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Reply:

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REPLY:

We thank Dr Wu and colleagues for their comments regarding our recent article “Cerebral Angiography for Evaluation of Patients with CT Angiogram-Negative Subarachnoid Hemorrhage: An 11-Year Experience.”¹ We agree that there remains much heterogeneity in the literature regarding CTA-negative subarachnoid hemorrhage, which leads to complicated management decisions that necessarily compare the financial cost of repeat imaging with the risk of missing a ruptured cerebral aneurysm.

In response to the first question raised by our colleagues, a retrospective review of the CTA studies in patients with perimesencephalic SAH (pSAH) due to rupture of an aneurysm did not reveal the culprit aneurysms. The vessel irregularity in the patient with pSAH due to vasculitis or vasculopathy was not convincingly detectable on the original CTA. This patient presented with a headache 8 days after delivering a baby, which might suggest a diagnosis of reversible cerebral vasoconstriction syndrome, but further clinical follow-up was not available. Thus, our results do suggest that DSA is helpful in cases of CTA-negative pSAH. We would argue that the referenced data by Westerlaan et al,² in which ruptured aneurysms were missed by CTA and identified in 27% of cases on re-review, should lead to additional caution regarding the reliability of CTA. Missed aneurysms may be found retrospectively, but to our knowledge, no study compares the sensitivity of a secondary and independent review of a CTA with negative findings with a digital subtraction angiogram. Such a study would certainly be of interest to undertake.

The authors’ article questioning the cost-effectiveness of digital subtraction angiography for evaluation of pSAH was well-written and compelling.³ However, we find it challenging to calculate accurately the cost of missing a cerebral aneurysm in a patient who subsequently has a second SAH and is left with a poor clinical outcome. Rupture of a missed aneurysm in a single young patient would be expected to incur millions of dollars in health care costs if that patient survives and is left with a large disability, as occurs in one-third of patients with rupture of a cerebral aneurysm.⁴ There is variability in the literature in determining the yield of diagnostic cerebral angiography in patients with CTA-negative SAH also makes cost-effectiveness analyses difficult.

We disagree with the publications that suggest that CTA should replace a lumbar puncture in patients with the sudden

onset of a severe headache. Cerebral aneurysms very rarely cause headaches in the absence of subarachnoid hemorrhage. A patient with a severe headache and a noncontrast head CT that does not demonstrate evidence of SAH should always undergo lumbar puncture. If the lumbar puncture is positive for xanthochromia, cerebral vessel imaging should be performed to identify a treatable cause of the SAH. Performing a CTA before a lumbar puncture would lead to a large number of incidentally identified unruptured aneurysms, and a lumbar puncture would still be required to determine whether the identified aneurysms should be treated acutely. This strategy would be expected to lead to increased costs due to additional imaging follow-up of these incidentally identified aneurysms and likely overtreatment of small cerebral aneurysms.

Last, we are all informed by our personal biases, values, and experiences as physicians. As interventional neuroradiologists who care for patients with ruptured aneurysms, we are very cognizant of the risk of re-rupture of a cerebral aneurysm, which is almost always a devastating or fatal event. Although perimesencephalic hemorrhage is very unlikely to be secondary to a ruptured cerebral aneurysm, we continue to believe that the minimal risk of diagnostic cerebral angiography (<0.2% at the authors’ institutions) outweighs the risk of missing a ruptured aneurysm by not performing the criterion standard examination.

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