



Anatomical Variation and Clinical Importance of Additional Anterior Intercostal Space

KEYWORDS

Gorlin-Goltz, intercostal space, thorax, ribs, sclerotome

Pramila Padmini Mantraratnam

Associate Professor, Department of Anatomy ,
Gitam Institute of Medical sciences and Research,
Rushikonda, Visakhapatnam, Andhra Pradesh, India

Narasinga Rao Bhattam

Professor , Department of Anatomy , Gitam Institute
of Medical sciences and Research, Rushikonda,
Visakhapatnam, Andhra Pradesh, India

ABSTRACT *The thoracic cage in its anterior aspect is formed by 9 ribs and their respective costal cartilages of the first seven ribs and costal margin formed by the fusion of costal cartilages of 8th, 9th and 10th ribs to that of 7th costal cartilage. Thereby enclosing nine intercostal spaces in anterior thoracic wall. As a part of routine dissections of thorax, a 60 year old male cadaver presented ten anterior intercostal spaces . The additional intercostal space was a result of bifid sixth rib on the left side. Eventhough it is asymptomatic it may be associated with chest lump, Gorlin syndrome. Bifurcated rib resulting in additional intercostal spaces are important in thoracic cage surgeries, radiological interventions.*

Introduction:

The ribs are essential structures of the osseous thorax and provide information that aids in the interpretation of radiologic images. Ribs develop from the costal process of thoracic vertebrae and thus are derived from the sclerotome portion of paraxial mesoderm (Sadler, 2009). A bifid rib (also bifurcated rib) is a congenital neuroskeletal abnormality of the anterior chest wall, which occurs in about 1.2% of humans.[Kumar N et al 2013] . Most commonly it occurs in 4th rib. Asymptomatic and often discovered incidentally by chest X-ray.[Etter LE 1944]

Material and methods:

A study was conducted on 60 cadavers for additional intercostal spaces formed by the bifid ribs as a part of routine dissections of thorax for first MBBS students during the period 2003-2013, 2015-2016.

Observation:

Only one cadaver showed a unilateral bifurcation of sixth rib on the left side close to the sternal end enclosing an additional anterior intercostal space(fig.1). an attempt was made to expose the additional intercostal space. Although the intercostal muscles were absent, there was a membrane covering it. The membrane is reflected to expose the contents of the space. The space was filled with fat(fig.2).

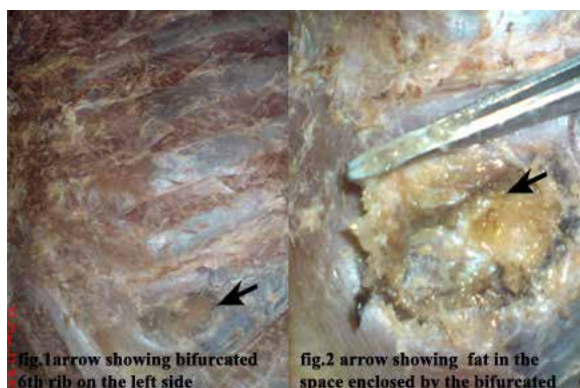


fig.1 arrow showing bifurcated 6th rib on the left side

fig.2 arrow showing fat in the space enclosed by the bifurcated

The fat is cleared to expose the neurovascular bundle if present. The fifth intercostal space was very much narrowed due to the bifurcation of sixth rib. The intercostals muscle of the fifth space were reflected to trace the intercostal nerves (fig.3). The collateral branch of fifth intercostal nerve when traced anteriorly , was found to be the content of additional intercostal space formed by bifurcated sixth rib. Deeper to the contents endothoracic fascia was observed(fig.4)



fig.3 showing 5th intercostal nerve and fig.4 showing collateral branch and its collateral branch in 5th intercostal space of 5th nerve within the space of bifurcated 6th rib

Discussion:

Bifid ribs are more common in males than females, and occur most frequently in the third and fourth ribs (incidence: third > fourth > fifth > sixth > second (Etter LE. 1944, Martin EJ 1960, Lim CK et al 1982, Schumacher Ret al 1992, Osawa T et al 2002, Osawa T et al 1998). They are slightly more common on the right side than on the left(Lim CK et al 1982) . In a study the bifid ribs were on the right fourth rib of all 3 male cadavers(Wu-Chul Song et al 2009) . Almost all reported cases of bifid rib were found in X-ray investigations or some symptomatic patients, with only 2 previous reports involving cadavers in a study by Osawa T et al 2002, Osawa T et al 1998 and 3 in another study (Wu-Chul Song et al 2009). Mostly they are asymptomatic except as a lump in anterior chest wall (Dhana et al., 2014).

Bloomberg (1926) suggests that one must be careful to differentiate this condition from the fusion of two ribs, which may give the appearance of a bifurcate rib.

Clinical importance: The presence of a bifid rib has been suggested as warranting further evaluation for nevoid basal cell carcinoma syndrome (Wattanasirichaigoon D et al 2003, Bitar GJ et al 2002). Nevoid basal cell carcinoma syndrome, also known as Gorlin's Syndrome (OMIM 109400), has been well documented and is associated with the occurrence of bifid ribs [Wattanasirichaigoon D et al 2003, Bitar GJ et al 2002, Gorlin RJ et al 1960, Lo Muzio L 2008]. This autosomal dominant condition displays high penetration and variable expression [Lo Muzio L 2008].

Conclusion:

The literature shows that bifid ribs are more common on right side , commonly affecting third or fourth ribs. In the present study the bifid rib is observed on left side of anterior thoracic wall and affected the left sixth rib which is rare. Bifurcated rib resulting in additional intercostal spaces are important in cardio-thoracic cage surgeries and radiological interventions.

Conflicts of Interest: None

References:

1. Sadler TW (2009). *Langman Medical Embryology* 11 144-145.
2. Kumar N, Guru A, Patil J, Ravindra S, Badagabettu SN. Additional circular intercostal space created by bifurcation of the left 3rd rib and its costal cartilage: A case report. *J Med Case Rep* 2013;7:6.
3. Etter LE. Osseous abnormalities of the thoracic cage seen in forty thousand consecutive chest photoroentgenograms. *Am J Roentgenol* 1944;51:359-63.
4. Martin EJ. Incidence of bifidity and related rib abnormalities in Samoans. *Am J Phys Anthropol.* 1960;18:179-187. [[PubMed](#)]
5. Lim CK, Lee KW, Bin JC, Rhee BC. Congenital anomalies of the ribs. *J Korean Soc Plast Reconstr Surg.* 1982;18:487-495.
6. Schumacher R, Mai A, Gutjahr P. Association of rib anomalies and malignancy in childhood. *Eur J Pediatr.* 1992;151:432-434. [[PubMed](#)]
7. Osawa T, Onodera M, Feng XY, Sasaki N, Nagato S, Matsumoto Y, et al. Two cases of bifid ribs observed in the fourth and the fifth rib. *Dental J Iwate Med University.* 2002;27:98-103.
8. Osawa T, Sasaki T, Matsumoto Y, Tsukamoto A, Onodera M, Nara E, et al. Bifid ribs observed in the third and the fourth ribs. *Kaibogaku Zasshi.* 1998;73:633-635. [[PubMed](#)]
9. Wu-Chul Song, Sang-Hyun Kim, Dae-Kyoon Park, and Ki-Seok Koh Bifid Rib: Anatomical Considerations in Three Cases *Yonsei Med J.* 2009 Apr 30; 50(2): 300-303. Published online 2009 Apr 30. doi: 10.3349/ymj.2009.50.2.300
10. Dhana Lakshmi V et al., (April 2014). Multiple Bifid Ribs: A Case Report. *Journal of Evolution of Medical and Dental Sciences* 3(15) 3883-3886.
11. Bloomberg MW: Bifurcate ribs—an unusual cause of deformity of the chest. *Can Med Assoc J.* 1926, 16: 807-808.
12. Wattanasirichaigoon D, Prasad C, Schneider G, Evans JA, Korf BR. Rib defects in patterns of multiple malformations: a retrospective review and phenotypic analysis of 47 cases. *Am J Med Genet A.* 2003; 122A: 63-69.
13. Bitar GJ, Herman CK, Dahman MI, Hoard MA. Basal cell nevus syndrome: guidelines for early detection. *Am Fam Physician.* 2002; 65: 2501-2504.
14. Gorlin RJ, Goltz RW. Multiple nevoid basal-cell epithelioma, jaw cysts and bifid rib. A syndrome. *N Engl J Med.* 1960; 262: 908-912.
15. Lo Muzio L. Nevoid basal cell carcinoma syndrome (Gorlin syndrome). *Orphanet J Rare Dis.* 2008; 3: 32.