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Commentary: Cerebral perfusion computed tomography scan imaging as a warning light

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Automobiles have a myriad of dashboard warning lights notifying drivers when gas, oil, or tire pressures levels are low. Perhaps surgical decision making would be easier if our patients' imaging had warning lights indicating when not to operate or how to adjust the surgical strategy.

Inoue and colleagues¹ share 2 case reports of patients with acute type A aortic dissection presenting with severe neurologic compromise who were evaluated with preoperative computed tomography (CT) scans that employed perfusion imaging software. The authors suggest that the use of this software (which at our center we have found helpful in assessment of postoperative acute embolic stroke) could guide surgical management.¹

CT perfusion software mapping provides quantitative analysis of cerebral volume (CBV), cerebral blood flow (CBF), and cerebral transit time measured as time to peak (TTP or also known as Tmax). Decreased CBV or CBF is indicative of irreversible tissue ischemia or an ischemic core. Elevated TTP/Tmax represents cerebral hypoperfusion, but not necessarily irreversible infarction. A comparison or a mismatch between TTP/Tmax and CBV/CBF correlates with penumbra or tissue that potentially is viable and can be salvaged. This analysis was used in numerous ischemic stroke clinical trials demonstrating the clinical benefit of mechanical thrombectomy.²⁻⁴ Rapid Processing of Perfusion and Diffusion software is an automated software that compares CBF with TTP/Tmax; and an

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CENTRAL MESSAGE

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ischemic core is identified as CBF <30%. Hypoperfusion or salvageable tissue is represented by a Tmax ≥6 seconds. The mismatch between CBF and Tmax correlates with the tissue that can be rescued.⁵ This algorithm can also serve as a promising new technology that quantifies ischemic stroke burden and could guide other surgical decision making.

In the present article, the authors also introduce a novel ratio: The hypoperfusion intensity ratio, which compares the ratio of Tmax >10 seconds over Tmax >6 seconds.¹ In this scenario, an elevated ratio ≥0.5 is suggestive of infarct with poor collateralization correlating with a malignant picture. This analytic model has not yet been validated in ischemic stroke trials for surgical decision making regarding the need for mechanical thrombectomy. However, a Tmax >10 seconds/Tmax >6 seconds ratio >0.5 in addition to a large-volume CBF <30% potentially could represent a patient population in whom other surgical interventions might be unwarranted.

The first patient in this report had cerebral perfusion imaging showing significant penumbra at risk, which benefited from prompt repair, whereas the second patient had a significant ischemic core of irreversible brain injury and ended up with massive reperfusion injury. The authors boldly considered ligating the carotid artery in the second patient to prevent severe reperfusion injury, but with a paucity of data available they opted for reperfusion, which was ultimately fatal.

Patients presenting with acute type A aortic dissection and severe neurologic impairment are an enormous challenge

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Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Oct 23, 2021; revisions received Oct 23, 2021; accepted for publication Oct 27, 2021; available ahead of print Oct 30, 2021.

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JTCVS Techniques 2021;10:198-9

2666-2507

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<https://doi.org/10.1016/j.jtc.2021.10.058>

for surgeons because they must decide to proceed with life-saving aortic repair with a risk of residual severe neurologic deficits. In the era of personalized medicine, technology that could inform surgeons which patients will have a favorable versus terminal result would be invaluable. However, it is still unclear whether or not the described cerebral perfusion imaging software is definitive enough to actually guide surgical decision making in the setting of aortic dissection.

There is an adage in stroke neurology that “time is brain” and accordingly, delays in obtaining further imaging may delay time to perfusion of precious penumbra. However, the authors in this cases series report that no significant delay was incurred in obtaining the additional cerebral perfusion CT scan, which can be completed in 2 to 3 minutes and could easily be added to a screening CT angiogram. We look forward to continued advances in cerebral imaging

technology to guide aortic surgeons in the care of these complex patients.

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