Complications of Myocardial Infarction

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DISCLOSURE

Relevant Financial Relationship(s)
None

Off Label Usage
None
Echocardiography in Acute MI

• Ideal imaging modality to detect complications
  • Non-invasive
  • Portable
  • Low-risk
  • Serial comparison studies
  • Information quickly available

Case

• 62 year old male
• Anterior Wall STEMI; Primary PCI (6 hrs after chest pain onset)
• Troponin T = 3.2 ng/ml

Question

• What is the incidence LV thrombus despite dual anti-platelet therapy over next 3 months?
  A. ≤1%
  B. 2-5%
  C. 6-10%
  D. >10%

LV EF 36% (48 hrs post-PCI)
Conclusion: LV thrombus formation is a frequent finding in patients with anterior wall ST elevation myocardial infarction treated acutely with PCI and dual antiplatelet therapy and should be assessed by echocardiography within the first week.

LV Thrombus Post-MI

- Static flow in region of akinesia or dyskinesia (apical location most commonly)
- Reduced EF (<30%)
- Risk of Emboli
- Differentiate from trabeculation (multiple planes)
Mobile LV Thrombus

Contrast Echocardiography
**LV Aneurysm vs Pseudoaneurysm**

**LV Apical Aneurysm**
- Wide neck with larger ratio of diameter of entry to maximum cavity

**LV Apical Pseudoaneurysm**
- Small neck communication
- Ratio of diameter of entry to maximum cavity < 0.5

**Not Always Easy: LV Aneurysm**
Color Doppler may be very helpful

- Contrast echo can also be helpful in making the diagnosis and determining the size of the neck which is important in differentiating a pseudoaneurysm (narrow neck) from a pseudoaneurysm (wide neck).
**LV Aneurysm vs Pseudoaneurysm**

- All 3 layers of myocardium (epicardium, mid-myocardium, and endocardium) are present
- Fibrotic Scar
- Only the pericardium is keeping blood in the ventricle

**Left Ventricular Pseudoaneurysm**

Video by Dr. Roger Click
LV Thrombus and Aneurysm

2D Four Chamber View  3D Four Chamber View

86 year old male with STEMI
LV Pseudoaneurysm: “Too and Fro Flow”

Ruptured LV Pseudoaneurysm
LV Aneurysm vs LV Pseudoaneurysm

• Post-MI LV pseudoaneurysm occurs when a rupture of the LV free wall is contained by overlying, adherent pericardium → usual treatment is urgent surgical repair

• Post-MI LV aneurysm is caused by scar formation resulting in thinning and expansion of the myocardium → usual treatment is conservative unless refractory angina, heart failure or ventricular arrhythmia

Brown SL et al. Chest 1997; 111:1403-09

Case

• 78 year old female
• Presented with chest pain and evidence of “NSTEMI” by biomarkers
• EKG - nonspecific
• Echocardiogram: Preserved EF, lateral HK
• Cath: occluded diagonal, 70% RCA and LCx → planned medical tx
• Worsening dyspnea and atypical chest pain 48 hours after admission
30-40% of patients may have “subacute” free wall rupture
- Hypotension
- Nausea/emesis
- Pericardial chest pain

Images by Dr. Rick Nishimura and Dr. Roger Click
Coagulum Tamponade from LV Rupture

- Occurs in approximately 1% of MI’s
- Accounts for up to 8-17% of deaths
- More common in women, hypertensive and older patients
- Single CAD
- Usually no clinical warning signs
- Sudden death
More Typical Scenario: Myocardial Rupture

• 65 year old male
• Inf Lat MI, PCI with DES, EF 45%

Two days later

• Patient in bathroom → syncope
• Stat Echo during code
• Echo reveals rupture with coagulum
Myocardial Rupture $\rightarrow$ Tamponade $\rightarrow$ Death

Image Courtesy of William Edwards, MD

TEE: Helpful to Identify Myocardial Rupture
Etiology of Cardiogenic Shock After Acute MI

251 patients from 19 centers

- LV failure: 85%
- VSD or MR: 8% (5%)
- RV infarct (2%)
- Others

Adapted from Hochman JS et al. *Circulation* 1995; 91:873-881

Post-MI Ventricular Septal Rupture or Defect
Post MI VSD: GUSTO-I Study

• Incidence 0.2% (84 of 41,021 patients)
• Onset 1 day
• Mortality 74% (47% vs 94%)
• Association with
  • Age
  • Anterior MI
  • Female sex
  • No previous smoking

Crenshaw BS et al: Circulation 2000; 101:27

Case: Apical VSD

• 84 year old female, post-MI day 5
• Sudden onset, pulmonary edema, loud murmur
• CHF improved with medical treatment
• Multidisciplinary discussion, not felt to be a good surgical candidate, VSD closed in cath lab with device

Post Infarct Ventricular Septal Rupture

• Poor Location and size for device closure in Cath Lab
66 yo man – Single Motor Vehicle Accident

Multiple injuries: - Loss of consciousness, confusion
- Open, compound fracture of right leg (mid tibia, lateral malleolus)
- Closed fracture of left leg
- L3 and L5 burst fractures
- Initial BP 130/80 mmHg, pulse 102 bpm
- Lactate level 6.8

In Trauma bay after pan CT: c/o severe chest pain
- SBP decreased to 80 mm Hg
66 year old man with chest pain: EKG

- Anterior ST elevation MI
- Cath lab activated

Agreement between cardiology, ortho, trauma, and neurosurgery that MI care superseded injury management

- Rx in ED: aspirin, ticagrelor, heparin
- Emergency coronary angiography
Coronary Angiography

Successful Revascularization
66 year old man – Anterior STEMI

In cath lab, then CCU
- Shock, SBP as low as 50 mm Hg
- Intubated, sedated
- Intra-aortic balloon pump
- IV dopamine, norepinephrine
- IV blood and fluids
- Persistent hypotension (SBP 70-90 mmHg)
- Quick-look Transthoracic Echo

Technically Difficult TTE – Subcostal View

– small IVC, tiny pericardial effusion
What would you do next?

1. Repeat ECG
2. Repeat CT chest, abdomen
3. Cardiac MRI
4. TEE
5. Supportive medical care in CCU
TEE - LVOT

Peak velocity 5.8 m/s, Peak gradient 135 mm Hg
Before TEE - LVOT After

1. Stopped IV norepinephrine
2. Stopped IV dopamine
3. Removed IABP
4. Given intravascular volume

Peak LVOT velocity 5.8 m/s

Peak LVOT velocity 1.6 m/s
TEE – LV Function (after)

Circulation

Dynamic Left Ventricular Outflow Tract Obstruction in Acute Myocardial Infarction With Shock: Cause, Effect, and Coincidence
Anand Chowdalingam, Lokesh Tejwani, Kul Aggarwal and Kevin C. Dellsperger
Circulation 2007;116:e110-e113
Apical MI Induced Dynamic LVOT or Mid-cavitary Obstruction


Hyperkinetic Basal Segments

Patient with Stress Induced CM and Dynamic LVOT Obstruction
62 year old woman with chest pain and severe pulmonary edema

Papillary Muscle Rupture: 3D TEE and Gross Pathology

Courtesy John Gorcsan, MD
Papillary Muscle Rupture

- Loss of papillary muscle integrity
  - Typically occurs 3-7 days after infarct
  - Hemodynamically, the most serious MV complication
  - Most commonly involves small infarct of RCA or Circumflex (inferior, inferolateral MI) → posteromedial papillary muscle
  - Rupture of RV papillary muscle rare

Ruptured Papillary Muscle

Video by Dr. Roger Click
Spectrum of Papillary Muscle Rupture

Partial Papillary Muscle Rupture
Partial Papillary Muscle Rupture: Chaotic Motion of Subvalvular Apparatus

Partial Papillary Muscle Rupture
Severe Eccentric Mitral Regurgitation

Patient underwent successful mitral valve repair
**Cardiovascular Surgery**

**Clinical Outcome After Surgical Correction of Mitral Regurgitation Due to Papillary Muscle Rupture**

Antonio Russo, MD; Rakesh M. Suri, MD; Francesco Grigioni, MD; Véronique L. Roger, MD, MPH; Jae K. Oh, MD; Douglas W. Mahoney, MS; Hartzell V. Schaff, MD; Maurice Enriquez-Sarano, MD

**Background**—Papillary muscle rupture (PMR) is an infrequent but catastrophic complication of acute myocardial infarction (MI). Although always considered, surgical treatment is often denied because of high operative mortality. Moreover, the effects of surgery for PMR on long-term outcome, particularly compared with expected outcome after MI, are undefined.

**Methods and Results**—Fifty-four consecutive patients (age, 70±8 years; 74% male) underwent mitral surgery for post-MI PMR from January 1980 through December 2000. Severe presentation (cardiogenic shock, pulmonary edema, or cardiac arrest) was noted in 91% preoperatively. Performance of coronary artery bypass graft was associated with lower operative mortality (odds ratio, 0.18; 95% CI, 0.04 to 0.83; P=0.011), whereas there was a trend for lower mortality after surgery after 1990 (odds ratio, 0.28; 95% CI, 0.06 to 1.3). Thus, operative mortality (overall, 18.5%) decreased from 67% up to 1990 without coronary artery bypass graft to 8.7% after 1990 with coronary artery bypass graft. Overall 5-year survival was 65±7%, and survival free of congestive heart failure was 52±7%. Five-year survival of 30-day operative survivors was 79±4%, identical (P=0.24) to that of matched controls with MI (similar age, sex, ejection fraction, MI location, and MI year). Survival free of congestive heart failure was similar in PMR cases and MI controls (10-year survival, 28±8% versus 36±6%; P=0.46).

**Conclusions**—Surgery for post-MI PMR involves a notable operative mortality, but there are recent trends for lower operative risk, particularly with associated coronary artery bypass graft. Long term after surgery, outcome is restored to that of similar MI without PMR. These encouraging observations emphasize the importance of prompt diagnosis and aggressive therapeutic approach for patients incurring PMR after MI. *(Circulation. 2008;118:1528-1534.)*

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**Differential Diagnosis of a New Loud Systolic Murmur Following MI**

<table>
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<th>VSD</th>
<th>Pap Musc Rupt.</th>
<th>LVOT Obst.</th>
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<tr>
<td><strong>Location</strong></td>
<td>Anterior or Inferior</td>
<td>Inferior &gt; Anterior</td>
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<tr>
<td><strong>Signs</strong></td>
<td>Low Cardiac Output</td>
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<td><strong>Hemodynamics</strong></td>
<td>O$_2$ step-up (RA→PA) &gt; 10%</td>
<td>V wave on PCWP tracing</td>
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<td><strong>Treatment</strong></td>
<td>Operation</td>
<td>Operation</td>
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Adapted from Oh JK et al. Echo Manual 3rd Edition
Inferior MI with RV Infarction

Ventricular septal rupture
Right ventricular infarction
Pericardial effusion

Conclusions: Echo and CAD

Dynamic LV Outflow Tract Obstruction
Ventricular septal rupture
Right ventricular infarction
Pericardial effusion
Ruptured papillary muscle
Free wall rupture
False aneurysm
True aneurysm
Mural thrombus