

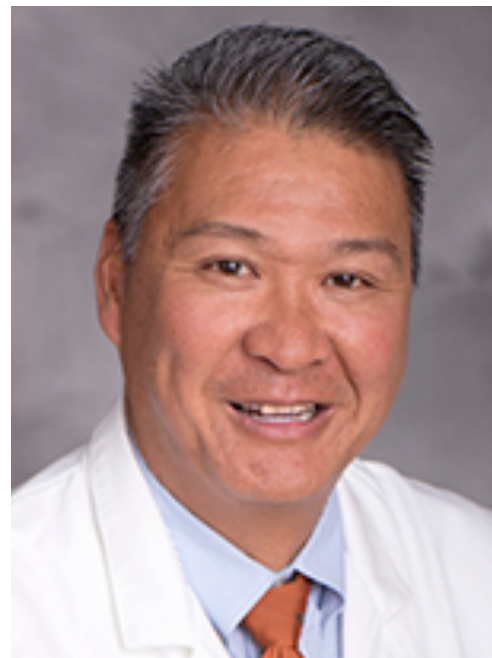
# E•QUAL | EMERGENCY QUALITY NETWORK

## Clinical Policy: Headache

## Presenters



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## Disclaimer & Disclosures

Centers for Medicare and Medicaid Innovation: ACEP TCPI

Contracted with Centers for Medicare and Medicaid Services to develop hospital outcome and efficiency measures

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# ACEP Clinical Policy

## **Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department With Acute Headache**

**Approved by the ACEP Board of Directors, June 26, 2019**

# Writing Subcommittee

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- David S. Cherkas, MD
- Peter D. Panagos, MD
- Richard D. Shih, MD
- Richard Byyny, MD, MSc (Methodologist)
- Stephen J. Wolf, MD (Committee Chair)

# Headache: Background

- Common and often a potentially high-risk complaint
- A query of the National Hospital Ambulatory Medical Care Survey for 2015 found that nontraumatic HA was identified as the 5<sup>th</sup> leading cause for ED visits, accounting for 3.8 million visits per year (2.8 % of all ED visits)
- Given the complex and often undifferentiated clinical presentation of HA in the acute setting, providers must determine which patients need neuroimaging in the ED and which can be appropriately referred for outpatient evaluation

# Case Study

- A 45 yo male presents with complaint of onset of headache while driving his car. He describes it as currently severe but has gradually worsened over the last 1.5 hours. He has photophobia but denies any further clinical findings including neck stiffness or other neurologic complaints. He has never really had headaches previously that he recalls...
- Physical Exam: Normal

***Do we have a tool to help support not imaging this patient?***

In the adult ED patient presenting with acute headache, are there risk-stratification strategies that reliably identify the need for emergent neuroimaging?



# Primary Driver:

Research

## Original Investigation

# Clinical Decision Rules to Rule Out Subarachnoid Hemorrhage for Acute Headache

Jeffrey J. Perry, MD, MSc; Ian G. Stiell, MD, MSc; Marco L. A. Sivilotti, MD, MSc; Michael J. Bullard, MD; Corinne M. Hohl, MD, MHSc; Jane Sutherland, MEd; Marcel Émond, MD, MSc; Andrew Worster, MD; Jacques S. Lee, MD, MSc; Duncan Mackey, MD; Merril Pauls, MD; Howard Lesiuk, MD; Cheryl Symington, RN, ENCC; George A. Wells, PhD

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**IMPORTANCE** Three clinical decision rules were previously derived to identify patients with headache requiring investigations to rule out subarachnoid hemorrhage.

**OBJECTIVE** To assess the accuracy, reliability, acceptability, and potential refinement (ie, to improve sensitivity or specificity) of these rules in a new cohort of patients with headache.

**DESIGN, SETTING, AND PATIENTS** Multicenter cohort study conducted at 10 university-affiliated Canadian tertiary care emergency departments from April 2006 to July 2010. Enrolled patients were 2131 adults with a headache peaking within 1 hour and no neurologic deficits. Physicians completed data forms after assessing eligible patients prior to investigations.

**MAIN OUTCOMES AND MEASURES** Subarachnoid hemorrhage, defined as (1) subarachnoid blood on computed tomography scan; (2) xanthochromia in cerebrospinal fluid; or (3) red blood cells in the final tube of cerebrospinal fluid, with positive angiography findings.

**RESULTS** Of the 2131 enrolled patients, 132 (6.2%) had subarachnoid hemorrhage. The decision rule including any of age 40 years or older, neck pain or stiffness, witnessed loss of consciousness, or onset during exertion had 98.5% (95% CI, 94.6%-99.6%) sensitivity and 27.5% (95% CI, 25.6%-29.5%) specificity for subarachnoid hemorrhage. Adding "thunderclap headache" (ie, instantly peaking pain) and "limited neck flexion on examination" resulted in the Ottawa SAH Rule, with 100% (95% CI, 97.2%-100.0%) sensitivity and 15.3% (95% CI, 13.8%-16.9%) specificity.

**CONCLUSIONS AND RELEVANCE** Among patients presenting to the emergency department with acute nontraumatic headache that reached maximal intensity within 1 hour and who had normal neurologic examination findings, the Ottawa SAH Rule was highly sensitive for identifying subarachnoid hemorrhage. These findings apply only to patients with these specific clinical characteristics and require additional evaluation in implementation studies before the rule is applied in routine clinical care.

*JAMA*. 2013;310(12):1248-1255. doi:10.1001/jama.2013.278018

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# Ottawa SAH Decision Rule

- 2,131 pts, 132 (6.2%) had SAH
- Initial decision rule: including any of the following...
  - Age  $\geq$  40 years or older,
  - neck pain or stiffness,
  - witnessed LOC, or
  - onset during exertion
- Demonstrated:
  - Sensitivity 98.5% (95%CI, 94.6%–99.6%)
  - Specificity 27.5% (95%CI, 25.6%–29.5%)

# Further Refining of Ottawa

- Added
  - “thunderclap headache” (i.e., instantly peaking pain) AND
  - “limited neck flexion on examination”

resulted ->

- The Ottawa SAH Rule:
  - Sensitivity of 100% (95%CI, 97.2%–100.0%)
  - Specificity of 15.3% (95%CI, 13.8%–16.9%)

# Additional Class II Study

## EVIDENCE-BASED DIAGNOSTICS

### Spontaneous Subarachnoid Hemorrhage: A Systematic Review and Meta-analysis Describing the Diagnostic Accuracy of History, Physical Examination, Imaging, and Lumbar Puncture With an Exploration of Test Thresholds

Christopher R. Carpenter, MD, MSc, Adnan M. Hussain, MD, Michael J. Ward, MD, MBA, Gregory J. Zipfel, MD, Susan Fowler, Jesse M. Pines, MD, MBA, MSCE, and Marco L. A. Sivilotti, MD, MSc

#### Abstract

**Background:** Spontaneous subarachnoid hemorrhage (SAH) is a rare, but serious etiology of headache. The diagnosis of SAH is especially challenging in alert, neurologically intact patients, as missed or delayed diagnosis can be catastrophic.

**Objectives:** The objective was to perform a diagnostic accuracy systematic review and meta-analysis of history, physical examination, cerebrospinal fluid (CSF) tests, computed tomography (CT), and clinical decision rules for spontaneous SAH. A secondary objective was to delineate probability of disease thresholds for imaging and lumbar puncture (LP).

**Methods:** PubMed, Embase, Scopus, and research meeting abstracts were searched up to June 2015 for studies of emergency department patients with acute headache clinically concerning for spontaneous SAH. QUADAS-2 was used to assess study quality and, when appropriate, meta-analysis was conducted using random effects models. Outcomes were sensitivity, specificity, and positive (LR+) and negative (LR-) likelihood ratios. To identify test and treatment thresholds, we employed the Pauker-Kassirer method with Bernstein test indication curves using the summary estimates of diagnostic accuracy.

**Results:** A total of 5,022 publications were identified, of which 122 underwent full-text review; 22 studies were included (average SAH prevalence = 7.5%). Diagnostic studies differed in assessment of history and physical examination findings, CT technology, analytical techniques used to identify xanthochromia, and criterion standards for SAH. Study quality by QUADAS-2 was variable; however, most had a relatively low risk of biases. A history of neck pain (LR+ = 4.1; 95% confidence interval [CI] = 2.2 to 7.6) and neck stiffness on physical examination (LR+ = 6.6; 95% CI = 4.0 to 11.0) were the individual findings most strongly associated with SAH. Combinations of findings may rule out SAH, yet promising clinical decision rules await external validation. Noncontrast cranial CT within 6 hours of headache onset accurately ruled in (LR+ = 230; 95% CI = 6 to 8,700) and ruled out SAH (LR- = 0.01; 95% CI = 0 to 0.04); CT beyond 6 hours had a LR- of 0.07 (95% CI = 0.01 to 0.61). CSF analyses had lower diagnostic

# Carpenter et al.

- 17 clinical variables
- Pooled sensitivities ranged – 7% to 89% (average 39%)
  - Specificities ranged – 26% to 96% (average 74%)
- Results demonstrated none of the clinical variables used in isolation had test characteristics good enough to rule-in or rule-out SAH

# Critical Question: Risk Stratification

## Level B

- Use the Ottawa Subarachnoid Hemorrhage Rule (>40 years, complaint of neck pain or stiffness, witnessed loss of consciousness, onset with exertion, thunderclap headache, and limited neck flexion on examination) as a decision rule that has high sensitivity to rule out SAH, but low specificity to rule in SAH, for patients presenting to the ED with a normal neurologic examination result and peak headache severity within 1 hour of onset of pain symptoms.

# Critical Question: Risk Stratification

## Level B

- *Although the presence of neck pain and stiffness on physical examination in ED patients with an acute headache is strongly associated with SAH, do not use a single physical sign and/or symptom to rule out SAH.*

# Case Study

- 45 yo male presents after having sudden onset of a “thunderclap” headache during intercourse approximately 2 hours earlier. He admits to having a history of migraines but feels this is worse.
  - Physical Exam: Normal
- You risk stratify him and determine that he needs emergent CT imaging which is obtained within the next hour and is read as negative for any SAH by both yourself and radiology

***Does this patient need further testing/studies at this time?***



## Critical Question

In the adult ED patient presenting with acute headache, does a normal noncontrast head CT scan performed within 6 hours of headache onset preclude the need for further diagnostic workup for SAH?

Surprisingly  
Limited Evidence

BMJ

BMJ 2011;343:d4277 doi: 10.1136/bmj.d4277

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RESEARCH

**Sensitivity of computed tomography performed within six hours of onset of headache for diagnosis of subarachnoid haemorrhage: prospective cohort study**

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# Findings

- Of 953 pts scanned <6 hours
  - 121 SAH identified and none missed by CT
- A few limitations but overall good study
  - SAH prevalence 7.7%
  - Sensitivity and specificity of <6h group 100%  
(95% CI of 97% to 100% and 99.5% to 100%, respectively)
  - 13 pts in less than 6h CT group lost to follow-up

# Supporting Evidence (Class III) but ...

## Sensitivity of Early Brain Computed Tomography to Exclude Aneurysmal Subarachnoid Hemorrhage A Systematic Review and Meta-Analysis

Nicole M. Dubosh, MD; M. Fernanda Bellolio, MD; Alejandro A. Rabinstein, MD;  
Jonathan A. Edlow, MD

**Background and Purpose**—Emerging evidence demonstrating the high sensitivity of early brain computed tomography (CT) brings into question the necessity of always performing lumbar puncture after a negative CT in the diagnosis of spontaneous subarachnoid hemorrhage (SAH). Our objective was to determine the sensitivity of brain CT using modern scanners (16-slice technology or greater) when performed within 6 hours of headache onset to exclude SAH in neurologically intact patients.

**Methods**—After conducting a comprehensive literature search using Ovid MEDLINE, Ovid EMBASE, Web of Science, and Scopus, we conducted a meta-analysis. We included original research studies of adults presenting with a history concerning for spontaneous SAH and who had noncontrast brain CT scan using a modern generation multidetector CT scanner within 6 hours of symptom onset. Our study adheres to the preferred reporting items for systematic reviews and meta-analyses (PRISMA).

**Results**—A total of 882 titles were reviewed and 5 articles met inclusion criteria, including an estimated 8907 patients. Thirteen had a missed SAH (incidence 1.46 per 1000) on brain CTs within 6 hours. Overall sensitivity of the CT was 0.987 (95% confidence intervals, 0.971–0.994) and specificity was 0.999 (95% confidence intervals, 0.993–1.0). The pooled likelihood ratio of a negative CT was 0.010 (95% confidence intervals, 0.003–0.034).

**Conclusions**—In patients presenting with thunderclap headache and normal neurological examination, normal brain CT within 6 hours of headache is extremely sensitive in ruling out aneurysmal SAH. (*Stroke*. 2016;47:750-755. DOI: 10.1161/STROKEAHA.115.011386.)

**Key Words:** brain ■ cerebrospinal fluid ■ confidence intervals ■ headache ■ subarachnoid hemorrhage

# Limitations of Study:

Dubosh et al. 2016

- Of the 5 studies, one was the Class II study by Perry et al discussed
- Remaining 4 studies were reviewed and received grades of “X” when reviewed individually and were not included as individual studies in the assessment of this critical question

# Dubosh et al. Results

- 8,907 pooled patients in this meta-analysis
  - 13 had SAH missed on the initial CT scan
  - 11 of which were from a single study
  - Incidence of missed SAH was 1.46 per 1,000
  - Sensitivity on the CT was 98.7% (95% CI 97.1% to 99.4%) and specificity was 99.9% (95% CI 99.3% to 100%)
  - Pooled likelihood ratio of a negative CT result was 0.010 (95% CI 0.003 to 0.034).

# ACEP Recommendation

## Level B

*Use a normal noncontrast head CT\* performed within 6 hours of symptom onset in an ED headache patient with a normal neurologic examination, to rule out nontraumatic SAH.*

*\*Minimum third-generation scanner.*

# Case Study

- Pt is a 40 yo female who presents 7 hours after “sudden” onset of a severe headache that she says came on suddenly and now has nausea with photophobia and some neck stiffness.
  - Physical Exam: normal
- You inform patient that she will need imaging and perform a noncontrast CT scan which is negative. The patient states she is a nurse and doesn’t want a lumbar puncture, “Can you perform a different test or imaging that is just as good?”



# ACEP Critical Question

In the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT, is CTA of the head as effective as LP to safely rule out SAH?

# Computed Tomographic Angiography for the Evaluation of Aneurysmal Subarachnoid Hemorrhage

Shaun D. Carstairs, MD, David A. Tanen, MD, Timothy D. Duncan, MD, Olaf B. Nordling, MD, John E. Wanebo, MD, Thomas R. Paluska, MD, Nicholas Theodore, MD, Robert H. Riffenburgh, PhD

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## Abstract

**Objectives:** Computed tomography (CT) followed by lumbar puncture (LP) is currently the criterion standard for diagnosing subarachnoid hemorrhage (SAH) in the emergency department (ED); however, this is based on studies involving a limited number of patients. The authors sought to assess the ability of CT angiography (CTA), a new diagnostic modality, in conjunction with CT/LP to detect SAH.

**Methods:** Consecutive patients presenting to the ED with symptoms concerning for SAH were approached. All patients had an intravenous catheter placed and underwent a noncontrast head CT followed by CTA. Patients whose CT did not reveal evidence of SAH or other pathology underwent LP in the ED. CTAs were read within 24 hours by a neuroradiologist blinded to the patient's history.

**Results:** A total of 131 patients were approached, 116 were enrolled, and 106 completed the study. In six of 116 patients (5.1%), aneurysm was found on CTA with normal CT and positive findings on LP; three had a positive CTA with normal CT and LP findings (one of which had a negative cerebral angiogram), and there was one false-positive CTA. Follow-up of all 131 patients showed no previously undiagnosed intracranial pathology. In this patient population, 4.3% (5/116) were ultimately found to have an SAH and/or aneurysm.

**Conclusions:** In this pilot study, CTA was found to be useful in the detection of cerebral aneurysms and may be useful in the diagnosis of aneurysmal SAH. A larger multicenter study would be useful to confirm these results.

ACADEMIC EMERGENCY MEDICINE 2006; 13:486–492 © 2006 by the Society for Academic Emergency Medicine

# Carstairs et al: CT/LP vs CT/CTA

- One tertiary care medical center
- Consecutive ED patients with SAH concern
- All had Head CT & Head CTA
  - CTA results not available to ED
  - CT & CTAs by neuroradiologist
- If (-) Head CT: LP performed
- Study objective: Compare CT/LP vs CTA for diagnosis of SAH

# Carstairs et al: CT/LP vs CT/CTA

- 131 patients met enrollment criteria:
  - 15 did not consent
  - 10 did not complete the study
  - 106 patients in study
- 5 cases of SAH diagnosed (4.3%):
  - CTA: (+) 5/5
  - CT/LP: (+) 2/5  
(-) 2/5  
LP refused 1/5

# Carstairs et al: CT/LP vs CTA

- CT/LP:
  - Sensitivity: 40% (95% CI 14.7%–94.7%)
- CT/CTA:
  - Sensitivity: 100% (95% CI 47.8–100%)

# CTA vs DSA

- Digital Subtraction Angiography (DSA)
  - Gold standard radiologic test
- Several studies show CTA compares well to DSA
  - El Khaldi et al; 2007 *Radiol Med*:  
CTA sensitivity: 99.3% (95% CI: 95.9–99.9%)
  - Menke et al; 2011 *Ann Neurol*:  
CTA sensitivity: 99.2% (95% CI: 97.5–99.8%)

# SAH: CT/LP vs CT/CTA

- We know CT/LP is extremely sensitive for SAH diagnosis:

Is the Combination of Negative Computed Tomography Result and Negative Lumbar Puncture Result Sufficient to Rule Out Subarachnoid Hemorrhage?

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# Perry et al: *Ann Emerg Med* 2008

592 patients enrolled

- SAH: 61 cases (10.3%)
  - CT scan: 55 (90%)
  - LP: 6 (10%)
  - Follow-up: 0



# CT/LP vs CT/CTA?

- Direct comparison of CT/LP vs CT/CTA: Only one study: data limited with only 5 total cases of SAH
- CTA's ability to diagnose aneurysms: CTA compares favorably with gold standard (DSA)
- CT/LP is extremely sensitive for ruling out SAH

# CT/LP vs CT/CTA: Other Considerations

- Favor CT/CTA:
  - Avoids an LP (invasive and uncomfortable)
  - Low diagnostic yield of LP:  $NN_{LP}$ : 90 (2008 Perry study)
  - High rate of LPs found with RBCs (approximately 35% where only one in 90 LPs are confirmed SAH): Is it a traumatic tap or SAH?
  - CSF xanthochromia: Timing and interpretation issues.
  - Shared decision making: Patients prefer CT/CTA option
- Favor LP:
  - CTA may discover an asymptomatic aneurysm which could lead to unnecessary neurosurgery
  - Increased radiation exposure
  - IV contrast exposure
  - Missed alternative diagnoses picked up with LP

# Class C Recommendations

- *Perform LP or CTA to safely rule out SAH in the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT result.*
- *Use shared decision making to select the best modality for each patient after weighing the potential for false-positive imaging and the pros and cons associated with LP.*

# Case Study

- 35 yo female presents with severe headache that is similar to her previous migraines.
  - Pt has no neck stiffness, LOC, and pain was gradual in onset over last several hours. She has tried OTC meds including Ibuprofen and Acetaminophen without relief. She reports that she rarely goes to doctors except when her migraines are at their worse and usually is best treated with a dose of IV dilaudid. You confirm she has had 3 visits to your ED in the last 6 months for acute cephalgia and was treated with opioids on 2 of those visits.
- This patient is clearly in discomfort but are opioids really the best choice?

# Critical Question

In the adult ED patient treated for acute primary headache, are nonopioids preferred to opioid medications?

# Randomized study of IV prochlorperazine plus diphenhydramine vs IV hydromorphone for migraine



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## ABSTRACT

**Objective:** To determine outcomes among patients with acute migraine in the emergency department (ED) who receive IV hydromorphone vs IV prochlorperazine + diphenhydramine.

**Methods:** This study was conducted in a tertiary care ED. Patients who met international criteria for migraine were randomized to receive IV hydromorphone 1 mg or IV prochlorperazine 10 mg plus diphenhydramine 25 mg. Patients who had not used an opioid within the previous month were eligible. Patients and research personnel were blinded to treatment assignment. The primary outcome was sustained pain relief at 48 hours.

Participants received hydromorphone 1 mg or prochlorperazine 10 mg plus diphenhydramine 25 mg. Diphenhydramine was administered to prevent the sedation side effect of IV prochlorperazine. The primary outcome was sustained pain relief, defined as achieving a headache level of mild or none within 2 hours of medication administration and maintaining that level for 48 hours without the requirement of rescue medication. A planned interim analysis was conducted once 48-hour data were available for 120 patients.

**Results:** The trial was halted by the data monitoring committee after 127 patients had been enrolled. The primary outcome was achieved in the prochlorperazine arm by 37 of 62 (60%) participants and in the hydromorphone arm by 20 of 64 (31%) participants (difference 28%, 95% confidence interval 12-45, number needed to treat 4, 95% confidence interval 2-9).

**Conclusions:** IV hydromorphone is substantially less effective than IV prochlorperazine for the treatment of acute migraine in the ED and should not be used as first-line therapy.

**ClinicalTrials.gov identifier:** NCT02389829.

**Classification of evidence:** This study provides Class I evidence that for patients in the ED with migraine, IV prochlorperazine + diphenhydramine is superior to IV hydromorphone. *Neurology*® 2017;89:2075-2082

Prochlorperazine >> Hydromorphone

# ACEP Recommendation

## Level A

*Preferentially use nonopioid medications in the treatment of acute primary headaches in ED patients.*

# Summary

- The Ottawa Subarachnoid Hemorrhage Rule can be used as a decision rule that has high sensitivity to rule out SAH within 1h of onset
  - (>40 years, complaint of neck pain or stiffness, witnessed loss of consciousness, onset with exertion, thunderclap headache, and limited neck flexion on examination)
- Do not use a single physical sign and/or symptom to rule out SAH



# Summary

- Use non-narcotics and avoid opioids for ED headache management
- Use a normal noncontrast head CT performed within 6 hours of symptom onset in an ED headache patient with a normal neurologic examination, to rule out nontraumatic SAH.
- Perform LP or CTA to safely rule out SAH in the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT result.
- Use shared decision making

## For More Information

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