Intra-aortic Balloon Pump: Indications and Interpretation of Tracings

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IABP

- Goal is to augment myocardial perfusion
  - Increases coronary blood flow during diastole
  - Unloads left ventricle during systole
- Accomplished by mass displacement of blood (30 to 50 mL)
Royal College

• You are called to the ER for a patient with angina, ST elevations, hypotension and shock....
• Emergency, full stomach
• ACLS algorithm
• Optimize myocardial oxygen supply and demand
  – MONA
    • Morphine
    • Oxygen
    • Nitroglycerin
    • Aspirin
  – Vasopressors
  – Inotropes
  – IABP
• Consult cardiology, cardiac surgery
<table>
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<tr>
<th>Indications</th>
<th>Contraindications</th>
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<tr>
<td>1. Cardiogenic shock</td>
<td>1. Aortic valvular insufficiency</td>
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<tr>
<td>a. Myocardial infarction</td>
<td>2. Aortic disease</td>
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<tr>
<td>b. Myocarditis</td>
<td>a. Aortic dissection</td>
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<tr>
<td>c. Cardiomyopathy</td>
<td>b. Aortic aneurysm</td>
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<td>2. Failure to separate from CPB</td>
<td>3. Severe peripheral vascular disease</td>
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<td>a. Ventricular septal defect</td>
<td>5. Massive trauma</td>
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<td>b. Mitral regurgitation</td>
<td>6. Patients with “do not resuscitate” instructions</td>
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<td>5. Procedural support during coronary angiography</td>
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<td>6. Bridge to transplantation</td>
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Kaplan’s Cardiac Anesthesia, 6th edition p. 1002
Dicrotic notch
- Aortic valve closure
- Beginning of isovolemic relaxation and diastole

Peak systolic pressure
Balloon Inflation
- Beginning of diastole for maximum blood volume displacement

Figure 32-4  Arterial waveforms seen during intra-aortic balloon pump (IABP) assist. The first two waveforms are unassisted, and the last is assisted. Notice the decreased end-systolic and end-diastolic pressures and augmented diastolic pressures caused by IABP augmentation and the (correct) point at which balloon inflation occurs. These are waveforms generated by a correctly positioned and timed balloon. (Courtesy of Datascade Corporation.)
**Diastolic Augmentation**

- Coronary blood flow and pressure ↑
  - ↑ oxygen delivery
  - ↑ coronary collateral circulation
- ↑ perfusion to distal organs (kidneys, brain)
Balloon Deflation

- At onset of systole during isovolemic contraction
- Isovolemic contraction is shortened
  - Sudden evacuation of 40mL of blood from aorta
  - Left ventricle does not have to generate as much pressure to achieve ejection
  - ↓ peak systolic pressure
  - ↓ oxygen demand
- Reduced afterload allows ventricle to empty
  - ↑ stroke volume, cardiac output
  - ↓ preload if elevated
Figure 32-4  Arterial waveforms seen during intra-aortic balloon pump (IABP) assist. The first two waveforms are unassisted, and the last is assisted. Notice the decreased end-systolic and end-diastolic pressures and augmented diastolic pressures caused by IABP augmentation and the (correct) point at which balloon inflation occurs. These are waveforms generated by a correctly positioned and timed balloon. (Courtesy of Datasonce Corporation.)
• Increased coronary perfusion
• Decrease myocardial oxygen demand
• Increased cardiac output
Clinical Parameters

- Decreased signs of ischemia: angina, ST changes, arrhythmias
- Increased coronary blood flow
- Decreased afterload
- Decreased oxygen demand
- Increased cardiac output
- Increased urine output
- Decreased preload (PCWP, CVP)
- Decreased pulmonary congestion, improved arterial oxygenation
- Improved mentation
- Decreased heart rate
- Decreased lactic acidosis
- Increased pulse pressure

Counterpulsation Applied An Introduction to Intra-Aortic Balloon Pumping. Arrow international. Table 2 p23.
Errors in Timing

- Diastolic augmentation
- Assisted systole
- Assisted aortic end diastolic pressure
- Unassisted aortic end diastolic pressure
Errors in Timing

- Diastolic augmentation
- Unassisted systole
- Widened appearance
- Prolonged rate of rise of assisted systole
- Assisted aortic end diastolic pressure
Errors in Timing

Diagram showing the timing of cardiac cycles with labeled points:
- Unassisted systole
- Assisted systole
- Diastolic augmentation
- Assisted aortic end diastolic pressure
Errors in Timing

- Unassisted systole
- Diastolic augmentation
- Assisted systole
- Dicrotic notch
- Assisted aortic end diastolic pressure
Timing set for optimal benefit!

10. Elements of Timing (continued)

3. Improper Timing

Hemodynamic

4. Improper Timing
1:1 – cannot accurately assess timing
Inflation optimal, early deflation – poor afterload reduction
Early inflation, deflation optimal. Premature closure of aortic valve, decreased cardiac output.
Inflation optimal. Late deflation - ↑↑O2 demand & afterload
Early inflation, early deflation – decreased cardiac output, poor afterload reduction
Late inflation. Deflation optimal – little increase in perfusion pressure
Late inflation. Late deflation – little increase in perfusion pressure, increased afterload
Late inflation, early deflation – why bother having an IABP?
Heart rate slowed, deflation initially early, then corrected
Trouble shooting in OR

• ECG trigger may not be functioning properly
  – Check slave cable connections
  – Check patient leads
  – Change ECG lead source

• Autofill may fail
  – Check helium and refill, then check balloon

• Balloon may not augment CO adequately
  – Check balloon position
  – Reposition balloon is necessary
38) Mécanisme IABP, lequel ne diminue pas:

a) LVEDV

b) Pression diastolique a/n racine aortique

c) Pression systolique a/n racine aortique

d) MVO2
39) Regarding IABP, all of the following are contraindications EXCEPT:

- Xa) Thrombocytopenia,
- b) Aortic insufficiency
- c) Thoracic aortic aneurysm
- d) Atherosclerosis,
Proper timing, but....

- Balloon is too small
- Patient’s stroke volume is much higher or lower than balloon volume
- Balloon is too low
- Severe hypovolemia
- Low systemic vascular resistance
- Catheter kinked
Proper timing, but...

- Balloon too large
- Balloon pressure waveform – height reflects pressure in aorta