Case Report

Curved Axillary Incision with Video-Assisted Thoracoscopic Surgery: An Alternative Approach for Teenage Female with Large Apical Chest Wall Tumor

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Primary chest wall tumors are rare, their common clinical features are not well known, and surgical resection remains the main treatment. Apical chest wall tumors require large skin incisions and dissection of the chest wall muscles, making it difficult to maintain cosmetic appearance, respiratory function, and support of the upper extremity. There are few treatment options and no studies have reported on thoracotomy that spares muscles and preserves cosmetic superiority. However, in benign chest wall tumors in young patients, it is necessary to consider radicality, cosmetic superiority, and muscle sparing. We used a combined axillary incision and thoracoscopic approach to treat a massive myxoid neurofibroma at the apical chest wall in a 14-year-old female and were able to preserve the chest wall, upper limb function, and cosmetic aspects. This report provides a detailed description of the combined axillary incision and thoracoscopic approach for apical chest wall tumors.

Keywords: chest wall tumor, myxoid neurofibroma, video-assisted thoracoscopic surgery, axillary incision

Introduction

Approaches for chest wall resection of apical chest wall tumors are limited. In apical chest wall tumors, the transmanubrial osteosarcoma-sparing approach is commonly used for tumors in the anterior region and the Paulson approach is commonly used for tumors in the posterior or lateral region.[1,2] However, while the Paulson approach may provide a good view of the lateral and posterior chest walls, the respiratory function and movement of the upper extremities are impaired due to the removal of muscles such as the latissimus dorsi and trapezius, and the very large incisions impair the cosmetic appearance.

Axillary incision, a classic technique reported by Roos et al. in 1966, is also commonly used in first rib resection for symptomatic relief of thoracic outlet syndrome.[3] It provides a good view of the brachial nerve and axillary arteriovenous vessels using the axillary approach, and allows safe resection of the first rib.

Ideally, in the case of benign chest wall tumors in young patients, the approach should be considered not only in terms of radicality but also in terms of cosmetic superiority and muscle preservation. In this case report, we describe an approach for a 14-year-old girl with a large

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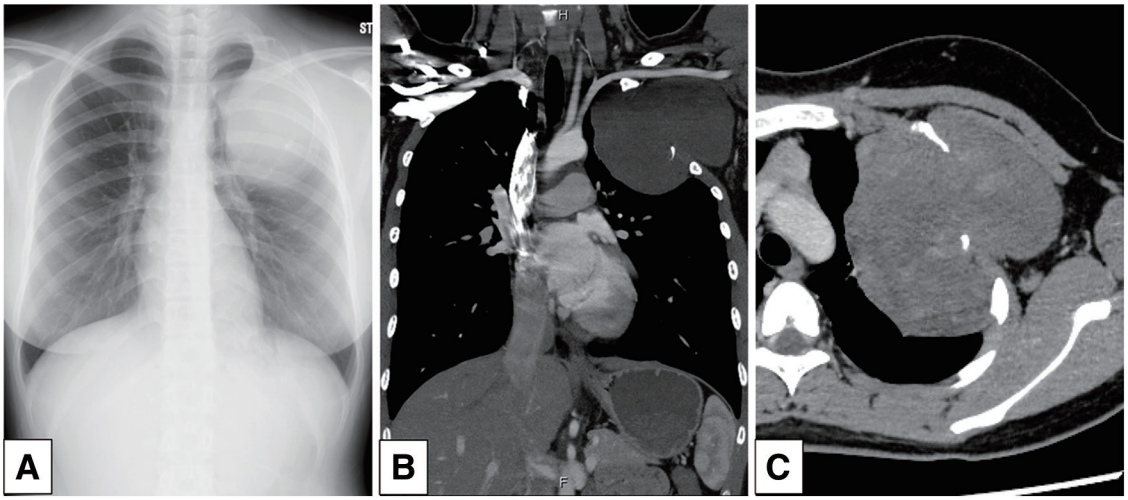

Fig. 1 Preoperative (**A**) chest X-ray film and (**B** and **C**) computed tomography images showing a 12-cm-sized chest wall tumor surrounding the second left rib, extending from the first to the fourth rib, and abutting the subclavian artery.

benign apical chest wall tumor, with minimal impact on upper extremity function and cosmetic appearance.

Case Report

A 14-year-old girl was diagnosed with a massive tumor overlying the left pulmonary apex during a close examination of the chest trauma (**Fig. 1A**). Chest computed tomography revealed a 12-cm-sized chest wall tumor surrounding the second left rib, extending from the first to the fourth rib and abutting the subclavian artery (**Figs. 1B** and **1C**). Microscopically, the tumor was reticulated with spindle-shaped or stellate tumor cells with eosinophilic cytoplasm accompanied by myxoid stroma. The pathological diagnosis was benign myxoid neurofibroma (**Fig. 2A**). As the tumor was benign and in a young patient, the surgical strategy was to minimize chest wall resection to a 1–2 cm tumor margin and preserve the first rib to preserve upper limb function as much as possible. The axillary incision approach was chosen because it provided a good view of the first rib and subclavian artery in contact with the tumor and preserved the latissimus dorsi and rhomboid muscles. The patient was placed in the right lateral decubitus position and a 20-cm axillary incision was made along the mammary line. The pectoralis minor muscle, which was extending compressively into the tumor, was dissected at the rib attachment site. With traction on the wound edge and the movement of the pectoralis major muscle and scapula, a panoramic view of the lateral aspect of the upper ribs to the first rib was obtained (**Fig. 2B**). A good anterior view of the sternal transition of the costal cartilage was obtained, and the anterior margins of the third and second ribs were sequentially dissected, while preserving the internal thoracic artery and vein. The tumor could be detached from the first rib while keeping the tumor and first rib in good view (**Fig. 2C** and **Supplementary Video 1**; The supplementary file is available online.). Next, the head of the rib and ligaments of the transverse costal joint were dissected up to the second rib under thoracoscopy with electrocautery to increase the mobility of the resected chest wall (**Fig. 2D**). The second and third ribs were then detached from the transverse process outside the bony thorax while moving the resected chest wall with increased mobility. Finally, the intercostal tissue under the dorsal first rib was dissected and chest wall resection was completed. Because the patient was in the growth period, chest wall reconstruction using a mesh was not performed. The operative time was 296 min, the volume of blood loss was 194 mL, and the postoperative course was uneventful. Pain numeric rating scale (NRS) values were recorded three times daily, postoperatively. The worst pain intensity since surgery was NRS value 7.0 on the first postoperative day. However, pain decreased quickly after removal of the chest tube, and the NRS value on postoperative day 7 was 0 to 2. The patient was discharged on postoperative day 10. Six months postoperatively, the patient was able to vertically elevate the affected upper extremity and play volleyball. The axillary incision was not visible from the front and no deformity of the breast was seen (**Figs. 3A** and **3B**). A chest radiograph obtained 6 months after the operation

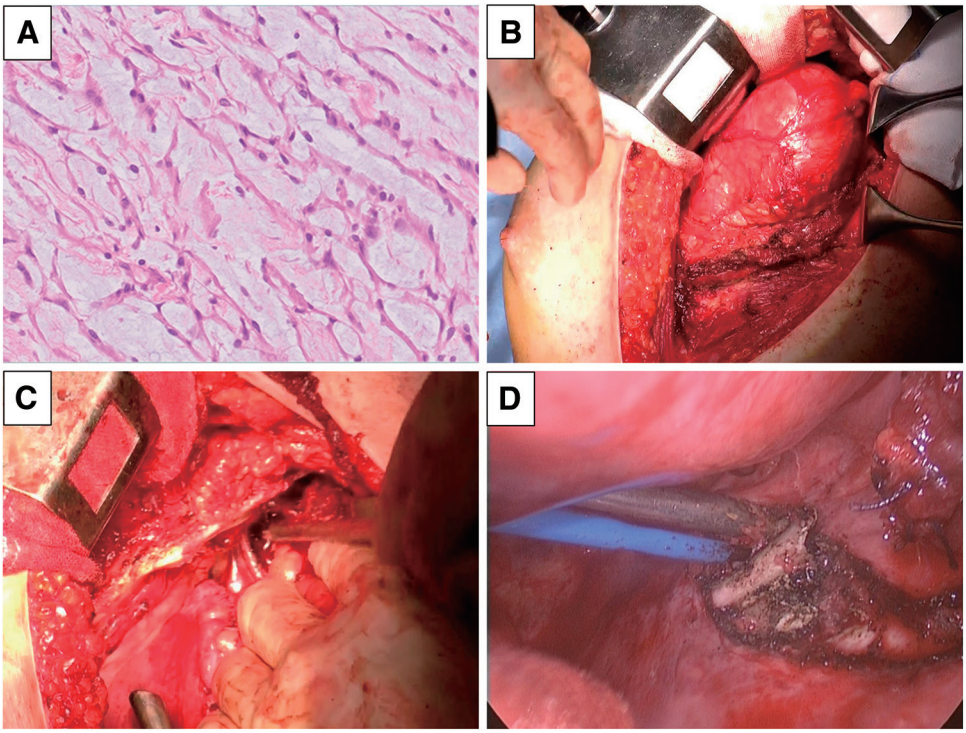

Fig. 2 (**A**) Histopathological sections (HE staining, magnification ×20) showing spindle and asteroid fibroblast-like tumor cells in a myxoid back. (**B** and **C**) Axillary incision allows good views of the first rib, axillary arteriovenous vein, brachial plexus, and superior bony thoracic aspect. (**D**) Thoracoscopic dearticulation of the costovertebral joint and transverse costovertebral ligament was needed. HE: hematoxylin and eosin

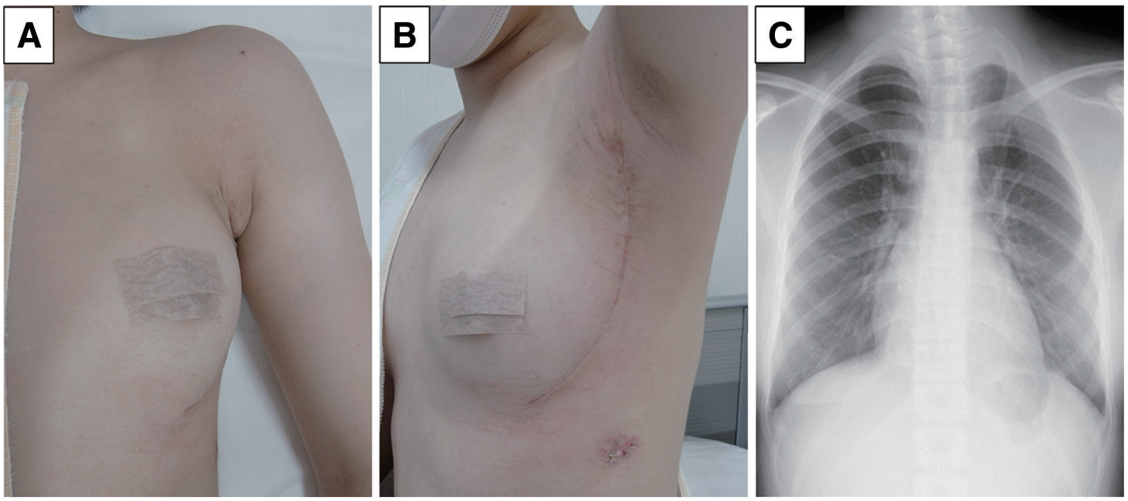

Fig. 3 (**A**) Front view and (**B**) axillary view of the chest wall showed that an axillary incision line along the mammary line provides cosmetic advantages. (**C**) Postoperative chest X-ray showed the well-expanded left upper lung.

revealed a well-expanded left upper lung (**Fig. 3C**). Sensory deficits associated with nerve injury were limited to sensory deficits in the axillary region of the area innervated by the intercostal brachial nerve. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Discussion

Myxoid neurofibroma, a subtype of neurofibroma, is a benign chest wall tumor that predominantly affects young people.[4] In general, primary chest wall tumors are rare, with varying histology from benign to malignant,

and their common clinical features and courses are not well known. This makes it challenging for thoracic surgeons to diagnose and treat primary chest wall tumors. Treatment of chest wall tumors with chemotherapy or radiation therapy is generally ineffective, and en bloc resection of the tumors and chest wall is required.

The main principle of determining the incision (approach) for chest wall resection is, first, to provide a good surgical view of the most technically challenging part of the operation. Second, the chest wall function and cosmetic appearance should be preserved as much as possible. Especially for chest wall tumors that predominantly involve the upper ribs, the first step is to safely dissect and resect around the first rib to provide a sufficient field of view to remove the bony rib cage, including multiple target ribs. Next, muscle preservation, reduction in incisional wound size, and improved cosmetic appearance should be pursued.

Usually, chest wall resection requires a 2-cm margin for benign tumors and a 4-cm margin for malignant tumors. Therefore, an approach or incision that provides a good view of the resected chest wall must be selected. However, in practice, most approaches for chest wall tumors are performed through an incision directly above the tumor. In contrast, for apical chest wall tumors that hang over the first rib and mimic superior sulcus tumors, as in this case, an anterior or posterior approach is the principle approach.[5] There are very few reports on the combined axillary incision and thoracoscopic resection of apical chest wall tumors.

This case demonstrates a detailed technique and good surgical indications for a combined axillary incision and thoracoscopic approach for chest wall resection of apical chest wall tumors. The advantages of this approach include good views of the first rib, axillary arteriovenous vessels, brachial plexus, and the superior bony thoracic aspect. Second, this technique requires only pectoralis minor muscle dissection and preserves most of the latissimus dorsi and serratus anterior muscles. It is clearly more muscle sparing than the conventional Paulson posterolateral incision, contributing to the preservation of thoracic and upper extremity function. Third, the lateral breast skin incision line is cosmetic, and benefits both women and young adults (**Fig. 2C**). The combined axillary incision and thoracoscopic approach is the least invasive approach for apical chest wall tumors, allowing preservation of chest wall and upper extremity function through muscle sparing without compromising radicality and safety.

However, the disadvantage of the axillary incision technique is the inability to approach the transverse costovertebral joint from outside the bony rib cage through an axillary thoracotomy. In this case, it was necessary to compensate for this disadvantage by performing thoracoscopic dissection of the costovertebral joint and transverse costovertebral joint ligament while preserving the sympathetic nerves traveling within the thoracic cavity. Additionally, this approach is not suitable for patients with tumors extending into the transverse costochondral joint.

Conclusion

The combined axillary incision and thoracoscopic approach is useful and the least invasive approach for benign primary chest wall tumors localized in the apical chest wall in young patients and when cosmetic and muscle preservation are important.

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Disclosure Statement

The authors declare no conflicts of interest associated with this manuscript.

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