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Case Report

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Neurogenic Thoracic Outlet Syndrome Secondary to Anomalous First Thoracic Rib: A Case Report

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ABSTRACT

Background: Thoracic outlet syndrome (TOS) is an uncommon condition resulting from compression of neurovascular structures at the thoracic outlet. Cervical ribs and fibrous bands are the common etiologies, whereas an anomalous first thoracic rib is extremely rare and only limited case reports have been described. Neurogenic TOS is the most frequent subtype and may mimic other neurological disorders, often delaying diagnosis.

Methods: We report the case of an 18-year-old female who presented with progressive pain and paresthesia in the left upper limb. Imaging with CT thorax and three-dimensional reconstruction revealed a hypoplastic anomalous first thoracic rib forming a pseudoarthrosis with the middle third of the second rib, compressing the brachial plexus. Preoperative evaluation also included an MRI, which confirmed the neurogenic component.

Results: The patient underwent surgical excision through a supraclavicular approach. The anomalous rib and pseudoarthrosis were carefully removed, decompressing the brachial plexus. Intraoperative pleural injury was promptly repaired. Postoperatively, symptoms improved rapidly, and at one-month follow-up, she had complete resolution with full upper limb mobility. The patient remained symptom-free at one year.

Conclusion: An anomalous first thoracic rib is a rare congenital cause of neurogenic TOS. Imaging with CT and MRI plays a crucial role in defining the anomaly and guiding surgical planning. Limited surgical excision via a supraclavicular approach offers adequate exposure and can provide excellent functional recovery with minimal morbidity.

Key-words: Anomalous first rib, Brachial plexus, Thoracic outlet syndrome (TOS), MRI

INTRODUCTION

Thoracic outlet syndrome (TOS) is a rare but clinically significant condition caused by compression of the neurovascular bundle at the thoracic outlet.

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Depending on the involved structures, it is categorized into neurogenic, venous, and arterial types, with neurogenic TOS being the most common [1]. The etiology is usually related to cervical ribs, fibrous bands, or muscular anomalies, while an anomalous first thoracic rib represents an exceptionally rare cause, with only a limited number of case reports published [2,3].

The clinical presentation of neurogenic TOS is often nonspecific and overlaps with cervical radiculopathy, plexopathy, and shoulder disorders. Patients may complain of pain, paresthesia, weakness, or functional

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impairment of the upper extremity, which frequently delays accurate diagnosis [4]. Early recognition is crucial, especially in young patients presenting with unexplained upper limb symptoms.

Imaging plays a pivotal role in establishing the diagnosis. While plain radiographs can sometimes demonstrate abnormal rib morphology, advanced modalities such as computed tomography (CT) with three-dimensional reconstruction and magnetic resonance imaging (MRI) provide superior visualization [5]. These imaging techniques not only confirm the anomaly but also define its relationship to adjacent neurovascular structures, aiding in surgical planning.

Surgical management is indicated in patients with progressive or disabling symptoms. A supraclavicular approach offers excellent exposure of the brachial plexus and subclavian vessels, facilitating safe excision of anomalous ribs or pseudoarthrosis. Previous studies have demonstrated favorable outcomes following limited excision, with resolution of neurological symptoms and minimal morbidity [6,7].

Here, we report an unusual case of a hypoplastic anomalous first thoracic rib forming pseudoarthrosis with the second rib in an 18-year-old female. The case emphasizes the importance of advanced imaging in diagnosis, careful surgical planning, and the effectiveness of limited excision in achieving symptom relief.

CASE PRESENTATION

An 18-year-old female patient presented with a history of pain in the left shoulder and upper limb, associated with intermittent numbness for the past 7 months. The pain and paresthesia worsened with increased activity of the left upper limb. She also reported diffuse swelling in the left supraclavicular region, which was tender on palpation and produced paresthesia in the left upper limb.

On physical examination, a bony swelling was noted in the left supraclavicular region. Tinel's sign was elicited on tapping the swelling, which reproduced paresthesia in the left upper limb. Sensory and motor examinations of the left upper limb were otherwise normal.

A chest X-ray (PA view) showed a hypoplastic first thoracic rib (Fig. 1). Contrast-enhanced CT (CECT) of the neck confirmed the hypoplastic first thoracic rib on the left side. An ill-defined, irregular bony exostosis measuring 8.6 × 6.2 × 6.4 mm was seen arising from the superior border of the middle third of the second rib, extending superiorly to reach the anterior end of the hypoplastic first rib and forming a pseudoarthrosis (Fig. 2).

MRI of the left brachial plexus demonstrated the bony exophytic outgrowth lying near edematous trunks, divisions, and cords of the plexus. The lesion was located posterolateral to the brachial plexus and displaced the subclavian artery anteriorly. An incidental finding of fusion of the C2 and C3 vertebral bodies with a rudimentary intervertebral disc was also noted.

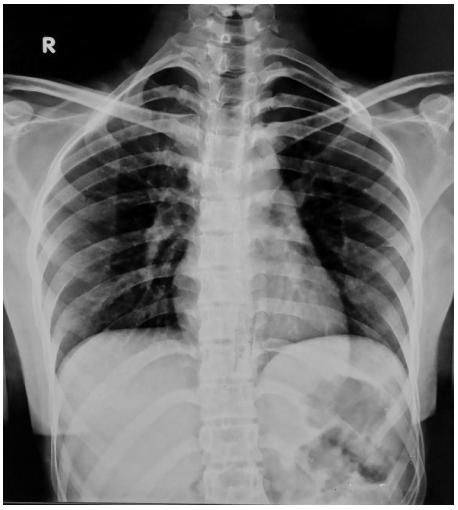

Fig. 1: X-ray chest PA view showing hypoplastic left first thoracic rib

The patient was operated on under general anesthesia through a supraclavicular approach. The pseudoarthrosis between the anterior end of the hypoplastic first rib and the bony exostosis of the second rib was identified, and the adjacent first rib was carefully dissected. The subclavian artery and brachial plexus were noted to be displaced anteriorly against the clavicle due to the pseudoarthrosis. The anterior end of the hypoplastic first thoracic rib, along with the bony exostosis of the second rib, was excised. Following the removal of the pseudoarthrosis, the second rib dropped downward, thereby decompressing the brachial plexus.

During the dissection of the anterior end of the first rib, the parietal pleura was accidentally opened, which was immediately repaired, and an intercostal drain was inserted into the left pleural cavity. The patient's neurological symptoms improved in the immediate postoperative period. The intercostal drain was removed on the 3rd postoperative day after a check chest X-ray confirmed resolution of pneumothorax. Physiotherapy

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for the left upper limb was initiated after 7 days. At one-month follow-up, the patient had complete resolution of symptoms with a full range of movement of the left upper limb. The patient remains symptom-free at one-year post-surgery.

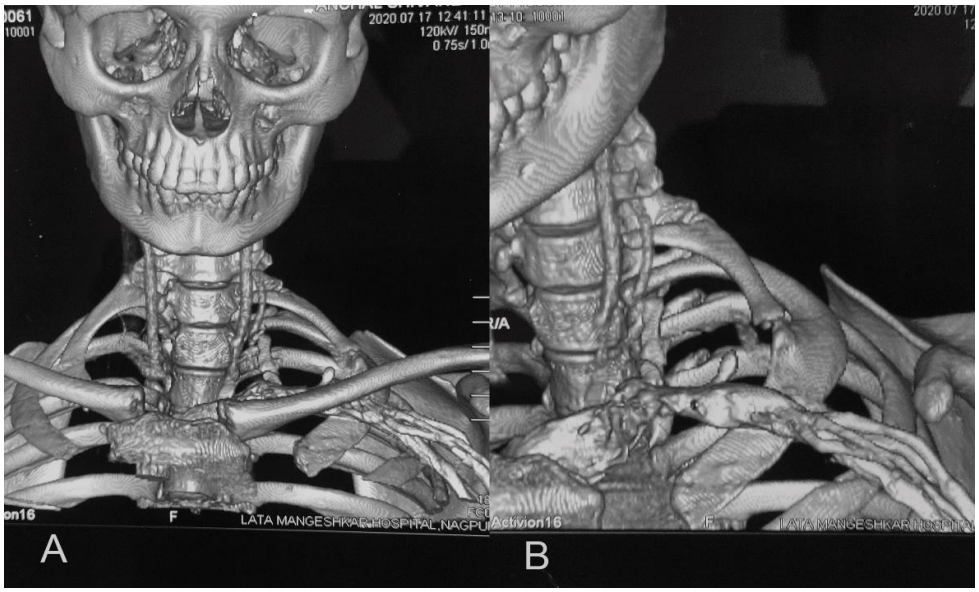

Fig. 2: (A) 3D CT Thorax showing anomalous left first thoracic rib having pseudoarthrosis with bony prominence of second rib, **(B)** relation of brachial plexus and subclavian vessels with bony anomaly.

DISCUSSION

Thoracic outlet syndrome is caused by compression of the brachial plexus and /or the subclavian artery and vein as it passes through the thoracic outlet. Depending on the structures involved, it is classified as neurogenic TOS, arterial TOS and venous TOS. [5] Neurogenic TOS is a common presentation and has reported incidence of up to 80% cases of all TOS.[2,6] Anomalies related to various anatomical structures around the thoracic outlet have been reported as causative factors for TOS viz. scalene group of muscles, subclavius tendon, cervical rib, first thoracic rib, congenital bands and other unidentified anomalies.[6] Anomalous first thoracic rib causing neurogenic TOS is a very rare entity with very few case reports in the literature. Sanders et al reported 7 cases of anomalous first thoracic rib in their series of 47 patients with cervical rib or first thoracic rib causing TOS.[2]. The reported incidence of an anomalous first thoracic rib in the literature is 0.34%.[7]

The majority of patients with TOS have no focal abnormality on imaging studies and hence, surgical management when indicated is general decompression of the anatomical space. Patients with TOS secondary to congenital anomalies detected on imaging are more amenable to specific surgical intervention and don't require generalized decompression.

In our case, MRI of the brachial plexus revealed the anterior displacement of edematous brachial plexus and subclavian vessels due to anomalous pseudoarthrosis between the first and second rib. Contrast-enhanced CT with 3D reconstruction clearly defined the nature of the bony anomaly and helped in planning the conservative excision of the anomalous segment of the first rib and the bony exostosis of second rib.

Literature on the surgical treatment of cervical rib and first thoracic rib advocates complete excision of ribs and detachment of the insertion of the scalene muscles to achieve decompression. However, these procedures are associated with a higher complication rate.[8] Hindaley *et al.* reported a case of an anomalous first thoracic rib and did focal removal of pseudoarthrosis and excess bony prominence of the second rib with complete resolution of symptoms. They suggested that "in cases of isolated congenital anomalies the surgeon needs only to adequately remove the focal abnormality to ensure adequate patient outcome."[3] In our case, only localized excision of anterior end of hypoplastic first thoracic rib and bony exostosis of second rib forming pseudoarthrosis was done with complete resolution of symptoms at one month follow up. There was no recurrence of symptoms at one-year follow-up.

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Surgical approaches described for the resection of cervical rib and first thoracic rib are supraclavicular and transaxillary. The supraclavicular approach is preferred by many authors because it provides better exposure of both cervical and first thoracic ribs and allows access to evaluate and address scalene muscle abnormalities and congenital bands.[2] It also provides easy access to the subclavian vessels if repair is indicated. In our patient, a supraclavicular incision was used. It provided easy access and adequate excision of the anomaly.

CONCLUSIONS

Thoracic outlet syndrome (TOS) resulting from an anomalous first thoracic rib is an exceptionally rare clinical entity, with only limited reports available in the literature. Such anomalies may remain undiagnosed for long periods due to nonspecific presentations and overlapping symptoms with other cervical or shoulder pathologies. Advanced imaging modalities, particularly CT with 3D reconstruction, play a crucial role in identifying the exact anatomical abnormality and its relationship to adjacent neurovascular structures, thereby facilitating precise surgical planning.

In our case, limited surgical excision of the anomalous rib through a supraclavicular approach provided excellent exposure, ensured safe removal of the pathology, and resulted in complete resolution of symptoms. These findings suggest that timely recognition and appropriate management of congenital rib anomalies can lead to satisfactory patient outcomes. Although rare, anomalous first thoracic rib should be considered in young patients with unexplained neurogenic TOS to allow early diagnosis and intervention.

CONTRIBUTION OF AUTHORS

Research concept- Jitendra Mehta, Manish Zade
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Supervision- Jitendra Mehta, Manish Zade
Materials- Jitendra Mehta, Manish Zade, Dhananjay Nakade
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Final approval- Jitendra Mehta, Manish Zade, Dhananjay Nakade

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