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Anatomic Moment

Hearing, II: The Retrocochlear Auditory Pathway

Joel D. Swartz, David L. Daniels, H. Ric Harnsberger, John L. Ulmer, Katherine A. Shaffer, and Leighton P. Mark

In contradistinction to the vestibular (Scarpa's) ganglion, which is located at the level of the internal auditory meatus, the cochlear (spiral) ganglion, the primary sensory ganglion for hearing, is located within the bony confines of the cochlea (1, 2). Multiple cochlear fibers converge to form the cochlear nerve, which courses within the anterior-inferior quadrant of the internal auditory canal inferior to the facial nerve and immediately anterior to the inferior vestibular nerve (2, 3) (Figs 1–4). The cochlear nerve then traverses the cerebellopontine angle (usually descending slightly) to synapse in the *dorsal* (higher frequencies) and *ventral* (lower frequencies) nuclei in the upper medulla immediately superficial to the inferior cerebellar peduncle (restiform body) (3–5). For imaging purposes, these nuclei have been referred to by Gebarski et al (6) as the *cochlear nuclear complex* (CNC), which is tubular, 8 mm in length and 3 mm thick. These authors have exquisitely defined landmarks for identification of the CNC, which appears as a modest convexity along the posterolateral surface of the upper medulla bordered by the foramen of Luschka and its accompanying choroid plexus. The choroid plexus extends from the roof of the fourth ventricle to the cerebellopontine angle via the lateral recess. The root entry zone and cerebellar flocculus are also consistent landmarks at this level.

From the CNC, fibers ascend primarily crossed but also uncrossed through the lateral lemniscus within the pons to the inferior colliculi in the midbrain. Fibers from the ventral cochlear nucleus form a structure referred to as the *trapezoid body*. Both crossed and a few of the uncrossed fibers terminate in the superior olivary nuclei. The significance of this latter detour may relate to interaural time differentials (location of sound) or sound dampening (stapedius contraction) (1). From the inferior colliculi in the midbrain, fibers ascend to the medial geniculate bodies in the thalamus and subsequently, via auditory radiations, to the transverse temporal gyrus of Heschl, which resides along the posterior surface of the superior temporal gyrus (7).

The reader should be aware that unilateral retrocochlear sensorineural hearing loss can result only from a lesion of the *cochlear nerve* or *cochlear nuclei* (7). Insults occurring within the more proximal auditory pathway cause bilateral sensorineural hearing loss usually more apparent on the contralateral side. Cortical lesions typically result in an auditory agnosia, an impaired interpretation of sound, rather than a true hearing loss.

Knowledge of the retrocochlear auditory pathway is of importance to the imaging specialist when detailed evaluation of the patient with sensorineural hearing loss is necessary (8). The observer must focus on the anatomy of the entire intraaxial auditory pathway and not just the internal auditory canal and cerebellopontine angle.

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From the Department of Radiology, Germantown Hospital and Medical Center, Philadelphia, Pa (J.D.S.), the Section of Neuroradiology, Department of Radiology, Medical College of Wisconsin, Milwaukee (D.L.D., J.L.U., K.A.S., L.P.M.), and the Section of Neuroradiology, Department of Radiology, University of Utah Medical Center, Salt Lake City (H.R.H.).

Address reprint requests to David L. Daniels, MD, Section of Neuroradiology, Department of Radiology, Medical College of Wisconsin, Froedtert Memorial Lutheran Hospital, 9200 W Wisconsin Ave, Milwaukee, WI 53226.

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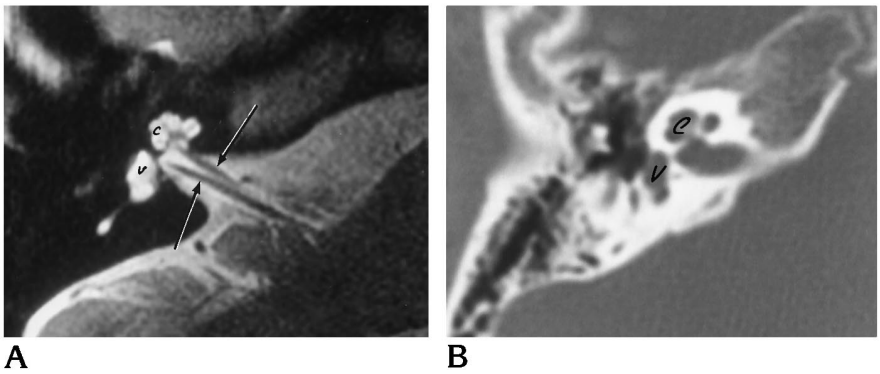

Fig 1. *A*, Axial T2-weighted fast spin-echo magnetic resonance (MR) image obtained with phased-array coils reveals the cochlea (*C*) and vestibule (*V*). The cochlear nerve (*upper arrow*) and the inferior vestibular nerve (*lower arrow*) are seen coursing through the inferior portion of the internal auditory canal.

B, Corresponding axial 1-mm-thick computed tomogram.

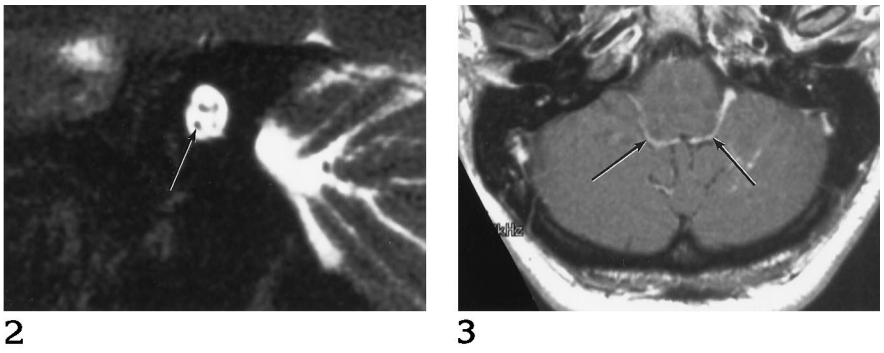

Fig 2. Sagittal T2-weighted fast spin-echo MR image shows the cochlear nerve (*arrow*) coursing anteroinferiorly within the fundus of the internal auditory canal.

Fig 3. Axial contrast-enhanced T1-weighted MR image shows choroid plexus enhancement (*arrows*) within the foramen of Luschka outlining the upper medulla in the region of the cochlear nuclei.

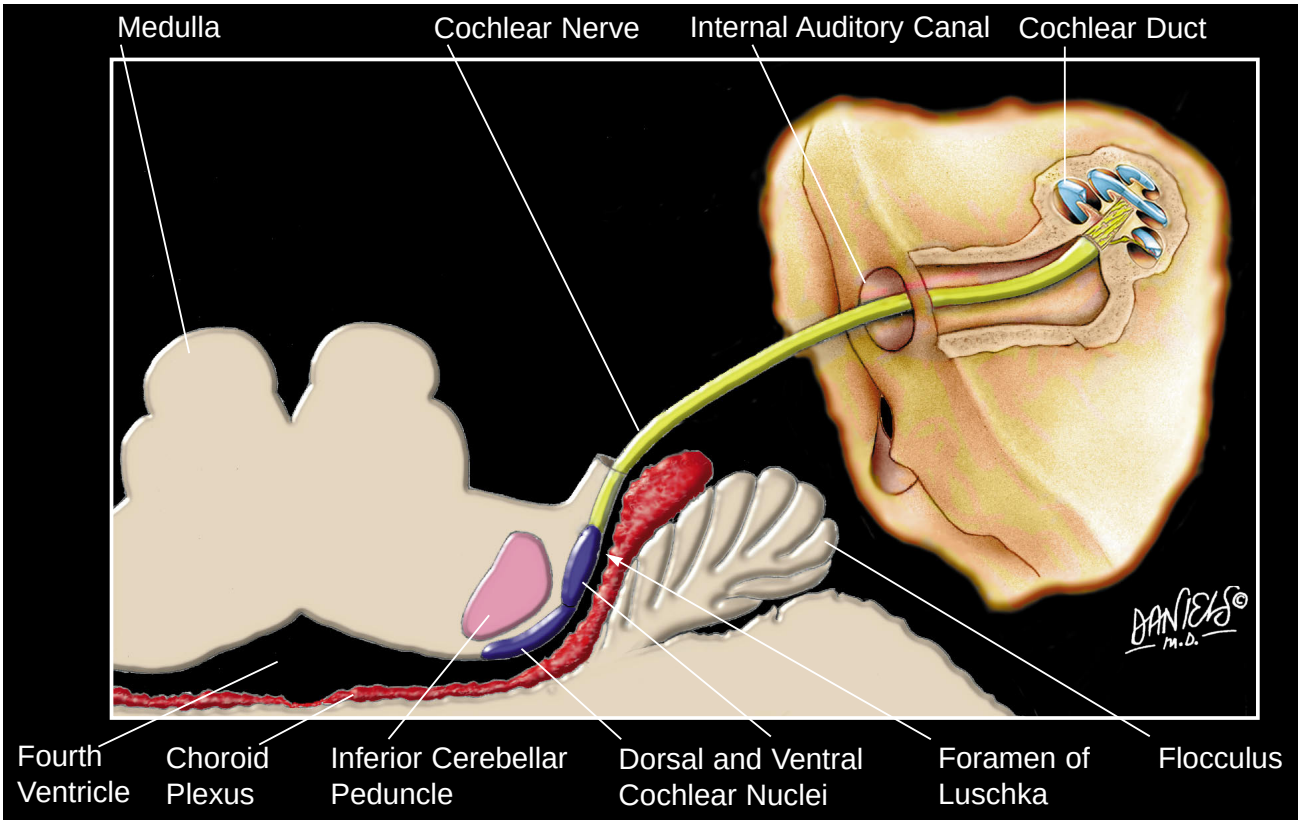

Fig 4. Schematic drawing demonstrates the cochlear nerve extending through the internal auditory canal and cerebellopontine angle cistern to synapse in the dorsal and ventral cochlear nuclei. These nuclei are located lateral to the inferior cerebellar peduncle and form a slight bulge along the posterior lateral surface of the upper medulla. The choroid plexus is located at the posterior aspect of the cerebrospinal fluid–containing foramen of Luschka and also medial to the flocculus (modified from Gebarski et al [6], Harnsberger [9], Ferner [10], DeArmond et al [11], and Netter [12]).

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