The IABP Numbers Game

GETINGE

Learning Objectives

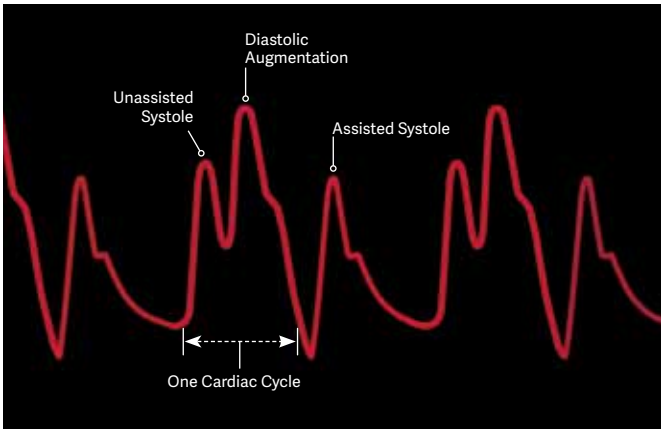
At the conclusion of this program, the participants will be able to:

- Discuss the characteristics of the Intra-aortic balloon pump (IABP) waveform
- Differentiate the differences between the IABP pressures vs. non-invasive blood pressure (NIBP) and bedside monitor pressures

IABP therapy review

How does IABP therapy affect blood pressure and arterial waveform?

- **Inflation** of the balloon within the aorta during diastole increases (augments) diastolic pressure
- This inflation results in an increased pressure, seen on the arterial waveform as **diastolic augmentation**
- **Deflation** of the balloon is timed just before ventricular systole, resulting in decreased aortic pressure (afterload reduction)
  - Decreased afterload reduces end diastolic pressure, lowering the pressure the heart must eject against (assisted systole)



Parissis V, Graham S et al. IABP: History-evolution-pathophysiology-indications: What We Need To Know. *Journal of Cardiothoracic Surgery.* 2016; 11:122.

Effect of IABP therapy on the arterial pressure

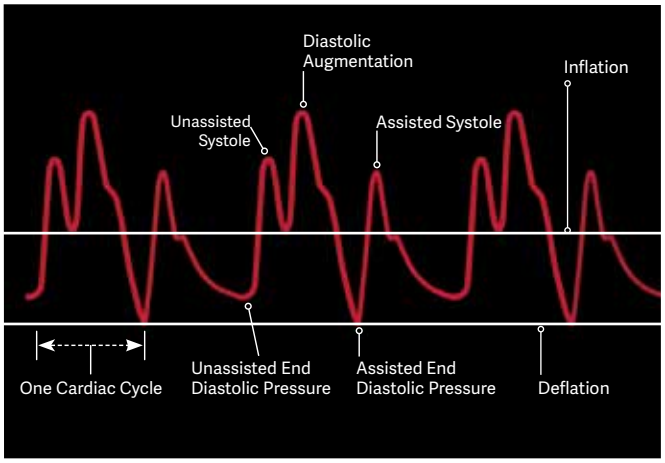
Proper IABP Timing

Inflation

- Occurs at the dicrotic notch
- Appears as a sharp "V"
- Ideally diastolic augmentation rises above systole

Deflation

- Occurs just prior to systolic ejection
- Results in a reduction in assisted end diastolic pressure
- Results in a reduction in assisted systolic pressure



Quaal SJ. Interpreting the arterial pressure waveform in the intra-aortic balloon-pumped patient. *Prog Cardiovasc Nurs.* 2001;16(3):116-118, 125.

The IABP vs. NIBP and Bedside Monitor Pressures

The IABP vs. NIBP

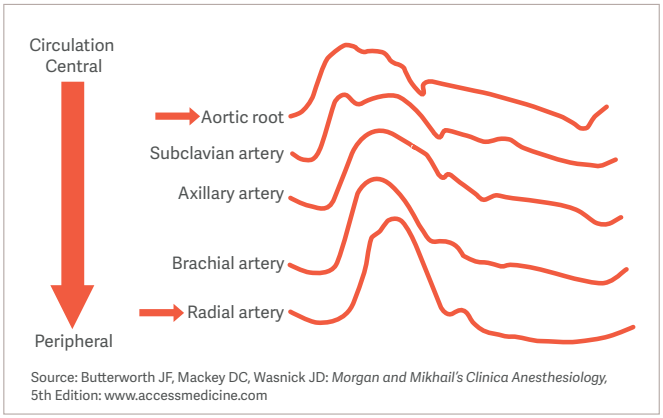
- When the IABP is pumping, the non-invasive blood pressure will not accurately reflect the patient's systolic and diastolic pressures[1]
- Non-invasive systolic BP correlated more closely to the augmented diastolic pressure of the IABP[1]
- The IABP blood pressure measurements displayed on the console should be used for monitoring, recording and clinical decision -making[2]

1. Parr, C and Schaffer, S. Comparison of Noninvasive and Invasive Blood Pressure Measurements in Patients with Intra-Aortic Balloon Pumps. *ASAIO Journal*. 2020; 66:(7): e87-e89.
2. Quaal SJ. Interpreting the arterial pressure waveform in the intra-aortic balloon-pumped patient. *Prog Cardiovasc Nurs.* 2001;16(3):116-118, 125.

Central pressure vs. peripheral pressure

The arterial pressure wave changes when moving from the central aorta to the periphery:

- Arterial upstroke becomes steeper
- Systolic peak becomes higher
- Dicrotic notch appears later
- Diastolic wave becomes more prominent
- End-diastolic pressure becomes lower
- When compared with central aortic pressure, peripheral arterial waveforms have higher systolic pressure, lower diastolic pressure, and wider pulse pressure.



Source: Butterworth JF, Mackey DC, Wasnick JD: *Morgan and Mikhail's Clinica Anesthesiology,* 5th Edition: www.accessmedicine.com

Schroeder, RA. Miller R. *Miller Anesthesia.* 7th ed. Saunders; 2007.

Bedside monitor vs. IABP pressures

- Some bedside monitors analyze the arterial waveform over several seconds and display an average of the highest and lowest pressure points measured during the sampling period
- Most are not programmed to distinguish between a high-pressure point generated by a patient's intrinsic systole or diastolic augmentation caused by balloon inflation
- This often results in augmentation being incorrectly labeled as systole.

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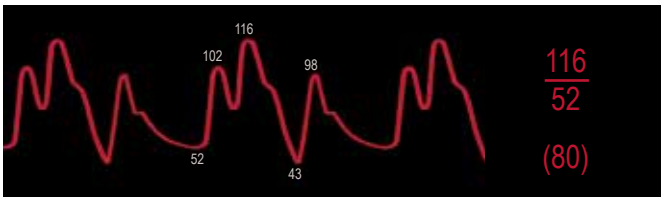
Cardiosave IABP Display



Bedside Monitor

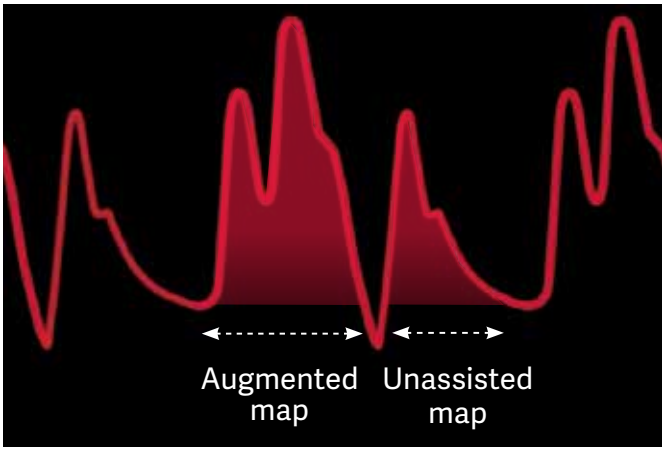
Mean arterial pressure (MAP): IABP

Augmented MAP

- Augmentation increases mean arterial pressure by increasing both the pressure and time under the pressure curve
- The IABP samples the waveform every 4 msec to calculate the MAP

Unassisted MAP

- During an *unassisted* beat, the MAP will be lower than an assisted beat – there is less pressure and less time under the pressure curve
- Standard MAP calculation does not take into account diastolic augmentation



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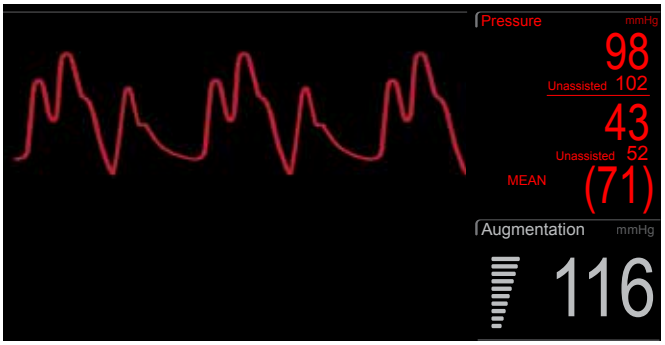
Mean arterial pressure (MAP): NIBP vs. IABP

- **Bedside monitor NIBP calculation**

  $$MAP = \frac{[(2 \times diastolic) + systolic]}{3} = 67 \text{ mmHg}$$



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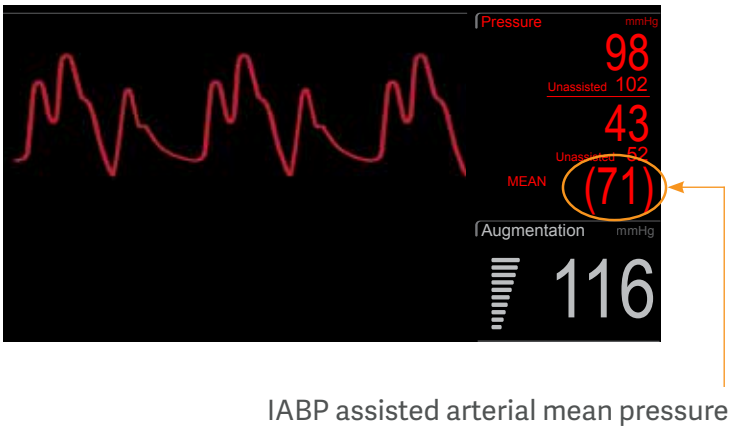
Mean arterial pressure (MAP): NIBP vs. IABP

- **Bedside monitor NIBP calculation**

  $$MAP = \frac{[(2 \times diastolic) + systolic]}{3} = 67 \text{ mmHg}$$

- **IABP assisted arterial mean pressure**
  - Augmentation increases mean pressure by increasing pressure and time under the curve
  - The pump samples the BP every 4 msec on the pressure waveform = MAP



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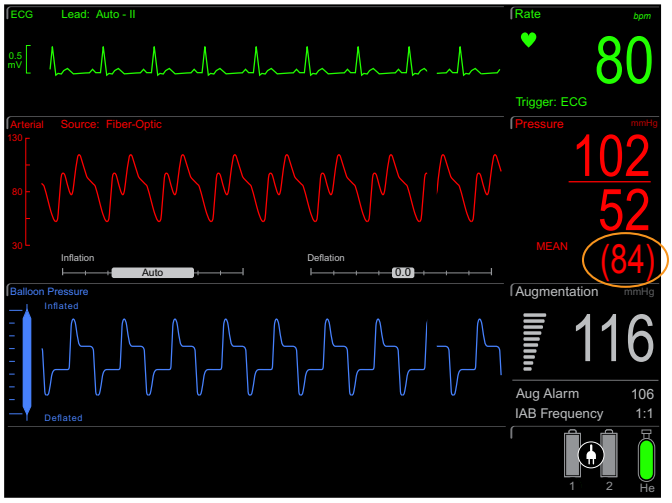
Titrating drips during IABP therapy

Consider using MAP as a guideline, not systolic pressure

- Why?
  - IABP therapy lowers systolic and end diastolic pressure, which signifies afterload reduction and decreased MVO_2 demand on the left ventricle
  - The diastolic augmentation is factored into the mean arterial pressure giving a more accurate pressure
- Detrimental outcomes can arise if one nurse assumes the physician medication titration order refers to MAP and another assumes the physician order refers to systole or perhaps peak diastolic augmented pressure



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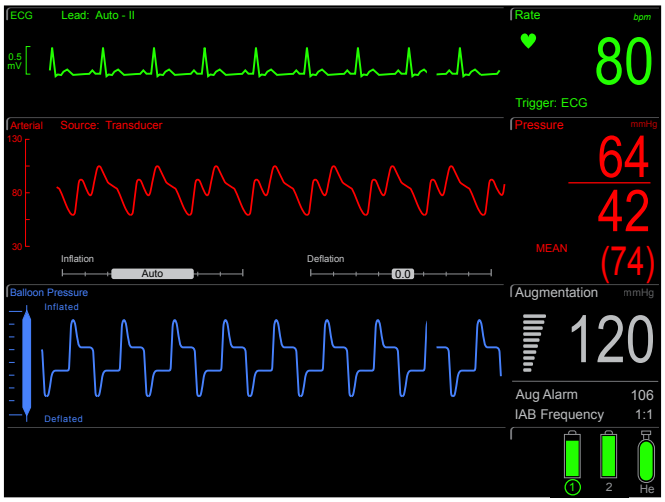
Case Studies

Call from the Emergency Support Line – Case Study 1

- Pressures from the beside monitor do not match the IABP display
- Systolic pressure on bedside monitor reading 114/40 MAP 66
- Why is systole lower than the mean pressure?
- Why is there such a difference in the systolic pressures?
- What pressure is the most accurate?



Call from the Emergency Support Line – Case Study 2

The arterial waveform is flat

The arterial pressures did not look right

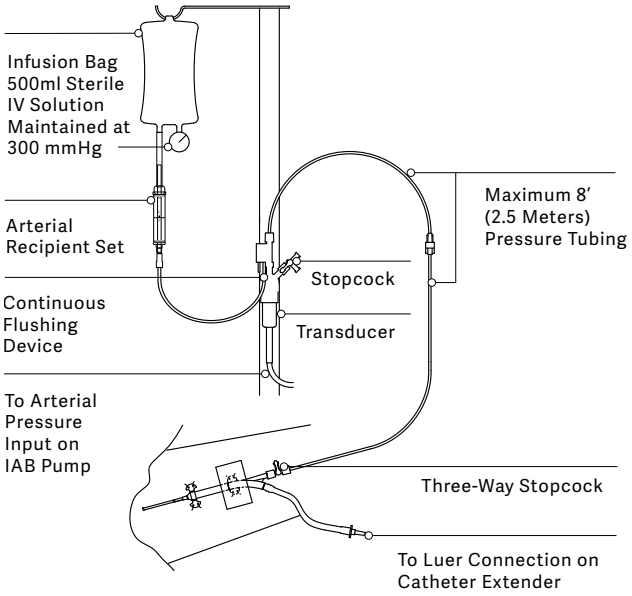
What can be done to improve the quality of the waveform?

What should be done if the waveform cannot be restored?

IAB catheter – Proper care of inner lumen

- If inner lumen aortic pressure signal becomes damped:
  - Aspirate and discard 3cc of blood
  - If **able** to aspirate blood, fast flush to clear pressure tubing for at least 15 seconds (with IABP on Standby)
  - If **unable** to aspirate blood, consider inner lumen clotted, cap lumen, provide alternate pressure source
  - **Do not** sample blood from inner lumen

Note: It is recommended that a continuous flush of 3cc/hour be maintained through the inner lumen of all Getinge IAB catheters (conventional and fiber-optic)



Summary

Key Points

- Blood pressure is different depending on the artery being monitored[1]
- Bedside monitors are not programmed to distinguish between augmented, assisted or unassisted blood pressures generated by the IABP[2]
- The use of IABP console blood pressure measurements should be used for monitoring and clinical decision-making[2]

1. Schroeder, RA. Miller R. *Miller Anesthesia.* 7th ed. Saunders; 2007.
2. Quaal SJ. Interpreting the arterial pressure waveform in the intra-aortic balloon-pumped patient. *Prog Cardiovasc Nurs.* 2001;16(3):116-118, 125.

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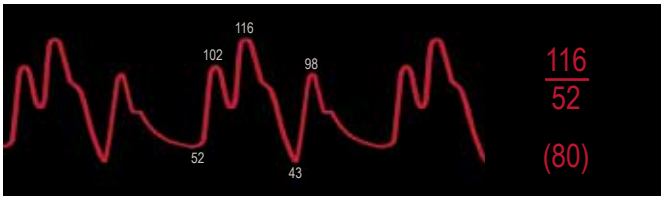

Bedside Monitor

For clinical assistance 24-hours/day – 7 days/week: 1 (800) 777- 4222

Notes

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*GETINGE

Getinge Manufacturing · 45 Barbour Pond Dr., Wayne, NJ 07470, USA
Getinge Sales · 1 Geoffrey Way, Wayne, NJ 07470, USA

www.getinge.com

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