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Should *American Journal of Neuroradiology* Commentary Be Evidence-Based?

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After the editorial alarmingly entitled “Death by Nondiagnosis: Why Emergent CT Angiography Should Not Be Done for Patients with Subarachnoid Hemorrhage”¹ in the *American Journal of Neuroradiology* (AJNR) in 2007, we were looking forward to an update in Dr Jayaraman’s recent commentary, “Cerebral Angiography: Not Yet Ready to Join the Dinosaurs,”² after 6 years of progress with CTA technology. On the basis of the title of the piece, we expected to read a commonsense plea for neuroradiologists to maintain their competence with catheters now that CTA has effectively become the first imaging test at many hospitals for patients presenting with nontraumatic subarachnoid hemorrhage. Therefore, we were surprised to read about his suggestion to bypass CTA altogether and go directly to DSA whenever possible, a point of view reminiscent of that 2007 editorial.

His commentary was in response to a scientific article in which Delgado Almandoz et al³ reported that 10%–20% of patients with acute subarachnoid hemorrhage but negative CTA or MRA had positive findings on DSA. This is of interest but not surprising and less so when one considers that only approximately 11 cases a year (18%) had negative CTA findings over the course of 5 years at their institution. In only approximately 3% (15% of 18%) of all the patients presenting to their hospital with subarachnoid hemorrhage, angiography was required to find the source of the hemorrhage. If we choose to look at the glass half full, in 97% of their patients CTA alone provided the correct diagnosis. That is better than most other diagnostic tests used routinely. Nevertheless, DSA was necessary to find that 3% in 18% of their patients, so let us say that CTA alone provided the correct diagnosis in approximately 80%.

He then cited another article that reported that even when the CTA findings are positive, the DSA examination changed the treatment plan in 20%–30% of patients.⁴ While that certainly would support his argument, some of the “changes” listed in that article would be insignificant in the setting of a patient with an acute subarachnoid hemorrhage. For example, a 4-mm anterior communicating artery aneurysm noted on CTA was 1 example of “change” when it was found to be to a 5-mm aneurysm on DSA. Acute subarachnoid hemorrhage was not required for inclusion in the study and, in both articles, MRA was lumped together with

CTA in the pre-DSA group. That explains the title of the Delgado Almandoz³ article, “Diagnostic Yield of Catheter Angiography in Patients with Subarachnoid Hemorrhage and Negative *Noninvasive Examinations*” (italics ours). Therefore, while neither article directly addresses the question of CTA versus DSA in patients with subarachnoid hemorrhage, let us accept that there is something to what they say and call CTA diagnostic in only 70% of cases.

With these facts in hand, Dr Jayaraman goes on to remind the readers of their obligation as physicians to eliminate unnecessary costs to the health system and concludes: “As part of this cost containment, if we can eliminate a ‘good’ test (CTA) to go directly to the ‘best’ test (DSA), I believe that we should take this opportunity.... Doing so may decrease the cost and will also decrease patient radiation dose.”²

“May” indeed. One might then ask on what basis? The commentary does not offer any numbers to support the advice to skip CTA. At our institution, the charge for DSA is approximately 5 times that of CTA. The difference may be even larger at other institutions, and that differential makes perfect sense considering that DSA is an invasive test (one that requires an hour or more to perform, catheters and the like, and with physicians in attendance) and should cost considerably more than CTA to perform. With regard to radiation dose, we rely on the report by Manninen et al,⁵ in which they used real measurements to show that CTA of the intracranial vessels has only one-fifth the effective dose of a DSA examination.

For keeping score, let us assign to CTA a relative cost value of 1 and the same for its dose. Using their relative values for a single brain DSA, we will assign a value of 5 for cost and 5 as well for dose. If we were to then choose to examine the next 100 patients who arrive at the emergency department with a subarachnoid hemorrhage with a DSA study as their only examination instead of a CTA, doing the “best” test first, as suggested in the commentary, the total cost in terms of our relative values would be 500 (5×100) for cost and 500 (5×100) for dose—that is, of course, assuming that there were no complications from the DSA, because they would certainly increase both the cost and dose of this approach. Now let us reset the counter and offer each patient a CTA at the time of presentation. The total cost for the CTA part of their work-up would then be 100, and their total dose, 100. Now

then if we assume that 30% of the 100 had normal or less-than-definitive CTA findings followed by DSA, if we used our relative-value scale, that would require an additional cost of 150 (30×5) and dose of 150 (30×5). The total then for the approach of using CTA followed by DSA in our group of 100 in total would add up to 250 for cost and 250 for dose compared with 500 and 500, respectively, for the DSA-only model. In short, using the DSA-first approach suggested by Dr Jayaraman would incur twice the cost and dose. While there may be flaws with this simple calculation, we believe, in broad strokes, that it is sound, and at least we offer an analysis to support the CTA-first approach.

What should be acknowledged at the outset is that in clinical practice, DSA is usually performed as part of the patient's endovascular procedure and not as a stand-alone diagnostic test. That is why this question of cost and dose is really quite complex. At most centers, CTA is used as a decision point on the way to surgical or, more frequently, endovascular treatment of an aneurysm. The benefit of endovascular treatment in this circumstance was recently reaffirmed by the Barrow Ruptured Aneurysm Trial from the Barrow Institute.⁶ Using CTA as the first examination is helpful in many ways: For example, it can determine whether the patient requires emergent surgery, it allows the family to understand the magnitude of the risks before any treatment, and it allows the interventionalist to limit the diagnostic portion of the endovascular procedure and decide how to best address the specifics of the aneurysm configuration before the procedure. Because diagnostic angiography is commonly performed without anesthesia but interventional procedures are not, one would have to consider the implications, in terms of cost, of performing a diagnostic DSA examination without anesthesia and then bringing in anesthesia, compared with the cost of doing all DSA examinations with anesthesia in anticipation of some going on to intervention. It is for these reasons that the impact of bypassing CTA goes well beyond any simple measure of sensitivity, because even a negative CTA finding in the middle of the night has a significant impact on patient care regardless of the results of the DSA that follows the next day.

We can all agree that CTA alone cannot address all the diagnostic questions for these patients with subarachnoid hemorrhage. Moreover, for those patients who need DSA for diagnosis, we wholeheartedly agree with Dr Jayaraman that neuroradiologists need to be well-trained and prepared to offer optimal DSA imaging with minimal risk whenever necessary. However, until real evidence is provided to the contrary, we believe that CTA remains the logical first examination for patients presenting with subarachnoid hemorrhage.

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