REPORT ON BIFID RIB OBSERVED IN THE THIRD AND FOURTH RIBS

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Abstract

Documentation of congenital defects and abnormalities is an important exercise that enables the scientific world to keep record on the reproductive processes. Asymptomatic bifid ribs occur less frequently and are usually identified by examining the chest radiographs and during autopsy and dissection. The current observation reports bifid ribs observed in one cadaver and it involved the third and the fourth ribs of the right chest. The distal part of the third rib was greatly expanded but did not birfucate. However, two costal cartilages were seen to arise from the expanded end to insert into the sternum. The fourth rib was also expanded but unlike the third it birfucated into the upper and the lower osseous branches. Each branch was attached separately to the sternum via the costal cartilage. The intercostal muscles, nerves and blood vessels appeared to be normal. The left chest did not show abnormalities of the rib. Aetiology of asymptomatic bifid ribs is not known, however, more studies are needed to examine the role of genetic factors in the genesis of these anomalies.

Key words: Bifid ribs, Costal cartilage, Intercostal muscles, Intercostal nerve, Intercostal vessels

Introduction

Documentation of congenital defects and abnormalities is an important exercise that enables scientists to keep record on the reproductive processes. It helps to detect changes in the incidence of congenital malformations and consequently this may lead into quick analysis of the possible aetiology.

Ribs are flat bones that make part of the thoracic wall, they articulate posteriorly with the vertebrae and anteriorly they join the sternum via the costal cartilages. Malformations of the ribs have been reported and are commonly referred to as costal malformation. They include presence of cervical ribs, bicipital ribs, bifid ribs and lumbar ribs.[1-8] Bifid rib or bifurcated rib is a congenital anomaly in which the sternal end of the rib is cleaved into two. It can involve the bony part of the rib, the costal cartilage or both.[6,7] These malformations in most cases are asymptomatic and are therefore detected during autopsy, chest X-ray and dissection. Anomalies of the ribs can however be associated with other malformations and therefore an individual may present with signs and symptoms early after birth and some are incompatible with life.[8-15] Bifid rib has been observed to occur in conditions such as Gorlin syndrome.[12]

Bifid rib occurring alone has been reported following reviews on chest radiographs.[1, 2, 7, 6, 16] In these reports the commonly affected one included the third, fourth and the fifth ribs and involved both the osseous and cartilagenous parts. In the current report bifid ribs were observed in one cadaver during dissection.

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Observations

The rib malformations were observed in a 42 years old male cadaver, and were confined on the right side of the chest (Figure 1). They involved both the osseous and cartilagenous parts of the third and the fourth ribs as reported below.

Figure1. Photograph of the outer surface of the chest showing the anomalous third (*3r*) and fourth (*4r*) ribs and the sternum (*S*). Part of the intercostal muscle is seen between the sixth and the seventh ribs (*arrows*).

Third rib

The osseous part of the third rib was wider than the corresponding third rib on the left chest. The widest area measured 35.79mm compared to 13.82mm measured on the third rib of the left chest. The expanded part came into contact with the second rib above and the fourth rib below thereby obliterating partly the intercostal space (Figure 2).

The other abnormality related to this rib was seen on its costal cartilage. Two costal cartilages were seen to arise separately from the expanded osseous end and each passed forward to attach to the sternum (Figure 1, 2). The sternal attachment of the lower cartilage was seen to correspond with that of the third rib on the left chest. But the sternal attachment of the upper cartilage did not correspond to any costal cartilage on the left chest. The space between the two

cartilages contained the intercostal muscles that appeared to be normal. The intercostal nerves and vessels occupied the costal groove. The third rib had a normal articulation with the vertebrae posteriorly.

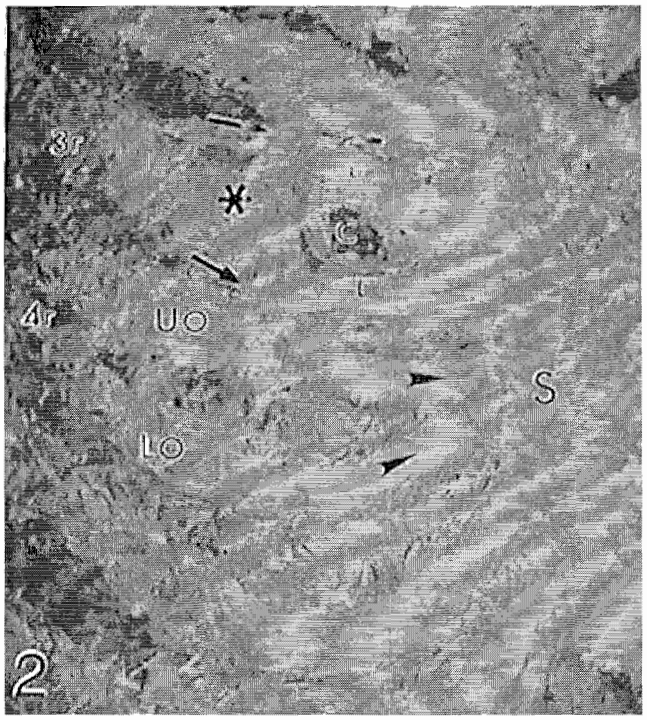

Figure 2. Photograph of the outer surface of the chest showing the detailed features of the anomalous third (*3r*) and fourth (*4r*) ribs. The third rib appears broader anteriorly (*asterisk*) to reach the second rib above and the fourth rib below (*arrows*). Two upper (*U*) and lower (*L*) costal cartilages arise from the sternal end of the expanded part to insert to the sternum (*S*). Note a near-circular space (*C*) between the two costal cartilages. The anomalous fourth rib (*4r*) bifurcates into the upper (*UO*) and lower osseous branches (*LO*) and each contains the costal cartilage (*arrowheads*) that attach to sternum (*S*).

Fourth rib

The fourth rib appeared also to have an expanded distal area and the widest part measured 38.5mm. After a short distance it birfucated into two branches; the lower branch and the upper branch both making a short course towards the sternum (Figure 2). The osseous branches measured 12.75 mm at the widest area and each one was attached to the sternum directly via the costal cartilage (Figure 1, 2). The sternal attachments of the lower branch corresponded with that of the fourth rib on the left chest. The costal cartilage of the lower branch did not correspond with any costal cartilage on the opposite chest.The costal groove of the fourth rib was normal and it contained the intercostal vessels and nerves and on reaching at the birfucation they gave branches that entered both the upper and lower branches. The area between the birfucated branches contained what appeared to be normal intercostal muscles. Muscle fibers and aponeurotic tissues were also observed. There was no deformity detected on the sternum and the vertebrae and the other ribs had normal morphology. Similarly the falx cerebri, oral region and major organs in the body appeared to be normal.

Discussion

This observation documents the presence of rib malformation on the right chest. Two costal cartilages appear to arise from the expanded osseous end of the third rib and attach to the sternum. The fourth rib was birfucated into two segments and each branch was attached to the sternum via a separate costal cartilage. The left chest did not have any anomalies of the ribs. Bifid rib occurring alone is asymptomatic and therefore it is mostly reported during dissection and on chest X-rays done for different reasons. It is generally a rare malformation and the frequency of occurrence varies from place to place. Studies that reviewed chest radiographs reported the frequency varying from 8.4%-0.013%[1, 2, 16], and observations made in the dissection room have reported a frequency of 1%.[6, 7] It is difficult for the current report to comment on the frequency of bifid ribs in Tanzania. This is the first report from our dissection room in the past 13 years. Reviews of past records on congenital anomalies have also not documented on bifid ribs. It is possible that some rib deformities passed unnoticed. Close observations in the dissection room together with reviews of chest radiographs may be useful in determining the frequency of bifid ribs in our environment.

The aetiology of bifid ribs is unknown and unlike other rib malformations such as cervical and lumbar ribs the genesis of bifid rib is difficult to explain embryologically. The ribs develop from costal processes, which appear in cervical, thoracic and lumbar vertebrae early during development. Whereas the costal processes associated with cervical and lumbar vertebrae regress with development, the thoracic costal processes persist and elongate to form ribs. It is easier to imagine the occurrence of lumbar or cervical ribs because some of the costal processes in these regions may fail to regress. How the costal process bifurcate to form a bifid rib is not clearly known. Studies using transgenic mice have showed that absence of hox-5; hoxb-6 genes cause the formation of bifid ribs.[17] Studies that have manipulated genes have also showed the occurrence of congenital anomalies in the vertebrae and the ribs.[18, 19] Such findings may strongly suggest the presence of a genetic factor in the genesis of bifid ribs. Experiments done in laboratory animals using chemical agents such as high doses of calcium valproate and stevioside, which causes appearance of supernumerary ribs, have not reported the occurrence of bifid ribs.[20,21] Whether asymptomatic incidental occurrences of bifid ribs indicate the presence of specific gene disruption during embryogenesis is a subject for future research. Some authors have considered the genetic factors to be an unlikely cause of bifid ribs and they suggest these to be incidental malformations in the thoracic wall.[6] Such arguments need to be considered carefully because gene disruption occurs also at a low frequency. These

observations call for more research into the thoracic wall malformations and possible aetiology.

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