Cath, ECHO and Hemodynamics

Glenn Whitman MD
Melinda Offer, RN, MSN
Disclosure

Glenn Whitman MD
No disclosures

Melinda Offer RN
No disclosures
Coronary Anatomy

Acute Marginals, Obtuse Marginals, and Diagonals

Anterior

Acute angle

Posterior

Obtuse angle
**Seq 1170-Number of Diseased Vessels**

**Definition:** Number of diseased major native coronary vessel systems: LAD system, Circumflex system, and/or Right system with $\geq 50\%$ narrowing of any vessel pre-op.

There are three (3) major coronary systems; Left Anterior Descending (LAD), Circumflex and Right Coronary System (RCA). Each system has “branches” that are considered part of their corresponding system.

**Note:**
- **Left main disease ($\geq 50\%$) is counted as TWO vessels** (LAD and Circumflex, which may include a Ramus Intermedius). For example, left main and RCA would count as three total.

- Stenosis at the ostia of the LAD and circumflex is not considered left main disease for the purpose STS. Stenosis needs to be in the left main artery.

- A vessel that has ever been considered diseased, should always be considered diseased.

- If bypass is performed for an anomalous, kinked or damaged vessel, or myocardial bridging this vessel is counted as one diseased or abnormal vessel.
Coronary artery trifurcation

Picture courtesy: Clinical Cardiac CT: Anatomy and Function By Halpern, Ethan J. Halpern Published by Thieme, 2008
Ramus Intermedius (RI)

What is the RI?
- The left main coronary artery instead of bifurcating into two, it trifurcates into three vessels (LAD, LCX, Ramus)
- The real incidence could vary between 10% to 30% of the population have a RI
- It generally goes in the angle between the LAD and the LCX.
- It may either behave like a large OM or a diagonal branch.

If the Ramus is part of the LAD system and functions much like a diagonal, AND the patient has no LAD, Circumflex, or RCA disease code 1 vessel disease.

If the Ramus is part of the Circumflex system and functions much like an obtuse marginal AND the patient has LAD disease AND no RCA disease code disease code 2 vessel disease.
### Number Diseased Vessels Scenario

**Cath 8/1/19 @ 0730**

<table>
<thead>
<tr>
<th>Left Main – No disease</th>
<th>LAD – Occluded at bifurcation of diagonal 2.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CX – Proximal lesion 70%. RI 75%.</td>
<td>RCA – Stent in proximal RCA patent</td>
</tr>
</tbody>
</table>

**Seq 1170 - How many diseased vessels?**

- A. 2 V disease
- B. 3 V disease
- C. 4 V disease
Poll: Seq 1170 - How many diseased vessels?
## Number of Diseased Vessels Scenario

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<td>LAD – Occluded at bifurcation of diagonal 2.</td>
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<td>C. 4 V Disease</td>
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<tr>
<td>RCA – Stent in proximal RCA patent</td>
<td></td>
</tr>
</tbody>
</table>
1. Pre-op results captured from objective studies (cath, echo, nuclear study, etc..) closest and prior to OR within 6 months of OR date
   • Cath be done can be used for up to one year

2. Use the OR pre-incision results if pre-incision results change the planned surgery.
   For example, if pre-op MV regurgitation was mild and pre-incision MV regurgitation is severe and the surgeon decides to do a MV Repair – code severe for MV regurgitation
   • Within 6 months, closest data to procedure, cath up to one year
   • Only if no data, use intraop data, or
   • If intraop data changes the plan, use intraop data
Source Document  Priority for Coding

3. Use the OR pre-incision results if no other values are available, the values were not available on prior exams, or if the valves were not visualized on any of the pre-operative exams regardless if planned surgery was changed or not.

4. If no other results are available, then Surgeon documentation should be used.

5. If a range is reported, use the average, and round up. For example, (50-55%) is coded as 53%.
EF by Nuclear Medicine

\[ ^{82}\text{Rb} \]

\[ ^{18}\text{F-FDG} \]
EF by Left Ventriculogram

Diastole

Systole
Now, 48 hours later, successfully weaned from ECMO
Now, 48 hours later, successfully weaned from ECMO.
No EF!
Seq 1545 – Ejection Fraction Scenario

7/1/18 - intra-op TEE prior to incision EF 50-55%

6/15/18 – echo EF 55 – 60%

6/14/18 – Cath EF 65%

• Which EF do you code for this patient?

A. 53%
B. 58%
C. 65%
Poll: Which EF do you code for this patient?
Seq 1545 – Ejection Fraction Scenario

7/1/18 CABG surgery intra-op TEE prior to incision EF 50-55%

6/15/18 – echo EF 55 – 60%

6/14/18 – Cath EF 65%

• Which EF do you code for this patient?

A. 53%
B. 58% - Correct Answer
C. 65%
<table>
<thead>
<tr>
<th>End Systolic</th>
<th>End Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVESD</td>
<td>LVEDD</td>
</tr>
<tr>
<td>LVIDs</td>
<td>LVIDd</td>
</tr>
<tr>
<td>LV(S)</td>
<td>LV(D)</td>
</tr>
</tbody>
</table>

LVSD or LVDD, PLAX = parasternal long axis view

Must be entered in mm, not cm (if cm, multiply x 10)

N.B. Diastolic dimension > Systolic dimension
LVEDd

LVESd

Modified quinones method

End-diastole

End-systole

LVEF = LVEDD² - LVESD²/LVEDD² × 100 + K

Normally contracting apex +10%, dyskinetic apex -10%
## Measurements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>01/24/2013</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVC ID</td>
<td>2.2 cm</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Left ventricle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LV ID, ED</td>
<td>5.8 cm</td>
<td>5.8</td>
<td>4.2 - 5.9</td>
</tr>
<tr>
<td>LV ID, ES</td>
<td>4.2 cm</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>LV fx shortening</td>
<td>28%</td>
<td>33</td>
<td>25 - 43</td>
</tr>
<tr>
<td>LV mid-wall fx shortening</td>
<td>16%</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>LV PW thickness, ED</td>
<td>1.0 cm</td>
<td>1.0</td>
<td>0.6 - 1.0</td>
</tr>
<tr>
<td>LV PW thickness, ES</td>
<td>1.2 cm</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>LV PW thickening</td>
<td>22%</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>IVS/LV PW ratio, ED</td>
<td>0.76</td>
<td>0.76</td>
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</tr>
<tr>
<td>LV end-diastolic volume</td>
<td>165 ml</td>
<td>165</td>
<td>67 - 155</td>
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<tr>
<td>LV end-systolic volume</td>
<td>78 ml</td>
<td>78</td>
<td>22 - 58</td>
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<tr>
<td>LV ejection fraction</td>
<td>54%</td>
<td>54</td>
<td>255</td>
</tr>
<tr>
<td>Stroke volume, 2D</td>
<td>89 ml</td>
<td>89</td>
<td></td>
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<tr>
<td>LV wall mass</td>
<td>195 g</td>
<td>195</td>
<td>98 - 200</td>
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<tr>
<td>Ventricular septum</td>
<td></td>
<td></td>
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<td>1.0 cm</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>IVS thickening</td>
<td>37%</td>
<td>47</td>
<td></td>
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<td>Pulmonary arteries</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PA pressure, S, DP</td>
<td>51 mm Hg</td>
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</tr>
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<tr>
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<td>3 m/sec</td>
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<td></td>
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<td>Tricuspid peak RV-RA gradient</td>
<td>36 mm Hg</td>
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PA Systolic Pressure Measured: Seq 1570
Where do you find it?

• In Cath Report, only if right heart cath performed (uncommon)
• In Echo Report: Right Ventricular Systolic Pressure
  = Gradient across tricuspid valve + CVP
RVSP by TR Jet

RVSP = 4(Vmax)^2 + CVP
### Measurements

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Valvular Heart Disease

Insufficiency or Stenosis

- Code the **highest** level of valve dysfunction (closest to surgery!)
  - mild – moderate will be coded as moderate
  - Sclerosis does **not** mean stenosis
- If you do not have an echo, then code insufficiency as Not Documented.
- The valve should be coded as being diseased if there is **mild, moderate or severe insufficiency**
- **Trace insufficiency is NOT a diseased valve, but it gets coded**
Aortic Stenosis

NML

RV

LV

Ao

LA
Aortic Insufficiency

Insufficiency: if > trace, code it as AV Disease
Valve Stenosis Scenario

• Pre-op echo 6/10/19:
  MV with annular calcification and mild mitral stenosis
  Aortic valve sclerotic with no regurgitation

• How do you code stenosis for MV and AV?
  A. Mitral stenosis YES; Aortic stenosis YES
  B. Mitral stenosis YES; Aortic stenosis NO
Poll: How do you code stenosis for MV and AV?
Valve Stenosis Scenario

• Pre-op echo 6/10/19:
  MV with annular calcification and mild mitral stenosis
  Aortic valve sclerotic with no regurgitation

• How do you code stenosis for MV and AV?
  A. Mitral stenosis YES; Aortic stenosis YES
  B. Mitral stenosis YES; Aortic stenosis NO – Correct Answer
Valve Disease Scenario

- Pre-op echo 6/10/19:
  Moderate mitral regurgitation
  Trace aortic insufficiency
  Mild triscupid regurgitation

- How do you code valve disease?
  A. AV disease Yes; MV disease Yes; TV disease Yes
  B. AV disease No; MV disease Yes; TV disease No
  C. AV disease No; MV disease Yes; TV disease Yes
Poll: How do you code valve disease?
Valve Disease Scenario

• Pre-op echo 6/10/19:
  Moderate mitral regurgitation
  Trace aortic insufficiency
  Mild tricuspid regurgitation

• How do you code valve disease?
  A. AV disease Yes; MV disease Yes; TV disease Yes
  B. AV disease No; MV disease Yes; TV disease No
  C. AV disease No; MV disease Yes; TV disease Yes – Correct Answer
Valve Insufficiency and Disease Scenario

• Pre-op echo 6/10/19 documents moderate mitral regurgitation
• Intra-op TEE prior to incision documents trace mitral insufficiency
• Cath 6/11/18 documents mild mitral regurgitation

• How do you code mitral regurgitation and MV disease?
  A. Mild MR and YES for disease
  B. Moderate MR and Yes for disease
  C. Trace MR and No for disease
  D. Mild MR and No for disease
Poll: How do you code mitral regurgitation and MV disease?
Valve Insufficiency and Disease Scenario

- Pre-op echo 6/10/19 documents moderate mitral regurgitation
- Intra-op TEE prior to incision documents trace mitral insufficiency
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- How do you code mitral regurgitation and MV disease?

  A. Mild MR and YES for disease – Correct Answer
  B. Moderate MR and Yes for disease
  C. Trace MR and No for disease
  D. Mild MR and No for disease
Valve Insufficiency Scenario

Pre-op echo:
TV – unable to visualize

Intra-op TEE prior to incision
TV – mild insufficiency

• How do you code TV regurgitation?
A – Not documented
B - Mild
C - No
Poll: How do you code TV regurgitation?
Valve Insufficiency Scenario

Pre-op echo:
  TV – unable to visualize

Intra-op TEE prior to incision
  TV – mild insufficiency

• How do you code TV regurgitation?
  A – Not documented
  B - Mild – Correct Answer
  C – No

If the valve was not visualized on the pre-op echo but was visualized on the intra-op pre-incision echo then you may use the intra-op pre-incision echo for the value of that valve only, not for all the valves if they were visualized on the pre-op echo.
Scenario – Valve Regurgitation

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECHO documents +2 aortic regurgitation.</td>
<td>A. Leave blank or use own hospital protocol</td>
</tr>
<tr>
<td></td>
<td>B. Mild</td>
</tr>
<tr>
<td>How would you answer aortic insufficiency?</td>
<td>C. Moderate</td>
</tr>
</tbody>
</table>


Poll: How would you answer aortic insufficiency?
## Scenario – Valve Regurgitation

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<tr>
<td>How would you answer aortic insufficiency?</td>
<td>B. Mild</td>
</tr>
<tr>
<td></td>
<td>C. Moderate</td>
</tr>
</tbody>
</table>

There is not a professional consensus to quantify the value of valve insufficiency using the numerical system i.e.. +1, +2 etc... Sites should coordinate with their echo-cardiographers, reporting cardiologists, and/or surgeons for the sites definition and develop a protocol for their hospital.
Valve Insufficiency and Disease Scenario

- Pre-op echo 6/11/19 documents moderate mitral regurgitation
- Intra-op TEE prior to incision documents severe mitral insufficiency and surgeon decides to MV repair
- Cath 6/10/19 documents mild mitral regurgitation

How do you code mitral regurgitation and MV disease?

A. Moderate MR and YES for disease
B. Severe MR and Yes for disease
C. Mild MR and YES for disease
Poll: How do you code mitral regurgitation and MV disease?
Valve Insufficiency and Disease Scenario

If intraop TEE finding changes plan, that is the valve dysfunction to report.

- Pre-op echo 6/11/19 documents moderate mitral regurgitation
- Intra-op TEE prior to incision documents severe mitral insufficiency and surgeon decides to do MV repair
- Cath 6/10/19 documents mild to mitral regurgitation

- How do you code mitral regurgitation and MV disease?
  A. Moderate MR and YES for disease
  B. *Severe MR and Yes for disease – Correct Answer*
  C. Mild MR and YES for disease
Valve Insufficiency Scenario

- Pre-op echo 6/10/19 documents mild to moderate mitral regurgitation
- Intra-op TEE prior to incision documents moderate mitral insufficiency
- Cath 6/11/19 documents moderate to severe mitral regurgitation

- How do you code mitral regurgitation?
  A. Moderate MR
  B. Severe MR
  C. Mild MR
  D. Moderate to Severe MR
  E. Mild to Moderate MR
Poll: How do you code mitral regurgitation?
Valve Insufficiency Scenario

- Pre-op echo 6/10/19 documents moderate mild to mitral regurgitation
- Intra-op TEE prior to incision documents moderate mitral insufficiency
- Cath 6/11/19 documents moderate to severe mitral regurgitation

- How do you code mitral regurgitation?
  A. Moderate MR
  B. Severe MR - Correct Answer
  C. Mild MR
  D. Moderate to Severe MR
  E. Mild to Moderate MR
AVA, AV mean, AV Peak Velocity: Seq 1610, 1615, 1616

- 1610: AV Area: Area in cm² - find in echo or cath
- 1615 AV Mean Gradient: mmHg - look for the word MEAN
- Watch out for PEAK or PEAK to PEAK- these are not “mean”
- 1616 AV Peak Velocity: maximum velocity on ECHO m/sec. Convert cm/sec to m/sec divide by 100. This measure is not reliably obtained from cath
Aortic Stenosis

CONCLUSIONS:
- Exam indication: AS
- The left ventricle is normal in size. Left ventricular systolic function is normal. EF = 56 ± 5% (2D biplane) Grade I left ventricular diastolic dysfunction.
- The right ventricle is normal in size. Right ventricular systolic function is normal.
- The left atrial cavity is mildly dilated.
- The right atrial cavity is mildly dilated.
- Tricuspid aortic valve. There is moderately severe aortic valve stenosis caused by calcified valve and restricted opening. AV area is 0.89 cm² (0.54 cm²/m²) by continuity, VTI. The peak gradient is 50 mmHg, the mean gradient is 29 mmHg and the dimensionless valve index is 0.28.
- Dilated coronary sinus, agitated saline study in left arm positive for persistent left SVC.
- Exam was compared with the prior CC echocardiographic exam performed on 4/26/17 and prior. Rapidly progressing AS.

Dimensionless Valve Index is not of concern to us (V AV/V LVOT)

- Ao mean PG
- AV mPG
- AV mnPG
- AV mean Gradient
Seq 1610 – AV mean Scenario – Surgery 9/5/19

• Pre-op echo 2/10/19 documents AV mean gradient of 37
• Pre-op echo 7/15/19 documents AV mean gradient of 35
• Intra-op TEE prior to incision documents AV mean gradient of 42
• Pre-op Cath 7/14/19 documents AV mean gradient of 45

• Which AV mean gradient do you code for this patient?
  A. 42
  B. 37
  C. 35
  D. 45
Poll: What AV mean gradient do you code for this patient?
Seq 1610 – AV mean Scenario – Surgery 9/5/18

- Pre-op echo 2/10/18 documents AV mean gradient of 37 mmHg
- Pre-op echo 7/15/18 documents AV mean gradient of 35 mmHg
- Intra-op TEE prior to incision documents gradient of 42 mmHg
- Pre-op Cath 7/14/18 documents AV mean gradient of 45 mmHg

Which AV mean gradient do you code for this patient?

A. 42
B. 37
C. 35 – Correct Answer
D. 45
Mitral Hemodynamic Data: Seq 1700, 1705

- Found on ECHO, rarely by cath
  1700: MV area (cm$^2$)
  1705: MV mean gradient (mmHg)
  - MV mean PG (pressure gradient)
  - MV mPG
  - MV mnPG
  - MV mean Gradient
Eccentric Jet

• Regurgitant jet may go straight through the valve (Central) or be directed to one side of the chamber (eccentric)

• Will be reported in narrative section of echo report

• An eccentric jet suggests a specific leaflet pathology and may be reported in the surgeon’s preop note
Aortic Valve - Eccentric Jet

EJ

Mitral Valve Eccentric Jet

http://ehjcimaging.oxfordjournals.org/content/11/4/307
Etiology of Valvular Disease

Rely on your Surgeon 😊

If the surgeon does not describe the etiology

- ECHO description is adequate
- Look for path report to define tumors or connective tissue disorders
- If not clearly documented: report not documented

Sievers Class (bicuspid) is a visual that must be documented by the surgeon....
Questions

Thanks you for Your Time and Attention

See You Next Year: Rhode Island 2020