



PERFORATED STERNUM: A CASE REPORT

Anatomy

Dr. Prerna Jagdish*

Assistant Professor, Department of Anatomy, KD Medical College, Mathura
* Corresponding Author

Dr. R. K. Ashoka

Professor & Head, Department of Anatomy, KD Medical College, Mathura

Dr. Nahid Yasmin

Tutor, Department of Anatomy, KD Medical College, Mathura

ABSTRACT

The flat bone sternum presents with many variation in gross bone morphology on images or autopsy. In the living subjects, these variations can be incidentally noticed on cross-sectional images. Knowing such a variation as sternal foramen is vital in the practice of acupuncture and sternal bone marrow aspiration, to prevent any damage to the heart. Chance cardiac or great vessel injury might prove to be hazardous during sternal puncture. They can also be commonly misinterpreted as osteolytic lesions in cross-sectional imaging. Many variations are found in human skeletons which may seldom demand distinction from pathologic changes.

KEYWORDS

Sternum, manubrium, xiphoid, mesosternum, sternbrae

Introduction:

Sternum or the breast bone is a flat bone which is located in the midline of the anterior wall of thorax. It has three parts (i) manubrium (ii) body (iii) xiphoid¹. Knowledge of a congenitally present perforated sternum may prove to be of great importance to the clinicians. Its importance lies in the potential hazard which might be caused when performing puncture in this region. Serious complications have been reported following sternal puncture for bone marrow biopsy² or acupuncture³.

Relevant embryology: Bilateral condensation of mesenchymal tissue in the dorsolateral region of body wall marks the beginning of the sternal development. These condensations are termed as sternal plates. Chondrification begins in these sternal plates and simultaneously they move ventrally towards each other from both sides. Eventually the plates fuse together across the midline in craniocaudal direction. This cartilaginous model of sternum consists of manubrium, mesosternum and xiphoid process. Mesosternum or the future sternal body ossifies from 4 sternbrae⁴. Sternal foramen, of varying size and form, may occur between third and fourth sternbrae due to incomplete fusion. Foramina in sternum are reported in manubrium, body (more common) and in xiphisternum^{5,6}. The arrangement and number of ossification centers vary according to the time of fusion and the level of completeness of the sternal plates. Incomplete fusion leaves a sternal foramen⁷.

Case Report: During routine Osteology tutorial classes scheduled for MBBS students in the Department of Anatomy, KD Medical College, Mathura, a sternum was observed with a foramen. The shape of the foramen was oval and it was located in the lower one third in the region of the body of sternum. The dimensions of the foramen were measured using a digital caliper. Length was found to be 11.71 mm and width was found to be 7.82 mm.



Figure I. Anterior surface of Sternum

Figure II. Posterior surface of Sternum

Discussion: Sternum or the breast bone very commonly presents variations and morphological anomalies. These malformations are detected co-incidentally by radiological examinations or during postmortem at the time of death. Any failure in the normal embryogenic sequence of events causes anomalies in sternum in the form of fissures or foramen. Of the known anomalies, sternal foramen is the most common variation of sternum. It is mostly symptomless. However, its presence has to be kept in mind for the serious complications after sternal biopsy and acupuncture. Patients with sternal foramen are at risk of spontaneous pneumothorax and/ or even pericardial tamponade during sternal biopsy or acupuncture⁸. The knowledge of sternal variations and anomalies is useful so as to not confuse them with pathological conditions or/ and acquired lesions, for example, gunshot or stab wounds. Knowledge of a sternal defect is important in the acupuncture interventions to avoid pericardium/ heart injury by needle insertion, since this area is targeted for a commonly used acupuncture point⁹. A pathologist should not mistake a sternal foramen for a bullet entry point, a traumatic penetration injury, or a pathological bone lesion from cancer or infection¹⁰. It is important to review the medical records of the concerned individual to aid an accurate investigation for the cause of death¹¹. In a CT study conducted by Gossner J, the prevalence of sternal foramina was found to be 4.5% in a sample size of 352. The mean width of sternal foramina was found to be 3.3 mm. Its vicinity to the adjacent thoracic organs was also found out. In most patients, the lung was directly adjacent to the sternal foramen (8 of 15) or mediastinal fat (5 of 15). Only in 3 cases the pericardium/ heart was located directly adjacent to a sternal foramen (3 of 15)¹². As a part of the study conducted by Babinski et al. to judge the organ of vicinity in relation to sternal foramen, needles were inserted through the sternal foramina in 16 cadaveric specimens and it was found that eventually every needle will have punctured the heart¹³. Distance of sterna foramen to heart was not stated in the study. Gossner et al confirmed the finding of Babinski et al in their study, and also gave an estimation of the depth from skin to the pericardium which varied considerably from 3 to 9.1 cm¹².

Conclusion: Knowledge of a congenitally present perforated sternum may prove to be of great importance to the clinicians. Its importance lies in the potential hazard which might be caused when performing puncture in this region. Serious complications have been reported following sternal puncture for bone marrow biopsy or acupuncture.

Acknowledgement: We are grateful to Mr. Ram Ikbal Kushwaha, Sr. Technician, Department of Anatomy, for his technical assistance.

References

1. Graeber GM, Nazim M (2007) The anatomy of the ribs and the sternum and their relationship to chest wall structure and function. *Thorac Surg Clin* 17: 473-489.
2. Bhootra BL. Fatality following a sternal bone marrow aspiration procedure: a case report. *Med Sci Law*; 2004; 44 (2): 170-172.
3. Halvorsen TB, Anda SS, Naess AB, Lewang OW. Fatal cardiac tamponade after acupuncture through congenital sternal foramen. *Lancet*. 1995; 345 (8958): 1175.
4. Breathnach AS. Frazer's Anatomy of the Human Skeleton. 5th Ed., London, J & A Churchill Ltd. 1958; 53-54.

5. Moore MK, Stewart JH, McCormick WF. Anomalies of the human chest plate area: radiographic findings in a large autopsy population. *Am J Forensic Med Pathol.* 1988; 9: 348–354.
6. Cooper PD, Stewart JH, McCormick WF. Development and morphology of the sternal foramen. *Am J Forensic Med Pathol.* 1988; 9: 342–347.
7. Susan Standing. *Gray's Anatomy, The Anatomical Basis of Clinical Practice.* 40th Ed. London, UK: Churchill Livingstone, Elsevier; 2008; 918.
8. Balta C. An Anatomic Abnormality: Double Sternal Foramina. *International Journal of Clinical and Medical Images.* 2018; 4: 605.
9. Jakhar JK, Dagar T, Dhatarwal SK, Pal V. The Sternal Foramen: The possible Forensic misinterpretation of an Anatomic abnormality. 2015; 37(3): 315-16.
10. Saccheri P, Sabbadini G, Toso F, Travan L. A keyhole-shaped sternal defect in an ancient human skeleton. *Surg Radiol Anat.* 2012, 34:965–968. 10.1007/s00276-012-0963-6.
11. Paraskevas G, Tzika M, Anastasopoulos N, Kitsoulis P, Sofidis G, Natsis K: Sternal foramina: incidence in Greek population, anatomy and clinical considerations. *Surg Radiol Anat.* 2015, 37:845–851. 10.1007/s00276-014-1412-5.
12. Gossner J: Relationship of sternal foramina to vital structures of the chest: a computed tomographic study. *Anat Res Int.* 2013, 2013:780193. 10.1155/2013/780193
13. Babinski MA, de Lemos L, Babinski MS, Goncalves MV, De Paula RC, Fernandes RM: Frequency of sternal foramen evaluated by MDCT: a minor variation of great relevance. *Surg. Radiol Anat.* 2015, 37:287–291. 10.1007/s00276-014-1339-x