Coronary Artery Bypass Grafting: Monitoring Patients and Detecting Complications

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

Disclosures

• None
These specific procedural indications include the use of TEE in selected cardiac operations (i.e., valvular procedures) and thoracic aortic surgical procedures as well as use in some coronary artery bypass graft surgeries...

...it is the recommendation of the writing committee that a physician trained in basic PTE echocardiography use ... views for a more comprehensive evaluation and for monitoring of global and regional LV function.

ASE GUIDELINES AND STANDARDS

Guidelines for Performing a Comprehensive Transesophageal Echocardiographic Examination: Recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

EXPERT CONSENSUS STATEMENT

Basic Perioperative Transesophageal Echocardiography Examination: A Consensus Statement of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists
Before CABG

Contractility
• Wall motion
• Diastolic function
• Associated issues

Before CABG

Contractility
• Wall motion
• Diastolic function
• Associated issues
Before CABG

**Contractility**
- Wall motion
- Diastolic function
- Associated issues

Transesophageal echocardiography interpretation: a comparative analysis between cardiac anesthesiologists and primary echocardiographers.

Joseph P. Mathew, et al.

- 154 exams by 10 anesthesiologists
- Offline validation by cardiologist and radiologist
- Percent agreement
  - A vs R = 83%
  - A vs. C = 80%
  - C vs. R = 82%
Before CABG

- **Contractility**
- **Wall motion**
- **Diastolic function**
- **Associated issues**
Wall Motion Abnormalities in CABG surgery

- 1,412 CABG cases
- Wall motion graded before and after revascularization
- Wall motion score derived
- Change in WMS categorized as improvement/deterioration or no change
- Association with MACE for up to 2 years assessed

Deterioration of Regional Wall Motion Immediately after Coronary Artery Bypass Graft Surgery Is Associated with Long-term Major Adverse Cardiac Events
Anesthesiology 2007; 107: 739-45

Deterioration of Regional Wall Motion Immediately after Coronary Artery Bypass Graft Surgery Is Associated with Long-term Major Adverse Cardiac Events
Anesthesiology 2007; 107: 739-45
What Monitoring is Needed?

- Contractility
- Wall motion
- Diastolic function
- Associated issues

- 2,500 CABG Cases
- Transmitral flow
- Diastolic tissue Doppler velocities
- Pulmonary vein flow

Diastolic Dysfunction in CABG Surgery

905 CABG Cases

- Normal
- Grade 1
- Grade 2
- Grade 3

- Lateral e’ > 10 cm/s
- Lateral e’ < 10 cm/s

1. $E/e’ < 8$
2. $E/A < 0.8$
3. $DT > 200$
4. $Ar-A < 30$

1. $E/e’ = 9-12$
2. $E/A = 0.8-1.5$
3. $DT = 160-200$
4. $Ar-A > 30$

1. $E/e’ > 13$
2. $E/A > 2$
3. $DT < 160$
4. $Ar-A < 30$
Diastolic Dysfunction in CABG Surgery

### 905 CABG Cases

#### Lateral e’

- **> 10 cm/s**
  - 1. $E/e’ < 8$
  - 2. $E/A < 0.8$
  - 3. $DT > 200$
  - 4. $Ar-A < 30$

- **< 10 cm/s**
  - 1. $E/e’ = 9-12$
  - 2. $E/A = 0.8-1.5$
  - 3. $DT = 160-200$
  - 4. $Ar-A > 30$

#### Normal
- 158

#### Grade 1
- 25

#### Grade 2
- 38

#### Grade 3
- 5

---

### 905 CABG Cases

#### Lateral e’

- **> 10 cm/s**
  - 1. $E/e’ < 8$
  - 2. $E/A < 0.8$
  - 3. $DT > 200$
  - 4. $Ar-A < 30$

- **< 10 cm/s**
  - 1. $E/e’ > 13$
  - 2. $E/A > 2$
  - 3. $DT < 160$
  - 4. $Ar-A < 30$

#### Normal
- 158

#### Grade 1
- 72

#### Grade 2
- 172

#### Grade 3
- 16
Diastolic Dysfunction in CABG Surgery

905 CABG Cases

158 Normal
309 Grade 1
267 Grade 2
161 Grade 3

Lateral e’

> 10 cm/s

< 10 cm/s

1. E/e’ < 8
2. E/A < 0.8
3. DT > 200
4. Ar-A < 30

1. E/e’ = 9-12
2. E/A = 0.8-1.5
3. DT = 160-200
4. Ar-A > 30

1. E/e’ > 13
2. E/A > 2
3. DT < 160
4. Ar-A < 30

Algorithm A

Normal
Grade 1
Grade 2
Grade 3
Diastolic Dysfunction in CABG Surgery

905 CABG Cases

Algorithm B

Lateral e’

> 10 cm/s

1. E/e’ < 8

Normal

Grade 1

1. E/e’ = 9-12

Grade 2

1. E/e’ > 13

Grade 3

< 10 cm/s

Diastolic Dysfunction in CABG Surgery

Algorithm A

The algorithm was unable to identify those at risk

No difference between different grades
Utility of a simple algorithm to grade diastolic dysfunction and predict outcome after coronary artery bypass graft surgery

Swaminathan, Nicoara, Phillips-Bute, Aesclimann, Milano, Mackensen, Podgoreanu, Velazquez, Stafford-Smith, Mathew and CARE

Diastolic Dysfunction in CABG Surgery

- 897 CABG Cases
- Simplified algorithm used for LVDD
- Determined on pre-CPB echo
- Women at higher risk
- Interaction with age

Diastolic dysfunction in patients undergoing cardiac surgery: The role of age and age-gender interaction

Before CABG

- Contractility
- Wall motion
- Diastolic function
- Associated issues
Before CABG

- Contractility
- Wall motion
- Diastolic function

Associated issues

Before CABG

- Contractility
- Wall motion
- Diastolic function

Associated issues
After CABG

- Contractility
- Wall motion
- Diastolic function
- Associated issues

After CABG

- Air
- Dissection
- Stunning
After CABG

- Air
- Dissection
- Stunning
After CABG

- Air
- Dissection
- Stunning

Iatrogenic intraoperative type A aortic dissection following cardiac surgery

Pradeep Narayan, Gianni D Angelini and Alan J Bryan

- 15,144 consecutive cases
- All cardiac surgery
- 0.04% incidence
- TEE recommended since mortality risk is high if detected late
After CABG

2,137 cases of Type A aortic dissection
100 cases were iatrogenic (4.7%)
18 of the 38 cases (47%) were CABG
Preoperative Three-Dimensional Strain Imaging Identifies Reduction in Left Ventricular Function and Predicts Outcomes After Cardiac Surgery.

- 163 patients undergoing CABG (n=50), AVR and MVR
- TTE done preop - including 3D speckle tracking
- 3D EF was reduced after cardiac surgery: Less in CABG
- Patients with EF < 45%
  - 3D-GAS, GCS, GRS - were predictive of worse outcomes and
  - 2D-GLPS and GLCS were also predictive of increased inotrope requirements

Predictors of inotrope use during separation from cardiopulmonary bypass.

- 1,009 patients undergoing CABG
- Intra-op TEE done in all cases
- Inotrope use defined as dopamine (>5), epi, norepi, milrinone or dobutamine
- 6 independent predictors of inotrope use
  1. Wall motion score index
  2. Combined CABG and MVR
  3. LVEF < 35%
  4. Redo surgery
  5. Mod-severe MR
  6. Aortic cross clamp time
Predictors of inotrope use in patients undergoing concomitant coronary artery bypass graft (CABG) and aortic valve replacement (AVR) surgeries at separation from cardiopulmonary bypass (CPB).

- 97 patients undergoing CABG AVR
- Intra-op TEE done in all cases
- Inotrope use defined as dopamine, epi, norepi, milrinone or dobutamine
- 4 independent predictors of inotrope use
  1. Cardiac index < 2.5L/min/m²
  2. LVEDP > 20 mm Hg
  3. LVEF < 40%
  4. CKD stage 3-5

Summary

- Intraoperative TEE not recommended for routine use in all CABG surgery in several documents
- Invaluable for monitoring and treatment of hemodynamic disturbances
- Complications are infrequent, but can be costly