REPLY:

We thank Drs Malhotra, Wu, and Seifert for their interest in our work and their comments regarding our recent article on blunt cerebrovascular injuries (BCVI).¹ As highlighted in our work, controversies exist regarding screening criteria, the modalities used for screening, and the treatment of these patients. The literature on the accuracy of CT angiography is diverse and is best studied by groups using both CTA and digital subtraction angiography for the diagnosis of BCVI in all patients.^{2–6} The study by Eastman et al² showed that the overall sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of 16-slice CTA for the diagnosis of BCVI were 97.7%, 100%, 100%, 99.3%, and 99.3%, respectively, with a single false-positive of a grade I vertebral injury. While most other studies have shown a modest sensitivity with good specificity, for example, Goodwin et al³ showed a sensitivity and specificity of 41% and 97%, respectively, combined for 16- and 64-slice CT, and Paulus et al⁴ showed a sensitivity and specificity of 68% and 92% for CTA on 64-slice CT.

In another study comparing CTA (16-slice) and DSA for diagnosis, Malhotra et al⁶ showed that the sensitivity and specificity of CTA was 74% and 84%, but all the false-negative CTAs were obtained in the first half of the study period. In the latter part, the specificity and the negative predictive value was 100%, and the most likely explanation was the learning curve of the radiologists reading the studies. Malhotra et al and Shahan et al⁷ have reported high false-positive rates of CTA with an incidence of approximately 43%⁶ and 45%, respectively. The reason for this high false-positive rate is poorly understood, and we agree that it could be related to overcalling from radiologists due to reported poor sensitivity of CTA. Whether this is best addressed by the radiology review process, improved awareness of this entity among radiologists, or a multidisciplinary team consensus will be an interesting topic for further studies. A systematic review of studies comparing CTA and DSA for the diagnosis of BCVI showed that the pooled sensitivity and specificity of CTA are 66% (95% CI, 49%–79%) and 97% (95% CI, 91%–99%), respectively.⁸ Hence, the authors concluded that CTA may have a low sensitivity for adequately ruling out a diagnosis but may be useful to rule in BCVI among patients with trauma with a high pretest probability of injury as highlighted by the Drs Malhotra, Wu, and Seifert in their letter.

Finally, in a study looking at the cost-effectiveness of various modalities for BCVI screening, CTA was shown to be the best test from the societal perspective with the most cost-effective screening strategy for patients at high risk for BCVI. From an institutional perspective, CTA was shown to prevent the most strokes at a reasonable cost.⁹ Hence, the use of CTA for screening, though imperfect, is likely the most widely used and is suggested as preferred (or equivalent) over DSA for screening for BCVI in the existing guidelines.^{10,11}

A recent multicenter study on stroke evaluation in patients

with BCVI showed that most strokes occur in the first 72 hours after injury, and 22% of patients were on antithrombotic therapy when the stroke occurred.¹² Such findings highlight the need for early and accurate diagnosis of BCVI.

REFERENCES

1. Nagpal P, Policeni BA, Bathla G, et al. **Blunt cerebrovascular injuries: advances in screening, imaging, and management trends.** *AJNR Am J Neuroradiol* 2017 Oct 12. [Epub ahead of print] CrossRef Medline
2. Eastman AL, Chason DP, Perez CL, et al. **Computed tomographic angiography for the diagnosis of blunt cervical vascular injury: is it ready for primetime?** *J Trauma* 2006;60:925–29; discussion 929 CrossRef Medline
3. Goodwin RB, Beery PR 2nd, Dorbish RJ, et al. **Computed tomographic angiography versus conventional angiography for the diagnosis of blunt cerebrovascular injury in trauma patients.** *J Trauma* 2009;67:1046–50 CrossRef Medline
4. Paulus EM, Fabian TC, Savage SA, et al. **Blunt cerebrovascular injury screening with 64-channel multidetector computed tomography: more slices finally cut it.** *J Trauma Acute Care Surg* 2014;76:279–83; discussion 284–85 CrossRef Medline
5. Utter GH, Hollingworth W, Hallam DK, et al. **Sixteen-slice CT angiography in patients with suspected blunt carotid and vertebral artery injuries.** *J Am Coll Surg* 2006;203:838–48 CrossRef Medline
6. Malhotra AK, Camacho M, Ivatury RR, et al. **Computed tomographic angiography for the diagnosis of blunt carotid/vertebral artery injury: a note of caution.** *Ann Surg* 2007;246:632–42; discussion 642–43 Medline
7. Shahan CP, Magnotti LJ, Stickley SM, et al. **A safe and effective management strategy for blunt cerebrovascular injury: avoiding unnecessary anticoagulation and eliminating stroke.** *J Trauma Acute Care Surg* 2016;80:915–22 CrossRef Medline
8. Roberts DJ, Chaubey VP, Zygun DA, et al. **Diagnostic accuracy of computed tomographic angiography for blunt cerebrovascular injury detection in trauma patients: a systematic review and meta-analysis.** *Ann Surg* 2013;257:621–32 CrossRef Medline
9. Kaye D, Brasel KJ, Neideen T, et al. **Screening for blunt cerebrovascular injuries is cost-effective.** *J Trauma* 2011;70:1051–56; discussion 1056–57 CrossRef Medline
10. Bromberg WJ, Collier BC, Diebel LN, et al. **Blunt cerebrovascular injury practice management guidelines: the Eastern Association for the Surgery of Trauma.** *J Trauma* 2010;68:471–77 CrossRef Medline
11. Biffl WL, Cothren CC, Moore EE, et al. **Western Trauma Association critical decisions in trauma: screening for and treatment of blunt cerebrovascular injuries.** *J Trauma* 2009;67:1150–53 CrossRef Medline
12. Burlew CC, Sumislawski JJ, Behnfield CD, et al. **Time to stroke: a Western Trauma Association multi-center study of blunt cerebrovascular injuries.** *J Trauma Acute Care Surg* 2018 May 25. [Epub ahead of print] CrossRef Medline

✉ P. Nagpal

✉ B.A. Policeni

✉ M. Kwofie

✉ G. Bathla

✉ C.P. Derdeyn

Department of Radiology

University of Iowa Hospitals and Clinics

Iowa City, Iowa

✉ D. Skeete

Trauma Services, Department of Surgery

University of Iowa Hospitals and Clinics

Iowa City, Iowa

<http://dx.doi.org/10.3174/ajnr.A5758>