

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect

journal homepage: [www.elsevier.com/locate/radcr](http://www.elsevier.com/locate/radcr)

## Case Report

# Solitary osteochondroma affecting the rib and adjacent vertebral body: a case with atypical radiology features ☆☆☆

Fahad B Albadr, MD<sup>a,b,\*</sup><sup>a</sup> Department of Radiology, College of Medicine, King Saud University Riyadh, Riyadh, Saudi Arabia<sup>b</sup> Department of Radiology and medical Imaging, King Saud University Medical City, Riyadh, Saudi Arabia

## ARTICLE INFO

## Article history:

Received 30 April 2021

Revised 6 May 2021

Accepted 7 May 2021

## Keywords:

Computed Tomography

Magnetic Resonance Imaging

Osteochondroma

Rib Tumor

Vertebral Body Tumor

## ABSTRACT

Costal osteochondroma is an uncommon primary benign tumor. Thorough radiological and pathological examinations should be performed to avoid misdiagnosis. Herein, we describe a case of a surgically resected costal osteochondroma in 23-year-old man. The aim of this report is the value of cartilage cap on imaging, leading to a correct preoperative impression. We also present a brief review of existing literature on costal osteochondroma.

© 2021 The Authors. Published by Elsevier Inc. on behalf of University of Washington.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

## Introduction

Chest wall neoplasms account for less than 5% of all thoracic malignancies and represent a heterogeneous group of lesions that can be challenging to classify and diagnose. They can be primary or secondary, malignant or benign, and may arise from cartilaginous, osseous, or soft tissues [1]. Overall, more than 50% of chest wall neoplasms are malignant [1,2]. The majority of surgically resected chest wall tumors are metastatic lesions or a result of direct invasion by primary lung neoplasms [2]. Pathologically, osteochondroma is a hamartoma-

tous, cartilage-capped osseous protuberance lesion that arises from the affected bone. The ribs and scapula are typically affected by osteochondromas, which account for 8% of all rib lesions [2,3]. Herein, we describe the case of a patient with a rare localization and extension of costal osteochondroma.

## Case presentation

The patient was a 23-year-old man who was not known to have any medical illness. A posterior chest wall mass was

☆ Acknowledgments: The author thanks Abdullah Abujmea for assistance in preparing the manuscript figures. Moreover, the author thanks the College of Medicine Research Center, deanship of Scientific Research, King Saud University.

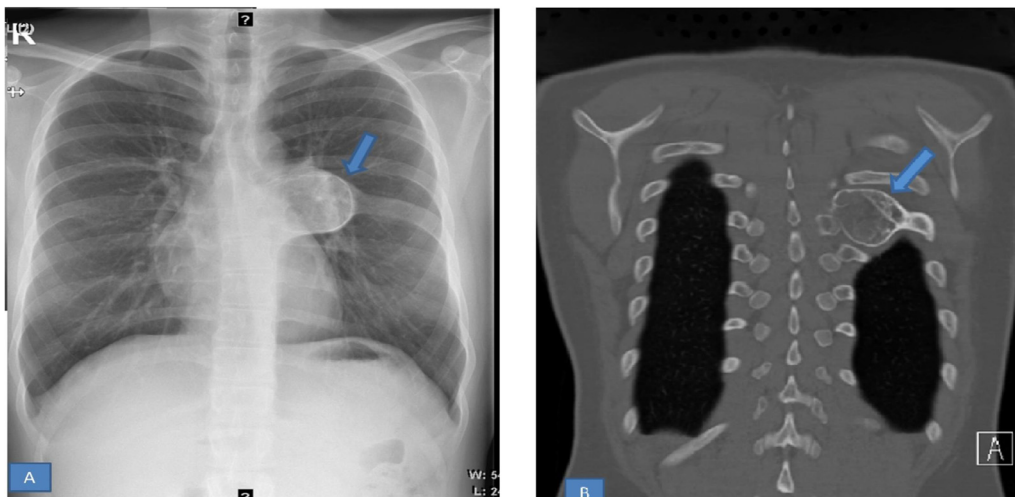
☆☆ Competing Interests: There are no conflicts of interest.

\* Corresponding author.

E-mail address: [fbmbader@yahoo.com](mailto:fbmbader@yahoo.com)

<https://doi.org/10.1016/j.radcr.2021.05.023>

1930-0433/© 2021 The Authors. Published by Elsevier Inc. on behalf of University of Washington. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)



**Fig. 1 – (A) Chest x-ray revealed an expansile osseous chest wall mass located in the proximal left 7th rib (blue arrow). (B) Selected coronal computed tomography scans depicted a well-demarcated and sharply outlined osseous mass that was continuous with the cortical outline of the rib (blue arrow). (Color version of the figure is available online.)**

detected incidentally on a chest x-ray performed for pre-employment purposes. He did not experience pain and was neurologically intact. No other concomitant bony lesions were noted.

A chest X-ray revealed an osseous expansile mass located in the left posterior chest wall within the proximal left 7th rib. Computed tomography (CT) revealed a large sharply outlined osseous mass. This expansile osseous lesion at the proximal left 7th rib was continuous with the medullary cavity (Fig. 1). The mass had a localized focal intra-thoracic expansile component with internal focal disfiguring of the normal rib shape; however, there was no internal calcification or soft tissue component. Similar radiological manifestations were found in the adjacent vertebra affecting the left pedicle, lamina, and adjacent vertebral body without significant bony expansion. The cartilage cap, a pathognomonic sign of osteochondroma, was not well delineated on the CT scan (Fig. 2). Magnetic resonance imaging (MRI) revealed a thin cartilage cap (thickness, 2–3 mm) without any adjacent soft tissue infiltration, fluid-fluid level, or spinal canal stenosis (Fig. 3). Collectively, these observations were highly suggestive of a benign tumor; however, low-grade chondrosarcoma cannot be excluded.

The patient underwent total surgical resection of the lesion with a midline posterior approach. Intraoperatively, the mass was determined to be firm and well-circumscribed, and it was affecting the proximal segment of the left 7th rib and adjacent T7 vertebral body. It was not vascular and contained intralesional cavities with internal trabeculae and yellowish fluid. The patient had T7 laminectomy, T7-8 instrumented fusion, and total tumor resection including the involved rib and part of the affected vertebral body. The patient had a smooth postoperative course and was well when he was discharged home.

The lesion consisted of fragments from a fibrous cap with underlying chondroid and osseous tissue. The osseous and chondroid tissues were merged together. The cystic appearance of the tumor was most likely caused by cystification sec-

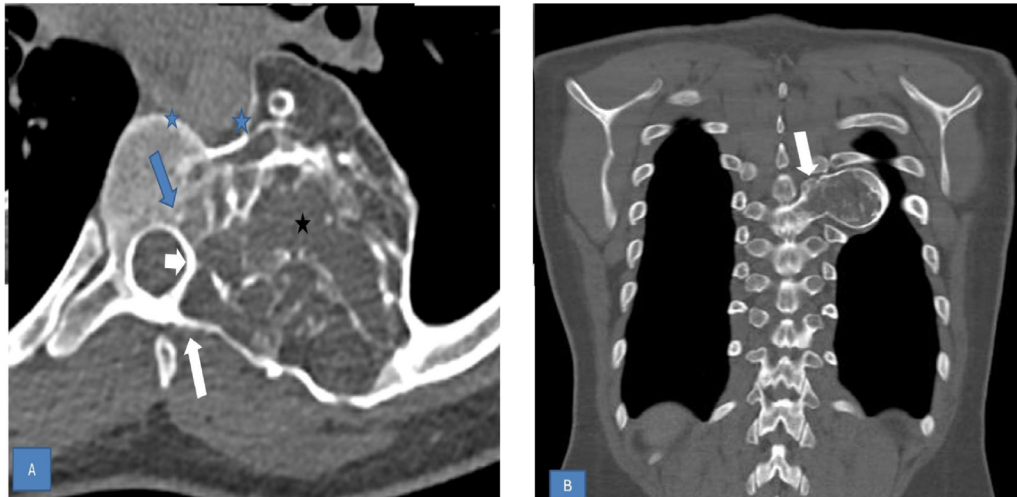
ondary to myxoid changes. There was no evidence of malignancy (Fig. 4).

## Discussion

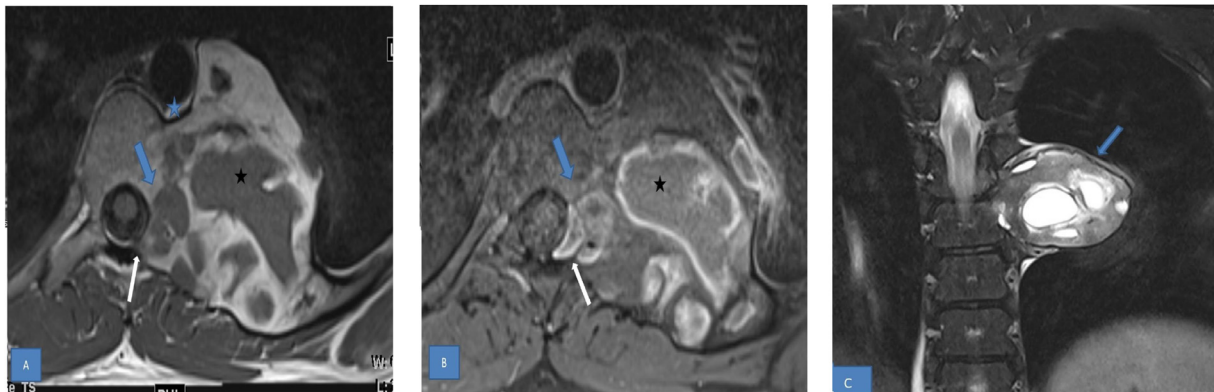
We report a rare type of isolated solitary osteochondroma in the current case arising at the proximal rib with involvement of the costovertebral junction, adjacent vertebral body, and a posterior neural arch. Only seven such cases have been previously reported, which described osteochondromas with neural foraminal extension and spinal cord compression [7,9]. Primary osseous tumors of the chest wall are uncommon, and approximately 95% are located within the ribs [4]. Benign osseous neoplasms do not result in extraosseous soft-tissue masses and typically exhibit nonaggressive behavior and imaging features.

Primary chest wall tumors can be classified as bone or soft-tissue tumors based on the 2002 World Health Organization classification [3]. The ribs and scapula are most typically affected by an osteochondroma, which accounts for 8% of all rib lesions [2,3]. Osteochondromas are usually found in the anterior region at the costochondral junction. This type of lesion usually affects children and young adults, and in 60% of cases, they are diagnosed before the age of 20 years. Clinically, the lesion is painless and extremely slow-growing and includes a hard outgrowth [5,6]. The reported incidence of isolated costal osteochondroma in the paraspinal area is considerably low. Various adjacent soft tissue injuries including hemothorax, pneumothorax, hemopericardium, and diaphragmatic lacerations have been reported in association with costal osteochondromas [7,8].

Hereditary multiple exostoses (HME) is an autosomal dominant condition characterized by multiple exostoses, usually in the long bones of the limb. In contrast, patients with solitary costal exostosis are usually asymptomatic as in the present



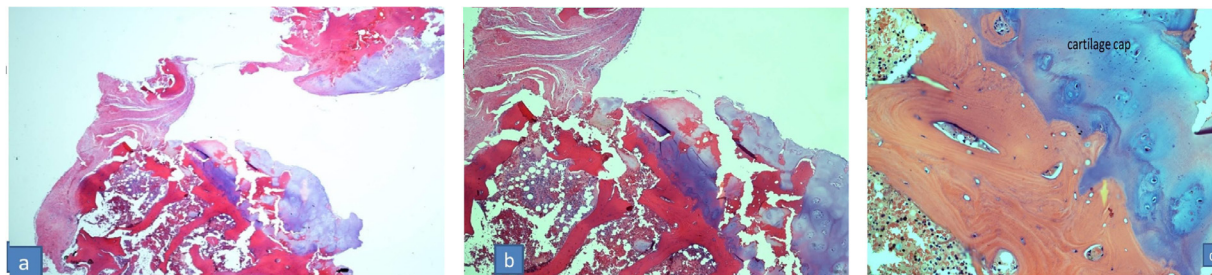
**Fig. 2 – (A)** Axial non-contrast bone window computed tomography scans. An expansile osseous lesion at the proximal left 7th rib that was continuous with the medullary cavity of the rib. The lesion was sharply outlined (\*). The mass had a localized focal intra-thoracic expansile component, with concomitant vertebral body involvement (blue arrow) and left pedicle and lamina (white arrow). There were variably sized internal cavities without fluid-fluid levels, and no soft tissue masses were depicted (\*). **(B)** Coronal reconstruction image derived from multiplanar computed tomography. The mass had a localized focal intra-thoracic expansile component, with concomitant involvement of the left pedicle and lamina (white arrow). The cortex thinned, but remained intact. No periosteal reaction was observed. (Color version of the figure is available online.)



**Fig. 3 – (A)** Axial T1-weighted magnetic resonance image. The osseous mass exhibited fatty marrow continuous with the medullary cavity of the rib and arose from the proximal left 7th rib at the costovertebral junction. The periosteum was intact (\*). There was concomitant involvement of the adjacent vertebral body (blue arrow) and posterior neural arch (white arrow). There were variably sized internal cavities without fluid levels (\*). **(B)** Axial contrast enhanced fat-saturated T1-weighted magnetic resonance image. There was a saturation of fatty marrow without abnormal enhancement of the mass lesion or adjacent soft tissue. There were variably sized internal cavities without fluid-fluid levels, and no soft tissue masses were depicted (\*). There was concomitant involvement of the adjacent vertebral body (blue arrow) and posterior neural arch (white arrow). **(C)** Coronal fat-saturated T2-weighted magnetic resonance image. There was an area of the thin cartilaginous cap (blue arrow) on the superior aspect of the paraspinal spinal rib mass that had a slightly higher signal intensity than muscle. (Color version of the figure is available online.)

case and have no family history of similar conditions [8]. Rib exostoses are often easy to diagnose in patients with HME, where the disease is more clinically apparent to the physician [8]; however, diagnosis may be difficult when isolated lesions occur, as in the current case.

The tumors are characteristically pedunculated or sessile osseous protuberances arising from the surface of the parent bone [6]. The classical ultrasound feature of osteochondroma is a hyperechogenic bulge underneath a hypoechoic band representing the cartilaginous cuff.



**Fig. 4 – Histopathology of the osteochondroma. Osteochondromatous exostosis consisting of a layer of cartilage (right side of the photomicrograph) with parts from the fibrous cap (upper left) and underlying bone. Hematoxylin and eosin staining, (A) 20 x and (B) 40 x magnification. (C) High-power microscopy view of the osteochondroma consisting of a cartilaginous layer with underlying cortical bone. Hematoxylin and eosin staining, 200 x .**

Routine CT and MRI are crucial for the radiological diagnosis and proper evaluation of costal osteochondroma, facilitating determination of the tumor's origin, size, and extent of invasion into the spinal canal [9]. The three-dimensional imaging capacity of CT often enables optimal depiction of the pathognomonic cortical and marrow continuity of the lesion and parent bone in osteochondromas [10]. Although the location of the bony part of the osteochondroma can be reliably demonstrated using multiplanar CT reconstruction, the exact size of the tumor may be underestimated because the cartilage cap of the tumor is invisible [9], as it was in the present case. The unique findings in the current patient were the concomitant involvement of the vertebral body, adjacent posterior neural arch, and high signal intensity around the tumor depicted on coronal fat-saturated T2-weighted images, which may represent the cartilage cap, leading to a correct preoperative impression.

Previous reports indicate the variable success of measurements of the hyaline cartilage cap thickness via CT [10]. Mineralization in the cartilage cap facilitates accurate measurement via CT. It can be extremely difficult to accurately measure the thickness of an entirely nonmineralized cartilage cap, as in the current case, because it cannot be easily differentiated from surrounding tissues [10]. MRI depicts cortical and medullary continuity between the osteochondroma and parent bone, and it is isointense to the medullary cavity of the involved bone on T1-weighted images [9,10]. The cartilaginous cap is isointense to muscle on T1-weighted images and hyperintense to muscle on T2-weighted images. In cases involving a thick cartilage cap (> 2 cm in adults or > 3 cm in children), malignant transformation should be suspected [2,6,9,10]. Conversely, the cap may appear indistinguishable from adjacent soft tissue including thickened pleura, epidural fat, or cerebrospinal fluid on T2-weighted images [9]. Mineralized areas in the cartilage cap exhibit low signal intensity in all magnetic resonance pulse sequences, although as endochondral ossification proceeds, yellow marrow signal is ultimately apparent. The high water content in non-mineralized portions of the cartilage cap has intermediate to low signal intensity on T1-weighted images, and considerably high signal intensity in T2-weighted MRI [10]. With intravenous gadolinium administration, enhancement of benign lesions is normally evident in

the tissue that covers the cartilaginous cap, which is fibrovascular in nature; however, the cartilaginous cap itself is generally not enhanced [9,10].

Complications associated with costal osteochondroma include fractures, osseous deformity, vascular injury, neural compression, bursa formation, and malignant transformation. Pain at the lesion site, as well as bone erosion, irregular calcification, or thickening of the cartilage cap depicted on radiological images indicate malignant transformation [6]. Asymptomatic osteochondromas can be monitored without intervention, whereas symptomatic lesions require surgical management [9].

## Conclusion

Solitary posterior costal osteochondroma is rare. The type of osteochondroma described in this case, which arose at the costovertebral junction with vertebral body and posterior neural arch involvement, is extremely rare. The unique finding was the cartilage cap, leading to a correct preoperative impression. Malignant transformation should be suspected if the tumor increases in size after skeletal maturation. Complete resection with adequate negative margins is essential. Close follow-up and genetic evaluations are recommended.

## Financial support and sponsorship

None.

## Patient consent

The patient's consent was not required because his identity was not disclosed or compromised in the report.



## REFERENCES

- 
- [1] Carter BW, Benveniste MF, Betancourt SL, et al. Imaging evaluation of malignant chest wall neoplasms. *Radiographics* 2016;36:1285–306.
  - [2] Bueno J, 3rd Lichtenberger JP, Rauch G, Carter BW. MR imaging of primary chest wall neoplasms. *Top Magn Reson Imaging* 2018;27:83–93.
  - [3] Nam SJ, Kim S, Lim BJ, et al. Imaging of primary chest wall tumors with radiologic-pathologic correlation. *Radiographics* 2011;31:749–70.
  - [4] Lee TJ, Collins J. MR imaging evaluation of disorders of the chest wall. *Magn Reson Imaging Clin N Am* 2008;16:355–79.
  - [5] Zarqane H, Viala P, Dallaudière B, Vernhet H, Cyteval C, Larbi A. Tumors of the rib. *Diagn Interv Imaging* 2013;94:1095–108.
  - [6] Tateishi U, Gladish GW, Kusumoto M, et al. Chest wall tumors: radiologic findings and pathologic correlation: part 1. Benign tumors. *Radiographics* 2003;23:1477–90.
  - [7] Shim JH, Park CK, Shin SH, Jeong HS, Hwang JH. Solitary osteochondroma of the twelfth rib with intraspinal extension and cord compression in a middle-aged patient. *BMC Musculoskelet Disord* 2012;13:57.
  - [8] Khosla A, Parry RL. Costal osteochondroma causing pneumothorax in an adolescent: a case report and review of the literature. *J Pediatr Surg* 2010;45:2250–3.
  - [9] Chazono M, Masui F, Kawaguchi Y, et al. Dumbbell-shaped osteochondroma of the fifth rib causing spinal cord compression. *J Orthop Sci* 2009;14:336–8.
  - [10] Murphey MD, Choi JJ, Kransdorf MJ, Flemming DJ, Gannon FH. Imaging of osteochondroma: variants and complications with radiologic-pathologic correlation. *Radiographics* 2000;20:1407–34.