Trigeminal Neuralgia, Facial Spasm, Intermedius and Glossopharyngeal Neuralgia with Persistent Carotid Basilar Anastomosis

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The finding of a vascular structure, aneurysm, arteriosclerotic plaque, or anomalous vascular channel with encroachment on a cranial nerve causing some degree of pain or paresis has been frequently described.\textsuperscript{2,4,7-9,13} This paper concerns facial pain or spasm as the clinical manifestation of persistence of the trigeminal, acoustic, or hypoglossal artery.

Case Reports

\textit{Case 1.} This patient, a 52-year-old woman, appeared to have the pain of typical trigeminal neuralgia over the second and third divisions of the nerve in the left side of the face. It was noteworthy, however, that the attacks were often precipitated during physical exertion, and were also frequent at nighttime. Neurological examination revealed that she had an area of hypesthesia over a portion of the second division of the left trigeminal nerve. Because of these atypical features in a patient with an otherwise classical clinical picture of trigeminal neuralgia, an angiographic study was done. This revealed a persistent primitive trigeminal artery (Figs. 1–3). Following this, the left retrogasserian sensory root was sectioned by way of a posterior fossa approach.\textsuperscript{8} At the time of surgery the fifth sensory root was seen to be elevated and in intimate contact with the persistent trigeminal artery (Fig. 4). This was dissected from the root prior to division and care taken to preserve the vessel.

\textit{Case 2.} This patient, a 55-year-old man, was known to have suffered with right-sided hemifacial spasm for many years. In addition, he complained of severe paroxysmal pain deep in his throat and right ear. The diagnosis of geniculate neuralgia was felt to be most probable. Surgical section of the nerve of Wrisberg was discussed with the patient, but he would never submit even to diagnostic studies. He stated repeatedly that so long as “his therapy” gave relief he would decline any surgical intervention. His therapy con-

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Fig. 1. Case 1. Lateral carotid arteriogram and drawing illustrating basilar artery filling via the persistent primitive trigeminal artery.
sisted of rather large amounts of alcoholic beverages. The patient was later found dead in his car, apparently the victim of carbon monoxide poisoning. At autopsy it was seen that the basilar artery appeared to be primarily fed by a large vessel which emerged through the anterior aspect of a rather large right internal acoustic meatus. A smaller vessel, possibly representing the internal auditory artery, was seen re-entering the internal acoustic meatus (Fig. 5). The seventh and eighth nerves were stretched and angulated by this large anomalous artery. This artery by its location seemed to be most readily explained as a persistent primitive acoustic artery.

Case 3. This patient, a 42-year-old woman, suffered sharp, burning, lancinating pain in the right tonsillar fossa, the back of the tongue, and outer ear canal. A trigger zone was present in the right tonsillar region.
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The tentative diagnosis of glossopharyngeal neuralgia was made. Prior to a planned intracranial section of the ninth nerve and the uppermost fibers of the vagus nerve, an angiographic study was done. This, surprisingly, revealed a persistent hypoglossal artery on the side of the patient's neuralgia (Figs. 6 and 7). At the time of surgery, the ninth, tenth, and eleventh nerves were seen to be intimately associated with and angulated around the large persistent hypoglossal artery as it passed superiorly to feed the basilar system. No left vertebral artery was seen (Fig. 8). The primitive hypoglossal artery entered the dura at a lower level than does the usual vertebral artery. The extradural portion of the artery, so far as this could be exposed, revealed the artery to be coursing from the anterior portion of the foramen magnum medial to the condyloid process. No vessel was seen at the usual vertebral groove location on either side of the atlas. The ninth nerve and the uppermost fibers of the vagus nerve were sectioned proximal to the area where they were intimately associated with the large persistent hypoglossal artery.

Fig. 4. Case 1. Drawing based on the surgical findings. Note the left trigeminal nerve root stretched over the persistent primitive trigeminal artery.

Fig. 5. Case 2. Drawing of the cranial floor after brain removal. Note the large anomalous vascular channel coursing from the right acoustic meatus to join the basilar artery.
Discussion

These unusual clinical observations served to illustrate one of the possible atypical etiological factors in the cranial nerve neuralgias. Since the persistence of the primitive acoustic artery seems to be exceptionally rare,\textsuperscript{1,3,8} Case 2 offered a stimulus to a review of the embryological development of the vertebral and basilar artery systems. Based on the few available descriptions, this persistent acoustic artery usually arises from the external carotid artery.\textsuperscript{7,8} However, in the present case, this vessel was observed to arise from the internal carotid artery within the carotid canal of the petrous bone and after coursing medially through this bone it emerged at the posterior surface of the petrous ridge. Here it joined the basilar artery,
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apparently forming the main supply route to this system.

To understand the formation of this vascular configuration, which is exceedingly rare in the adult, it is necessary to review the embryological development of the cranial vasculature.6,10-12,14

In the 4 mm embryo (Fig. 9) it can be seen that the vertebral artery arises from anastomotic connections between the dorsal rami of the intersegmental arteries which, in turn, are branches of the dorsal aorta. These longitudinal linkages of the dorsal rami undergo maturation changes to form the usual configuration of the vertebral artery (Fig. 10). Later all dorsal rami disappear, leaving only the most caudal, the seventh cervical dorsal intersegmental artery, which thus gives origin to both the vertebral and the subclavian arteries.

At the 4 mm embryo stage, the basilar artery appears to arise essentially as a continuation of the internal carotid artery via the posterior communicating arteries. At this stage there are also relatively constant large anastomotic channels, the presegmental dorsal arteries, between the internal carotid and basilar artery at the levels of the fifth and eighth cranial nerves (Fig. 9). These anastomoses, should they persist, are therefore given the names of primitive trigeminal and primitive acoustic arteries. More proximally anastomotic channels are frequently noted between both the third and fourth aortic arches and the basilar artery; these being at the level of the twelfth cranial nerve are given the name of primitive hypoglossal arteries (Fig. 9). Figure 9 illustrates only the anastomosis with the fourth aortic arch. It is, however, the anastomosis with the third aortic arch that forms the most commonly seen persistent hypoglossal artery, since the proximal portion of this third arch gives origin to the common carotid artery while its distal portion forms the root of the internal carotid artery. These anastomotic channels ordinarily disappear completely prior to the 12 mm embryonic stage (Fig. 10).

FIG. 8. Case 3. Drawing based on the surgical exposure. Note the large anomalous hypoglossal vessel on the right in contact with the ninth, tenth, and eleventh cranial nerves.
Examination of various embryos of this stage reveals that the basilar artery sometimes seems to receive its main blood supply from the primitive trigeminal or acoustic artery orally, and caudally from the primitive hypoglossal artery. Should this condition persist, the adult basilar artery will appear to have its main origin from the anomalous persistent vessel, and the vertebral artery will then be either hypoplastic or absent. In Case 1, no vertebral artery was present on the left side, and, indeed, the major flow to the basilar artery, at least angiographically, would appear to have been through this persistent primitive trigeminal anastomosis (Figs. 1–4). In Case 2, two vessels were described as vertebral arteries; however, on the right side the vessel was quite hypoplastic. In addition it should be noted that the brain was removed without prior knowledge of the anomaly, and the vessels near the foramen magnum were torn. It could not be positively established that the vessel on the right (Fig. 5) was actually a hypoplastic vertebral artery or whether this was one of the cerebellar branches. In Case 3, there was definitely no vertebral artery on the left side (Fig. 8). The angiogram, while not proving this to be the sole supply of the basilar system, certainly indicated a significant proportion via the persistent hypoglossal route.

**Summary**

Three different carotid basilar anastomoses have been described. These were persistent primitive trigeminal, persistent primitive acoustic, and persistent primitive hypoglossal arteries. All three patients gave a history of cranial nerve root irritation consisting respectively of tic douloureux, hemifacial spasm with neuralgia of the nerve of Wrisberg, and glossopharyngeal neuralgia. Development of the persistent carotid basilar anastomoses has been discussed, and the embryology of the vertebral basilar artery system reviewed.
FIG. 10. Drawing illustrating the 12 mm embryo stage.

References


