

Point-of-Care Guides

Identifying Patients with Headache Who Are at Risk of Subarachnoid Hemorrhage

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Clinical Question

When is urgent imaging warranted in patients presenting with new nontraumatic headache and normal findings on a neurologic examination?

Evidence Summary

At least one-half of adults worldwide have a headache at least once within any given year.¹ A study of more than 9,000 physician visits for headaches from 1999 to 2010 found trends toward increased use of imaging during the evaluation.² Physicians justify the use of imaging to avoid missing a potentially life-threatening intracranial pathology such as a subarachnoid hemorrhage (SAH).

The incidence of hospital admissions because of SAH has remained stable over the past 30 years and is estimated to be 7.2 to 9 per 100,000 person-years.³ In a series of 1,507 patients diagnosed with SAH, 5.4% (95% confidence interval [CI], 4.3% to 6.6%) had a missed diagnosis at initial presentation to the emergency department.⁴ The risk was higher in patients who presented with a low acuity of symptoms (odds ratio = 2.7) and in patients who presented to a nonacademic hospital, regardless of the hospital's emergency department volume (odds ratio = 2.1).

A meta-analysis of 22 studies revealed that a history of neck pain (positive likelihood ratio [LR+] = 4.1) and the physical examination finding of neck stiffness (LR+ = 6.6) significantly increase

the likelihood of SAH.⁵ Noncontrast computed tomography within six hours of headache onset was the most accurate test for SAH (LR+ = 230, negative likelihood ratio [LR-] = 0.01). Noncontrast head computed tomography after six hours also demonstrated good accuracy in ruling out SAH when normal (LR- = 0.07). Cerebrospinal fluid analysis to evaluate for red blood cells or xanthochromia had a much lower diagnostic accuracy than imaging.

The Ottawa SAH clinical decision rule (<https://www.mdcalc.com/ottawa-subarachnoid-hemorrhage-sah-rule-headache-evaluation>) was created to determine when imaging is warranted in persons 15 years and older with new severe headache, peaking within one hour, and no history of trauma. It does not apply to patients with new neurologic findings, prior aneurysm, prior SAH, known brain tumors, or chronic recurrent headaches (three or more of same character and intensity for more than six months).

According to the Ottawa rule, patients with any of the following risk factors should receive imaging⁶:

- Age \geq 40 years
- Limited neck flexion on examination
- Neck pain or stiffness
- Onset during exercise
- Thunderclap headache (instantly peaking pain)
- Witnessed loss of consciousness

This guide is one in a series that offers evidence-based tools to assist family physicians in improving their decision making at the point of care.

This series is coordinated by Mark H. Ebell, MD, MS, Deputy Editor for Evidence-Based Medicine.

A collection of Point-of-Care Guides published in *AFP* is available at <https://www.aafp.org/afp/poc>.

CME This clinical content conforms to AAFP criteria for continuing medical education (CME). See CME Quiz on page 203.

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The Ottawa rule was prospectively validated in a study of 2,131 patients at 10 centers; 132 patients (6.2%) had SAH. The Ottawa rule had 100% sensitivity (95% CI, 97% to 100%) but only 15% specificity (95% CI, 14% to 17%).⁶ In an external validation study of the Ottawa rule, 454 out of 5,034 emergency department visits for acute headache met criteria for use of the rule. Of these 454 patients, only nine had SAH. The Ottawa rule detected all nine patients with SAH (100% sensitive), but the specificity was again low at 7.6% (95% CI, 5.4% to 10.6%). This corresponds to a positive predictive value of only 2.1% and a negative predictive value of 100%.⁷ The small number of patients to whom the rule could be applied and its low specificity are limitations of the Ottawa rule.

Recently, the EMERALD (emergency medicine, registry analysis, learning, and diagnosis) SAH clinical decision rule was developed using data from 1,561 Japanese patients who had non-traumatic new headache with acute onset. Of these patients, 18% had SAH, a higher rate than in most other studies. The EMERALD rule uses objectively measured clinical data to predict the likelihood of SAH, and may therefore be more reproducible than the Ottawa rule. According to the EMERALD rule, patients with any of the following measurements should receive imaging⁸:

- Systolic blood pressure > 150 mm Hg
- Diastolic blood pressure > 90 mm Hg
- Blood glucose level > 115 mg per dL (6.4 mmol per L)
- Serum potassium level < 3.9 mEq per L (3.9 mmol per L)

The EMERALD rule has a 100% sensitivity (95% CI, 98.6% to 100%) and 14.5% specificity (95% CI, 12.5% to 16.9%), similar to the Ottawa rule.⁸ The EMERALD rule has been proposed as a second step, after applying the Ottawa rule, to improve specificity without compromising sensitivity. However, the EMERALD rule has not been externally validated.

Applying the Evidence

A 42-year-old woman presents to her primary care physician's office with a left-sided headache over the occiput, parietal, and frontal regions that started abruptly after her exercise class that morning. She describes her pain as throbbing in nature and grades it as an 8 out of 10 in intensity.

She is not able to determine if the headache had peaked rapidly. She has no other associated symptoms such as an aura, fever, upper respiratory symptoms, nausea, emesis, vision changes or scotoma, photophobia or phonophobia, or gait changes, and has no history of hypertension. She has slight neck stiffness that she attributed to vigorous exercise that morning. She had taken 800 mg of ibuprofen, which helped her neck discomfort but not her headache. She had normal vital signs and benign physical examination findings, including a normal funduscopic examination and normal neurologic examination with no signs of meningeal irritation.

The patient meets at least two of the criteria for imaging using the Ottawa SAH rule (age older than 40 years and neck stiffness). The abrupt onset after exercise also increases the probability of SAH. She is referred for urgent noncontrast computed tomography of the head, which reveals SAH over the left frontal and temporal lobes. She is admitted for further management of SAH.

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