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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

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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

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
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
TEE Probe Movements

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

Flex to the right

Left

Flex to the left

Small wheel

Large wheel

Brake

Array rotation buttons
Cardiology

• 20-28 views for comprehensive TEE

ED

• 3-4 views during ACLS
AIN'T NOBODY GOT TIME FOR THAT
• 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
• Advance probe into stomach and anteflex
• Retract probe until short axis comes into view
• 0 degrees
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


- 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

- Continuous Compressions with “Best Possible” Perfusion
- Compressions Halt
- Inadequate Perfusion
- Compressions Resume
- No Perfusion

Perfusion Pressure vs. Time
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.
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

Four Chamber

Two Chamber

LAX

Mid

RCA
LAD
CX
RCA or LAD
RCA or Cx
LAD or Cx
CX
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
• 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
• 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