

HINTS Exam: Determining the Cause of Acute Vestibular Syndrome

Acute Vestibular Syndrome (AVS)^{1,2}

- Rapid onset of dizziness, nausea/vomiting, head motion intolerance, nystagmus, and unsteady gait
- Continuous dizziness for ≥ 24 hours
- Symptoms can last days to weeks

Causes of AVS

- Peripheral
 - Acute peripheral neuropathy (APN) affecting CN VIII or the labyrinth
 - Vestibular neuritis or labyrinthitis
 - Trauma/surgical injury
 - Tumor, structural lesion (e.g. vestibular schwannoma, compression from tortuous vertebral artery)
- Central
 - Posterior circulation stroke – vertebrobasilar arterial system supplies the brainstem and cerebellum
 - PICA, AICA, Pontine arteries, SCA
 - 25% of patients in ED with AVS have posterior circulation stroke²⁻⁴
 - Progressive neurologic conditions (e.g. MS, Friedreich's ataxia), tumor/structural lesion, paraneoplastic syndrome, vestibular migraine, medication reaction

Posterior Circulation Associated with AVS

- Strokes in any of these territories can present as isolated AVS; patients can also have other neurological signs/symptoms
- Posterior Inferior Cerebellar Artery (PICA)
 - From vertebral arteries – supplies medulla and posterior inferior portion of cerebellum
 - Most common artery for cerebellar infarcts
 - Possible signs/symptoms: isolated AVS
 - Other possible neuro signs/symptoms: truncal ataxia⁵, dysarthria, dysphagia, contralateral sensory loss, decreased coordination^{6,7}
- Anterior Inferior Cerebellar Artery (AICA)
 - From basilar artery – supplies pons, anterior inferior portion of cerebellum, and inner ear⁸
 - Possible signs/symptoms: isolated AVS⁹
 - Other possible neuro signs/symptoms: dysarthria, sudden hearing loss, ipsilateral CN V and VII involvement, dysmetria of UE more than LE, contralateral sensory loss^{5,9,10}

- Labyrinthine Artery
 - From AICA most commonly, or direct branch of basilar artery – supplies inner ear
 - Possible signs/symptoms: isolated AVS (if vestibular loss, peripheral pattern of nystagmus)
 - Other possible neuro signs/symptoms: sudden hearing loss
- Pontine Arteries
 - From basilar artery – supply the pons
 - Possible signs/symptoms: isolated AVS¹¹
 - Other possible neuro signs/symptoms: motor involvement (UE>LE; distal >proximal), sensory involvement,³¹ dysarthria, ataxia, CN V – VII palsy^{10,11}
- Superior Cerebellar Artery (SCA)
 - From the basilar artery – supplies the superior cerebellum, cerebellar white matter, midbrain, and pons
 - Possible signs/symptoms: isolated AVS
 - Other possible neuro signs/symptoms: dysarthria, diplopia, ataxia, contralateral loss of CN IV or pain/temp¹⁰

Other Posterior Circulation Not Associated with AVS

- Posterior Cerebral Artery (PCA)
 - From the basilar artery – supplies the occipital lobe, midbrain, thalamus, posterior inferior parietal lobe¹⁰
 - A stroke isolated to the PCA will not cause AVS
 - It is possible to have multiple lesions sites in the posterior circulation. If there is a lesion in the PICA, AICA, Labyrinthine artery, Pontine arteries or SCA, in addition to the PCA, the patient could have S/S of AVS as well as the neurological S/S associated with the occipital lobe and midbrain.
 - Possible signs/symptoms associated with PCA: visual field loss, contralateral sensorimotor loss, CN III-IV palsy, ataxia, contralateral tremor, choreoathetosis, thalamic pain ¹⁰

Diagnostic Tools – HINTS exam is the best tool for ruling out central cause of AVS

- CT:
 - Only 16% sensitivity for ischemic stroke⁸
 - Good for tumors and hemorrhagic stroke, but only 4% of AVS causing strokes are hemorrhagic³
- Early MRI in patients with AVS and at least 1 stroke risk factor¹
 - 88% sensitive, 96% specific when done within 48 hours of symptom onset
 - 80% sensitive, 97% specific when done within 24 hours of symptom onset
- HINTS exam¹
 - 3-part oculomotor exam: **H**ead **I**mpulse Test, **N**ystagmus, **T**est of **S**kew
 - >96% sensitive and specific in patients with AVS and at least 1 stroke risk factor¹
 - Only for patients with AVS: dizziness present for ≥24 hours and nystagmus in at least 1 gaze evoked position
 - Valuable exam during first few days of symptoms: ED, acute hospital, subacute setting if new symptoms arise

HINTS Exam in Patients with AVS				
	Test Procedure	Stroke/Central Pathology	Unilateral Peripheral Pathology	Clarifying Information
Head Impulse Test	Patient keeps eyes on examiner's nose; passively rotate head back/forth at varying speed From ~ 20° rotation quickly rotate head back to midline	<ul style="list-style-type: none"> • Normal HIT (no corrective saccade) or • Abnormal HIT (corrective saccade) 	<ul style="list-style-type: none"> • Abnormal HIT in only 1 direction 	<ul style="list-style-type: none"> • Assesses the VOR • Tests the side the head is rotated towards • Abnormal HIT: eyes move in the direction the head was rotated requiring a corrective saccade to return to target • Normal HIT in pts with AVS single best indicator of central pathology
Nystagmus	With head stationary in midline the patient looks straight ahead, to the R and to the L for several seconds each	<ul style="list-style-type: none"> • Direction changing nystagmus (e.g., R-beating with R gaze and L-beating with L gaze) or • Direction fixed nystagmus 	<ul style="list-style-type: none"> • Direction fixed nystagmus <ul style="list-style-type: none"> ○ Alexander's Law: strongest when looking in direction of the fast beat & most subtle/absent when looking in direction of slow beat 	<ul style="list-style-type: none"> • Named for the direction of the fast phase • Fast phase is away from the side of the lesion and must be in opposite direction of the abnormal HIT with a peripheral pathology
Test of Skew	Alternate cover test; pt looks straight ahead, examiner covers 1 eye then covers the other eye	<ul style="list-style-type: none"> • Abnormal: Vertical refixation of at least 1 eye or • Normal: No refixation 	<ul style="list-style-type: none"> • No vertical realignment 	<ul style="list-style-type: none"> • Imbalance of vestibular input to oculomotor system • Least common central finding
Interpretation of Results		<u>Only 1</u> of the results in bold must be present to indicate a central pathology	<u>All 3 must be present</u> to indicate an unilateral peripheral vestibular pathology	
Dangerous HINTS = INFARCT (Impulse <u>N</u>ormal, Fast-phase <u>A</u>lternating, Refixation on <u>C</u>over <u>T</u>est)¹				

	Stroke/Central Pathology	Unilateral Peripheral Pathology
Actions Based on Results	<ul style="list-style-type: none"> • Document findings • Discuss with MD • Acute: MD may prescribe meds (vestibular suppressant or antiemetic) • Patient education: stroke and treatment options • Provide interventions as necessary for deficits 	<ul style="list-style-type: none"> • Document findings • Discuss with MD • Acute: MD may prescribe meds (vestibular suppressant or antiemetic)¹² • Acute/Chronic: Vestibular rehab as long as symptomatic¹²
	<ul style="list-style-type: none"> • Prognosis typically worse for those with central cause as compared to peripheral cause; ability for CNS to compensate may be reduced • Possible referral to neuro-ophthalmologist or neuro-optometrist for persistent diplopia • Possible referral for vehicle driving assessment if persistent ataxia, dynamic visual acuity deficit or diplopia • Vestibular rehab may include same interventions as those for a peripheral cause¹³ • Postural control, balance and gait exercises are important to improve visual and somatosensory input^{13,14} 	<p>Components Peripheral Vestibular Rehab¹²</p> <ul style="list-style-type: none"> • Gaze stability exercises (e.g. VOR) • Habituation exercises • Balance/gait training • Walking for endurance

Resources

1. Kattah JC, Talkad A V., Wang DZ, Hsieh Y-H, Newman-Toker DE. HINTS to Diagnose Stroke in the Acute Vestibular Syndrome. *Stroke*. 2009;40(11):3504-3510. doi:10.1161/STROKEAHA.109.551234.
2. Norrving B, Magnusson M, Holtås S. Isolated acute vertigo in the elderly; vestibular or vascular disease? *Acta Neurol Scand*. 1995;91(1):43-48. <http://www.ncbi.nlm.nih.gov/pubmed/7732773>. Accessed September 24, 2015.
3. Tarnutzer A a., Berkowitz AL, Robinson K a., Hsieh YH, Newman-Toker DE. Does my dizzy patient have a stroke? A systematic review of bedside diagnosis in acute vestibular syndrome. *Cmaj*. 2011;183(9):571-592. doi:10.1503/cmaj.100174.
4. Newman-Toker DE, Kattah JC, Alvernia JE, Wang DZ. Normal head impulse test differentiates acute cerebellar strokes from vestibular neuritis. *Neurology*. 2008;70(Issue 24, Part 2):2378-2385. doi:10.1212/01.wnl.0000314685.01433.0d.
5. Kim HA, Lee H. Recent advances in central acute vestibular syndrome of a vascular cause. *J Neurol Sci*. 2012;321(1-2):17-22. doi:10.1016/j.jns.2012.07.055.
6. Hacking C, Gaillard F. Posterior inferior cerebellar artery: Radiopaedia.org. *Radiopaedia.org*. <http://radiopaedia.org/articles/posterior-inferior-cerebellar-artery>. Accessed February 19, 2016.
7. Posterior Inferior Cerebellar Artery Syndrome:iTriage website. *iTRIAGE*. <https://www.itriagehealth.com/conditions/posterior-inferior-cerebellar-artery-syndrome-stroke-syndrome-596>. Accessed April 4, 2016.
8. Shetty A, Gaillard F. Anterior inferior cerebellar artery: Radiopaedia.org.
9. Lee H, Kim JS, Chung E, Yi H, Chung I. Cerebellar Artery Spectrum of Audiovestibular Loss. 2009. doi:10.1161/STROKEAHA.109.564682.
10. Schwartzman R. *Differential Diagnosis in Neurology*. IOS Press; 2006. https://books.google.com/books?id=UsjiHqWNQHkC&pg=PA33&lpg=PA33&dq=tegmental+signs&source=bl&ots=XKuxRmTWsF&sig=rtLl33m4-H7yOAFZp-p_LAQ9bbA&hl=en&sa=X&ved=0ahUKewj-nbvdv_XLAhWKFR4KHS-aCCUQ6AEIXjAJ#v=onepage&q=tegmental signs&f=false.
11. Kumral E, Bayülkem G, Evyapan D. Clinical spectrum of pontine infarction. Clinical-MRI correlations. *J Neurol*. 2002;249(12):1659-1670. doi:10.1007/s00415-002-0879-x.
12. Hall CD, Herdman SJ, Whitney SL, et al. *Vestibular Rehabilitation for Peripheral Vestibular Hypofunction*. Vol 40. 2016. doi:10.1097/NPT.000000000000120.
13. Han BI, Song HS, Kim JS. Vestibular rehabilitation therapy: Review of indications, mechanisms, and key exercises. *J Clin Neurol*. 2011;7(4):184-196. doi:10.3988/jcn.2011.7.4.184.
14. Suarez H, Arocena M, Suarez a, De Artagaveytia T a, Muse P, Gil J. Changes in postural control parameters after vestibular rehabilitation in patients with central vestibular disorders. *Acta Otolaryngol*. 2003;123(2):143-147. doi:10.1080/0036554021000028109.