American College of Radiology
ACR Appropriateness Criteria®

Hearing Loss and/or Vertigo

Variant: 1 Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT temporal bone without IV contrast	Usually Appropriate	☢☢☢
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head and internal auditory canal without and with IV contrast	Usually Not Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 2 Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
CT temporal bone without IV contrast	Usually Appropriate	☢☢☢
MRI head and internal auditory canal without IV contrast	May Be Appropriate	O
CT temporal bone with IV contrast	May Be Appropriate	☢☢☢
CTA head with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 3 Acquired sensorineural hearing loss. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Appropriate	O
CT temporal bone with IV contrast	May Be Appropriate	☢☢☢
CT temporal bone without IV contrast	May Be Appropriate	☢☢☢

MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 4 Mixed conductive and sensorineural hearing loss. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Appropriate	O
CT temporal bone without IV contrast	Usually Appropriate	☢☢☢
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 5 Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Appropriate	O
CT temporal bone without IV contrast	Usually Appropriate	☢☢☢
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 6 Episodic vertigo with or without associated hearing loss or aural fullness

(peripheral vertigo). Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Appropriate	O
CT temporal bone without IV contrast	Usually Appropriate	☢☢☢
MRA head and neck without and with IV contrast	May Be Appropriate	O
CTA head and neck with IV contrast	May Be Appropriate	☢☢☢
MRA head and neck without IV contrast	Usually Not Appropriate	O
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 7 Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head and internal auditory canal without and with IV contrast	Usually Appropriate	O
MRI head and internal auditory canal without IV contrast	Usually Appropriate	O
MRA head and neck without and with IV contrast	May Be Appropriate	O
MRA head and neck without IV contrast	May Be Appropriate	O
CT head with IV contrast	May Be Appropriate	☢☢☢
CT head without IV contrast	May Be Appropriate	☢☢☢
CTA head and neck with IV contrast	May Be Appropriate	☢☢☢
MRV head with IV contrast	Usually Not Appropriate	O
MRV head without IV contrast	Usually Not Appropriate	O
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without and with IV contrast	Usually Not Appropriate	☢☢☢
CT temporal bone without IV contrast	Usually Not Appropriate	☢☢☢

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Summary of Literature Review

Introduction/Background

Clinical assessment and audiometric testing can determine the type of hearing loss as conductive, sensorineural, or mixed [1,2] and guide the appropriateness of subsequent imaging. Conductive hearing loss results from diseases affecting the conduction of mechanical sound wave energy to the hair cells of the organ of Corti within the cochlea. These serve as the auditory receptors, converting the mechanical energy of sound waves into electrical neural impulses that are then transmitted along the auditory pathways to the auditory cortex [1]. Sensorineural hearing loss is caused by diseases that impair the cochlear function or the transmission of electrical signal along the auditory pathway, including the cranial nerve nucleus in the brainstem through the superior olive, inferior colliculus, medial geniculate body of the thalamus, and auditory cortex in the temporal lobe.

Given the proximity of the cranial nerves and their nuclei, disorders that affect hearing may also affect vestibular function and vice versa. The vestibule and semicircular canals are the end organs responsible for balance and equilibrium. Central vestibular pathways involve extensive connections between the vestibular nuclei within the brainstem and the cerebellum, extraocular nuclei, and spinal cord. Vertigo is a sensation that you or the environment around you is moving or spinning. Although vertigo often indicates dysfunction of the vestibule or semicircular canals, patients commonly report dizziness, a less specific term that may imply disequilibrium, lightheadedness, or presyncope [3-5]. Accordingly, imaging workup in these patients may require assessment for disease processes that produce symptoms reported as dizziness rather than vertigo. Appropriateness of imaging often depends upon clinical categorization of vertigo into peripheral (vestibular) and central (affecting central vestibular pathways) categories based upon factors such as onset, duration, persistence, aggravating factors, and results of clinical testing [3-7]. In some cases however, this categorization may be difficult on clinical assessment, especially in less subspecialized care [3].

Discussion of Procedures by Variant

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.

A. CT head

There is no evidence to support use of CT head in patients with conductive hearing loss.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.
B. CT temporal bone with IV contrast

Temporal bone CT is considered to be the first-line imaging modality in patients presenting with conductive hearing loss without any mass lesion seen within the middle ear cavity [1,2,5]. CT provides excellent delineation of the external auditory canal, ossicular chain, and the bony labyrinth of the inner ear structures. CT is helpful in identifying changes of otospongiosis (otosclerosis), ossicular erosion or fusion, round window occlusion, and dehiscence of the superior semicircular canal [1,2,5,8-12]. The latter can produce conductive hearing loss and Tullio phenomenon, or sound-induced vertigo, by dissipating mechanical energy through the bony dehiscence. If this condition is suspected, performing CT reconstructions along the Pöschl plane and perpendicular to the Stenver plane then the orientation of the superior semicircular canal may be helpful in identification of bony dehiscence and estimating its extent [8,9].

Given the density of temporal bone and the rather small size of individual structures of interest, such as ossicles, details of temporal bone morphology are only evident on bone windows. Accordingly, intravenous (IV) contrast is not beneficial for evaluation of temporal bone in patients with conductive hearing loss.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.
C. CTA head

There is no evidence to support use of CT angiography (CTA) in patients with conductive hearing loss.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.
D. MRA head without and with IV contrast

There is no evidence to support use of MR angiography (MRA) for initial evaluation of patients with conductive hearing loss.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.
E. MRI head and internal auditory canal

MRI of the temporal bone is insufficient in delineation of the bony details usually needed for evaluation of patients with conductive hearing loss, and there is no evidence to support its use as a first-line imaging modality in these patients.

Variant 1: Acquired conductive hearing loss in absence of clinically evident mass in the middle ear. Initial imaging.
F. MRV head

There is no evidence to support use of MR venography (MRV) for initial evaluation of patients with conductive hearing loss.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with

suspected intracranial or inner ear extension. Surgical planning.
A. CT head

There is no evidence to support use of CT head for assessment of patients with conductive hearing loss and middle ear mass identified on otoscopy.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.
B. CT temporal bone

High-spatial resolution CT of the temporal bone is helpful in defining small inflammatory or neoplastic masses within the middle ear cavity [1,2,13]. In addition, CT can help in surgical planning by demonstrating erosions of ossicles or other inner ear structures (such as perilymphatic fistulae) caused by such masses [14]. Given the surrounding dense bone, IV contrast is usually not beneficial in studying enhancement characteristics of middle ear masses. However, contrast enhancement may help delineate extraosseous soft tissue associated with invasive neoplasms.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.
C. CTA head

There is no definite evidence to support use of CTA as a first-line modality for assessment of patients with conductive hearing loss and middle ear mass identified on otoscopy. However, in patients with high clinical suspicion of middle ear paraganglioma, CTA is sometimes used initially for diagnostic confirmation and for planning further management.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.
D. MRA head

MRA is usually not used as a first-line imaging modality in patients presenting with conductive hearing loss. However, it may be helpful in assessing patency of the carotid artery if initial imaging raises suspicion of vascular involvement.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.
E. MRI head and internal auditory canal

Extent of a middle ear cavity mass identified on otoscopy in a patient with conductive hearing loss is much better defined using MRI obtained without and with IV contrast [2,5,13,15]. This assessment is better done using thin sections across the temporal bone as part of a dedicated internal auditory canal (IAC) protocol rather than a routine brain MRI. Excellent soft-tissue contrast afforded by even a noncontrast MRI often complements the bony details seen on temporal bone CT for complete evaluation of such patients prior to surgical intervention.

Variant 2: Acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension. Surgical planning.
F. MRV head

Although not used as the initial imaging modality, MRV may be helpful in assessing patency of jugular vein for surgical planning in patients with documented middle ear masses.

Variant 3: Acquired sensorineural hearing loss. Initial imaging.

Variant 3: Acquired sensorineural hearing loss. Initial imaging.
A. CT head

Contrast-enhanced head CT is a less-sensitive imaging modality to detect tumors, such as vestibular
schwannomas [17], or assess the IAC, cerebellopontine angle cisterns, or the brainstem compared to MRI.

Variant 3: Acquired sensorineural hearing loss. Initial imaging.
B. CT temporal bone

CT of the temporal bone is insensitive in detection of soft-tissue abnormalities that commonly cause sensorineural hearing loss. Small size and proximity to the dense bone of inner ear structures and IAC also precludes visualization of intralabyrinthine or intracanalicular enhancement following IV contrast administration. It may demonstrate labyrinthine ossification [16] resulting from prior infection or give an indirect clue to presence of a vestibular schwannoma in the form of bony remodeling of the IAC. In post-traumatic sensorineural hearing loss, CT can demonstrate fractures extending across the otic capsule [2,13].

Variant 3: Acquired sensorineural hearing loss. Initial imaging.
C. CTA head

There is no evidence to support use of CTA in the initial workup of patients presenting with isolated sensorineural hearing loss.

Variant 3: Acquired sensorineural hearing loss. Initial imaging.
D. MRA head

There is no evidence to support use of MRA in the initial workup of patients presenting with isolated
sensorineural hearing loss.

Variant 3: Acquired sensorineural hearing loss. Initial imaging.
E. MRI head and internal auditory canal

Imaging evaluation of patients presenting with sensorineural hearing loss involves detailed assessment of the cochlear contents, vestibulocochlear nerve, and auditory pathways. MRI is the imaging modality of choice for evaluating these soft-tissue structures [2,5,18-20]. MRI can demonstrate signal alterations induced by inflammation or hemorrhage within the cochlear contents, identify neoplasms within the cochlear labyrinth or IAC, assess the size of vestibular aqueducts, and visualize abnormalities affecting the brain parenchyma along the auditory pathways [21-25]. Although differential considerations may vary based upon sudden, fluctuating, or progressive nature of sensorineural hearing loss, MRI remains the imaging modality of choice for all these subcategories. MRI should be done using dedicated IAC protocol using thin sections across the IAC and the inner ear. These protocols include evaluation of the brainstem and thalami. Given the extreme rarity of cortical deafness, there is no strong evidence to recommend routine assessment of the entire brain parenchyma in addition to the MRI IAC protocol in patients presenting with isolated sensorineural hearing loss [26,27]. High-resolution 3-D T2-weighted images providing submillimeter assessment of fluid-filled inner ear structures and the IAC are highly sensitive for detection of diseases presenting with sensorineural hearing loss [27,28]. Visualization of inflammatory changes (eg, labyrinthitis, neuritis) as well as neoplasms, such as vestibular schwannomas, can befacilitated by administration of IV contrast [29,30]. However, there is insufficient evidence to prove incremental benefit of contrast administration beyond an MRI IAC protocol performed without IV contrast [27,28].

Variant 3: Acquired sensorineural hearing loss. Initial imaging.

F. MRV head

There is no evidence to support use of MRV in the initial workup of patients presenting with isolated sensorineural hearing loss.

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
A. CT head

Relative to MRI, CT head is much less sensitive in detecting or excluding retrocochlear pathology to account for the sensorineural component of the hearing loss [17].

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
B. CT temporal bone

CT scan of the temporal bones can delineate changes of otospongiosis, a common cause of mixed conductive and sensorineural hearing loss. In some patients with clinical suspicion of otospongiosis, it may suggest alternate diagnoses to explain hearing loss. [31,32]. Administration of IV contrast is usually not beneficial for assessment of temporal bone.

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
C. CTA head

There is no evidence to support use of CTA in the initial workup of patients presenting with mixed hearing loss.

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
D. MRA head

There is no evidence to support use of MRA in the initial workup of patients presenting with mixed hearing loss.

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
E. MRI head and internal auditory canal

MRI obtained using IAC protocol can be helpful in looking for any retrocochlear pathology responsible for a sensorineural component of the hearing loss. In case IV contrast is administered, punctate enhancement can be seen within the bony otic capsule in the presence of otospongiosis [2].

Variant 4: Mixed conductive and sensorineural hearing loss. Initial imaging.
F. MRV head

There is no evidence to support use of MRV in the initial workup of patients presenting with mixed hearing loss.

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
A. CT head

High-spatial resolution of CT head is insufficient in providing anatomic details of temporal bone needed for surgical planning prior to cochlear implantation. Accordingly, there is no evidence to support routine use of CT head for this indication.

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
B. CT temporal bone

High-spatial resolution provided by CT of the temporal bone is valuable prior to cochlear implantation surgery in patients with profound hearing loss. It can provide preoperative delineation of underlying cochlear malformation in patients with congenital hearing loss, detect changes of otospongiosis, suggest round window occlusion, identify labyrinthitis ossificans, congenital bony fusion of the ossicles, and alert the surgeon regarding underlying otomastoiditis or variant anatomy (such as that of the facial nerve) [33,34]. It can also delineate the size of cochlear and vestibular aqueducts, alerting the surgeon for possibility of intraoperative cerebrospinal fluid gusher [24,35,36].

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
C. CTA head

There is no evidence to support routine use of CTA for surgical planning prior to cochlear implantation in patients with deafness.

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
D. MRA head

There is no evidence to support routine use of MRA for surgical planning prior to cochlear implantation in patients with deafness.

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
E. MRI head and internal auditory canal

MRI may provide a complementary role to temporal bone CT in preoperative assessment of patients prior to cochlear implantation. Exquisite details of inner ear structures visible on high-resolution T2-weighted images can help in detecting abnormalities, such as cochlear malformations or cochlear nerve deficiency, that directly impact surgical approach [37,38]. In addition, MRI may reveal unexpected soft-tissue abnormalities, such as vestibular schwannomas that may impact the planned surgery [39].

Variant 5: Congenital hearing loss or total deafness or cochlear implant candidate. Surgical planning.
F. MRV head

There is no evidence to support routine use of MRV for surgical planning prior to cochlear implantation in patients with deafness.

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.
A. CT head

CT head provides insufficient details of the inner ear to be useful in patients with peripheral vertigo. Accordingly, diagnostic yield of CT head in patients presenting with vertigo is low [40].

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness

(peripheral vertigo). Initial imaging.
B. CT temporal bone

CT of the temporal bone provides excellent delineation of the bony labyrinth and is helpful in detecting a number of pathologies resulting in peripheral vertigo. It is highly sensitive in detecting temporal bone fractures in patients with post-traumatic vertigo, assessing for superior semicircular canal dehiscence in patients with vertigo provoked by loud noises, and diagnosing erosions in the bony labyrinth from inflammatory or iatrogenic causes [5,8,9,14].

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.
C. CTA head and neck

There is no evidence to support use of CTA in patients presenting with peripheral causes of vertigo. In patients with episodic vertigo that cannot be confidently categorized as peripheral, CTA can be used to detect underlying vertebrobasilar insufficiency [41].

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.
D. MRA head and neck

There is no evidence to support use of MRA in patients presenting with peripheral causes of vertigo. In patients with episodic vertigo that cannot be confidently categorized as peripheral, MRA without and with IV contrast can be used to detect underlying vertebrobasilar insufficiency [55].

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.
E. MRI head and internal auditory canal

Based on clinical assessment, peripheral vertigo in many patients is presumed to be secondary to benign processes such as benign paroxysmal positional vertigo or Meniere disease, and these patients are often managed successfully without imaging [3-5]. High-resolution T2-weighted images are capable of delineating endolymphatic sac, and delayed 3-D FLAIR images can demonstrate hydrops associated with Meniere disease following IV or intratympanic contrast administration as contrast accumulates in perilymphatic but not endolymphatic space. However, the role of such studies in management of these patients is still not clearly established [42-53]. IV contrast can be helpful in showing enhancement of vestibule or semicircular canals in patients with labyrinthitis. MRI of the brain can be used to detect rare but significant central causes of vertigo in cases where distinction between peripheral and central categories is not clinically evident [54].

Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo). Initial imaging.
F. MRV head

There is no evidence to support use of MRV in the initial workup of patients presenting with vertigo; however, in patients who may have vertigo as a symptom of pseudotumor cerebri, MRV may show narrowing of the transverse sinuses.

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
A. CT head

Head CT without or with IV contrast may be used to look for central causes of dizziness, albeit with lesser sensitivity than MRI [40,54]. IV contrast may help in either detection or characterization of various neoplastic or inflammatory disease processes affecting the central nervous system. In patients presenting to the emergency department with acute onset of symptoms, CT may demonstrate intracranial hemorrhage as a rare central cause of dizziness [56].

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
B. CT temporal bone

CT of the temporal bone is not useful in looking for central causes of vertigo.

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
C. CTA head and neck

In patients suspected of vertebrobasilar insufficiency as a cause of episodic vertigo, CTA can be used to detect vascular stenosis or occlusion [41].

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
D. MRA head and neck

In patients suspected of vertebrobasilar insufficiency as a cause of episodic vertigo, MRA can be used to detect vascular stenosis or occlusion [55].

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
E. MRI head and internal auditory canal

MRI is the modality of choice in evaluation of the brain in patients suspected to have central cause for vertigo. It can detect posterior fossa neoplasms, Chiari malformation, posterior fossa infarcts, and demyelinating lesions that may result in dizziness or vertigo [3,54,56-58]. Contrast administration can be helpful in detection or characterization of such lesions [58]. Compared to CT, MRI has a much higher sensitivity of detecting acute infarcts in patients with dizziness [40]. It should be noted that infarcts causing isolated vestibular symptoms are usually small, and normal initial MRI does not entirely exclude brain infarction as a cause for vertigo [59].

Variant 7: Persistent vertigo with or without neurological symptoms (central vertigo). Initial imaging.
F. MRV head

There is no evidence to support use of MRV in the initial workup of patients presenting with isolated vertigo.

Summary of Highlights

- Variant 1: CT temporal bone without IV contrast is the first-line imaging modality in patients presenting with acquired conductive hearing loss without any mass lesion seen within the middle ear cavity.
- Variant 2: For presurgical planning of patients with acquired conductive hearing loss secondary to cholesteatoma or neoplasm with suspected intracranial or inner ear extension,

CT temporal bone without IV contrast or MRI head and internal auditory canal without and with IV contrast is recommended. It may be necessary to do both examinations for complete presurgical evaluation.

- Variant 3: MRI head and internal auditory canal without IV contrast, or without and with IV contrast, is recommended for evaluating patients with acquired sensorineural hearing loss.
- Variant 4: Mixed conductive and sensorineural hearing loss can be evaluated with either CT temporal bone without IV contrast, or MRI head and internal auditory canal without IV contrast, or without and with IV contrast.
- Variant 5: Congenital hearing loss, total deafness, or cochlear implant is best assessed with either CT temporal bone without IV contrast, or MRI head and internal auditory canal without IV contrast, or without and with IV contrast.
- Variant 6: Episodic vertigo with or without associated hearing loss or aural fullness (peripheral vertigo) can best be assessed with either CT temporal bone without IV contrast, MRI head and internal auditory canal without IV contrast, or without and with IV contrast.
- Variant 7: Evaluation of persistent vertigo with or without neurological symptoms (central vertigo) can best be assessed initially with MRI head and internal auditory canal without IV contrast, or without and with IV contrast.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation.

		"May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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