

Proatlantal Intersegmental Artery

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Summary. Persistent proatlantal intersegmental artery, a rare form of carotico-basilar anastomosis is described. The literature is reviewed.

1ère artère intersegmentaire cervicale

Résumé. Les auteurs décrivent un cas de persistance de la 1ère artère intersegmentaire cervicale, une forme rare

d'anastomose carotido-basilaire. Ils font une revue de la littérature.

Vor dem Atlas liegende Intersegmental-Arterie

Zusammenfassung. Beschreibung einer persistierenden vor dem Atlas liegenden Intersegmental-Arterie. Es handelt sich dabei um eine seltene Form einer carotido-basilären Anastomose.

From the embryological point of view the proatlantal intersegmental artery is as important as the primitive trigeminal artery. Its demonstration angiographically has been reported, to our knowledge, only four times before in the literature (Conforti *et al.*, 1966; Lie, 1968; Hutchinson and Miller, 1970; Sutton, 1971). This artery is one of the carotico-basilar anastomoses which undergoes involution with development of the foetus. Its persistence signifies failure of involution of embryologic vascular channels. Congdon (1922) and Padget (1954) noted that this artery starts to regress at the 7–12 mm (crown-rump length) stage of embryonic development and it has completely disappeared by the time the embryo has reached the 12–14 mm length stage.

This artery originates from the internal carotid artery and connects suboccipitally with the horizontal segment of the vertebral artery. This segment has a curve (convex superiorly) and courses between the atlas and occiput. The further intracranial course is identical to that of the vertebral artery. It joins with the basilar artery through the foramen magnum.

The proatlantal region contains the embryonic intersegmental artery which is considerably augmented to become the upper horizontal (suboccipital) part of the vertebral artery (Fig. 1). This artery has many synonyms (Padget, 1954) but it is now accepted that the term "proatlantal intersegmental artery" is the most suitable from the embryological point of view. Other carotico-basilar anastomoses are known. These include the trigeminal and proatlantal arteries which supply the cranial and caudal portions of the brainstem, respectively, and are more important than the otic and hypoglossal arteries in the primitive embryo. The trigeminal artery regresses at the 8–12 mm stage of embryonic development (Padget, 1948). This is at the stage when the posterior communicating artery is acting as a dominant communication between the carotid and basilar circulations.

The development of the vertebral arteries starts with the formation of longitudinal anastomoses between the intersegmental arteries at their dorsal ends (Fig. 1). This is seen in the embryo of 7–12 mm length. These anastomoses develop in a craniocaudal sequence (Padget, 1954 and Lie, 1968). Each anastomosis is formed from the more proximal end of the intersegmental artery with the more distal end of the caudally situated intersegmental artery. After a longitudinal anastomosis has developed, the attachments to the dorsal aortae of the corresponding intersegmental arteries regress. Only the sixth intersegmental arteries remain patent. They form, with the last longitudinal anastomoses, the most proximal parts of the vertebral arteries. Both sixth intersegmental arteries are considered to take part in the establishment of the sub-

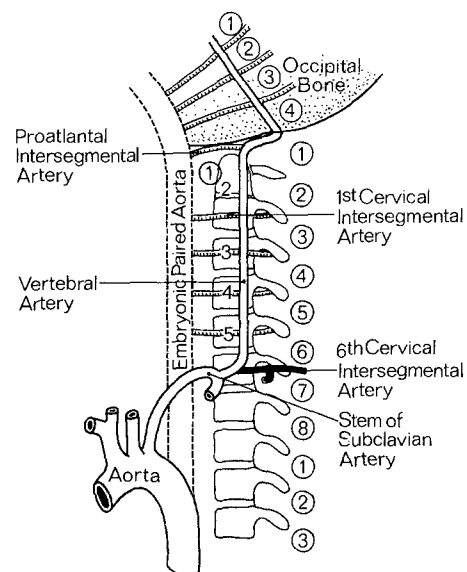
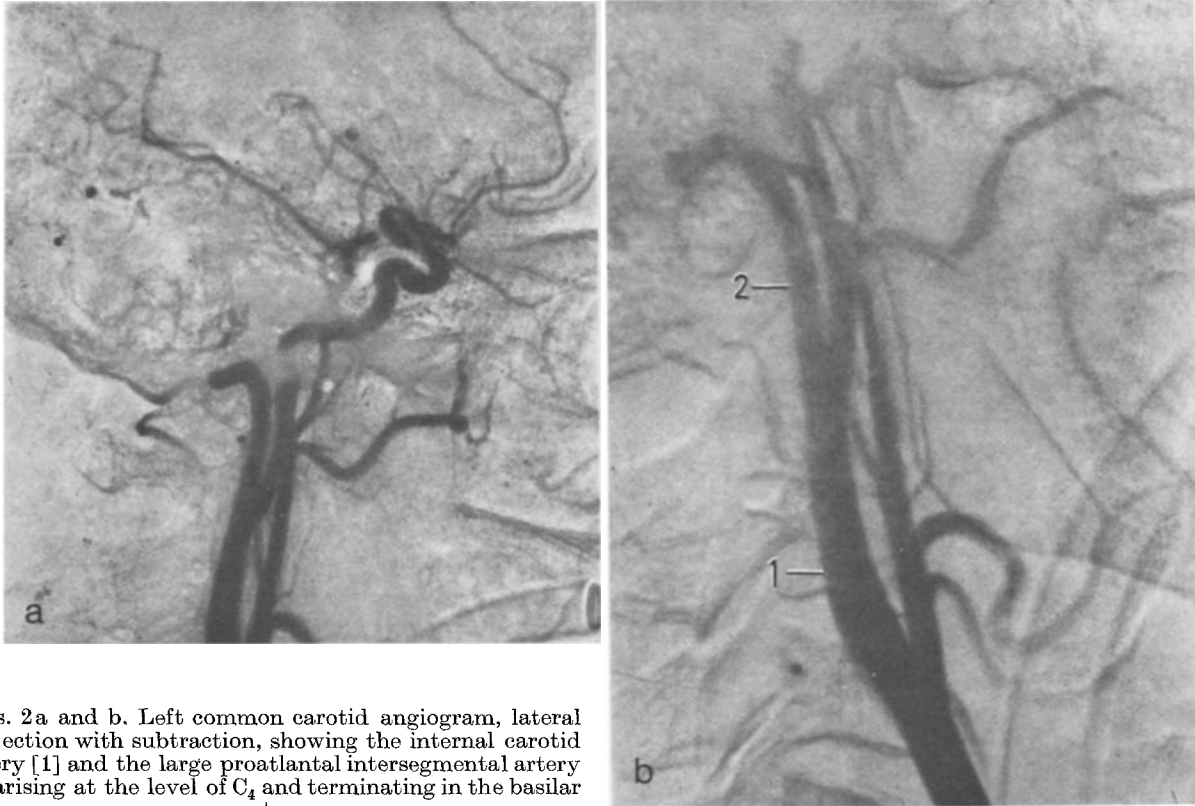


Fig. 1. Diagram to show the formation of the subclavian stem and vertebral artery. (after Padget, D.H., 1954)

clavian arteries. The proatlantal artery is thought to contribute to the transversely directed portion of the vertebral trunk between the upper border of the first cervical transverse process and the occipital bone. If this proatlantal artery persists, the result is a communication between the internal carotid artery and the basilar artery on the affected side.

Discussion

The finding of the carotico-basilar anastomoses is usually incidental and of no clinical significance. However, these anastomoses have been reported in association with intracranial aneurysms and whether this is a related or a coincidental association is uncertain.



Figs. 2a and b. Left common carotid angiogram, lateral projection with subtraction, showing the internal carotid artery [1] and the large proatlantal intersegmental artery [2] arising at the level of C₄ and terminating in the basilar artery

Case History

A man aged forty years presented with persistent left sided headaches for which no cause could be found clinically.

Left carotid angiography demonstrated both the carotid and posterior circulations. An anomalous artery arising from the internal carotid artery at C₄ and communicating with the horizontal portion of the vertebral artery was demonstrated (Fig. 2). No intracranial abnormality was demonstrated.

A right carotid angiogram demonstrated a normal carotid artery in its cervical portion.

Because of this vascular anomaly, the patient was referred for arch angiography. Selective catheterisation of the left vertebral artery via the femoral route demonstrated that it was hypoplastic (Fig. 3). No intracranial filling could be demonstrated.

Difficulty was experienced in catheterising the right vertebral artery. Visualization of this artery was then obtained by retrograde injection of the right axillary artery (Fig. 4). This vertebral artery was also seen to be hypoplastic and again there was no filling of the intracranial circulation.

As has been stated above, the proatlantal intersegmental artery is as important as the primitive trigeminal artery in the embryo. It is therefore surprising that this artery is seen so uncommonly.

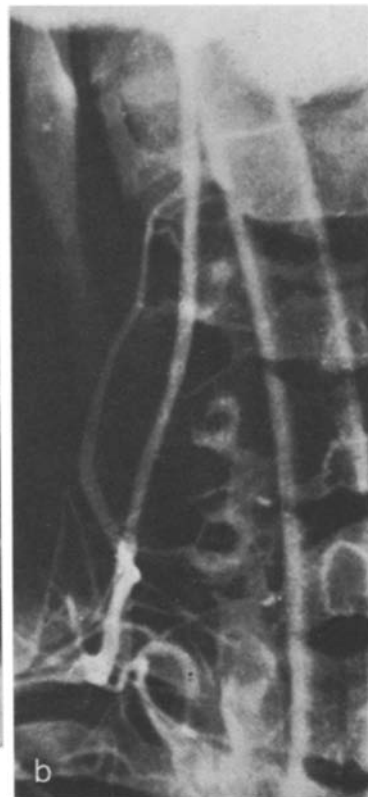
At times it can be difficult to differentiate this artery from a persistent hypoglossal artery. We consider the anomalous artery in our case to represent a proatlantal intersegmental artery, firstly because the artery originates at the fourth cervical level which is low for a hypoglossal artery.

Secondly, on the anteroposterior projection, with subtraction, this anomalous artery initially runs lateral to the internal carotid artery (Fig. 5), which is in favour of a proatlantal intersegmental artery (Lie, 1972).

Thirdly, because the atlantooccipital portion of this artery has the same appearance as that of a normal vertebral artery. The extracranial segment of a hypoglossal artery takes a more vertical course and lacks the dorsal sweep of a persistent proatlantal artery.



Fig. 3. Selective left vertebral angiogram, AP projection, demonstrating a hypoplastic vertebral artery



Figs. 4a and b. Right retrograde axillary artery injection, AP projection, demonstrating a hypoplastic right vertebral artery

Finally, it appears to enter the skull through the foramen magnum and not through the anterior condyloid foramen (Lie, 1968).

Both vertebral arteries were hypoplastic and not contributing significantly to the intracranial posterior fossa circulation. Thus, the main arterial blood supply to the posterior fossa was by the wide calibre left proatlantal intersegmental artery. It is further postulated that both vertebral arteries failed to develop normally because of persistence of this artery. However, this artery may have persisted because of a primary error in the development of the vertebral arteries. This dependency of the vertebrobasilar circulation on blood flow through the internal carotid artery can be of great significance when, for whatever reason, occlusion of the internal carotid artery occurs, or is surgically contemplated.

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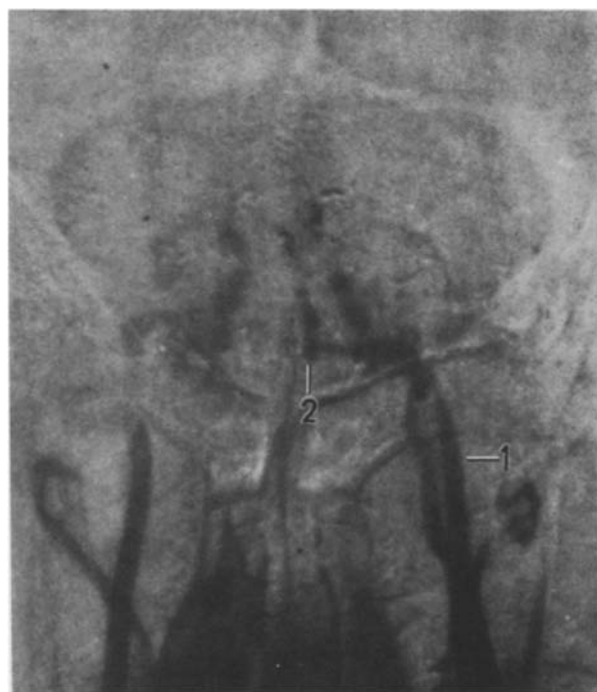


Fig. 5. Left carotid angiogram, AP projection with subtraction, showing the proatlantal artery initially lying lateral[2] to the internal carotid artery and terminating in the basilar artery[2]

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