INTRA-AORTIC BALLOON PUMP by Nick Mark MD

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PRINCIPLE:

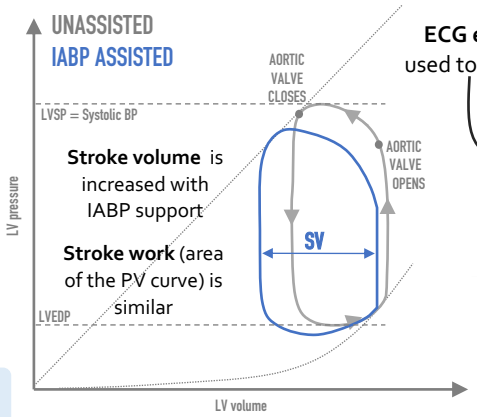
Intra-aortic balloon counter-pulsation is a method of invasive hemodynamic support. A catheter is placed through an arterial sheath and advanced into the thoracic aorta. A gas filled balloon at the end of the catheter inflates in sync with the cardiac cycle:

- Balloon ***inflates*** in diastole → ***increases*** coronary perfusion
- Balloon ***deflates*** in systole → ***decreases*** afterload & ***increases*** LV stroke volume (SV)

The thick-walled LV is only perfused by the coronaries during diastole. By increasing diastolic pressure, the IABP improves coronary artery perfusion.

Intra-aortic balloon pumps (IABP) can be used to support people in ***cardiogenic shock***, those ***undergoing revascularization***, or ***as a bridge to to intervention*** or for ***interfacility transport***. It can also be used as an ***LV vent in patients receiving VA ECMO***.

While ithas salubrious hemodynamic effects, neither RCTs nor meta-analysis has found a survival benefit to IABP use in people with cardiogenic shock.



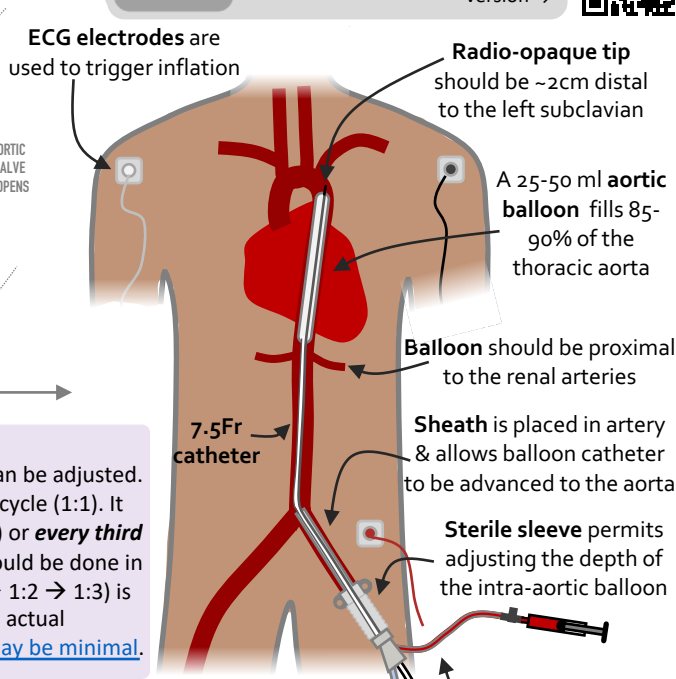
TRIGGER:

Proper IABP support depends on precise inflation & deflation timing. In order to sync the balloon with the cardiac cycles, the controller uses EKG or aortic pressure to ***trigger*** inflation. Asynchronous (e.g. set at a rate of 80) can be used as a backup.

- **EKG**: triggers inflation at the middle of the T-wave & triggers deflation at the peak of the R wave. Arrythmias such as afib & pacer spikes can disrupt EKG triggering. (Atrial pacing is particularly problematic). ECG triggering is preferable in most patients.
- **Pressure:** aortic pressure triggers inflation at the dicrotic notch and deflates based elapsed time. Pressure trigger is inherently less precise than EKG (the pressure wave propagates slower than electricity)

AUGMENTATION/WEANING:

The level of hemodynamic support can be adjusted. By default, the IABP augments ***every*** cycle (1:1). It can be decreased to ***every other*** (1:2) or ***every third*** (1:3) cycle. Timing & adjustments should be done in 1:2 mode. Decreasing support (1:1 → 1:2 → 1:3) is often done to wean IABP, though the actual coronary perfusion provided in 1:3 may be minimal.



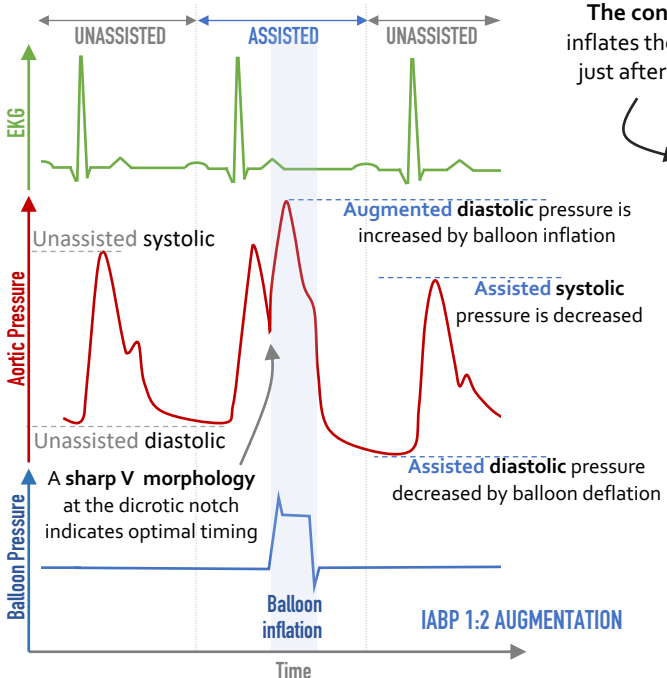
TIMING:

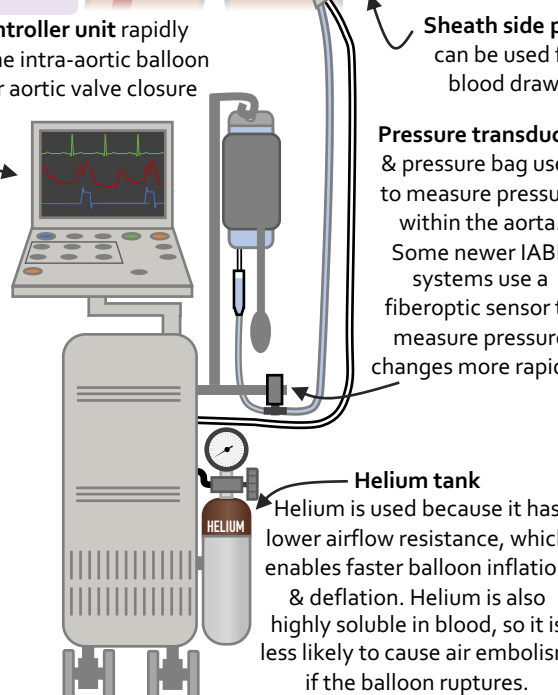
Ideally the balloon would inflate immediately at the onset of diastole (40 msec before the dicrotic notch). Modern IABP have automatic timing but timing can (& should be) manually optimized.

Consequences of improper timing include:

- Early balloon inflation →increased afterload
- Late balloon inflation → decreased diastolic augmentation
- Early balloon deflation → no decrease in myocardial O_2 demand
- Late balloon deflation → increases afterload
- Poor diastolic augmentation → suboptimal coronary perfusion

Timing should always be adjusted in 1:2 support mode.





ANTICOAGULATION:

The catheter is potentially thrombogenic, however based on limited data, routine anticoagulation may not be required in 1:1 mode. It may be necessary if augmentation is reduced to 1:2, 1:3.

COMPLICATIONS & MONITORING:

- Limb ischemia → monitor distal pulses
- Juxta-renal positioning → monitor urine output, CXR
- Bleeding, hematoma → monitor sheath site, check coags
- Decreased augmentation → consider low SVR (sepsis), decreased cardiac output (AIBP requires a CI of >1 to "augment")
- Worsening cardiac ischemia → adjust timing/trigger