ACTA SCIENTIAE ANATOMICA

ISSN: **2595-7651**
Acta Sci Anat. 2019;1(3):158-160.

The sternal foramen - a small anomaly of clinical relevance that can mimic traumatic complications

José Aderval Aragão[1], Cássia Lorena Dantas Rodrigues[2], Luan Mateus Rodrigues Sousa[2], Iapunira Catarina Sant'Anna Aragão[3], Felipe Matheus Sant'Anna Aragão[3], Francisco Prado Reis[2]

ABSTRACT

Sternal foramens are developmental defects on the medium line of the sternum due to incomplete fusion of its ossification centers. Its prevalence varies from 4.3 to 18.3%, and because of its location, most of the time, on the inferior third of the body, it predisposes risk of fatal complications during sternal puncture or bone marrow biopsy. It was observed on an adult sternal bone, without sex or age identification, a semi-elliptical foramen located on the inferior third of the body, on the level of the fifth notch of the costochondral junction, whose length and width were of 8,0 mm and 10,0 mm, respectively. The knowledge of this foramen is of great importance to health professionals, especially on the execution of sternal procedures, since its presence can lead to complications during the acupuncture practice and on bone marrow sternal punctures, as well as to prevent radiological and pathological misinterpretations, so, in that way, patient care can be improved.

Keywords: sternum, abnormalities, sternal cleft, puncture biopsy, variations, acupuncture points, anatomy.

INTRODUCTION

The sternal bone and its joints are important structures of the anterior chest wall with frequent variations that can simulate pathologies on images or on a series of autopsies [1].

Of those, the sternal foramens are the most known anatomical variations, with a prevalence that can vary from 4.3 to 18.3% [1-5].

These foramens, most of the time located on the caudal parts of the sternal body, result from the incomplete fusion of the ossification centers [6, 7]. The presence of the sternal foramens on patients submitted to bone marrow biopsies, sternal punctures [1, 4, 8] and acupuncture [9-11] increases the perforation risks of organs located on chest cavity, which can lead to a pneumothorax or a cardiac tamponade [2, 11, 12].

CASE REPORT

During routine osteology classes for medical students of the Tiradentes University, it was observed a sternal bone with a semi-elliptical foramen located on the body inferior third on the level of the fifth notch of the costochondral junction (Figure 1). The length and width of the sternal foramen were of 8.0 mm and 10.0 mm, respectively, measured with a digital caliper with a 0.01 millimeters precision.

[1]Department of Morphology, Federal University of Sergipe (UFS), Aracaju, Sergipe, Brazil.
[2]Medical School of Tiradentes University (UNIT), Aracaju, Sergipe, Brazil.
[3]University Center of Volta Redonda (UNIFOA), Volta Redonda, Rio de Janeiro, Brazil.
Corresponding author: José Aderval Aragão, MD, PhD - jaafelipe@infonet.com.br

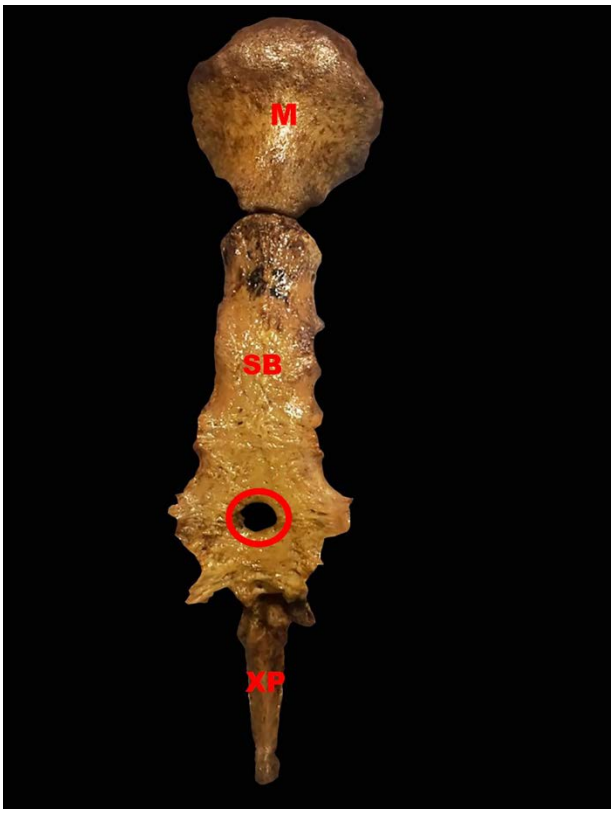

Figure 1: Photograph showing a foramen on the sternal body (red circle). M: manubrium; SB: sternum body; XP: xiphoid process.

DISCUSSION

The embryonic development of the sternal bone starts from a longitudinal pair of a linear agglomeration of mesenchymal cells on both sides of the medium line. These structures convert into pre-cartilage and fuse on the medium line on a cephalocaudal direction [8]. The two sternal halves ossify caudally from the cartilage centers from the 5th intrauterine month, and after the birth complete its development, forming the manubrium and the xiphoid process. Fusion failure of both halves results in sternal crevices and foramens [1, 6, 7].

The incidence of this foramen in literature is very variable, and may differ between the studies on dry bones or on cadavers, with a percentage of 13.8-18.3% [4, 5, 13], on imaging exams, varying from 4.5% to 11.6% [1-3, 7, 14, 15] and 6.7% in autopsies [6, 16].

In our study, the sternal foramen was located on the body inferior third on the level of the 5th notch of the costochondral junction. Which was also found in dry bones of human sternums from 38.5 to 77.8% [4, 13] and on 78.8% of patients, using computed tomography of the chest [15]. In comparison, the sternal foramen diameter, in the world literature, varied from 2 to 16.7 mm [1-6, 11, 15] which also, on average, is in agreement with what was found in our study.

The sternal foramen on the inferior third of the body is located on a dangerous zone because of the probability of injuries in the pericardium and, consequently, cardiac tamponade, therefore, the sternum interventions should be avoided on the level of the fourth to the sixth costochondral junctions.

In conclusion, the sternal foramen consists of an anatomical defect due to a failure during the embryonic development. The knowledge of this variation is of great importance to experts and health professionals, since its presence can lead to complications during acupuncture practice and on bone marrow sternal punctures.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ACKNOWLEDGMENTS

None.

REFERENCES

1. Yekeler E, Tunaci M, Tunaci A, Dursun M, Acunas G. Frequency of sternal variations and anomalies evaluated by MDCT. AJR Am J Roentgenol. 2006 Apr;186(4):956-60.
2. Gossner J. Relationship of sternal foramina to vital structures of the chest: a computed tomographic study. Anat Res Int. 2013;2013:780193.
3. Babinski MA, de Lemos L, Babinski MS, Gonçalves MV, De Paula RC, Fernandes RM. Frequency of sternal foramen evaluated by MDCT: a minor variation of great relevance. Surg Radiol Anat. 2015 Apr;37(3):287-91.
4. 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 Sep;37(7):845-51.
5. Gkantsinikoudis N, Chaniotakis C, Gkasdaris G, Georgiou N, Kapetanakis S. Morphological approach of the sternal foramen: an anatomic study and a short review of the literature. Folia Morphol (Warsz). 2017;76(3):484-490.
6. Cooper PD, Stewart JH, McCormick WF. Development and morphology of the sternal foramen. Am J Forensic Med Pathol. 1988 Dec;9(4):342-7.
7. Aktan ZA, Savas R. Anatomic and HRCT Demonstration of Midline Sternal Foramina. Turk J Med Sci. 1998;28(5): 511-514.
8. Anand A, Dougall P. Sternal Foramina in Patient with Hepatocellular Carcinoma: A Diagnostic Dilemma on Bone Scan. Indian J Nucl Med. 2019 Jan-Mar;34(1):35-37.
9. Babinski MA. A presença do forame esternal anômalo e a prática de acupuntura no meridiano extra (ren mai). Fisioterapia Brasil. 2005 Jan-Fev;6(1):71-74.
10. Barlas P. Skeleton with foramen sternale. Acupunct Med. 2010 Jun;28(2):62.
11. Babinski MA, Rafael Fábio A, Steil AD, Sousa-Rodrigues CF, Sgrott EA, de Paula RC, Rodrigo MPF. High Prevalence of Sternal Foramen: Quantitative, Anatomical Analysis and its Clinical Implications in Acupuncture Practice. Int J Morphol. 2012 Sep;30(3):1042-1049.
12. Halvorsen TB, Anda SS, Naess AB, Levang OW. Fatal cardiac tamponade after acupuncture through congenital sternal foramen. Lancet. 1995 May6;345(8958):1175.
13. El-Busaid H, Kaisha W, Hassanali J, Hassan S, Ogeng'o J, Mandela P. Sternal foramina and variant xiphoid morphology in a Kenyan population. Folia Morphol (Warsz). 2012 Feb;71(1):19-22.
14. Turkay R, Inci E, Ors S, Nalbant MO, Gurses IA. Frequency of sternal variations in living individuals. Surg Radiol Anat. 2017 Nov;39(11):1273-1278.
15. Boruah DK, Prakash A, Yadav RR, Dhingani DD, Achar S, Augustine A, Mahanta K. The safe zone for blinded sternal interventions based on CT evaluation of midline congenital sternal foramina. Skeletal Radiol. 2016 Dec;45(12):1619-1628.
16. 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 Dec;9(4):348-54.

RESUMO

O forame esternal: uma pequena anomalia de relevância clínica que podem mimetizar complicações traumáticas

Forames esternais são defeitos de desenvolvimento na linha média do esterno devido à fusão incompleta dos centros de ossificações. Sua prevalência varia de 4,3 a 18,3%, e em virtude de sua localização estar, na maioria das vezes, no terço inferior do corpo, predispõe ao risco de complicações fatais durante a punção esternal ou biópsia da medula óssea. Foi observado em um osso esterno de adulto, sem identificação de sexo ou idade, um forame semi-elíptico localizado no terço inferior do corpo, ao nível da quinta incisura da junção costo-condral, cujo o comprimento e a largura foram de 8,0 mm e 10,0 mm, respectivamente. O conhecimento desse forame é de suma importância aos profissionais de saúde, especialmente na realização de procedimentos esternais, visto que sua presença pode levar a complicações nas práticas de acupuntura e nas punções esternais de medula óssea, bem como impedir interpretações errôneas radiológicas e patológicas para que o cuidado ao paciente possa ser melhorado.

Palavras-chave: esterno, anormalidades, fenda esternal, biópsia por punção, variações, pontos de acupuntura, anatomia.