



Presence of Unusual Foramen in the Sternum – A Case Report

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Authors' contributions

This work was carried out in collaboration between both authors. Author TRR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SRR managed the analyses and the literature searches of the study. Both authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Presence of sternal foramen is a familiar variation of the sternum that brings the danger of fatal impediments like pneumothorax, damage to vital structures like pericardial and cardiac puncture during acupuncture. The present day autopsy population shows about 6.7% of bony defects in the sternum. When present it is seen in solitary and found in the body of the sternum, rarely multiply and may be found in the manubrium. Review of literature suggests that presence of unusual foramen in the sternum is found at the age of 8-years and also in the persons of old age.

During routine visual inspection of the bone collection housed in the Department of Anatomy, in one of the sternum we observed the presence of sternal foramen and bifid xiphoid process. The sternal foramen was somewhat oval shaped measuring 6.75 mm × 5.55 mm, and was present in lower one third of the body of the sternum. The sternal foramen and the bifid xiphoid process when present will be usually asymptomatic. Sternal foramen can be misinterpreted sternal foramen can be misinterpreted as osteolytic lesion. Manifestation of sternum in close relation to the mediastinal structures, occurrence of sternal foramen makes the lung, heart and great vessels vulnerable while execution of invasive procedures like bone marrow aspiration, acupuncture leading to life threatening impediments such as pneumothorax and cardiac tamponade.

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1. INTRODUCTION

The long, flattened chest bone or sternum is present in the anterior part of the thoracic cage. It articulates with the clavicle in the upper part to form the sternoclavicular joint. Its lateral border articulates with the cartilages of the first seven pairs of ribs forming sternochondral joints. It comprises of three parts, the manubrium (Prosternum), the body or gladiolus (Mesosternum), and the xiphoid process (Metasternum) named from above downwards. During embryonic period the body consists of four segments or sternebrae. The average length of the sternum in the adults is about 17 cm, and is rather greater in the male than in the female [1].

In the early embryonic life, the sternum originally made up of two cartilaginous bars, positioned one on either side of the midline, articulating with the cartilages of the upper nine ribs on each side. These two cartilaginous bars get fused with each other from six ossification centres to form the cartilaginous sternum. These ossification centres are found in a particular pattern like one centre for the manubrium, four centres for the body, and one centre for the xiphoid process, in the intervals between the articular depressions for the costal cartilages. The centres make their appearance at the upper parts of the segments, and proceed gradually downward. The ossification centres follow the specific pattern and time: during the sixth month it appears in the manubrium and first piece of the body, at seventh month of foetal life in the second and third pieces of the body, in its fourth piece, during the first year after birth; and in the xiphoid process, between the fifth and eighteenth years. Sporadically some of the segments are formed from more than one centre, which vary from its number and position. Consequently, the first piece may have two, three, or even six centres. The irregular union, number and position of these centres explains the rare occurrence of the sternal foramen [2].

2. CASE REPORT

During routine visual inspection of the bone collection housed in the Department of Anatomy, in one of the sternum we observed the presence of sternal foramen and bifid xiphoid process. The sternal foramen was somewhat oval shaped

measuring 6.75 mm × 5.55 mm, and was present in lower one third of the body of the sternum (Fig. 1). Fusion of inferior end of sternum is sometimes incomplete, resulting in a bifid xiphoid process. The sternal foramen and the bifid xiphoid process when present will be usually asymptomatic.



Fig. 1. Sternum with presence of sternal foramen and bifid xiphoid process

1. Manubrium sterni, 2. Body of sternum, 3. Sternal foramen, 4. Bifid xiphoid process

3. DISCUSSION

Many variations are found in human skeletons which may seldom demand distinction from pathologic changes. The sternum is one with recurrent variation in appearances on images or

autopsy series. These variations of the sternum can be noticed incidentally on cross-sectional images in the living subjects. Knowing the variation of a sternal foramen is vital in acupuncture practice and sternal marrow aspiration to prevent any damage to the heart. At the tenth week of foetal period the sternum is completely formed by the migration of the cells from two lateral plates of mesoderm on either side of the anterior chest wall will fuse in the midline. As the sternal plates fuse together, the superior seven pairs of ribs, which growing and have also begun to chondrify, make contact with the lateral edges of the plates. The fused sternal plates later ossify to form the sternum with several ossification centres [3]. The manubrium and sternal body continues to ossify until child attains the age of three. Any failure in the developing course results in many sternal anomalies, such as fissures or foramen. Fusion of inferior end of sternum is sometimes incomplete, resulting in a bifid or perforated xiphoid process. Malformations of xiphoid process are seen in mice mutant for both HOXC-4 and HOXA-5, and mice mutant for HOXB-2 and HOXB-4 have split sternums [4]. The knowledge of presence of sternal foramen must be kept in mind by the clinicians in order to elude serious heart injury during sternal puncture.

Developmental abnormalities of the sternum encompass a wide-ranging malformations. In 1990 Shamberger and Welch divided sternal anomalies into four groups: cervical ectopic cordis, thoracic ectopic cordis, thoracoabdominal ectopic cordis and cleft sternum. Sternal anomalies like, a band like scar from the umbilicus to the sternal defect or from it to the chin, cervicofacial hemangiomas, and diastasis recti, branched xiphoid process, V-shaped bifurcation, sternum bifidum, synchronodrosis sternii, anomalies in the shape of the sternum, sternum gallinaceam and sternal foramen have also been documented in the literature review [5].

In about 6.7% of a large existing autopsy population bony flaws of sternum has been documented, generally these defects appear solitary and located in the body of the sternum. Rarely these defects can multiply in the manubrium ranging from 8 years of age to the adult age. Sternal foramina are located along the lines of fusion of multiple centres of ossification as a result of incomplete fusion. They have been mistaken as acquired lesions like gunshot wounds [6].

Various dimensions of sternal foramina have been reported in manubrium, body and xiphisternum. Typically, the imperfection occurs in the lower third of the sternal body, as a single midline foramen, which asymptomatic and can be validated only by CT scan. The awareness of such foramina is crucial because of the potential danger of cardiac tamponade, which may result during the procedures of bone marrow aspiration or bone marrow biopsy or acupuncture [7]. It is prudent to take an X-ray to rule out such disparities of the sternum. Henceforth this variation must be kept in mind while execution of invasive procedures like sternal puncture for bone marrow aspiration to preclude life-threatening impediments [8].

4. CONCLUSION

The sternal foramen and bifid xiphoid process are the most common variants and are mostly asymptomatic. The sternal foramen can be mistaken as acquired lesion like a gunshot wound. Sternum is in close relation with the mediastinal structures, presence of sternal foramen makes the lung, heart and great vessels vulnerable while carrying out invasive procedures; therefore it is prudent to take an X-ray to rule out such glitch of the sternum; before carrying out intrusive procedures like bone marrow aspiration, acupuncture leading to life threatening impediments such as pneumothorax and cardiac temponade.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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