



SNS COLLEGE OF ALLIED HEALTH SCIENCES
SNS Kalvi Nagar, Coimbatore - 35
Affiliated to Dr MGR Medical University, Chennai



DEPARTMENT OF CARDIOPULMONARY PERFUSION CARE
TECHNOLOGY

COURSE NAME: CPB & PERFUSION TECHNOLOGY II

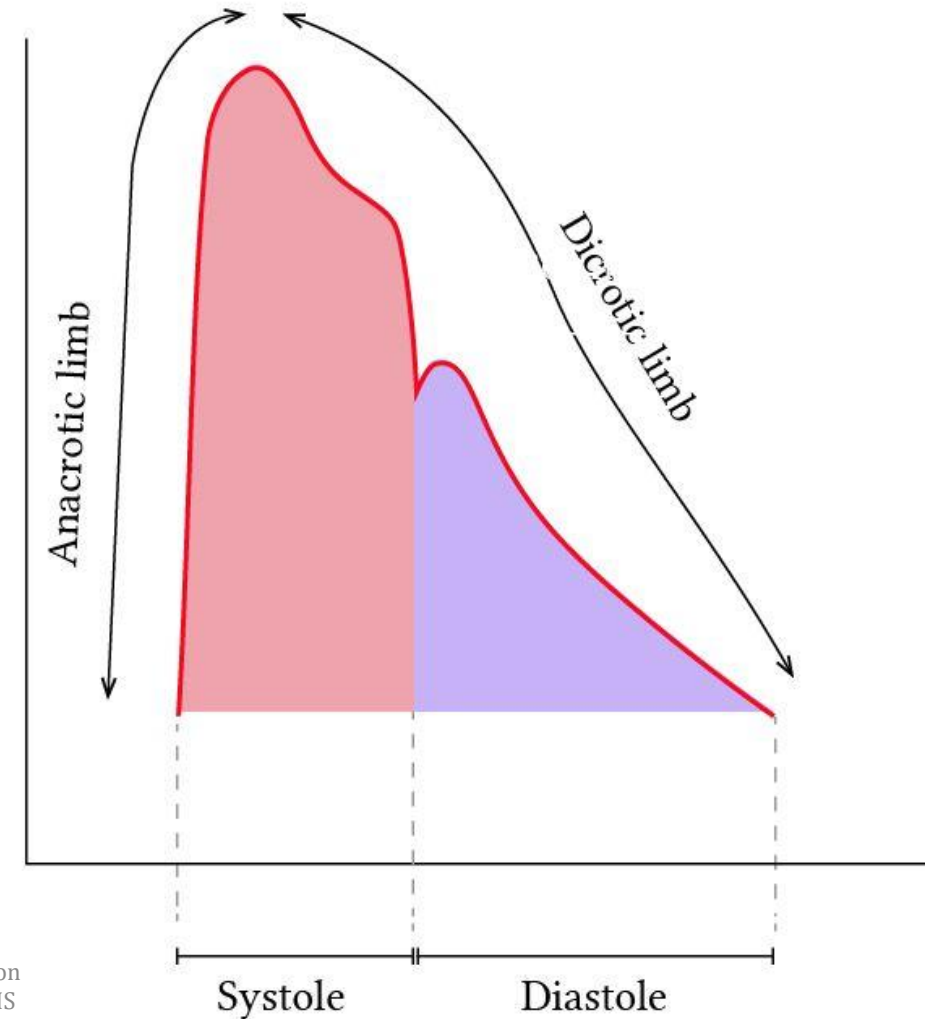
**TOPIC: INTRA AORTIC BALLOON PUMP – TRIGGERS &
WEANING**



Arterial Wave Form



- The systolic phase, characterized by a rapid increase in pressure to a peak, followed by a rapid decline.
- **The Systolic Phase** - begins with the opening of the aortic valve and corresponds to the left ventricular ejection
- **The dicrotic notch** - closure of the aortic valve
- **The diastolic phase**, which represents the run-off of blood into the peripheral circulation.



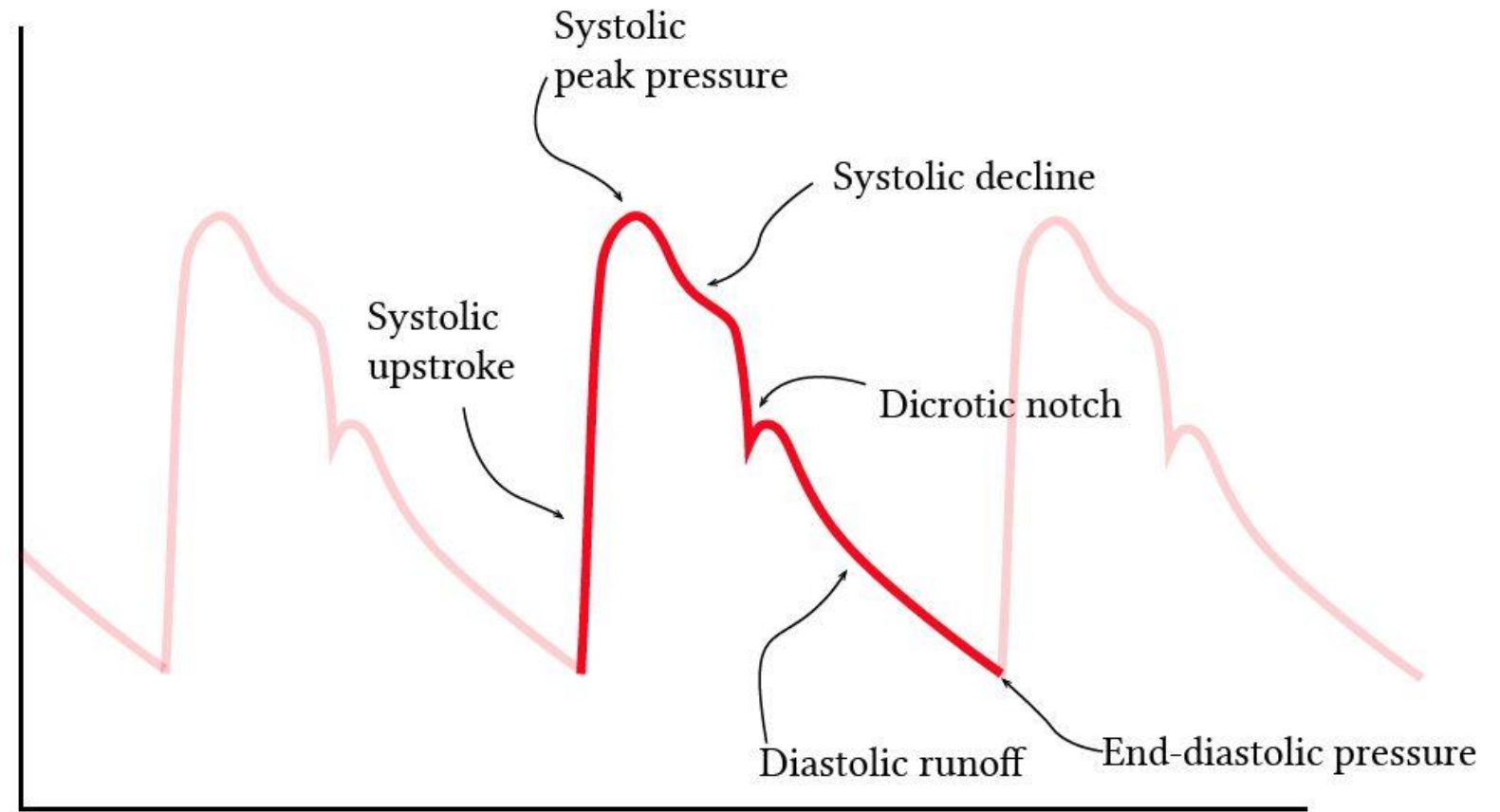


Pulse Pressure Waveform



The pulse pressure waveform has several components

- Systolic upstroke
- Systolic peak pressure
- Systolic decline
- Dicrotic notch
- Diastolic runoff
- End-diastolic pressure

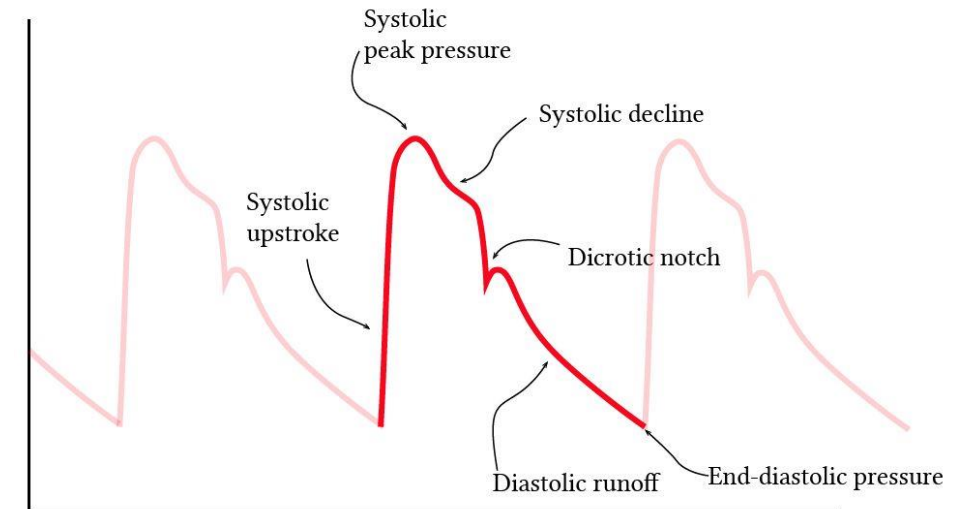




Pulse Pressure Waveform - Importance

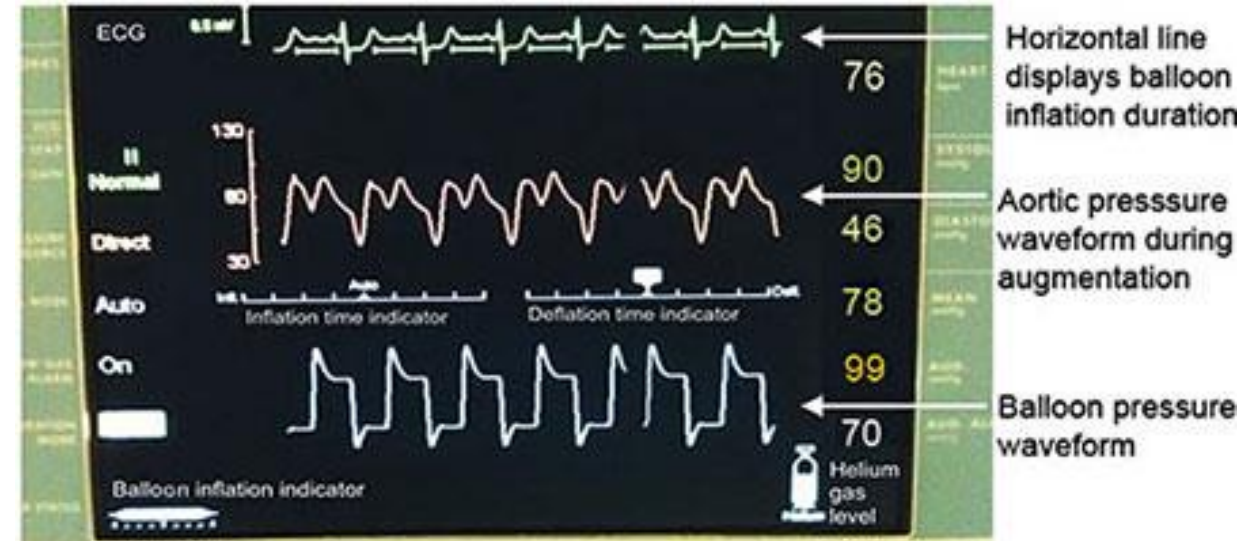


- **Systolic Upstroke** - ventricular ejection
- **Peak systolic pressure** - the maximum pressure in the central arteries
- **Systolic Decline** - ventricular contraction comes to an end
- The fall in pressure represents a period of time during which the efflux of blood from the central arterial compartment
- **Dicrotic Notch** - aortic valve closing
- **End-diastolic pressure** - This is the pressure exerted by the vascular tree back upon the aortic valve

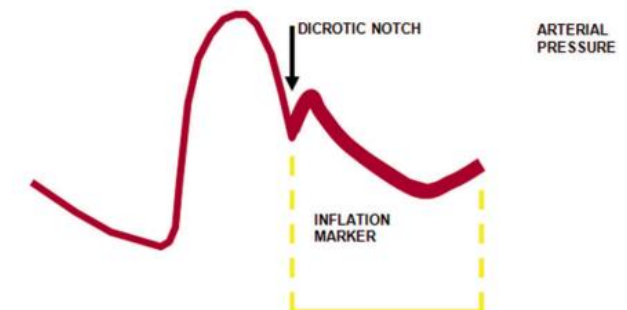
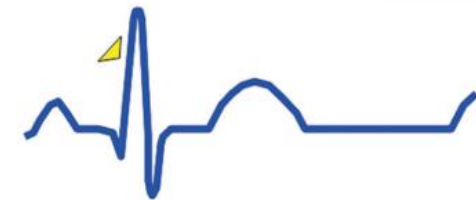


Triggers of IABP

- The IABP must have a consistent signal in order to perform trigger and timing functions
- **ECG:** using **R wave** on the ECG to start pumping.
- **Pressure wave :** the **dicrotic notch** in the arterial pressure wave is used to initiate inflation.
- Both the ECG and the arterial pressure (AP) waveforms should be monitored on the IABP
- If the ECG trace is lost (e.g. electrode falls off) the pump will automatically use the pressure signal for the trigger



ELECTROCARDIOGRAM





Triggers of IABP

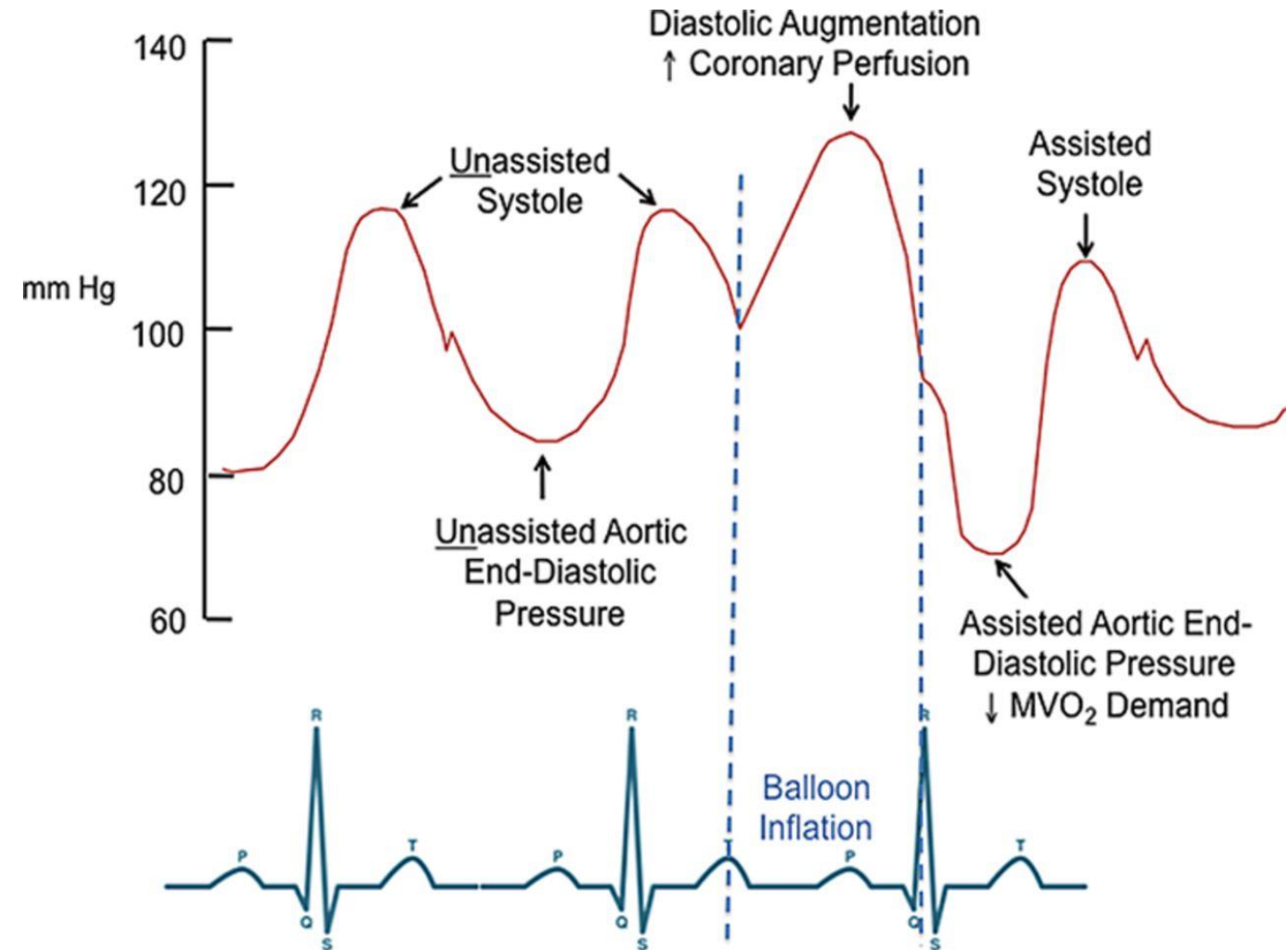


- **Internal:** The balloon inflates and deflates at a present rate regardless of the patient's cardiac activity. This mode is only to be used in situations where there is no ECG and no cardiac output , such as **cardiopulmonary bypass(Operator mode)**. The balloon inflates and deflates by **internal rate** with range between 40 and 120 beats/min.
- **Pacer V/AV:** uses **spikes of the ventricle** that been generated by pacing box.
- **Pacer A:** uses the **atrial pacing spike** as the trigger signal.



- Timing is relationship between the balloon inflation and deflation, and the heart systole and diastole.
- The timing is to have the right time of inflation at the closure of the aortic valve and deflation at the early systole.
- **Inflation at the closure of the aortic valve**
- **Deflation at the early systole**

Timing

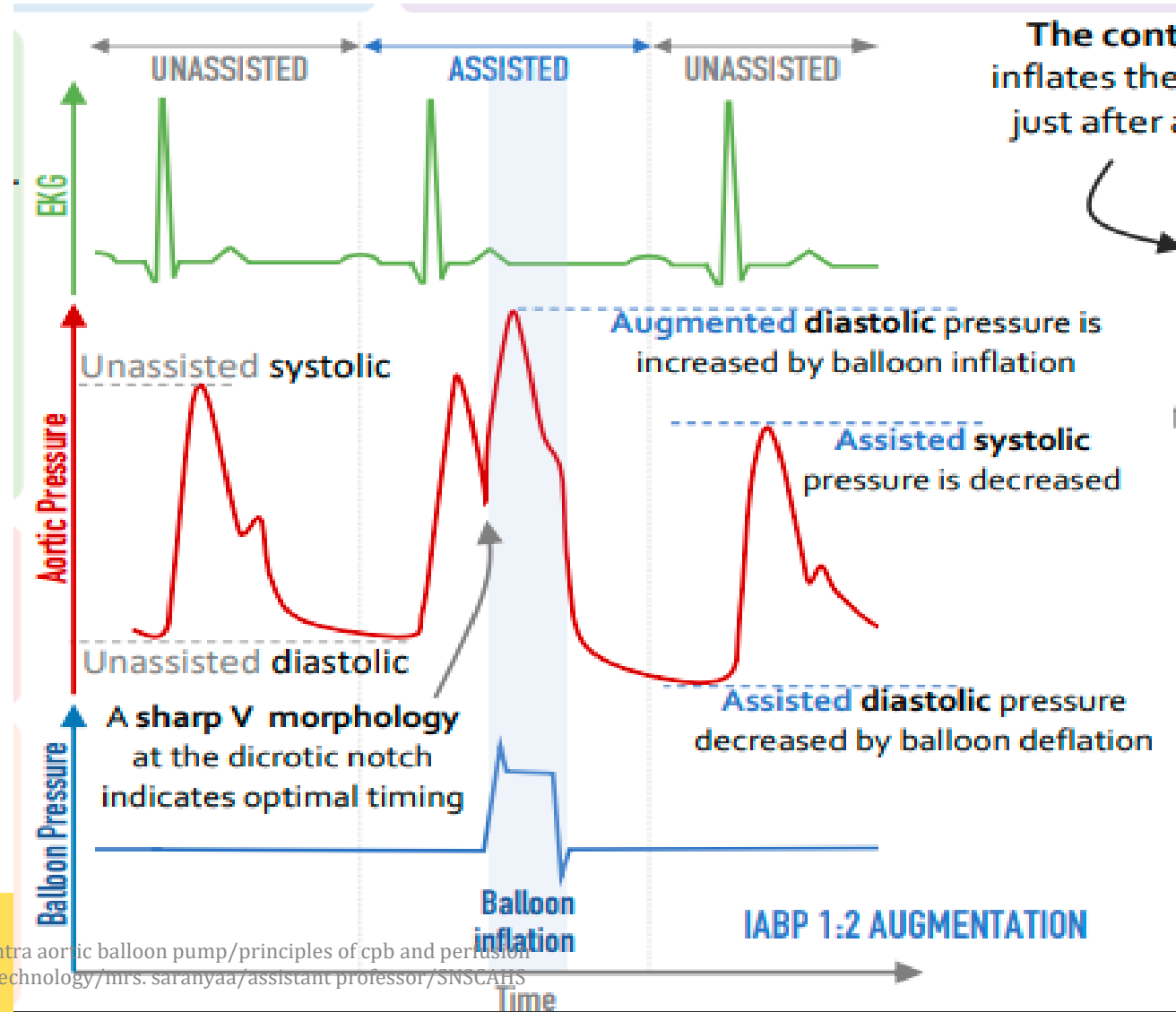


Inflation & its Ratio

Balloon inflation occurs at the beginning of **diastole** after aortic valve closure

Immediately after **peak T wave** in the ECG

The inflation ratio refers to the number of balloon inflations to the number of QRS complexes and can be set at 1:1, 1:2 or 1:3





Deflation

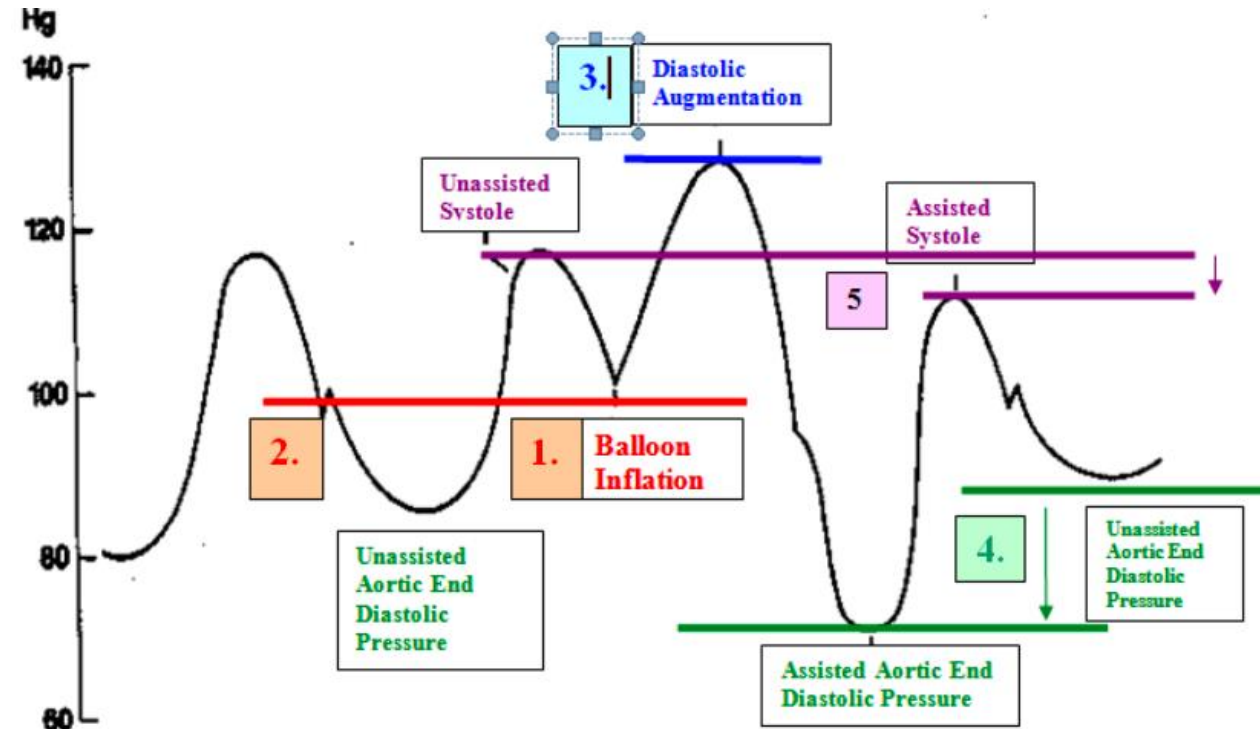


- Balloon deflation occurs **just before the systole**, before aortic valve open
- In the ECG the deflation appear on **peak of R wave**
- **The effectiveness of IABP augmentation is reduced when there is excessive tachycardia (>120 bpm) or cardiac arrhythmia**



Proper Timing

- Balloon inflation occurs at just prior to the dicrotic notch
- Exceeds **Peak diastolic pressure(PDP)** above **peak systolic pressure(PSP)**
- Deflation occurs just prior the systole
- **Balloon aortic end diastolic pressure (BAEDP)** is less than the **patient's aortic end diastolic pressure(PAEDP)**
- The **assisted peak systole pressure (APSP)** is less than **unassisted peak systolic pressure (PSP)**
- Both inflation and deflation cause a sharp V shape



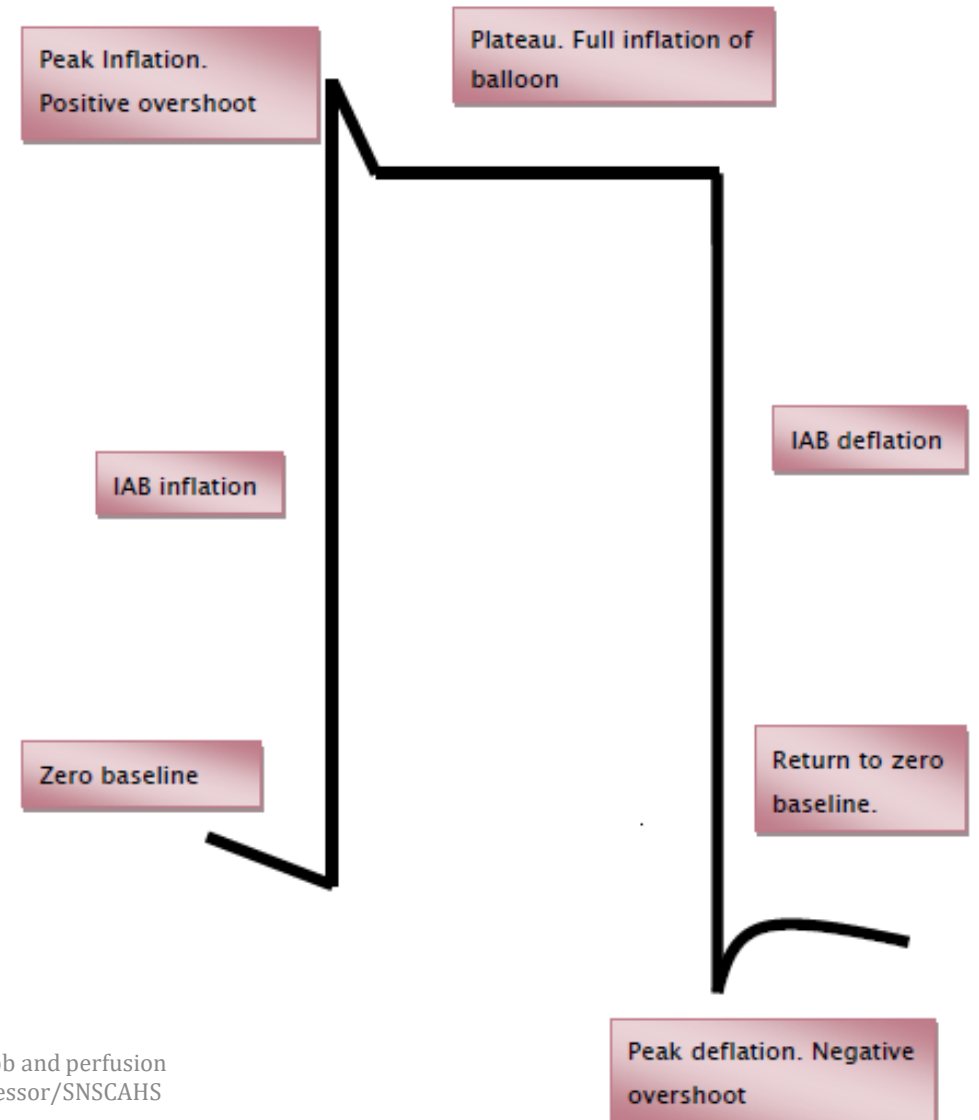


Balloon Waveform

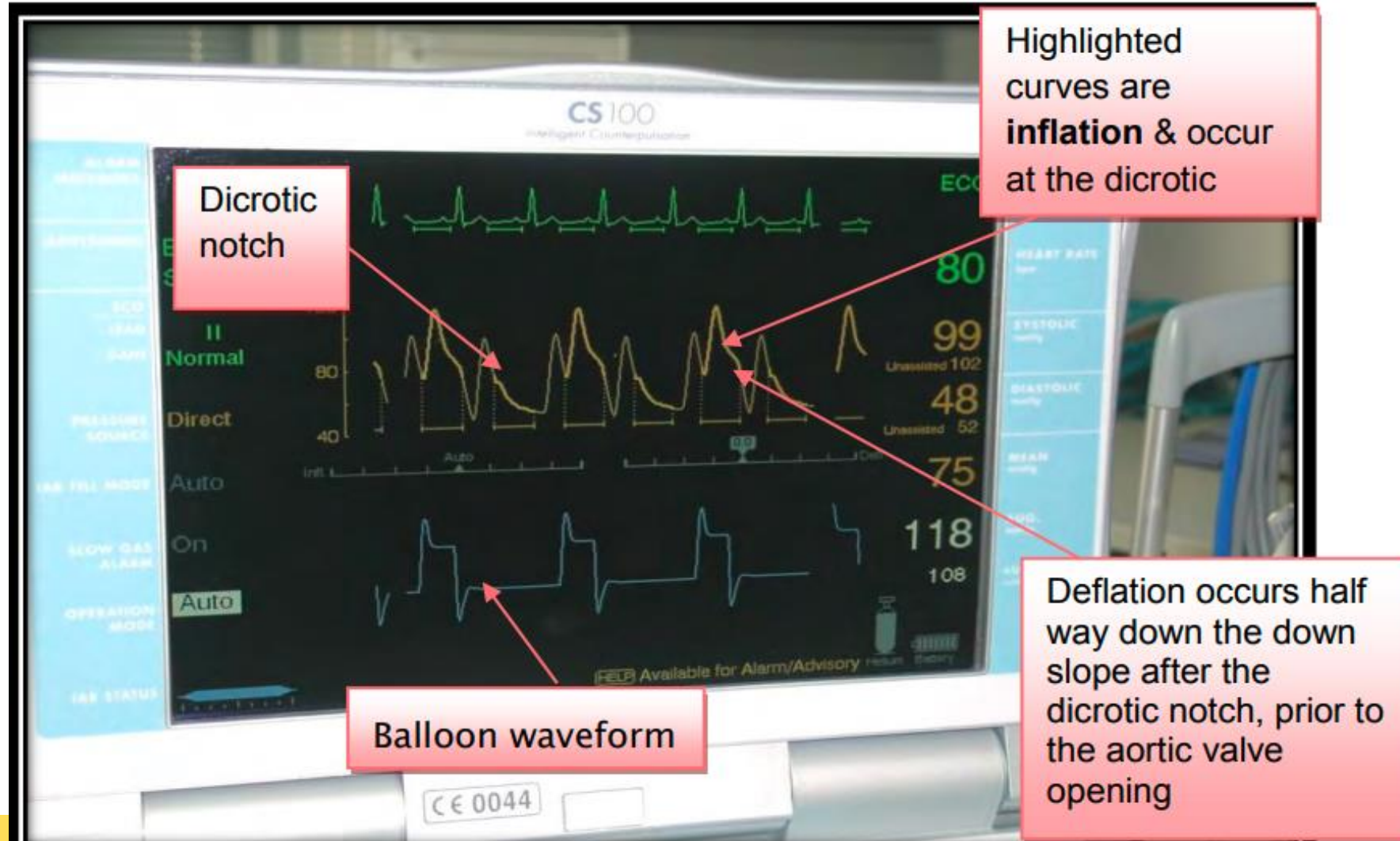


Two important points about the shape of the waveform are:

- The width of the waveform corresponds to the duration of balloon inflation during the cardiac cycle
- The **plateau** of the waveform reflects pressure within the aorta when the **balloon is inflated**.



Exact Balloon Inflation and Deflation





Common Timing Errors



- EARLY INFLATION - Inflation of IAB before aortic valve closure. - **increased afterload**
- LATE INFLATION - Inflation of IAB after closure of aortic valve - **decreased diastolic augmentation**
- EARLY DEFLATION - pre matured deflation during diastolic phase - **no decrease in myocardial O2 demand**
- LATE DEFLATION - Deflation after the onset of systolic - **increases afterload**



Commencement of Counter Pulsation Technique



- Connect to mains **power** to ensure the battery is preserved
- Check the **helium tank** is open at the back of the pump
- Ensure both an **ECG and pressure trace** can be obtained
- Obtain a trigger for IABP and set optimal timings, which **initiates balloon inflation**
- Frequency of inflation when first commencing IABP is **1:1**
- **Connect the extension tubing** to the balloon catheter and on the balloon console at the back
- Once connected, press the **IAB fill button**, holding it down for a second.
- Once filled, commence counter-pulsation by pressing the **assist/standby button**.
- Increase **slowly to the maximum augmentation**

Weaning of IABP

- Intra-Aortic Balloon generally improves the cardiac function within 1-3 days at which time the IABP can be removed.
- Firstly, the IABP augmentation can be reduced to 50% for **2-4 hours**.
- The inflation ratio is then progressively reduced from **1:1 to 1:2** for another 2-4 hours and then to 1:3
- Observing the **patient hemodynamic** before the balloon catheter is removed.

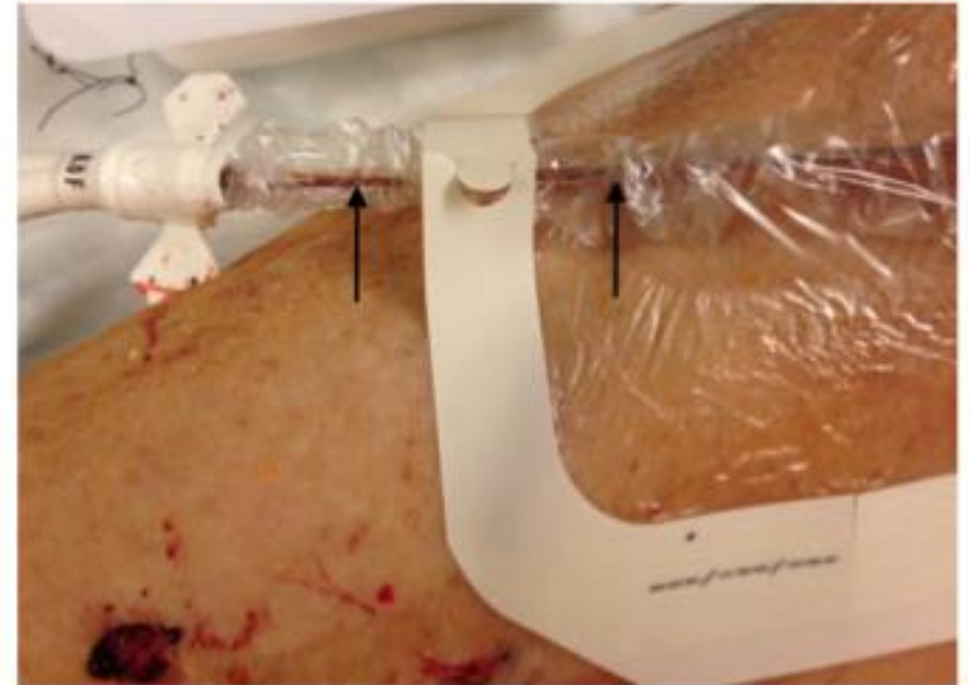




IAB Removal



- The IABP must be switched off and the **catheter completely deflated just prior to removal.**
- **Heparin should be discontinued at the start of IABP weaning** so that coagulation is normalized by the time the IABP catheter is removed.
- Carefully remove dressing from insertion site. Remove all sutures and ties anchoring catheter to skin.
- **Switched off IABP and disconnect helium line from control system**

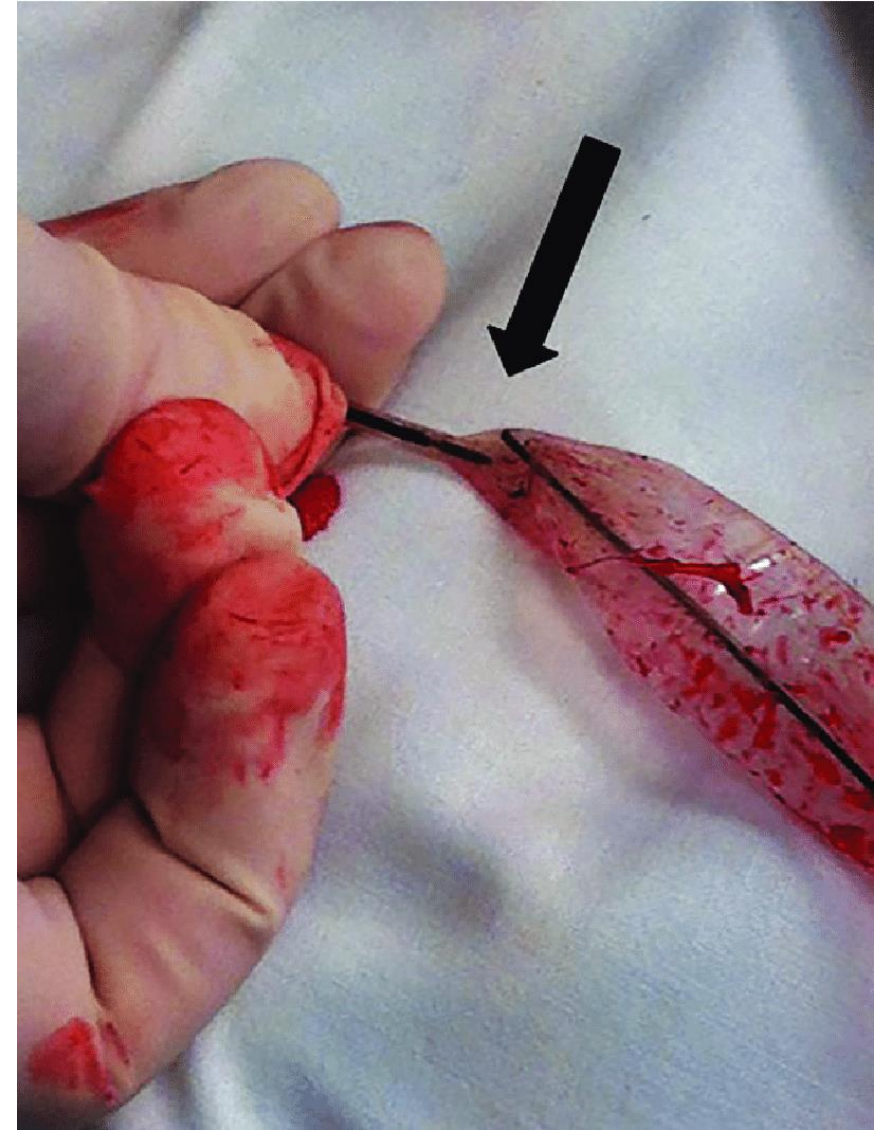




IAB Removal



- **Remove the balloon**
- After remove the balloon, allow free flow of blood to flush puncture site for several seconds.
- **Apply firm pressure to site for 30 minutes**, or until haemostasis has been achieved.
- During and after removal, check **distal pulses** frequently and assess for signs of complications.





THANK YOU



- <https://derangedphysiology.com/main/cicm-primary-exam/required-reading/cardiovascular-system/Chapter%20760/normal-arterial-line-waveforms>
- Manual of Cardiopulmonary Bypass
- Cardio Pulmonary Bypass , Sunit Ghosh Florian Falter Albert C. Perrino
- <https://rk.md/2017/intra-aortic-balloon-pump-arterial-line-ekg-waveforms/>
- <https://www.thieme-connect.com/products/ejournals/pdf/10.1055/s-0039-1688727.pdf>
- [http://www.files.sulli.us/IABP/Train the Trainer Manual.pdf](http://www.files.sulli.us/IABP/Train_the_Trainer_Manual.pdf)
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