Critical Review Form
Diagnostic Test

Normal head impulse test differentiates acute cerebellar strokes from vestibular neuritis. Neurology. 2008 Jun 10;70(24 Pt 2):2378-85.

Objectives: **To assess the accuracy of a three-step examination (including horizontal head impulse testing, directionality of nystagmus, and skew deviation) in differentiating vestibular neuritis from posterior circulation stroke.**

Methods: **This prospective study was conducted over one year at a single, tertiary care hospital. Patients presenting to the emergency department (ED) with acute isolated vertigo were identified. Inclusion criteria were acute prolonged vertigo without clear diagnosis, nausea or vomiting, and at least one vascular risk factor (smoking, hypertension, diabetes, dyslipidemia, atrial fibrillation, or recent neck trauma). Patients with brainstem signs were excluded, as were those with resolution of symptoms in the ED allowing safe discharge home.**

Bedside oculomotor testing was performed by one of two neurologists within 12 hours of referral from the ED. The examiners underwent formal neuro-otology training, consisting of a 3-hour video-based lecture and 1-hour small group tutorial. Testing involved a 4-step oculomotor examination, including horizontal head impulse testing, directionality of nystagmus, assessment of skew deviation, and vertical smooth pursuit. All patients underwent MRI with diffusion weighted imaging (DWI), which was considered the criterion standard. The neurologists performing oculomotor testing were blinded to MRI results.

Of 36 patients identified, 12 were excluded, leaving 24 subjects meeting all inclusion criteria. All patients presented within 72 hours of symptom onset. The mean age was 64 years and 63% were men. Four patients presented with acute hearing loss. Ten patients were diagnosed with stroke based on MRI results, and 14 were diagnosed with vestibular neuritis. Of patients diagnosed with stroke, 40% had at least one stroke risk factor. Of those diagnosed with vestibular neuritis, 70% had more than 2 risk factors. No patients required repeat MRI for unexplained findings on serial exam.

Guide		Comments
I.	**Are the results valid?**	
A.	**Did clinicians face diagnostic uncertainty?**	Yes. Patients with acute vestibular syndrome (AVS) in whom the diagnosis of central vs. peripheral vertigo was uncertain were included in the analysis. This was, however, a moderate to high-risk group of patients with at least one risk factor for stroke.
B.	**Was there a blind comparison with an independent gold standard applied similarly to the treatment group and to the control group? (Confirmation Bias)**	Yes. All patients included in the study underwent MRI with DWI. Neurologists performing oculomotor testing were blinded to MRI results.
C.	**Did the results of the test being evaluated influence the decision to perform the gold standard? (Ascertainment Bias)**	No. All patients underwent neuroimaging (MRI with DWI) regardless of the findings of oculomotor examination.
II.	**What are the results?**	
A.	**What likelihood ratios were associated with the range of possible test results?**	Of 14 patients diagnosed with vestibular neuritis, 2 had evidence of skew deviation and 4 had abnormal vertical smooth pursuit. Head impulse testing and nystagmus were consistent with peripheral vertigo in all 14. All 10 subjects diagnosed with stroke had at least one abnormal exam component. In all patients with stroke, at least one component of the HINTS exam (horizontal head impulse test, directionality of nystagmus, and skew deviation) was consistent with a central pathology. The sensitivity of the 3-component HINTS exam for stroke was 100% (95% CI 69.0 to 100.0), specificity was 85.7% (95% CI 57.2-97.8), PPV was 83.3% (95% CI 51.6-97.4), NPV was 100.0% (95% CI 73.4 to 100.0), LR+ was 7.0 (95% CI 1.9 to 25.3), and negative LR was 0.
III.	**How can I apply the results to patient care?**	
A.	**Will the reproducibility of the test result and its interpretation be satisfactory in my clinical setting?**	Uncertain. Oculomotor testing in this study was performed by neurologists who underwent specialized training (involving a 3-hour video-based lecture and 1-hour small group tutorial). It seems likely that emergency physicians with similar training would be able to perform oculomotor testing with similar proficiency. The authors did not assess the reproducibility of interrater reliability of testing using kappa values.

B.	**Are the results applicable to the patients in my practice?**	Yes. Patients with vertigo frequently present to the ED. Distinguishing central from peripheral causes of vertigo is clinically difficult, and patients in whom there is clinical concern often undergo neurologic consultation, admission, and advanced neuroimaging (MRI). The ability to differentiate between these two entities by clinical exam would reduce unnecessary testing and admission and reduce the risk of missing potentially dangerous central pathology.
C.	**Will the results change my management strategy?**	No. This was a small study with wide confidence intervals surrounding the estimates of the test characteristics. Also, in the current study, the HINTS exam was performed by neurologists with 4 hours of training specific to the exam technique and interpretation. Further studies will need to address the accuracy and reliability of the HINTS exam in the hands of the emergency physician, will need to assess the extent of training necessary for proficiency with the exam, and should examine the impact of the exam on patient-centered outcomes, such as decreasing unnecessary testing and reducing cases of missed stroke.
D.	**Will patients be better off as a result of the test?**	Uncertain. The diagnostic test characteristics of the HINTS exam are promising, and it seems likely that its use could result in a decrease in the incidence of missed posterior circulation stroke. This is especially true in light of the risk of missed posterior circulation stroke on MRI (Oppenheim 2000, Morita 2011). Further research will need to assess the impact of the test on clinical decision-making and on patient-centered outcomes.

Limitations:

1. **The HINTS exam was performed on patients admitted to the stroke unit, and the external validity of the results in emergency department patients is uncertain.**

2. **This is a moderate risk population in which the prevalence of stroke was 42%. While the prevalence of disease should not affect sensitivity or specificity, there is the possibility of spectrum bias.**

3. **The exam was performed by neurologists following specific training: 3-hour video-based lecture and 1-hour small group tutorial. The accuracy and reliability of the exam in the hands of emergency physicians still needs to be assessed.**

4. **This study included a small sample size, and hence the results are imprecise (i.e. there are wide confidence intervals around the estimates of the diagnostic test characteristics).**

5. **There is the potential for false-negative tests in patients with initially normal MRI whose symptoms did not progress, potentially representing TIAs.**

6. **The inter-rater reliability of the HINTS exam was not assessed.**

Bottom Line:

The 3-part oculomotor HINTS exam demonstrated an excellent LR- of 0, indicating that it adequately excludes stroke in patients with a negative exam. Unfortunately, this was a very small study, including only 24 patients, and hence the precision of the results is poor. The study also involved a moderate risk population with a stroke prevalence of 42%, was conducted using patients admitted to stroke ward, and involved oculomotor examinations performed by neurologists with 4 hours of specific training. The external validity of these results to patients in the emergency department with testing performed by emergency physicians is uncertain. Further research will need to assess the accuracy and reliability of the exam in these conditions, the impact of the test on clinical decision-making and on patient-centered outcomes, and the exam's impact on lower-risk patient populations.