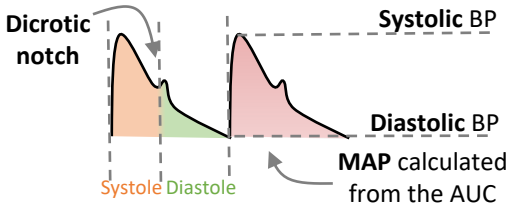
ARTERIAL LINE by Nick Mark MD

ONE onepagericu.com @nickmmark Link to the most current version →

UTILITY

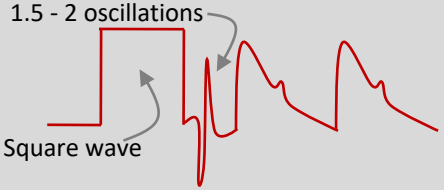
Arterial lines permit continuous invasive **blood pressure measurement**, frequent **arterial blood sampling**, and analysis of the waveform can be used to **estimate cardiac output**, **predict volume responsiveness**, and **identify specific pathologies**.



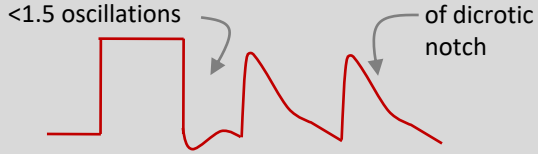
SQUARE WAVE TEST

The arterial line can measure BP inaccurately unless properly calibrated. Rapidly flushing the line (by pulling the release on the **flush device**) generates a **square wave**. Counting oscillations after the square wave indicates if the arterial line is working properly.

Normal = accurate BP

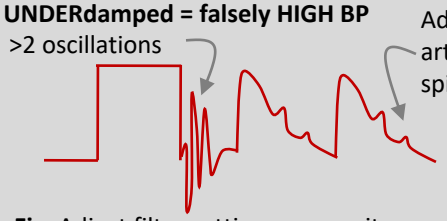


OVERdamped = falsely LOW BP



Fix: Remove extra tubing & any air bubbles.

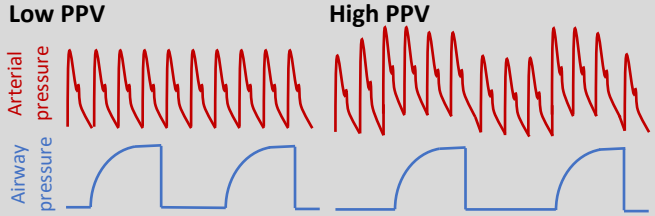
UNDERdamped = falsely HIGH BP



Fix: Adjust filter settings on monitor

PULSE PRESSURE VARIATION (PPV)

Pulse pressure is proportional to stroke volume. Pulse Pressure Variation (PPV) represents an interaction between lungs and heart. Ventilation (either spontaneous or mechanical) alters the intrathoracic pressure and causes stroke volume to vary. Greater variability in stoke volume (increased PPV) may suggest fluid responsiveness.



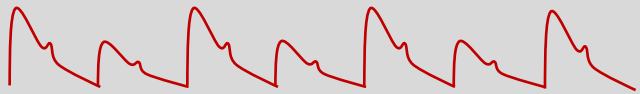
$$PPV = \frac{PP_{max} - PP_{min}}{PP_{mean}}$$

Specifically, a **PPV > 12% is suggestive that there will be an increase in stroke volume with fluid challenge**. However in order to interpret PPV **3 conditions** must be met:

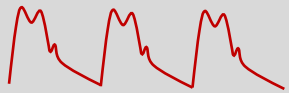
1. Sinus rhythm (consistent filling time)
2. Mechanically ventilated w/o spontaneous respirations; TV= 8 cc/kg (consistent effect of ventilator)
3. Must not have an open chest (heart/lungs interacting)

In contrast to an increase in BP with respiration causing high PPV, ***pulsus pardoxus*** is the decrease in SBP > 10 mmHg with respiration, associated with tamponade & other conditions.

SPECIFIC ARTERIAL WAVEFORM PATTERNS



Pulsus alternans - alternating strong and weak pulses; seen in low cardiac output shock states



Pulsus bisfirens - double peaked pulse in severe AR ± AS

Pulsus tardus - late peaking pulse; seen in severe AS

CARDIAC OUTPUT ESTIMATION

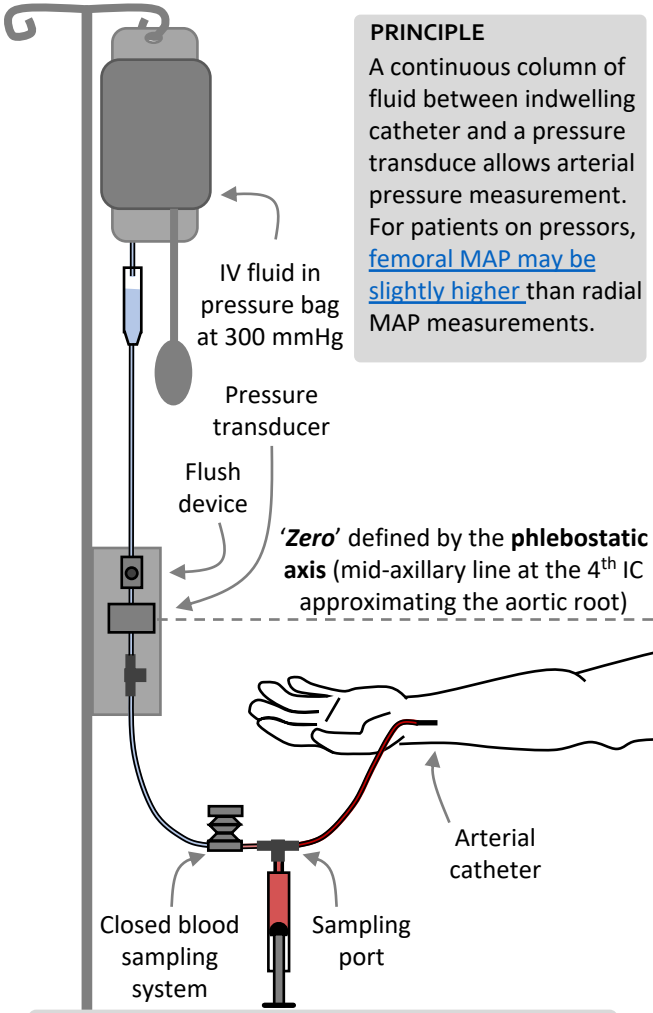
Several techniques can be used to estimate cardiac output using an algorithm to analyze the waveform. There are two types: uncalibrated and calibrated. None is proven superior.

CARDIAC ARREST

During cardiac arrest, an arterial line can be used to gauge adequacy of CPR (e.g. DBP > 25mmg on waveform), to identify ROSC, and to differentiate PEA from pseudo-PEA. See *Cardiac Arrest OnePager* for more.

PRINCIPLE

A continuous column of fluid between indwelling catheter and a pressure transduce allows arterial pressure measurement. For patients on pressors, femoral MAP may be slightly higher than radial MAP measurements.



Closed blood sampling systems enable blood draws with minimal waste. They are associated with lower risk of bacterial contamination and when combined with smaller size sample tubes and decreased lab frequency they can reduce blood transfusions.

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