American College of Emergency Physicians®
ADVANCING EMERGENCY CARE

POLICY STATEMENT

Approved June 2023

Use of Transesophageal Echocardiography (TEE) in the ED for Shock, Cardiac Arrest, and Procedural Guidance

Revised June 2023 with current title

Originally approved April 2017 titled "Guidelines for the Use of Transesophageal Echocardiography (TEE) in the ED for Cardiac Arrest"

1. Introduction

The American College of Emergency Physicians (ACEP) has developed these criteria to assist physicians performing emergency ultrasound (EUS) examinations using transesophageal echocardiography (TEE) during shock, cardiac arrest, and procedural guidance.

Cardiac ultrasound can be used to identify left ventricle (LV) and right ventricle (RV) dysfunction, pericardial effusion, cardiac tamponade, hypovolemia, and signs suggestive of pulmonary embolism (PE).[1] These can help to characterize the type of shock, evaluate intrinsic cardiac activity, and establish the underlying etiology in cardiac arrest (CA) and post-arrest patients.[2-4] These findings can lead to life-saving interventions, such as administration of intravenous fluids, blood products, vasopressors, thrombolytics, or the performance of a pericardiocentesis.

However, transthoracic echocardiography (TTE) may have significant limitations in critically ill and injured patients. In this setting, TTE may be limited due to body habitus, subcutaneous emphysema, chest wall trauma, mechanical ventilation, defibrillator pads and monitoring equipment, ongoing cardiopulmonary resuscitation (CPR), or a distended air-filled stomach from bag-valve-mask ventilation.[5-8] In comparison, TEE provides physicians with an ultrasound-informed evaluation in patients with undifferentiated shock or acute hemodynamic decompensation when TTE windows are inadequate.[9] During CA resuscitation, TEE is situated in the esophagus closer to the heart, providing high-quality images regardless of the patient characteristics or clinical context. In addition to the same diagnostic and prognostic role provided by TTE, TEE provides unique advantages including the potential to optimize the quality of chest compressions, shorten CPR interruptions, provide continuous hemodynamic monitoring, and facilitate emergent endovascular procedures. Focused TEE has been shown to be feasible, safe, and impactful in the resuscitation of patients in shock, cardiac arrest, or needing procedural guidance.

2. Clinical Indications[14]

a. Evaluation of shock in the presence of inadequate TTE windows
   i. Evaluation of LV function
   ii. Evaluation of RV function
   iii. Identification of pericardial effusion/tamponade
   iv. Serial hemodynamic assessments to guide therapy
   v. Identify acute aortic pathology

b. Evaluation of cardiac arrest
   i. Identification of myocardial activity
   ii. Characterization of organized/disorganized myocardial contractions, including shockable fine ventricular fibrillation
   iii. Identification of signs of right heart dysfunction
   iv. Identification of pericardial effusion/cardiac tamponade
   v. Evaluation of chest compression quality and location

c. Guidance of emergent endovascular procedures
   Real-time guidance of emergency endovascular procedures [eg, intravenous pacemaker placement, cannulation for veno-venous and veno-arterial extracorporeal membrane oxygenation (ECMO)]

3. Contraindications

a. Lack of a definitive airway
b. Known or presumed esophageal injury, esophageal stricture, tracheoesophageal fistula, or perforated viscus
c. Transgastric views should not be performed in the setting of known or presumed active upper gastrointestinal bleeding or esophageal varices
d. Recent esophageal and stomach surgery

4. Limitations

a. As a modality of cardiac EUS, focused TEE does not evaluate all aspects of cardiac function. Some findings that may contribute to hemodynamic decompensation, but are generally considered outside of the scope of EUS, include valvular pathology, septal defects, and intracardiac thrombus or mass.
b. Evaluation for extracardiac causes of shock and cardiac arrest may require complementary ultrasound examination using surface EUS modalities (eg, thoracic EUS for pneumothorax, abdominal EUS for hemoperitoneum).

5. Recommendations on Competency and Criteria for Credentialing

Competency in TEE involves motor skills required for transducer insertion and manipulation for image acquisition, and cognitive skills required for image interpretation. Current ACEP Ultrasound Guidelines recommend a benchmark minimum of 25-50 quality-reviewed scans per non-procedural EUS application to demonstrate motor and cognitive skills.[15] For ultrasound-guided procedures, 10 quality-reviewed procedures are recommended. Additionally, the guidelines recommend that for moderately different procedures (eg, transvaginal ultrasound after having already completed transabdominal obstetric ultrasound training), 10 quality-reviewed scans are recommended.

Credentialing for focused TEE is relatively unique in that as an advanced EUS application, physicians seeking credentialing in TEE have already achieved competency in image interpretation of TTE. In this respect, competency for TEE primarily entails the development of motor skills required for transducer insertion and image acquisition. Given that TEE is highly dependent on hand-eye coordination and

kinesthetic abilities, direct observation of proctored examinations using structured assessment tools is recommended for this modality.

Physicians seeking credentialing in focused TEE for emergency applications should have completed appropriate training and met competency standards in focused TTE and:

- Completed a minimum of 4-6 hours of structured TEE-specific education, including motor and cognitive skills (eg, CME or didactics);
- Demonstrated competency in the performance of a minimum of 10 proctored TEE examinations, including transducer insertion, on live patients and simulation models; and
- Completed a standardized assessment by a physician credentialed in focused TEE.

Ongoing maintenance of competency is encouraged and should include facets of quality assurance, scans performed, or other standards in accordance with local hospital policy and the ACEP Ultrasound Guidelines.

6. Framework for Focused TEE in Emergency Department

In contrast to comprehensive TEE examinations, focused TEE is performed with a goal-directed framework aimed to provide immediate and actionable information at the point of care.[16] A key feature of focused TEE examinations is the time-sensitive nature of these studies, where the diagnostic information is expected to impact management decisions within seconds or minutes. For most clinical scenarios where TEE is used, a small number of views can generally provide the information needed. Protocols for focused TEE in the ED should aim to limit the complexity of the exam and to maximize the efficiency of the procedure and the information acquired. Depending on the clinical application, purpose of the exam, and focused question(s) to assess, a different subset of views may be required or sufficient. Some of the most commonly used views in focused TEE include midesophageal 4-chamber (ME 4C), midesophageal long-axis (ME LAX), and transgastric short-axis at the level of papillary muscles (TG SAX); the aforementioned TEE views have analogous views in TTE with which emergency physicians are already familiar. Additional views used primarily in the setting of procedural guidance include midesophageal bicaval (ME Bicaval), and views of the descending thoracic aorta in short- and long-axis (ME DTA SAX and LAX, respectively). Combined, these views provide essential diagnostic, therapeutic, and procedural information pertinent to the main emergency applications of this modality. **Table 1** summarizes the main views used in focused TEE.

Focused TEE View	**Main Clinical Applications**
Mid-esophageal four chamber (ME 4C)	LV/RV size & function Pathology pericardium Regional wall motion abnormality (RWMA) Myocardial activity during resuscitation
Midesophageal long axis view (ME LAX)	LV function Chest compression location in CPR (Area of maximal compression) Pathology of mitral valve Pathology pericardium Aortic outflow tract size and morphology
Mid-esophageal transgastric short axis papillary view (TG SAX Pap)	LV function RWMA Pathology pericardium

Mid-esophageal bicaval (ME Bicaval)	Procedural guidance: · Venous guidewire in ECMO · Intravenous pacemaker placement Preload tolerance superior vena cava
Descending thoracic aorta short axis view (DTA SAX)	Evaluation of descending aorta Procedural guidance: · Arterial guidewire in ECMO
Descending thoracic aorta long axis view (DTA LAX)	Evaluation of descending aorta Procedural guidance: · Arterial guidewire in ECMO
Right ventricular inflow outflow (RV I-O**)**	RV size and function Pathology right ventricular outflow tract Procedural guidance: · Venous guidewire in ECMO · Intravenous pacemaker placement
Deep transgastric 5 chamber view (Deep TG 5C)	LV/RV size & function Pathology pericardium Doppler left ventricular outflow tract
Midesophageal ascending aorta short axis view (ME Asc Ao SAX)	Saddle embolism Evaluation of pulmonary trunk and ascending aorta
Midesophageal ascending aorta long axis view (ME Asc Ao LAX**)**	Saddle embolism Evaluation of pulmonary trunk and ascending aorta

Table 1. Description of the transducer location, visualized anatomy and clinical applications of views most commonly used in focused TEE

7. Procedure Description

Similar standard requirements for any EUS examination apply to focused TEE. These include systematic recording and archiving of video images, procedure documentation, and regular quality assurance of studies.

a. Procedure preparation. While in some scenarios (eg, cardiac arrest resuscitation), the procedure is performed emergently, physicians should follow general principles applying to any invasive procedure such as analgesia and sedation to minimize patient's discomfort and optimize the conditions for the procedure. In contrast with some comprehensive TEE examinations, focused TEE in the ED is performed in intubated patients. Depending on the clinical indication, sedation, analgesia, and/or paralytics may be required to optimize the procedure.
b. Transducer insertion. The placement of the TEE transducer is similar to the placement of an oral gastric tube, a procedure commonly performed by emergency physicians. To facilitate placing the transducer safely and efficiently, maintain midline position while advancing the transducer into the oropharynx. This can be accomplished by visualization under video or direct laryngoscopy, or manually guiding the transducer's tip onto the base of the tongue. Once at the base of the tongue, a "chin lift" or "jaw-thrust" maneuver will facilitate passage of the transducer into the esophagus.

Placement of a bite block previously loaded into the transducer is recommended to avoid transducer damage caused by bite marks.

c. Logistics of focused TEE. Like many other emergency procedures, performing focused TEE can present some logistical challenges for physicians, particularly during cardiac arrest resuscitation. In this setting, given the need to perform multiple time-dependent interventions, a predefined protocol to incorporate TEE safely and efficiently into the workflow of resuscitation is recommended. The specific location of the ultrasound machine as the position of the operator varies depending on a number of factors including the number of operators, specific roles, and the physical space. The ultrasound systems used for focused TEE in the ED are the same used for other common EUS applications. Given that TEE cannot remain with the machine, it is recommended that this storage location be easily accessible and close to the high-acuity resuscitation rooms of the ED in which it will be most used.

8. Documentation

Cardiac EUS should be obtained and interpreted by the treating physician and used to guide decision-making in real time. These findings should be documented in the medical record. Documentation should include the indication, description of the exam performed, and pertinent findings. Images should be stored as part of the medical record in accordance with facility policy requirements.

9. Quality Control and Improvements, Safety, Infection Control and Patient Education[17]

Since TEE transducers come into contact with mucous membranes, a high-level disinfection is required after use. Policies and procedures related to quality, safety, infection control and patient education should be developed in accordance with existing hospital policies for TEE transducers.

References

1. Kennedy Hall M, Coffey EC, Herbst M, Liu R, Pare JR, Andrew Taylor R, Thomas S, Moore CL. The "5Es" of emergency physician-performed focused cardiac ultrasound: a protocol for rapid identification of effusion, ejection, equality, exit, and entrance. *Acad Emerg Med*. 2015;22(5):583-93.
2. Gottlieb M, Alerhand S. Managing Cardiac Arrest Using Ultrasound. *Ann Emerg Med*. 2022;SO196-0644(22)01129-9.
3. Long B, Alerhand S, Maliel K, Koyfman A. Echocardiography in cardiac arrest: An emergency medicine review. *Am J Emerg Med*. 2018;36(3):488-93.
4. Perera P, Mailhot T, Riley D, Mandavia D. The RUSH exam: Rapid Ultrasound in SHock in the evaluation of the critically lll. *Emerg Med Clin North Am*. 2010;28(1):29-56, vii.
5. Cook CH, Praba AC, Beery PR, et al. Transthoracic echocardiography is not cost-effective in critically ill surgical patients. *J Trauma*. 2002;52:280-4.
6. Clattenburg EJ, Wroe P, Brown S, Gardner K, Losonczy L, Singh A, Nagdev A. Point-of-care ultrasound use in patients with cardiac arrest is associated prolonged cardiopulmonary resuscitation pauses A prospective cohort study. *Resuscitation*. 2018;122:65-8.
7. Hu K, Gupta N, Teran F, Saul T, Nelson BP, Andrus P. Variability in Interpretation of Cardiac Standstill Among Physician Sonographers. *Ann Emerg Med*. 2018;71(2):193-8.
8. Mark DG, Ku BS, Carr BG, etal. Directed bedside transthoracic echocardiography: preferred cardiac window for left ventricular ejection fraction estimation in critically ill patients. *Am J Emerg Med*. 2007;25(8):894-900.
9. Arntfield R, Pace J, Hewak M, Thompson D. Focused Transesophageal Echocardiography by Emergency Physicians is Feasible and Clinically Influential: Observational Results from a Novel Ultrasound Program. *J Emerg Med*. 2016;50(2):286-94.
10. Teran F, Dean AJ, Centeno C, et al. Evaluation of out-of-hospital cardiac arrest using transesophageal echocardiography in the emergency department. *Resuscitation*. 2019;137:140-7.

11. Wray TC, Johnson M, Cluff S, et al. Transesophageal Echocardiography Performed by Intensivist and Emergency Physicians-A 5-Year, Single-Center Experience. *J Intensive Care Med*. 2022;37(7):917-24.
12. Arntfield R, Lau V, Landry Y, Priestap F, Ball I. Impact of Critical Care Transesophageal Echocardiography in Medical-Surgical ICU Patients: Characteristics and Results From 274 Consecutive Examinations. *J Intensive Care Med*. 2020;35(9):896-902.
13. Prager R, Bowdridge J, Pratte M, Cheng J, McInnes MD, Arntfield R. Indications, Clinical Impact, and Complications of Critical Care Transesophageal Echocardiography: A Scoping Review. *J Intensive Care Med*. 2023;38(3):245-72.
14. Beaulac GR, Teran F, Lecluyse V, et al. Transesophageal Echocardiography in Cardiac Arrest: the Heart and Beyond [published online ahead of print, 2023 Jan 5]. *Can J Cardiol*. 2023;S0828-282X(23)00001-6.
15. American College of Emergency Physicians. Ultrasound guidelines: emergency, point-of-care, and clinical ultrasound guidelines in medicine [policy statement]. Approved April 2023. Accessed July 2023: https://www.acep.org/patient-care/policy-statements/ultrasound-guidelines-emergency-point-of--care-and-clinical-ultrasound-guidelines-in-medicine
16. Teran F, Prats MI, Nelson BP, et al. Focused Transesophageal Echocardiography During Cardiac Arrest Resuscitation: JACC Review Topic of the Week. *J Am Coll Cardiol*. 2020;76(6):745-54.
17. American College of Emergency Physicians. Guideline for Ultrasound Transducer Cleaning and Disinfection [policy statement]. Approved April 2021. Accessed July 2023: https://www.acep.org/patient-care/policy-statements/guideline-for-ultrasound-transducer-cleaning-and-disinfection