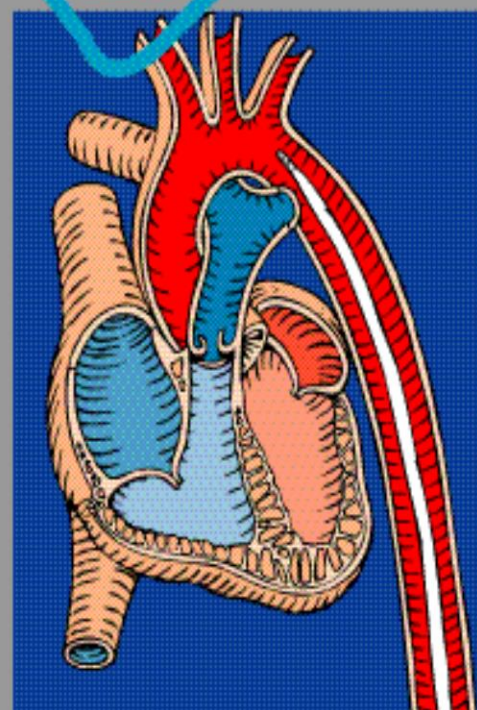
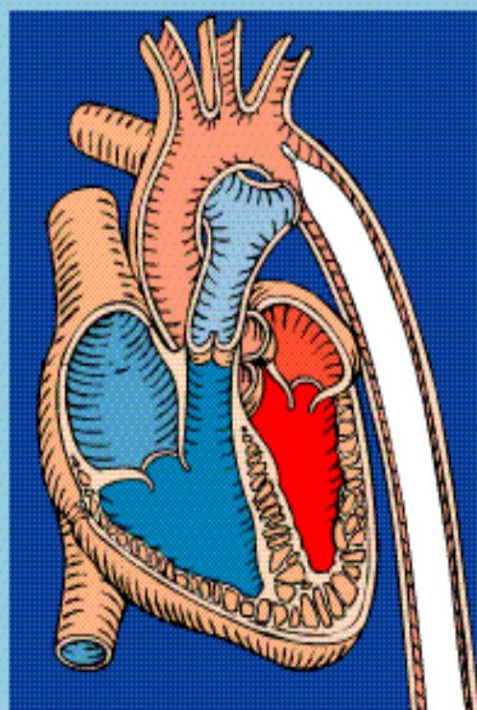
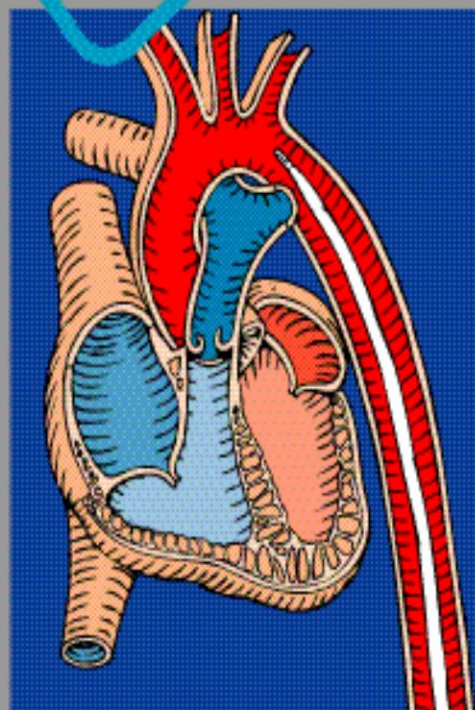
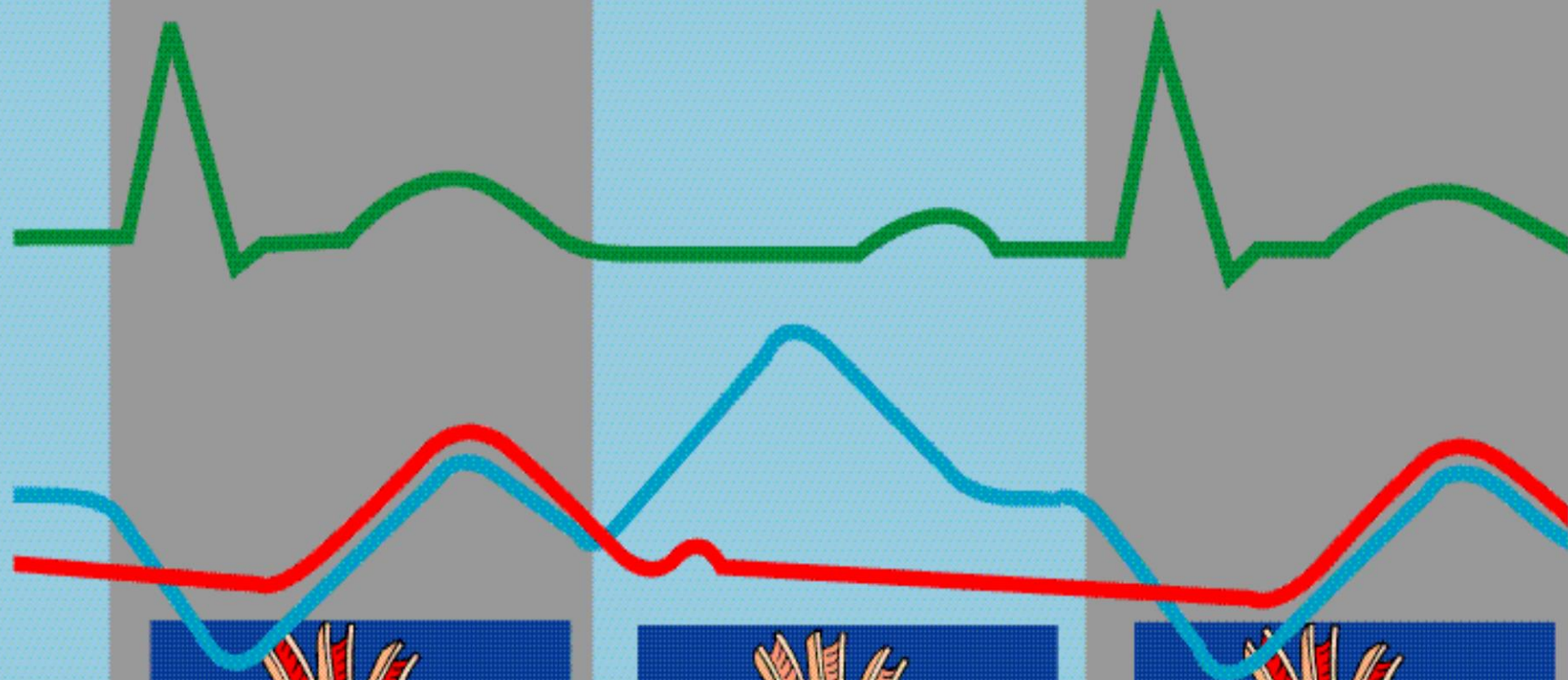


ARROW[®]

INTERNATIONAL





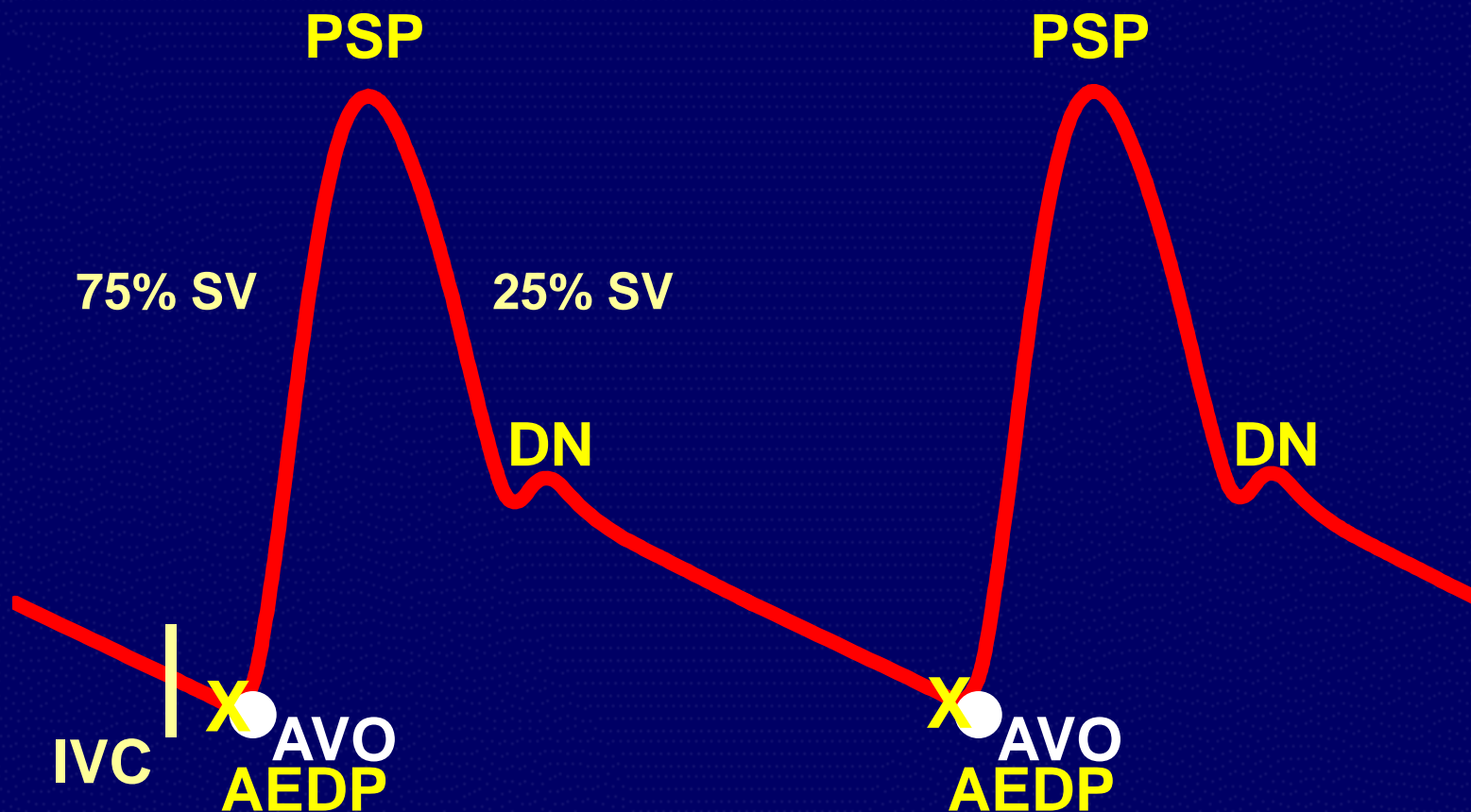
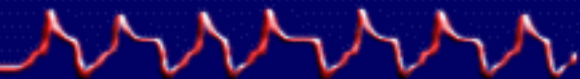
Timing

How is proper timing achieved?

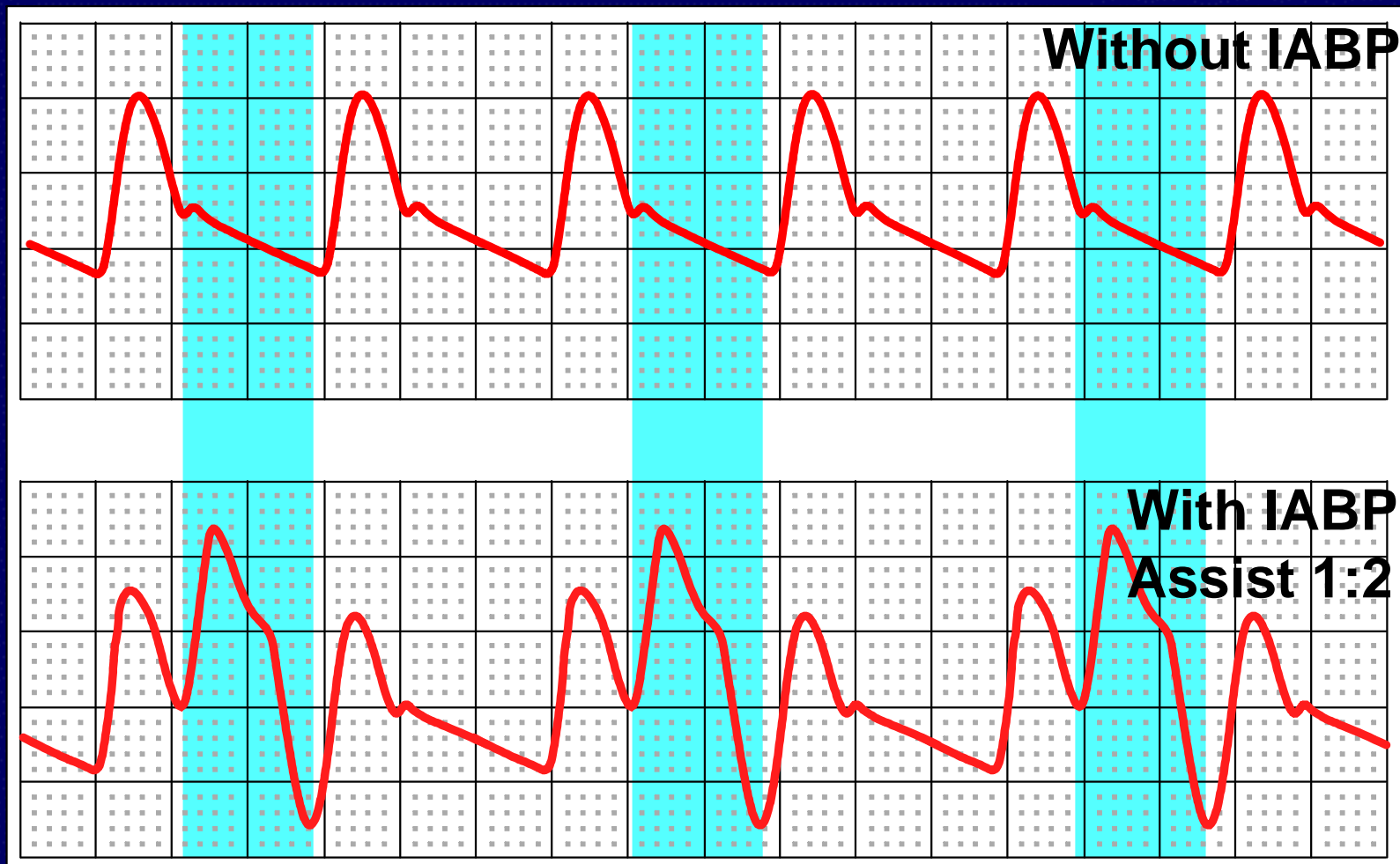
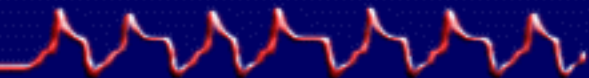


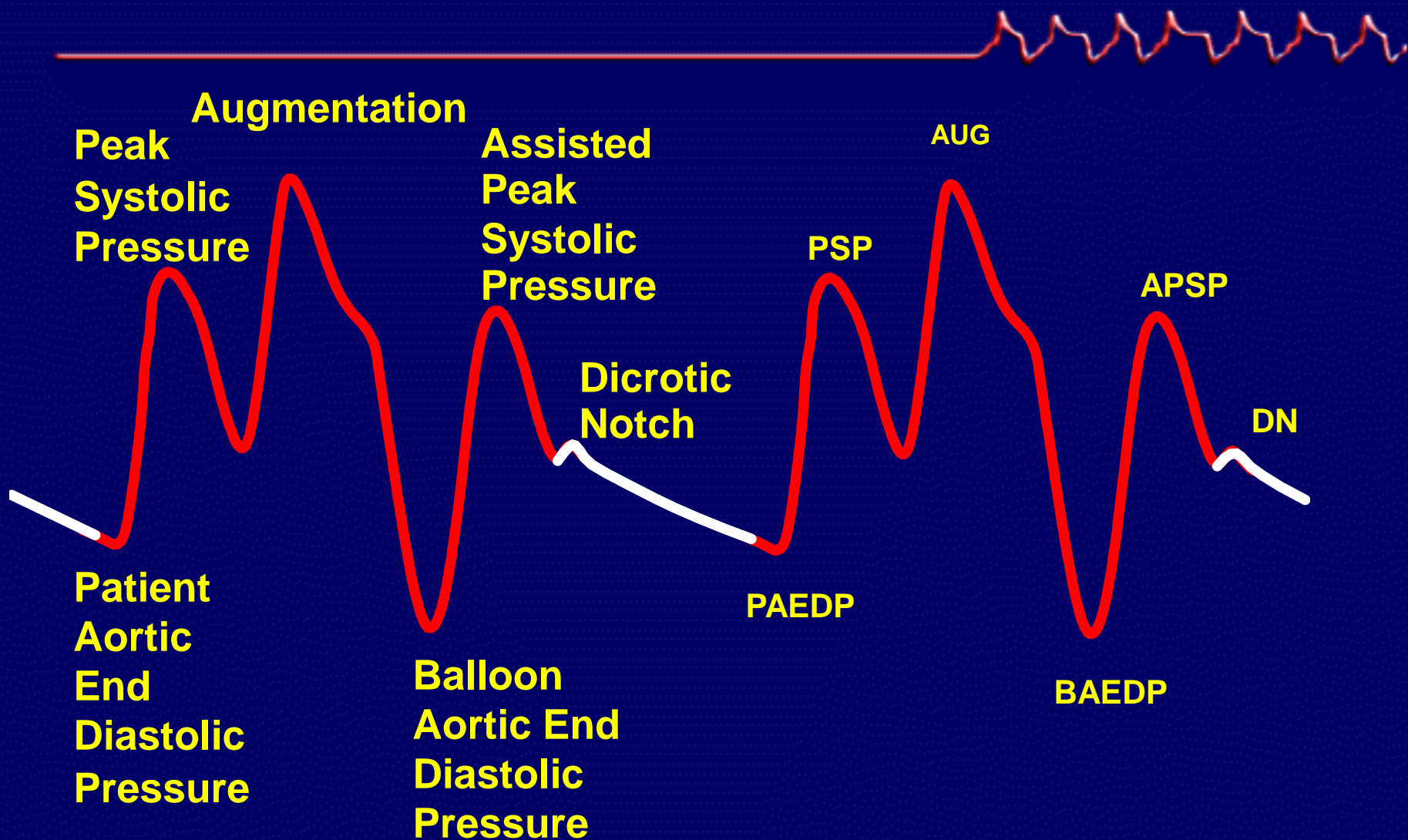
- **Always performed using the arterial pressure waveform as the guide**

Arterial Pressure Waveform



Arterial Pressure Waveform

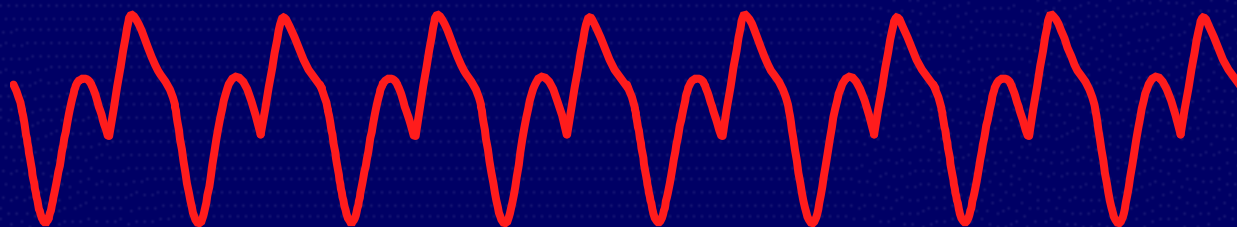




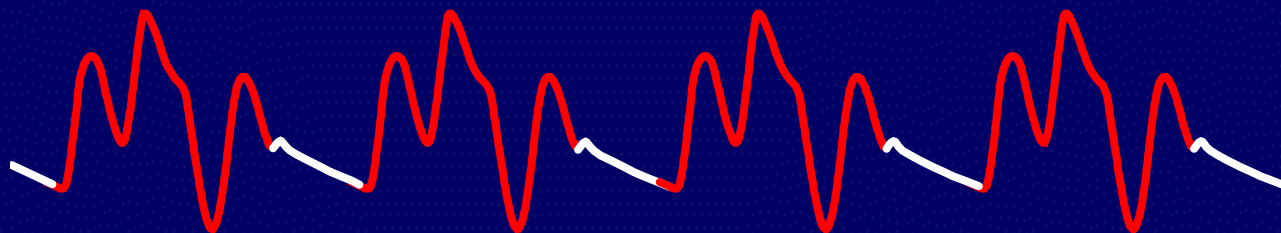
Assist Ratios



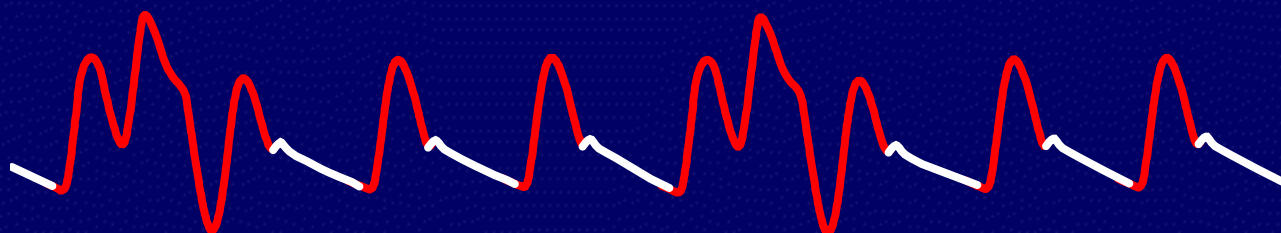
1:1



1:2

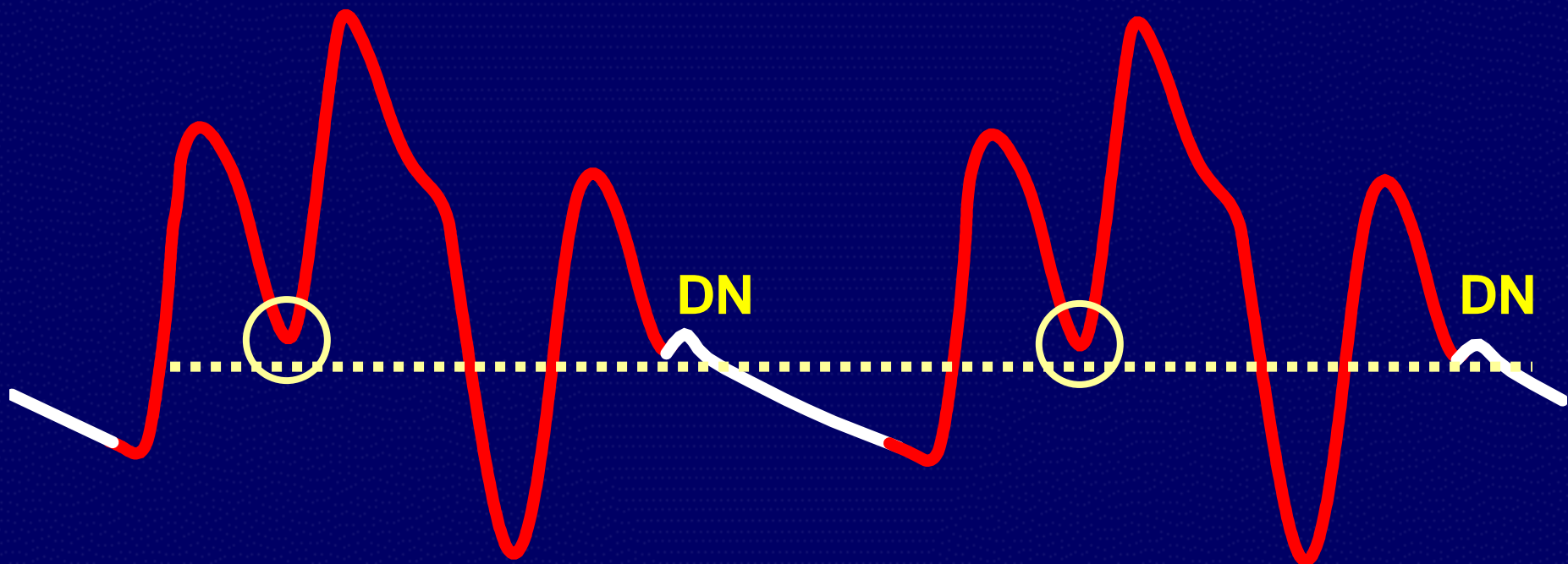


1:4

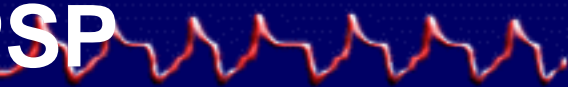


Correct Inflation

Just prior to DN

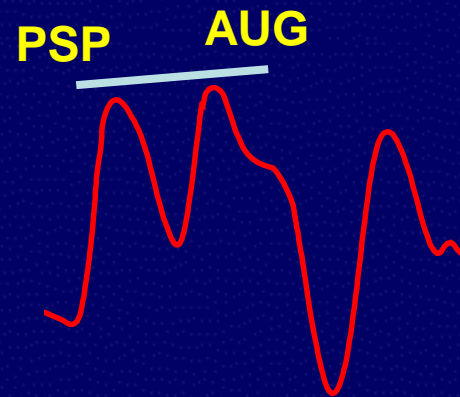


AUG should be higher than PSP



Unless:

1. Patient's SV significantly greater than balloon volume
2. Balloon is positioned too low
3. Hypovolemia
4. Balloon is too small
5. Low SVR
6. Improper timing
7. Partial obstruction of gas flow



Correct Deflation

PSP

APSP

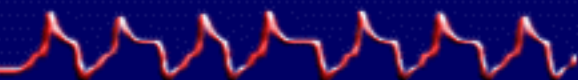
BAEDP < PAEDP

APSP < PSP

PAEDP

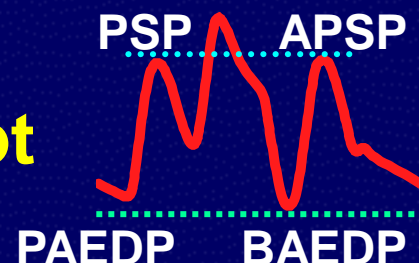
BAEDP

Poor afterload reduction

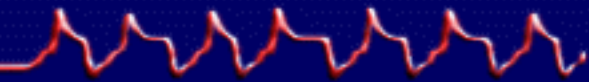


May be caused by:

1. Balloon not large enough or not filled to full volume
2. Compliant aortic wall
3. Improper placement
4. Partial obstruction of gas flow

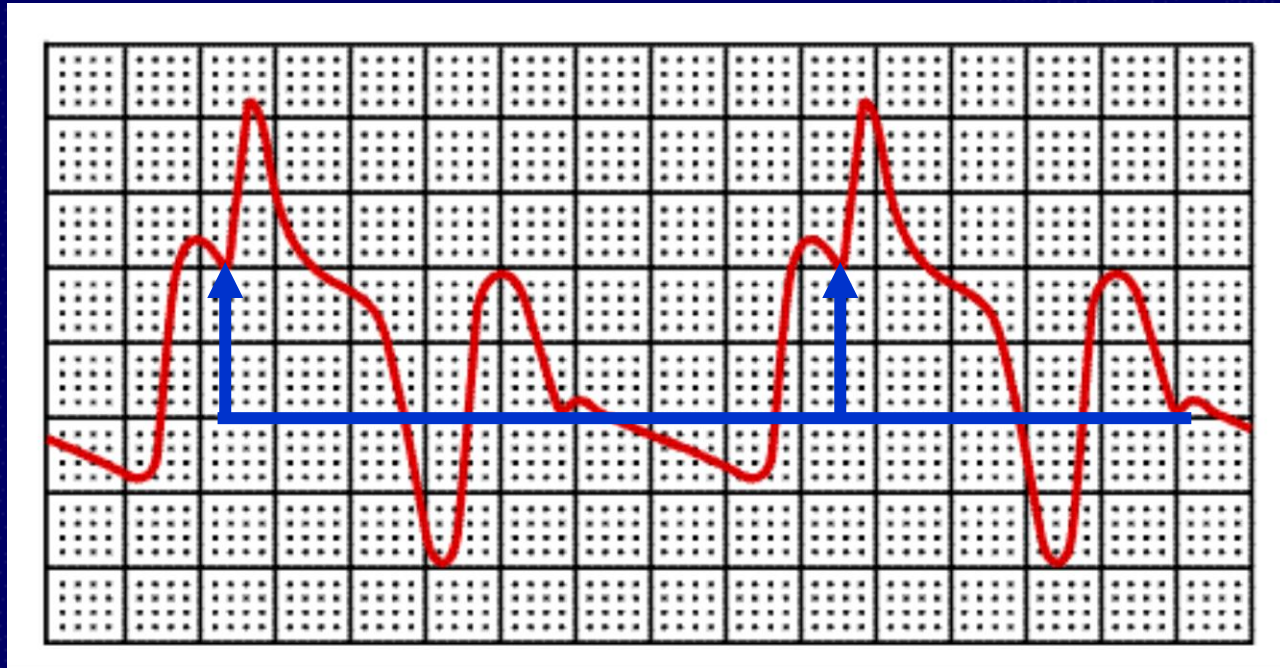


Timing Errors

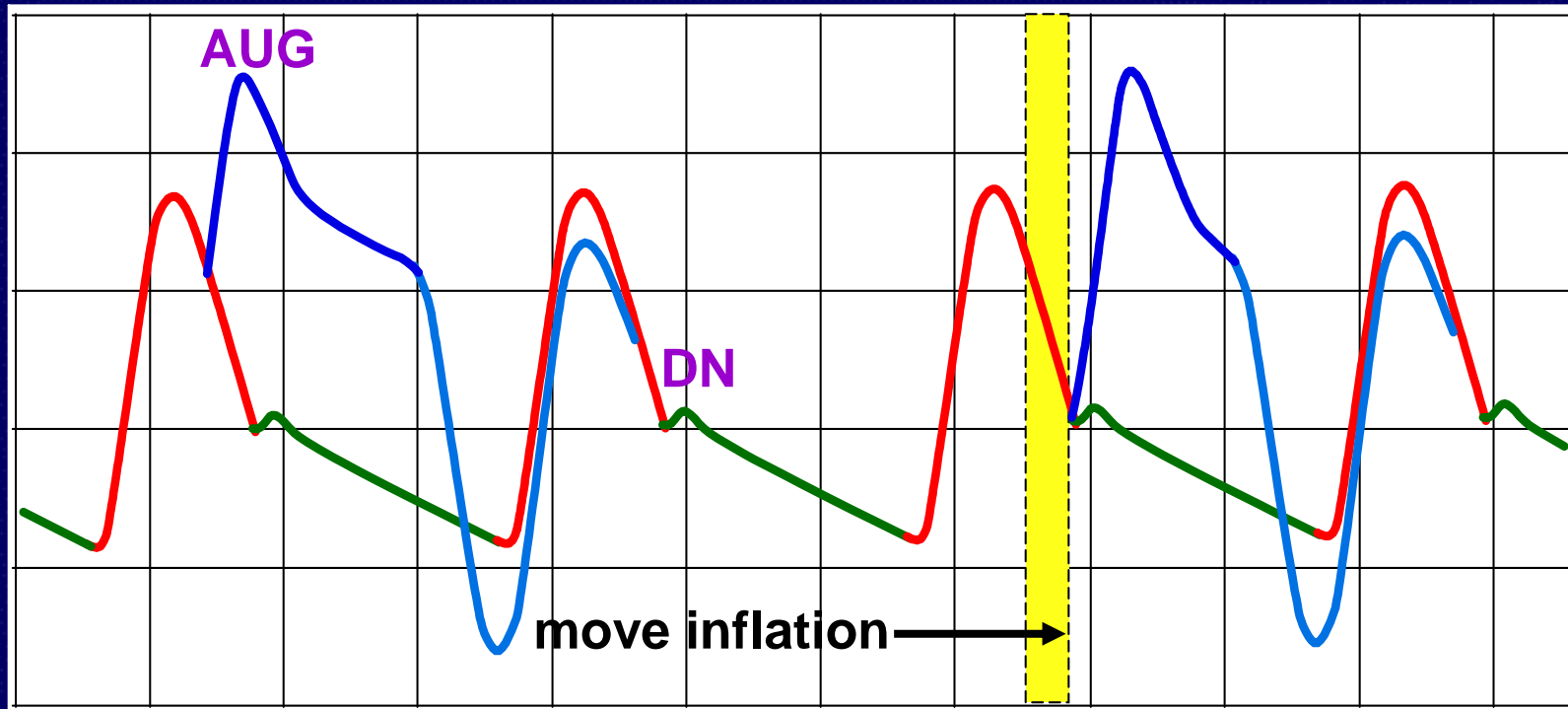


- **Early Inflation**
- **Late Inflation**
- **Early Deflation**
- **Late Deflation**

Early Inflation

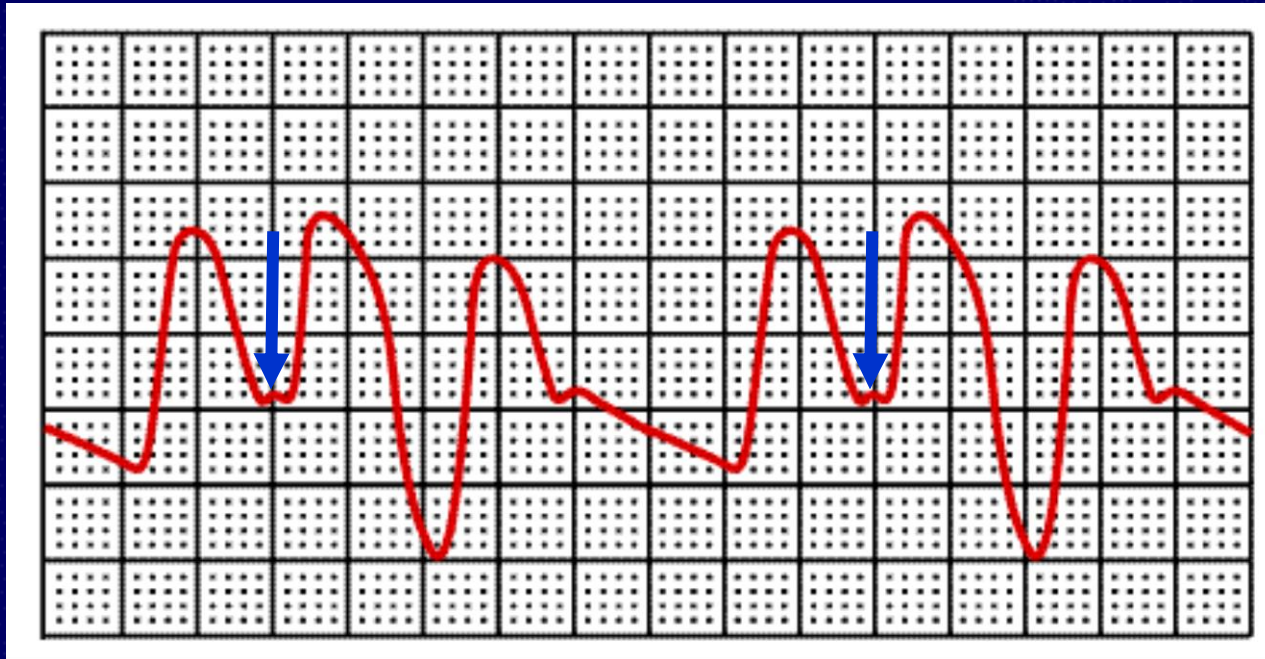
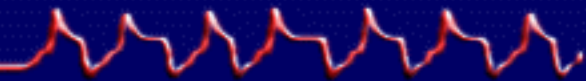


Early Inflation

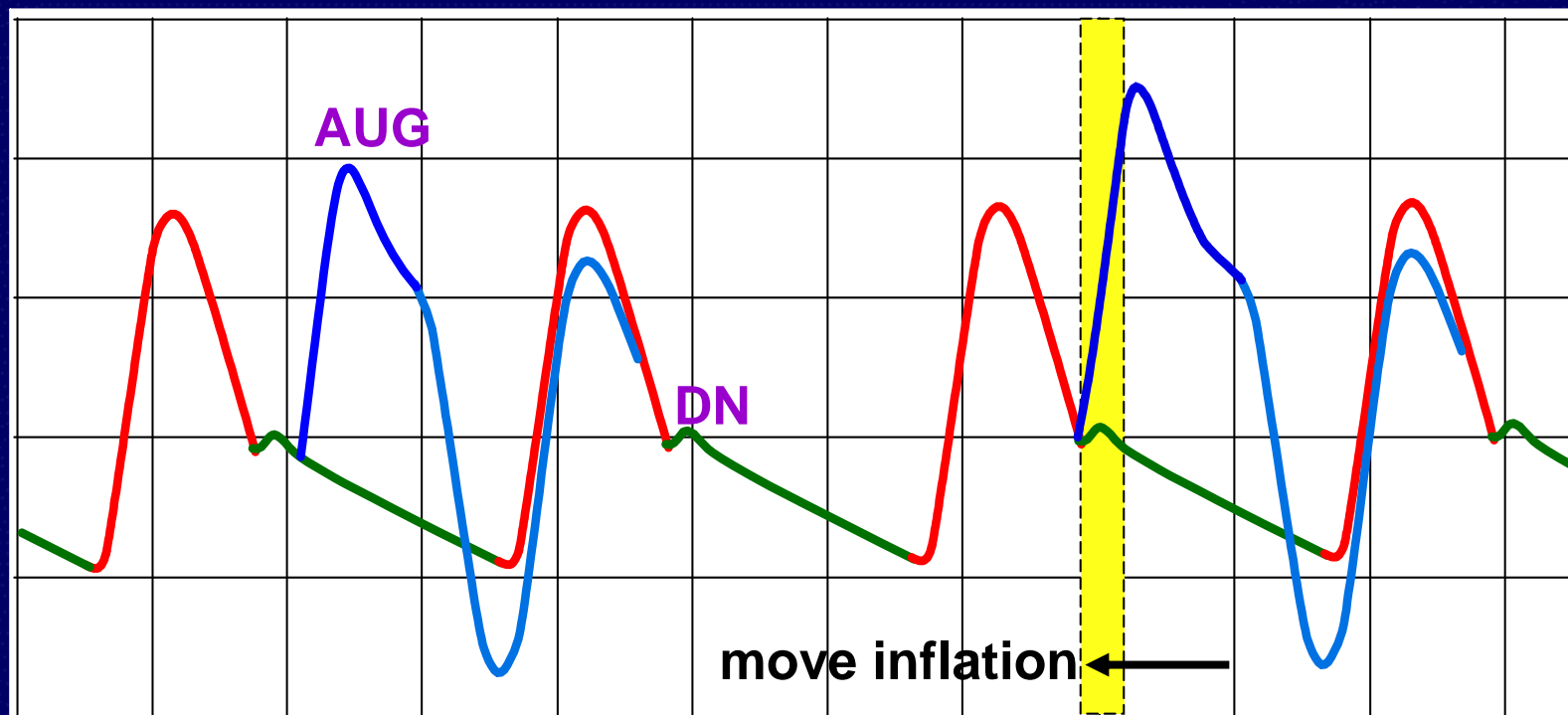


Correct Timing

Late Inflation

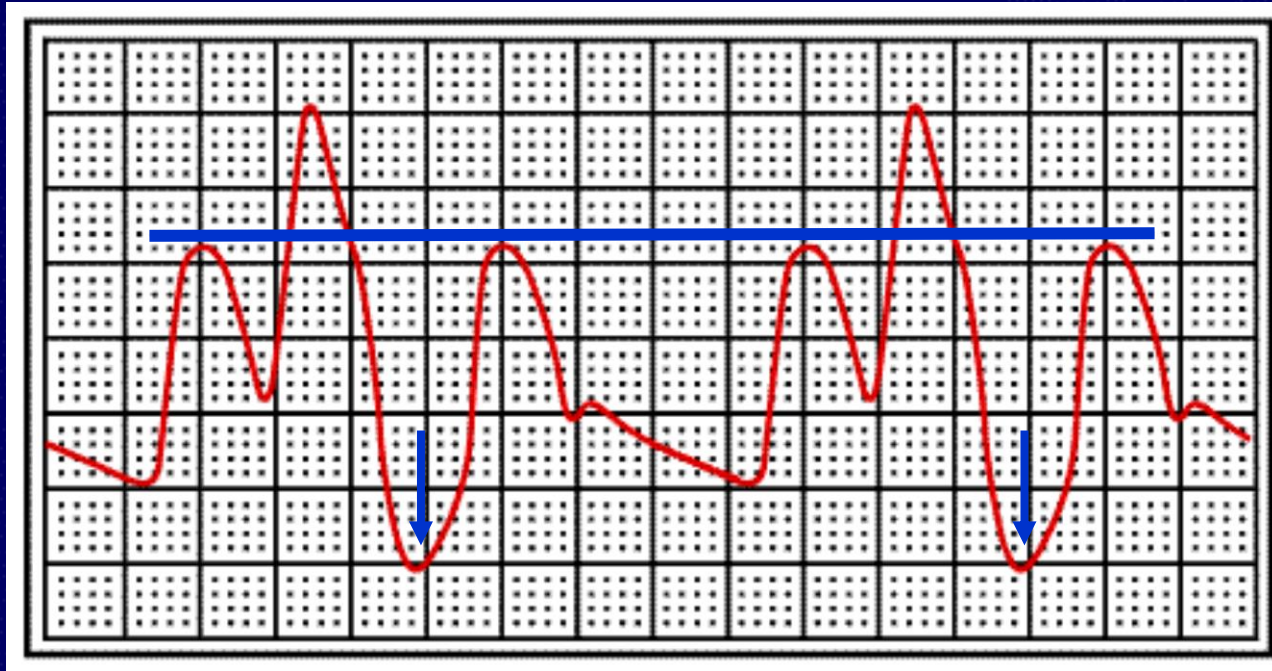
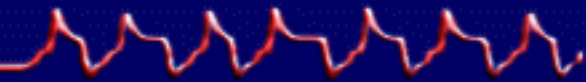


Late Inflation

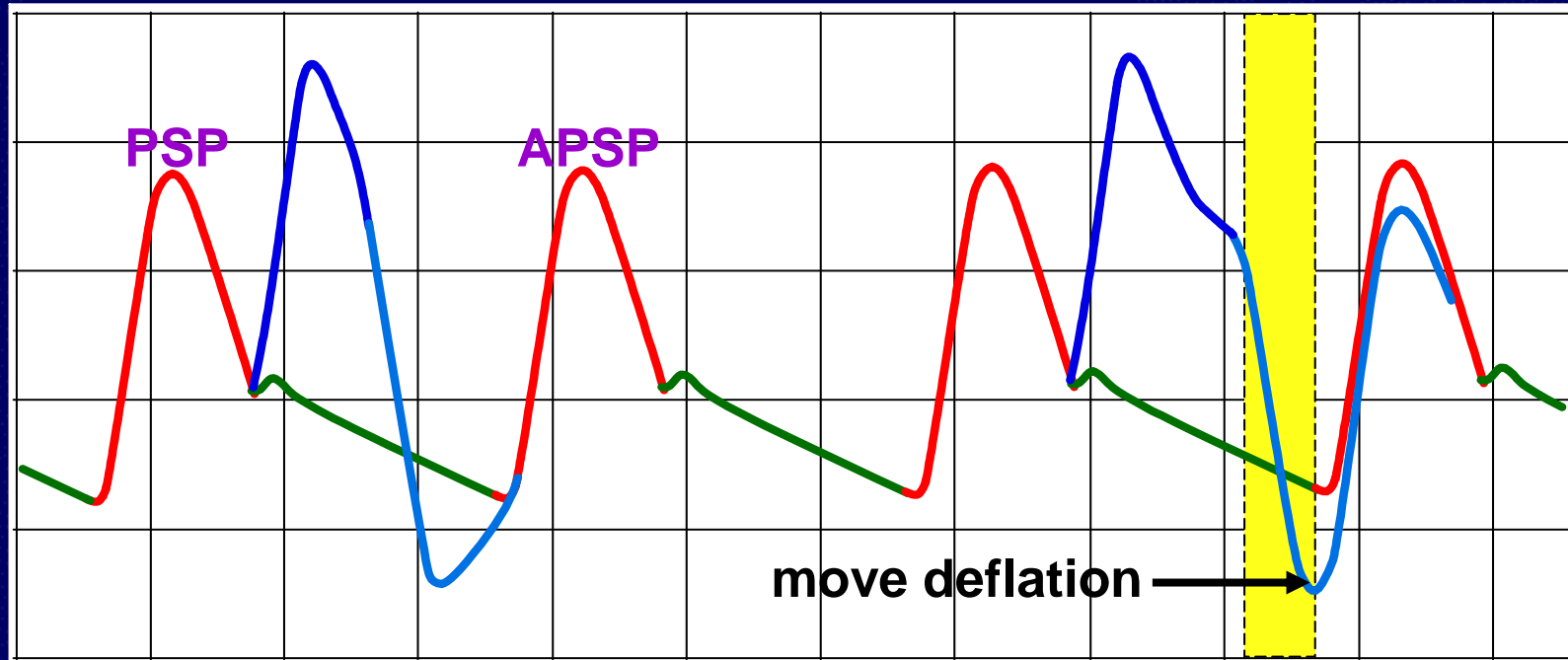


Correct Timing

Early Deflation

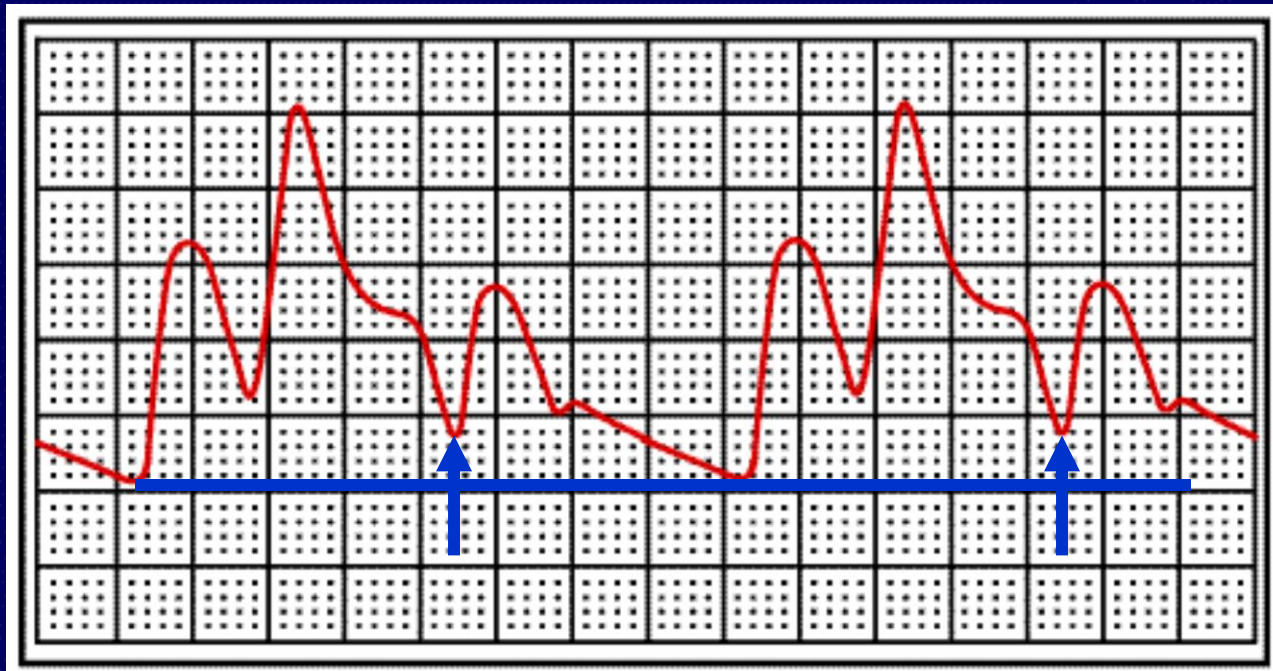
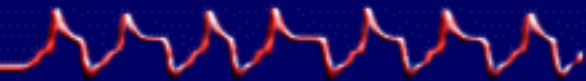


Early Deflation

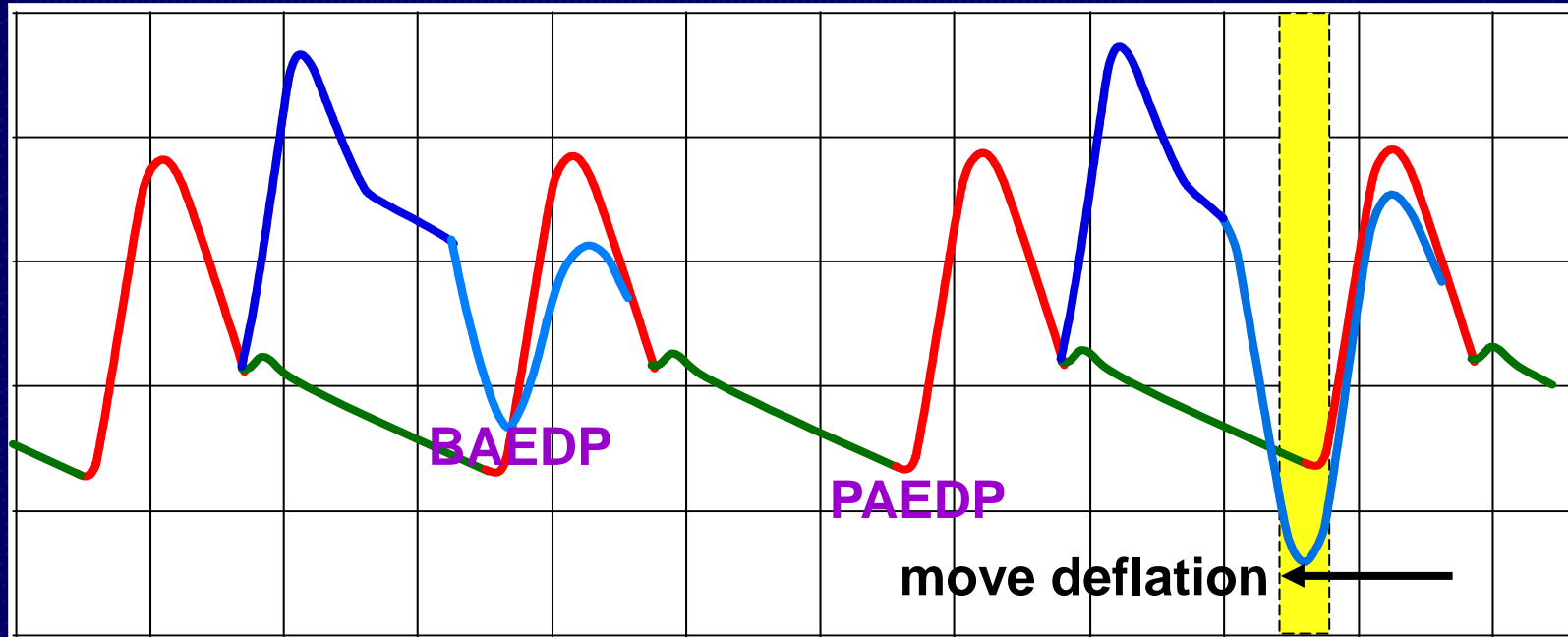


Correct Timing

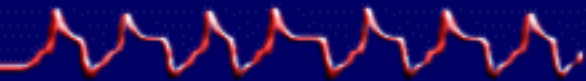
Late Deflation

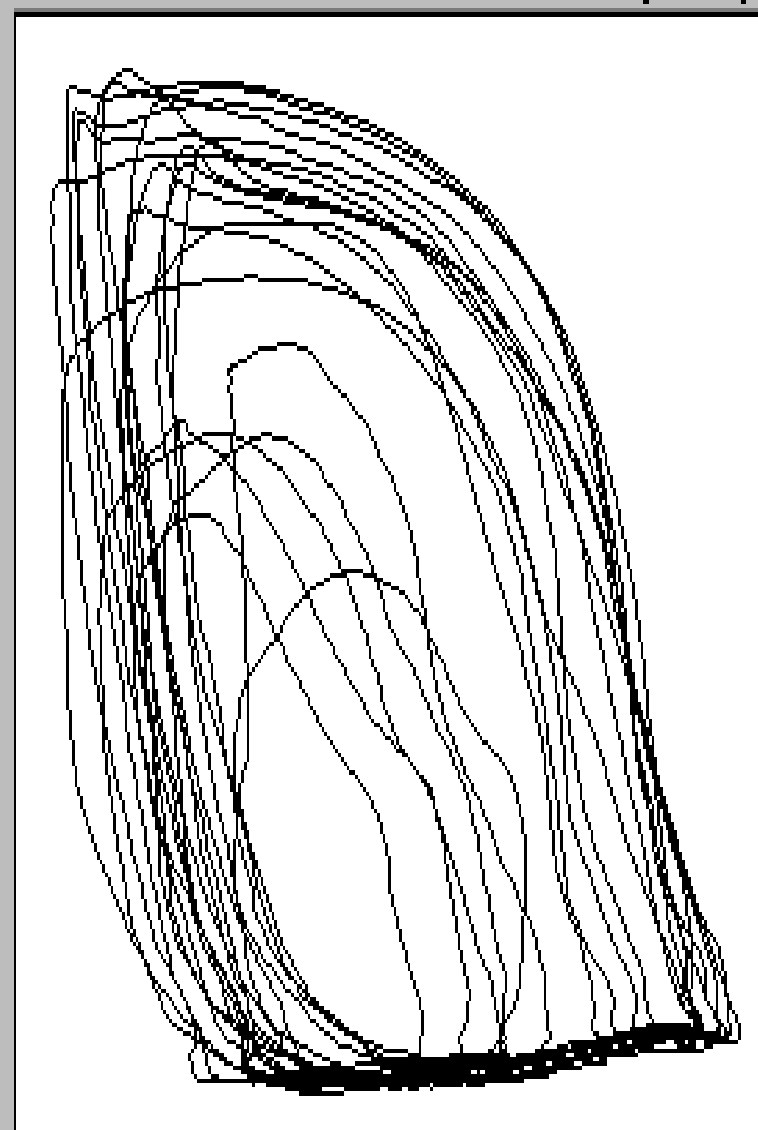
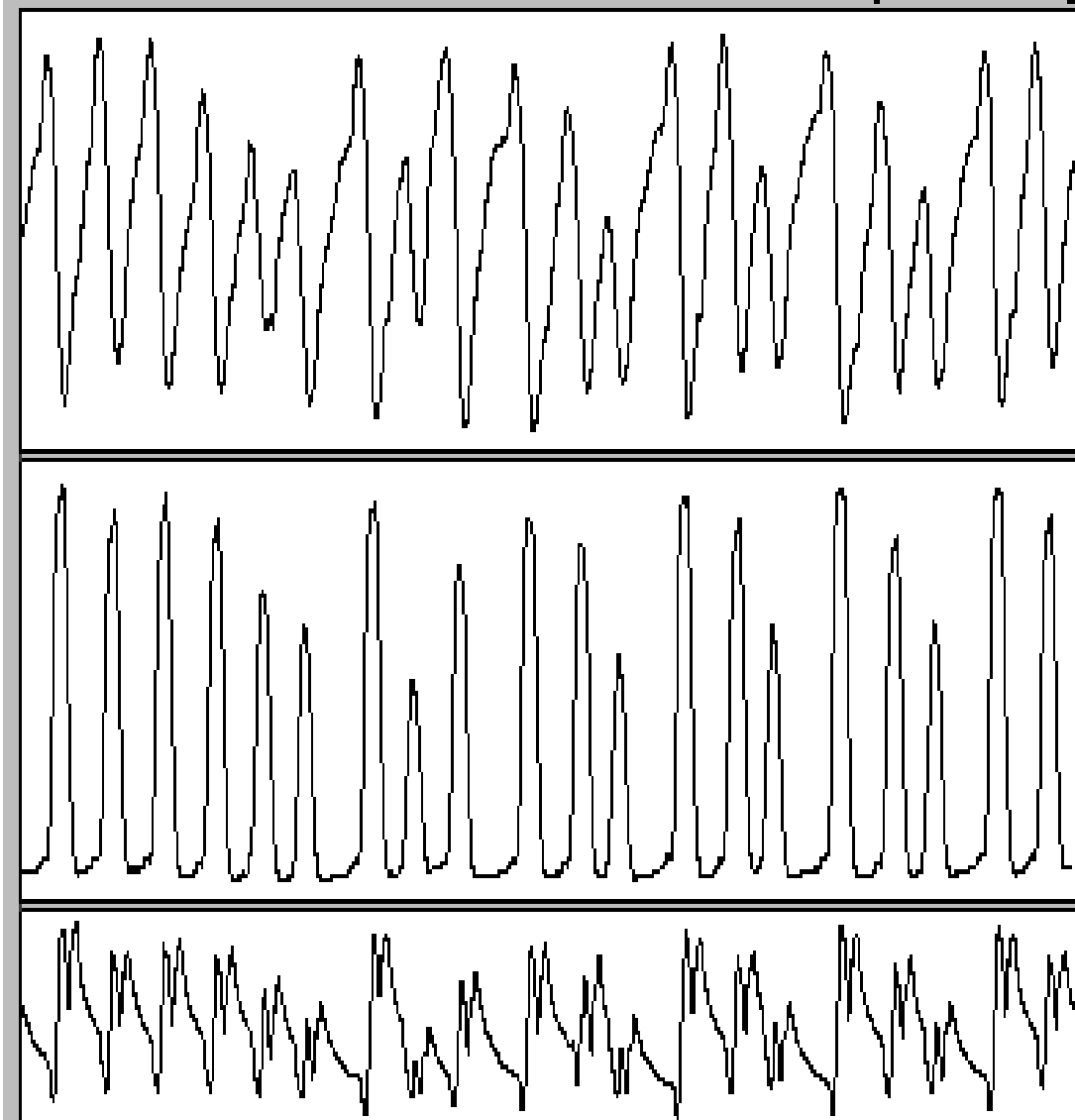


Late Deflation



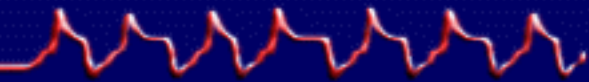
Correct Timing



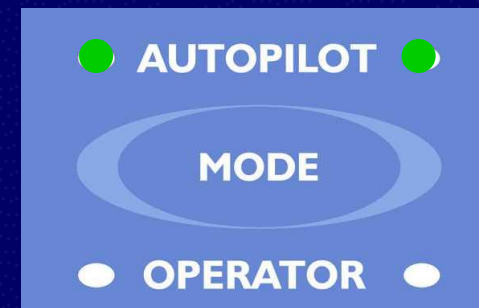


NYHA class III patient, EF 25%, during off-pump CABG. HR varied between 73-139 bpm with significant changes in Pulse Pressure on a beat to beat basis.

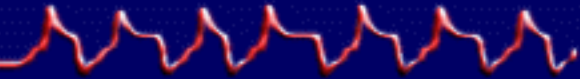
AutoPilot™ Mode



- **Automatically selects the best available ECG source / lead**
- **Automatically selects the AP source**
- **Automatically selects the appropriate trigger mode**
- **Automatically selects the optimal timing method and settings**

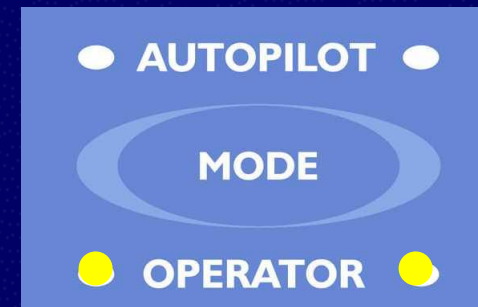


Operator Mode

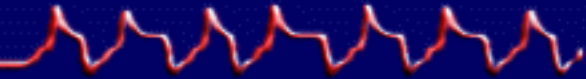


Clinician selects:

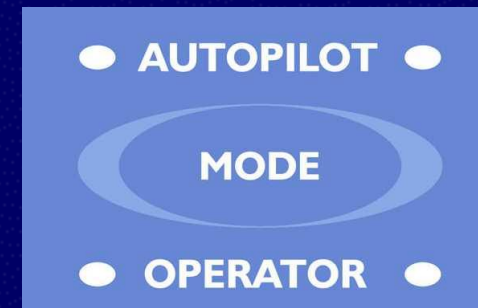
- ECG source / lead
- AP source
- Trigger mode
- Timing settings



Both Modes



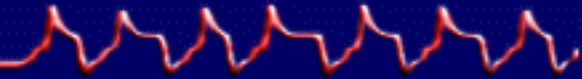
- **Automatically adjust ECG gain**
 - Unless manual gain function selected
- **Automatically selects AP scale**
 - Unless manual scale function selected
- **User can select ECG source / lead and AP source**





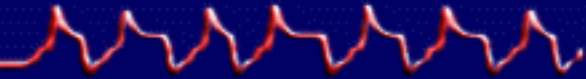
Triggering

Definition



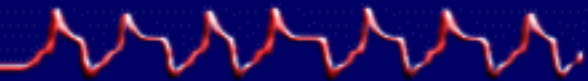
The computer in the IAB console needs a stimulus to cycle the pneumatic system which inflates and deflates the balloon. The trigger signal tells the computer that another cardiac cycle has begun.

Options



In most cases it is preferable to use the R wave of the ECG as the trigger signal. However, the operator also has the option of using the arterial pressure waveform or pacing spikes as the trigger event.

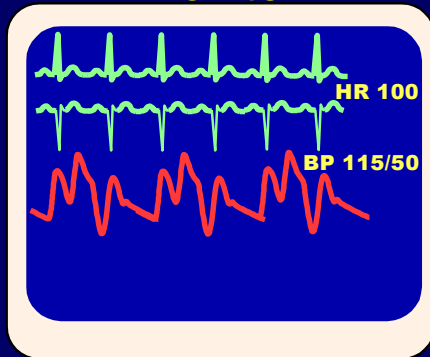
Patient Signal Connections



Direct connections are always best

ECG

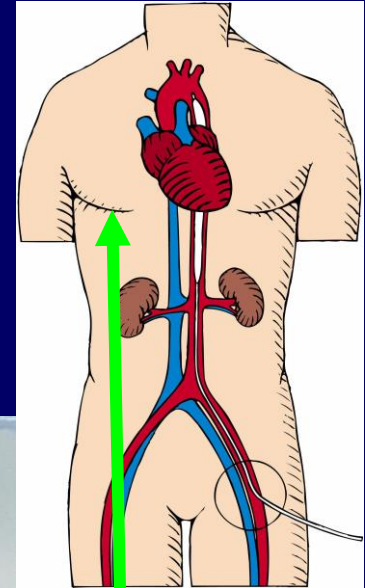
Monitor



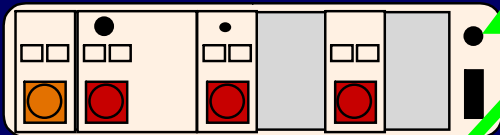
"Slaved"



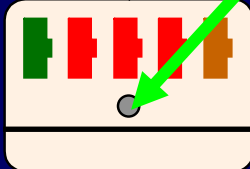
Direct



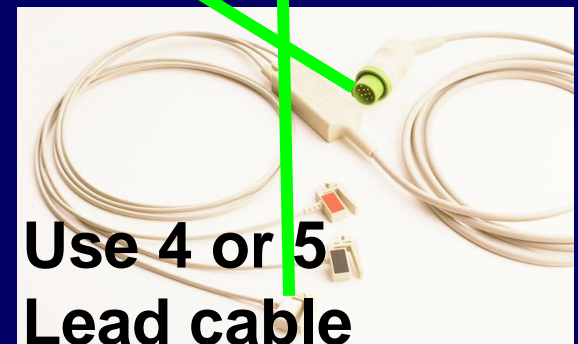
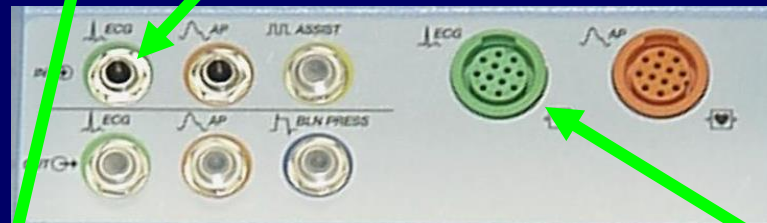
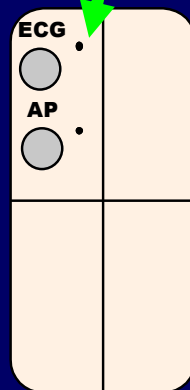
HP Merlon



Marquette
Tram

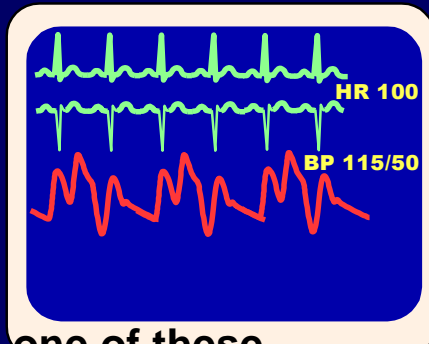


SpaceLabs



Use 4 or 5
Lead cable

Monitor

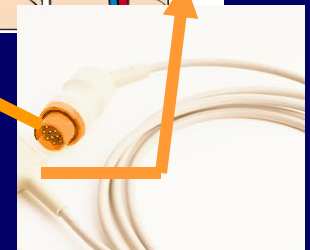
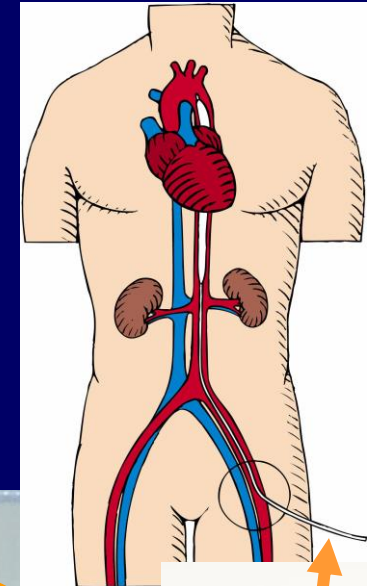


"Slaved"



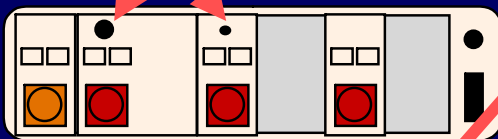
AP

Direct

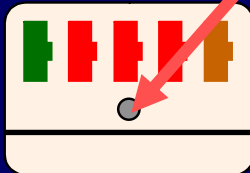


one of these

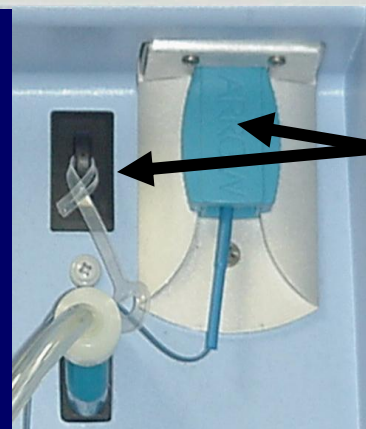
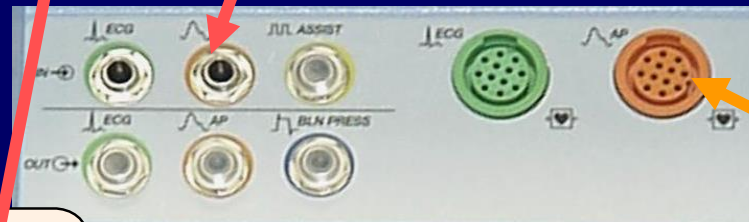
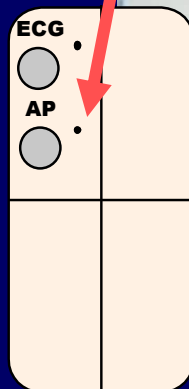
HP Merlon



**Marquette
Tram**

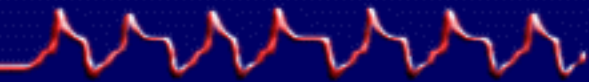


SpaceLabs



**Fiber Optic AP
connection if
LightWAVE™
catheter is used**

FOR GOOD, CONSISTENT TRIGGERING IT IS IMPORTANT TO PROVIDE THE PUMP WITH A GOOD ECG SIGNAL



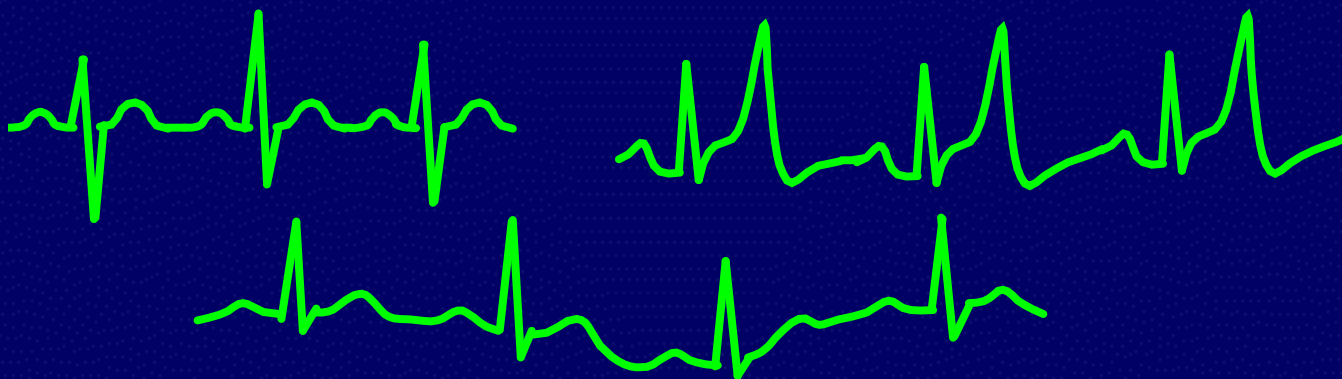
Good Choices –

Unidirectional QRS with minimal
artifact

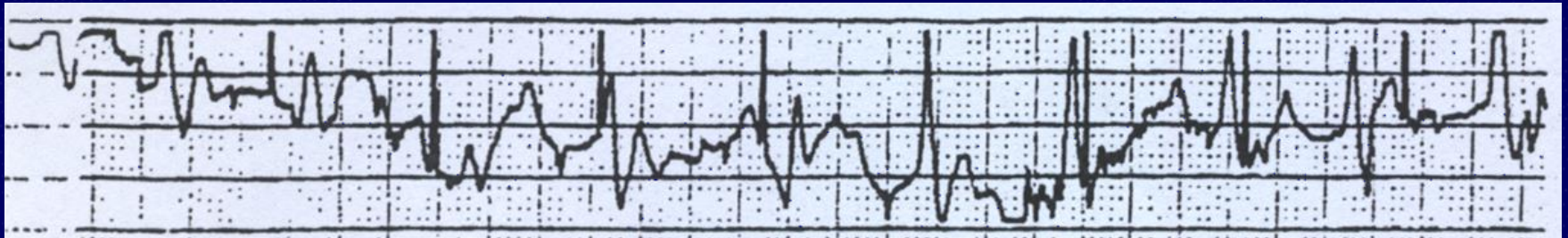
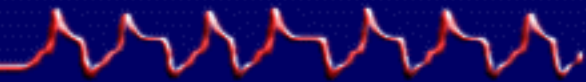


Poor Choices –

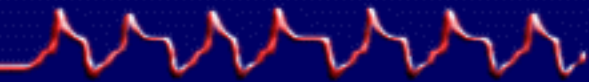
Biphasic QRS, tall T or P waves, wandering baseline,
artifact present



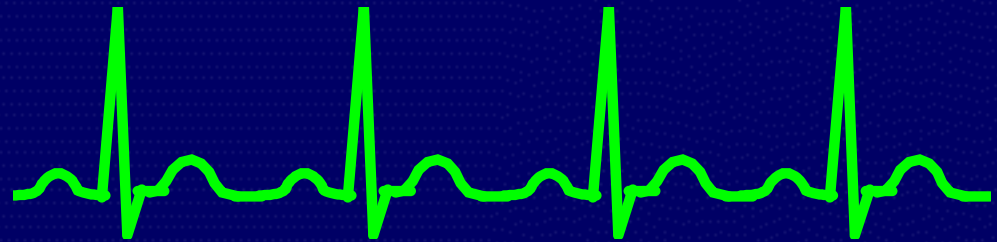
This lead will give you both triggering
and timing problems



ECG Pattern



This is the preset trigger mode.

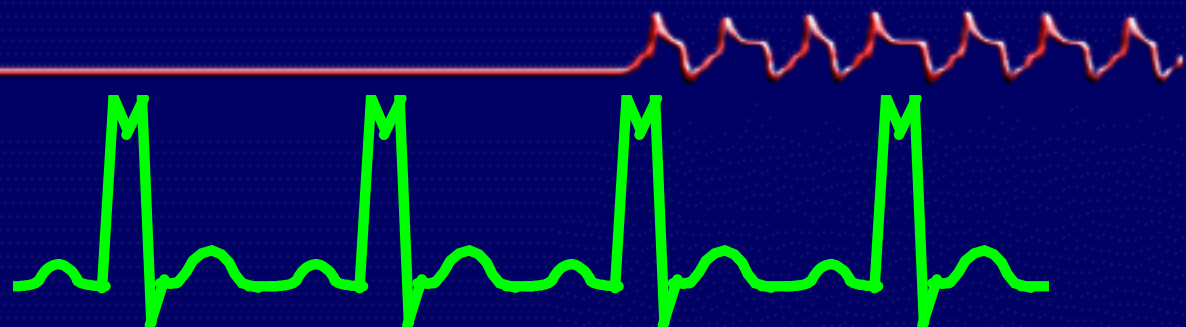


The computer analyzes the height, width (25-135 msec), and slope of a positively or negatively deflected QRS complex.

Rejection of pacer spikes is automatic.

AutoPilot™'s choice when the QRS complex is normal and the HR < 130

ECG Peak



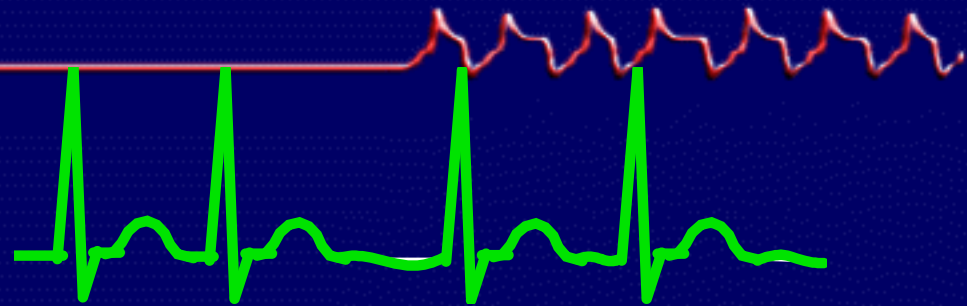
The computer analyzes the height and slope of a positively or negatively deflected QRS complex.

This may be the trigger mode of choice for wide complex or rapid rhythms.

Rejection of pacer spikes is automatic.

AutoPilot™'s choice when the QRS complex is wide, the HR > 130, or during arrhythmia when Arrhythmia Timing is OFF.

AFIB

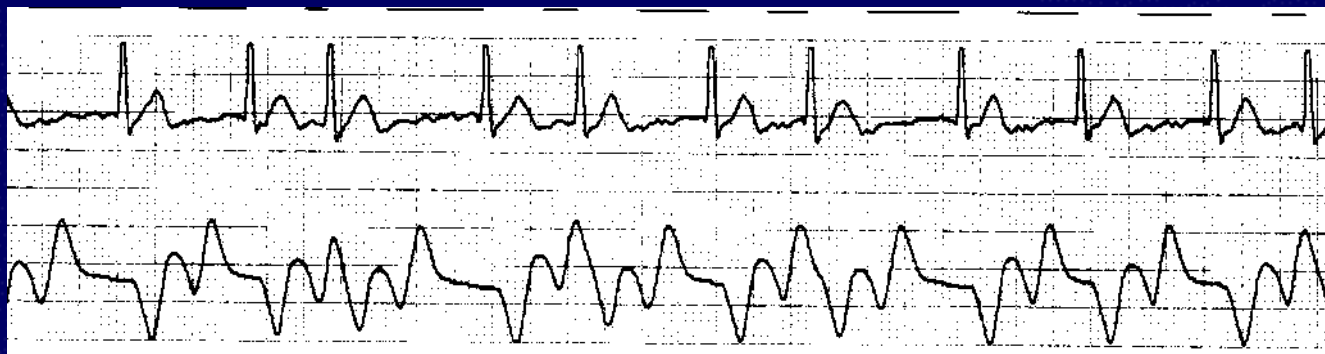
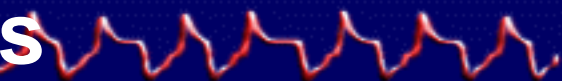


The computer analyzes the QRS complex in the same manner as Peak mode and initiates “Real-Time” timing.

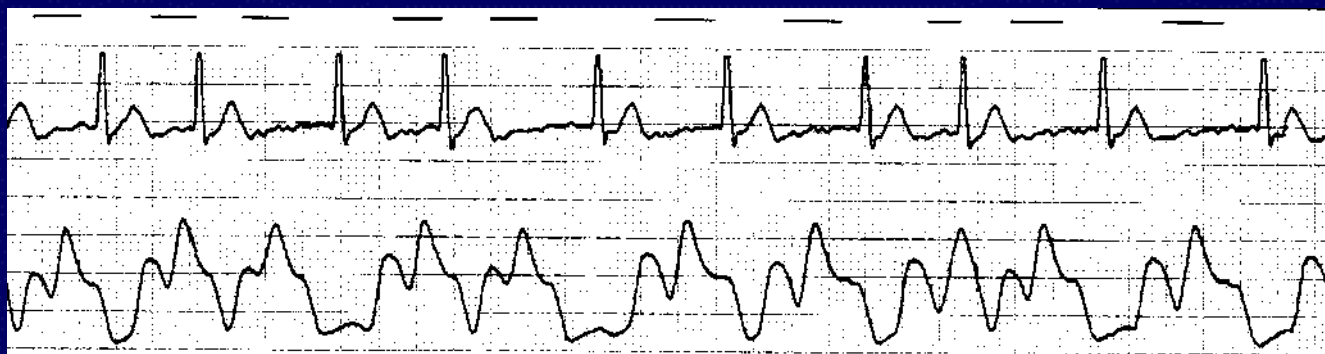
Deflation is automatic when the next trigger event is identified, allowing for more consistent deflation timing when R to R intervals are irregular. Rejection of pacer spikes is automatic.

AutoPilot™’s choice the rhythm is irregular and Arrhythmia Timing is ON.

Timing with Irregular Rhythms

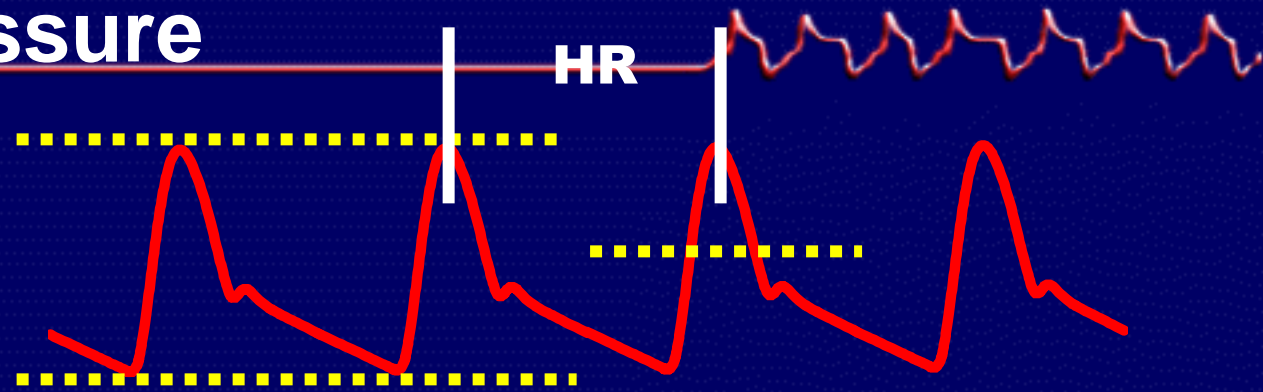


“Real-Time” Timing



Conventional Timing

Arterial Pressure



The computer uses the systolic upstroke of the arterial pressure waveform as the trigger signal.

This mode is an option when an ECG is unavailable or distorted.

AutoPilot™'s choice when there are no R-waves available.

V Pace

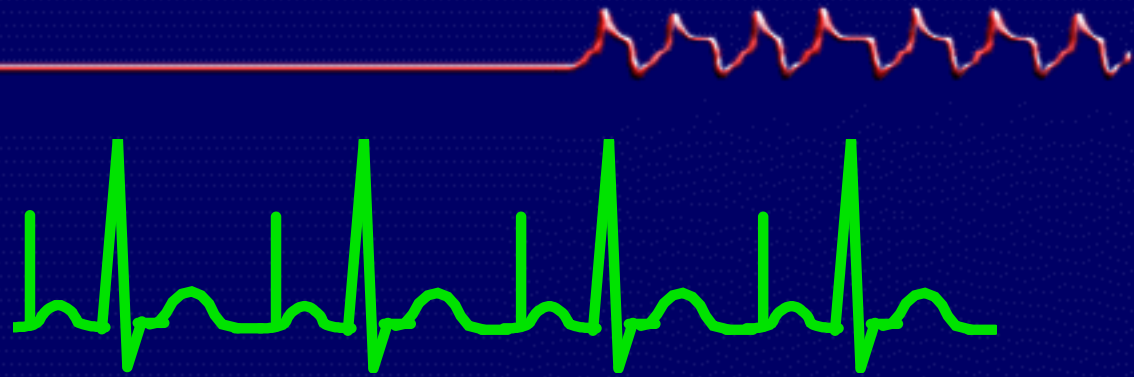


The computer uses the ventricular spike as the trigger signal. This mode can be used with ventricular or AV paced rhythms.

Must be 100% paced.

AutoPilot™'s uses this mode when there are no R-waves or AP waveforms present, however, there are V or AV pacer spikes.

A Pace

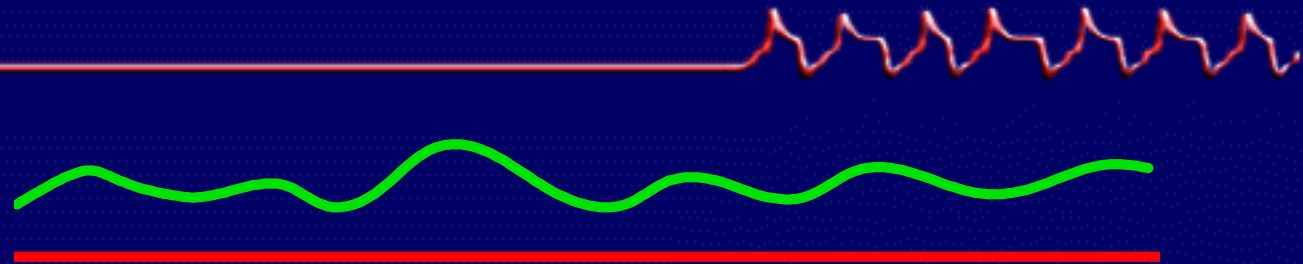


The computer uses the atrial pacing spike as the trigger signal. This mode can be used with atrially paced rhythms only.

Must be 100% paced.

AutoPilot™'s choice when the ECG is intermittent and pacer spike to R wave is > 100ms.

Internal

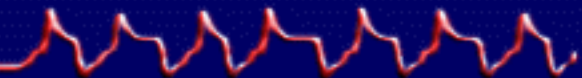


The balloon inflates and deflates at a preset rate regardless of the patient's cardiac activity.

This mode is only to be used when there is no cardiac output and no ECG.

Preset rate is 80 bpm; can be varied between 40 to 120.

Cardiac Arrest

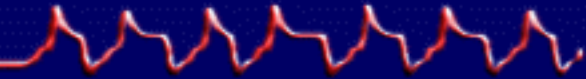


What do you do with the IABP?



Helium Delivery

Pneumatic Systems

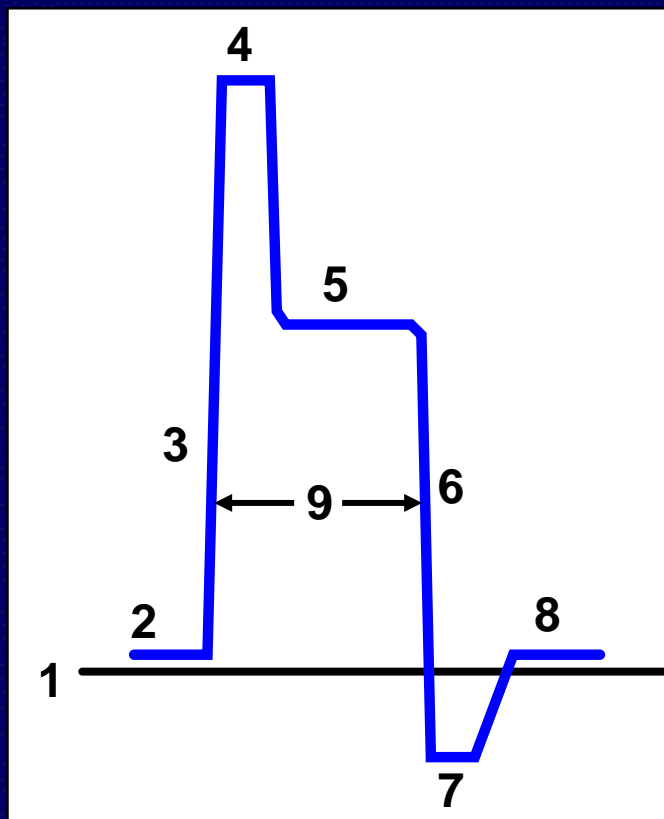
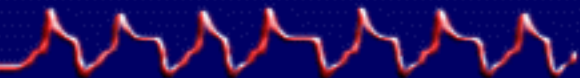


2 types of gas delivery systems:

Vacuum / compressor system

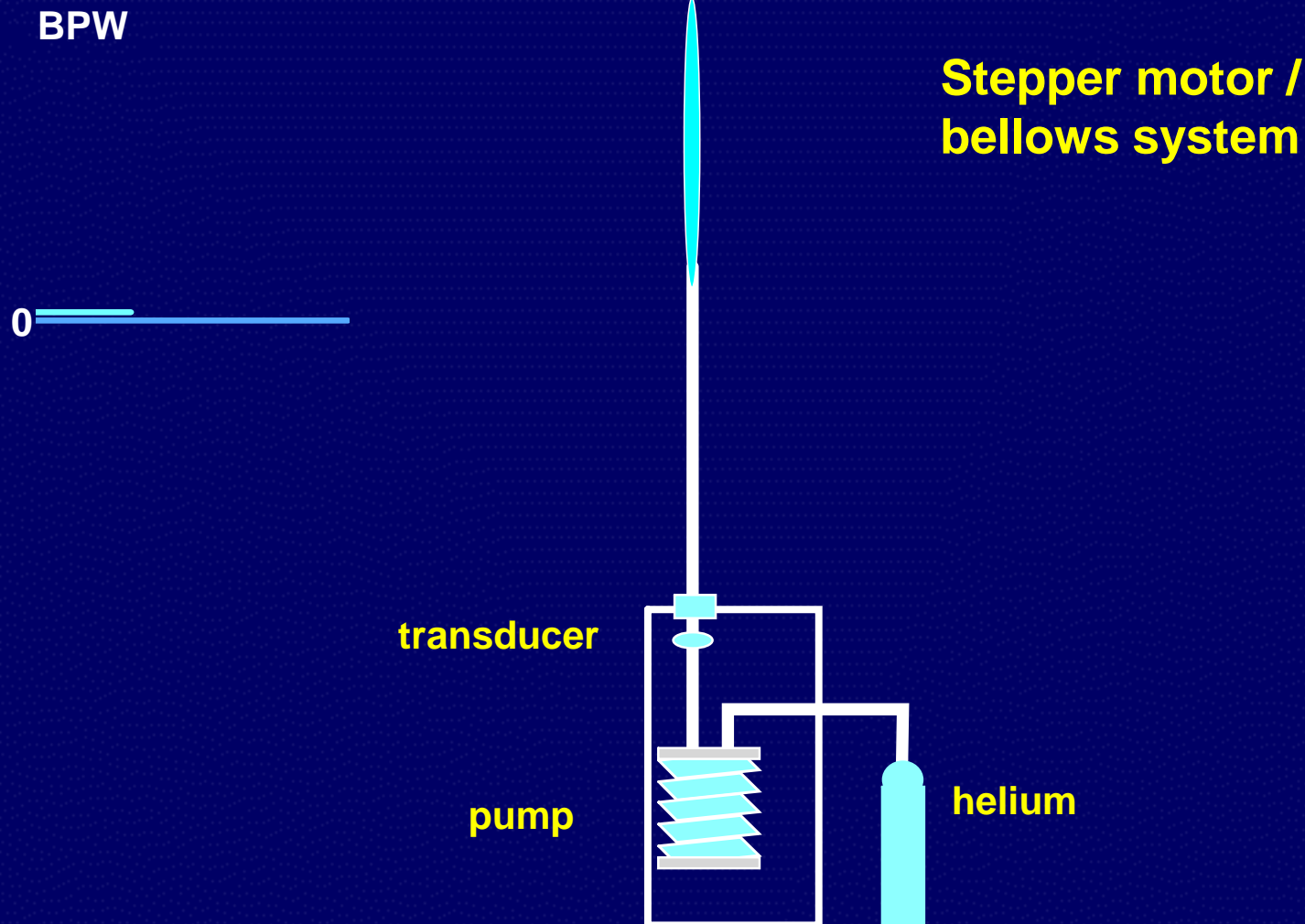
Bellows / stepper motor system

Balloon Pressure Waveform

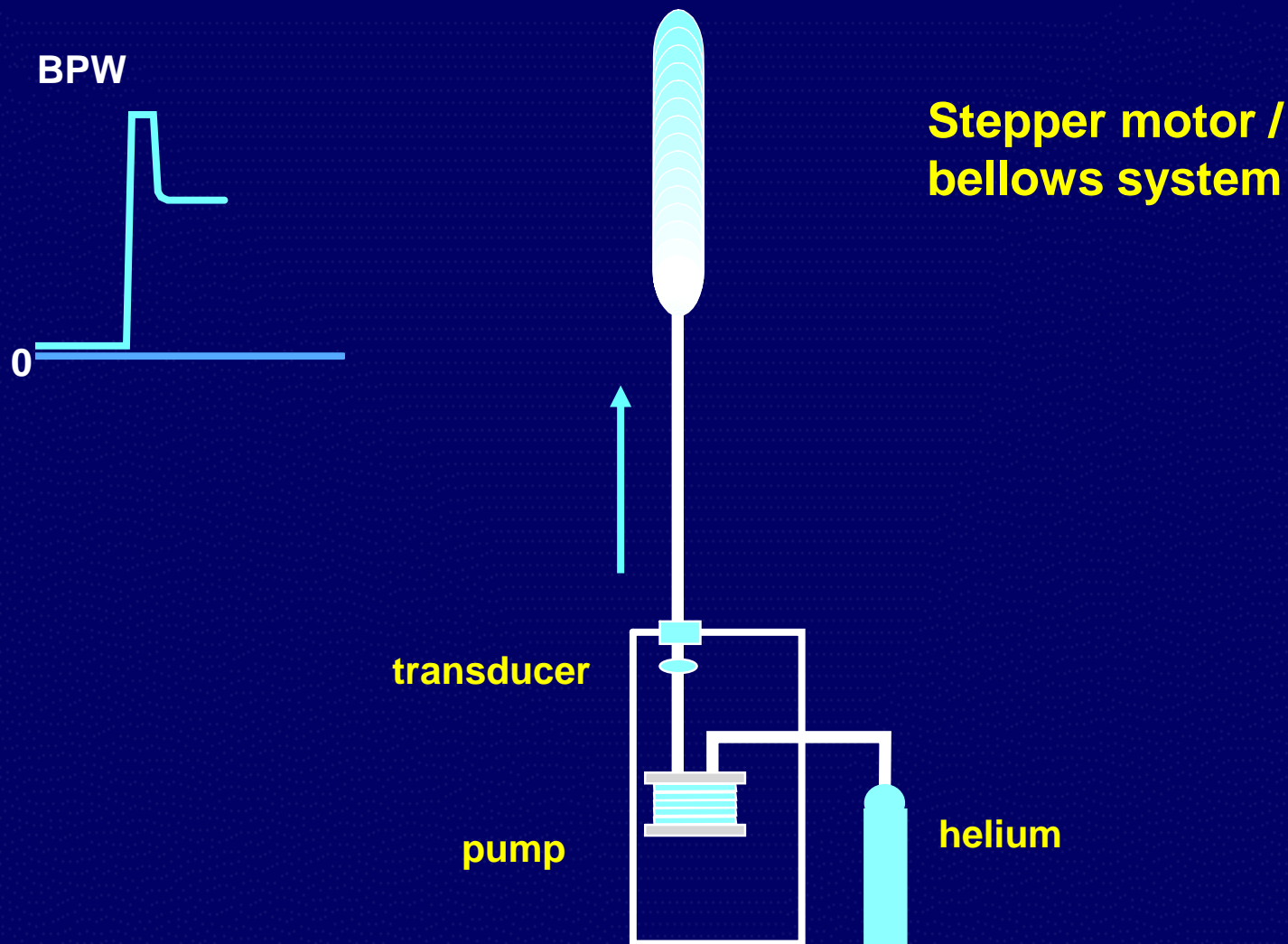


1. Zero Baseline
2. Balloon Pressure Baseline
3. Rapid Inflation
4. Peak Inflation Artifact
5. Plateau Pressure
6. Rapid Deflation
7. Deflation Artifact
8. Return to Baseline
9. Duration of Balloon Cycle

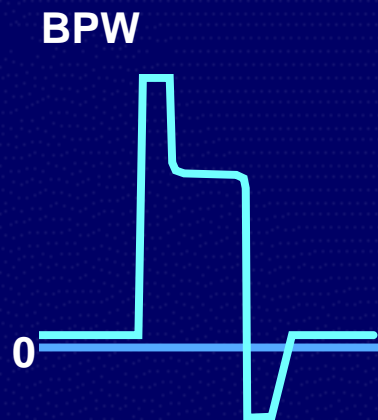
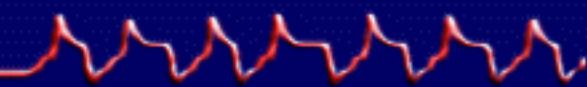
Helium Fill Pressure



Balloon Inflation



Balloon Deflation

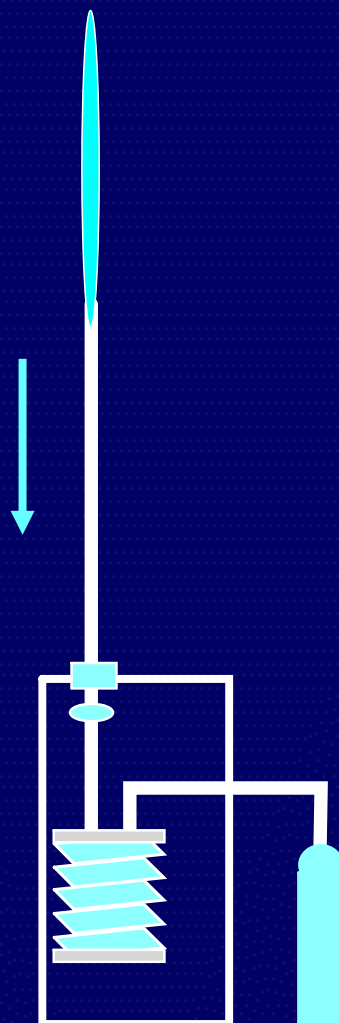


**Stepper motor /
bellows system**

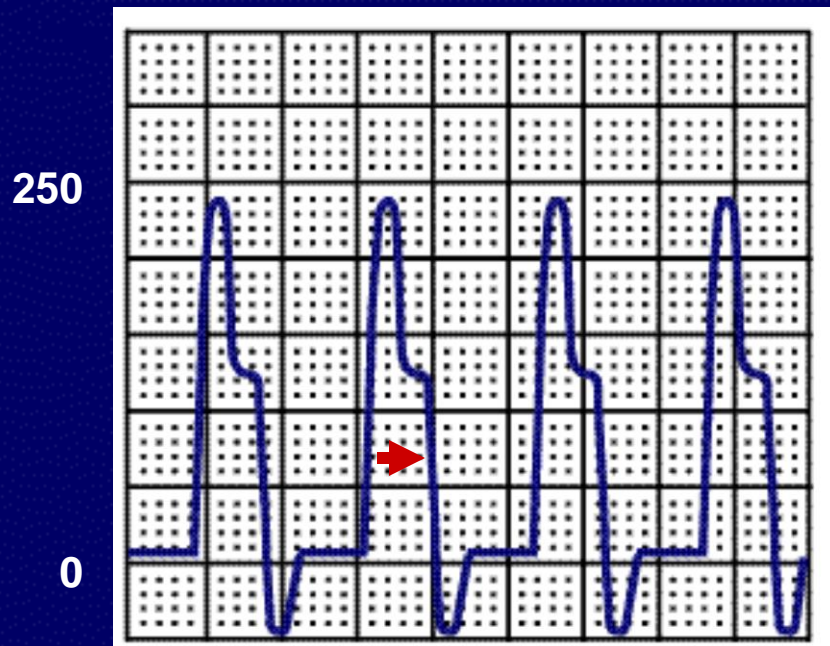
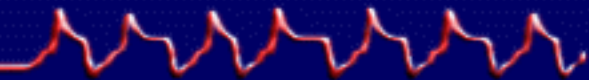
transducer

pump

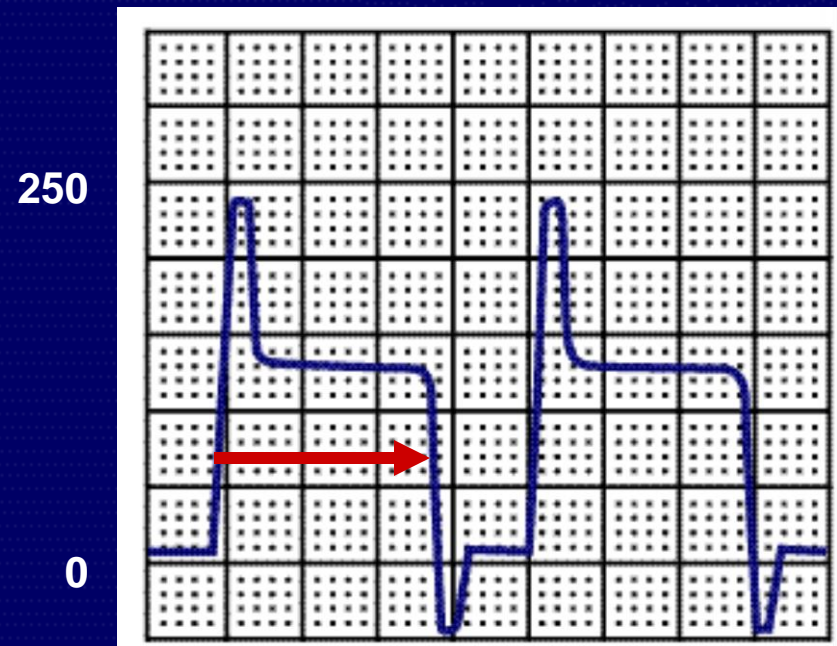
helium



Heart Rate Variations

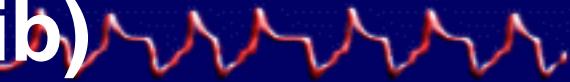


Tachycardia

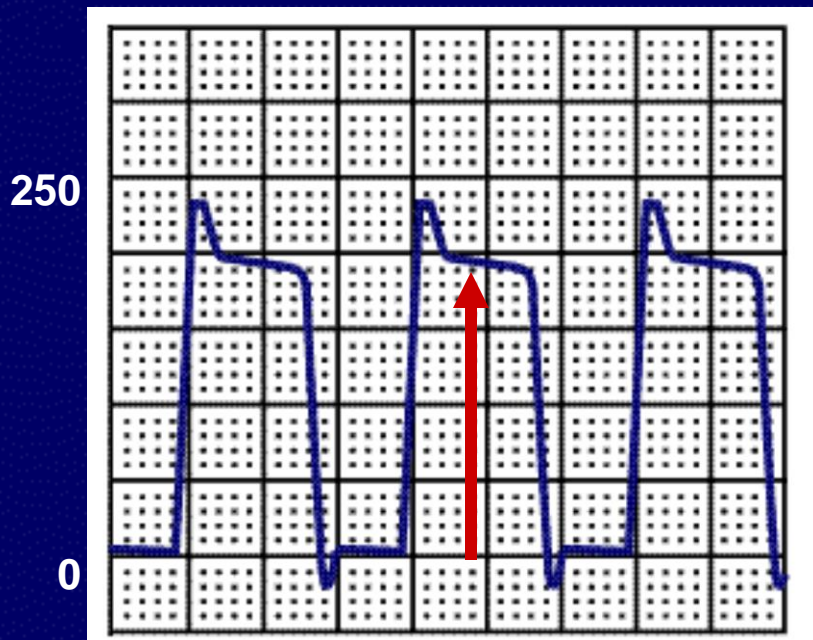
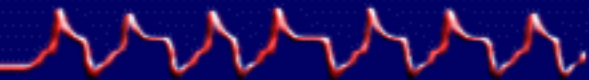


Bradycardia

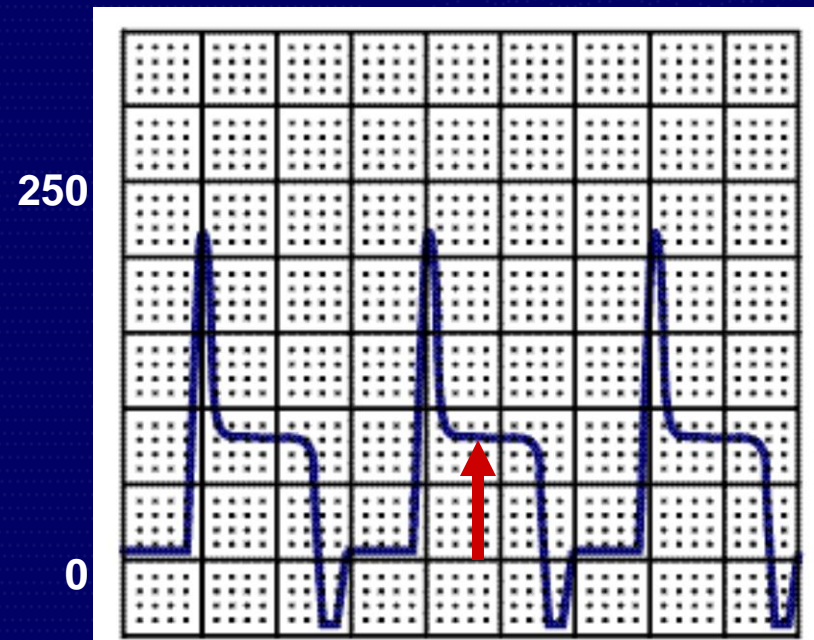
BPW in Irregular Diastole (Afib)



Pressure Variations

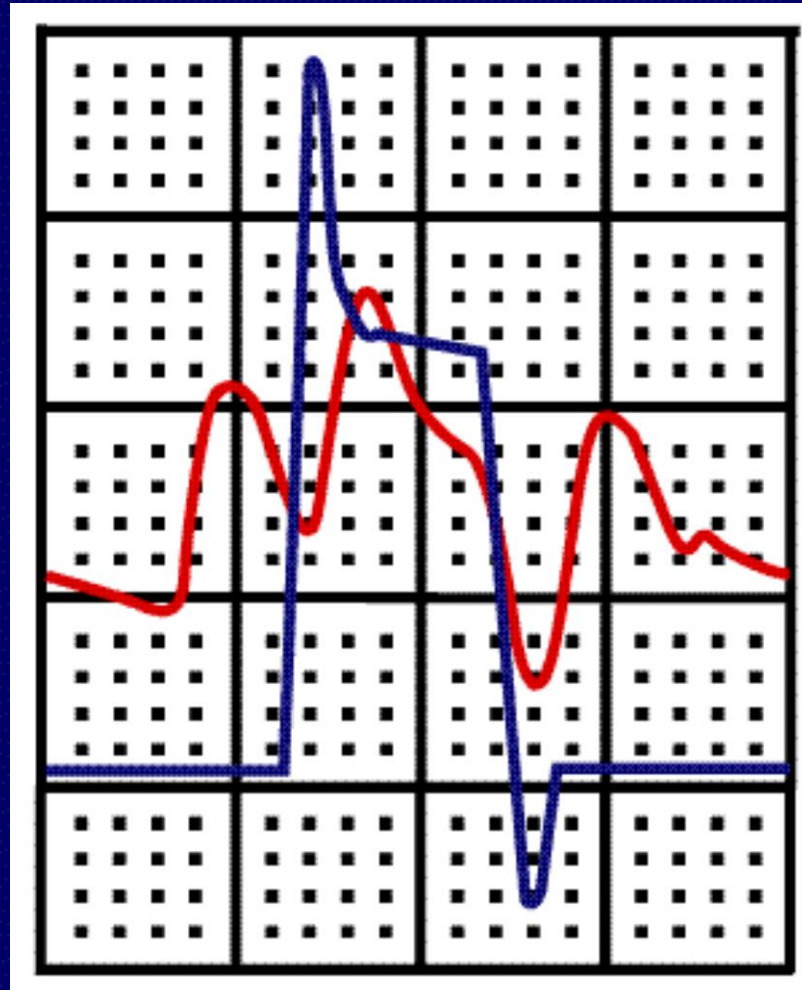


Hypertension

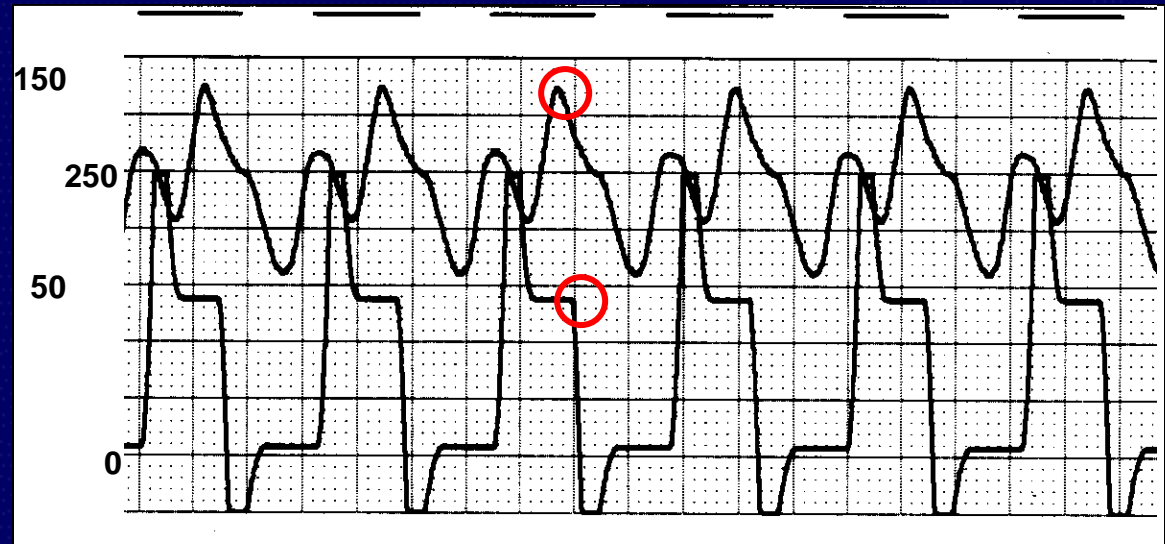
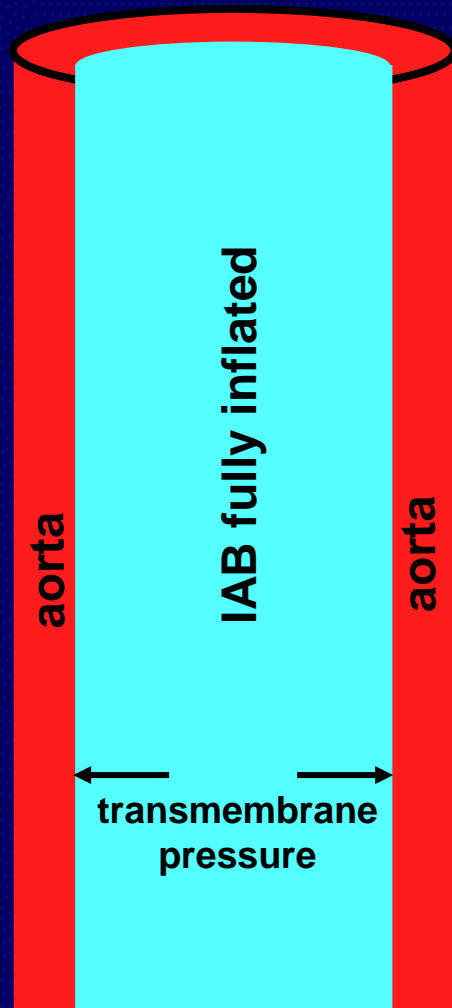


Hypotension

Comparison of Augmented AP waveform and Plateau of Balloon Pressure waveform

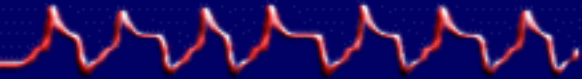


Intra-aortic Relationship of Inflated Balloon Catheter and Vascular Pressure



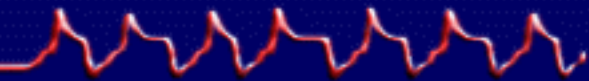
Note that the endpoint of the BPW plateau should be equal or up to 20 mmHg higher than the Augmented Pressure.

Troubleshooting

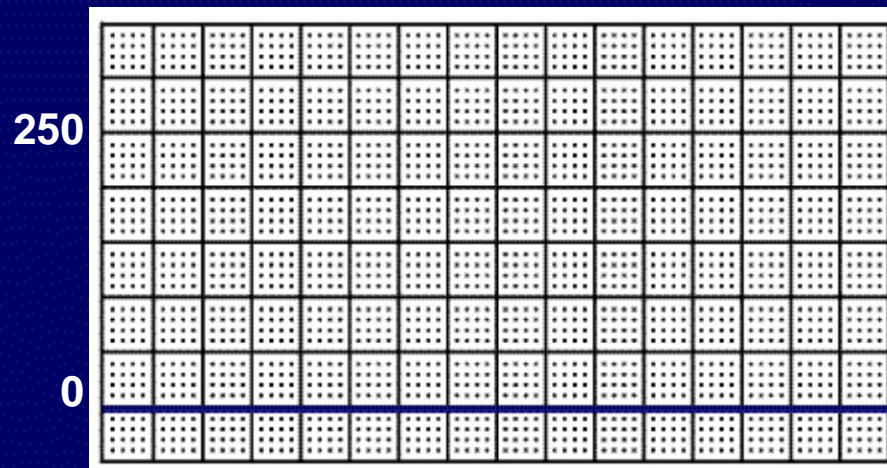


Gas Surveillance Alarms

Purge Failure



Pump did not fill adequately with helium to establish the balloon pressure waveform baseline



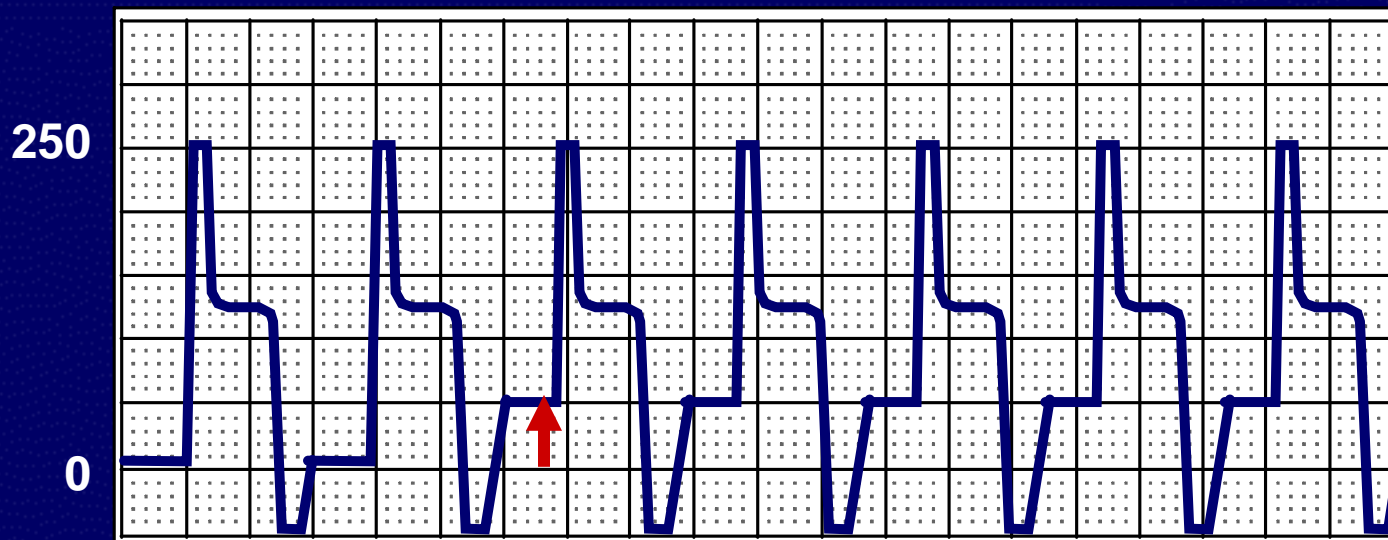
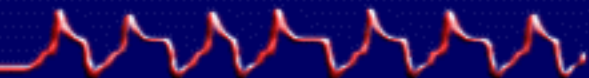
Verify:

Helium tank not empty

Catheter connections intact

Trigger present

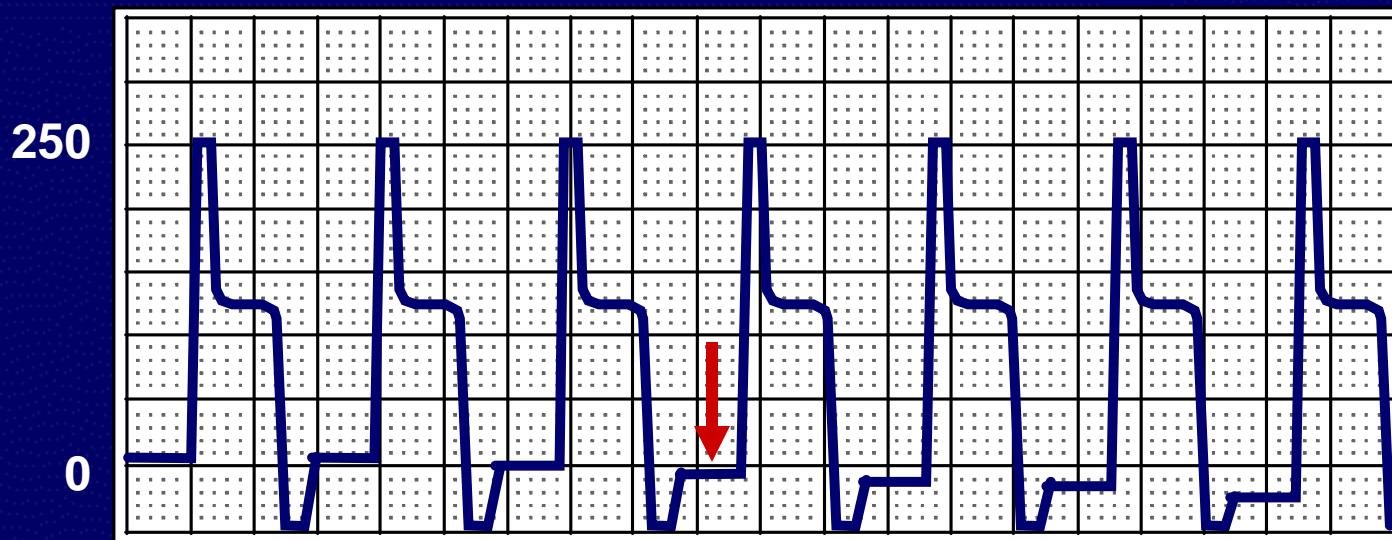
High Baseline



Check for:

- 1. Partially wrapped balloon**
- 2. Kinked catheter**

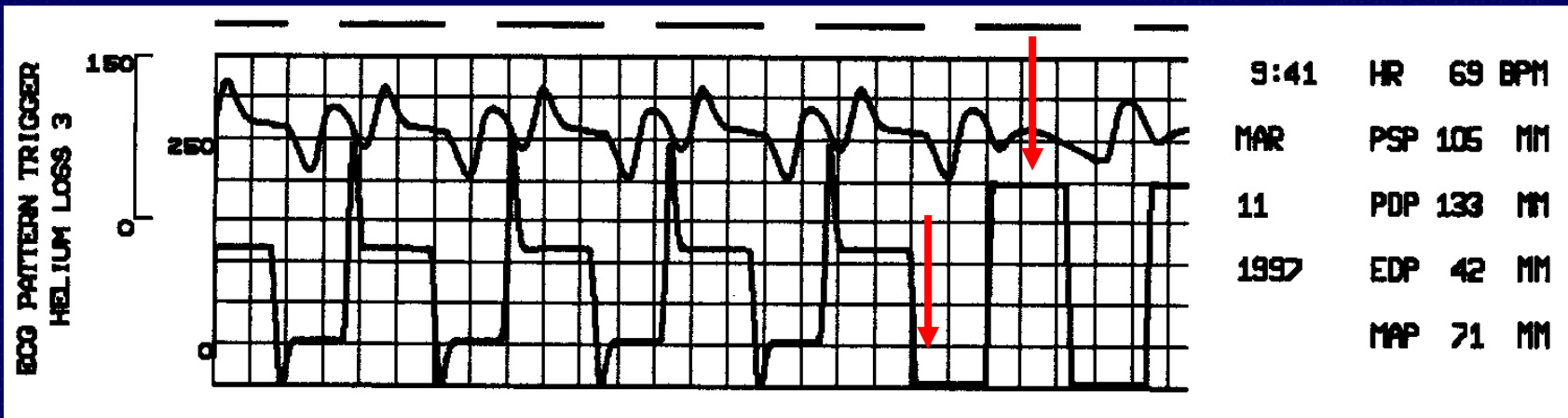
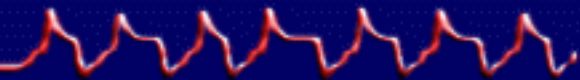
Helium Loss



Check for:

1. Leak in tubing and connections
2. Blood in catheter tubing
3. Kinked catheter
4. Ectopic beats

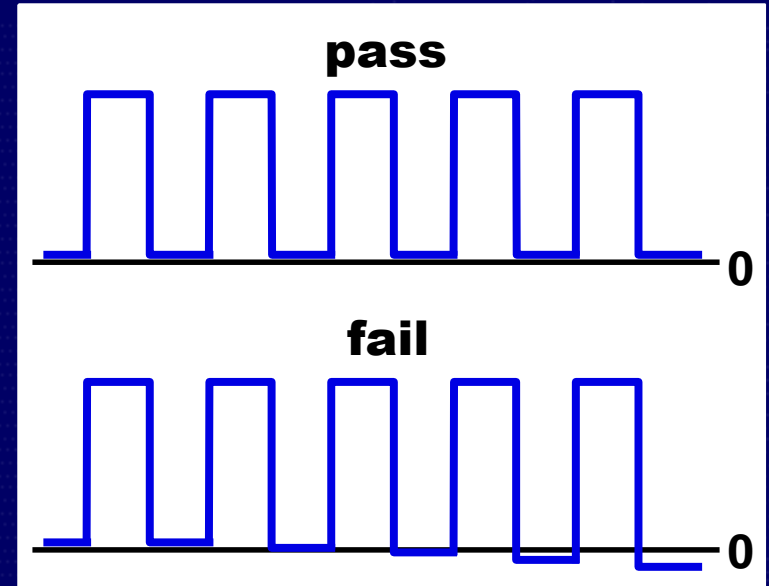
Classic BPW appearance of a Kinked Catheter



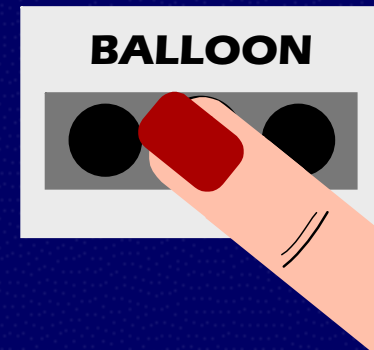
Internal Leak Test



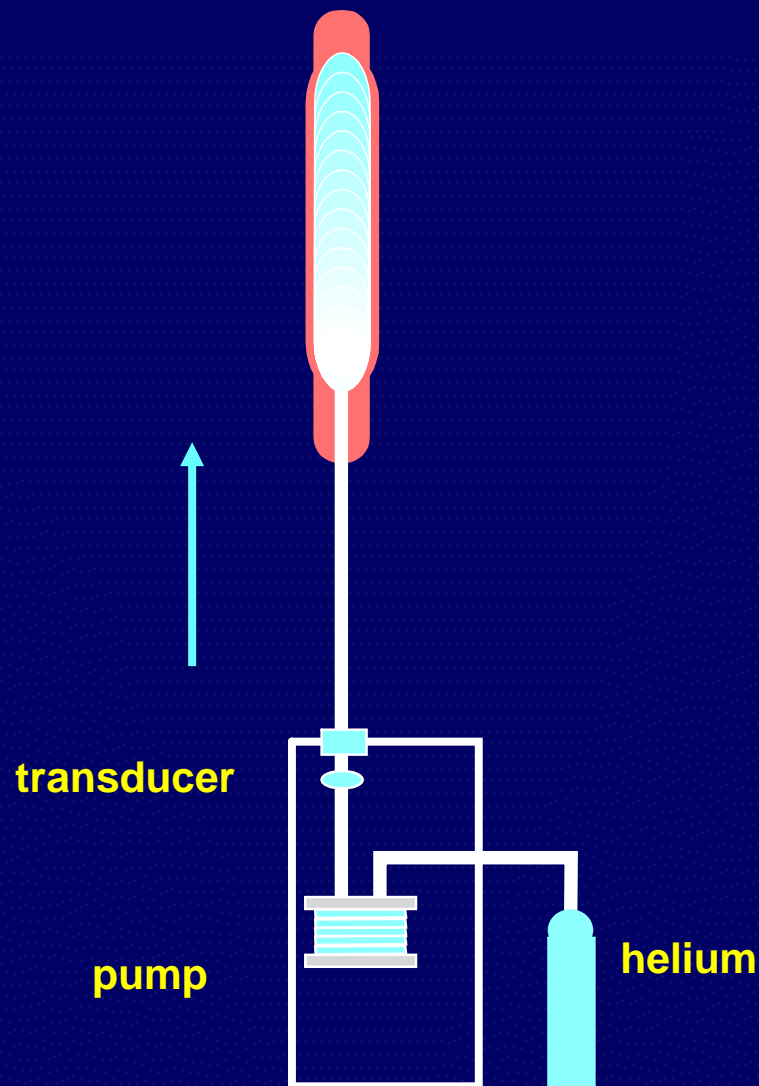
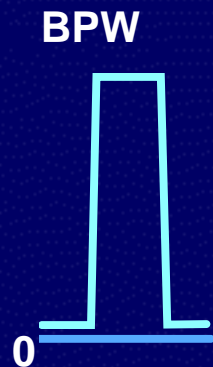
- Turn alarms **OFF**
- Select **INTERNAL** trigger



Observe BPW baseline
for 1 - 2 minutes



IAB too Large for Aortic Environment





Hands on review of the **AutoCAT® 2** **WAVE™**

ARROW[®]

INTERNATIONAL