Supernumerary cervico-dorsal vertebra-bearing ribs, with vertebral and costal asymmetry : abnormal articulation in a sternum / by W. Arbuthnot Lane.

With the Writer's compliments

16

Supernumerary Cervico-dorsal
&
Vertebra-bearing Ribs
by
W. Arbuthnot Lane

FROM THE

JOURNAL OF ANATOMY & PHYSIOLOGY

1885. XIX.

SUPERNUMERARY CERVICO-DORSAL VERTEBRA-BEARING RIBS, WITH VERTEBRAL AND COSTAL ASYMMETRY; ABNORMAL ARTICULATION IN A STERNUM.

By W. Arbuthnot Lane, M.S., F.R.C.S., *Demonstrator of Anatomy to Guy's Hospital, and Assistant-Surgeon to the Hospital for Sick Children, Great Ormond Street.*

In the end of a paper I wrote in the Guy's Hospital Reports, 1883–84—"Cervical and Bicipital Ribs in Man"—I described the skeleton of a silvery gibbon (*Hylobates leuciscus*, No. 65, Order Primates), in the Museum of the Royal College of Surgeons. It presented seven cervical vertebræ, and below these thirteen vertebræ-bearing ribs.

The first pair of ribs were but slightly curved, differing altogether in form from the first ribs in others of the same species. In front they were pointed, and were attached by slender fibro-cartilaginous bands to the manubrium, behind the facets for articulation with the clavicles. On the left side the second costal cartilage was attached to the manubrium in the position and after the manner of the normal first, and on the right side just a little below. The cartilages of the third ribs articulated on the same level with the sternum, at the junction of the manubrium and gladiolus. In that case, I was inclined to regard the upper pair of ribs as cervical ribs, and the supernumerary vertebra as an eighth cervical. At the same time, it suggested to me the possibility that many of the cases which are described as cervical ribs, fused cervical and first thoracic, or fusion of the upper two thoracic ribs, are frequently instances of a rib articulating with an eighth cervical, or fusion of this with a first thoracic rib; and that, owing to the absence of the rest of the skeleton, or to its imperfect examination, this fact has been overlooked. Against such a rib being regarded as cervical, it is not so very uncommon to find in man thirteen dorsal vertebræ, each bearing a rib; and in these cases there is no difficulty in regarding the lowest dorsal vertebra as the supernumerary one.

Instances of this kind have been described by Professor Struthers in the *Journal of Anatomy and Physiology*, vol. ix.—"On Variations of Vertebræ and Ribs in Man"—along with instances of supernumerary lumbar, sacral, and coccygeal vertebræ. I have failed to find any recorded case of supernumerary cervical vertebræ not bearing ribs. I recently observed in the dissecting-room a male subject, in which there were thirteen dorsal vertebræ-bearing ribs. These were typical dorsal vertebræ, and the ribs were normally arranged, eight articulating symmetrically with the sternum, the upper piece of which measured $1\frac{1}{2}$ inches, and the lower $4\frac{1}{4}$ inches. The outer span of the first ribs, which were symmetrical, was $2\frac{1}{4}$ inches. This subject presented many muscular abnormalities, among which were, on either side, chondro-epitrochlearis and three-headed biceps muscles. The case I will now describe is one of some importance, owing to the numerous deviations from the normal present in it.

It was a male subject. There were present seven cervical vertebræ, thirteen vertebræ-bearing ribs, five lumbar, and five sacral. There are thirteen ribs on either side. The first right rib resembles exactly in appearance the usual supernumerary cervical rib. It is movable, and extends forwards from its tubercle for three-quarters of an inch. Its head articulates with a prominence on the side of the body of the eighth vertebra. Till I had thoroughly dissected the subject, I considered it to be an instance of a cervical rib articulating with the seventh cervical, though I felt puzzled by the large size of the lower ribs and mesosternum. A dense fibrous band extended from its extremity to the upper margin of the rib below it. This band was merely a thickening in a fibro-muscular expansion, which was inserted into the whole upper border of this rib. Outside this was a layer of muscle fibre, apparently external intercostal muscle. Inside this was the anterior branch of the ninth nerve, which soon disappeared beneath the rib below. The greater part of the ninth nerve crossed the neck of the rib, and just before doing so it was joined by a large branch of the tenth spinal nerve.

The ganglia on the seventh, eighth, and ninth nerves were connected together by a greyish process. This appeared to contain no nerve fibre, and passed between the neck of the rib

transverse process, and through the foramen in the bifid transverse process of the seventh cervical.

The right second rib resembled in every particular a normal first rib. It articulated by its head with the side of the body of the ninth vertebra, and in front by a cartilage, corresponding in form and relations to the first costal, with the manubrium. The greatest span of this rib was $3\frac{7}{8}$ inches, its greatest breadth 1 inch. The measurements along its convexity and concavity were 7 inches and $4\frac{1}{2}$ inches respectively.

Anteriorly, the right third rib articulated by its cartilage, like the normal second, with the sternum at the junction of the first and second pieces. Its greatest breadth was half an inch. Below it six other ribs articulated with the sternum, making eight in all.

The right thirteenth rib was $4\frac{1}{2}$ inches long.

The left first rib articulated with the side of the body of the eighth vertebra, and with its transverse process.

In front of its tubercle the rib presented but a very slight horizontal curve, the shaft running almost directly forwards, being connected to the manubrium by its cartilage, in the usual position of the normal first cartilage.

The greatest span of this rib was 3 inches; its greatest breadth $\frac{5}{8}$ inch. The measurements along its convexity and concavity were 5 and $3\frac{1}{2}$ inches respectively. It differs very much from a normal first rib in appearance.

The left second rib resembles a normal second rib in form and direction. Its cartilage articulates with the sternum at the junction of the manubrium and gladiolus, one-third of an inch higher than the right third rib, owing to the lower margin of the manubrium being directed slightly obliquely upwards and to the left. Its convex measurement was 7, and its concave $5\frac{1}{4}$ inches.

The thirteenth rib is $4\frac{3}{4}$ inches long. On the whole, right costal cartilages articulate with the left half of the sternum, all below the first being on a level slightly higher than those on the right side.

Lying on the neck of the left first rib is a nerve formed by the greater part of the ninth and part of the tenth. The ganglia of the seventh, eighth, ninth, and tenth were connected, as were

those on the right side. The scalenus anticus was very small on both sides. On the right side it was perforated by the subclavian artery, and on the left by the artery and the cord formed by the ninth and tenth nerves. The right clavicle was 6 inches long; the left $5\frac{1}{3}$ inches. The omohyoids had only one fleshy belly each, which arose by an aponeurotic origin from the clavicle. There was no subclavius muscle present on either side.

The spinous processes presented numerous abnormalities. There was only one limb of bifurcation of the spine of the third cervical, viz., the left; and to it both the interspinous muscles were attached. The spinous processes of the fifth, sixth, seventh, and eighth vertebræ were not bifid. That of the seventh was rotated on itself through an angle of 45°. Its right transverse processes was bifid and perforated by a foramen, and the left was perforated but not bifid. The spines of the eighth and ninth resembled that of the ordinary vertebra prominens.

The left transverse process of the eighth vertebra is a quarter of an inch lower than the right; while that of the ninth is about one-third of an inch below its fellow. This is due to this transverse process being forced downwards and backwards, so forming a deeper and narrower groove between itself and the spinous processes than on the opposite side. It is evidently a compensatory change to allow of the greater crowding the ribs on this side. I have not seen this condition of vertebral asymmetry occurring congenitally before, though a similar change in form is produced by carrying heavy weights, or in ordinary lateral curvature. The left transverse process of the tenth and eleventh vertebræ are also slightly lower than those on the right, while the transverse processes of the twelfth are symmetrically arranged.

The spinous processes of the tenth, eleventh, and twelfth vertebræ were extremely short, merely forming stunted eminences at the junction of the laminæ. The spines of the thirteenth and fourteenth gradually increase in size, and that of the fifteenth is almost normal in character.

The supraspinous ligament connecting the spines of the fifteenth, sixteenth, and seventeenth vertebræ is very dense and thick, and in it are two pieces of bone, the upper half an inch,

and the lower three-quarters of an inch, long. These do not appear to be connected in any way with the spinous process, but look like ossifications in the ligament.[1]

The vertebral arteries enter the foramina in the transverse processes of the sixth cervical vertebra.

Looking at the whole description, I would regard the vertebra as a supernumerary cervical vertebra bearing ribs, and not as an instance of thirteen dorsal vertebræ bearing ribs, and in which the upper part of the chest was undeveloped. This is of course quite a matter of opinion, and I have published the full account, as it differs from any case I have yet come across.

The spinal column presented marked pressure changes, and was a good example of the second form of deformity which I described in the *Transactions of the Medico-Chirurgical Society* vol. lxvii.—"Three Forms of Spinal Deformity." The bodies of the cervical vertebra were more modified in form than they generally are, and the arthrodial articulations developed from the amphiarthrodial allow of much more movement than they usually do in this form of physiological deformity.

The next specimen is a sternum which I obtained from the body of an old woman in the dissecting-room. The manubrium and upper pair of pleurostea have united to form a single bone, which articulates with the remainder of the sternum by an amphiarthrodial articulation allowing of considerable movement. It is quite transverse in direction, and there is no synovial membrane present. The length of the upper piece of the sternum is $2\frac{7}{8}$ inches, and the first and second costal cartilages articulate with it, and on either side of the amphiarthrodial articulation are the third costal cartilages articulating partly with both bones.

Articulating also with the lower piece of the sternum, which measures $3\frac{1}{8}$ inches, are the cartilages of the four following ribs, and these are symmetrically arranged. The sternum is much narrower than usual. The ribs are about the average size. I have not seen this condition of sternal articulation, nor have I read of it as occurring in man.

[1] These I find sometimes in the greatly hypertrophied supraspinous ligament present in this region in this form of lumbar curve.

In a paper in the *Journal of Anatomy and Physiology*—"Sternal and Costal Asymmetry"—I suggested that the articulation usually present between the manubrium and sternum was due to the leverage action of the clavicle upon the first costal arch and manubrium; and these movements appear to be limited to man almost entirely.

In the orang-utans and in the gorillas it is not unusual for the manubrium to unite with one or more pleurostea of the gladiolus. In man it is by no means very uncommon to find the manubrium fused to the gladiolus. Why union should occur in some cases and not in others is difficult to understand. Maisonnauve ("Luxations du Sternum," *Archiv. Gen. de Medécin*, ser. iii. vol. xiv.) ascribed it to changes taking place in old age; but I have found it as frequently in the vigorous adult as in the old subject.

I have thoroughly examined many chests in which this fusion of the sternal pieces had taken place, but I have failed to find any circumstances which is invariably present which can be regarded as a determining influence or cause. It seems to occur more frequently among men than women. It is present in cases in which the upper part of the chest is relatively large, as well as where it is relatively small. It is also present in men who had performed much hard labour, as well as in women.

As a very large proportion of sterna possess an articulation, one can only conclude that its absence is due to an unusually rapid growth and fusion of the pleurostea before the causes determining the formation of an articulation have had time to act, and that in the sternum I have just described, though the manubrium and the upper pair of pleurostea had united, these causes were sufficient to determine the formation of an articulation, and so to associate intimately in the movements of the clavicle the second as well as the first costal arch. I had hoped that this specimen would have thrown some light on the causes which determine the joint formation.

Cervical Rib in Female Subject.

The vertebral formula is normal.

The cervical rib, which is on the right side, is a fixed one.

From its tubercle to its head it measures 1 inch, and from the tubercle to the anterior extremity its length is 1½ inches. Its head is connected by fibrous tissue and ligaments to the adjoining margins of the sixth and seventh cervical vertebræ and intervertebral substance, it being, however, bound more intimately to the seventh than to the sixth vertebra.

This attachment of the head differs from what I have previously seen, as it is usually attached to the body of the seventh vertebra, midway between its upper and lower borders.

The neck is separated from the transverse process by a space, through which pass an artery and vein.

The tubercle presents a large facet, connected to the transverse process by ligamentous tissue chiefly, but in its outer part by bone, so rendering the rib a fixed one.

The shaft of the rib presents near its extremity two grooves, the anterior being well marked and occupied by the subclavian artery. The posterior one is grooved by the cord formed by the eighth cervical and first dorsal nerve.

From the extremity and lower margin of the rib a fibro-muscular layer is attached to the upper margin of the first thoracic rib, and into the outer half-inch of its cartilage. It is very fibrous in its inner portion, forming in its inner margin a firm tendinous cord.

Behind this expansion, and intimately connected with it, is the dome of the pleura.

The scalenus anticus is small, but arises normally from the tubercles. Below it spreads out and forms a tendinous expansion, which is inserted into the outer part of the margin of the tendinous prolongation of the cervical rib.

The scalenus medius is inserted partly into the cervical and partly into the first thoracic rib.

The eighth cervical nerve, before being joined by the first dorsal, gives off an anterior branch, which runs in the space below the cervical rib, then on beneath the fibro-muscular expansion, and then beneath the first thoracic rib, perforating the muscles in the interspace below it, and becoming cutaneous. On the left side the cervical rib consists of a head which is connected by intervening ligament to the upper margin of the seventh cervical, and of a neck which is separated from the

transverse process by a foramen-transmitting vessel. Outside this it is continuous with a large transverse process, and only projects slightly from it, forming a blunt extremity. There is arising from it a fibro-muscular expansion, exactly similar but smaller than that on the opposite side. The subclavian artery lies on the free margin of this expansion, and not on the rib below.

The scalenus anticus is inserted as on the right side, the inner limit of its expansion reaching the upper margin of the first rib. It is split by the artery. The arrangement of the nerves is the same as on the opposite side.

The first thoracic ribs articulate equally with the seventh cervical and first dorsal vertebræ. They are more oblique than usual, resembling rather normal second ribs in appearance. Neither is grooved by the subclavian artery. The outer span measures $2\frac{7}{8}$ inches.

The eleventh rib measures about 8 inches, the left being a little longer than the right.

The twelfth rib is fixed on the right side, and measures 2 inches, and on the left side it is absent.

The manubrium is very broad, its broadest part measuring $2\frac{1}{2}$ inches. It is $1\frac{3}{4}$ inches long. The gladiolus is $3\frac{3}{4}$ inches long. Seven cartilages articulate with the sternum.

In this instance, though the cervical rib is larger on the right side, the twelfth rib is alone present on the same side. The subclavian arteries appeared to lie in a plane posterior to that usually occupied by them. Though the manubrium is not much longer than usual, it is certainly considerably broader. I have described this case in detail, as it presents some deviations in character from those I have already examined.