

Review of the Ottawa Subarachnoid Hemorrhage Rule

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Abstract

The Ottawa Subarachnoid Hemorrhage (SAH) Rule is a validated clinical decision tool used to identify SAH in patients who present to the emergency department with acute nontraumatic headache. It aims to reduce missed diagnoses while minimizing unnecessary imaging and invasive testing (e.g., lumbar puncture, CTA, digital subtraction angiography). The rule applies to alert patients (GCS of 15) aged ≥ 15 years with a new severe headache that peaks within one hour; further investigation is warranted if any of the following high-risk features are present: age ≥ 40 years, neck pain or stiffness, witnessed loss of consciousness, onset during exertion, thunderclap headache, or limited neck flexion on examination. Exclusion criteria include head trauma within the past 7 days and the presence of any new neurological deficits. While most validation studies demonstrate 100% sensitivity, specificity is relatively low. Thus, this rule should only be used to rule out SAH, not to confirm or diagnose it.

I. HOW TO USE

When to Use

The Ottawa Subarachnoid Hemorrhage Tool can be used to rule out subarachnoid hemorrhage in neurologically intact patients who present with severe headache. All subsequent references to SAH in this manuscript refer to non-traumatic SAH (as distinct from traumatic SAH).

Pearls / Pitfalls

The Ottawa SAH Rule was designed for use in the emergency department setting in patients who are neurologically intact and present with headache. The tool has very specific inclusion and exclusion criteria that must be followed for proper use.

This tool can only be applied in patients who are 15 years of age or older, those who have not sustained any head trauma within the past 7 days, and patients who are alert and oriented without any focal neurological deficits.

The Ottawa SAH Rule is not validated in all patient populations (there is limited data in pediatric patients, anticoagulated patients, and patients with significant comorbid neurologic disease). It also cannot be utilized in any patients with prior brain aneurysm, prior SAH, known brain tumors or masses, or chronic recurrent headaches.

While it rules out SAH (shown to be 100% sensitive for SAH in its validation), specificity is relatively low

(meaning that it should not be used to diagnose SAH, but rather to rule it out and reduce unnecessary neurodiagnostics).

Use of this clinical decision-making tool does not replace clinical judgment. Further work-up may still be warranted despite a subthreshold risk score if the clinician feels the patient has a concerning story.

Why Use

Atraumatic subarachnoid hemorrhage is rare but catastrophic. Headache presentations are often variable, and clinician risk tolerance may differ. The Ottawa SAH Rule provides an evidence-based framework to help clinicians rule out SAH in patients who meet specific inclusion criteria. This tool has undergone extensive external validation and may reduce the use of unnecessary neurodiagnostics.

II. NEXT STEPS

Advice

While the Ottawa SAH Rule can be used to rule out SAH in patients who do not meet specific high-risk criteria, it should not replace clinical judgment. A score of at least +1 (≥ 1 criterion met) warrants further testing (CT or LP), though many of these results will ultimately be negative. Clinicians should use the rule as part of the patient's

overall clinical picture in order to determine the best next steps in management.

Management

Subarachnoid hemorrhage cannot be ruled out in patients who score at least +1 on the tool ('yes' to any of the six criteria). Further work-up is indicated in these patients, starting with non-contrast CT imaging.

Non-contrast head CT rules out SAH in most patients if performed within 6 hours of symptom onset; however, diagnostic accuracy depends on the use of a high-quality CT scanner and interpretation by an experienced neuroradiologist.

If the patient presents more than 6 hours after symptom onset and non-contrast head CT is negative—or if clinical suspicion remains high—lumbar puncture and/or CT angiography should be considered.

LP evaluates for blood breakdown products (indicated by xanthochromia) or red blood cells in the CSF; xanthochromia usually takes 6-12 hours to develop and may persist for up to 2-3 weeks. Concern arises when red blood cells do not clear across serial collection tubes, suggesting active bleeding rather than a traumatic tap.

CTA can be used to help identify an underlying aneurysm or vascular malformation as the source of bleeding in these patients. Conventional cerebral angiography (digital subtraction angiography), however, remains the gold standard and is more sensitive than CTA for aneurysm detection. If clinical suspicion persists despite an unrevealing non-contrast head CT, CTA, and LP, digital subtraction angiography should be considered.

Critical Actions

This tool should only be utilized in patients who meet specific inclusion criteria and does not replace clinical judgment.

In patients with suspected or confirmed SAH, consult neurosurgery, neurology, and neurointerventional radiology early on. Strict blood pressure control should also be maintained.

III. EVIDENCE

Evidence Appraisal

The original Ottawa SAH Rule derivation study by Perry et al. was a prospective multicenter cohort study conducted from November 2000 to November 2005 at six university-affiliated tertiary care teaching hospitals in Canada. The study included patients aged 16 years or older who had a Glasgow Coma Scale score of 15 and presented with a non-traumatic headache that reached maximal intensity within one hour. Patients with any new focal neurological deficits or recurrent similar headaches (at least 3 episodes over six months) were excluded. Of 1,999

patients enrolled in this study, 130 cases of SAH were identified. Several features were found to be strongly associated with SAH, with the most important predictors being age ≥ 40 years, neck pain or stiffness, limited neck flexion on exam, witnessed loss of consciousness, onset during exertion, thunderclap headache (severe, sudden headache that peaks within 60 seconds of symptom onset and is often described as the "worst headache of life"), arrival by ambulance, and raised blood pressure. Three clinical decision-making rules were subsequently derived from this study. Each of the three derived rules had 100% sensitivity with varying specificities and investigation rates.¹

This study was validated by Perry et al.², who evaluated the accuracy and reliability of the three previously derived rules in a new cohort of neurologically intact patients presenting to the emergency department with headache. Patients were included if they had a GCS of 15, no falls or head trauma within the past 7 days, and presentation within 14 days of headache onset. One of the three rules from the previous study was further refined to create the Ottawa SAH Rule. The revised rule achieved 100% specificity but relatively low specificity, potentially leading to a higher number of false positives and increased testing.

The Ottawa SAH Rule was further validated by Belolio et al. in 2015.³ This was a retrospective external validation study conducted at a U.S. tertiary care emergency department. The Ottawa SAH Rule was applied to 454 patients (of 5,034 that were reviewed for eligibility) who presented to the ED for headache. Nine cases of SAH were identified in this group. While sensitivity for SAH was 100%, specificity was 7.6%, which was lower than the previous validation study. Since only a small proportion of ED headache presentations met eligibility criteria, its potential use in clinical practice may be limited.

Additional validation studies have since been performed.⁴⁻⁷ In these studies, the Ottawa SAH rule similarly demonstrated 100% sensitivity, further emphasizing its utility as a tool to aid clinical decision making in ruling out SAH. One study performed in a Chinese population, however, demonstrated 94% sensitivity (due to a small number of false-negative cases). The authors subsequently proposed a modified version of the rule which achieved 100% sensitivity.⁸

Formula

Facts & Figures

For alert patients (GCS of 15) with a new, severe headache that peaks within 1 hour of onset. Patients require further investigation if any of the following high-risk features are present:

- Age ≥ 40 years
- Neck pain or stiffness

- Witnessed loss of consciousness
- Onset during exertion
- Thunderclap headache
- Limited neck flexion on examination

Literature

Original/Primary & Validation

ORIGINAL/PRIMARY:

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