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Anatomic and HRCT Demonstration of Midline Sternal Foramina

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Abstract: Midline sternal foramina are uncommon anomalies. Because of this, it is possible to mistakenly identify such a defect as defect as a gunshot wound or sternal disease by CT.

In this study the frequency of midline sternal foramina in Turkish adults is investigated by high resolution computed tomography (HRCT) and visual inspection of sternal bones.

Key Words: Midline sternal foramen, accessory fissure, high resolution computed tomography.

Introduction

The adult sternum has three components. The broad, triangular manubrium articulates with clavicles and the cartilages of the first pair of ribs. The elongated body ends at the slender xiphod process (1, 2).

The sternum is derived from a pair of vertical mesenchymal bands, called sternal bars, that develop ventrolaterally in the body wall. Chondrification occurs in these bars craniocaudally in the median plane to produce cartilaginous models of the manubrium, body segments (sternebrae), and the xiphoid process. Fusion of the bars at the inferior end of the sternum is sometimes incomplete (1, 3). This fusion defect can also be seen occasionally between the third and fourth body sternebrae. This imperfect union is known as midline sternal foramen. This condition is seen more frequently in the lower part of the sternum, as mentioned above, but may occur even in the manubrium (2, 4). It may be an isolated malformation or may be accompained by displacement of the heart or other midline abnormalities (2).

Materials and Methods

350 thoracic HRTC (high resolution computed tomography) studies performed in the Radiology Department at Ege University, and 62 sternal bones used as teaching materials in the Anatomy Department at Ege University were used to determine the frequency of midline defect of the sternum in Turkish adults.

350 adults (175 male and 175 female) aged between 25-65 years undergoing HRCT for various pulmonary conditions were studied. Patients with prior ches trauma, chest surgery, and local or systemic bone disease were excluded. The family histories were unremarkable.

Results

During observations of 350 thoracic HRCT scans, 19 midline formina (12 min males and 7 in females) were noted. Seventeen of them presented as isolated anomalies. It the other two cases, the midline foramen were associated with accessory fissures on the left lungs. In all these cases, the sternal foramen were located in the lower part of sternum (Fig. 1-3).

The CT cuts above and below were normal. The mean distance from the superior border of manubrium to the defect was 12.0±0.23 cm and the mean distance from the foramen to the inferior tip of processus xiphoideus was 7.04±0.17 cm.

Midline sternal foramina were observed in only 2 of the 62 prepared sternal bones. The foramina were also located in the inferior part of the sternum.

Discussion

The sternum begins to develop from mesenchymal bands on either side of the midline that later fuse to form

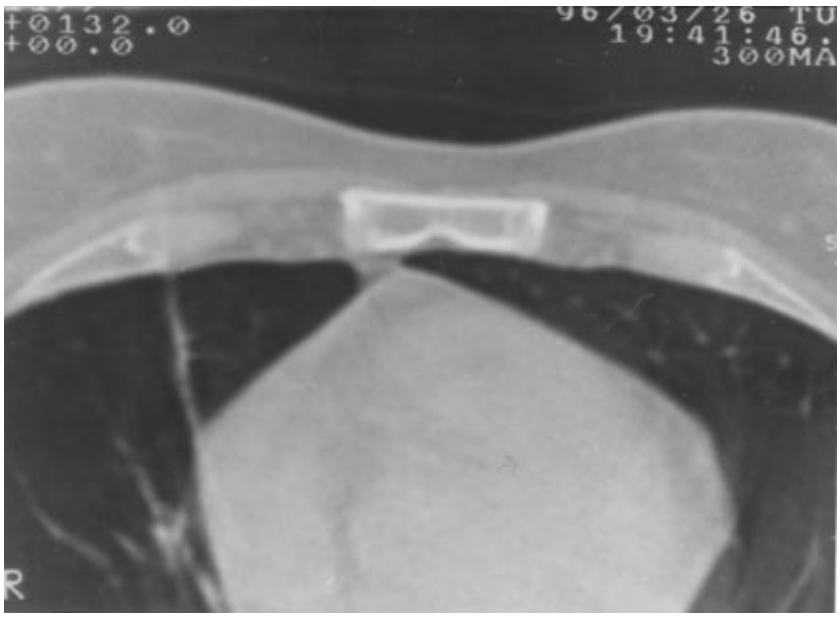

Figure 1. The cut above the foramen.

Figure 2. Midline sternal foramen (section through lower sternal body).

the cartilaginous models of the manubrium, sternebrae and xiphoid process. Sometimes, fusion at the inferior part of the sternum is incomplete. Thus if the incomplete fusion is limited to only one pair of sternal primordia, this part of the sternum is perforated as a midline circular defect of the sternum, seen in 19 of our cases by HRCT on two sternal bones (3, 5). Familiarity with the HRCT appearance of this sternal anomaly will prevent the overdiagnosis of sternal pathology and improve the capability to differentiate variants of normal from sternal disease (6). Foramina in the sternum have been also misinterpreted as acquired lesions, usually gunshot wounds (7).

Stark reported the frequency of midline sternal foramen to be 4.3% in Stark's study (6) and 6.7% in Cooper's large autopsy population (7). These values are similar to the 5.1% frenquency we observed in our sample.

Partial or complete sternal cleft (sternum bifidum) may be observed as an isolated anomaly, or may be accompanied by other anomalies and lesions (8).

Pasic et al. reported a 45 year-old woman with a sternal cleft associated with craniofacial and brain hemangiomata, an aneurysm of the aortic arch, anomalous micrognathia, supraumblical midline raphe,

Figure 3. The cut below the foramen.

Figure 4. Two sternal bones with midline sternal foramina.

and a cervical cyst (8). Hersh et al. reported two additional patients with sternal cleft and cutaneous, craniofacial hemangiomata. It is possible that the formation of the sternum and proliferation of midline angioblastic tissue may be affected by certain mechanisms during the sixth to ninth gestational weeks (9, 10). In conclusion, in an asymptomatic patient with sternal cleft, careful investigation is needed to identify possible asymptomatic internal vascular anomalies (8).

More frequently seen abnormalities of the lung and bronchial tree are abnormal divisions of the bronchial tree, sometimes resulting in the presence of supernumerary lobules, as in our two cases. These variations in the bronchial tree are of little functional significance, but may cause unexpected difficulties in bronchoscopy (11).

Few doctors, and possibly fewer acupuncturists, are aware of congenital sternal foramina. Some authors conclude that if sternal acupuncture is planned in the corpus sterni region, radiographs should first be done to rule out this anomaly to avoid such fatal complications as cardiac tamponade following sternal puncture during treatment (12, 13).

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