



Computed tomography angiography for acute headache may be more painful than lumbar puncture

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The article by Wong confirms the prevalence of incidental un-ruptured aneurysm in emergency department (ED) patients who have cerebral computed tomography angiography (CTA) [1]. This risk was 3.3%. Other studies have determined CTA is sensitive for aneurysm identification in the setting of suspected subarachnoid hemorrhage (SAH) [2]. Wong and colleagues extrapolate their findings to conclude that CTA is a reasonable test to rule out SAH after a normal computed tomography (CT) head, in the > 6 h from headache-onset group instead of performing a lumbar puncture (LP) [3]. They argue the low risk of contrast allergy, low nephrotoxicity and low rate of incidental un-ruptured aneurysm identification make this a reasonable strategy compared to a time-consuming, painful LP which may not give a definitive diagnosis.

The incidental cerebral aneurysm prevalence obtained by Wong and colleagues is comparable with the literature. Prevalence is higher in Finnish and Japanese cohorts; however, Wong's incidental aneurysm prevalence is similar to North American and European (outside of Finland) cohorts [4]. The size of the aneurysms identified, median 4 mm ranging from 0.7 to 11 mm, is consistent with digital subtraction

angiography and magnetic imaging angiography (MRA) literature.

However, the benefit of routine CTA to investigate headache patients for aneurysmal SAH is debateable. Few incidental aneurysms ever bleed in a patient's lifetime. The overall probability of an incidental cerebral aneurysm rupturing is about 0.25% or 1/400 [4]. Yet, an aneurysm deemed symptomatic, i.e., having a headache, of any size is recommended to be repaired [5]. Further, it is medico-legally safer for the specialist to intervene. Additionally, many patients want their aneurysms repaired to mitigate their perceived risk of a catastrophic bleed. Thus, most of the 3.3% of headache patients with an incidental aneurysm identified (plus those with truly symptomatic aneurysms) will have an intervention to repair the aneurysm.

Yet, current evidence shows that very few aneurysmal SAHs are diagnosed using LP. In a previous multicentre prospective cohort study of 4,121 acute headache patients, only 15 aneurysm SAH cases were identified over a 10-year period at 12 sites [6]. Thus only 15 had an intervention to repair an aneurysm. However, if CTA had been encouraged in this study, it is likely most of the 1,739 patients who had an LP would have had a CTA instead, theoretically identifying 57 aneurysms; 15 symptomatic (i.e., the ones identified in the study by LP) and 42 incidental ones. Almost all of these identified incidental aneurysms would have been unnecessarily treated. Indeed, the true number of CTAs performed and the number of resulting aneurysms would likely have been higher because only 42.1% had an LP performed in this cohort (due to physician and/or patient judgement).

Aneurysm repair is not benign. Those undergoing aneurysmal clipping have 1.7% mortality and 5% morbidity and those having coiling have 0.6% mortality and 4.5% morbidity. Coiling is only 86.1% successful in occluding the aneurysm and the aneurysm recurs in ¼ of cases within 3 years

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[4]. Thus, those with coiling may have to undergo supplementary procedures with additional associated procedural risks. Those who opt to not undergo repair (e.g., have a negative LP or the treating neurosurgeon determines that the risk of the aneurysm causing the headache is very low) have to live with the fear of a ticking time bomb in their head and may have difficulties obtaining insurance.

Given low rupture rates, it is difficult to argue that it is in patients' best interest to have an incidental aneurysm repaired. There are features however which make it compelling to recommend repair. Aneurysm size, shape, and location can identify higher risk lesions. Aneurysms less than 7 mm are considered low risk, 7–25 mm medium risk and > 25 mm high risk. Large openings to the aneurysm or irregular shapes are at higher risk of rupture. Aneurysms in the posterior circulation are at higher risk of rupture. Patient factors potentially increasing the subsequent rupture risk include young age, cigarette smoking, hypertension, female, prior SAH, or family history of SAH [4].

CTA instead of LP is compelling for emergency physicians. LPs prolong the ED length of stay by several hours [7]. The specimens need to be hand delivered to the lab and may take multiple attempts to obtain. They may require point of care ultrasound guidance or interventional radiology to obtain. Finally, 1/3 of patients require clinical interpretation and judgement to separate traumatic tap versus SAH. Having < 2000 × 10⁶ red blood cells/L and no visual xanthochromia is a low risk tap with a sensitivity of 100% (95% CI 74.7–100%); specificity of 91.2% (95% CI 88.6–93.3%) for aneurysmal SAH [6]. However, the confidence band is wide, so patients with very high pretest probability without a completely normal LP will need a CTA.

Performing CTA indiscriminately will ultimately pass the decision making to the neurosurgeons. At that point, many neurosurgeons will take the less risky route of aneurysmal repair. Some may proceed with an LP after CTA to look for evidence of bleeding (i.e., red blood cells or xanthochromia). The presence of large amounts of blood or any xanthochromia would be considered proof of a recent SAH. If coiling is performed, there is no other way to determine if the aneurysm bled. If the aneurysm is clipped, xanthochromia staining of the adjacent brain parenchyma from recent bleeding would confirm SAH.

Therefore, while CTA is a good option for acute headache patients with delayed presentation (e.g. > 1 week after headache onset), when LP is contraindicated, not feasible or has indeterminate results, it should not routinely replace LP. CTA will work for 96.7% patients, but will identify incidental aneurysms in 3.3%, leading to difficult decisions

for our neurosurgical colleagues, increased patient morbidity and mortality due to unnecessary aneurysm repairs or increased patient anxiety. Also, indiscriminate CTA use may be impractical in countries with relatively limited interventional neuro-radiological and neurosurgical resources compared to North America. Knowing the prevalence of incidental aneurysm and the risks of identifying aneurysms must be weighed against the relatively minor negative aspects of a LP. Further risk stratification with a careful history and exam and applying the Ottawa SAH Rule and the 6-Hour CT Rule will decrease testing rates [8, 9]. If proceeding with CTA, a well-informed conversation about the risks and benefits is important to have with our patients prior to testing.

Declarations

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