Case Report

Morphological Variation of Subarcuate Artery and Canal in Atresia

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Key Words

Subarcuate artery · Subarcuate canal · Temporal bone · High-resolution computed tomography · Microtia · Canal atresia

Abstract

Objectives: An aberrant subarcuate artery (SAA) and its related canal are infrequent and asymptomatic. The presence of this variation may cause untoward hemorrhages, if accidentally nicked. Therefore, it is important for otologists to be aware of this entity, and its relative anatomy, to avoid any unexpected complication. We present a case of a 7-year-old girl who presented with right-sided microtia with membranous atresia. **Methods:** High-resolution computed tomographic scan and three-dimensional reconstruction of the temporal bone showed bilateral enlarged SAA. **Results:** The width of the right-sided bone canal was between 0.76 and 1.33 mm. The left temporal bone showed the same variation, with the width of the canal consistently greater than 1.0 mm, ranging from 1.07 to 1.23 mm in greatest transverse dimension. **Conclusions:** The variation proposed in microtia was not previously reported in the literature, which may have important implications for the canal reconstruction.

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Introduction

The subarcuate canal (SAC) defined as a bony pathway connects the mastoid antrum with the intracranial cavity [1]. It houses the subarcuate artery (SAA), which provides blood supply to the bony labyrinth, the facial canal and the mastoid antrum. The SAC originates from the

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Fig. 1. High-resolution CT scan through the right temporal bone. **a** Demonstration of a mild auricle malformation (arrow). **b** Right-sided osseous external auditory meatus stenosis with membranous atresia (arrow). **c** Abnormal ossicular chain (arrow). **d, e** Representation of a proximal SAC with many mastoid air cells around it and a wider SAC in the distal terminal (arrow). **f** Display of SAC on coronal CT scan (arrow).

subarcuate fossa, a space localized on the posterior surface of the petrosa. The SAA enters the SAC and runs in the anterior, lateral and superior direction. Based on our literature search, its presence and related anatomy have been rarely reported [2–4]. The SAC is a capacious cavity in the fetus and gradually diminishes in size in the first 5 years of life [5]. We present a case of bilateral enlarged SAC of the temporal bone in a patient requiring canal reconstruction.

Methodology and Case Report

A 7-year-old girl presented at our department with a mild congenital right-sided microtia and without maxillofacial dysplasia. A unilateral conductive hearing loss had occurred since infancy. The patient denied having symptoms of otorrhea, tinnitus, headache, dizziness or facial paralysis. An audiometry test showed right-sided profound conductive hearing loss and normal hearing on the left side. A high-resolution computed tomography (CT) of the temporal bone was obtained for further definite evaluation. CT scans showed right auricular and ossicular chain malformations, right external meatal and bony canal stenosis with membranous atresia, and bilateral enlarged aberrant SAC in the temporal bone (fig. 1, 2). The diameter of the right bony canal was between 0.76 and 1.33 mm. The left temporal bone showed the same variation, with the diameter of the canal consistently greater than 1.0 mm, ranging from 1.07 to 1.23 mm in greatest transverse dimension.

Fig. 2. Schematic diagram of the course of the right SAC. Three-dimensional reconstruction by surface-shaded display. **a** Display of a mild auricle malformation. **b** The distal segment of SAC heads to the antrum (arrowhead). **c** In the intermediate tract, the SAC runs deeply in the petrous bone and reaches the superior semicircular canal passing through its arches. **d** In the proximal segment, the SAC enters into the dura (arrow). EACS = External auditory canal stenosis.

Discussion

The incidence of congenital malformation of external and middle ear ranges from 1 in 10,000 to 1 in 20,000 [6, 7]. Typical presentations include microtia, varying degrees of malformation of the external auditory canal ranging from complete absence to mild stenosis and malformation of the middle ear. The aberrant SAC has not been previously reported in the literature on canal atresia repair.

Several studies have examined the SAC or the petromastoid canal which houses the SAA and vein [1, 8, 9]. Mazzoni [8] found that the SAA most often originates from the anteroinferior cerebellar artery, which accounts for 80 percent of all cases. Less frequently, the SAA is a branch of the accessory anteroinferior cerebellar artery in 17%, and rarely, it originates from the posteroinferior cerebellar artery in 3%. In only a few cases, the SAA originates from the internal auditory artery [8, 9]. It supplies the otic capsule of the semicircular canals, the vestibule, facial nerve canal, and mastoid antrum. Several anastomoses have been described, which include the dural branches of the posterior meningeal artery, branches of the external carotid artery in the middle ear, and branches of the stylomastoid artery [10]. The SAA courses through the SAC in the temporal bone. Typically, on imaging, the SAC is seen only as a barely

Fig. 3. High-resolution CT scan through the left temporal bone. **a** Demonstration of SAC (thin arrow). **b** Representation of the SAC coursing between the arch of the superior semicircular canal (arrowhead) and posterior semicircular canal (bold arrow). **c–f** Display of SAC course on coronal CT scan (bold arrow).

perceptible curvilinear lucency in the region of the subarcuate fossa and in between the arches of the superior semicircular canal. Distally, its course is often not visualized.

In this case, malformation of external and middle ear, including right-sided microtia, a right-sided external auditory meatus and bony canal stenosis with membranous atresia and short rod-like malleus were shown on CT scans. The right SAA begins in the region of the subarcuate fossa. It then courses straight between the arch of the superior semicircular canal and anterior semicircular canal and terminates along the mastoid cavity. The beginning of the SAA is surrounded by mastoid air cells. On coronal oblique reformations, the distal SAA is obviously wider than the initiating terminal (fig. 1, 2). The left SAA course is like the right one, which runs between the arch of the superior semicircular canal and posterior semicircular canal (fig. 3). It should be noted that the SAC is a capacious cavity in the fetus and gradually diminishes in size in the first 5 years of life [5]. Anatomic microdissection studies in the adult population have demonstrated the mean width of SAC to vary from 0.5 to 1.0 mm but never greater than 1.0 mm in size [3, 5]. In the present case, it is clearly enlarged (about 1.07–1.23 mm) and this could be related to the pneumatization of the temporal bone [11].

The SAA is not an essential vessel and its coagulation does not produce any sequelae. If not previously recognized in the preoperative CT study, the presence of this anomaly may lead to untoward hemorrhage from the SAA. The CT scan, particularly high-resolution CT, is a very useful tool for the study of intrapetrous vessels and their funnels, and should be considered mandatory in the case of a posterior approach to the tympanic cavity.

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors have no conflict of interest.

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