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SOME ANOMALIES OF THE ORIGIN OF THE LEFT VERTEBRAL ARTERY

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Although the origin of the left vertebral artery from the aortic arch, or from the left subclavian artery close to the arch, has often been recorded in the literature, these anomalies remain uncommon and worthy of placing on record when encountered.

Material

In a small series of 27 cadavers in the dissecting rooms of the anatomy department, University of Cape Town, 4 cases showing such anomalous origins of the left vertebral artery were noted. The series consisted of 13 Bantu males, 3 Bantu females, 5 Coloured males, 4 Coloured females and 2 European females.

Observations

Specimen 1 (Adult Bantu male). The left vertebral artery arises immediately posterior and slightly to the left of the left common carotid artery. It enters the left foramen transversarium of the 5th cervical vertebra (Fig. 1).

Specimen 2 (Adult Bantu male). The left vertebral artery arises between the left common carotid and the left subclavian artery. It enters the left foramen transversarium of the 4th cervical vertebra (Fig. 2).

Specimens 3 and 4 (Adult Bantu and adult Coloured female). In both cases the left vertebral artery arises from the left subclavian artery close to the aortic arch. In the Bantu specimen (Fig. 3) the vertebral artery arises from the root of the subclavian artery and enters the left foramen transversarium of the 4th cervical vertebra. In the Coloured specimen (Fig. 4) the vertebral artery arises from the left

subclavian artery at a higher level, and enters the 5th foramen transversarium.

In all 4 cases the vertebral artery leaves the thorax through the superior mediastinum immediately posterior to the common carotid artery. In the neck it lies posterior to the carotid sheath, medial to the vagus nerve, and is crossed anteriorly by the inferior thyroid artery. Posteriorly it is related to the longus cervicis muscle before entering the foramen transversarium of a cervical vertebra at a higher level than that of the sixth. The right vertebral artery is normal in these specimens, as are the vertebral veins on both sides.

DISCUSSION

The origin of the vertebral artery from the aortic arch has been divided into 3 main types (Adachi).¹

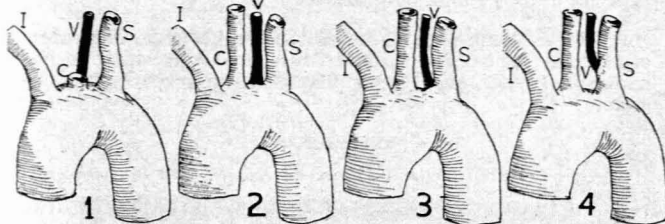
Type 1

The right vertebral artery arises from the aortic arch. This variation is extremely rare and was recorded only once in 800 specimens studied by Quain² and Thomson.³ Adachi¹ did not record any in his study of 516 Japanese cadavers, nor did DeGaris⁴ or Williams⁵ in their comparative studies on the American Whites and Negroes.

Type 2

The left vertebral artery arises from the aortic arch between the origins of the left common carotid and left subclavian arteries. Specimens 1 and 2, described above, belong to this type. It is the commonest variety found, the recorded incidence of which varies from 3.3% to 5.8%, e.g. in the English series the incidence was 5.8% (Thomson³), in the Japanese series 4.8% (Adachi¹), in the American Negro series 3.3% (McDonald and Anson⁶) and in the American White series 3.7% (McDonald and Anson⁶). The incidence in the small series reported here is 7.1%.

Adachi¹ found that in this type (2) the vertebral artery nearly always enters the foramen transversarium of the 5th cervical vertebra, and never that of the 7th. DeGaris,⁴ in 8 recorded specimens, found that the vertebral artery entered the foramen of the 5th in 3 cases, that of the 6th in 4, and the foramen of the 7th in 1 case. In this series the vertebral artery entered the foramen of the 4th in the one case and that of the 5th in the other.



Figs. 1-4. Diagrammatic representation of the branches arising from the aortic arch. I=Innominate artery. C=Left common carotid artery. V=Left vertebral artery. S=Left subclavian artery.

The origin of the left vertebral artery from the left subclavian artery, close to the aortic arch, can be regarded as a subdivision of type 2 in which the separation of the origin of the left vertebral from the subclavian has not been completed. This variety has been recorded only 6 times in a series of 1,453 cases.⁶ Williams⁵ encountered 2 cases in his Negro series and 1 among the Whites, DeGaris⁴ found 2 cases (1 Negro and 1 White), while McDonald and Anson⁶ found 1 case among the American White. In this series 2 such cases are recorded (1 Bantu male, and 1 Coloured female), representing an incidence of 7.1%.

Type 3

The left vertebral artery arises from the aortic arch just distal to the origin of the left subclavian artery. This variety is rarely encountered and has only been described 6 times in a series of 1,453 cases⁶: 3 times in the Japanese, twice in the American Negro (1 male and 1 female), and once in the American White (male). In all 3 Japanese specimens the artery entered the foramen transversarium of the 7th cervical vertebra.

EMBRYOLOGY

The somatic intersegmental arteries, arising from the primitive dorsal aortae, form a regular series of paired vessels throughout the cervical, thoracic and lumbar and sacral regions in the early embryo. These vessels divide into dorsal and ventral branches which accompany the posterior and anterior primary rami of the spinal nerves. The dorsal branches run backwards between the transverse processes of the vertebra

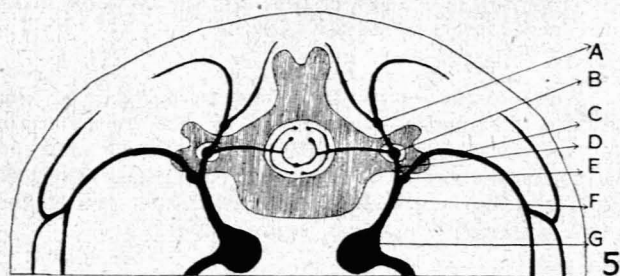


Fig. 5. Arrangement and communications of intersegmental arteries in the region of the cephalic aortic arches (after Cunningham). A=Post-transverse anastomosis. B=Post-costal anastomosis. C=Ventral branch. D=Dorsal branch. E=Pre-costal anastomosis. F=Somatic intersegmental artery. G=Primitive dorsal aorta.

and are connected behind the neck of each rib by post-costal anastomoses, and behind the transverse processes of the vertebrae by post-transverse longitudinal anastomosing channels⁷ (Fig. 5).

In the thoracic and lumbar regions the intersegmental arteries persist and form the posterior intercostal and lumbar arteries.

In the cervical region the first 6 pairs of somatic intersegmental arteries lose their connections with the dorsal roots of the aortic arches. The 7th pair, however, persist in their entirety. The first part of the vertebral artery represents the dorsal branch of the 7th somatic intersegmental artery, while the second part—that passing through the cervical transverse processes—consists of post-costal

anastomoses between the dorsal branches of the first 7 intersegmental arteries. Padget⁸, however, states that the intersegmental artery, accompanying the first cervical nerve, should not be numbered in the cervical series, as has been done in the past, because it does not pass between 2 cervical segments. He suggests that it be called the sub-occipital intersegmental artery, and it thus becomes the transverse suboccipital part of the vertebral artery between the atlas and occipital bone. Numbering the first cervical intersegmental artery as that associated with the second cervical nerve, the artery which becomes a stem of the subclavian and vertebral arteries is the 6th cervical intersegmental artery and not the 7th.

The anomalous origin of the vertebral artery from the aortic arch between the left common carotid and left subclavian artery is thus due to the absorption of the stem of the 7th (6th according to Padget) intersegmental artery into the arch. Thus the vertebral and subclavian arteries come to a rise independently from the aortic arch. Figs. 4 and 3, respectively, show progressive stages in the process of absorption. Figs. 1 and 2 show the ultimate result—the left vertebral artery arising separately from the aortic arch.

SIGNIFICANCE OF THIS ANOMALY

Most anatomists have in the past regarded this anomalous origin of the vertebral artery as a progressive variety and one peculiar to man. Among the many species of primates and other mammals that have been studied, such an origin has only been found among the phoca (seals). In the species of seal known as *Phoca vitulina*, the left vertebral artery normally arises from the aortic arch between the left common carotid and the subclavian arteries. Adachi¹ thus regarded this anomaly as a primitive rather than a progressive variety. Furthermore, the fact that in type 3 he found the vertebral artery in his small series always entering the 7th foramen transversarium, led him to believe that this vessel corresponds to the supreme intercostal artery (thoracic vertebral artery) as found in many mammals.

The practical significance of this anomaly applies to the procedure of ligation of the common carotid artery. An unsuspected vessel, lying behind the carotid artery, may lead to a serious mishap if included in the ligation.

SUMMARY

Four cases of anomalous origin of the vertebral artery from the aortic arch are described, with notes on their classification embryology and significance.

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REFERENCES

1. Adachi, B. (1928): *Das arteriensystem der Japaner*, Band 1. Tokyo: Kenyusha Press.
2. Quain, R. (1844): *The Anatomy of the Arteries of the Human Body*, 1. London.
3. Thomson, A. (1893): *J. Anat. (Lond.)*, 27, 189.
4. Degaris, C. F., Black, I. H. and Riemenschneider, E. A. (1933): *Ibid.*, 67, 599.
5. Williams, G. D. and Edmonds, H. W. (1935): *Anat. Rec.*, 62, 139.
6. McDonald, J. J. and Anson, B. J. (1940): *Amer. J. Phys. Anthropol.*, 27, 91.
7. Brash, J. C. and Jamieson, E. B. eds. (1951): *Cunningham's Text-book of Anatomy*. 9th ed., p. 1389. Edinburgh: Oxford Medical Publications.
8. Padget, D. H. (1954): *Anat. Rec.*, 119, 349.