publication

Informed consent for publication was obtained.

Competing interests

The authors declare no competing interests.

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References

1. Brito ÍM, Teixeira S, Paupério G, et al. Giant chondrosarcoma of the chest wall: a rare surgical challenge. Autops Case Rep. 2020;10(3):e2020166.
2. Emori M, Hamada KI, Kozuka T, et al. Case of an unusual clinical and radiological presentation of pulmonary metastasis from a costal chondrosarcoma after wide surgical resection: a transbronchial biopsy is recommended[J]. World J Surg Oncol. 2011;9(1):50–50.
3. Tahir M, Rahman J, Arekemase H, et al. Chondrosarcoma Ribs Cureus. 2020;12(7):e9158.
4. Al-Refaie RE, Amer S, Ismail MF, et al. Chondrosarcoma of the chest wall: single-center experience. Asian Cardiovasc Thorac Ann. 2014;22(7):829–34.
5. Wang L, Yan X, Zhao J, et al. Expert consensus on resection of chest wall tumors and chest wall reconstruction. Transl Lung Cancer Res. 2021;10(11):4057–83.
6. Dorfman HD, Czerniak B. Bone cancers. Cancer. 1995;75(1 Suppl):203–10.
7. Gelderblom H, Hogendoorn PCW, Dijkstra SD et al. Clin Approach towards Chondrosarcoma[J] Oncologist, 2008, 13(3).
8. Doyle LA. Sarcoma classification: an update based on the 2013 World Health Organization Classification of Tumors of Soft Tissue and Bone[J]. Cancer, 2014, 120(12).
9. Dantis K, Singh R, Goel A et al. An innovative reconstruction of an enbloc resected composite giant chest and abdominal wall chondrosarcoma with 3D-composite mesh[J]. J Cardiothorac Surg, 2024, 19(1).
10. Khurana JS, Mccarthy EF, .Tumors. and Tumor-Like Lesions of Bone[J]. Springer-, 2010.
11. Jiang ZM, Zhang H. z.Diagnostic challenges and Grading Criteria for Chondrosarcoma[J]. Chin J Pathol, 2016(9):4.
12. Huemer GM, Puelzl P, Schoeller T. Breast and chest wall reconstruction with the transverse musculocutaneous Gracilis flap in Poland syndrome. Plast Reconstr Surg. 2012;130(4):779–83.
13. Asai K, Suzuki K, Shimota H, Ito Y, Asano K, Kazui T. Full-thickness chest wall reconstruction using autologous tissue grafts after resection of recurrent desmoid tumor. Jpn J Thorac Cardiovasc Surg. 2004;52(6):296–9.
14. Sanna S, Brandolini J, Pardolesi A, Argnani D, Mengozzi M, Dell'Amore A, Solli P. Materials and techniques in chest wall reconstruction: a review. J Vis Surg. 2017;3:95.
15. Goldsmith I. Chest Wall Reconstruction with 3D Printing: anatomical and functional considerations. Innovations (Phila). 2022 May-Jun;17(3):191–200.

16. Xu P, Yu G, Wang H, et al. Surgical resection of giant chest Wall Chondrosarcoma combined with sandwich chest Wall Reconstruction in one case. Ann Ital Chir. 2024;95(2):126–31.
17. National Comprehensive Cancer Network. [NCCN Clinical Practice Guidelines in Oncology-Bone Cancer]. [Version 1.2025-August 20, 2024]. Available from: [https://www.nccn.org/guidelines/guidelines-detail?category=1&id=1418]
18. Chow W, Frankel P, Ruel C, et al. Results of a prospective phase 2 study of pazopanib in patients with surgically unresectable or metastatic chondrosarcoma. Cancer. 2020;126(1):105–11.
19. Tap WD, Villalobos VM, Cote GM, et al. Phase I study of the mutant IDH1 inhibitor ivosidenib: Safety and clinical activity in patients with advanced chondrosarcoma. J Clin Oncol. 2020;38(15):1693–701.
20. Rock A, Ali S, Chow WA. Systemic therapy for Chondrosarcoma. Curr Treat Options Oncol. 2022;23(2):199–209.

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