

Does This Emergency Department Patient With Headache Require Neuroimaging?

EBEM Commentator Contact

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RATIONAL CLINICAL EXAMINATION REVIEW SOURCE

This is a rational clinical examination abstract, a regular segment of *Annals'* Evidence-Based Emergency Medicine (EBEM) series. Each segment features an abstract of a rational clinical examination review from the *Journal of the American Medical Association* and a commentary by an emergency physician knowledgeable in the subject area.

The source for this rational clinical examination review is: Detsky ME, McDonald DR, Baerlocher MO, et al. Does this patient with headache have a migraine or need neuroimaging? *JAMA*. 2006;296:1274-1283. The *Annals'* EBEM editors assisted in the preparation of the abstract of this rational clinical examination review, as well as selection of the Evidence-Based Medicine Teaching Points.

OBJECTIVE

This article reviews the usefulness of medical history and physical examination findings in distinguishing migraine headache from other types of headaches, including the ones requiring neuroimaging in the emergency department (ED).

DATA SOURCES

The authors conducted a comprehensive MEDLINE search from 1966 to November 2005 for articles relevant to diagnostic accuracy of components of the clinical examination and simple investigations in diagnosing patients with headache. Once articles were retrieved, their reference lists were manually searched for additional pertinent studies. Further information was abstracted from review articles and standard textbooks of physical examination.

STUDY SELECTION

The migraine studies were selected for inclusion if they addressed the diagnostic utility of medical history and physical examination in predicting the diagnosis of a migraine-type headache with the International Headache Society criteria as applied by neurologists as the criterion standard. The neuroimaging studies were included if they investigated the medical history and physical examination features suggestive of significant intracranial pathology in ED patients presenting with

nontraumatic headache. They excluded studies that only assessed patients with specific underlying diseases such as cancer. Study quality was determined on a scaling system, with the highest grades assigned to studies that prospectively assessed the operating characteristics of various clinical findings among a large number of patients with headache. Lesser grades were assigned to studies with smaller numbers of patients (level 2), nonconsecutive or nonrandomized samples (level 3), and the studies that did not meet the criteria for at least level 3 evidence (level 4).

DATA EXTRACTION AND ANALYSIS

The authors extracted the data from published studies and constructed 2×2 tables for each variable. Classification of the final neuroimaging diagnosis was based on US Headache Consortium criteria: significant intracranial abnormalities, possibly significant abnormalities, insignificant abnormalities, and normal. For creating the 2×2 tables, authors dichotomized "significant abnormalities" as "disease positive" and "abnormalities possibly related to headache" and "insignificant abnormalities" as "disease negative." Raw data were used to calculate likelihood ratios (LRs) for the specific clinical variables. Where data for the same variable were available from 2 or more sources, the authors calculated summary LR and 95% confidence intervals (CIs) with the Dersimonian and Laird random effects approach. To account for heterogeneity between prevalence values within the groups, the authors used a random effects model to compute summary prevalence estimates.

MAIN RESULTS

Does This Patient Have Migraine?

The most useful positive findings were nausea (+LR 19; 95% CI 15 to 25), photophobia (+LR 5.8; 95% CI 5.1 to 6.6), phonophobia (+LR 5.2; 95% CI 4.5 to 5.9), and exacerbation by physical activity (+LR 3.7; 95% CI 3.4 to 4.0). To evaluate the value of the combination of findings, the authors developed a mnemonic (POUNDing [Pulsatile quality; duration of 4-27 hOurs; Unilateral location; Nausea or vomiting; Disabling intensity]) based on the reviewed studies. When 4 or more of these findings were present simultaneously, the +LR was 24 (95% CI 1.5 to 388); for 3 criteria, the +LR was 3.5 (95% CI

Table 1. Summary LRs for clinical features that predict an increased (LR+), or decreased (LR-) likelihood of significant abnormality on neuroimaging.

Clinical Feature	LR+ (95% CI)	LR- (95% CI)
Cluster-type headache	11 (2.2–52)	0.95 (0.84–1.1)
Abnormal neurologic examination result	5.3 (2.4–12)	0.71 (0.60–0.85)
“Undefined” headache*	3.8 (2.0–7.1)	0.66 (0.44–0.97)
Headache with aura	3.2 (1.6–6.6)	0.51 (0.24–1.1)
Headache with focal symptoms	3.1 (0.37–25)	0.79 (0.51–1.2)
Headache aggravated by exertion or Valsalva	2.3 (1.4–3.8)	0.70 (0.56–0.88)
Headache with vomiting	1.8 (1.2–2.6)	0.47 (0.29–0.76)

*Refers to headaches that were difficult to classify and were not recognized as primary headache disorders (cluster-, migraine-, or tension-type).

1.3 to 9.2); and for 1 or 2 criteria, the +LR was 0.41 (95% CI 0.32 to 0.52).

Does This Patient Need Neuroimaging?

There were several clinical findings with pooled positive LRs that were significantly greater than 1.0 (Table 1). These variables included cluster-type headache, abnormal neurologic examination result, undefined headache, headache with aura, headache aggravated by exertion or Valsalva-like maneuver, and headache with vomiting. Clinical features with minimal value in predicting significant intracranial abnormalities in patients with headache included headache with focal symptoms, worsening headache, male sex, quick-onset headache, new-onset headache, headache with nausea, increased headache severity, and migraine-type headache.

Prevalence of Significant Intracranial Pathology

The authors reviewed 5 studies to estimate the prevalence of significant intracranial pathology in patients presenting with headache. According to these studies, the prevalence of significant intracranial pathology was 1.20% (95% CI 0.77% to 1.80%) in patients with “chronic headaches” who were seeking a neurologist’s evaluation, 0% (95% CI 0% to 5.3%) in neurology clinic patients with adult-onset headache (older than 40 years), 32% (95% CI 24% to 42%) in neurology clinic patients with new-onset or changed headaches within the past 12 months, and 43% (95% CI 20% to 68%) in ED patients with acute thunderclap headache (severe and sudden onset).

CONCLUSIONS

Examination of the evidence indicates that no single feature of the clinical examination will be sufficient to rule in or rule out the diagnosis of migraine. The use of combinations of findings can be helpful (POUNDing mnemonic).

The prevalence of intracranial pathology in patients with headache varies from 1% in chronic headaches to 43% in thunderclap headache. The pretest probability of significant pathology in patients with thunderclap headache is so high that absence of abnormal findings is unlikely to provide enough reassurance to forgo further investigations. Certain clinical findings significantly increase the likelihood of intracranial

pathology, the most robust of these being abnormal neurologic examination result.

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COMMENTARY: CLINICAL IMPLICATION

Headaches result in more than 8 million physician visits per year.¹ Migraine sufferers lose more than 157 million workdays because of headache. Together with medical costs, this disease costs the nation \$50 billion annually, and nearly 90% of men and 95% of women have at least 1 headache per year.^{1,2}

Because migraine is a condition defined by clinical criteria, the diagnosis of migraine in the ED can be made according to physical examination and medical history. The POUNDing mnemonic proposed in this review, which has not been clinically validated, appears to assist in ruling in pathology (positive LR=24) only in the presence of 4 clinical features. The mnemonic is nondiagnostic for any combination of features fewer than 4. This cutoff unfortunately makes it less useful for emergency physicians who are routinely confronted with the task of differentiating migraine from potentially dangerous headaches. Constellations that are less than definitively diagnostic in the ED may not confer an adequate level of medicolegal protection or diagnostic certainty to make clinicians comfortable in forgoing neuroimaging, given the risks involved with missed intracranial pathology.³ However, according to the International Headache Society diagnostic criteria⁴ for migraine (Table 2) on which the mnemonic is based, it is reasonable to assume that a few more features in addition to those represented could generate a diagnostic rather than predictive tool. A mnemonic that incorporates the full diagnostic criteria therefore is STUDIO 54 (2 of Severe, Throbbing, Unilateral, and Disabling; 1 of Intestinal symptoms and Otophobia/photophobia; both 5 attacks and 4 or more hours) (see Table 2 for details). Patients meeting the International Headache Society criteria represented in this mnemonic can be diagnosed with migraine headache with higher certainty and treated accordingly.

Table 2. Criteria for diagnosis of “migraine without aura.”

International Headache Society Diagnostic Criteria ³	STUDIO 54 Mnemonic
A. At least 2 of the following characteristics	A. At least 2 of
1. Moderate or severe intensity	S evere
2. Pulsating quality	T hrobbing
3. Unilateral location	U nilateral
4. Inhibits or prohibits daily activities	D isabling
B. At least 1 of the following symptoms	B. At least 1 of
1. Nausea or vomiting	I ntestinal symptoms
2. Phonophobia and photophobia	O tophobia/photophobia
C. Attacks have occurred	C. Both of
At least 5 times,	5 Attacks
Lasting 4-72 h each	4- To 72-h duration

When emergency physicians are not satisfied with the diagnosis of migraine, they can search for clinical features that may indicate the need for neuroimaging. Among the potential predictors, abnormal neurologic examination result is the most strongly supported indicator of intracranial pathology in patients with headache, though other findings (Table 1) may also be helpful. Notably, however, these findings are largely generalized from primary care and other nonemergency outpatient settings, often with unimpressive methodological rigor and low total enrollment numbers. The difficulty in extrapolating or reliably using these clinical findings is highlighted by the discovery that “headache with aura,” a historical feature often thought to be highly specific for migraine, appears to be associated with a significantly increased likelihood of intracranial pathology. Unfortunately, high-quality data are lacking for the clinical prediction of intracranial pathology in the ED presentation of headache. Fortunately, promising prospective research to develop and validate a clinical decision rule for subarachnoid hemorrhage in neurologically intact patients in the ED is being completed. According to results reported in abstract form for the derivation phase, a prediction rule comprising 4 factors, arrival by ambulance, vomiting, diastolic blood pressure greater than or equal to 100 mm Hg, and age greater than or equal to 45 years, provides the highest sensitivity for detecting subarachnoid hemorrhage.⁵

Finally, this review mostly addresses diagnosis of migraine and highlights the clinical features that may suggest serious intracranial pathologies. However, it does not cover the entire spectrum of headaches that are as or more common than migraine. Therefore, determining which headaches are nonmigraine remains a judgment call, given the lack of adequate evidence.

TAKE-HOME MESSAGE

Migraine is a clinical diagnosis; therefore, combinations of clinical findings can, in some patients, positively diagnose

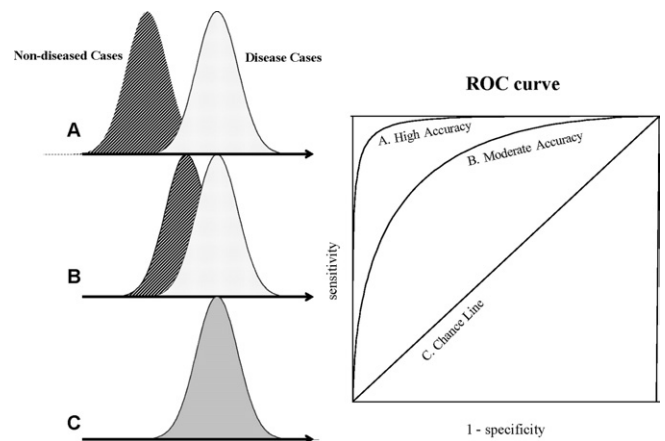


Figure. Receiver operating characteristic (ROC) curves and their relationship to the degree of overlap between the probability curves of “diseased” and “nondiseased.”

migraine headache without neuroimaging studies. When the need for neuroimaging studies is in question, identification of clinical features such as abnormal neurologic findings and presence of thunderclap headache may help to determine which patients will most benefit. However, the prediction of intracranial pathology in the setting of nontraumatic headache is difficult, and no reliably sensitive or specific set of criteria has yet been derived or validated.

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EBEM TEACHING POINT

The logic behind diagnostic test interpretation is to estimate the probability of a disease, given a certain test result. The sensitivity and specificity of a diagnostic test depend on the definition of what constitutes an abnormal test result. Almost invariably, for any clinical entity the distribution curves of “diseased” and “nondiseased” overlap (Figure). Therefore, no test can distinguish normal from disease with 100% accuracy. The area of overlap indicates where the test cannot distinguish normal from disease. In practice, we choose a cutoff level above the test result that we consider to be abnormal and below the test result we consider to be normal. The position of the cutoff point will determine the number of true positives, true negatives, false positives, and false negatives.

Receiver operating characteristic curves plot the sensitivity of a test versus its false positive rate for any value produced by the test in question, as if each test result is a cutoff value. A curve is produced that covers all the cutoff points. Then the area under this curve is compared to the area under the

unity or chance line, which represents a test with no discriminatory power. This comparison will determine whether the test in question is able to distinguish diseased from nondiseased accurately. Receiver operating characteristic analysis has wide applicability in radiology research.

The name "receiver operating characteristic" originates from "signal detection theory" developed during World War II for the analysis of radar screen blips. The operators of the radar equipment had to distinguish the signals produced by friendly ships from the ones produced by enemy targets or noise. Signal detection theory simply measured the ability of radar receiver operators to make these important distinctions. It was not until the 1970s that signal detection theory was recognized as useful for interpreting medical test results.⁶ Receiver operating characteristic curves have recently become extremely useful in medical decisionmaking.

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2008 Undersea and Hyperbaric Medicine Subspecialty Certification Examination

The American Board of Emergency Medicine (ABEM) and the American Board of Preventive Medicine (ABPM) will administer the certifying examination in Undersea and Hyperbaric Medicine from September 29 through October 10, 2008. The examination is administered at computer-delivered testing centers. Candidates will schedule an appointment on one of the available dates.

Physicians must submit a certification application to the board through which they hold their primary specialty certificate. Physicians certified by an American Board of Medical Specialties member board other than ABEM and ABPM and who fulfill the eligibility criteria must apply to ABPM. Upon successful completion of the examination, certification is awarded by the board through which the physician submitted their application.

The eligibility criteria are available from both board offices or on the boards' websites: www.abem.org or www.abprevmed.org.

Application materials for ABEM diplomates will be accepted with postmark dates from March 1 through July 1, 2008. ABPM diplomates should contact ABPM for application cycle information.

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