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F.J. Wippold II and P.A. Turski

AJNR Am J Neuroradiol 2009, 30 (8) 1623-1625
http://www.ajnr.org/content/30/8/1623

This information is current as of April 19, 2024.

ACR APPROPRIATENESS CRITERIA

Vertigo and Hearing Loss

F.J. Wippold II
P.A. Turski

Dizziness and Vertigo

Dizziness and vertigo (Table 1) are common clinical complaints. Vertigo is caused by a disturbed vestibular system and is subdivided into peripheral vertigo (due to failure of the end organs) or central vertigo (due to failure of the vestibular nerves or central connections to the brainstem and cerebellum).[1-5]

Benign Positional Vertigo, Ménière Disease, and Peripheral Vestibular Disorders

Patients with benign positional vertigo rarely demonstrate imaging findings.[2,4] Ménière disease manifests as paroxysmal attacks of whirling vertigo due to failure of regulation of endolymph. CT or MR imaging, or both, may be used to evaluate the vestibular aqueduct, endolymphatic duct, and sac and to rule out associated infectious or neoplastic disease.[4-12]

Vestibular neuritis and labyrinthitis may also cause vertigo. Labyrinthitis is usually viral in origin with few sequelae; however, bacterial labyrinthitis may progress to partial or complete occlusion of the lumen of the affected labyrinth, detectable on MR imaging as loss of the signal intensity of the fluid contents.[3,4] Progressive labyrinthitis obliterans may be diagnosed on high-resolution CT.[13] Gadolinium enhancement of the labyrinthine structures or vestibular nerves may also occur and should not be mistaken for hemorrhage.[14-16]

Superior semicircular canal dehiscence, another cause of vertigo, can be diagnosed by high-resolution coronal CT imaging of the temporal bones.[17-19] Diseases of the internal auditory canal and cerebellopontine angle, such as tumors, are readily evaluated with CT and MR imaging techniques.

Central Vestibular Disorders

Central lesions of the brainstem or cerebellum that result in central vertigo can be readily diagnosed by MR imaging. Posterior fossa vascular disorders may be evaluated with MR angiography or conventional angiography of the posterior fossa vasculature.[3,20,21] Cervical spondylosis, which causes vertigo by compressive osteophyte formation, may be evaluated with CT.[3,20,21]

Sensorineural Hearing Loss

Sensorineural hearing loss (SNHL) results from the pathologic changes of inner ear structures such as the cochlea or the auditory nerve[1] and is best evaluated with gadolinium-enhanced MR imaging.[22-25]

Patients with fluctuating SNHL may have congenitally enlarged vestibular aqueducts (apertures greater than 4 mm) detected by either CT or MR imaging.[26-29]

The imaging findings must be correlated with audiometry.[27,28]

Initial evaluation of symmetric or unilateral SNHL requires determination of whether the site of the lesion is cochlear[30] or retrocochlear.[31] Following preliminary audiometric or auditory brain response testing, patients with retrocochlear localization should have a complete MR imaging study of the head to include the internal auditory canal, temporal bones, central nuclei in the brainstem, and the auditory pathways extending upward into the cerebral hemispheres.[22,23,32-34] Gadolinium contrast enhancement may be used. CT is sometimes diagnostic in lesions 1.5 cm or greater in diameter when dedicated techniques are used, but it does not readily detect small brainstem lesions such as infarctions or demyelination.[33-40]

In general, most cochlear disorders such as otosclerosis are evaluated by high-resolution CT imaging. Similarly, preoperative assessment for cochlear implants is usually best accomplished by using thin-section CT with reformatted multiplanar images. In patients with congenital etiologies for hearing loss, recent reports suggest that high-resolution MR imaging is more useful for surgical planning.[41,42]

Conductive Hearing Loss

Conductive hearing loss results from pathologic changes of either the external or middle ear structures and is best evaluated with CT. Indications include suspected complications of acute and chronic otomastoiditis, such as cholesteatoma, and the assessment of congenital or vascular anomalies. Fistulization through the tegmen tympani of the temporal bone is usually detected by CT, though the actual involvement of the meninges and veins is better assessed by MR imaging. MR imaging is also indicated when complicated inflammatory lesions are suspected to extend into the inner ear or toward the sigmoid sinus or jugular vein. Neoplasms arising from or extending into the middle ear require the use of both techniques, as their combined data provide essential information. Vascular imaging should be performed when there is suspicion of a paraganglioma extending into the middle ear.[43]

Trauma

CT is used extensively to delineate fractures, ossicular dislocations, fistulous communications, and facial nerve injury and to evaluate post-traumatic hearing loss.[44]

This article is a summary of the complete version of this topic, which is available on the ACR Website at www.acr.org/ac. Practitioners are encouraged to refer to the complete version.

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Please address correspondence to Franz J Wippold II, MD, FACR, Neuroradiology Section, Mallinckrodt Institute of Radiology, 510 S Kingshighway Blvd, St. Louis, MO 63110-1076; e-mail: wippold@mir.wustl.edu; or Patrick A Turski, MD, FACR, Department of Radiology, University of Wisconsin Hospital, E1/398, 600 Highland Ave, Madison, WI 53792-0001; e-mail: pturski@uwhealth.org

Rating of Techniques: Clinical condition—vertigo and hearing loss*						
	MRI Head and Internal Auditory Canal without and with Contrast	MRI Head and Internal Auditory Canal without Contrast	CT Temporal Bone without Contrast	CT Head without and with Contrast	MRA Head with or without Contrast	CTA Head
Sensorineural hearing loss, acute and intermittent vertigo	8	7	6†	3	N/A	N/A
Sensorineural hearing loss, no vertigo	8	7	5	4	N/A	N/A
Conductive hearing loss, rule out petrous bone abnormality	3	3‡	8	3	N/A	N/A
Total deafness, cochlear implant candidate, surgical planning	5	5	9	3	N/A	N/A
Fluctuating hearing loss, history of meningitis or to rule out congenital anomaly	7	7	8	4	N/A	N/A
Episodic vertigo, new onset (hours to days)	7	6	4	5	6	5
Vertigo, no hearing loss, normal findings on neurologic examination	8	7	5	4	N/A	N/A

Note:—MRI indicates MR imaging; MRA, MR angiography; CTA, CT angiography; N/A, not rated.
* Appropriateness criteria scale from 1 to 9: 1 indicates least appropriate; 9, most appropriate.
† For possible cholesteatoma with labyrinthine fistula.
‡ MR imaging is superior to CT for the detection of dural invasion and extradural extension.

Congenital and Childhood Hearing Loss

The ideal imaging method for children with unilateral or asymmetric sensory neural hearing loss is still controversial. Most reports suggest that children with unilateral or asymmetric sensory neural hearing loss should have a high-resolution temporal bone CT scan and that brain and temporal bone MR imaging be obtained in select cases. In general high-resolution CT has been shown to be efficacious for the preoperative work-up for congenital hearing loss due to aural dysplasia, congenital ossicular anomalies, large vestibular aqueduct syndrome, congenital absence of cochlear nerve, and labyrinthitis ossificans.[45-54]

Review Information

This guideline was originally developed in 1996. The last review and update was completed in 2008.

Appendix

Expert Panel on Neurologic Imaging: Franz J. Wippold II, MD, Co-Author and Panel Chair; Patrick A. Turski, MD, Co-Author; Rebecca S. Cornelius, MD; James A. Brunberg, MD; Patricia C. Davis, MD; Robert L. De La Paz, MD; Pr. Didier Dormont; Linda Gray, MD; John E. Jordan, MD; Suresh Kumar Mukherji, MD; David J. Seidenwurm, MD; Robert D. Zimmerman, MD; Brian Nussenbaum, MD, American Academy of Otolaryngology; Michael A. Sloan, MD, MS, American Academy of Neurology.

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