The Patient with Shock

Madhav Swaminathan, MD, FASE
Professor of Anesthesiology
Division of Cardiothoracic Anesthesia & Critical Care
Duke University School of Medicine

Disclosures

• None
Outline

1. Shock and instability
2. When to use TEE
3. Cases
4. Summary
Shock and Instability

• Hemodynamic Issues
  • Unexplained hypotension
  • Cardiac arrest
  • Rhythm problems
  • Escalation of inotropes

Intraoperative or Postoperative

• Guidance with therapy
  • Inotrope withdrawal
  • Discontinuation of EC Support

Postoperative

Shock and Instability
Mr. JH gave us permission to use his picture for this talk.

Shock and Instability

We see crazy stuff!

Courtesy Dr. Manisha Mishra
1. Is echo appropriate?

2. If yes, which modality should I use?

**TEE or TTE**

- TTE as first line in the critically ill unstable patient
  - Hypotension or hemodynamic instability of uncertain or suspected cardiac etiology (A-9)
- TEE as initial or supplemental test
  - High likelihood of non-diagnostic TTE (A-8)
  - Re-evaluation for interval change (A-8)
  - Anticipated change in therapy (A-9)
  - Aortic pathology or embolic source (A-9)
When is TEE Better?

• When TTE is impossible...

• When TTE is impractical...
When is TEE Better?

- When TTE is inadequate...

Case 1

- 52 year old male
- Hx of CAD, HTN, DM, AAA, s/p EVAR two days prior
- Becomes short of breath, associated chest pressure, nausea... unresponsive
- Standard ACLS protocol initiated
  - Organized electrical activity on monitor
  - Appeared to be in PEA arrest
  - CPR continued

TTE attempted but the cardiac windows were inadequate due to the large body habitus of the patient and the resuscitation paraphernalia.
Case 1

- After several rounds of ACLS, decision made to end resuscitation
- Simultaneously, a TEE probe was inserted...

Case 1

- Severe LV dysfunction, but coordinated contraction
- Inotropes started
- Taken for mechanical support after neuro intact
• The goal of FOCUS in the setting of cardiac arrest is to improve outcome of resuscitation by
  • Identifying organized electrical contractility to help distinguish between asystole, PEA and pseudo PEA
  • Determining cause of cardiac arrest
  • Guiding lifesaving procedures at bedside

• Identification of causes of PEA arrest by FOCUS with zero or minimal interruption in cardiopulmonary resuscitation improves outcome by decreasing time to treatment and to return of spontaneous circulation

• Should not be used in other ventricular arrhythmias
Echo in Cardiac Arrest

Diagnostic Accuracy of Transesophageal Echocardiography During Cardiopulmonary Resuscitation

van der Wouw et al.
J Am Coll Cardiol. 1997 Sep;30(3):780-3

• 48 cases of TEE during resuscitation
• Pathology found in 64%
• TEE sensitivity of 93%; specificity of 50%; PPV of 87%
• Treatment changed due to TEE in 31%

Echo in Cardiac Arrest

The usefulness of transesophageal echocardiography during intraoperative cardiac arrest in noncardiac surgery


• 22 patients undergoing non-cardiac surgery
• Diagnosis established in 19/22
  • Acute MI
  • Thromboembolism
  • Tamponade
  • Hypovolemia
• Aided further management in 18
• Use TEE as first line
• Asystole, PEA and pseudo-PEA only
• No interruptions in chest compressions
• Algorithmic approach


You have to plan well...
Case 2

- 77 year old female
- Class III heart failure
- Severe AS
- CAD, previous CABG, COPD, HTN, HL
- Scheduled for elective TAVR (CoreValve)
Case 2

- TAVR Deployed
- Hypotension worsens...
Case 2

Case 2
Case 2

- On CPB emergently
- Attempt occluder device...
Case 2

- Back on CPB
- Definitive repair
- TAVR went well...
- Postop
  - AKI
  - Respiratory issues
  - Tracheostomy
  - LTAC
Case # 3

- 58 year old male
- Progressive shortness of breath
- Known systolic murmur
- Workup - degenerative mitral valve disease
- Scheduled for elective mitral repair
- Everything goes okay in the OR...
• Post-CPB findings not communicated to ICU team
• He becomes progressively hypotensive
• Rise in filling pressures
• Dopamine and furosemide!!!
• More tachycardia, low cardiac output
• Stat TEE
Case # 3

- Stop Dopamine
- Give fluids
Case # 4

- 73 year old overweight woman
- Undergoing open hemi-colectomy
- Largely sedentary, hypertensive, smoker
- Prolonged surgery
- Intraop - Becomes suddenly hypotensive and tachycardic
- Unresponsive to fluids and dopamine
- No EKG changes
- Call for TEE...
Case # 4

• 2,508 patients with TEE over 15 years
  • Hemodynamic instability indication in 39%
  • LV function 9%
  • Tamponade 3%

Echo for Unexplained Hypotension

The use and safety of transoesophogeal echocardiography in the general ICU -- a minireview.
Echo for Unexplained Hypotension

The Role of Transesophageal Echocardiography in Optimizing Resuscitation in Acutely Injured Patients
Burns et al. J Trauma 2005 59(1) 36-40

- 2/3 patients benefitted from changes in management due to TEE findings
- Adequate filling by PAC
- Hypovolemic by TEE

Echo for Unexplained Hypotension

Transesophageal Echocardiography in Critically Ill Patients

- 308 ICU cases
- 40% evaluated for hypotension by TEE
- Cause identified in 67%
- Management change in 31%
• Pulmonary Embolus
  • 5% of all cardiac arrests
  • PEA initial rhythm in 63%
  • Early thrombolysis leads to return of spontaneous circulation (81% vs. 43%)

Pulmonary embolism as a cause of cardiac arrest: Presentation and Outcome

Communicate!
TEE in Devices

Case # 5

- 58 year old female
- HTN, DM, COPD, ACS, EF 45-50%
- Uneventful CABG x 3
- Low cardiac output postop; multiple inotropes
- Decision made to insert IABP for LV support at 2 AM
- Post-insertion CXR looks ‘okay’
• Still not doing well....
• TEE done to determine why
Case # 5

• Still not doing well....

• TEE done to determine why

OMG!
Case # 5

• Still not doing well....

• TEE done to determine why

Case # 5

• IABP Removed
Case # 5

- New IABP inserted
- Hemodynamics stabilized

42-year old female
Hx of post-partum cardiomyopathy
Bi-V ICD placed 3 years prior
Presents with an infected lead
Scheduled for elective laser-assisted lead removal
All goes well... until the RV lead is extracted

Another kind of problem...

Case # 6

- 42-year old female
- Hx of post-partum cardiomyopathy
- Bi-V ICD placed 3 years prior
- Presents with an infected lead
- Scheduled for elective laser-assisted lead removal
- All goes well... until the RV lead is extracted
Another kind of problem...

Case # 6

• Becomes suddenly hypotensive
• Echo shows gradually increasing pericardial effusion
• Immediate institution of fem-fem cardiopulmonary bypass
• Sternotomy
• Develops iliac vascular injuries
• Massive transfusion

Another kind of problem...

Case # 6

• Develops pulmonary edema/TRALI
• Unable to ventilate or come off CPB
• Institution of VA-ECMO
• Continues to require massive transfusion
• Unable to control bleeding
• r-Factor VIIa given... perfusionist complains of high venous pressure
• Oops....
Another kind of problem...

Case # 6

Another kind of problem...

Case # 6
Another kind of problem...

Case # 6

- She could not be resuscitated from the OR table
- Index case that changed the practice at Duke

Teamwork

When things go terribly wrong...
Teamwork

When things go terribly wrong...

- Scrub Nurse
- Surgeon
- Anesthesiologist
- Surgical Assistant
- Perfusionist

It was us!

Summary

- Instability is common in the perioperative setting
- Especially in cardiac surgery
- TEE offers distinct advantages in the evaluation of patients in circulatory shock
- Use echo early in cardiac arrest and in the differential for hypotension
- Echo is a part of the team in the successful management of the critically ill patient