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 Online Journal Club-Article Review

Background/Overview	
Article Citation	Kattah JC, Talkad AV, Wang DZ, et al. HINTS to diagnose stroke in the acute vestibular syndrome: three-step bedside oculomotor examination more sensitive than early MRI diffusion-weighted imaging. <i>Stroke</i> 2009;40:3504-10.
Study Objective/Purpose (hypothesis)	The authors sought to assess the diagnostic accuracy of skew deviation for identifying stroke in AVS, including any added value beyond the horizontal head impulse test (h-HIT). They hypothesized that the presence of skew would be insensitive but specific for stroke and that it would add probative diagnostic information to h-HIT results alone. They further sought to assess the overall sensitivity and specificity of a 3-step bedside oculomotor examination (Head-Impulse - Nystagmus - Test of Skew [HINTS]) for differentiating stroke from acute peripheral vestibulopathy (APV) in acute vestibular syndrome (AVS).
Methods	
Study Design	Prospective, cross-sectional study at an academic hospital
Target Population	The target population was patients who presented to an urban, academic hospital with core features of acute vestibular syndrome, including rapid onset of vertigo, nausea, vomiting, and unsteady gait with or without nystagmus, primarily identified from the emergency department. Included patients had at least one stroke risk factor (smoking, hypertension, diabetes, hyperlipidemia, atrial fibrillation, eclampsia, hypercoagulable state, recent cervical trauma, or prior stroke or myocardial infarction). Excluded were subjects with a history of recurrent vertigo with or without auditory symptoms. The study population was 65% men with a mean age of 62 years (SD, 13 years; range, 26 to 92 years).

Interventions (if applicable):	See below.
Outcome Measures	<p>A neuro-ophthalmologist conducted a neurological and vestibular examination according to standard protocol:</p> <ul style="list-style-type: none"> -Horizontal head impulse test -Alternate cover testing (Prism cross-cover test for ocular alignment) -Observation of nystagmus in different gaze positions <p>A search for ocular counterroll by head-upright fundus photography to determine the presence of complete pathological ocular tilt reaction was performed in patients with either head tilt or vertical misalignment (suspected skew) without internuclear ophthalmoplegia.</p> <p>Patients also underwent neuroimaging, generally after bedside evaluation, most underwent MRI with diffusion-weighted imaging (DWI). All patients (including patients with suspected APV) were admitted for observation and underwent serial daily examinations for evolution of clinical findings. Follow-up MRIs an average of 3 days following initial examination revealed strokes and caloric testing was used to confirm peripheral diagnoses in 22/25 individuals diagnosed with AVS using this battery of tests.</p>
Results	
Summary of Primary and Secondary Outcomes: note results that were statistically significant	<p>Taking skew together with h-HIT and direction-changing nystagmus as a 3-step bedside examination battery, a dangerous HINTS result was 100% sensitive and 96% specific for the presence of a central lesion, giving a positive likelihood ratio of 25 (95% CI, 3.66 to 170.59) and a negative likelihood ratio of 0.00 (95% CI, 0.00 to 0.11). Compared with traditional findings thought to indicate brainstem or cerebellar involvement in AVS, the HINTS battery was more sensitive than general neurological signs (100% versus 51%), obvious oculomotor signs (100% versus 32%), or both of these taken together (100% versus 67%; all $P=0.001$; Table 1).</p> <p>Neuroimaging by MRI with DWI was falsely negative in 8 patients with ischemic stroke (5 lateral medullary, one lateral pontomedullary, and 2 middle cerebellar peduncle infarctions). Negative scans were obtained 8 to 48 hours after symptom onset, including 4 that were negative at 24 hours. Follow-up MRI an average of 3 days later revealed the strokes. The sensitivity of early MRI</p>

	<p>with DWI for lateral medullary or pontine infarction was lower than that of the bedside examination (72% versus 100%, $P=0.004$) with comparable specificity (100% versus 96%, $P=1.0$).</p> <p>Of 101 high-risk patients with AVS, 25 had APV and 76 had a central lesion. Peripheral lesions were confirmed by caloric testing in 22 patients. Central lesions included 69 ischemic strokes, 4 hemorrhages (one dentate nucleus, 3 pontine [2 with pontine cavernoma]), 2 demyelinating disease (one presumed midbrain lesion, one medullary lesion), and one anticonvulsant toxicity (carbamazepine).</p>
<p>Authors' Conclusions</p>	
<p>Authors' Conclusion</p>	<p>This study proves that finding one of 3 dangerous, subtle oculomotor signs (normal h-HIT or horizontal nystagmus that changes direction in eccentric gaze or skew deviation) is more sensitive than the combined presence of all other traditional neurological signs for identifying stroke as a cause of AVS. The dangerous signs can be remembered using the acronym INFARCT (Impulse Normal, Fast-phase Alternating, Refixation on Cover Test). Perhaps most importantly, they have shown that a benign HINTS examination result at the bedside “rules out” stroke better than a negative MRI with DWI in the first 24 to 48 hours after symptom onset with acceptable specificity (96%).</p> <p>Our prospective findings build on prior retrospective work suggesting a strong link between subtle oculomotor signs and stroke in patients with central AVS mimicking APV. Although a normal h-HIT remains the single best bedside predictor of stroke and its test properties are comparable to those of early MRI DWI, roughly one in 10 strokes will still be missed if other findings are not considered. We have identified 2 other subtle findings that should improve bedside detection of stroke without substantial loss of specificity.</p> <p>Although physicians have become increasingly reliant on MRI DWI for acute stroke diagnosis, our study presents further evidence that care should be taken not to use DWI alone to rule out stroke in AVS in the first 24 to 48 hours after symptom onset.</p> <p>Although the bedside techniques in the HINTS examination are not widely known among emergency physicians, internists, or even general neurologists, those without subspecialty training in neuro-otology can accurately interpret subtle oculomotor findings of this type, suggesting that training in the use of these techniques may be possible. The 3 components of the HINTS can be tested in approximately 1 minute at the bedside, whereas a more thorough, traditional</p>

	<p>neurological examination generally takes 5 to 10 minutes or more. An acute MRI brain with DWI takes at least 5 to 10 minutes of scan time plus a wait time of several hours to several days and typically costs around \$1000. In an era in which efficiency and cost containment are at a premium, this bedside method may offer a quick, inexpensive alternative to current practice.</p>
Reviewer's Discussion and Conclusion	
Study Strengths	<ul style="list-style-type: none"> -Level 2 evidence -Directly clinically applicable -Large sample size
Study Limitations and Potential for Bias	<ul style="list-style-type: none"> -The researchers restricted the enrollment to high-risk patients with AVS with no history of prior recurrent vertigo and at least one stroke risk factor. They chose this approach because funds were not available to image all low-risk patients in whom MRI could not be justified clinically. This selection led to a highly enriched cerebrovascular cohort (76% central, 73% cerebrovascular, 69% ischemic stroke) and patients with APV who might be atypical (92% with leukoaraiosis). -Internal validity: this study had a partially unmasked examiner. Although the examiner was masked to imaging results, he was unmasked to the patient's clinical history, general neurological examination, or obvious oculomotor findings when testing for subtler eye signs. -MRI follow-up scans were obtained in only selected cases based on evolution of new neurological signs or atypical subtle oculomotor signs. This selective retesting could have led to some misclassification of strokes as APV, increasing the apparent sensitivity of the HINTS battery. -More research needs to be done on the use of the HINTS assessment in patients who have a recurrent symptom presentation.
Applicability: <ul style="list-style-type: none"> ● Types of patients (dx) that results apply to ● Types of settings or patient acuity that the results apply to 	<p>The target population of this study was patients who presented with acute vestibular syndrome with at least one risk factor for stroke. Patients were excluded if they had any history of recurrent vertigo with or without auditory symptoms. The researchers chose to only include high-risk patients with AVS due to limited funds and the inability to use MRI on all patients (low risk) and justify it clinically. Due to the applicability and ease of performing the HINTS assessment, this</p>

<ul style="list-style-type: none"> • Can interventions be reproduced? Can results be applied to other pt populations? 	<p>outcome measure would be quick and easy to perform on all patients presenting with acute vestibular syndrome while maintaining it's sensitivity and specificity.</p> <p>As stated above, the patient population was people who for the most part presented to the emergency department of a single urban, academic hospital serving as a regional stroke referral center for 25 community hospitals.</p> <p>The HINTS assessment was performed by a neuro-ophthalmologist in this study, however the assessments performed are common examination techniques used by physical therapists in the clinic.</p> <p>This specific study looked at patients presenting with acute vestibular syndrome and excluded patients with recurring vertigo with or without auditory symptoms. After completing a literature search on the HINTS assessment, it appears that most research is done with patients presenting with AVS which limits the assessment to patients with new onset vertigo/dizziness that do not have a recurring symptom presentation consistent with Meniere's disease, BPPV, vestibular migraine, or idiopathic recurrent vertigo.</p>
<p>How will study results impact PT management of this patient population?; List suggestions for how to implement changes in your clinic/department to integrate study findings into patient care</p>	<p>The HINTS battery of tests and the helpful INFARCT acronym for recognizing dangerous signs suggestive of acute stroke should be used clinically by physical therapists as a quick, efficient, and cost effective tool to rule in/out stroke in the acutely dizzy patients we often see. Presenting the information from this study, as well as findings from the larger systematic review looked at during this week's journal club, to our colleagues and staff members may help establish new protocols for easily identifying signs of new stroke. Though the patients in this study were seen in an acute, ED setting, a majority of the patients we see as neurotherapists have stroke risk factors and could present with dizziness at any given time across the continuum of their care, from acute hospital stays, through inpatient rehab, to home and outpatient services. Using the HINTS to rule out infarct in patients with dizziness could be as simple a step in our PT examination as using blood pressure readings to rule in/out orthostasis as a cause of dizziness, and may prove particularly useful when neuroimaging is not available or too acute to reflect damaged structures. The videos included in the systematic review by Tarnutzer et al may be a particularly useful tool to share with our colleagues to increase knowledge and awareness of the HINTS battery of tests as well as interpretation of results. Finally, hands-on lab-style practicing of these simple tests as a staff inservice may be a useful way to implement these study findings into patient care.</p>

