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Sternal Foramen - Medicolegal and Clinical Implications

Medical Science

KEYWORDS : Skeletonised body, developmental defect, autopsy.

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ABSTRACT

The purpose of this study is to discuss the developmental defect of sternum to avoid any misinterpretation during autopsy and clinical practices.

The case was reported during autopsy of the skeletonised body in the autopsy room of Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi. During autopsy, the sternal body was having an oval foramen at lower one third part measuring 8mm x 6mm. The foramen was having smooth and regular margins. The sternal foramen is a developmental defect usually found at lower one third of sternal body and formed by incomplete fusion of sternal bars.

During autopsy, this foramen may be misinterpretated as gunshot or stab wound and during biopsy and acupuncture, there is risk of fatal complication such as pneumothorax and cardiac tamponade. Thus the autopsy surgeons and clinicians must have the knowledge of sternal foramen.

Introduction-

Sternum is a flat bone present in the anterior wall of the chest in the midline. It is about 17 cm long in adult males, a little less in females. Sternum is having three parts i.e. manubrium, body of sternum and xiphoid process.

Anatomically on the right side of median plane, the posterior surface is related to the anterior border of right lung and pleura. On the left side, the upper two pieces of the body (out of total four sternabrae) are related to the left lung and pleura and the lower two pieces to the pericardium[1].

The sternum develops by fusion of two sternal plates which are initially present on either side of midline. They fuse cranio-caudally. Any defect in fusion of these plates lead to congenital anomalies such as foramina, bifid xiphoid, cleft sternum. Non union of sternal plates cause ectopia cordis where heart is left uncovered on the surface.

Sternal foramen is most commonly found at lower end of body of sternum but may also be found in manubrium and xiphisternum. The knowledge of sternal foramen is essential for clinicians as well as forensic experts because during bone marrow aspiration or biopsy insertion of needle may cause cardiac tamponade or pneumohorax. In forensic point of view this foramen may be misinterpreted as gun shot wound specially during autopsy of skeletonised body[1].

Case Report-

The case was reported during routine autopsy of an unidentified skeletonised body in the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi (U.P.), India. We observed a large oval defect at the lower one third part of sternum with smooth and regular margins. Size of foramen was 8 mm x 7 mm measured by using scale.

Discusion-

During fetal development sternum develop by two cartilaginous bars (mesenchymatous tissue). During this period these bars get attached to upper nine costal cartilages on each side of midline and they migrate and converge towards midline during eighth week of gestation and fused cranio-caudally with each other which is completed by tenth week. Sternal foramen is an oval or round defect which is mostly found at lower one third of sternal body. It is formed by incomplete fusion of sternal bars. In the thoracic region, a cartilaginous sternal bar forms on each side connecting the growing end of the rib cartilage with one another in the 6th week of intrauterine life. These bars are brought into contact at cephalic end at thorax, as the body wall is completed there and fuse together with an unpaired ventral rudiment in the 7th week forming first the manubrium sterni, then sternal body and finally the xiphoid process at about 9th week of intrauterine life. During this fusion process sometimes there is incomplete fusion in sternal body leading to sternal foramen. Sometimes complete fusion also fails in xiphoid process leading to forked or perforated xiphoid process[1].

Ossification of sternum occur by six ossification centers, one for manubrium, four for body and one for xiphoid process. Manubrium is ossified from its center usually appearing in fifth fetal month. First and second sternabrae ossify from single center that appear at about same time fourth and fifth centers (3rd and 4th sternabrae) are usually paired and appeared in fifth and sixth months respectively. Xiphoid process begins to ossify in third year or later. Union between mesosternal centers begins at puberty and proceed from below upward by the age 25 years, they all are united.

Complete fusion defect leads to cleft sternum and incomplete fusion leads to sternal foramina.

Sternal variations are rare but out of all sternal anomalies sternal foramen is more common than other anomalies. The incidence of sternal foramen was evaluated by stark as 4.3% on chest CT, 6.7% cases on autopsy by Cooper, 6.6% by Moore et al Aktan and Sowas observed in Turkish population as 5.1% cases[2].

The size of sternal foramen varies from 2mm to 16mm with the mean of 6.5mm. In our case we measured the diameter of foramen as 8mm. x 7mm.

Clinical and Medicolegal Implication-

Clinical importance of the defect lies in the fact that cardiac

tamponade can occur during needle insertion for bone marrow aspiration. As we know that there are two favoured site for bone marrow aspiraton,one is sternum and other is posterior part of iliac crest.

So during aspiration improper needling may cause cardiac tamponade or great vessel injury. Another importance lies in acupuncture technique as acupuncture point cv-17 (sea of energy) is located at the level of nipples in the midline. So during insertion of acupuncture needle there is risk of pericardial effusion followed by cardiac tamponade. Thus these procedure may also raise medico-legal issue in future.

The sternal foramen is usually asymptomatic and not visible on plane radiograph. It is visible only on CT scan. Multiplaner and 3D reconstructed multi detector CT(MDCT) images are the modality of choice for detecting sternal foramen[3].

Regarding Forensic aspect, during autopsy the sternal foramen may be misinterpreted as gunshot injury. But the careful examination may distinguish between the two. The sternal foramen is having smooth and regular edges and covered with cortical bone. In bullet injury there will be beveling and fracture line and absence of cortical bone at edges. The sternal foramen is mostly located at lower end of sternal body with same measurement on outer and inner surface[4].

Sometimes there may be teeth or claws marks or erosion around the foramen due to skeleton exposed to insects or animals. These should not be mistaken as ante mortem injuries.

Thus misinterpretation of sternal foramen as bullet injury may lead to serious erroneous conclusion in determining the nature and cause of suspected death[5].

Conclusion-

This case report is important for Clinicians as well as Forensic experts. During bone marrow biopsy and acupuncture there is risk of cardiac tamponade due to needle insertion through foramen which may cause death of the patient and may raise medico-legal issue in future. So knowledge of such anomaly is essential and prior CT is recommended.

For forensic experts this foramen may be misinterpreted as bullet injury. So to avoid such misleading erroneous conclusion the knowledge of sternal foramen is essential.

Fig.1- Sternal foramen at lower part of body of Sternum.

Fig. 2- Vertical diameter of sternal foramen (8 mm.).

Fig.3- Transverse diameter of sternal foramen (7 mm.).

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