



Fig. 2. Multivariable associations between myocardial injury and area under curve (AUC) under each blood pressure component threshold restricted to patients with scheduled troponin testing and excluding potential nonischemic etiologies of troponin elevation. Bonferroni correction was used to adjust for four comparisons to the reference group within each exposure of interest so that $P < 0.0125$ ($0.05/4$) was considered statistically significant.

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COVID-19 Infection: Perioperative Implications: Comment

To the Editor:

We read with great interest the manuscript by Greenland *et al.*, discussing the perioperative and

critical care implications of coronavirus disease 2019 (COVID-19) infection with a focus on management of associated respiratory failure.¹ We congratulate the authors for the comprehensive article which is imperative in these times for the critical care physicians.

The authors have discussed the typical presentation enumerating the primary presenting symptoms, major complications, and variations in presentation. However, we would like to add to this list an important aspect of involvement of the central nervous system. In a recent case series of 214 patients, about 36.4% (78 of 214) of the patients had neurologic manifestations pertaining to the central and peripheral nervous systems and skeletal muscle injury.² The patients who had severe infection were prone to develop neurologic manifestations. The symptoms observed were dizziness, headache, seizures, impaired consciousness, acute cerebrovascular disease, and ataxia. The loss of smell and taste seen in these patients indicates the possible involvement of the peripheral nervous system by the virus. The transsynaptic transfer from peripheral to central nervous system is quite a possibility. The neurotropism of this novel coronavirus is believed to be similar to other coronaviruses.³ The report of acute necrotizing encephalopathy affecting the thalamus, brain stem, white matter, and cerebellum strongly indicates the involvement of the nervous system by this novel virus.⁴

The cytokine storm implicated in COVID-19 infection may cause breakdown of the blood–brain barrier causing inflammation, edema, encephalitis, and meningitis. The detection of the virus in cerebrospinal fluid, instead of *via* nasopharyngeal swab, indicates the need for high suspicion of COVID-19 infection in all patients presenting with altered sensorium and neurologic symptoms.⁵ The involvement of the brainstem and vital centers might possibly be an important reason for respiratory failure and the number of unexplainable deaths seen worldwide.³ Another reason for high fatality may possibly be due to unrecognized pulmonary thromboembolism. The observed increase in D-dimer seen in these patients, can be due to cytokine storm, sepsis and procoagulable state. Patients may present with thromboembolic complications or develop them despite the use of anticoagulant prophylaxis. Studies have found that about 8 to 15% developed arterial/venous thromboembolic complications.^{6,7} The incidence of acute cerebrovascular manifestation is about 5.7%, with ischemic stroke observed to be 2.5 to 5%.⁶

Thus, neurologic manifestations as the primary presenting symptom are quite common in COVID-19 infection. A high index of suspicion in such patients may help avoid delay in diagnosis and catastrophic sequelae.

Competing Interests

The authors declare no competing interests.

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COVID-19 Infection: Perioperative Implications: Reply

In Reply:

We thank Drs. Mahajan, Kapoor, and Prabhakar¹ for their response to our review² and agree that new loss of smell or taste are important, previously unrecognized manifestations of coronavirus disease 2019 (COVID-19). Of symptoms in seroprevalence studies, new loss of taste or smell was the most strongly associated with the detection of SARS-CoV-2 antibodies.³ Thus, these sensory symptoms, which are now included in Centers of Disease Control diagnostic guidelines, may even be more specific for COVID-19 than fever, cough, or dyspnea. Neurologic involvement of COVID-19 might have been expected based on the observations from the 2002 SARS-CoV virus, which was shown to infect brain cells. In mice expressing

human angiotensin-converting enzyme 2, the virus entered the brain *via* the olfactory bulb generating a lethal infection linked to involvement of medullary respiratory centers and secretion of interleukin 6.⁴ Viral cytopathic effects on the brain could potentially complicate other neurocognitive sequelae of critical illness.

Additional clinical manifestations merit attention. Conjunctivitis has been reported as a presenting syndrome, emphasizing the importance of eye protection to reduce transmission. Maculopapular eruptions and pseudo-chilblains are among dermatologic symptoms of COVID-19.⁵ Emerging data suggest that COVID-19 may present like Kawasaki syndrome in children, with fever, gastrointestinal symptoms, conjunctivitis, rash, and/or myocarditis.⁶ Now that COVID-19 has become prevalent in many regions, providers must be vigilant for atypical or asymptomatic presentations.

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Competing Interests

The authors declare no new competing interests.

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Perioperative Care for Patients with COVID-19: Comment

To the Editor:

I have read Chen *et al.*'s¹ article "Perioperative Management of Patients Infected with the Novel Coronavirus: Recommendation from the Joint Task Force of the Chinese Society of Anesthesiology and the Chinese Association of Anesthesiologists" with great interest. After the coronavirus disease 2019 (COVID-19) pandemic, I believe that there will be a substantial need for management strategies focused on care of the patient previously infected with COVID-19. As of March 28, 2020, more than 1,000 patients required ICU level of care related to COVID; this number is certainly much higher at the time of this letter.² There appears to be sparse data published up to this point regarding COVID-19 patients in the weeks and months after infection, particularly when intensive care is required. I believe that your team is uniquely suited to provide informed guidance on the perioperative care of these patients. Given the number of unanswered questions, any experiences that you have pertaining to this population after the acute setting may address the potential medical needs of this unique population as elective surgeries again resume in the United States and worldwide.