

A Case of Sternal Foramen-Embryological Background and Clinical Implications

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ABSTRACT:

Sternal variations and anomalies have been identified in the past during autopsy or cadaveric studies.

Sternal foramina are a well-known variant anatomy of the sternum with reported prevalence between 4.3 to 6.7%^{1,2}

They carry the risk of life-threatening complications like pneumothorax or even pericardial /cardiac puncture during sternal interventions like marrow aspiration/biopsy/acupuncture.

Discussed below, is one such case of sternal foramen, throwing light on its anatomical aspects and clinical implications

Keywords: Sternum, Foramen, mesosternum, pneumothorax

INTRODUCTION:

The sternum or breast bone has 3 components. The broad triangular Manubrium has a central jugular notch between the 2 oval fossae for articulation of sternal end of clavicle, laterally it has an articular facet for 1st rib and demi facet for 2nd rib.

The elongated body which has articular demi facet for 2nd rib and 7th rib at superior and inferior angles respectively, a complete facet for articulation of 3rd to 6th rib.

The slender xiphoid process is continuous with the lower end of body at xiphisternal joint.

The sternum is derived from a pair of vertical mesenchymal bands on vertebral body called sternal bars.

Chondrification occurs craniocaudally in sternal bars to form a cartilaginous model of manubrium, sternabrae of the body and xiphoid process. Failure of fusion of these Sternebrae results in a Sternal foramen which is more common at the level of 3rd and 4th sternabrae¹.

The morphometric study of sternal foramen is important as it can be misinterpreted as acquired lesions like gunshot wound, fracture, lytic lesions etc.

As the sternum is closely related to mediastinal structures, sternal foramen leaves heart, lungs and great vessels unprotected especially while performing invasive procedures like bone marrow aspiration, acupuncture etc and may lead to life threatening complications like pneumothorax and cardiac tamponade

CASE REPORT:

During routine undergraduate osteology demonstration in the Department of Anatomy, Raja Rajeswari Medical college and Hospital, Bengaluru, the author found a sternum with a foramen in the lower part of its body.

The bone specimen was studied in detail and photographed. The dimensions were measured by using Vernier calipers The sternum had a small, oval shaped defect in the lower 1/3rd of the body between the attachments of 5th and 6th costal cartilages. (Figure-1)

Size of the foramen as measured by Vernier calipers was 8mm x 6mm (length and breadth respectively) Distance from the sternal angle was 6.5 cm and distance from the lower end of sternum was 2.5 cm. edges of the foramen was smooth and well ossified.



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Fig-1 Sternal foramen (Marked by an asterix)

DISCUSSION:

The sternum develops from a pair of longitudinal mesenchymal condensations, the sternal bars that form in the ventrolateral body wall.

As most of the cranial ribs make contact with them in the 7th week, the sternal bars meet along the midline and begin to fuse.

Fusion commences at the cranial end of the sternal bars and progresses caudally, finishing with the formation of xiphoid process in the ninth week. Like the ribs, the sternal bones ossify from cartilaginous precursors. The sternal bars ossify in the craniocaudal succession from 5th month until shortly after birth, producing the definitive bones of the sternum. The manubrium, the body and the xiphoid process.

Any failure in this developmental process results in various sternal anomalies, such as fissure or foramen²

In a study by Ensar Yekelar et al² out of 1000 patients who underwent MDCT examination, evaluated for detection of sternals variations and anomalies, manubriosternal fusion was partial in 100(10%) subjects and complete in 196(19.6%) subjects. Incomplete and sternoxiphoid fusions

were found in 324(32.4%) and 303(30.3%) subjects respectively

According to Grossner J(2013)³, In more than 50% of patients, direct adjacent structure dorsal to sternal foramen was the lung. Therefore safe depth for needle insertion is not more than 2.5 cm.

The incidence of sternal foramen was evaluated as 4.3% on chest CT by Stark⁴, 6.7% in autopsy cases by cooper⁵, 6.6% by Moore et al⁶ and 5.1 % of Turkish population as observed by Aktan and Savas⁷.

According to parvathi⁸, sternal foramen is a congenital oval fusion defect of the sternum occurring in upto 6.7% of autopsy and prevalence of focal bone thinning, fissures and other abnormalities seen in sternum can be detected with bone scintigraphy, radiography and CT Imaging.

CONCLUSION:

Sternal foramina may pose a great hazard during sternal puncture, due to inadvertent cardiac or great vessel injury. They can also be misinterpreted as osteolytic lesions in cross sectional imaging of the sternum.

Fatal cardiac tamponade following sternal puncture in inferior part of sternum with a congenital sternal foramen was reported. The awareness of presence of sternal variations and anomalies is important to prevent these fatal complications by avoiding 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 variation.

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DECLARATION: I declare that this article has not been published elsewhere.