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**Specific Considerations for the Protection of Patients and Echocardiography
Service Providers When Performing Perioperative or Periprocedural
Transesophageal Echocardiography During the 2019 Novel Coronavirus
Outbreak: Council on Perioperative Echocardiography Supplement to the
Statement of the American Society of Echocardiography**

Endorsed by the Society of Cardiovascular Anesthesiologists

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Background

Protecting healthcare workers and preventing transmission of SARS-CoV-2 should be a top priority during the ongoing COVID-19 pandemic. Transesophageal echocardiography (TEE) examinations carry a heightened risk of SARS-CoV-2 spread in non-intubated patients due to possible direct droplet transmission and/or viral aerosolization and inhalation during insertion/removal of the probe and/or coughing. Although conducting a TEE in an already intubated patient may reduce the risk of viral aerosolization, viral transmission may still occur through direct contact with the patient's secretions, resulting in contaminated hands and surfaces. These infection risks apply not only to echocardiographers, but also to other patients and personnel in the vicinity, as a result of cross-contamination whenever there may have been improper handling or cleaning of the equipment.

The performance of TEE examinations, therefore, deserves special consideration in determining appropriate use and special precautions. This statement reflects recommendations based on expert opinion, national guidelines, and available evidence specifically as they pertain to performing safe perioperative TEE. This document will not address specific recommendations during point-of-care surface ultrasound (lung, heart, abdomen, vascular), nor will it address criteria used in the decision making regarding postponing elective procedures or proceeding with cardiac surgical procedures deemed urgent or emergent.

Whom to image?

Practice guidelines for the use of perioperative TEE were developed by the American Society of Anesthesiologists (ASE) and the Society of Cardiovascular Anesthesiologists^{1,2}. As indicated in the main statement of the ASE on protection during COVID-19³, TEE examinations should be postponed or canceled if they are unlikely to change clinical care, or if an alternative imaging modality (e.g. off axis transthoracic echocardiography (TTE) views, ultrasound enhancing agent with TTE) can provide the necessary information. While non-essential TEE examinations should be either deferred or postponed, patients under investigation or confirmed with COVID-19 may still require TEEs in several clinical situations including (1) urgent or emergent cardiac surgery, (2) patients with cardiac co-morbidities undergoing emergent non-cardiac surgery, or (3) hemodynamic instability due to undifferentiated shock in the perioperative period.

Deployment of alternative imaging modalities may not always be possible in the perioperative patient population undergoing cardiac surgery and special consideration should be given to triaging these patients on a case-to-case basis. Additionally, TEE provides invaluable dynamic information, paramount to performing a successful procedure in certain clinical situations.

Surgical procedures in which the benefit of performing a TEE exam may outweigh the risk of contamination or cross-contamination include but are not limited to the following:

- (a) Infective endocarditis with valvular and perivalvular involvement
- (b) Stanford type A aortic dissection, especially in the presence of associated complications (e.g., aortic insufficiency, aortic root involvement, pericardial effusion).
- (c) Initiation of temporary or durable mechanical circulatory support

- (d) Myocardial infarction with mechanical complications (e.g., ventricular septal defect, left ventricular wall rupture, papillary muscle rupture).
- (e) Prosthetic valve assessment

There are surgical procedures in which the use of TEE can be supplanted by observing invasively derived hemodynamic data, other imaging modalities (e.g., fluoroscopy, epicardial ultrasound imaging), or direct visualization of the heart in the surgical field, such as coronary artery bypass graft, or endovascular stenting for Stanford type B aortic dissection with peripheral malperfusion. In these procedures, TEE can be considered in situations of severe hemodynamic instability or procedural complications, which require immediate diagnosis and in which the TEE findings would highly impact patient outcome (**Figure 1**)

Where to image?

Perioperative TEE examinations will likely be performed in operating rooms, structural heart and catheterization laboratory rooms, or in the intensive care units. Patients with suspected or confirmed COVID-19 infections should undergo surgical or interventional procedures in dedicated COVID-19 operating rooms, or may be admitted in intensive care unit rooms. Specific considerations should be given to entering and especially exiting these spaces in order to limit virus transmission.

How to image?

Protocols

TEE examinations performed in patients with suspected or confirmed COVID-19 should follow an abbreviated but adequate pathology-directed protocol to limit personnel exposure time. This focused exam approach should also be extensive enough for detecting and adequately evaluating any significant unexpected pathology. Limiting factors in performing a comprehensive TEE exam may be related to the patient's clinical condition and the nature of the surgical procedure, especially in patients undergoing urgent or emergent cardiac surgery. It is important to record and store the acquired imaging data and cine loops so that they are available for review by other clinicians. Findings should be communicated and reported in a timely manner, as per routine practice.

Protection

Personnel

The levels and categories of personal protection equipment (PPE) are detailed in the main statement of the ASE on protection during COVID-19³. While the type of PPE may depend on institutional policies and available resources, it is generally accepted that performing TEEs in suspected or confirmed cases of COVID-19 warrants the use of airborne precautions, irrespective of the intubation status of the patient. All personnel should be educated in appropriate utility of PPE as per institutional policies. Whenever possible, trained observers or the use of a “buddy system” should ensure appropriate donning and doffing of the PPE. The most experienced

echocardiographer should perform the examination, including probe insertion/removal. Although airborne precautions should be followed in all high risk patients (patients under investigation or confirmed COVID positive patients), droplet precautions are recommended for TEEs in all non-COVID patients^{4, 5}.

Equipment

Proper handling and cleaning of the equipment is critical in prevention of virus transmission to other healthcare providers and other patients. The exact steps to be followed for disinfection of the TEE probe and equipment will depend on local institutional protocols that should be guided by infectious disease experts and resource availability. Plastic covers for the ultrasound machine, its touchable parts (knobs, screen) and transducer ports are commercially available and should be considered in order to reduce bioburden on these “high touch” surfaces with hard-to-clean grooves, slots or crevases (**Figure 2**). In order to avoid contamination of surfaces, one person can be designated to probe manipulation and another one to adjusting instrument settings for image optimization and data acquisition, although this approach has to be balanced with PPE availability. As noted in the ASE main document³, removal of any non-essential accessory equipment from the ultrasound machine (cart) such as additional alternate transducers, ECG cables, ECG stickers, paperwork, gel (and any other items) will facilitate thorough cleaning and minimize risk for cross contamination.

A practical approach is suggested in the **Table**. Following a TEE examination, all exposed equipment should be wiped down with the hospital-approved and vendor-recommended disinfection product in the procedure or intensive care room, and in the induction room or anteroom. The TEE probes should also be thoroughly wiped (including handle, cable, and connector), placed in closed containers and transported in those containers to the cleaning facility. The equipment surfaces should stay wet with the disinfection solution for the minimum recommended “wet time” provided on the product label.

Role of learners

The educational benefit for trainees from performing TEEs in the perioperative period in patients with suspected or confirmed COVID-19 should be weighed against the potential for prolonging the examination time, the risk for contamination and cross-contamination and the additional utilization of PPE. One approach would be to have trainees involved in interpreting and reporting but not in performing these examinations. As institutional practices may vary, if trainees in advanced fellowship programs are involved in performing this examinations, they should be knowledgeable and trained in the institutional protocols to reduce infection transmission. This group does not recommend the involvement of medical students and residents in performing perioperative TEEs in suspected or confirmed COVID-19 patients.

Conclusion

The performance of transesophageal echocardiography carries a heightened risk of transmission of SARS-CoV-2. This risk may be greater in non-intubated patients. TEE should be avoided in these patients and alternative imaging modalities considered. TEE should be performed in intubated patients only in those perioperative situations in which the benefits outweigh the risks. Careful consideration and practice of the recommendations above may help reduce the risk of transmission and cross contamination.

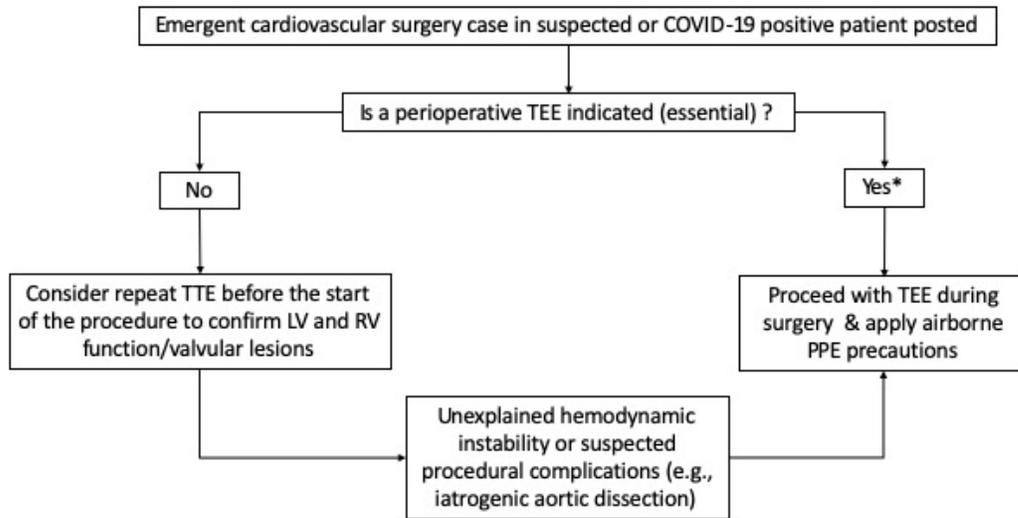
Figure 1. Suggested algorithm for determining indication for intraoperative transesophageal echocardiography (TEE)

Abbreviations: LV, left ventricle; RV, right ventricle; PPE, personal protection equipment; TTE, transthoracic echocardiography

Figure 2. Ultrasound system with transesophageal echocardiography capabilities is shown with a plastic cover. The screen, touchable parts and the transducer ports are covered by the disposable plastic cover.

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*Myocardial infraction with mechanical complications (e.g., VSD, papillary muscle rupture, LV wall rupture)
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Table. Suggested stepwise approach to performing a transesophageal echocardiographic examination (TEE) in a patient with suspected or confirmed COVID-19.

<p>BEFORE PROCEDURE</p> <ul style="list-style-type: none"> ○ Don PPE for airborne precaution measures (gown, face shield or goggles, airborne protection mask) ○ Double glove ○ Consider covering the ultrasound system (knobs, screen) with a plastic barrier, including transducer ports
<p>DURING PROCEDURE</p> <ul style="list-style-type: none"> ○ Consider using video laryngoscope or direct laryngoscopy to limit contact with patient’s secretions ○ Limit examination time by performing a focused exam ○ Remove outer gloves and wipe inner gloves with approved viricidal wipes or solution whenever other patient activities are undertaken ○ Avoid unnecessary contamination of touchable surfaces of the ultrasound system (knobs, screen)
<p>AFTER PROCEDURE</p> <ul style="list-style-type: none"> ○ Remove TEE probe from patient, disinfect probe and place in closed container and/or biohazard bag ○ Wipe outer gloves, gown, and sleeves with approved viricidal wipes or solution ○ Wipe down equipment and probe container ○ Remove outer glove. ○ Remove equipment and probe container to induction room/anteroom ○ Wipe equipment and probe container with approved viricidal wipes ○ Doff PPE ○ Transport probe in closed container to the cleaning room for immediate cleaning

Abbreviations: PPE, personal protection equipment