VASCULAR ANOMALIES OF THE TEMPORAL BONE

Essay
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INTRODUCTION

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Vascular anomalies of the temporal bone are rarely seen. Mismanagement of these anomalies, however, may have grave consequences. The more common vascular anomalies involve the internal carotid artery, stapedial artery, jugular bulb and vascular loops at the internal auditory canal and cerebello-pontine angle.

The patient presenting with a red mass behind the eardrum and a pulsating tinnitus may well have a vascular tumor. One must be ever mindful, however, that the mass may represent a congenital vascular anomaly (Glasscock, et al, 1980).

The key to preoperative diagnosis of vascular anomalies is a high degree of suspicion. Neurotologic examination is necessary. Audiometric studies can be significant as they will document conductive or sensorineural hearing losses. These anomalies can be effectively diagnosed radiographically. Biopsy is unnecessary and, furthermore, is uninfromative except that it usually produce profuse bleeding (Glasscock, et al, 1980).

AIM OF THE ESSAY

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The objective of this essay is to review the literature dealing with vascular anomalies of the temporal bone with the purpose of highlighting the following points:

- How to suspect such cases.
- The best diagnostic tools to confirm the diagnosis.
- Update the management of such lesions.

REVIEW

CHAPTER I
EMBRYOLOGY

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Embryology

Development of The Arterial System

The heart and the blood vessels of the embryo arise from angioblastic tissue differentiated from the intraembryonic mesoderm. Apart from the aortae, none of the adult's main vessels arise as single trunks in the embryo. Along the course of each vessel a capillary network is first laid down, and by the selection and enlargement of definite paths in this network the larger arteries and veins are defined. The branches of the main arteries are not always simple modification of the vessels of the capillary network, but may arise as new outgrowths from the enlarged stem (Williams and Warwick, 1980).

Subsequent to the formation of the head fold of the embryo, each primitive aorta consists of ventral and dorsal parts which are continuous through the first aortic arch. The dorsal aortae run caudally, one on each side of the notochord but in the fourth week they fuse from about the level of the fourth thoracic to that of the fourth lumbar segment to form a single descending aorta. The ventral aortae are fused and form a dilated aortic sac (Fig. 1).

The first aortic arches run through the mandibular arches, and caudal to them five additional pairs are developed within the corresponding branchial arches; so that, in all, six pairs of aortic arches are formed. The fifth arches are atypical and probably transient, at most, in man. Some of the arteries remain as permanent structures, while others disappear or are obliterated (Williams and Warwick, 1980), (Fig. 2).

The aortic arches arise successively from the aortic sac and course ventrally through their corresponding branchial arches into the ipsilateral dorsal aorta. During this branchial phase of arterial development there is correspondence between each branchial arch and it's aortic arch. However, not all the aortic arch arteries exist at the same time. The first and second arch arteries disappear before the more caudal arch arteries develop (Gulya, 1990).

Steffen (1968) reported that the first aortic arches undergo involution about the time the fourth arch arteries are completed, and the second disappear before the pulmonary (Sixth) are finally developed.

The first two branchial arch arteries have dorsal and ventral components. At 4 mm stage, Fig. (3) as these vessels involute, the dorsal component of the first arch vessel remains for a time as the mandibular artery. The dorsal portion of the second arch vessel persists as the hyoid artery, from which the stapedial artery will eventually develop. The ventral components of the first and second branchial arch vessels join with small branches that arise from the ventral aspect of the third arch artery at the 6 mm stage to form the ventral pharyngeal artery. This structure supplies the first and second arches via the maxillary-mandibular division, as it terminates by dividing into mandibular and maxillary branches (Sinnreich, et al, 1984). It is subsequently involved in the formation of the stapedial and external carotid arteries (Gulya, 1990).

Congdon (1922) described these temporary structures, which he named "the ventral pharyngeal arteries" (Fig. 4), arising directly from the aortic sac to supply the region of the first and second branchial arches. They originate near the midline and migrate laterally rather than as new buds of the third arch. The changes in these structures proceed rapidly between 9-14 mm stages. By the 16 mm stage, the ventral pharyngeal arteries are interrupted into a distal and a proximal portions. At this stage, the proximal portion, which carries the anlage of the definitive superior thyroid, lingual, facial and internal maxillary arteries, has become a structure which can be observed to develop through subsequent stages as the 'external carotid artery'. concurrently, the distal portion of the ventral pharyngeal artery becomes anastomosed to the stapedial artery.

By the 13 mm stage of development, the segment of the dorsal aorta between the third and fourth arches on each side becomes interrupted, and the ventral junctions between the third and fourth arches form the 'common carotid arteries'. The dorsal aortae cranial to the third arch persist as part of the definitive 'internal carotid arteries'; with a forward continuation, which differentiates at the time the first and second arches disappear, from a plexiform vascular network extending to the walls of the fore and mid brain (Steffen, 1968). The third arch artery becomes the proximal part of the internal carotid artery (Davies and Ducker, 1991), (Fig. 5 - A & B).

In the 6-7 mm (5 weeks) embryo, the stapedial artery branches off of the dorsal stem of the hyoid artery (Glasscock, et al, 1980). At 12 mm (6 weeks) embryo, as the transition from the branchial phase to the post-branchial phase takes place, the stapedial artery appears as a small offshoot of the hyoid artery and passes through the stapes blastema to enter the mandibular bar; where it anastomases with the distal remnant of the shrinking ventral pharyngeal artery (Gulya, 1990), (Fig. 6).

Immediately beyond the stapes, the stapedial collateral produces a cranial offshoot (the future supraorbital division or cranial division) which can be traced for a short distance lateral to the gasserian ganglion. The continuation in the main artery, which represents the lower (caudal) or maxillo-mandibular division of the stapedial artery, courses ventrally along the mandibular division of the trigeminal nerve. It joins a plexiform vessel at the mandibular root of chorda tympani nerve; this represents the distal remnants of the ventral pharyngeal artery (Steffen, 1968).

The stapedial artery reaches the height of it's development at 7 weeks (18-19 mm) stage. The supra-orbital division supplies the primitive orbit. Over the next week the maxillo-mandibular artery and supra-orbital divisions of the stapedial artery are annexed by the internal maxillary artery of the external carotid artery and the ophthalmic artery, respectively (Gulya, 1990), (Fig. 7, 8 & 9). At the 24 mm ($7^1/_2$ weeks) stage, the midportion of the stapedial artery involutes at the region of the developing stapes (Sinnreich, et al, 1984), (Fig. 10).