STROKE AND DIZZINESS

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Case History
A 50-year-old man presents to the emergency department (ED) with the sudden onset of severe dizziness, nausea, and vomiting. He reports feeling well all morning, but about 60 minutes ago symptoms developed abruptly. He has a hard time describing the dizziness symptom in more detail. He states he feels somewhat "disoriented" and that it is "like being drunk." After specific questioning, he reports that there is lightheadedness and at times the feeling that he may pass out. In addition, he reports a spinning sensation and significant imbalance. The symptoms were so bothersome that he had to hold on to the wall for support and call for help from his spouse. The symptoms improve substantially when he lies still and worsen after any movement. He thinks he might have food poisoning from his dinner at a restaurant last night, but his wife ordered the same food and she is not feeling sick. Since being in the ED, the intensity of the symptom has lessened. He recalls similar, but less severe, symptoms 3 years ago.

Past medical history is significant for hypertension and hyperlipidemia. On specific questioning, he reports a history of occasional headaches that are moderate in intensity and associated with sensitivity to light and sound, though he has not had any "bad" headaches for more than 5 years.

On review of systems, he currently has a mild headache. He also reports some neck stiffness but notes that this is not uncommon for him. Denies auditory symptoms. There are no other focal neurologic symptoms.

His blood pressure is 145/80 mm Hg, his heart rate is regular at 75 beats/min, and his respiratory rate is 15 breaths/min. On the general examination, he appears ill. He prefers to keep his eyes closed. He does not want to move because doing so results in substantial worsening of his symptoms. The general examination is otherwise unremarkable.

Because stroke is a concern, the NIH Stroke Scale is performed and the score is 0. On the ocular motor examination, nystagmus appears to be present when the patient opens his eyes, but he quickly closes his eyes. The importance of the ocular motor exam is explained to the patient and he agrees to open his eyes for a longer period of time so that the nystagmus can be characterized. There is a spontaneous left-beating nystagmus, mild in intensity. The velocity of the nystagmus increases with left gaze and decreases with right gaze. The nystagmus does *not* change to right-beat on right gaze. No skew deviation is observed. The head impulse test (HIT) (Figure) reveals a positive corrective saccade after movements to the right side but not to the left side. On gait examination, the patient is unsteady but able to ambulate while touching onto the wall. How do you proceed in considering the diagnosis and management?

Background
In presentations of acute constant dizziness, stroke is a serious concern.[1-4] The clinical evaluation focuses on determining the likelihood of stroke. Ischemic stroke is the most common cerebrovascular etiology and can even cause isolated dizziness.[2, 5] Intracerebral hemorrhage is also possible but is much less likely in the absence of other focal features.[6] In contrast to BPPV, there is no current multidisciplinary society endorsed guideline for the diagnosis of stroke or vestibular neuritis in dizziness presentations.

The diagnostic evaluation begins with estimating the pre-test probability of the outcome of interest, which is equivalent to the prevalence of stroke in this specific clinical scenario. One prospective study at a tertiary medical center – which used rigorous surveillance methods to capture eligible patients, and both clinical and research MRIs to classify the outcome – found an 11% (29/272; 95% CI, 7%-15%) prevalence of acute stroke in ED dizziness visits.[4] This study recruited patients with new onset and constant dizziness, and also nystagmus or imbalance. Excluded were patients with posterior canal BPPV, clear neuro exam general central deficits (patients with mild or borderline general central signs/symptoms were not excluded), known multiple sclerosis, or other obvious causes (e.g., known intoxication). Outcome classification was based on MRI results regarding acute

infarction or ICH. Patients who did not receive a clinical MRI were offered a research MRI. In addition, patients who received an early clinical MRI (i.e., <24 hours from symptom onset) were offered a research MRI performed >24 hours from onset. Stroke prevalence may be lower at non-tertiary care medical centers.

The bedside assessment can meaningfully adjust the probability of stroke in individual patients. The components include a combination of demographics, past medical history, blood pressure, an ocular motor assessment, and other mild or borderline central signs or symptoms. The ABCD2 score (A = Age, B= Blood pressure, C= Clinical findings of weakness or speech change, D2 = diabetes and duration) is a summary scale of vascular risk developed in the setting of transient ischemic attack, but has also been evaluated in the setting of acute dizziness.[4, 5, 7] The most important aspects of the ocular motor examination are referred to as "HINTS": Head Impulse, Nystagmus, and Test of Skew.[5] The HINTS findings that suggest a central lesion are the following; a normal head impulse test (HIT) (Figure), a central pattern of nystagmus (bi-directional gaze evoked nystagmus, or spontaneous or gaze-evoked vertical nystagmus), *or* skew deviation.

One study found that the HINTS exam was more accurate in identifying stroke etiology compared with the ABCD2 score.[5] This study found an extremely high accuracy of HINTS in the classification of stroke: 96.5% sensitivity, 84% specificity,[5] which would make it more accurate than the troponin assay for identifying myocardial infarction in chest pain patients (sensitivity/specificity, 90.7%/90.2%).[8] The design and methods of the HINTS development study likely contributed to the very high accuracy, including the very high prevalence of stroke (60%) in the population.[4]

A study that analyzed the ABCD2 score and HINTS exam in a multivariable model found that the ABCD2 score, the ocular motor assessment, and also other borderline central signs/symptoms, all made a statistically significant contribution to identifying MRI infarction or ICH (Table).[4] Patients with none of the high-risk categories (ABCD2>4, HINTS central findings, other borderline CNS signs/symptom) have a very low risk of stroke on MRI, whereas patients with more than one of the high-risk categories have a high risk of stroke on MRI (Table).

Table. Predicted probability and observed prevalence of stroke based on bedside components in patients presenting with new onset dizziness and nystagmus or imbalance.[4]

	Low probability of stroke	Intermediate probability of stroke	High probability of stroke
Components	All of the following: -ABCD2 <4 -Either no nystagmus or HINTS peripheral findings[a] -No other borderline CNS signs or symptoms	Any 1 of the following: - ABCD2 4-7 - HINTS central findings[b] - Other borderline CNS sign or symptom	More than 1 of the following: - ABCD2 4-7 - HINTS central exam - Other borderline CNS sign or symptom
Predicted probability	<5%	5-10%	>10% (10%-54%)
Observed prevalence, 95% CI	0% (0%-4%)	10% (5%-17%)	22% (14%-32%)
Proportion of study population	About 1/3rd	About 1/3rd	About 1/3rd

[a] HINTS peripheral findings = uni-directional horizontal nystagmus, abnormal head impulse test to the side opposite the fast component of nystagmus, and no skew deviation.
[b] HINTS central findings = central pattern of nystagmus (bi-directional gaze evoked nystagmus, or spontaneous or gaze-evoked vertical nystagmus), normal head impulse test, *or* skew deviation.

MRI accuracy

Measuring the accuracy of MRI for acute stroke requires a comparison with a gold standard. Use clinical diagnosis as the gold standard, a pooled analysis reported 99% sensitivity of MRI when performed >12 hours after onset.[9] The MRI sensitivity was lower (73%) when performed <3hours from onset (73%).[10]

Accuracy of MRI has been evaluated specifically in the setting of acute dizziness presentations comparing early MRI (performed <48hours from onset) to a gold standard late MRI (performed >48 hours from onset). Overall, the sensitivity of early MRI was 86%.[5] The sensitivity varied by stroke size. For lesions <10mm, the sensitivity of early MRI was 47% (7/15). For lesions >10mm, the sensitivity of early MRI was 92% (83/90).[11] The MRI protocol is

important to consider when evaluating MRI accuracy for stroke. The MRI DWI protocol used in this study was 5mm cuts and 2mm gaps, and thus 29% (2mm/7mm) of the brain was not imaged.[5] Another study of acute dizziness found the MRI stroke sensitivity to be 97% (28/29).[4] The initially negative MRI was a 0.4cm^3 infarction of the medulla.[4] The sensitivity of MRI performed <48hrs from onset was 95% (19/20). In this study, the MRI protocol was either 5mm slices with 1mm gap, 6mm slices with 0mm gap, or 4mm slices with 1mm gap.

Should aspirin be used even in patients low risk for stroke etiology?

Although the risk of stroke after ED discharge for non-stroke diagnosis is very low (0.3-0.5%),[3, 12] the risk is still increased compared with non-dizziness groups.[13, 14] This finding suggests that presentation to the ED for dizziness is a stroke risk factor. Similar clinical scenarios – isolated sudden sensorineural hearing loss (pathology presumed similar to vestibular neuritis) and presumed non-ischemic transient neurological attacks (TNAs) – have also demonstrated increased stroke risk in the follow-up period.[15, 16] The reason for the increased risk for patients with ED dizziness visits is not clear but could theoretically stem from the intrinsic inaccuracies of tests including MRI, peripheral ischemic mechanisms (thus mimicking vestibular neuritis), or inflammatory cascades set off by non-ischemic etiologies. Should acute dizziness patients with low probability of stroke (even those with negative MRI) be started on aspirin in the short-term? This issue has not been previously studied. Some of these patients will already meet criteria for aspirin from a primary prevention standpoint. Short-term aspirin is very low risk and most of the benefit of aspirin in secondary prevention of stroke occurs within the first 12 weeks.[17]

Case summary

The case presented is in the low probability category for stroke etiology based on a low ABCD2 score, absence of other borderline CNS signs/symptoms, and the HINTS peripheral findings.

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Figure. The head-impulse test (HIT). This test specifically assesses the vestibuloocular reflex (VOR). The patient sits in front of the examiner and the examiner holds the patient's head steady in the midline. The patient is instructed to maintain gaze on the nose of the examiner. The examiner then quickly turns the patient's head 10° to 20° to one side and then observes whether the patient's eyes stayed locked on the examiner's nose or not. If the patient's eyes stay locked on the examiner's nose (i.e., no corrective saccade) (A), the peripheral vestibular system is assumed to be intact. If the patient's eyes move with the head (B) and the patient makes a voluntary eye movement back to the examiner's nose (i.e., corrective saccade), then this suggests a lesion of the peripheral vestibular system. Thus, in the context of Case 1, the test result shown in (A) would suggest a CNS lesion (because the peripheral vestibular system is intact), whereas the test result in (B) would suggest a peripheral vestibular lesion on the right side (because the VOR is not intact). (From Edlow JA, et al. Lancet Neurology 2008;7:951-964).