

Two cases of bifid ribs observed in the fourth and the fifth rib

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[Received : May 17, 2002 ; Accepted : June 7, 2002]

Abstract : Two cases of bifid rib were found in two cadavers during routine dissections at Iwate Medical University School of Dentistry. They were found in the fourth rib in one cadaver, and in the fifth rib in the other cadaver. In one case both the branching and the reunion of the rib occurred in the osseous part, and in the other case they occurred in the cartilage part. The space between the two branches was filled with presumably normal intercostal muscles. The blood supply had been maintained by small branches from the internal thoracic artery to the upper branch and the intercostal muscles. However, the intercostal nerves did not branch toward the upper branch but only ran along the lower margin of the lower branch of the bifid rib in both cases.

Key words : bifid rib, costal cartilage, intercostal muscle, intercostal nerve, intercostal artery

Introduction

It is known that the malformations sometimes occur in the costae, such as cervical ribs, bicipital rib, bifid rib and lumber rib¹⁻⁶⁾. Among them, cervical and lumber ribs result from abnormalities in embryologic processes. These malformations are induced by excessive formation of the costal element in a process such as the transverse process or costal process. On the other hand, bicipital and

bifid ribs are not thought to result from abnormalities in embryologic processes, and pathogenic mechanisms have been proposed for their development⁶⁻⁸⁾. Bifid ribs can be experimentally induced in laboratory animals. Bifid ribs are found in some mutant mice, suggesting that disruption of certain genes results in this anomaly^{9, 10)}.

During routine dissections, we encountered two cases of bifid ribs in two cadavers. We report the morphologies of these cases, and discuss the frequency and

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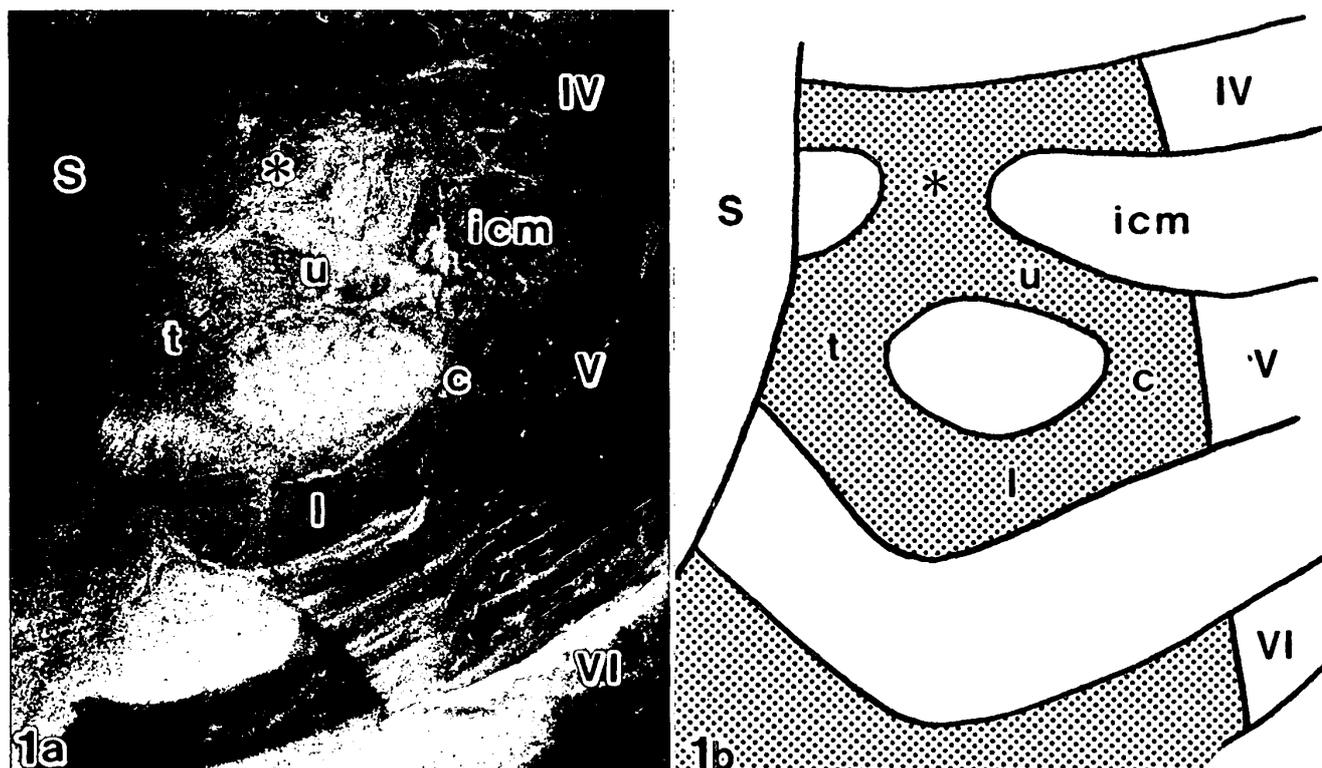


Fig. 1. Photograph (a) and drawing (b) of the outer surface of the thorax of Case 1. The costal cartilage (c) of the left fifth rib (V) bifurcates into upper (u) and lower (l) branches. They fuse again to form the trunk (t). The upper branch fuses (*) to the costal cartilage of the fourth rib (IV). VI=the sixth rib; S=sternum; icm=intercostal muscle.

the cause of bifid ribs.

Results

Case 1

The cadaver was an 88-year-old Japanese male, who had died of septicemia with prostate cancer. The costal cartilage of the left fifth rib bifurcated, and the two branches of costal cartilage again fused to form one trunk, which was connected to the sternum. The upper branch fused, in part, with the costal cartilage of the fourth rib. The space between the two branches was filled with intercostal muscles, which appeared to have normal morphology. No other abnormality except for the bifid rib was found in this cadaver (Figs. 1 a, 1 b).

Case 2

The cadaver was a 93-year-old Japanese

female, who had died of brain infarction. The osseous part of the left fifth rib bifurcated, and the two branches again fused to form one osseous trunk, which was connected to the costal cartilage. The space between the two branches was filled with normal intercostal muscle. No other abnormality except for the bifid rib was found in this cadaver (Figs. 2 a, 2 b).

Distribution of blood vessels and nerves

The two cases showed nearly the same distribution of blood vessels and nerves. In both cases, the thin arterial and venous branches, which came from the internal thoracic artery and vein, respectively, ran not only toward the upper branch of the bifid ribs, but also towards the intercostal muscle.

The intercostal nerves did not bifurcate

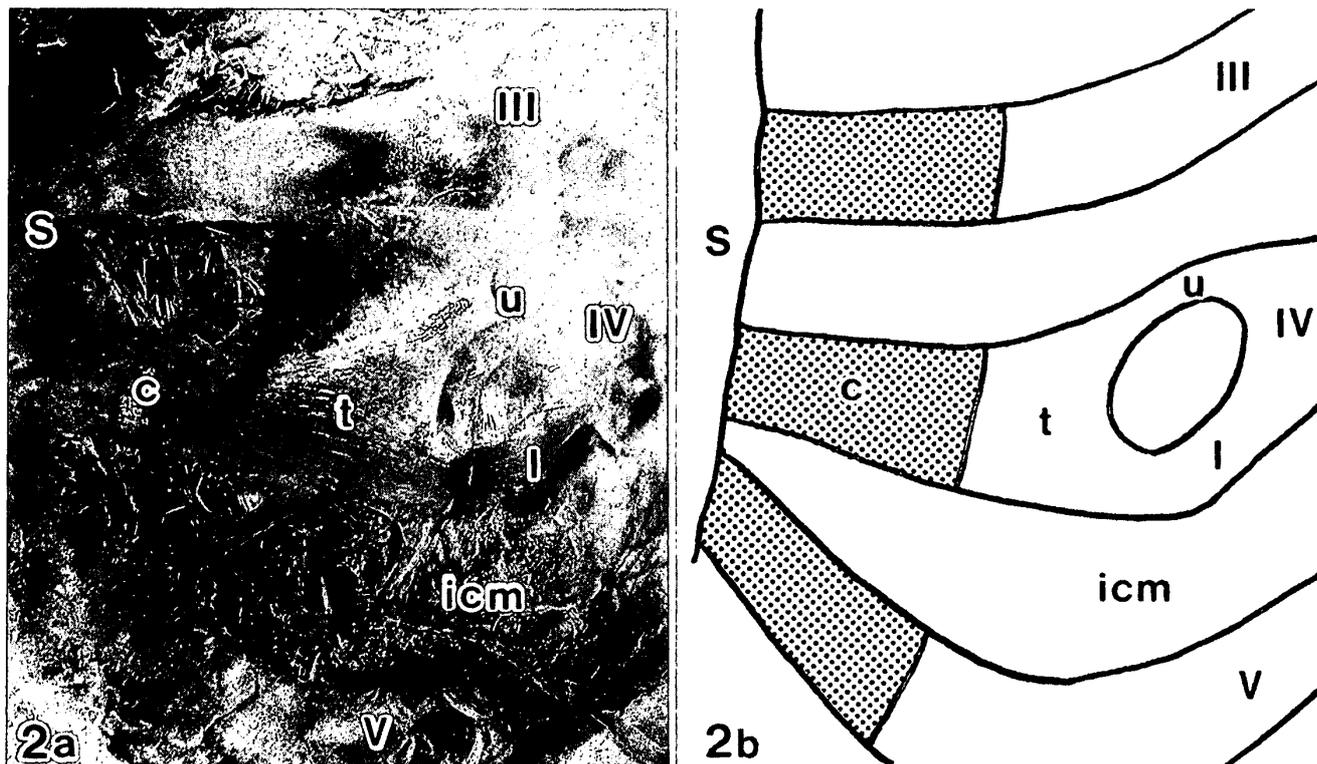


Fig. 2. Photograph (a) and drawing (b) of the outer surface of the thorax of Case 2. The osseous part of the left fourth rib (IV) bifurcates into upper (u) and lower (l) branches. They fuse again to form the osseous trunk (t). III=the third rib; V=the fifth rib; c=costal cartilage; S=sternum; icm=intercostal muscle.

and ran along the lower margin of the lower branch in both cases. Thus, the upper branch of the bifid ribs in the two cases did not have intercostal nerves.

Discussion

Varied percentages have been reported as to the frequency of the bifid ribs. Martin (1960)³⁾ reported the frequency of bifid rib to be 8.4% based on investigation of the chest X-ray films of 500 male and 500 female adult Samoans. This frequency is the highest in the literature. He also reported that the frequency of bifid rib was 2.2% among Cincinnatians for comparison. This number is much higher than those reported by other authors^{1, 2, 4)}. He mentioned that the frequency of bifid rib was higher among males than among females in both populations, and other studies supported

this^{5, 6)}.

The authors who reported a low frequency of bifid rib are as follows. Steiner (1943)¹⁾ reported a frequency of 0.013% based on investigation of 38,105 chest X-ray films at the Colorado Medical School and Hospitals. Etter (1944)²⁾ examined 40,000 chest X-ray films and found 257 cases of bifid rib, which indicated a frequency of 0.64%. The reason for the differences in frequency of bifid rib is unknown.

There have been a few reports on the frequency of bifid rib based on data from cadavers. Takemoto et al. (1987)⁴⁾ reported a frequency of 1.32% among Japanese cadavers. We previously reported three cases of bifid rib among Japanese cadavers⁶⁾; however we did not mention the frequency. In the present study, we reported additional two cases, which were our fourth and fifth

cases. Therefore, we encountered a total of 5 cases of bifid rib among approximately 600 cadavers, which is a frequency of approximately 1%. The frequency that Takemoto et al. (1987)⁴⁾ reported is thought to be accurate among the Japanese.

Pathological malformation is thought to be one of the origins of bifid ribs. Bifid ribs are often found in patients with Gorlin-Goltz syndrome^{7,8)}. Schumacher et al. (1992)⁵⁾ reported that various kinds of rib anomalies including bifid rib were associated with malignancy in childhood. However, in the two cadavers in the present report, we found no jaw cysts, abnormal calcification in the falx cerebri, nor tumors. The absence of such observations ruled out the possibility that the bifid ribs in the two cases in this report were pathological malformations, such as those induced by Gorlin-Goltz syndrome or malignancy.

Bifid rib occurs most frequently in the third and fourth ribs, and less frequently in ribs distant from the third and fourth ribs^{2,5)}. All four cases of bifid rib reported by Takemoto et al. (1987)⁴⁾ and the three cases that we previously reported in Japanese cadavers⁶⁾ were found in either the third or the fourth rib. Bifid ribs were found in the fourth and the fifth rib also in the two cases in the present report.

Steiner (1943)¹⁾ and Etter (1944)²⁾ who studied chest X-ray films did not mention the positions where the bifurcation and the reunion occurred. In the majority of bifid ribs, the rib bifurcates in the osseous part, and each branch has its own costal cartilage; they then reunite to form one trunk in the costal cartilage^{4,6)}. However in Case 1 of the present study, the bifurcation and the reunion both occurred in the costal

cartilage. On the other hand, in Case 2 of the present study, the bifurcation and the reunion both occurred in the osseous part. There is a tendency of bifid ribs to bifurcate in the osseous part and to reunite in the costal cartilage, as seen in the four cases reported by Takemoto et al. (1987)⁴⁾ and our three previously-reported cases⁶⁾. However, the present report made it evident that other pattern of bifurcation and reunion of bifid ribs may occur; in the present report, we demonstrated a case where bifurcation and reunion were both completed in the osseous part and a case where they were both completed in the cartilaginous part of the rib.

The intercostal blood vessels showed fine branchings that supplied the upper and lower branches as well as the intercostal muscles. However, the intercostal nerves ran along only the lower branch of the bifid rib in both cases, being similar to the three cases in our previous report⁶⁾. This indicated that the upper branch of the bifid rib in both cases had developed independently from the intercostal nerves, and there were no additional segments. Therefore, the bifid ribs reported in the present study should be recognized as malformations that accidentally occurred at the joints between the ribs and the sternum, and not as an increase in the number of segments.

Acknowledgement. This work was supported in part by a grant from the Iwate Medical University Keiryokai Research Foundation (No. 67).

References

- 1) Steiner, H. A. : Roentgenologic manifestations

- and clinical symptoms of rib abnormalities. *Radiology* 40 : 175-178, 1943.
- 2) Etter, L. E. : Osseous abnormalities of thoracic cage seen in forty thousand consecutive chest photoroentgenograms. *Am. J. Roentgenol.* 51 :359-363, 1944.
 - 3) Martin, E. J. : Incidence of bifidity and related rib abnormalities in Samoans. *Am. J. Phys. Anthropol.* 18 : 179-187, 1960.
 - 4) Takemoto, R., Murakami, Y., Nagata, H., Tezuka, M. : Four cases of rib anomalies. *Acta Anat. Nippon.* 62 : 232-240, 1987. (in Japanese with English abstract)
 - 5) Schumacher, R., Mai, A., Gutjahr, P. : Association of rib anomalies and malignancy in childhood. *Eur. J. Pediatr.* 151 : 432-434, 1992.
 - 6) Osawa, T., Sasaki, T., Matsumoto, Y., Tsukamoto, A., Onodera, M., Nara, E., Chen, J-K., Fujimura, A., Nozaka, Y. : Bifid ribs observed in the third and the fourth ribs. *Acta. Anat. Nippon.* 73 : 633-635, 1998.
 - 7) Gorlin, R. J., Goltz, R. W. : Multiple nevoid based-cell epithelioma, jaw cysts and bifid rib. *New Eng. J. Med.* 262 : 908-912, 1960.
 - 8) Koutnik, A. W., Kolodny, S. C., Hooker, S. P., Roche, W. C. : Multiple nevoid basal cell epithelioma, cysts of the jaw, and bifid rib syndrome : report of case. *J. Oral Surg.* 33 : 686-689, 1975.
 - 9) Suemori, H., Takahashi, N., Noguchi, S. : Hoxc-9 mutant mice show anterior transformation of the vertebrae and malformation of the sternum and ribs. *Mech. Dev.* 51 : 265-273, 1995.
 - 10) Zhang, W., Behringer, R. R., Olsen, E. N. : Inactivation of the myogenic CHLH gene MRF 4 results in up-regulation of myogenin and rib anomalies. *Genes & Dev.* 9 : 1388-1399, 1995.

第4および第5肋骨に見いだされた二分肋骨の2例

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(受付: 2002年5月17日)

(受理: 2002年6月7日)

抄録: 岩手医科大学歯学部の解剖学実習において2例の二分肋骨に遭遇した。1例は第4肋骨に、他の1例は第5肋骨に存在していた。1例では肋骨の分岐と再癒合が骨部でおこっていたが、他の1例では、分岐と再癒合が軟骨部でおこっていた。分岐の間は正常と思われる肋間筋で充たされていた。どちらの例においても、内胸動脈からの小枝が二分肋骨の上方の分岐と肋間筋に分布していたが、肋間神経は上方の分岐には分布せず、下方の分岐の下縁にのみ沿って走行していた。

キーワード: 二分肋骨, 肋軟骨, 肋間筋, 肋間神経, 内胸動脈