High Risk Percutaneous Coronary Intervention and Hemodynamic Support

Scott E. Ewing, DO, FACOI

Disclosures

- Medical Director – Plaza Medical Center Cardiac Rehab
- Off-label usage will be discussed

Who Am I?

- Scott E. Ewing, DO, FACOI
- Interventional Cardiologist, Ft Worth, TX
- Texas Health Care, PLLC 2008 - present
- Various moonlighting 2003 - 2008
- Interventional Cardiology Fellowship 2008
- Cardiology Fellowship 2004 - 2007
- Internal Medicine Residency 2001 - 2004
- UNT Texas College Osteopathic Medicine 1997 - 2001
- Texas Instruments 1975-1997
- MS Mechanical Engineering MIT 1984
- BS Mechanical Engineering SMU 1980
- Graduated High School 1974
What is an Interventional Cardiologist?

- Manage Cardiovascular Disease
  - Coronary Artery Disease and Myocardial Infarctions (CAD)
  - Hypertension / Hyperlipidemia
  - Congestive Heart Failure (CHF)
  - Arrhythmias
  - Carotid Artery Disease
  - Peripheral Artery Disease (PAD)
  - Valvular Heart Disease
  - Adults with Congenital Heart Disease

What is an Interventional Cardiologist?

- Diagnostic Imaging
  - Echocardiography
  - Transesophageal Echocardiography
  - Left Heart Catheterization
  - Right Heart Catheterization
  - Peripheral Angiography
What is an Interventional Cardiologist?

- Coronary, Carotid, and Peripheral Revascularization
  - Acute MIs (ED Call)
  - Balloon angioplasty
  - Thrombectomy (Angiojet, Trellis)
  - Rotational and Directed Atherectomy (Rotablator)
  - Stent placement (BMS/DES/Self Expanding)
- Pacemakers
- Percutaneous PDA/PFO/ASD/VSD Closure (Amplatz)
- Valvuloplasty and Percutaneous Valve Replacement (TAVR)
- Cardiac Thrombus Aspiration (Angiovac)
The Heart and How it Works

- Pulmonary artery
- Right lung
- Head and arms
- Vena cava
- Aorta
- Right ventricle
- Left ventricle
- Aortic valve
- Pulmonary valve

Rotational Atherectomy

- Very High Risk Patients
  - Cardiogenic shock
  - Overt heart failure (HF) or severe left ventricular dysfunction
  - Recurrent or persistent rest angina despite intensive medical therapy
  - Hemodynamic instability due to mechanical complications (e.g., acute mitral regurgitation, ventricular septal defect)
  - Unstable ventricular arrhythmias
Intra-Aortic Balloon Pump - History

- Pioneered at Grace Sinai Hospital in Detroit during the early 1960s by Dr. Adrian Kantrowitz and his team
- Developed for use in heart surgery by Dr. David Bregman in 1976 at New York-Presbyterian Hospital in New York City
- First clinical implant was performed at Maimonides Medical Center, Brooklyn, N.Y. in Oct., 1967
- Original balloon was 15 Fr but eventually 9 and 8 Fr balloons were developed

Intra-Aortic Balloon Pump - Indications

- Cardiogenic shock when used alone as treatment for myocardial infarction - 9-22% survive the first year
- Reversible intra-cardiac mechanical defects complicating infarction, i.e. acute mitral regurgitation and septal perforation
- Unstable angina pectoris benefits from counterpulsation
- Post cardiothoracic surgery - weaning patients from cardiopulmonary bypass
- High risk Percutaneous coronary angioplasty
- High risk coronary artery bypass graft surgery
- Thrombolytic therapy of acute myocardial infarction
Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock  

Helger Thiele, M.D., Uwe Zeymer, M.D., Franz-Josef Neu mann, M.D., Miroslaw Feren c, M.D., Hans-Georg Olbrich, M.D., Jorg Hausleiter, M.D., Klaus Emsen, M.D., Georg Pantoni, M.D., Stefan Dirsch, M.D., Hugo Fleif M.D., Rene Hausbruch, M.D., Jorg Steinmaier, M.D., Michael Rohr, M.D., Krauton Heil, M.D., Stefan Schneider, Ph.D., Gerhard Schuler, M.D., and Karl Werdan, M.D., for the IABP-SHOCK II Trial Investigators  

Is the IABP Indicated in All Patients with Cardiogenic Shock?  

Table 3. Clinical Outcomes. Relative Risk  

<table>
<thead>
<tr>
<th>Outcome</th>
<th>IABP (N=300)</th>
<th>Control (N=298)</th>
<th>P-value with IABP (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary end point: all-cause mortality at 30 days</td>
<td>119 (39.7)</td>
<td>123 (41.3)</td>
<td>0.69 (0.76-1.17)</td>
</tr>
<tr>
<td>Reinfarction in hospital</td>
<td>9 (3.0)</td>
<td>4 (1.3)</td>
<td>0.16 (0.70-2.18)</td>
</tr>
<tr>
<td>Stent thrombosis in hospital</td>
<td>4 (1.3)</td>
<td>3 (1.0)</td>
<td>0.71 (0.30-1.75)</td>
</tr>
<tr>
<td>Stroke in hospital</td>
<td>2 (0.7)</td>
<td>5 (1.7)</td>
<td>0.24 (0.09-0.66)</td>
</tr>
<tr>
<td>Ischemia</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>0.50 (0.08-3.05)</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perioperative ischemic complications requiring intervention in hospital</td>
<td>3 (1.3)</td>
<td>0 (0.0)</td>
<td>0.53 (0.08-3.76)</td>
</tr>
<tr>
<td>Bleeding in hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life-threatening or severe bleeding in hospital</td>
<td>8 (3.3)</td>
<td>0 (0.0)</td>
<td>0.51 (0.04-7.80)</td>
</tr>
<tr>
<td>Moderate</td>
<td>42 (14.0)</td>
<td>49 (16.4)</td>
<td>0.77 (0.58-1.01)</td>
</tr>
<tr>
<td>Sepsis in hospital</td>
<td>47 (15.7)</td>
<td>46 (15.4)</td>
<td>0.85 (0.54-1.36)</td>
</tr>
</tbody>
</table>

P=0.92 by log-rank test.
Table 1. Technical features of hemodynamic support devices for the high-risk PCI patient.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Tandem Heart</th>
<th>IABP</th>
<th>Impella</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of access</td>
<td>yes</td>
<td>no</td>
<td>rarely</td>
</tr>
<tr>
<td>Access and entry options</td>
<td>femoral</td>
<td>femoral</td>
<td>femoral</td>
</tr>
<tr>
<td>Intra-aortic balloon size</td>
<td>13 Fr</td>
<td>7 Fr</td>
<td>7 Fr</td>
</tr>
<tr>
<td>Ease of insertion</td>
<td>transseptal</td>
<td>standard</td>
<td>standard</td>
</tr>
<tr>
<td>Cash</td>
<td>high</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>

Table 2. Hemodynamic parameters of cardiac support devices.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Tandem Heart</th>
<th>IABP</th>
<th>Impella</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP</td>
<td>80 ± 10 mmHg</td>
<td>80 ± 10 mmHg</td>
<td>80 ± 10 mmHg</td>
</tr>
<tr>
<td>LV wall stress</td>
<td>10 ± 2 mJ/m²</td>
<td>10 ± 2 mJ/m²</td>
<td>10 ± 2 mJ/m²</td>
</tr>
<tr>
<td>Oxygen demand</td>
<td>500 ± 100 mJ</td>
<td>500 ± 100 mJ</td>
<td>500 ± 100 mJ</td>
</tr>
<tr>
<td>Coronary blood flow</td>
<td>4.0 ± 0.5 L/min</td>
<td>4.0 ± 0.5 L/min</td>
<td>4.0 ± 0.5 L/min</td>
</tr>
<tr>
<td>Augmentation</td>
<td>0.5 L/min</td>
<td>2.5 L/min</td>
<td>3.5 L/min</td>
</tr>
</tbody>
</table>

Table 4. Indications and contraindications for hemodynamic support during high-risk percutaneous coronary intervention.

**Indications**
- Severely depressed ejection fraction
- PCI of sole remaining or primary remaining coronary artery or bypass graft
- Unprotected left main coronary artery PCI (especially if the right coronary artery is occluded)
- Ongoing ischemia
- Hypotension
- Cardiogenic shock
- Hemodynamic instability
- Hypotension
- Hypovolemia

**Contraindications**
- Severe iliac/femoral atherosclerotic disease or tortuosity
- Aortic dissection or aneurysm
- Moderate or severe aortic regurgitation
- Bleeding diathesis
- Bypass grafting to femoral arteries or aorta
- Patent ductus (augments the abnormal shunting)
- Sepsis

Table 5. Comparison of IABP, Impella, and Tandem Heart in the Cath Lab.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Tandem Heart</th>
<th>IABP</th>
<th>Impella</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ease of placement</td>
<td>IABP &gt; IMP</td>
<td>IMP &lt; T H</td>
<td>IMP = T H</td>
</tr>
<tr>
<td>Rapidity of insertion</td>
<td>IMP = IABP</td>
<td>IMP &gt;&gt; IABP</td>
<td>IMP &gt; IABP</td>
</tr>
<tr>
<td>Hemodynamic support</td>
<td>IABP &gt; IMP</td>
<td>IMP &gt;&gt; IABP</td>
<td>IMP &gt; IABP</td>
</tr>
<tr>
<td>Duration of support</td>
<td>Several days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheath/catheter size</td>
<td></td>
<td>14 Fr</td>
<td>14 Fr</td>
</tr>
<tr>
<td>Consoles functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>$20 000-$25 000</td>
<td>$800-$1 200</td>
<td>$800-$1 200</td>
</tr>
<tr>
<td>Potential complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limb ischemia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding, hematoma at site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascular injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embolization of thrombus or plaque</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Indications and contraindications for hemodynamic support during high-risk PCI.

**Indications**
- PCI of sole remaining or primary remaining coronary artery or bypass graft
- Unprotected left main coronary artery PCI (especially if the right coronary artery is occluded)
- Ongoing ischemia
- Hypotension
- Cardiogenic shock
- Hemodynamic instability
- Hypotension
- Hypovolemia
- Transseptal access required
- Standard femoral technique, minimal set up
- Console setup needed
- Surgical assistance occasionally
- Manual compression
- Manual compression, occasionally surgical assistance

**Contraindications**
- Severe iliac/femoral atherosclerotic disease or tortuosity
- Aortic dissection or aneurysm
- Moderate or severe aortic regurgitation
- Bleeding diathesis
- Bypass grafting to femoral arteries or aorta
- Patent ductus (augments the abnormal shunting)
- Sepsis
Purpose
To evaluate safety and feasibility of using Impella after percutaneous coronary intervention (PCI) in patients with ST-elevation myocardial infarction.
Evaluate effects of left ventricular unloading by Impella 2.5 on coronary hemodynamics.
Evaluate safety and efficacy of Impella 2.5 compared with intraaortic balloon pump (IABP) in cardiogenic shock after acute myocardial infarction.
To evaluate feasibility and long-term safety of Impella-assisted high-risk PCI.
To evaluate the use and safety of the Impella 2.5 in elective high-risk PCI.

Sample size
19 consecutive patients undergoing high-risk PCI.
11 consecutive patients who underwent elective high-risk PCI.
26 patients with cardiogenic shock after acute myocardial infarction, randomized to IABP (n=13) or Impella (n=12).
One patient died before implantation.
10 consecutive patients undergoing elective high-risk PCI.
All patients had ejection fractions <30% and multivessel or left main coronary disease.
26 of 30 consecutive patients who underwent high-risk PCI; 3 patients excluded because of cardiogenic shock; 1 excluded because of device malfunction.

Findings
Successful placement achieved in all patients.
No major complications related to the Impella developed in any patients.
Bleeding developed in 1 patient who required a blood transfusion.
2 patients died of causes not related to the Impella.
Aortic and coronary pressures increased with Impella support (P<0.001).
Primary end point of hemodynamic improvement (defined as improved cardiac index at 30 minutes after implantation) was achieved in 25 patients.
Mean arterial pressure increased more in patients with Impella than in patients with the IABP, but the difference was not significant (P<0.09).
Improvement in cardiac index significantly greater in Impella patients (P<0.02).
Diastolic pressure increased significantly more with Impella support than with IABP (P<0.002).
Use of inotropic agents and vasopressors was similar in both groups of patients.
Serum level of lactate was lower in patients treated with Impella.
Hemolysis measured by plasma free hemoglobin was higher in patients treated with Impella (P<0.05).
More blood products were administered to patients treated with Impella.
Left ventricular ejection fraction at 6-month follow-up increased significantly (P<0.02).

No access site complications.
No blood products required.
PCI was successfully performed in all patients.
88.8% remained hemodynamically stable during procedure.
3 patients had severe hypotension develop because of no-reflow.
1 patient died of intracranial hemorrhage 8 hours after the Impella was removed.
3 patients had limb ischemia develop; 1 required surgical intervention.
1 patient had hemolysis develop that required blood transfusion.

Repositioning unit
Red pressure sideport
Sideport to hemostasis sheath
 Infusion filter
Hemostasis sheath
Pigtail tip
Pressure reservoir
Outlet area
Blood pump
Placement markings on the catheter shaft

Image courtesy ABiOMED Inc, Danvers, Massachusetts.
**Baseline Patient Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IABP</th>
<th>Impella</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>67±11</td>
<td>68±11</td>
<td>0.583</td>
</tr>
<tr>
<td>Gender-Male</td>
<td>82.0%</td>
<td>80.6%</td>
<td>0.704</td>
</tr>
<tr>
<td>History of CHF</td>
<td>82.9%</td>
<td>91.2%</td>
<td>0.011</td>
</tr>
<tr>
<td>Current NYHA (Class III/IV)</td>
<td>54.9%</td>
<td>58.5%</td>
<td>0.485</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>49.3%</td>
<td>53.2%</td>
<td>0.414</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>30.5%</td>
<td>22.7%</td>
<td>0.086</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>27.0%</td>
<td>25.4%</td>
<td>0.697</td>
</tr>
<tr>
<td>Implantable Cardiac Defib.</td>
<td>31.0%</td>
<td>35.6%</td>
<td>0.304</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>28.9%</td>
<td>39.4%</td>
<td>0.023</td>
</tr>
<tr>
<td>LV EF</td>
<td>24.0±6.3</td>
<td>23.3±6.3</td>
<td>0.258</td>
</tr>
<tr>
<td>STS Mortality score</td>
<td>6±7</td>
<td>6±6</td>
<td>0.562</td>
</tr>
<tr>
<td>Not Surgical Candidate</td>
<td>64.5%</td>
<td>63.3%</td>
<td>0.625</td>
</tr>
<tr>
<td>SYNTAX score</td>
<td>20.5±13.7</td>
<td>20.3±13.2</td>
<td>0.594</td>
</tr>
</tbody>
</table>
Procedural Characteristics

<table>
<thead>
<tr>
<th>Procedural Characteristics</th>
<th>IABP (N=211)</th>
<th>Impella (N=216)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Heparin</td>
<td>82.4%</td>
<td>93.5%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Platelet Inhibitors</td>
<td>26.5%</td>
<td>13.4%</td>
<td>0.033</td>
</tr>
<tr>
<td>Rotational Atherectomy (RA)</td>
<td>9.0%</td>
<td>14.2%</td>
<td>0.051</td>
</tr>
<tr>
<td>Median # of RA passes/lesion</td>
<td>1 (1-2)</td>
<td>1 (1-2)</td>
<td>0.001</td>
</tr>
<tr>
<td>Median # of RA passes/pt</td>
<td>3 (2-6.4)</td>
<td>4 (3-6.4)</td>
<td>0.001</td>
</tr>
<tr>
<td>Median RA time/lesion</td>
<td>0.8 (0.5)</td>
<td>0.8 (0.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>RA of Left Main Artery</td>
<td>7.7%</td>
<td>5.6%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total Support Time (hours)</td>
<td>13.2±21.0</td>
<td>13.6±21.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge from Cath Lab on device</td>
<td>17.7%</td>
<td>16.7%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Protect II MACE Outcome**

Pre-specified High Risk PCI Without Atherectomy Group

Per Protocol (N=374)

30 day MACE

90 day MACE

Per Protocol (N=374)

Per Protocol (N=427)

PROTECT II: Per Protocol MAE (N=427)

IABP

IMPELLA

Log rank test, p=0.048
CABG is Preferred in Patients with Complex Anatomy and Less Than High Surgical Risk

**Protect II High Risk**

- Left main intervention with LVEF <35%
- Intervention with 3-vessel disease patients with LVEF <30%
- Intervention on the last patent coronary conduit
- PCI on a vessel supplying >50% of the remaining viable myocardium
- Complex PCI on multiple major vessels

**TIMI Risk Score**

- To calculate the score, a value of 1 is assigned when each variable was present and 0 when it was absent:
  - Age ≥ 65
  - Aspirin use in the last 7 days
  - At least 2 anginal episodes within the last 24 hrs
  - ST changes of at least 0.5mm in contiguous leads
  - Elevated serum cardiac biomarkers
  - Known Coronary Artery Disease (CAD) (coronary stenosis ≥ 50%)
  - At least 3 risk factors for CAD, such as:
    - Hypertension: ≥ 140/90 or on anti-hypertensives
    - Current cigarette smoker
    - Low HDL cholesterol (< 40 mg/dL)
    - Diabetes mellitus
    - Family history of premature CAD
**TIMI Risk Score Interpretation**

- Increased risk all-cause mortality, new or recurrent MI, or severe recurrent ischemia requiring revascularization at 14 days:
  - Score of 0/1 – 4.7%
  - Score of 2 – 8.3%
  - Score of 3 – 13.2%
  - Score of 4 – 19.9%
  - Score of 5 – 26.2%
  - Score of 6/7 – at least 40.9%

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**Percutaneous Ventricular Assist Device - Tandem Heart**

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**Extracorporeal Membrane Oxygenation (ECMO)**

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Surgically Implanted Left Ventricular Assist Device (LVAD)

Case #1

- 43 yo W/M with x1 week chest discomfort
- Associated SOB
- No sig PMH
- No sig PSH
- Smoker
- Presents to outlying ED and troponin elevated 2:1
- ECG shows non-specific changes
- Patient electively taken to the cath lab for LHC and possible stent(s)
Case #1 Results
- Patient discharged home x2 days post procedure
- Home meds
  - Prasugrel 10 mg
  - ASA 81 mg
  - Metoprolol ER 50 mg
  - Lisinopril 10 mg
  - Atorvastatin 40 mg

Case #2
- 70 y.o. W/M with chest pain and SOB
- PMH: CAD, DM, Htn, hyperlipidemia
- PSH: multi-vessel CABG
- Presents with unstable angina
- Taken electively to the cath lab for LHC and possible PCI
Case #2

- Patient referred for redo CABG
- SVG to OM1 and SVG to OM2 placed
- Patient "flew" through surgery, recovered quickly, and discharged home
- Seen in the clinic, referred to cardiac rehab which was completed
- 6 months later patient returns to clinic with symptomatic CHF (he really didn't look very good)
- Repeat LHC performed, patient taken for high-risk PCI
Case #2 Results

- LMCA to LCX stented with drug-eluting stent
- Discharged home x2 days later
- Patient has returned to cardiac rehab
- Doing well at this point

Case #3

- 68 yo W/M with 2-3 weeks of "heartburn"
- PMH: CAD, CHF, DM, Htn, hyperlipidemia
- PSH: coronary stents, AICD
- Troponin 0.3
- Taken electively to the cath lab
Case #3

- High risk PCI planned
- Percutaneous Left Ventricular Assist Device
- Rotational Atherectomy
- RCA stenting
Case #3 Results

- Excellent results
- Patient discharged back to usual cardiologist
Case #4

- 90 yo W/M presents to out lying hospital with chest pain and shortness of breath
- PMH: DM, Htn, HLD
- PSH: Inguinal hernia
- Troponin 0.452, BNP 140
- Patient taken to the cath lab
Case #4

- Patient referred for surgical evaluation
- Felt to be prohibitive risk by CT surgery and palliative care recommended
- Instead, patient taken for high risk PCI
Case #4

- L femoral artery bleeding noted at the start of the case due to unsuccessful "PreClose"
- Case terminated before anticoagulation given

Well, that wasn't a very good start!
Patient taken back to the cath lab the next day for second attempt
Case #4 Results

- Excellent results
- Medications
  - ASA 81 mg daily
  - Clopidogrel 75 mg daily
  - Carvedilol 6.25 mg BID
  - Amlodipine 5 mg daily
  - Isosorbide Mononitrate 10 mg daily
  - Rosuvastatin 10 mg daily
  - Insulin Lispro and Glargine
  - Exenatide 10mcg SC BID
- Pt discharged back to usual cardiologist
- Pt doing rather well at 2 week follow up

Summary

- High risk PCI is a viable alternative to CABG
- Hemodynamic support can reduce morbidity and mortality
- IABP does not appear to be as good as we thought
- Percutaneous Left Ventricular Assist Device has been shown to be superior to the IABP for hemodynamic support

Question #1

- Which of the following is a characteristic of a high risk patient for planned percutaneous coronary intervention?
  - Normal or near normal LV ejection fraction
  - Patient with a low TIMI risk score
  - Planned left main coronary PCI with severely reduced LV ejection fraction
  - 1 or 2V coronary artery disease involving 25% of the myocardium
Question #2

The Protect II trial compared which of the following pairs of hemodynamic support?
- ECMO vs. surgically implanted LVADs
- IABP vs. ECMO
- Pressor support vs. IABP
- Percutaneous LVAD vs. IABP

Question #3

Which of the following is true?
- CABG is the treatment of choice in low risk patients with 1-2 vessel coronary artery disease not involving the LMCA
- High risk PCI is a viable alternative to CABG in the elderly with severe CAD and low ejection fraction
- Current ACC appropriate use criteria (AUC) clearly delineate which high risk patients should proceed with CABG vs. high risk PCI
- IABP remains the clear first choice for hemodynamic support in high risk PCI

Question #4

Which of the following is true?
- Hemodynamic support is used routinely for low and intermediate risk PCI
- The Protect II trial showed reduced rates of MACE and MAE at 30 and 90 days when a percutaneous LVAD was used
- IABP is the treatment of choice for hemodynamic support when performing high risk PCI
- Rotational atherectomy is used routinely to prepare coronary vessels for stenting
"Dr. Ewing, may I be excused? My brain is full."

Questions???