Maryland ACEP Chapter Educational Conference & Annual Meeting
March 12, 2020

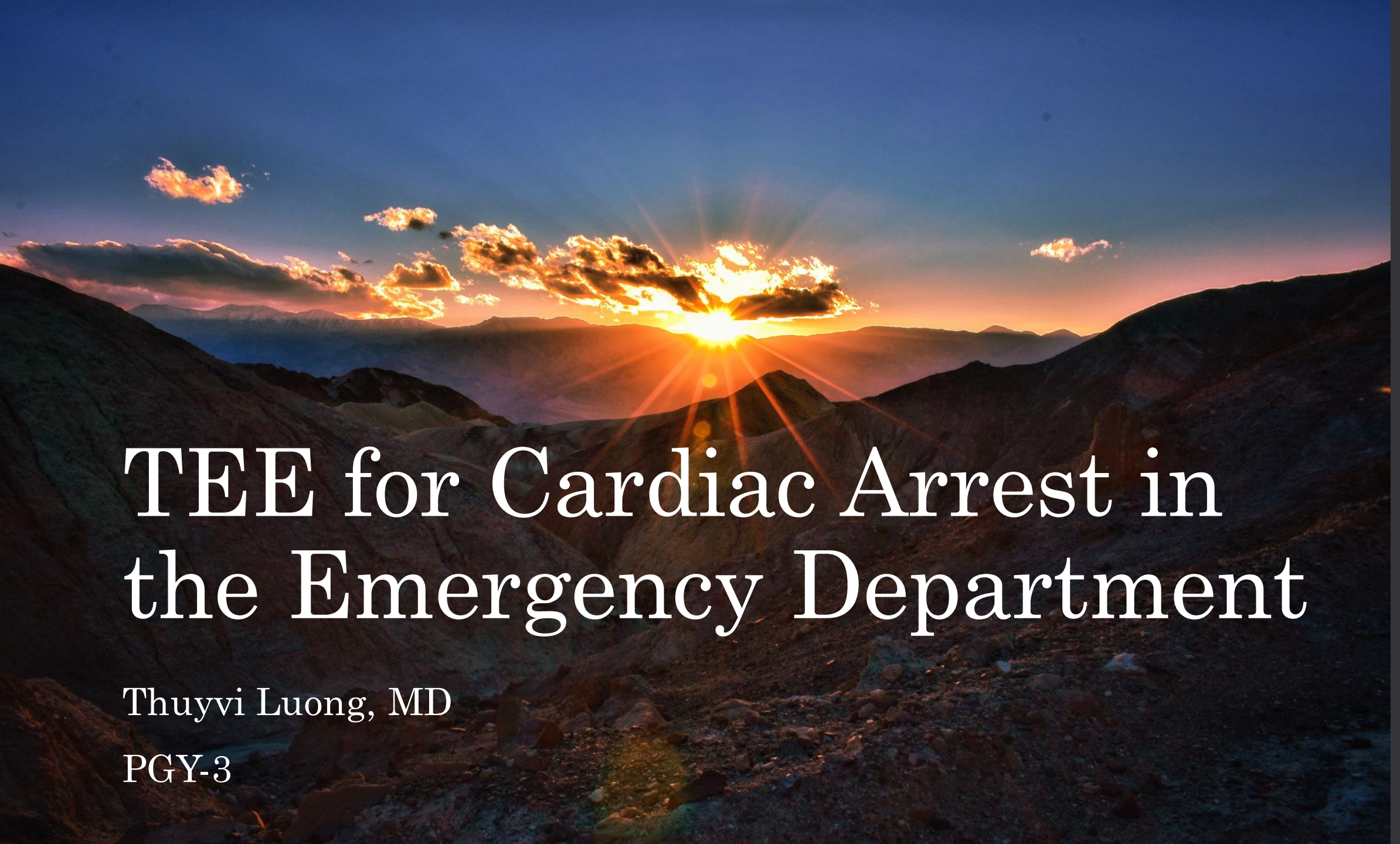
FACULTY: Thuyvi Luong, MD

PRESENTATION
TEE for Cardiac Arrest in the Emergency Department

DESCRIPTION
ACEP published guidelines in 2017 stating that TEE, if available, is the preferred method of bedside echocardiography in cardiac arrest in the emergency department. TEE provides multiple benefits over TTE, which will be discussed in this presentation.

OBJECTIVES
- POC TEE basics.
- Benefits of TEE over TTE
- Role of echo in cardiac arrest.
- Why TEE?
- TEE basics.
- Benefits of TEE in cardiac arrest.

DISCLOSURE
No significant financial relationships to disclose.



TEE for Cardiac Arrest in the Emergency Department

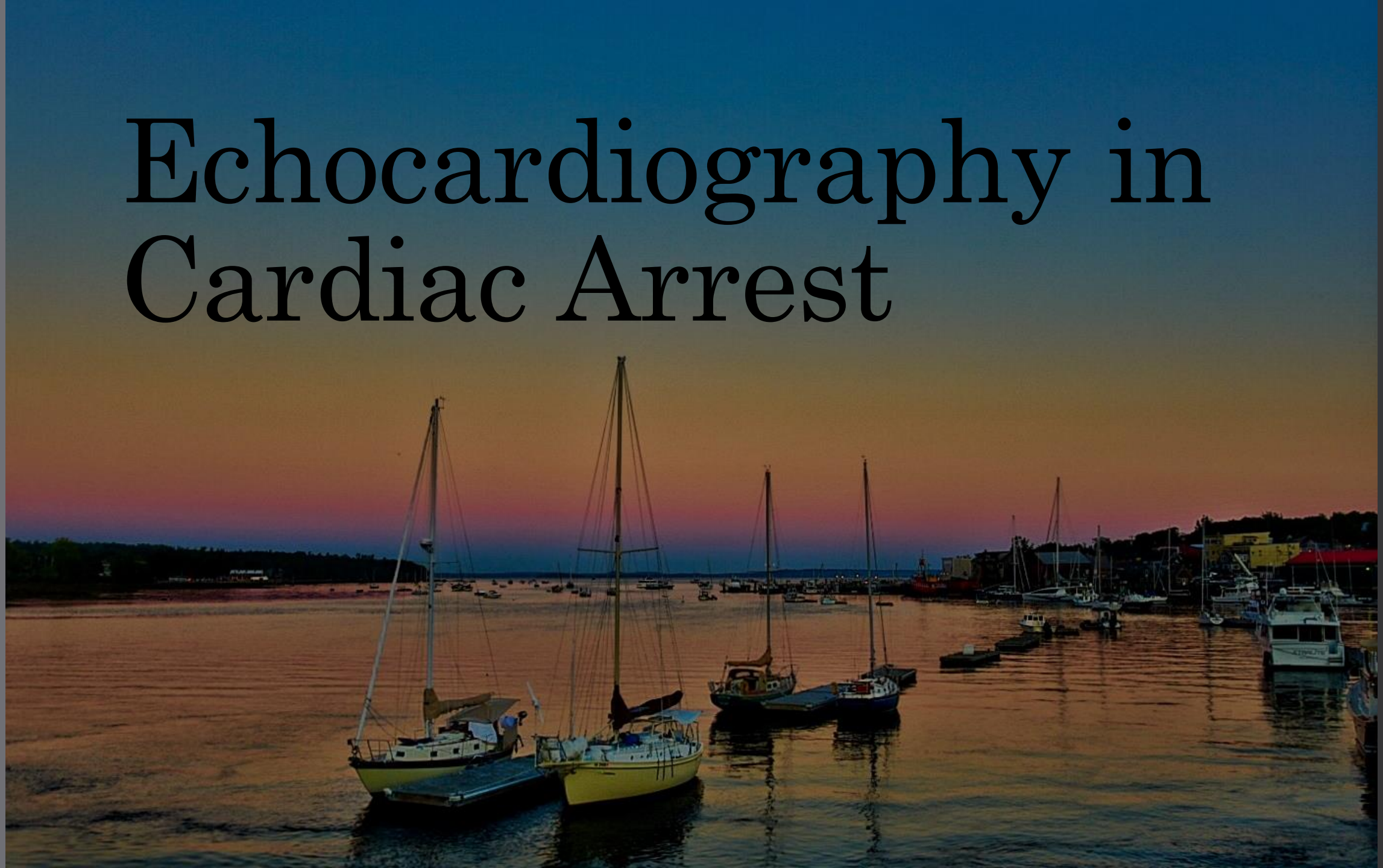
Thuyvi Luong, MD

PGY-3

Objectives

- Role of echocardiography in cardiac arrest
- Why TEE?
- TEE probe
- TEE views
- ACEP guidelines for TEE
- TEE in cardiac arrest
- Feasibility of training EM docs in TEE

Echocardiography in Cardiac Arrest



- Visualization of the heart during ACLS
- Determine presence of cardiac activity
- Identify pathology requiring treatment or procedures outside ACLS protocol
  - Pericardial effusion, tamponade
  - Right heart strain, PE
  - Aortic dissection
  - Wall motion abnormalities

REASON Trial

Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest.

Gaspari R[1], Weekes A[2], Adhikari S[3], Noble VE[4], Nomura JT[5], Theodoro D[6], Woo M[7], Atkinson P[8], Blehar D[9], Brown SM[10], Caffery T[11], Douglass E[4], Fraser J[8], Haines C[12], Lam S[13], Lanspa M[10], Lewis M[2], Liebmann O[14], Limkakeng A[15], Lopez F[16], Platz E[10], Mendoza M[9], Minnigan H[17], Moore C[18], Novik J[19], Rang L[20], Scruggs W[21], Raio C[12].

- First large multicenter study of use of POCUS during ACLS
- Focused on patients in PEA arrest
- EPs performing the TTEs were not RDMS certified or fellowship trained in POCUS, makes this study more generalizable
- Echo interpretation kappa coefficient 0.63

REASON Trial

- Patients with cardiac activity on US associated with higher rate of ROSC and survival to admission and discharge than patients without cardiac activity on US
- 54% of patients in PEA arrest had cardiac activity on US
- 51% of patients in PEA arrest with cardiac activity on US had ROSC

REASON Trial

- Identify reversible causes of cardiac arrest, i.e. tamponade or right heart strain
  - 15.4% of patients with pericardial effusion survived to discharge after pericardiocentesis
  - 6.7% of patients with right heart strained and presumed PE survived to discharge after TPA

REASON Trial

- Primary outcome was survival
- Neurologic outcome of survivors not assessed

Why TEE?

The Perks

- Echocardiographic imaging in cardiac arrest
  - Determine presence or lack of cardiac activity
  - Can help determine rhythm and diagnose pathology
- Studies have shown benefit in using TEE over TTE in cardiac arrest
  - Continuous cardiac imaging throughout resuscitation
  - Out of the way of CPR
  - Quicker pulse check times
  - Assess quality of CPR
- Wall motion abnormality
- ECMO cannulation

Pitfalls of TTE During Cardiac Arrest

- Prolonged pulse check times have been consistently demonstrated in studies regarding use of TTE in arrest
- Difficulty obtaining adequate windows due to lung disease, air in the stomach, or body habitus
- Defibrillator pads or LUCAS device in the way
- In the way of chest compressions
- Crowding with other personnel

Resuscitation. 2017 Oct;119:95-98. doi: 10.1016/j.resuscitation.2017.07.021. Epub 2017 Jul 25.

Ultrasound use during cardiopulmonary resuscitation is associated with delays in chest compressions.

Huis In 't Veld MA[1], Allison MG[2], Bostick DS[1], Fisher KR[3], Goloubeva OG[4], Witting MD[5], Winters ME[6].

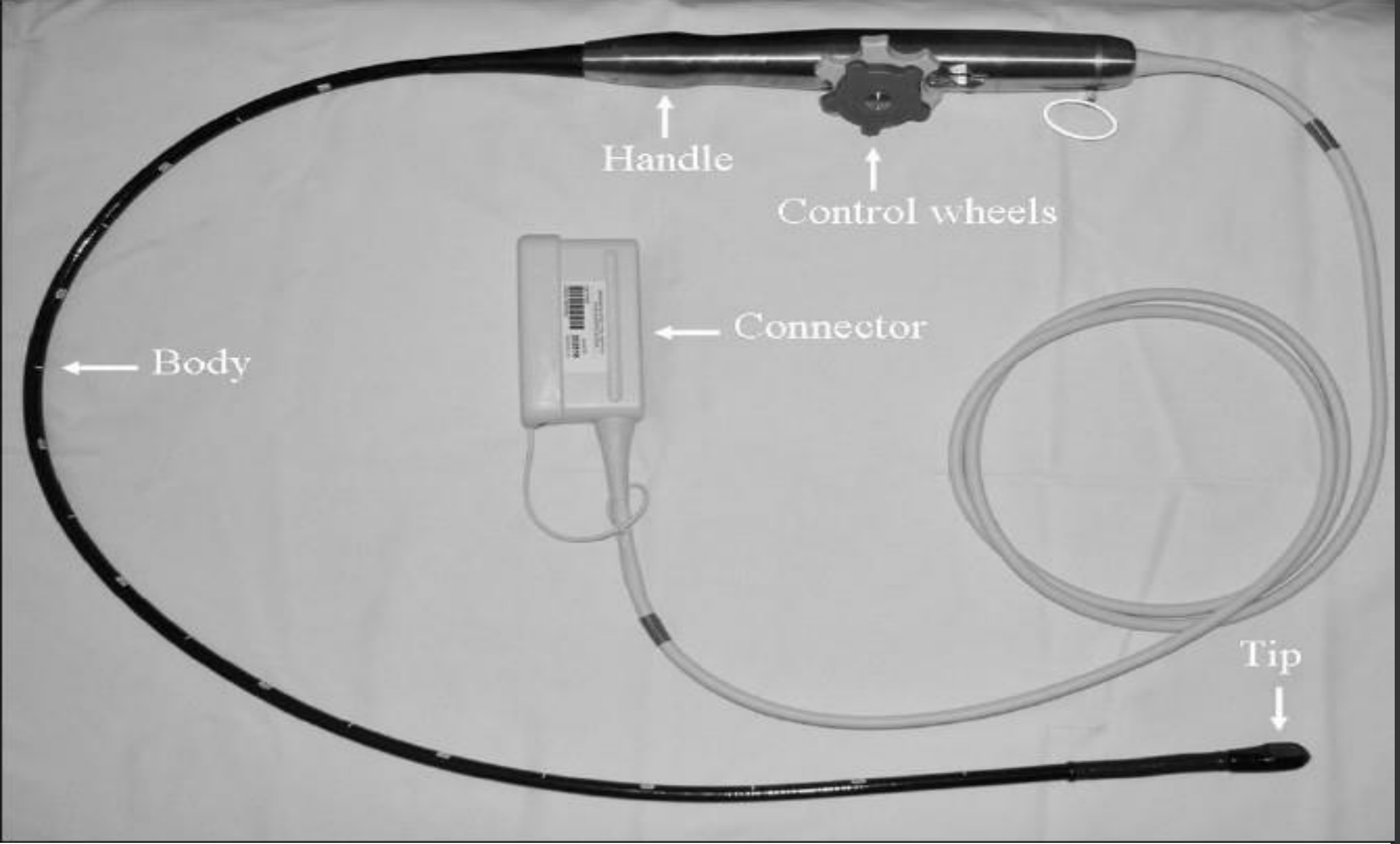
Resuscitation. 2018 Jan;122:65-68. doi: 10.1016/j.resuscitation.2017.11.056. Epub 2017 Nov 23.

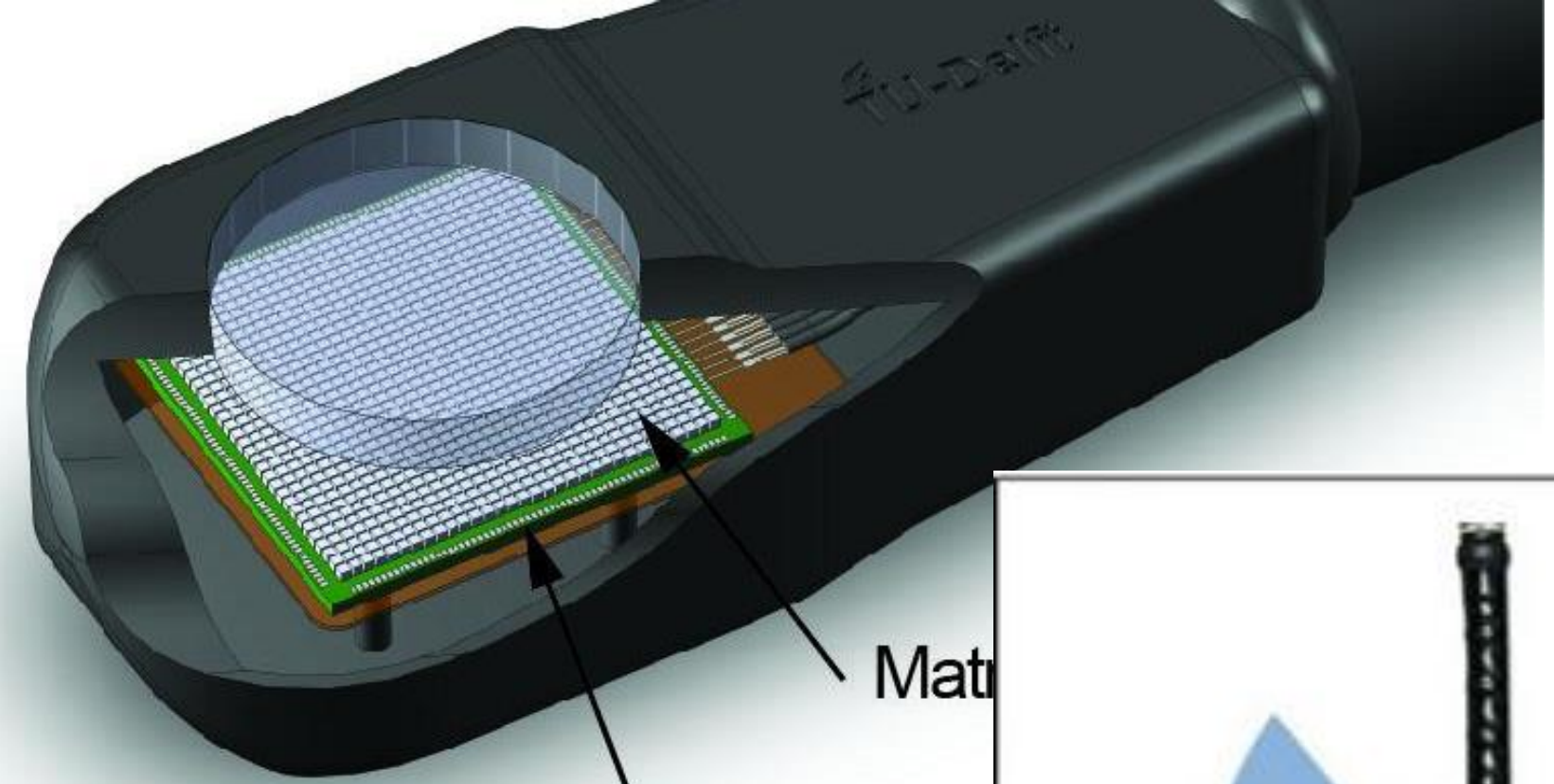
Point-of-care ultrasound use in patients with cardiac arrest is associated prolonged cardiopulmonary resuscitation pauses: A prospective cohort study.

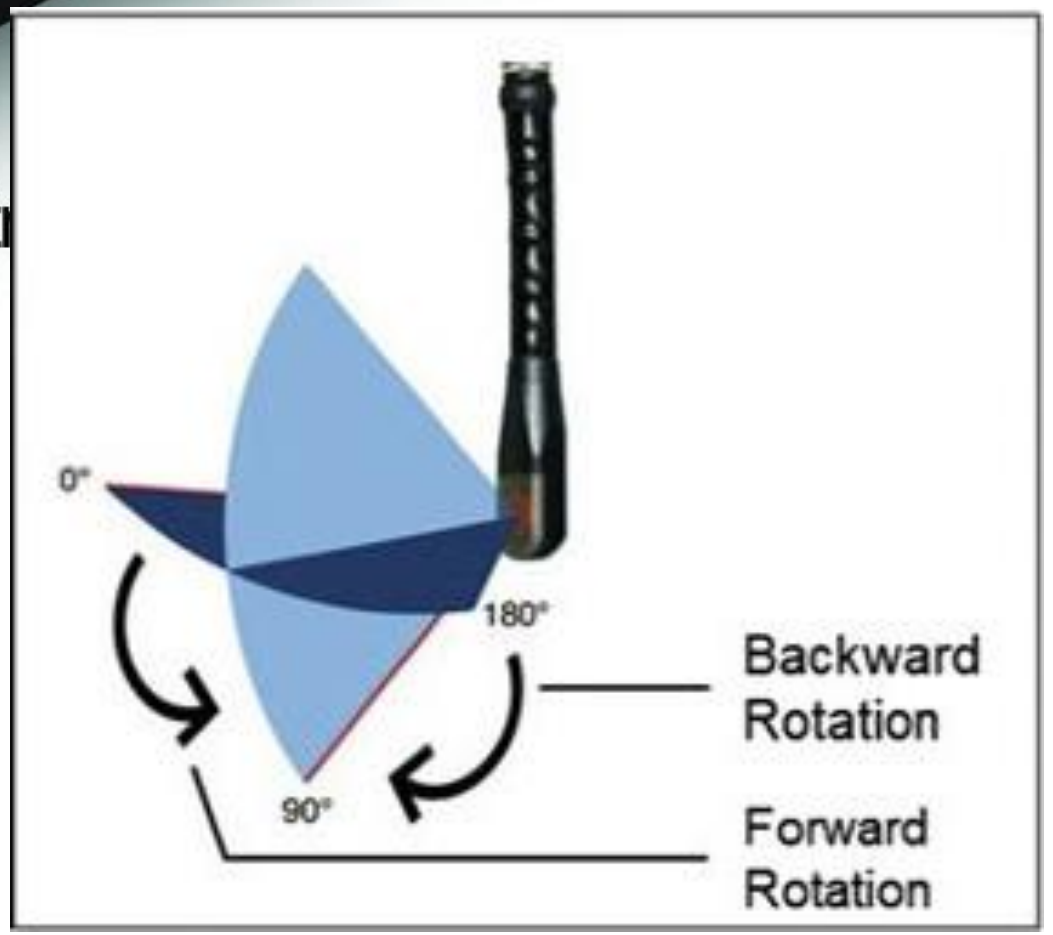
Clattenburg EJ[1], Wroe P[2], Brown S[3], Gardner K[2], Losonczy L[2], Singh A[2], Nagdev A[4].

- Studies are small although have consistently shown that POCUS during cardiac arrest is associated with prolonged pulse check times
- Well known that prolonged pulse check times have effect on perfusion and cardiac arrest outcomes and mortality

TEE Probe

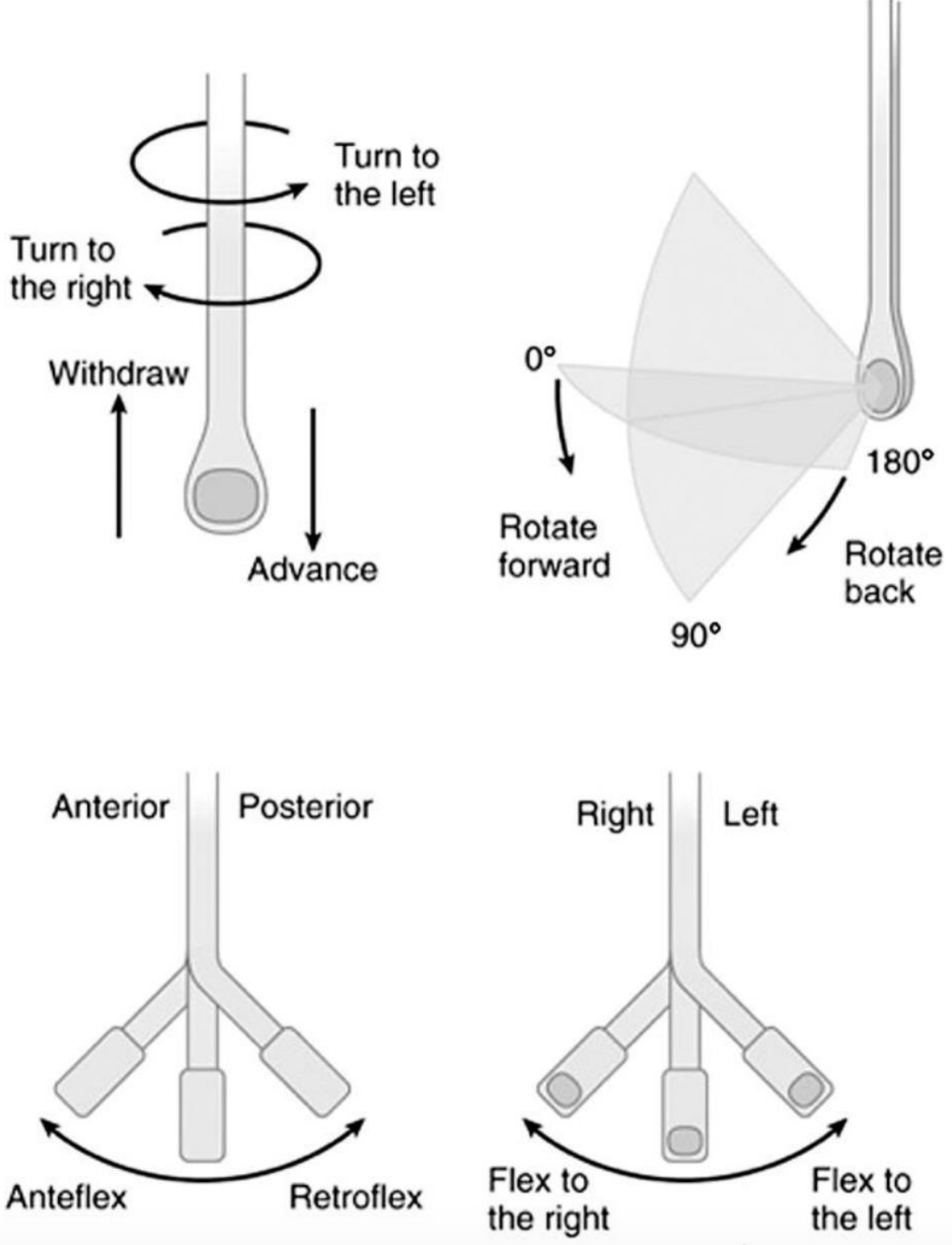

Handle
Control wheels
Connector
Body
Tip

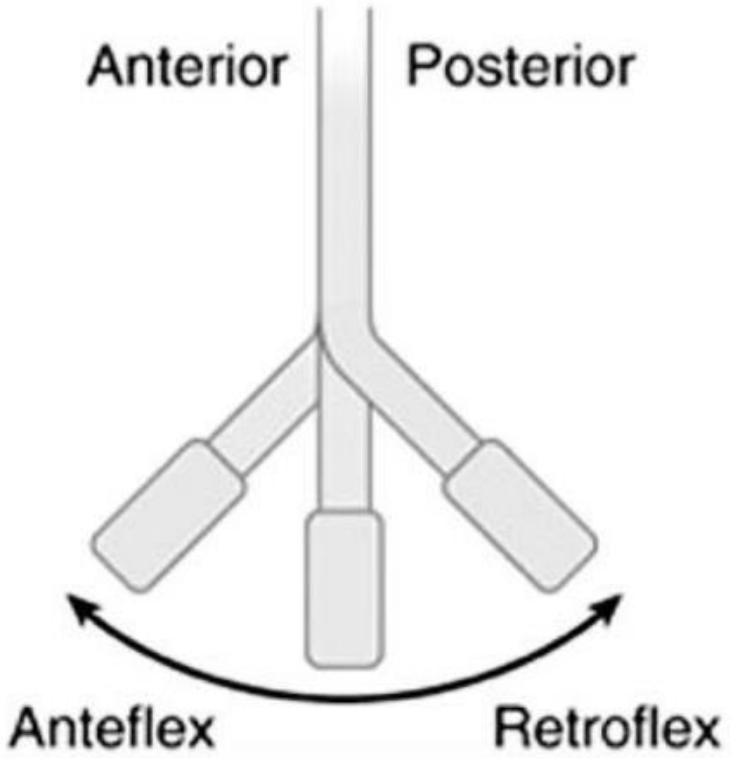

ASIC
Matr

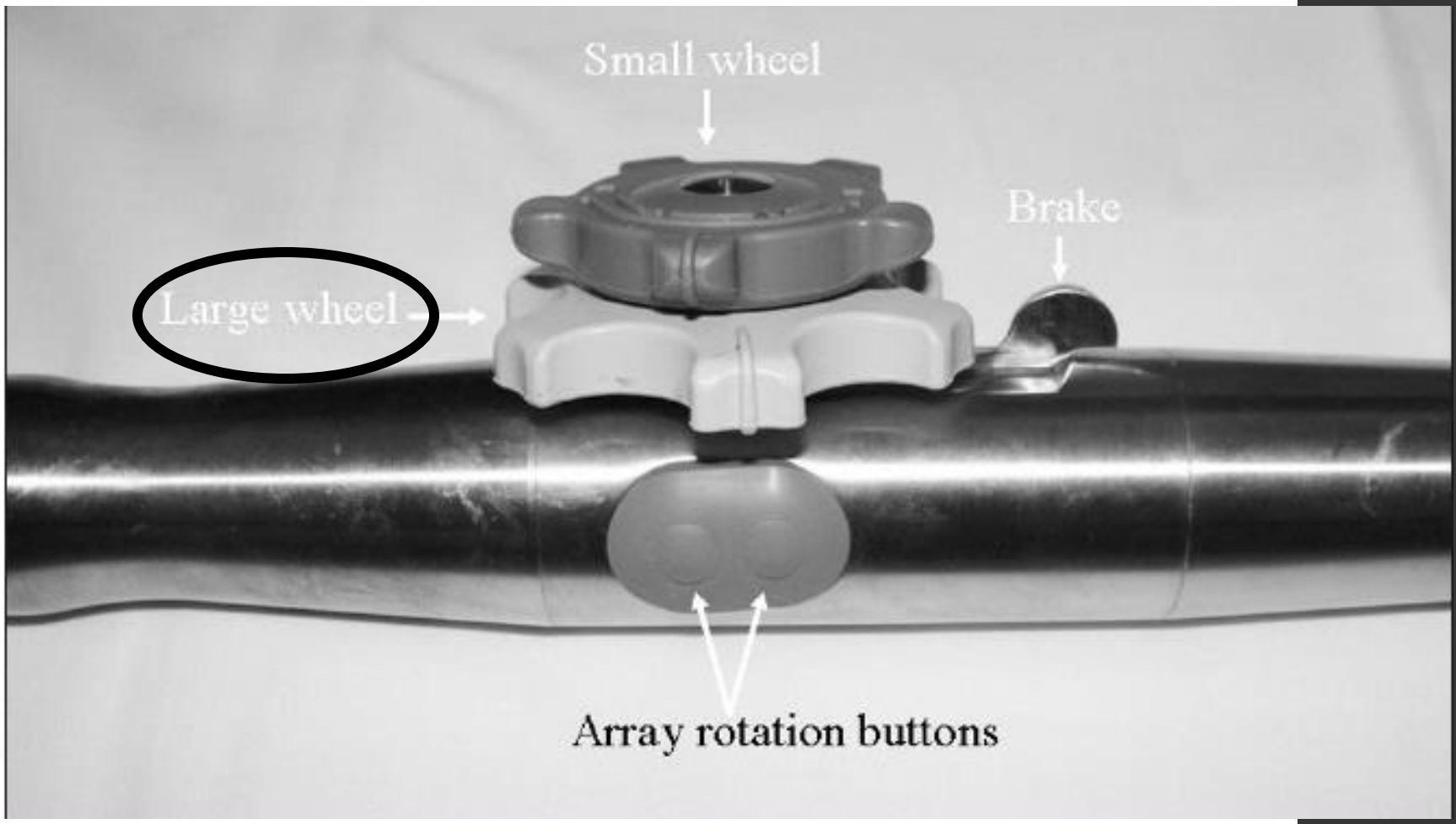

0°
180°
90°
Backward Rotation
Forward Rotation

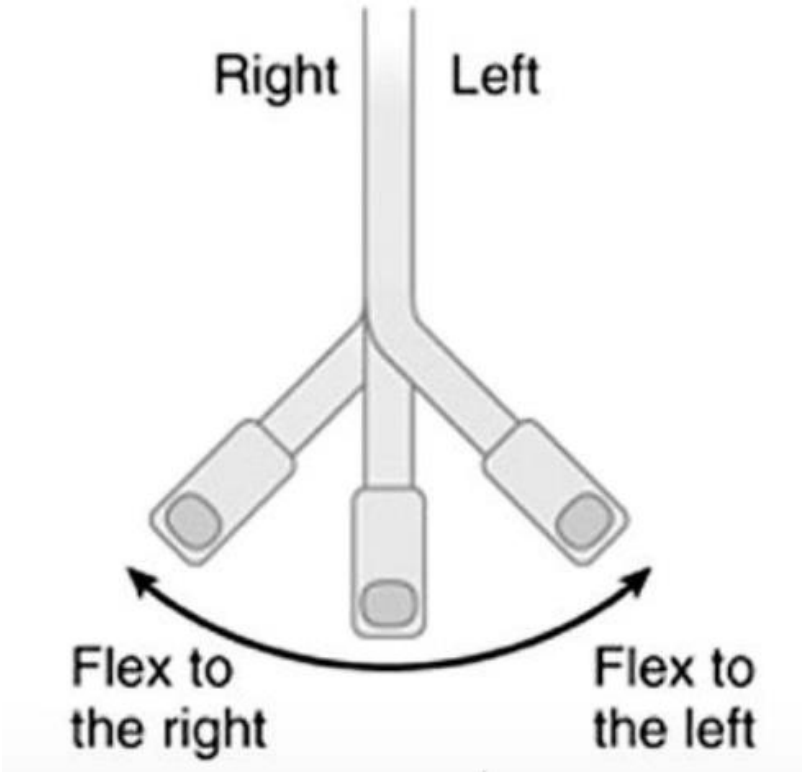
TEE Probe Movements

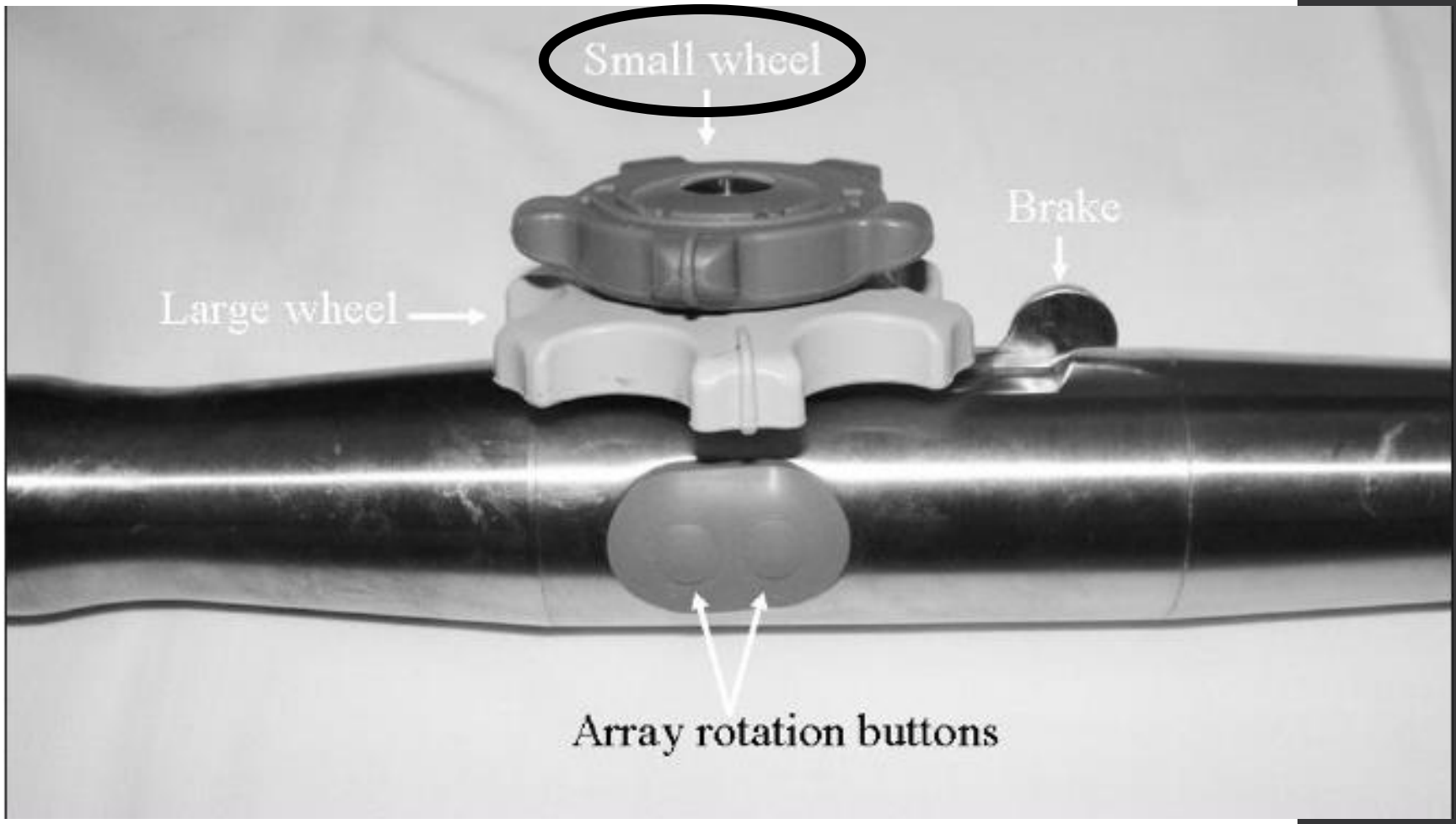
- Advance/withdraw
- Rotate clockwise/counterclockwise
- Anteflex/retroflex
- Flex right and left
- Rotate beam

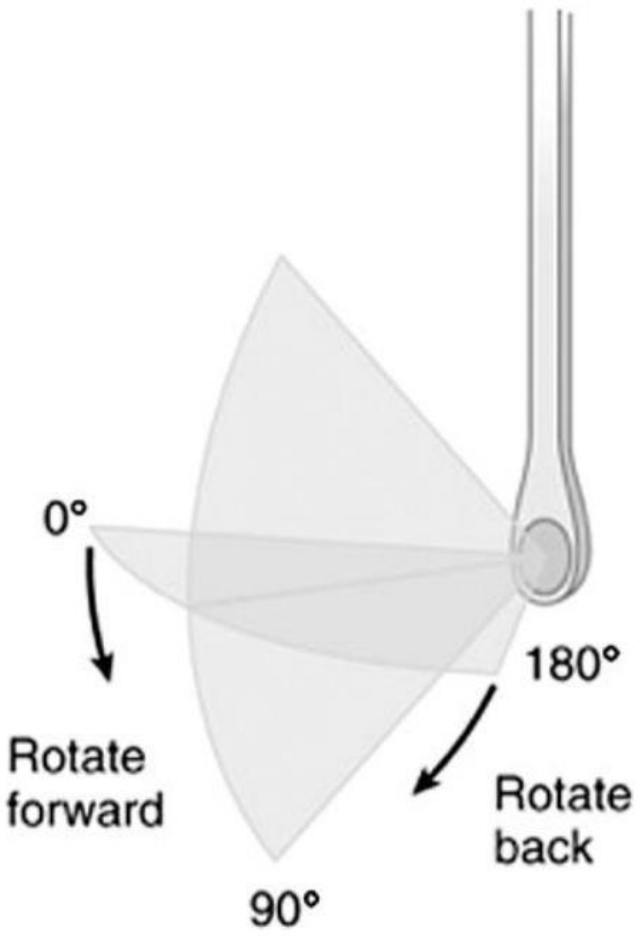


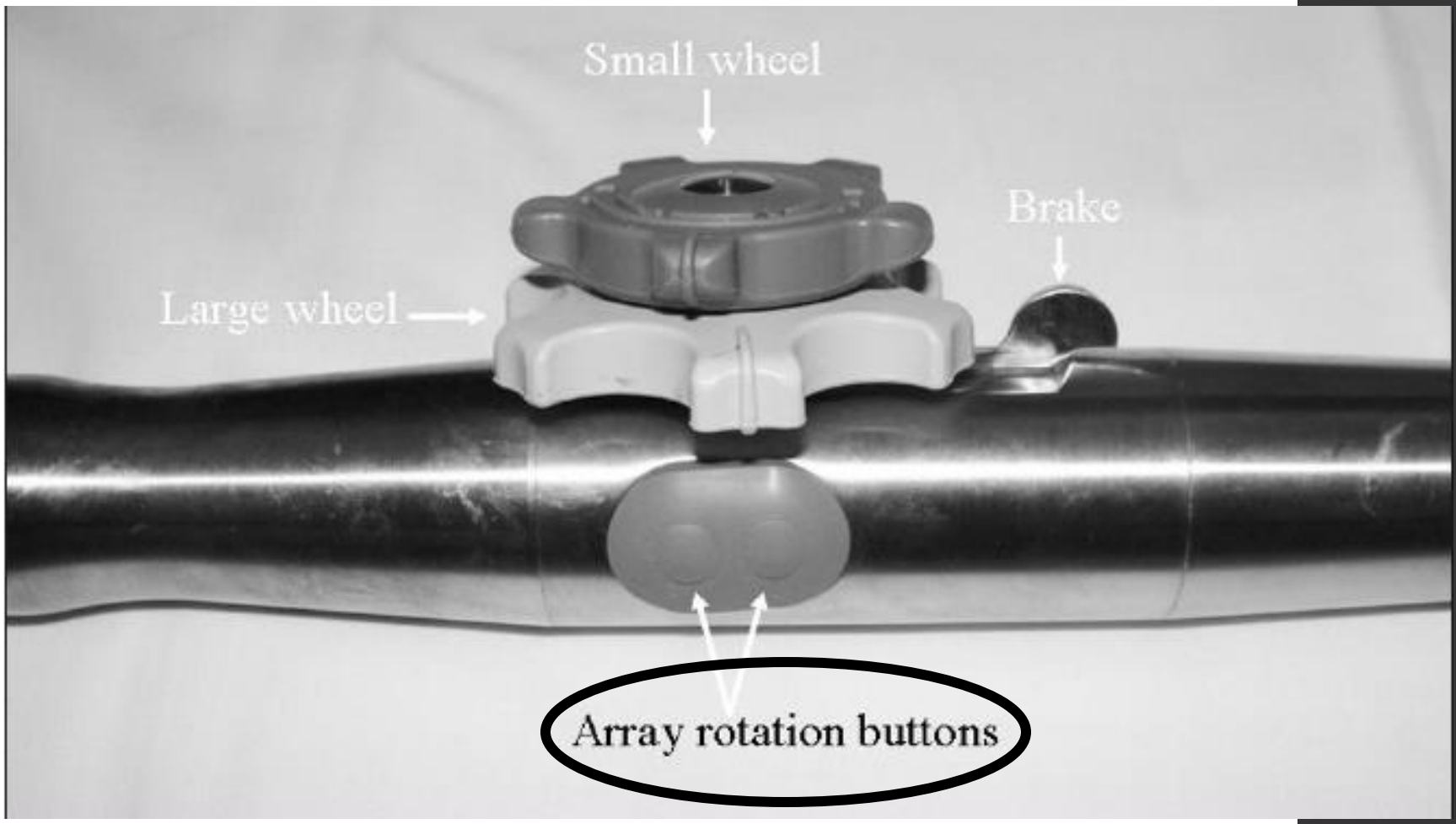

Anterior
Posterior
Anteflex
Retroflex


Small wheel
Brake
Large wheel
Array rotation buttons


Right
Left
Flex to
the right
Flex to
the left


Small wheel
Brake
Large wheel
Array rotation buttons


0°
180°
Rotate forward
Rotate back
90°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Brake
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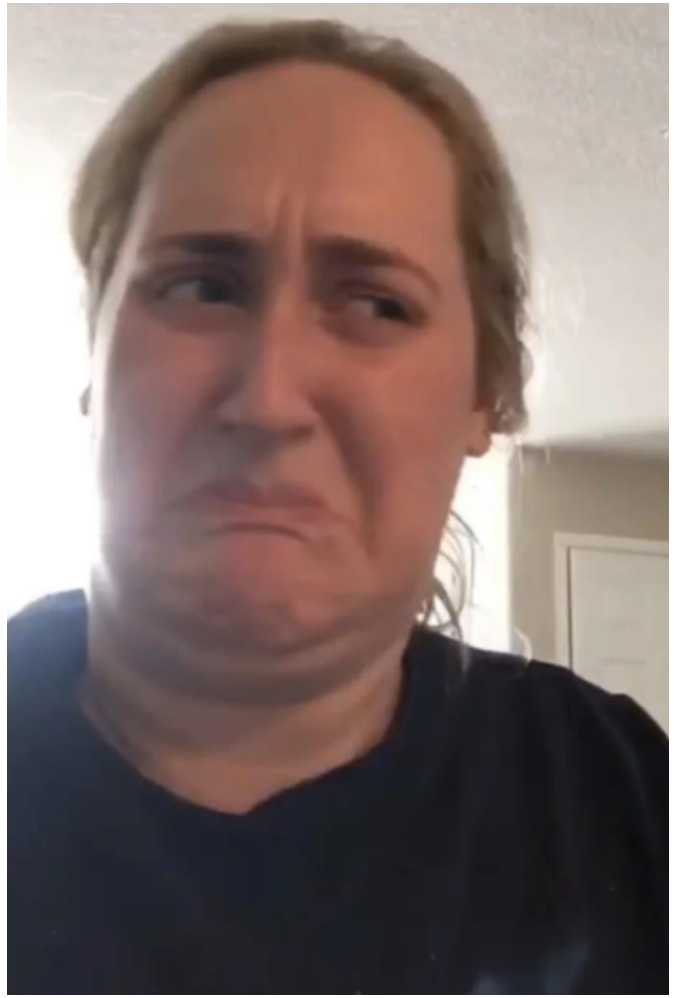
TEE Views

Cardiology

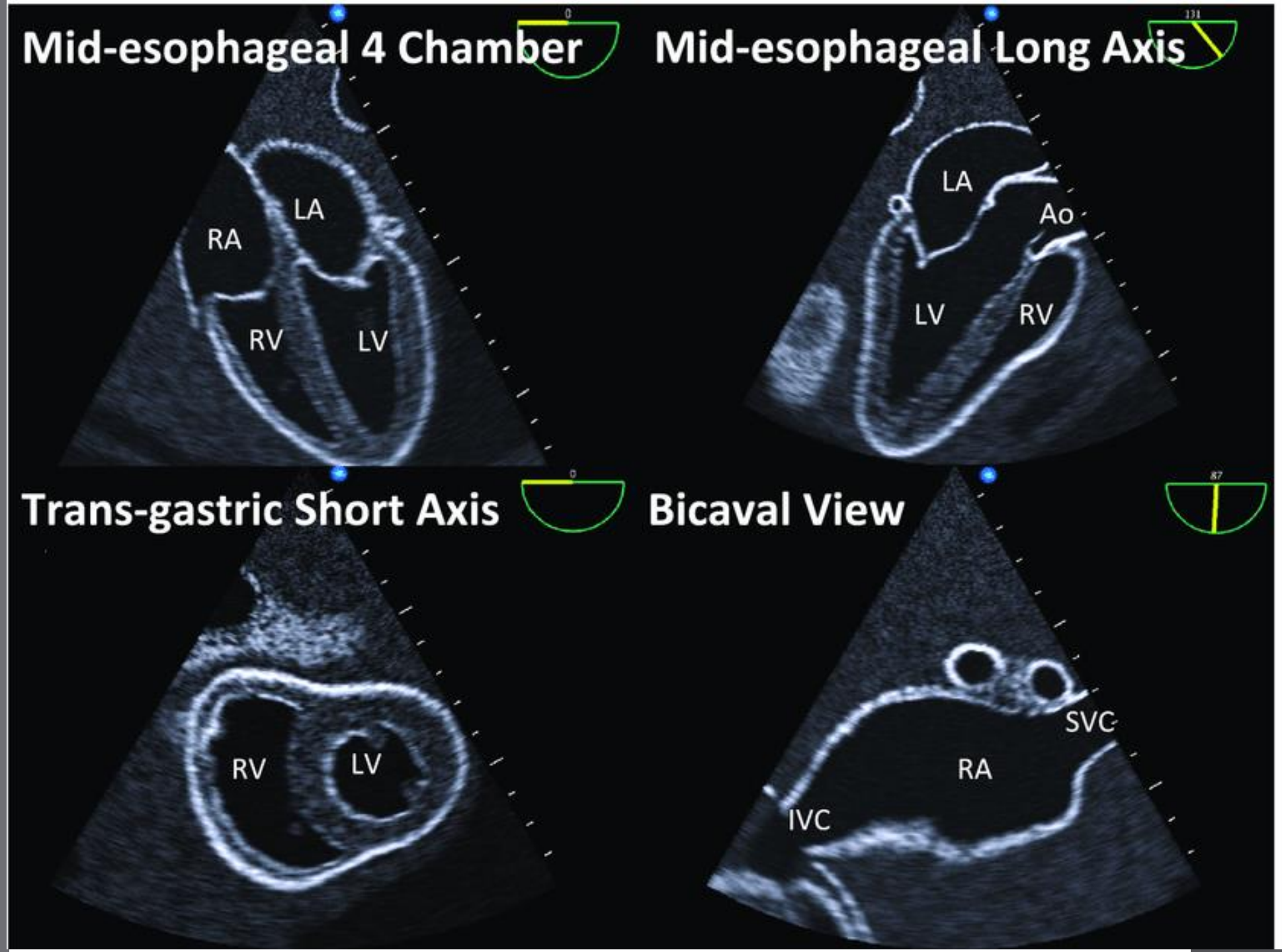
- 20-28 views for comprehensive TEE



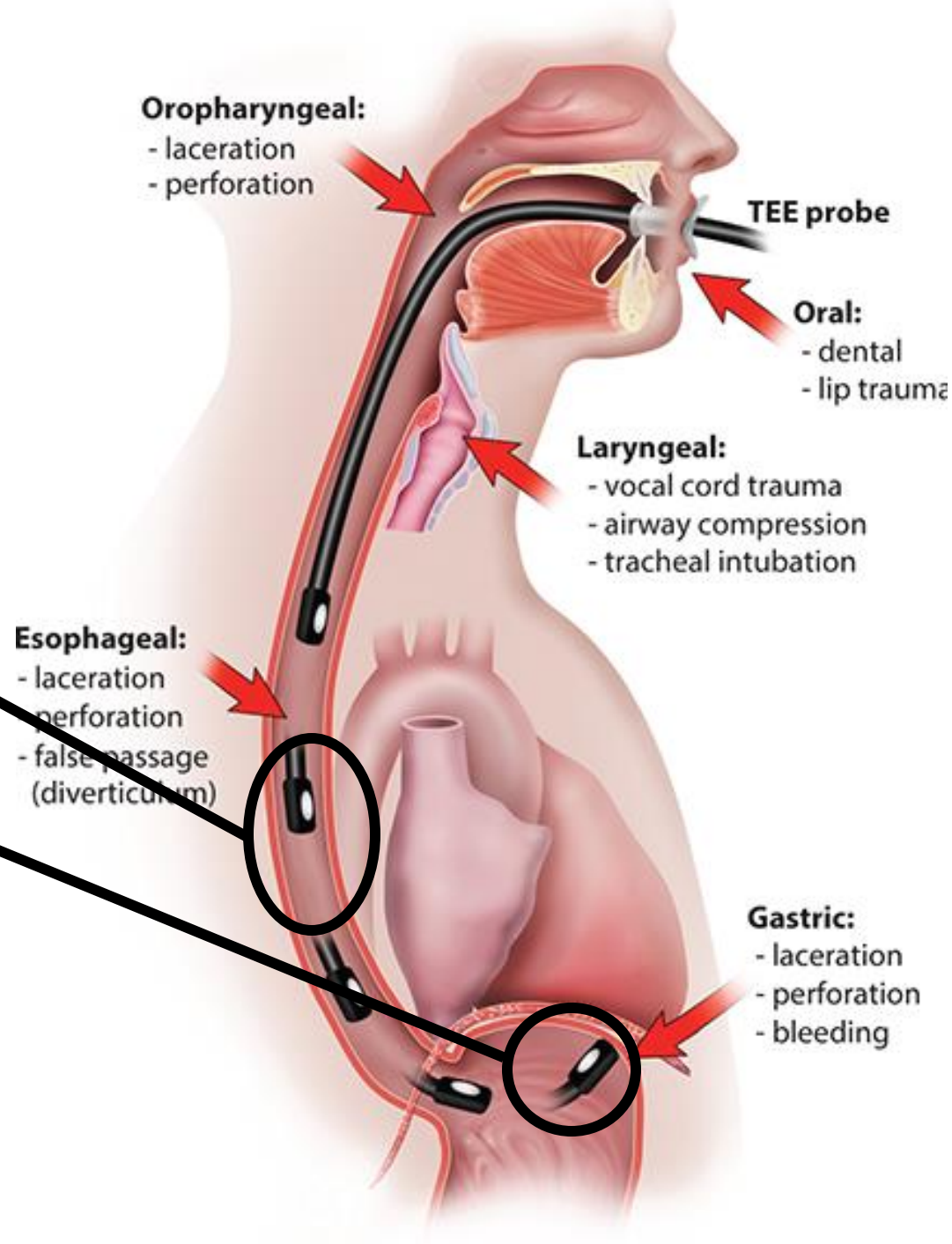
ED

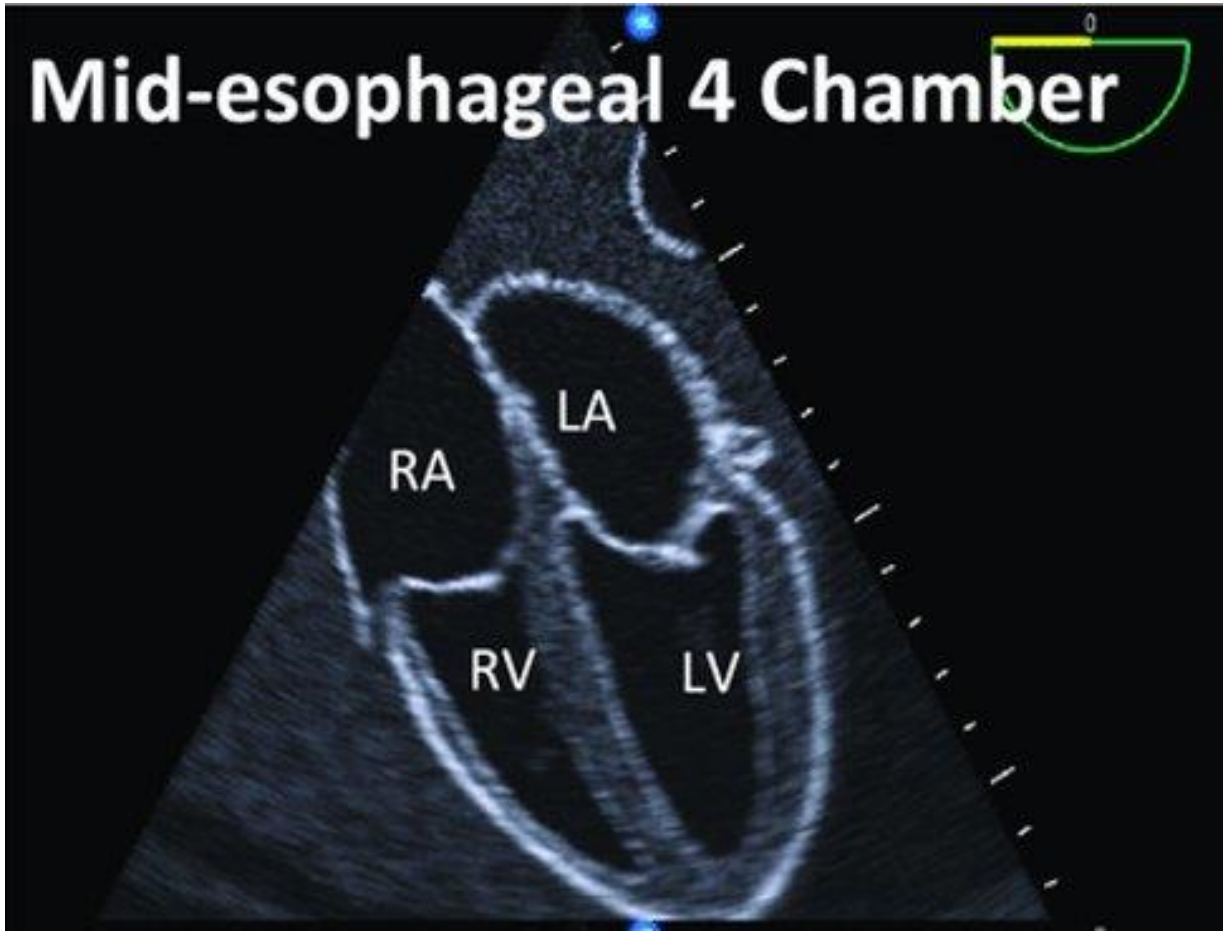
- 3-4 views during ACLS


AIN'T NOBODY GOT
TIME FOR THAT


Mid-esophageal 4 Chamber
LA
RA
RV
LV
Mid-esophageal Long Axis
LA
Ao
LV
RV
Trans-gastric Short Axis
RV
LV
Bicaval View
SVC
RA
IVC

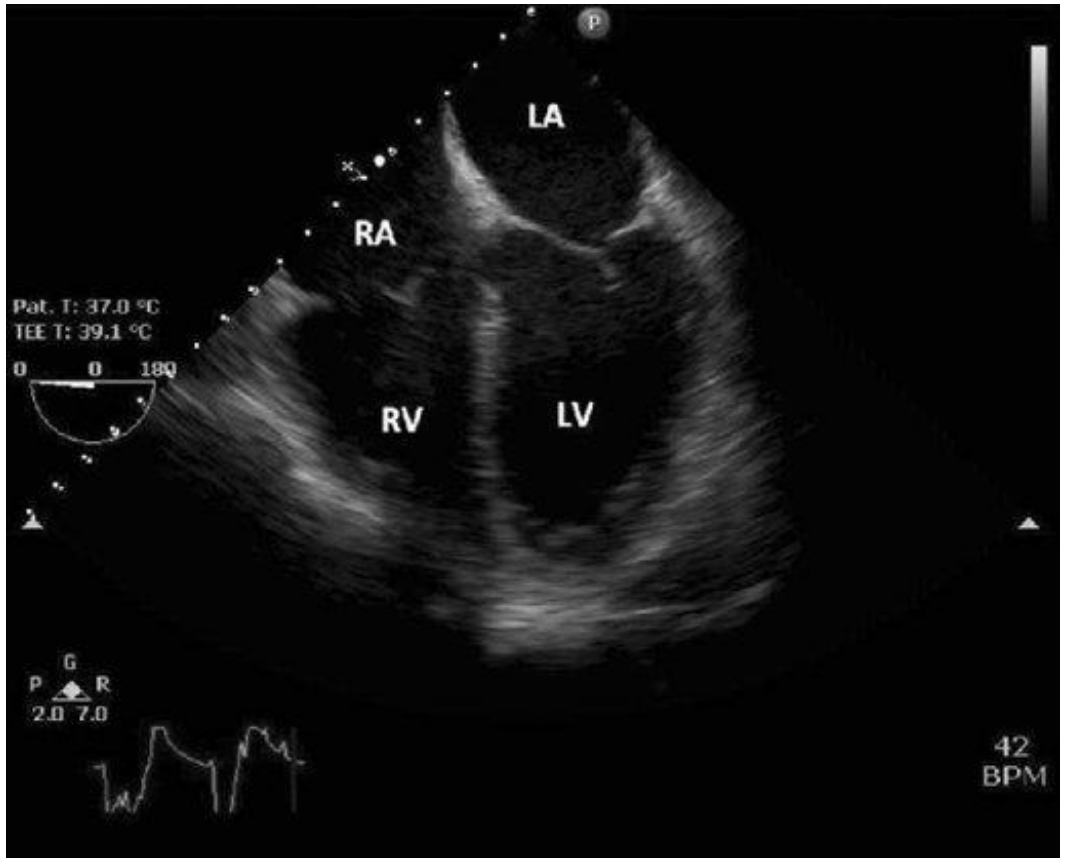
- Probe inserted with transducer facing anteriorly
- Midesophageal views
- Transgastric view



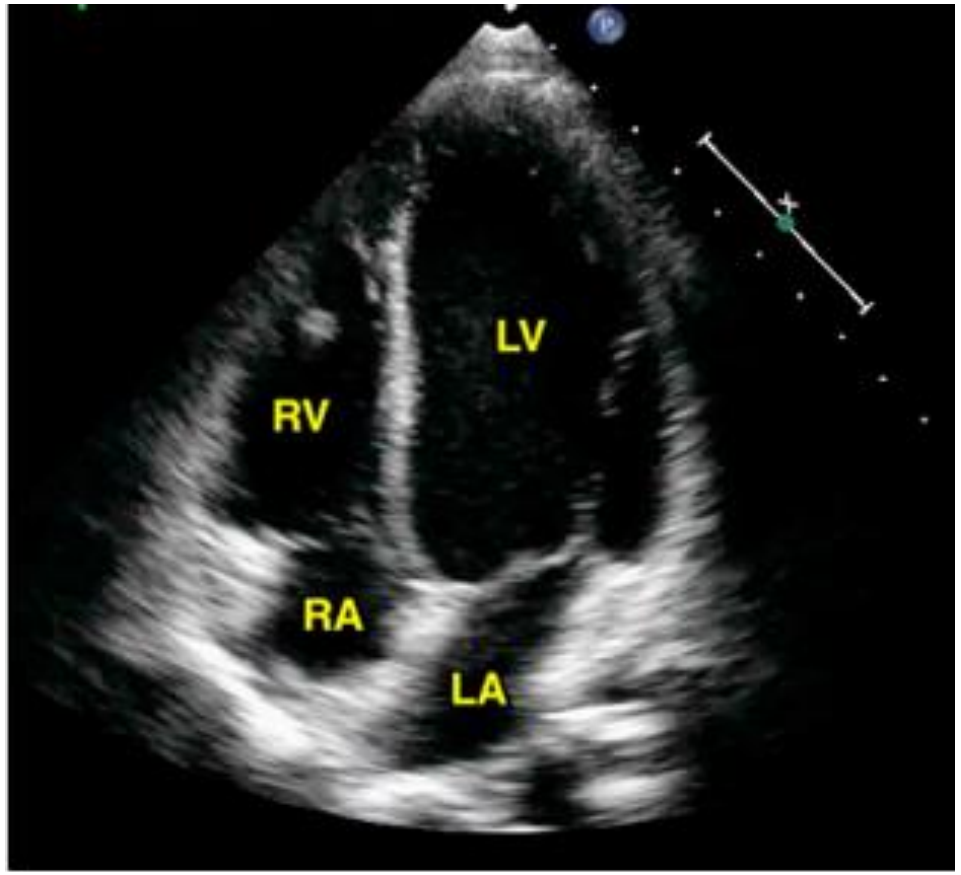


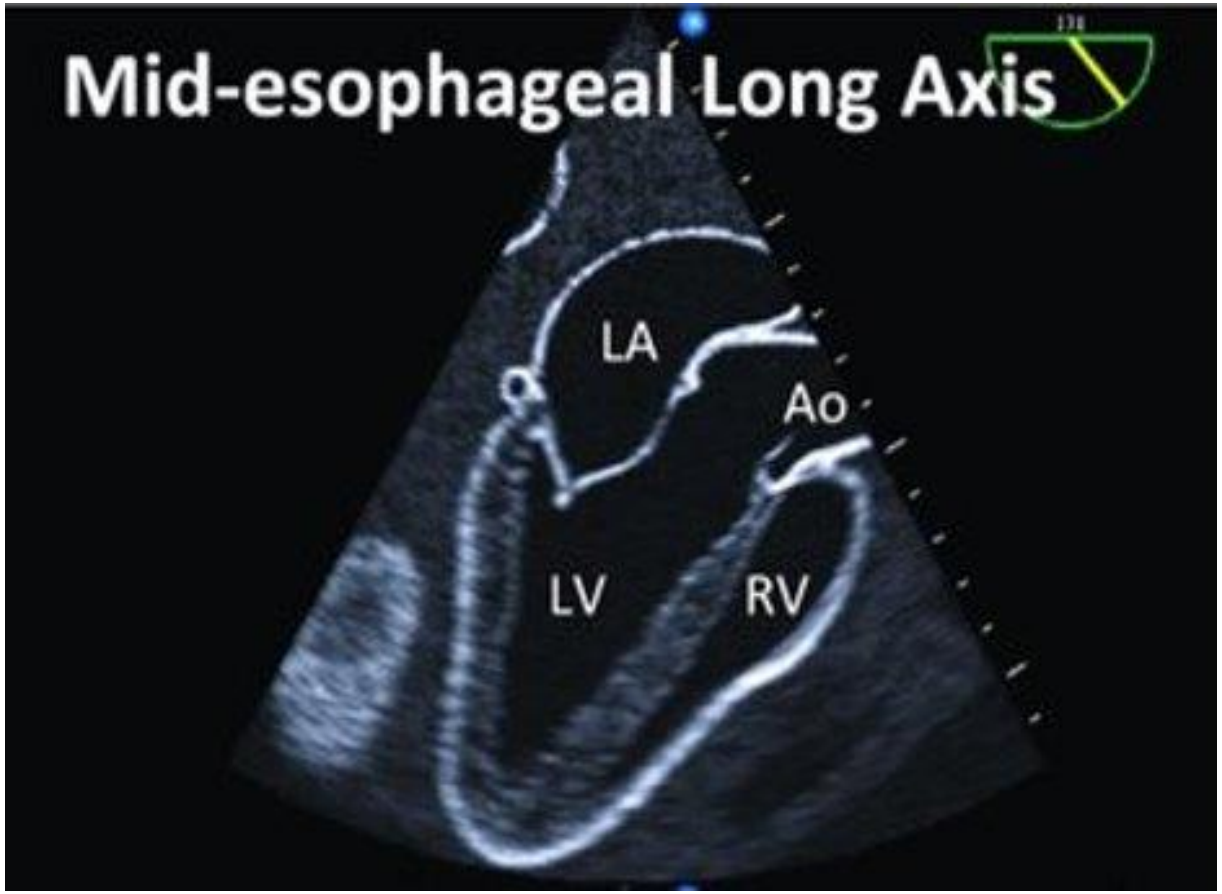
- 0 degrees

Midesophageal 4 Chamber



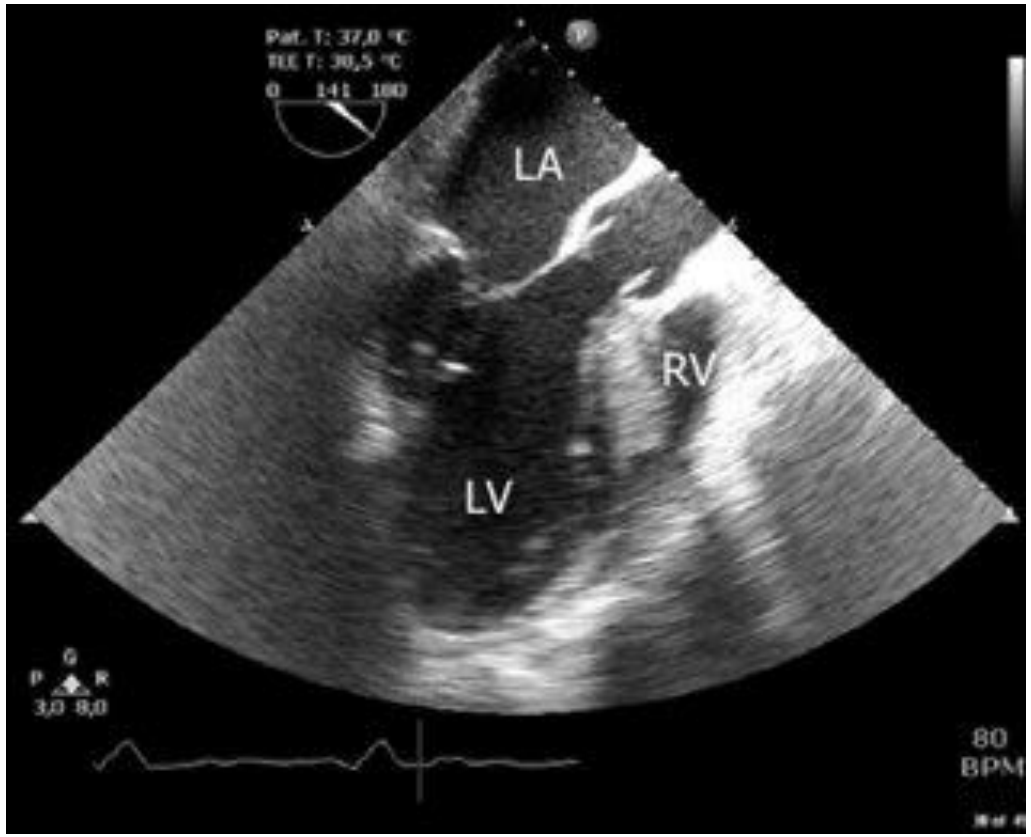
Apical 4



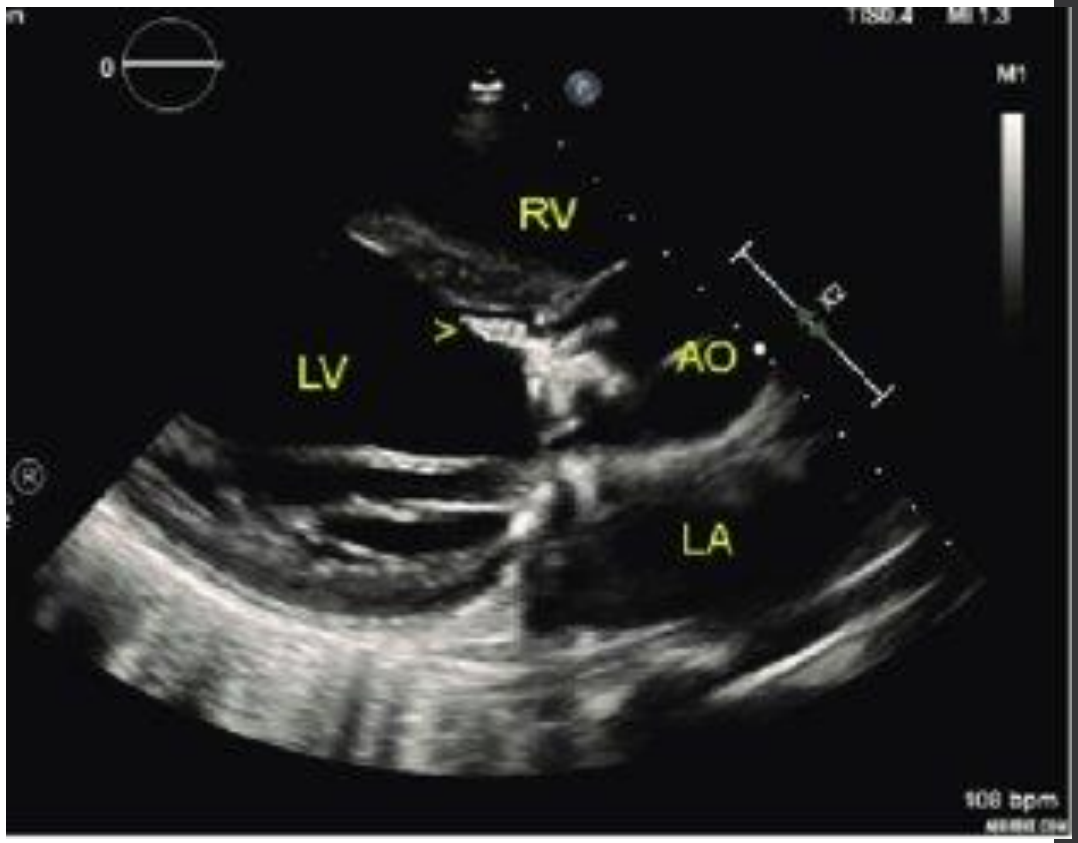


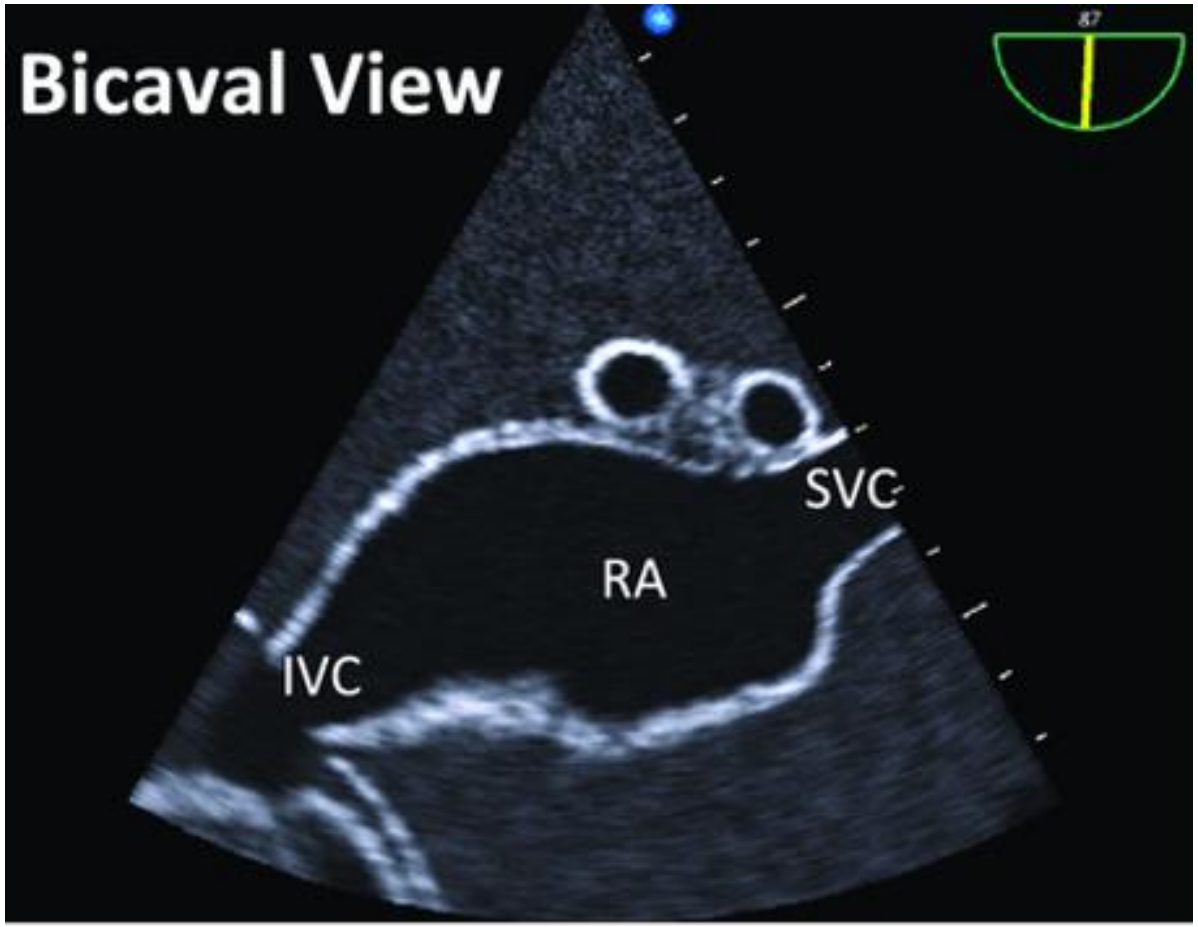
- 120 degrees

Midesophageal Long Axis



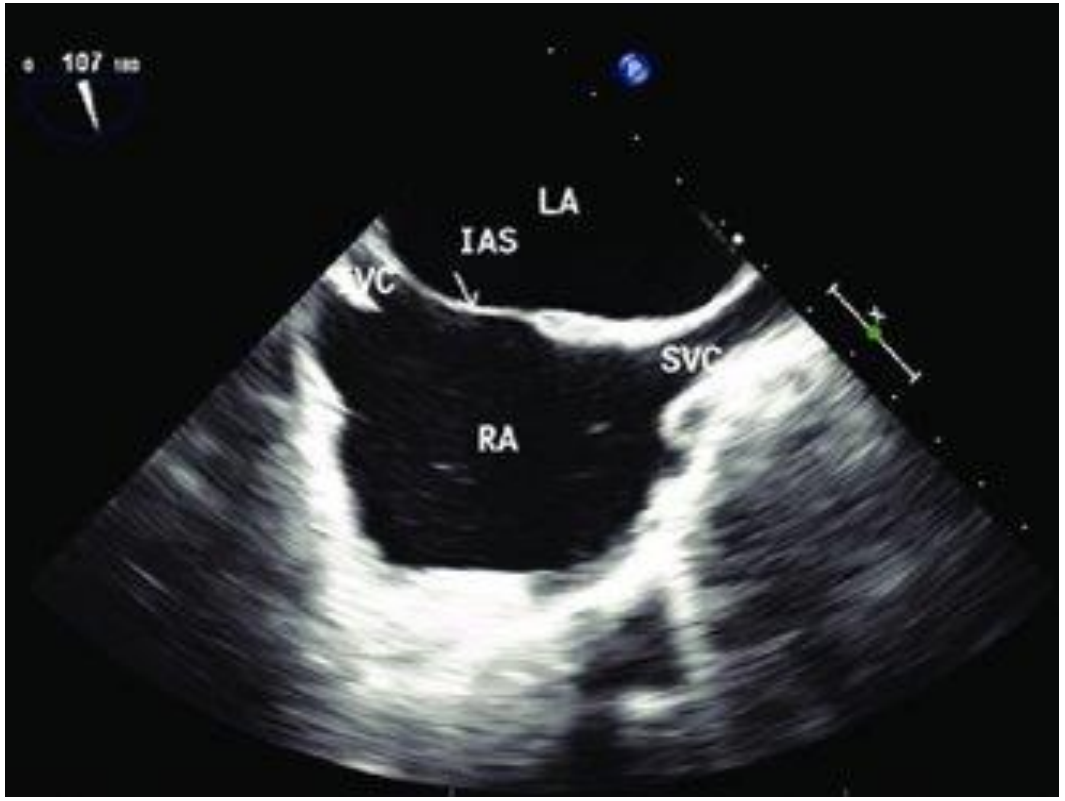
Parasternal Long Axis



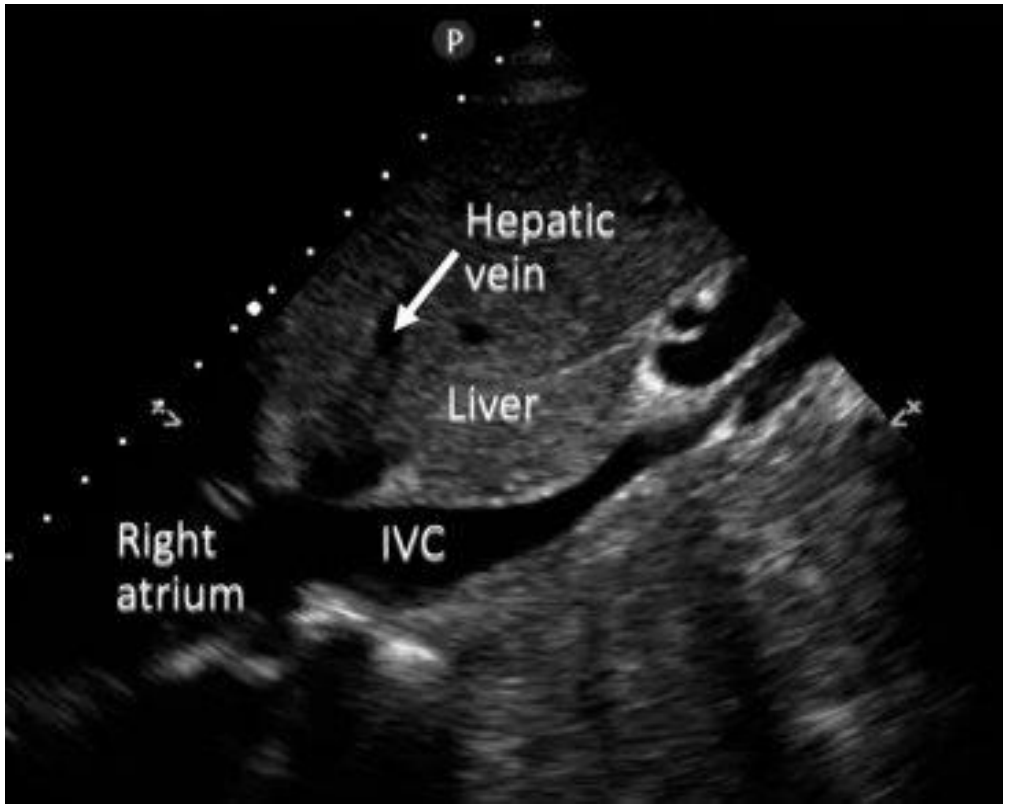


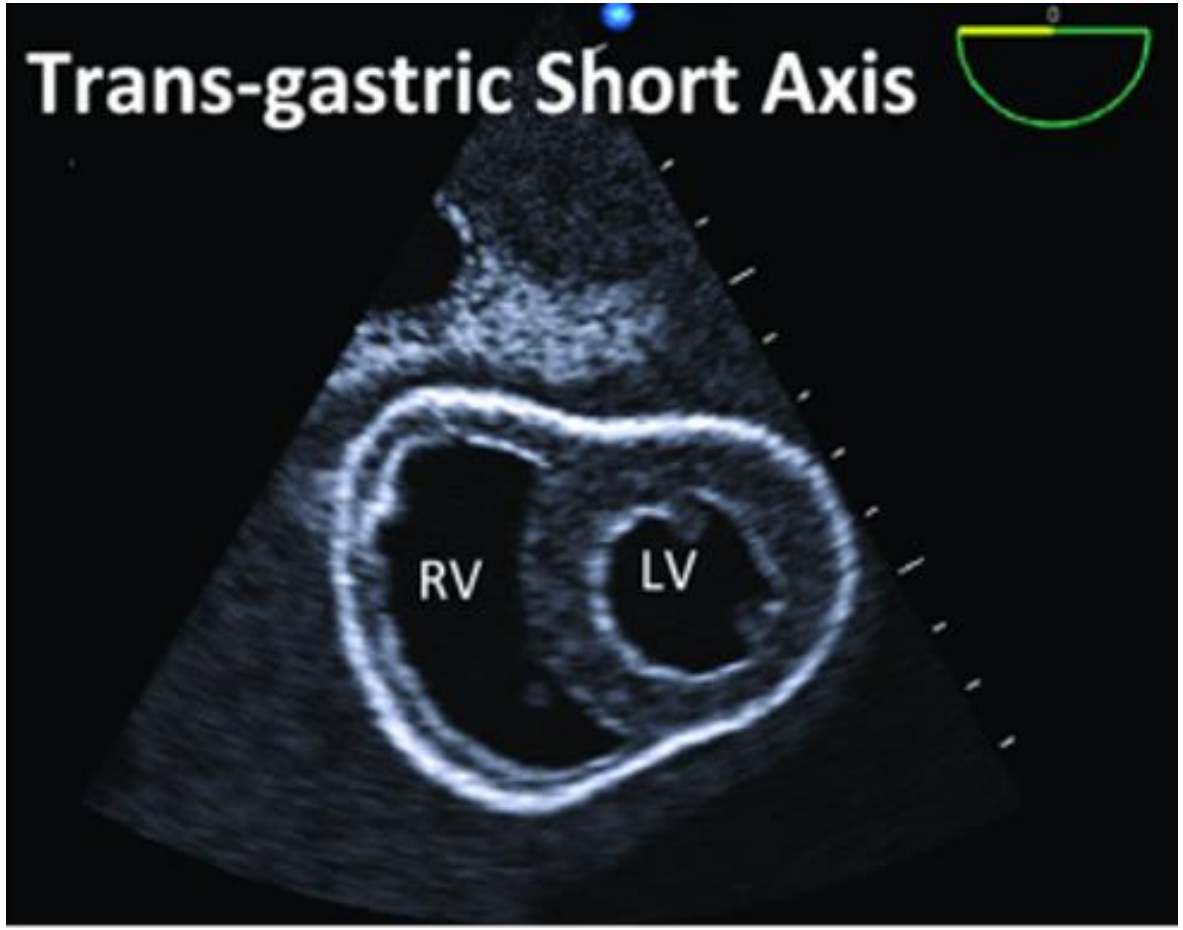
- Midesophageal
- 90 degrees

Bicaval View



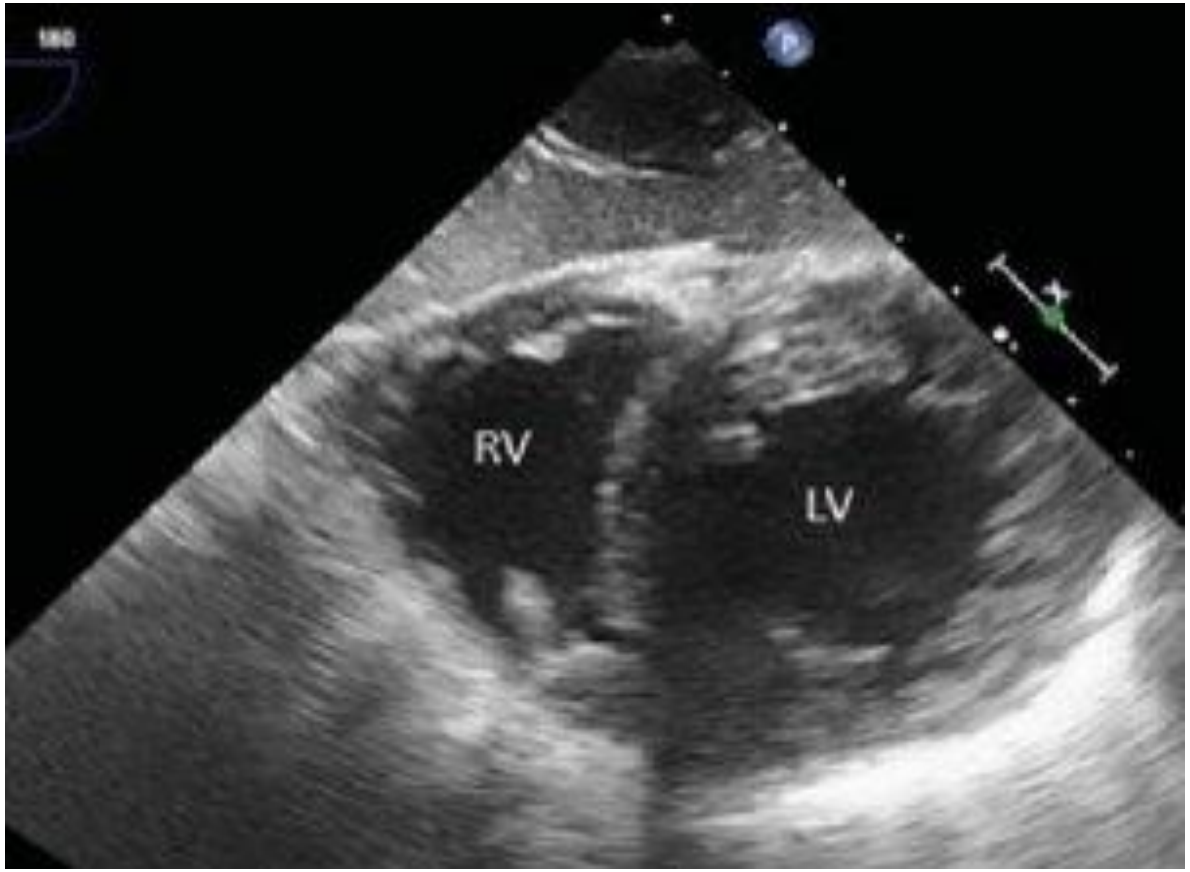
Subcostal IVC



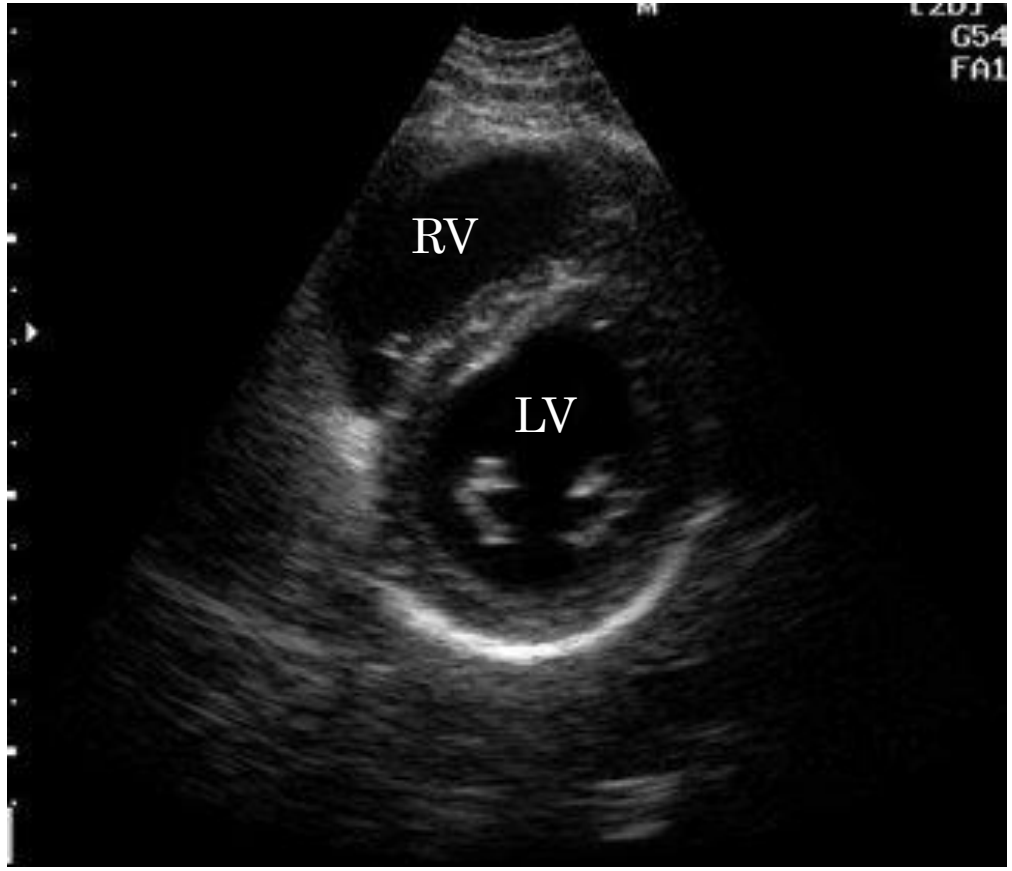


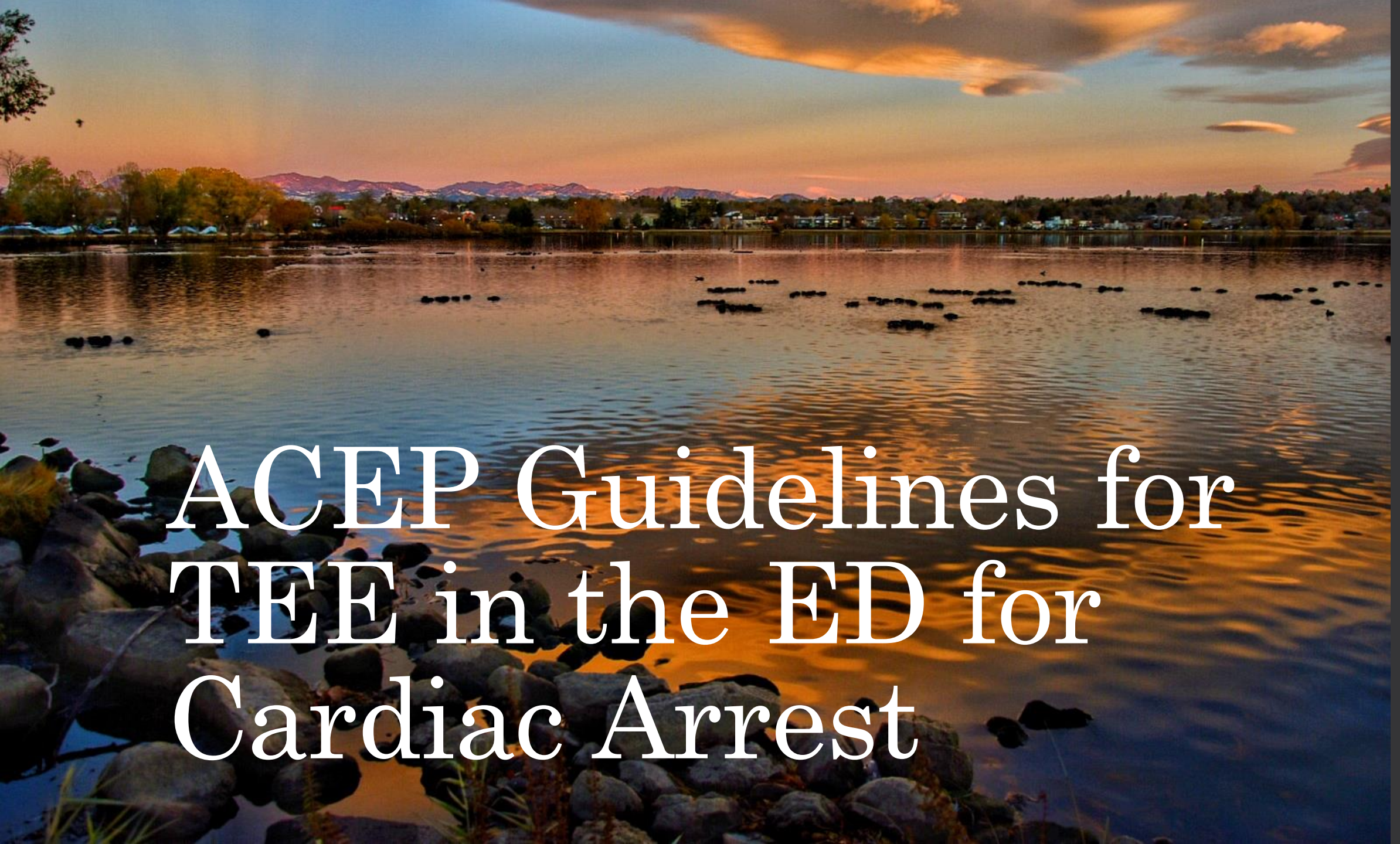
- Advance probe into stomach and anteflex
- Retract probe until short axis comes into view
- 0 degrees

Transgastric Short Axis



Parasternal Short Axis





ACEP Guidelines for TEE in the ED for Cardiac Arrest

Objectives

- Identify presence/absence of cardiac activity
- Identify cardiac rhythm
- Evaluation of left and/or right ventricular function
- Identify pericardial effusion/tamponade

Contraindications

- Esophageal injury or stricture
- Lack of definitive airway

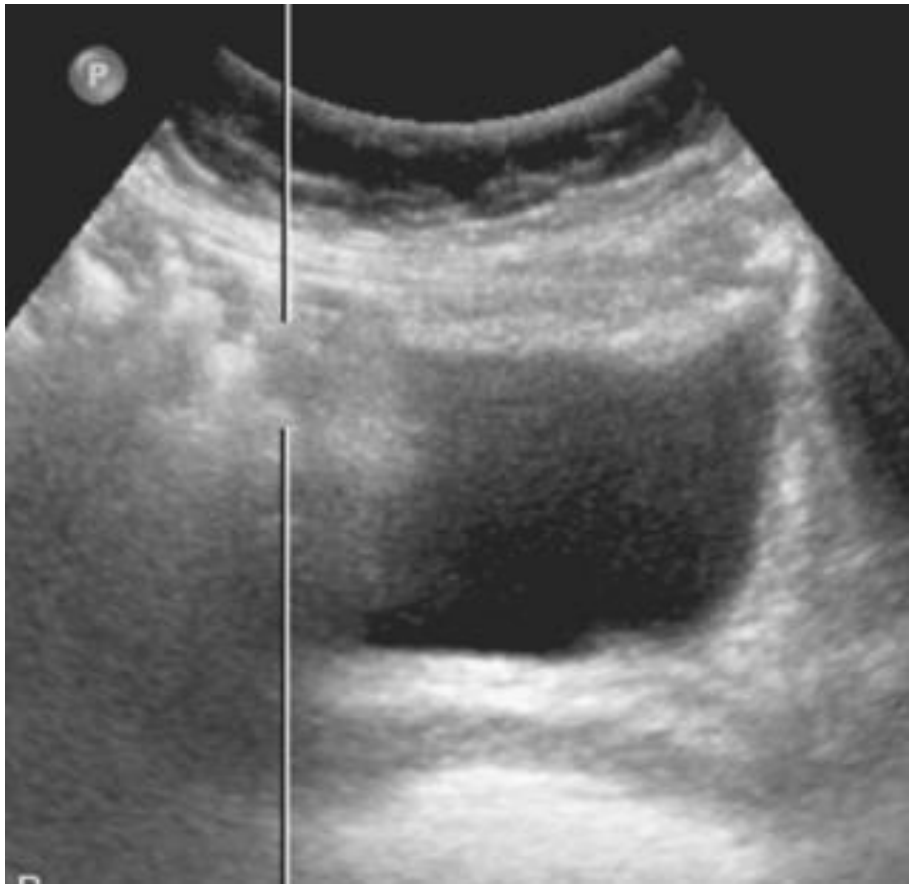
Limitations

- POCUS does not evaluate all aspects of cardiac function
- Technical limitations
  - Inability to pass probe
  - Excessive air in esophagus*
  - Excessive mitral annular calcifications*

*Ultrasound shadowing

Clean Shadowing

Dirty Shadowing



Views

- Midesophageal 4 chamber
- Midesophageal long axis
- Transgastric short axis

TEE in Cardiac Arrest

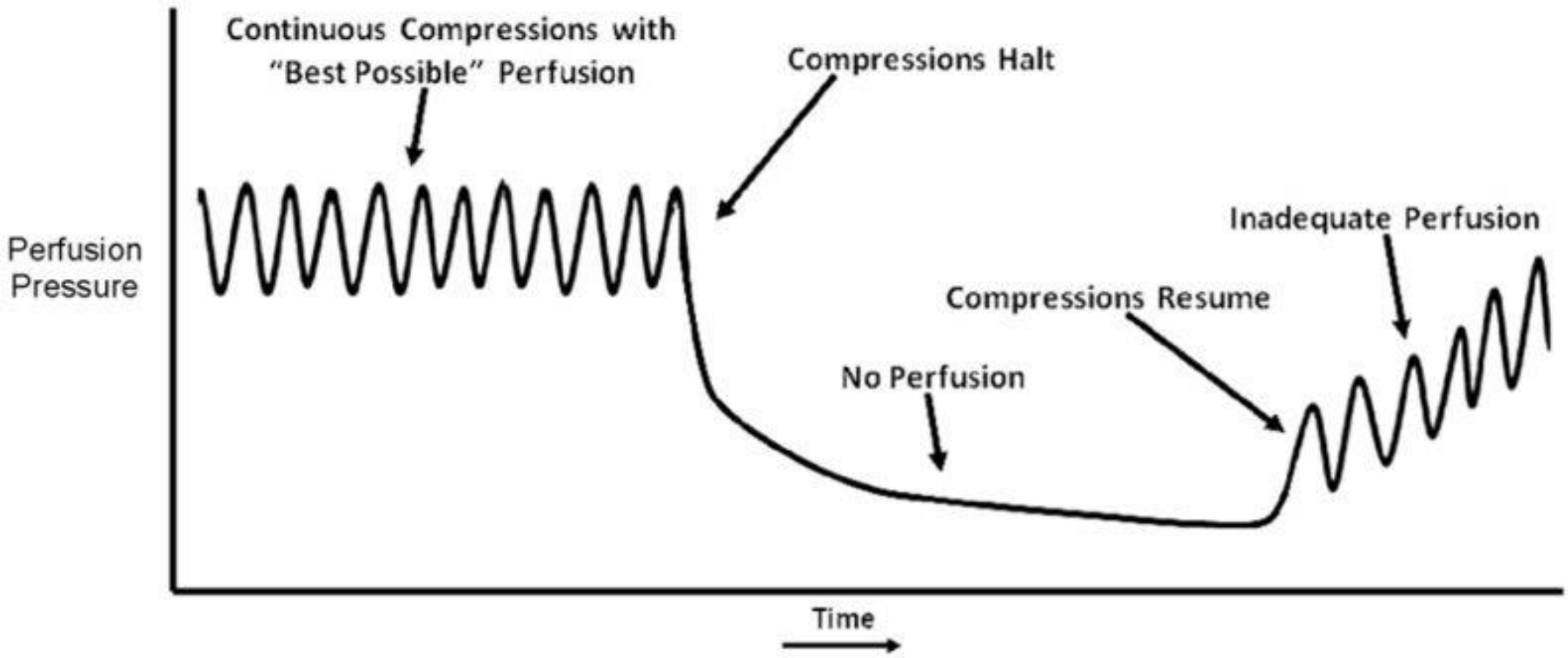
Multiple studies showing benefit of TEE over TTE

Evaluation of out-of-hospital cardiac arrest using transesophageal echocardiography in the emergency department.

Teran F[1], Dean AJ[2], Centeno C[3], Panebianco NL[2], Zeidan AJ[4], Chan W[2], Abella BS[5].

- Higher quality images
- Continuous visualization of heart
- Identify fine Vfib or pseudo-PEA
- Out of way of CPR, defibrillator pads, LUCAS device
- Fewer disruptions in CPR
- Assess quality and location of CPR
- Defibrillate without removing US probe
- Guide ECMO cannulation

Chest Compressions During Cardiac Arrest
Magnitude of Perfusion Resulting from Chest Compressions



Transesophageal Echocardiography During Cardiopulmonary Resuscitation Is Associated With Shorter Compression Pauses Compared With Transthoracic Echocardiography

James Fair III, MD*; Michael P. Mallin, MD; Aaron Adler; Patrick Ockerse, MD; Jacob Steenblik; Joseph Tonna, MD; Scott T. Youngquist, MD, MS

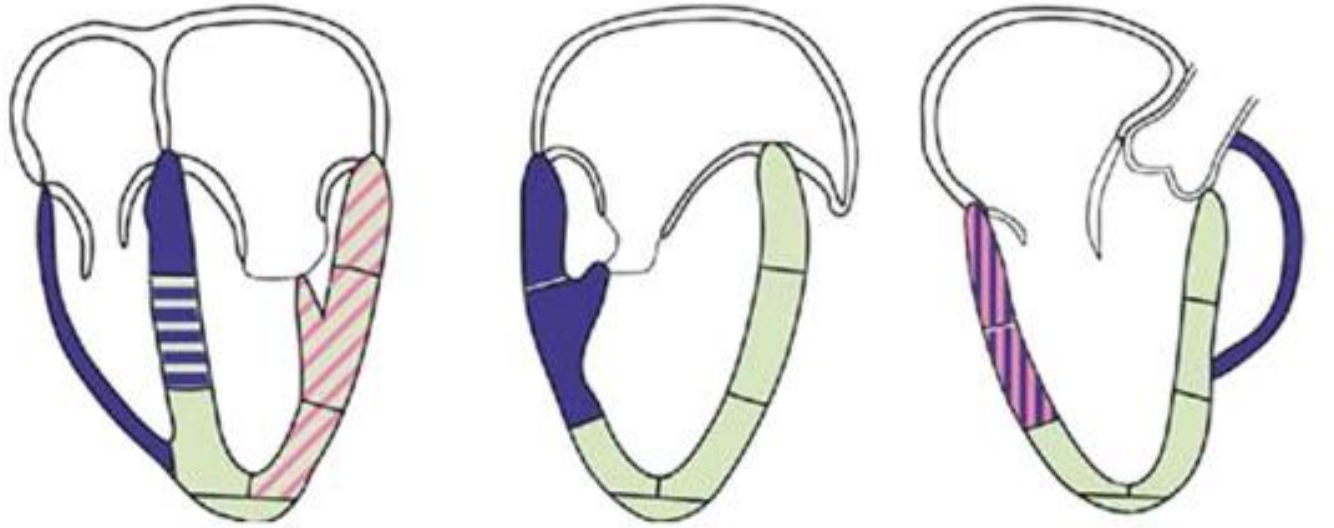
- Suggested pulses checks would be faster with TEE than TTE since TEE can provide continuous imaging without moving the probe
- ACLS guidelines state pulse checks should be no longer than 10 seconds
- Average pulse check times:
  - TTE – 18 seconds
  - Manual palpation – 10 seconds
  - TEE – 7 seconds
- Statistically significant prolongation of pulse check time with TTE compared to TEE but no statistically significant difference between TEE and manual palpation

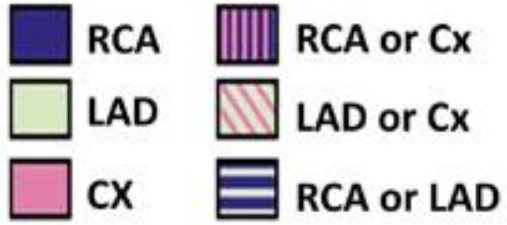
Diagnostic Accuracy of Transesophageal Echocardiography During Cardiopulmonary Resuscitation

POLL A. VAN DER WOUW, MD, RUDOLPH W. KOSTER, MD, PHD, BEN J. DELEMARRE, MD, PHD,* RIEN DE VOS, ANGELA J. E. M. LAMPE-SCHOENMAECKERS, MD, KONG I. LIE, MD, PHD

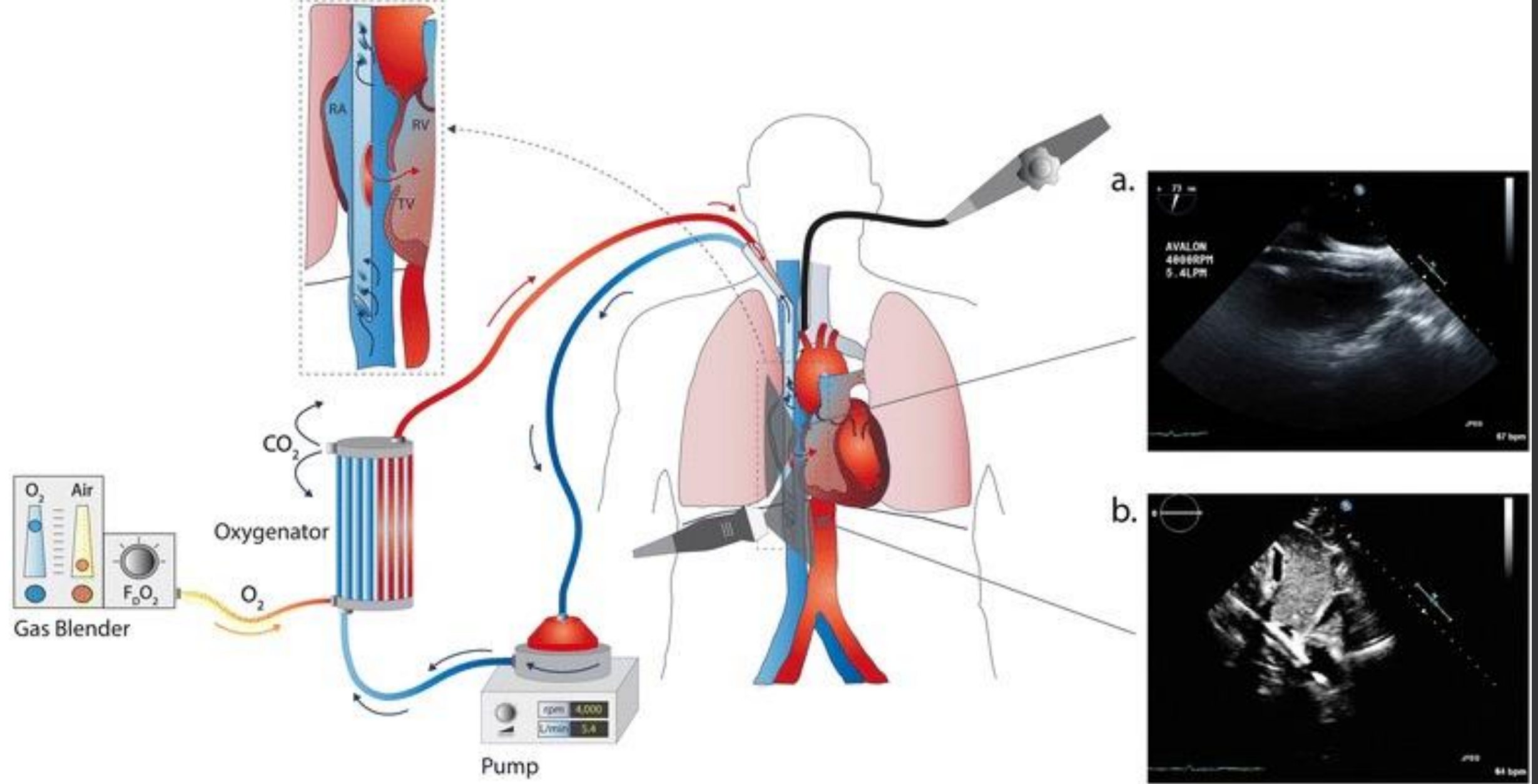
- Diagnoses established by TEE (41/48 patients):
  - MI (wall motion abnormality)
  - PE (right heart strain)
  - Tamponade
  - Thoracic aortic dissection
- Identified 31% of cardiac arrest cases in which treatment changed based on diagnosis obtained by TEE
- Definitive diagnoses by other imaging and clinical data, surgical findings, autopsy data in 31 patients
- 25/31 patients with definitive diagnoses accurately diagnosed by TEE

Wall Motion Abnormality





TEE in ECMO Cannulation

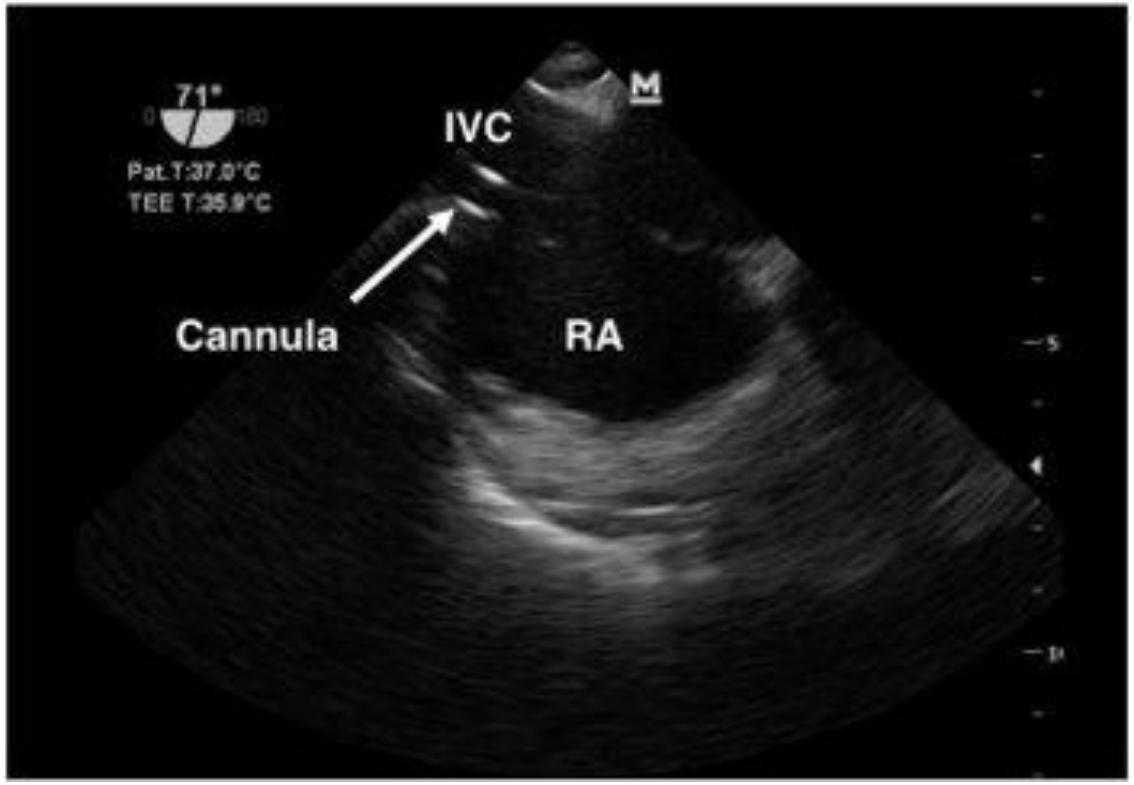


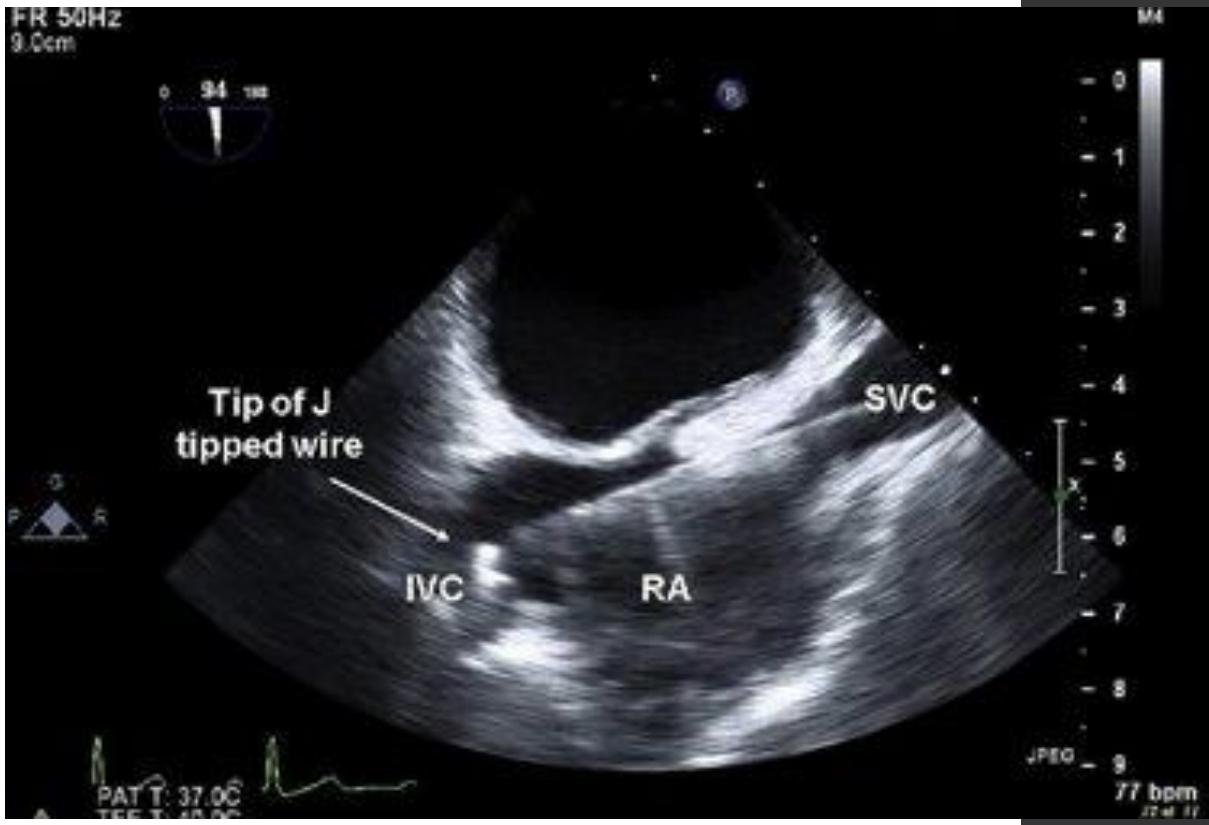
VV ECMO

Dual Lumen Bi-Caval Cannulation

ECMO Cannulation

- Direct visualization of guidewire and/or cannula in correct position in IVC (midesophageal bicaval view)





Feasibility of Training EPs in TEE

West J Emerg Med. 2017 Aug;18(5):830-834. doi: 10.5811/westjem.2017.5.33543. Epub 2017 Jul 19.

Emergency Physician-performed Transesophageal Echocardiography in Simulated Cardiac Arrest.

Byars DV[1], Tozer J[2], Joyce JM[2], Vitto MJ[2], Taylor L[2], Kayagil T[1], Jones M[1], Bishop M[1], Knapp B[1], Evans D[2].

- Feasibility of training EM residents in TEE on an ultrasound training mannequin
- 40 EM residents with no prior TEE training
- After 4 training sessions, residents were able to diagnose pathology on simulated TEE accurately and quickly
  - Sensitivity 98%, Specificity 99%
  - Kappa coefficient 0.95
  - Average time to diagnosis 12-35 seconds

J Emerg Med. 2016 Feb;50(2):286-94. doi: 10.1016/j.jemermed.2015.09.018. Epub 2015 Oct 24.

Focused Transesophageal Echocardiography by Emergency Physicians is Feasible and Clinically Influential: Observational Results from a Novel Ultrasound Program.

Arntfield R[1], Pace J[2], Hewak M[3], Thompson D[2].

- 14 EPs participated in 4-hour TEE workshop
- 54 TEEs done during study period
- 98% of studies obtained had adequate views that were interpretable
- Therapeutic impact in 67% of cases
- Did not assess diagnostic accuracy

Recap

- Echocardiography is useful in cardiac arrest
- Main TEE views:
  - ME4C – most useful, easiest view to obtain
  - MELA
  - Transgastric short axis
  - Bicaval
- TEE has multiple benefits over TTE in cardiac arrest
- Training EPs to become proficient in obtaining and interpreting TEE images is feasible

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