



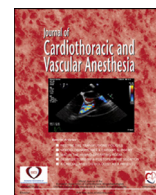
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Editorial

Perioperative Echocardiography: Key Considerations During the Coronavirus Pandemic



THE CURRENT pandemic stemming from severe acute respiratory syndrome—related coronavirus-2 began in December 2019 with an outbreak of pneumonia in Wuhan, China.^{1,2} Since the initial cases, the outbreak has spread rapidly around the world, presenting health care systems with a global health crisis. This enveloped virus has an incubation period up to 14 days and produces a spectrum of clinical disease in humans.³ It can vary from mild upper respiratory tract infection with fever and cough to severe acute respiratory distress syndrome that may progress to sepsis and multiorgan failure.^{3,4} Because the risks of infection in health care workers and patients are significant, the management of an infected patient requires meticulous management of this risk in a multimodal fashion, including the judicious application of personal protective equipment.¹⁻⁴

The purpose of this freestanding editorial is to provide perspectives on this important disease for the perioperative echocardiographic community, including consideration of imaging indications, optimal imaging venue, and imaging approaches. The American Society of Echocardiography recently released a comprehensive statement to outline strategies for the protection of patients and echocardiographers in this challenging setting.⁵ These compelling considerations also have prompted similar statements from the British Society of Echocardiography and the Italian Society of Echocardiography and Cardiovascular Imaging.^{6,7} These recommendations are examined herein in more detail from the perspective of the cardiovascular anesthesiologist and perioperative echocardiographer. This perspective also highlights best practices in this clinical space to encourage the highest standards of safety for both our patients and ourselves. References are provided for those readers and leaders who would like to dive into the details as they prepare to cope with the demands of the pandemic at their institutions.

Consider the Indications for Imaging

Perioperative echocardiography, whether transthoracic or transesophageal, should be avoided if the findings are likely to be low yield in the patient with known or suspected coronavirus infection. The appropriateness of an indication for perioperative

echocardiography has been reviewed in depth both for valvular and nonvalvular heart disease.^{8,9} If the examination is unlikely to provide clinical benefit, the current guidelines recommend that the echocardiography examination be withheld in the interests of safety.⁵⁻⁷ Furthermore, elective examinations should be postponed when possible. Clearly, emergency examinations with strong indications should proceed.⁵⁻⁷ Because the trajectory of this pandemic is so dynamic, the management and triage of echocardiography examinations will have to be flexible and responsive to local conditions at a given medical center, including patient-level and provider-level factors.^{5,6} This management and triage process should focus on the prevention of infection of patients and health care workers.^{10,11}

Transesophageal echocardiography poses an increased risk of the spread of coronavirus infection because it can provoke the aerosolization of a large viral load.^{5,6} The indications for transesophageal imaging therefore require additional scrutiny in light of this additional risk. The examination should be postponed or cancelled if the indication is weak, if the findings are unlikely to change clinical care, and/or an alternative imaging modality can provide the diagnostic information.^{5,8,9}

Consider the Venue Selection for Imaging

Echocardiography already is established at the point of care by clinicians taking care of a given patient who may have suspected or proven coronavirus infection.^{12,13} The advantages of this bedside approach include patient convenience and no risk of viral transmission as a result of transport. The optimal location for an echocardiographic examination will include consideration of the following factors: risk of viral transmission, monitoring capabilities, and staffing requirements.⁵

In the operating room, transesophageal echocardiography most often is performed in the setting of a secure airway. This type of airway management can minimize aerosolization of viral particles.^{14,15} The conduct of transesophageal echocardiography in the setting of suspected or confirmed coronavirus infection should be consistent with current recommendations, including the institutional protocols.^{5-7,14,15} There may be dedicated

probes and machines in this setting, depending on local factors related to patients, providers, and disease burden.⁵⁻⁷

Consider the Approaches to Imaging

The conduct of the echocardiographic examination in suspected or confirmed coronavirus infection should be focused but comprehensive enough to answer the diagnostic indication and answer the clinical question.⁵⁻⁷ Prolonged examinations should be avoided in order to minimize the duration of exposure and hence minimize infectious risk. Whenever possible, the echocardiographic examination should be performed efficiently by an experienced practitioner in order to minimize infectious exposure.^{6,7}

Beyond the imaging protocol, the examination must be performed according to institutional standards to prevent viral transmission and protect the echocardiographer.^{5,6} A standard of care includes rigorous hand sanitization and disposable gloves as routine measures. Thereafter, the degree of personal protective equipment will depend on hospital protocol and may be titrated to the level of infectious risk as follows: low risk (infection not suspected), moderate risk (infection suspected), and high risk (infection confirmed). Droplet precautions include a gown, gloves, head cover, facemask, and eye shield.^{1,2} The addition of airborne precautions includes special masks, such as N-95 and N-99, and powered air-purifying respirators.^{10,11} Full precautions, including droplet precautions, are recommended for transesophageal examinations in suspected or confirmed cases of coronavirus infection because of the increased risk for viral aerosolization.⁵⁻⁷

Beyond tailored imaging protocols and comprehensive protection for personnel, the care of equipment also constitutes an important part in the prevention of viral transmission.⁵ Probes and machine consoles may be covered with disposable plastic covers. Certain probes and machines may be set aside for imaging of suspected or confirmed cases of coronavirus infection.⁵⁻⁷ Even though the coronavirus is destroyed by most virucidal disinfectant solutions, all equipment should be cleaned thoroughly to ensure viral clearance but also the preservation of probe and console functionality.⁵⁻⁷ Local sanitation standards will vary but should be in compliance with vendor recommendations to balance infectious risks with imaging functionality and quality.⁵⁻⁷ Full details for cleaning and disinfecting ultrasound equipment have been compiled by the American Institute for Ultrasound in Medicine.¹⁶

Although education in echocardiography remains important, in the era of the current pandemic, the safety of learners should be placed first. It is recommended that elective rotations be cancelled and that all trainees who do not have essential roles in clinical care be restricted.⁵⁻⁷ As an interim measure, training and education in echocardiography can be mostly internet based with multiple educational offerings such lectures, webinars, and simulators.⁵⁻⁷ Furthermore, echocardiography staff who have risk factors for severe infection with coronavirus such as advanced age, chronic conditions, immunosuppression, and pregnancy could limit their exposure to suspected and confirmed cases, if local conditions permit.

Conclusions

The current coronavirus pandemic has affected the delivery of health care worldwide, including in the perioperative and critical care settings. The provision of the best care must include measures to prevent transmission of infection in the hospital environment to protect both our patients and echocardiography staff. The conduct of perioperative echocardiography can be both meticulous and safe in this challenging setting with appropriate teamwork and protocol-driven practices. Comprehensive consideration of the indications for imaging and the imaging venue and approach can provide the guiding principles to minimize the risks of viral transmission during this pandemic.

John G. Augoustides, MD, FASE, FAHA

Cardiovascular and Thoracic Section, Department of Anesthesiology and Critical Care, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

References

- Peng PWH, Ho PL, Hota SS. Outbreak of a new coronavirus: What anaesthetists should know. *Br J Anaesth* 2020 Feb 27. <https://doi.org/10.1016/j.bja.2020.02.008>; [E-pub ahead of print], Accessed March 28, 2020.
- He H, Zhao S, Han L, et al. Anesthetic management of patients undergoing aortic dissection repair with suspected severe acute respiratory syndrome coronavirus-2 infection. *J Cardiothorac Vasc Anesth* 2020;34:1402–5.
- Holshue MI, DeBolt C, Lindquist S, et al. First case of 2019 novel coronavirus in the United States. *N Engl J Med* 2020;382:929–36.
- Huang C, Wang Y, Li X, et al. Clinical features of patients with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497–506.
- American Society of Echocardiography. Statement on protection of patients and echocardiography service providers during the 2019 novel coronavirus outbreak. Available at: <https://www.asecho.org/wp-content/uploads/2020/03/ASE-COVID-Statement-FINAL-1.pdf>. Accessed March 19, 2020.
- British Society of Echocardiography. Clinical guidance regarding provision of echocardiography during the COVID-19 pandemic. Available at: <https://bsecho.org/covid19>. Accessed March 19, 2020.
- Italian Society of Echocardiography and Cardiovascular Imaging. Statement about echocardiography during the COVID-19 pandemic. Available at: <https://www.siec.it/documento-ad-uso-degli-operatori-di-ecografia-cardiovascolare-per-covid-19/>. Accessed March 19, 2020.
- Doherty JU, Kort S, Mehran R, et al. 2017 appropriate use criteria for multimodality imaging in valvular heart disease. *J Am Soc Echocardiogr* 2018;31:3812–404.
- Doherty JU, Kort S, Mehran R, et al. 2019 appropriate use criteria for multimodality imaging for assessment of cardiac structure and function in non-valvular heart disease. *J Am Soc Echocardiogr* 2019;32:553–79.
- Bowdle A, Munoz-Price LS. Preventing infection of patients and healthcare workers should be the new normal in the era of novel coronavirus epidemics. *Anesthesiology* 2020 Mar 19. <https://doi.org/10.1097/ALN.0000000000003295>; [E-pub ahead of print], Accessed March 27, 2020.
- Greenland JR, Michelow MD, Wang L, et al. COVID-19 infection – implications for perioperative and critical care physicians. *Anesthesiology* 2020 Mar 19. <https://doi.org/10.1097/ALN.0000000000003303>; [E-pub ahead of print], Accessed March 27, 2020.
- Sanders JA, Navas-Blanco JR, Yeldo NS, et al. Incorporating perioperative point-of-care ultrasound as part of the anesthesia residency curriculum. *J Cardiothorac Vasc Anesth* 2019;33:2414–8.

- 13 Beaubien-Souligny W, Denault A, Robillard P, et al. The role of point-of-care ultrasound monitoring in cardiac surgical patients with acute kidney injury. *J Cardiothorac Vasc Anesth* 2019;33:2781–96.
- 14 Chen X, Liu Y, Gong Y, et al. Perioperative management of patients infected with the novel coronavirus: Recommendations from the joint task force of the Chinese Society of Anesthesiology and the Chinese Association of Anesthesiologists. *Anesthesiology* 2020 Mar 19. <https://doi.org/10.1097/ALN.0000000000003301>; [E-pub ahead of print], Accessed March 28, 2020.
- 15 Meng L, Qui H, Wan L, et al. Intubation and ventilation amid the COVID-19 outbreak: Wuhan's experience. *Anesthesiology* 2020 Mar 19. <https://doi.org/10.1097/ALN.0000000000003296>; [E-pub ahead of print], Accessed March 27, 2020.
- 16 American Institute for Ultrasound in Medicine. Guidelines for cleaning and preparing external and internal-use ultrasound transducers between patients and safe handling and use of ultrasound coupling gel. Available at: https://www.aium.org/accreditation/Guidelines_Cleaning_Preparing.pdf. Accessed March 19, 2020.