

Case Report

The Sternal Foramen: The Possible Forensic Misinterpretation of an Anatomic Abnormality

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Abstract

The sternum is one of the skeleton parts with frequent variation in appearance on images or during autopsy studies. Therefore the knowledge of sternal variations and anomalies is useful so as not to confuse those with pathological conditions and acquired lesions, usually gunshot or stab wounds. Awareness of a sternal foramen is important in acupuncture practice also. Acupuncturists should be aware of congenital sternal foramina to avoid serious heart injury by needle insertion, especially since this area holds a commonly used acupuncture point. Besides this it is important for doctors to have thorough knowledge about sternal anomalies for better diagnosis and treatment. Here we discuss one case brought for autopsy in the Department of Forensic Medicine PGIMS, Rohtak. We observed in this case a sternum with a large oval foramen in lower one third of the body which could have misled to the diagnosis of a firearm/stab wound in a skeletonized remains of a body.

Key Words: Sternum, Foramen, Autopsy, Skeletonized Remains

Introduction:

The adult sternum has three components i.e. manubrium (Prosternum), the body of sternum (Mesosternum) and xiphoid process (Metasternum). [1] The sternum is formed from bilateral mesenchymatous condensations, sternal plates, which begin in ventrolaterally region of body wall.

These plates undergo chondrification, move ventrally towards each other from both sides, and they eventually fuse together across the midline in a craniocaudal direction.

This chondrification produces cartilaginous models of the manubrium, body segments (sternebrae), and the xiphoid process. Fusion of the bars at the inferior end of the sternum is sometimes incomplete. [2] This fusion defect can also be seen occasionally between the third and fourth body sternebrae. This imperfect union is known as midline sternal foramen.

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This condition is seen more frequently in the lower part of the sternum, but may occur even in the manubrium. [3, 4]

It may be an isolated malformation or may be accompanied by displacement of the heart or other midline abnormalities. [2]

Case Report:

During routine autopsy of an unknown/ unidentified dead body in the Department of Forensic Medicine PGIMS, Rohtak, Haryana, India. We observed a sternum with a large oval foramen in lower one third of the body. (Fig. 1) The length and the width of the sternal foramen were 18.75 mm and 12.50 mm respectively, measured by using digital caliper.

Fig. 1: Large Oval Sternal Foramen in the Lower Part of Body of Sternum



Discussion:

A specialized mesenchymal condensation of the anterior thoracic wall is form the sternum, which is a vertical component of

the axial skeleton. As the ribs grow laterally and anteriorly, a pair of mesenchymal sternal bars condenses and forms within the ventral body wall. By the 8th week of development, these bars begin to condense into cartilaginous sternal plates and then fuse into a single midline structure.

As the sternal plates fuse together, the superior seven pair of ribs, which growing and have also begun to condense, make contact with the lateral edges of the plates.

The fused sternal plates later ossify to form the sternum through the development of several ossification centers, giving rise to distinctive anatomy of the adult sternum. The manubrium and sternal body begin to ossify until child is about three years of age. [5]

Any failure in the developmental process results in various sternal anomalies, such as fissures or foramen. [6-8]

Sternal foramen is a congenital defect at the lower third of the sternum, usually asymptomatic. Sternal foramen may be associated with sternal sclerotic bands [9] sternal clefts with displacement of the heart or other midline abnormalities. Sternal foramen associated with accessory fissures on left lung were reported by using high-resolution computed tomography. [10]

The incidence of sternal foramen was evaluated as 4.3% on the chest CT by Stark [11] 6.7% in autopsy cases by Cooper [7], 6.6% by Moore et al [8] and 4.5% by Yekeler E et al. [9]

Aktan and Savas observed it in 5.1% of Turkish population. [10] The size of sternal foramina ranged between 2 and 16 mm, with mean of 6.5 mm. [9] But the sternal foramen in our study measured to be 18.75 mm and 12.50 mm, a larger size reported so far.

A sound knowledge of sternal variations and anomalies is very important for medical practitioners. Fatal cardiac tamponade resulting from a congenital sternal foramen located in the inferior part of the sternum and low thickness of sternal body was seen during the sternal puncture. [12]

Foramina in sternum were misinterpreted as acquired lesions like gunshot wounds. [13] The Forensic expert should have knowledge of gunshot wound and sternal foramen. The hole due to earlier reason should have irregular edges, beveling and fracture lines and latter have unique, smooth, rounded edges.

To be familiar with the imaging appearances of the sternal variation and anomalies, it is necessary to differentiate those from the pathological conditions, such as traumatic fissures or fracture and lytic lesions. Absence of cortical irregularity, expansion and soft tissue mass can be taken into consideration in the differentiation. [9]

Deep perpendicular needling at REN [14] is therefore contraindicated for patients with congenital sternal foramen, oblique or transverse needling should be used. [15]

Serious complications following sternal puncture for bone marrow biopsy [13] or acupuncture [14] have been reported in the literature. Fatal cardiac tamponade following sternal puncture in the inferior part of the sternum with a congenital sternal foramen was reported. Therefore, awareness of the presence of sternal variations and anomalies is important to prevent these fatal complications by avoiding the inferior part of the sternal body during bone marrow aspiration.

When sternal puncture is planned in corpus sterni region, radiographs should be taken to rule out this variation to avoid fatal complications.

Conclusion:

This article documents the occurrence of a relatively rare congenital anomaly which may be misleading and may result in serious erroneous conclusions, particularly when evaluating skeletonized human remains.

This abnormality and its relationship to medico-legal cases have not been previously reported in the forensic literature.

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