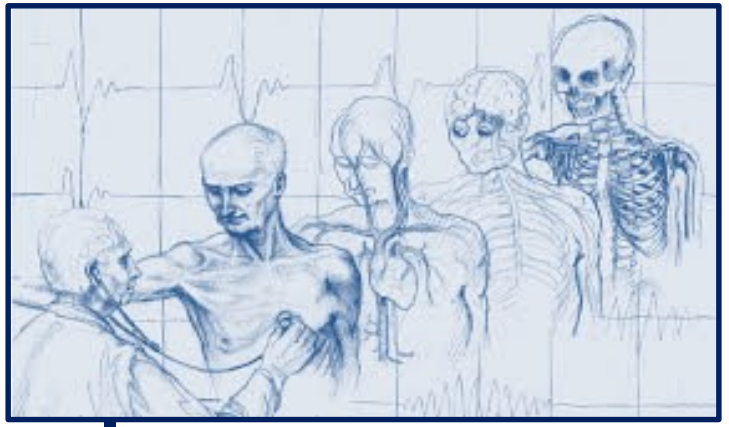
Apex beat. Heart sounds (VI.) Systolic time intervals (XIII.)



Department of Physiology
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Apex beat

- External manifestation of heart function
- Maximum in 4th or 5th intercostal space on the left (1-2 cm from medioclavicular line)
- Observation (inspection), palpation

Heart sounds

- **1st heart sound:** Closing of mitral and tricuspid valves
- **2nd heart sound:** Closing of aortic and pulmonary valves
- **systolic pause:** Time interval between 1st and 2nd heart sounds
- **diastolic pause:** Time interval between 2nd and 1st heart sounds
- **3rd heart sound:** In first part of diastole, physiological in young people; in elderly people sign of decreased compliance of LV (hypertrophy)

Heart sounds

1st heart sound - CHARACTERISATION

- **Vibration of mitral and tricuspid valves due to their rapid closure (because of increase of pressure in ventricles above the pressure in atria in the beginning of systole)**
- **Low-frequency sound takes 100 ms**
- **Circa 50 ms after beginning of QRS**
- **Maximum in region of apex beat (laying on left side)**
- **Clinically relevant: assessment of loudness of heart sound – intensification or attenuation, or splitting**

Heart sounds

2nd heart sound - CHARACTERISATION

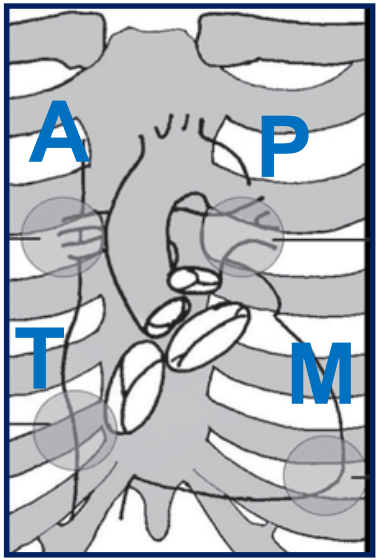
- **Vibration of aortic and pulmonary valves due to their rapid closure (because of decrease of pressure in ventricles under the pressure in aorta at the end of systole)**
- **High-frequency sound has two components – aortic and pulmonary; physiological splitting in inspiration (unsplit when the subject is holding his/her breath in expiration)**
- **Maximum in region of apex beat (laying on left side)**
- **Clinically relevant: assessment of loudness of heart sound – intensification or attenuation, or splitting**

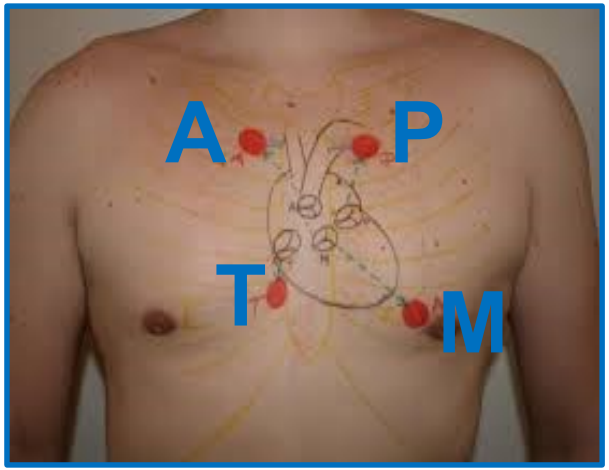
Heart sounds

- Auscultation
  - By ear
  - By stethoscope
  - By microphone - phonocardiography

Heart sounds

- Places of optimal audibility of particular valves





Aortic valve

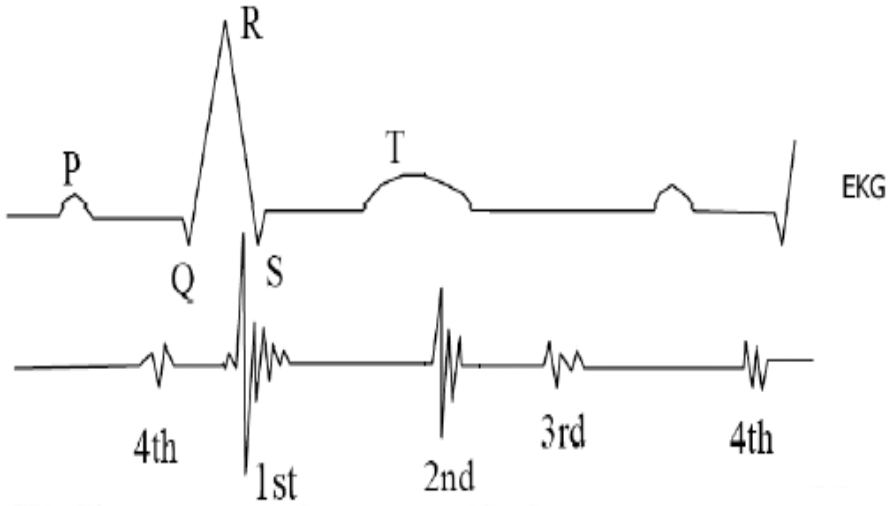
Pulmonary valve

Mitral valve

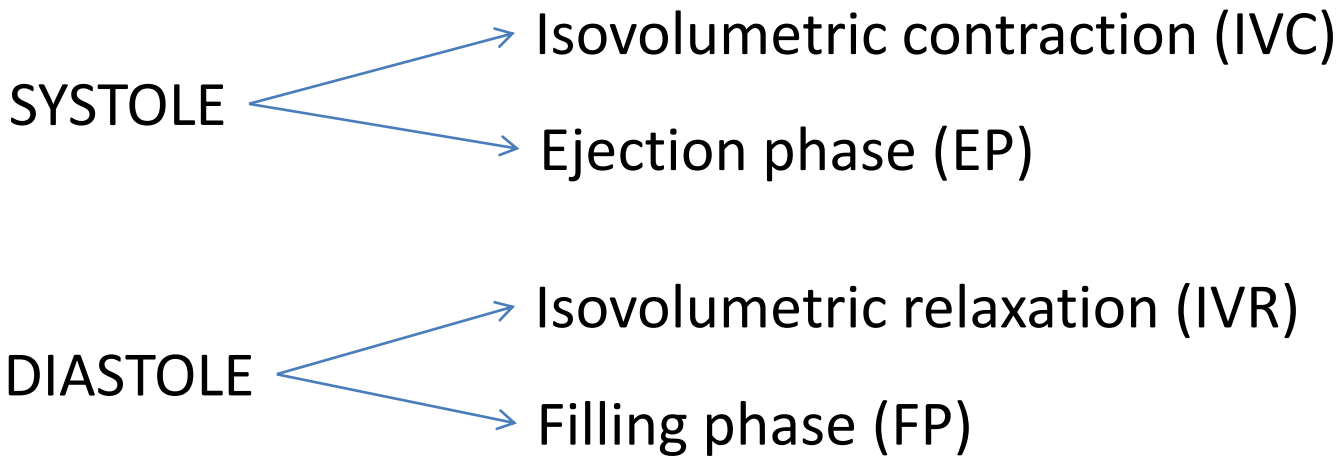
Tricuspid valve

Heart sounds

- Timing of heart sounds: ECG + phonocardiography



Heart cycle


SYSTOLE
Isovolumetric contraction (IVC)
Ejection phase (EP)
DIASTOLE
Isovolumetric relaxation (IVR)
Filling phase (FP)

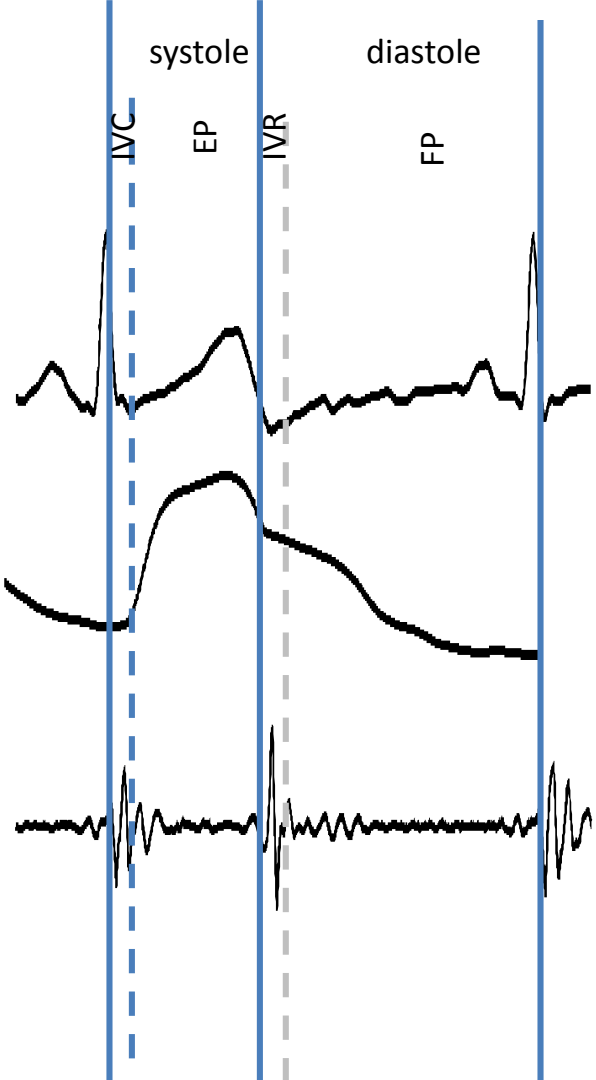
POLYGRAPHY

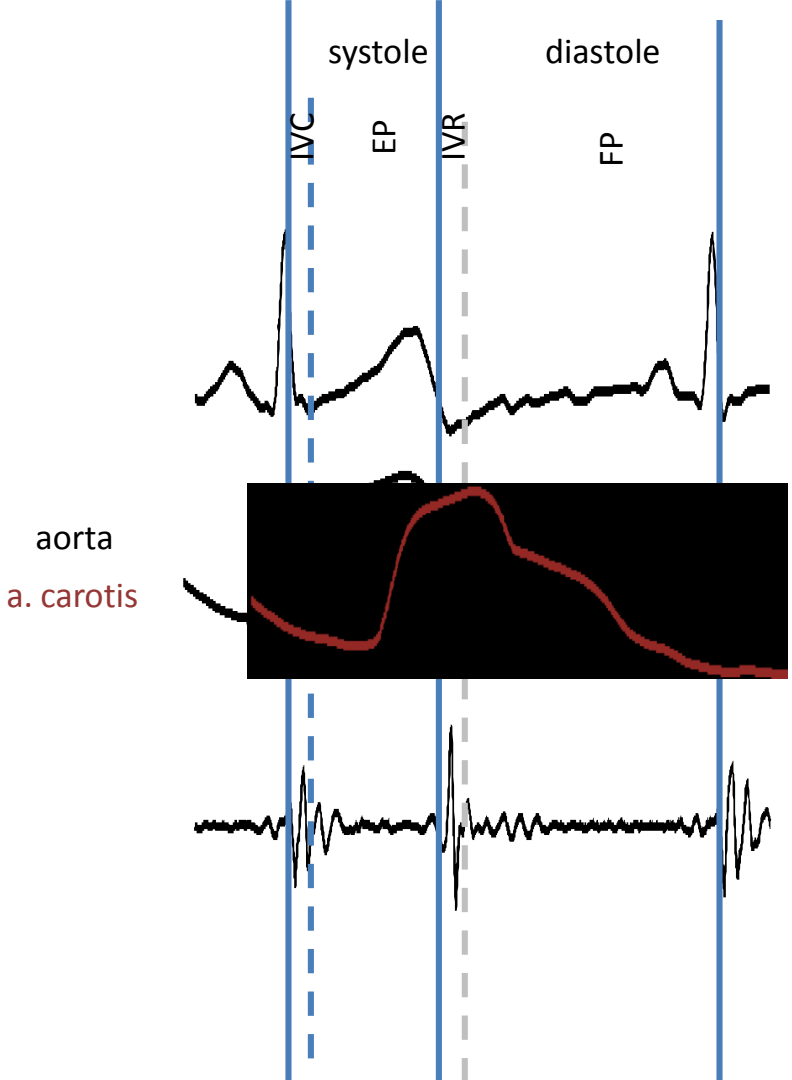
– recording of several physiological quantities (signals) in the same time

PHONOCARDIOGRAPHY - recording of heart sounds (by microphone)

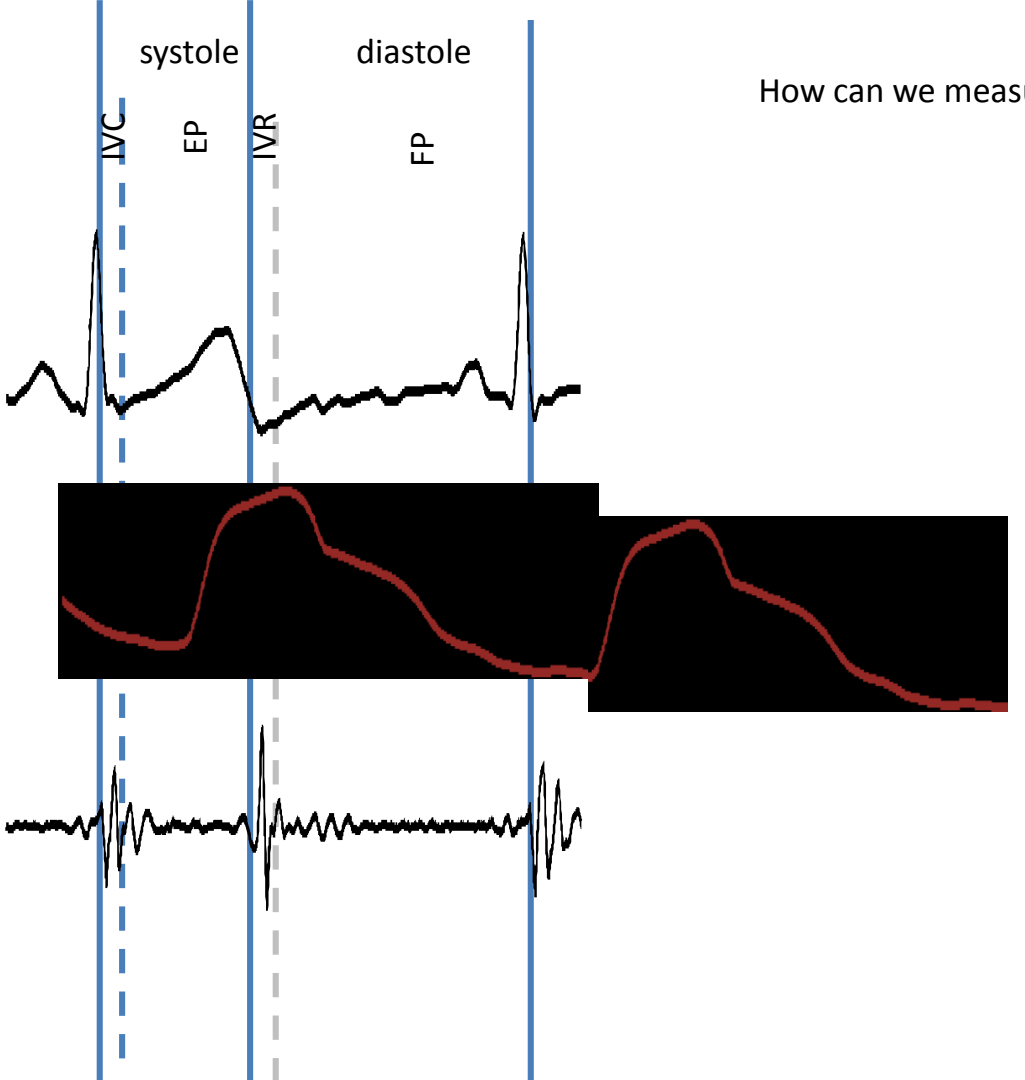
ELECTROCARDIOGRAPHY (ECG)

SPHYGMOGRAPHY - recording of arterial pulse wave

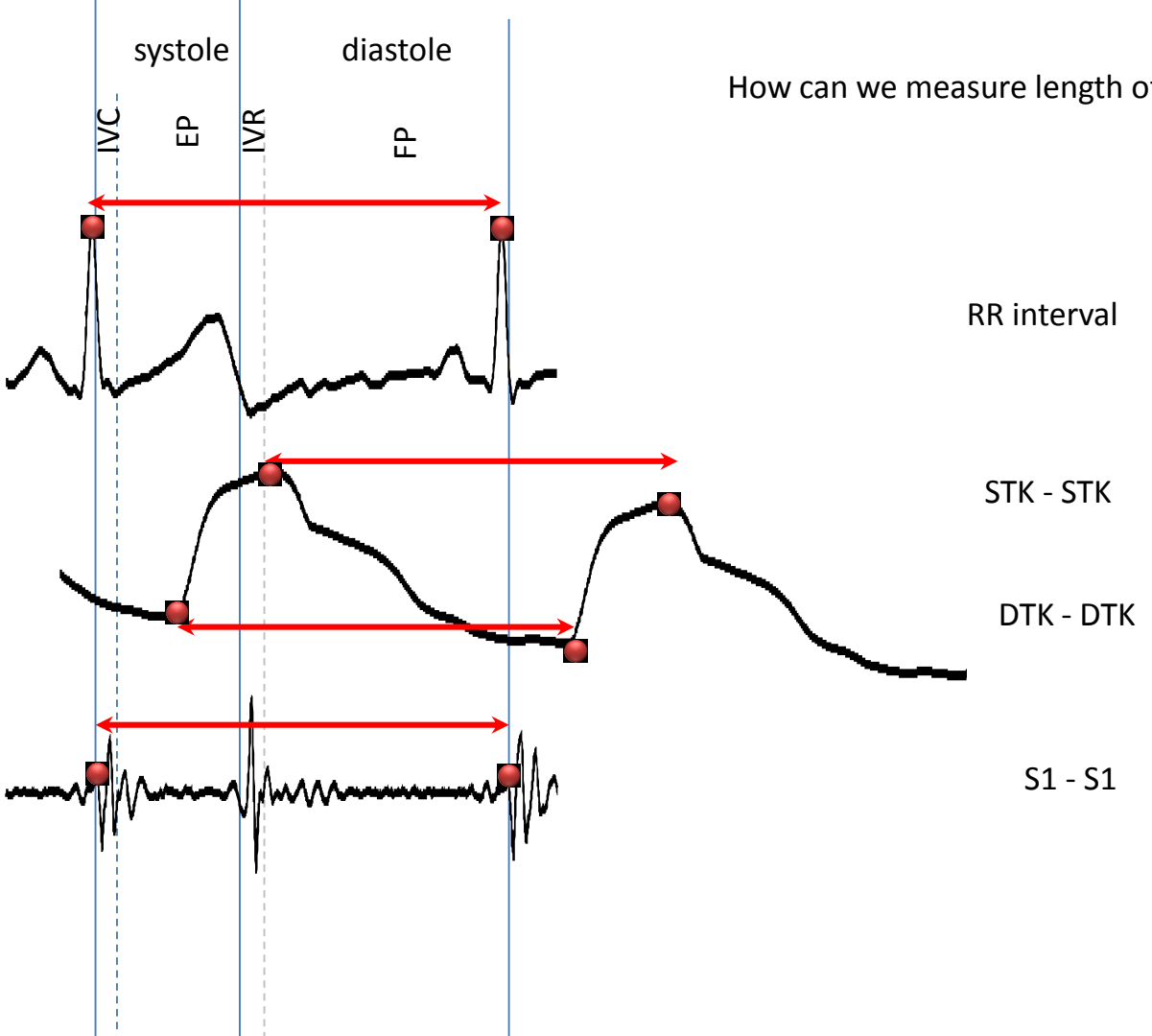

systole
diastole
IVC
EP
IVR
FP



The record of pulse wave from carotid artery is shifted against the record from root of aorta!



How can we measure length of heart cycle?



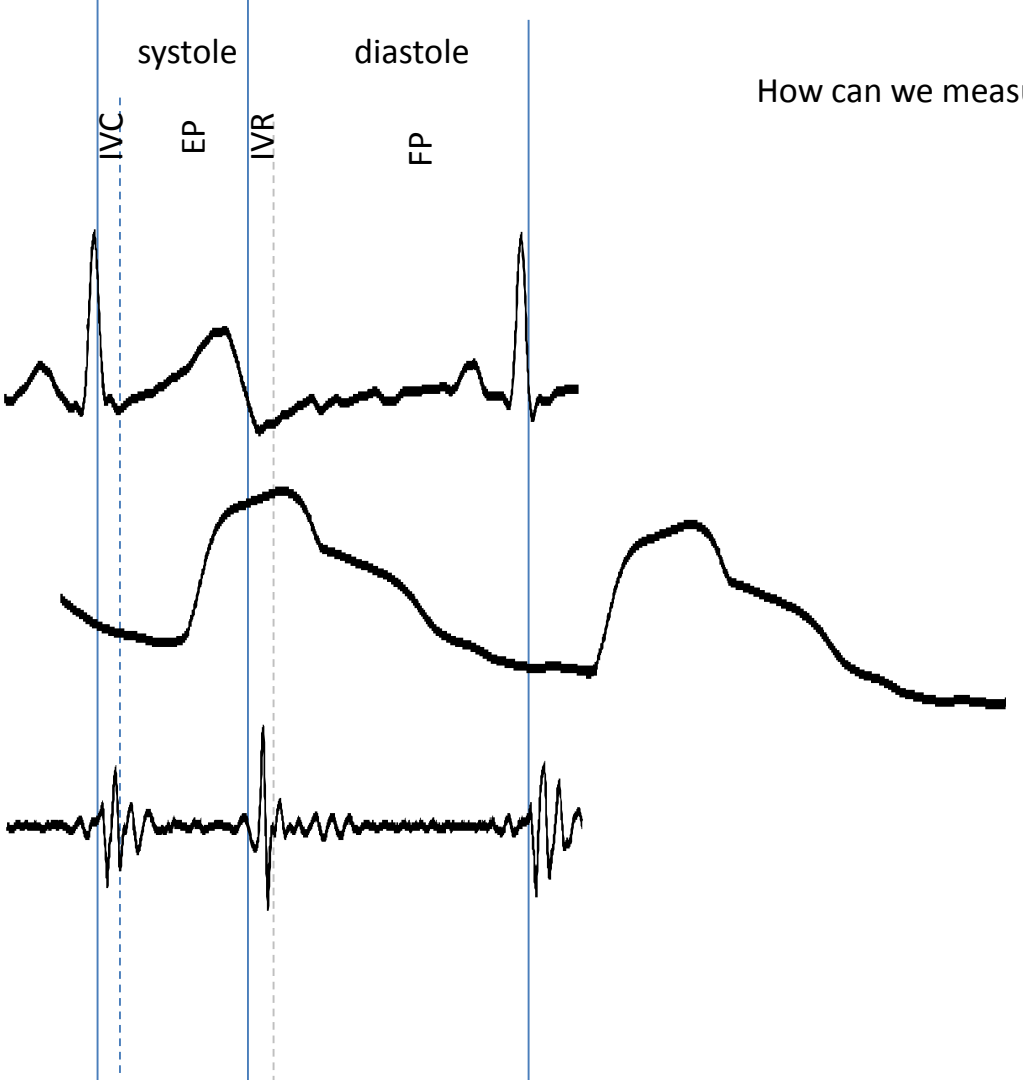
How can we measure length of heart cycle?

RR interval

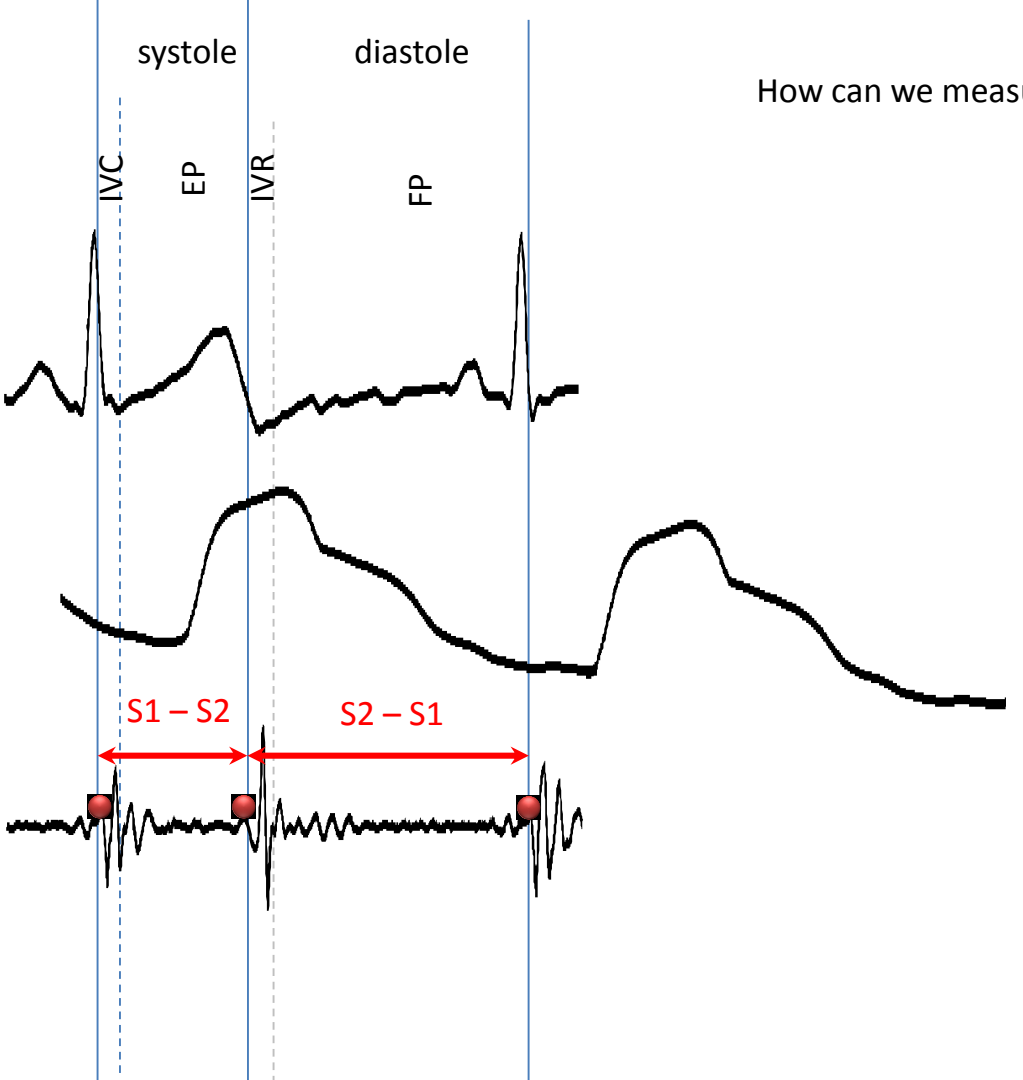
STK - STK

DTK - DTK

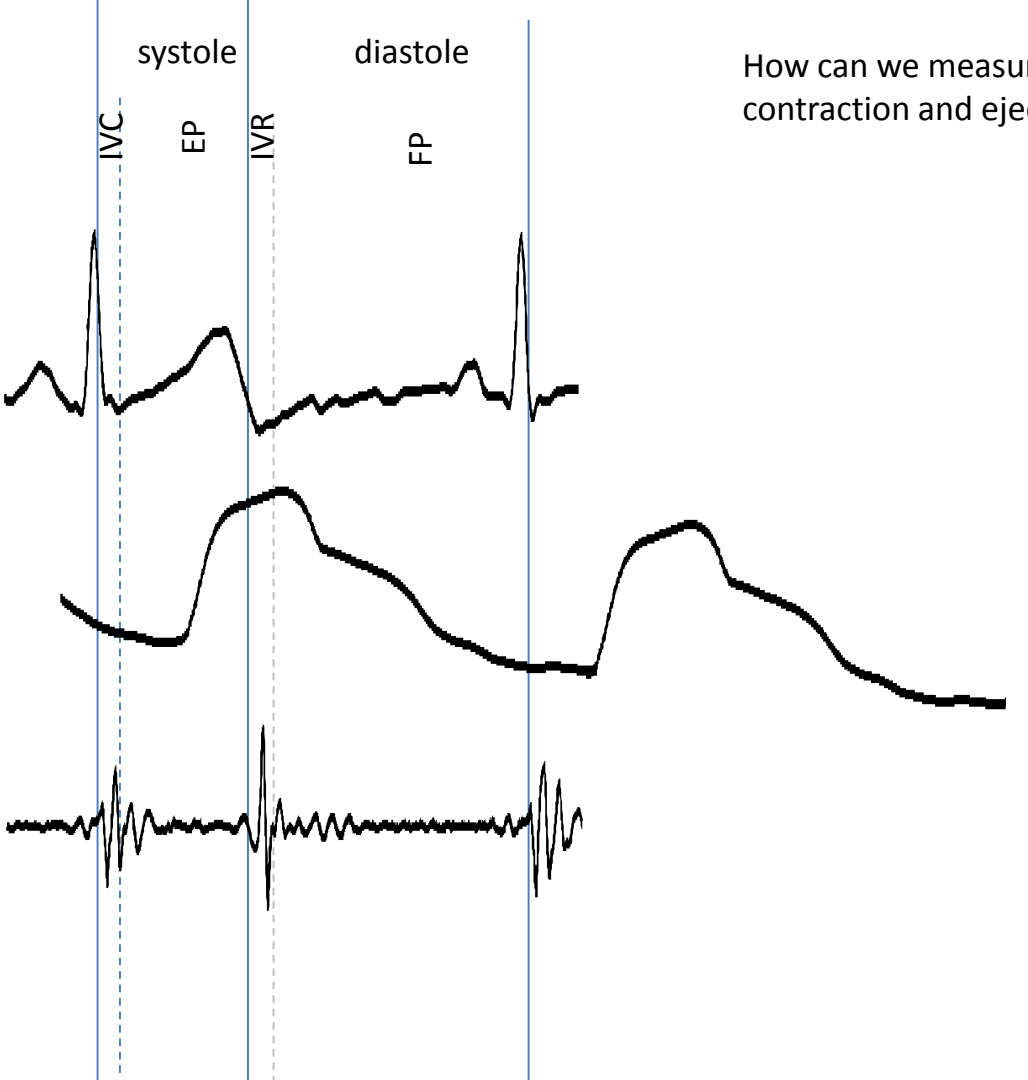
S1 - S1



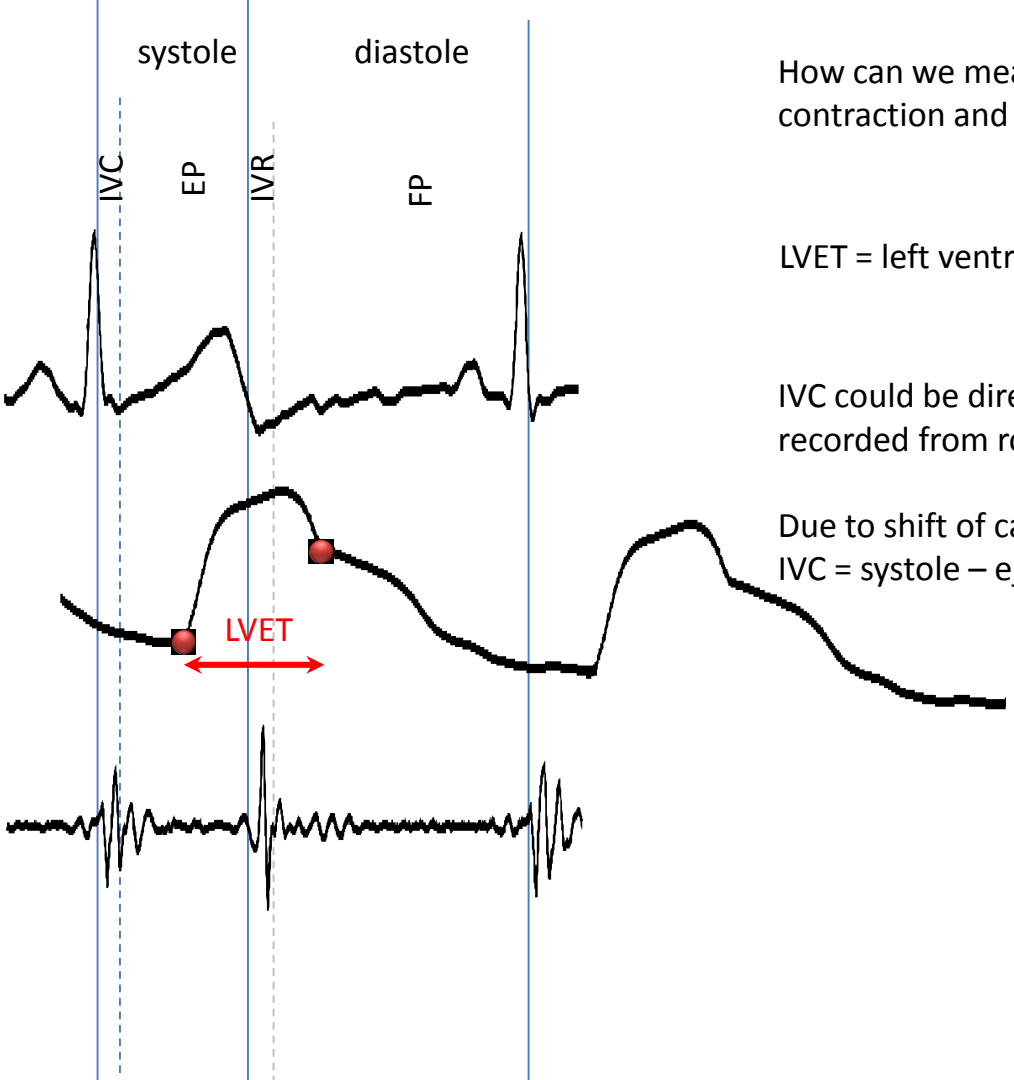
How can we measure length of systole and diastole?



How can we measure length of systole and diastole?



How can we measure length of isovolumetric contraction and ejection phase?

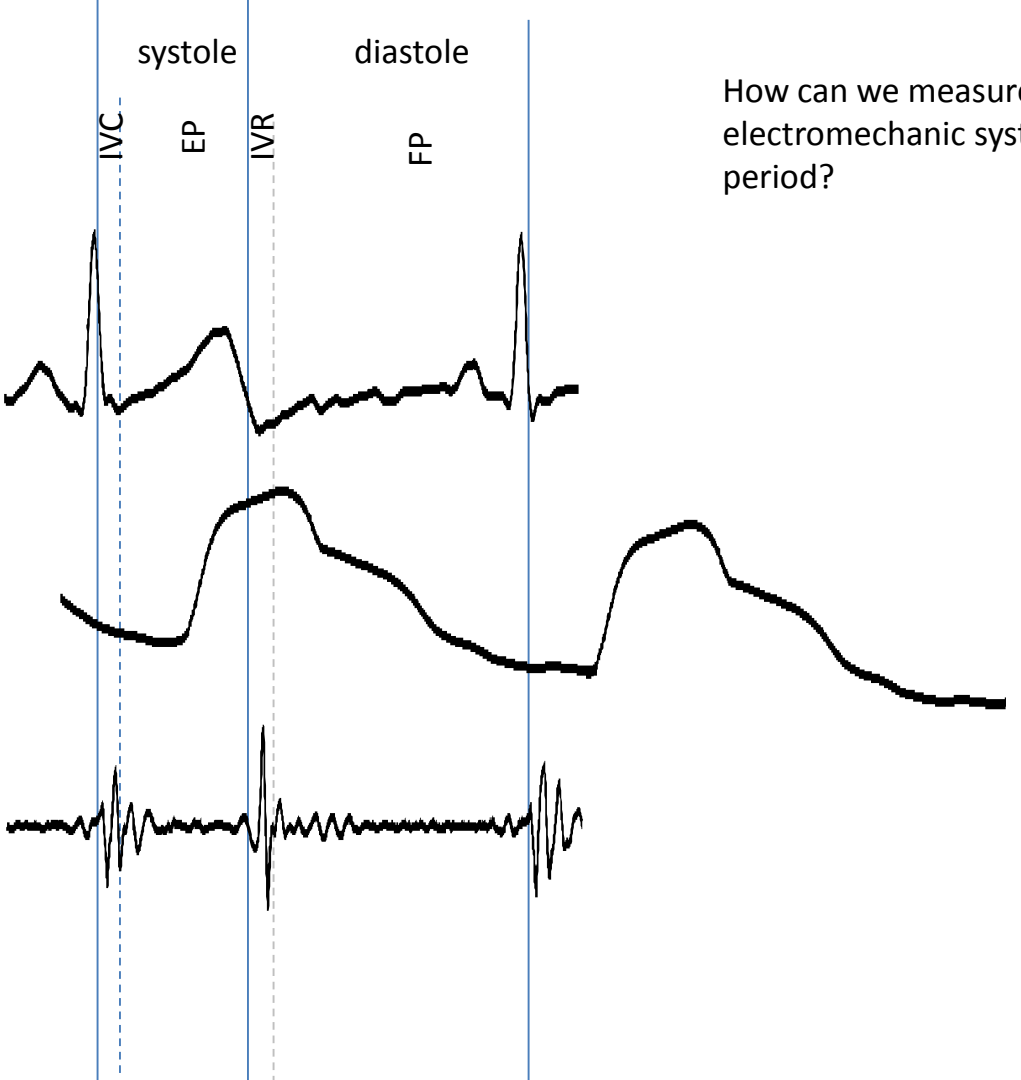


How can we measure length of isovolumetric contraction and ejection phase?

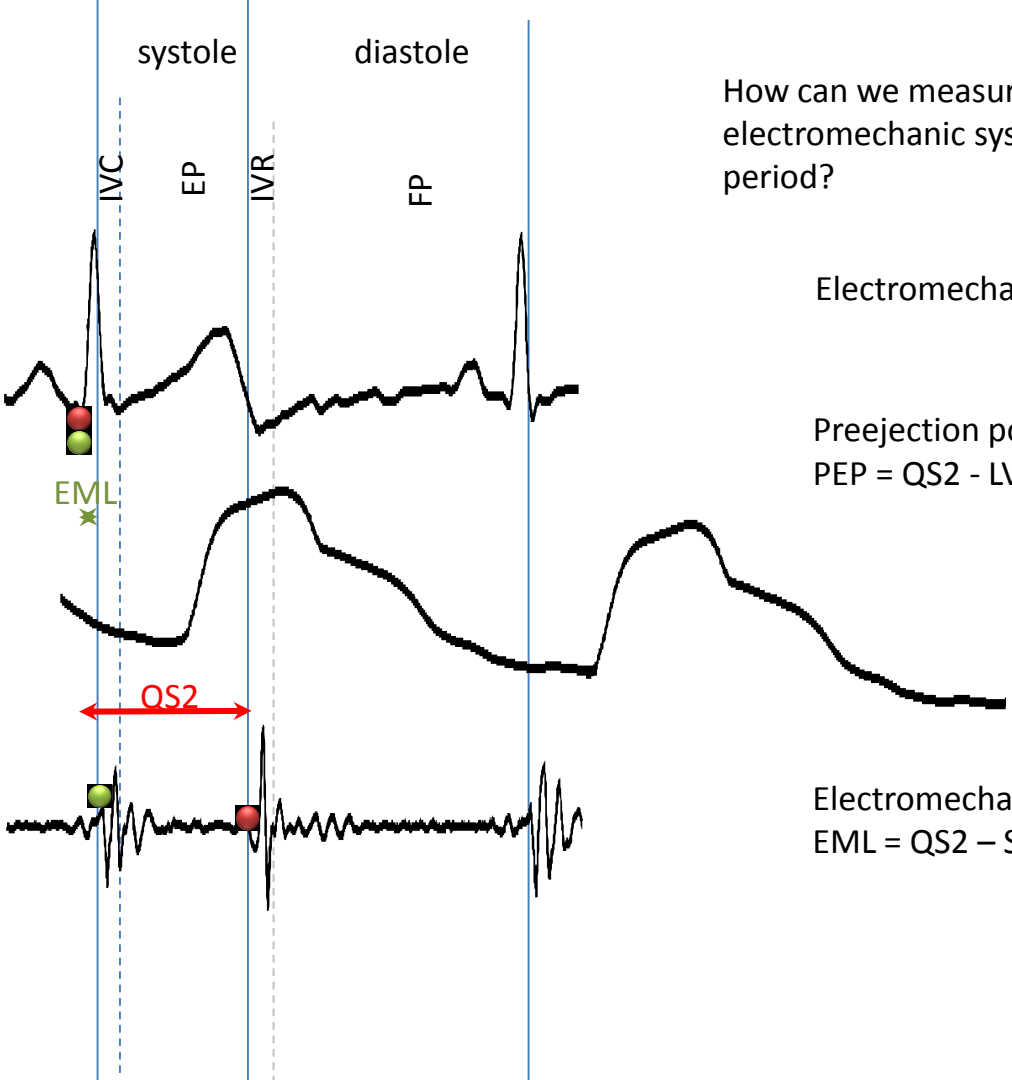
LVET = left ventricle ejection time = EP

IVC could be directly measured in sphygmorgaphy recorded from root of aorta.

Due to shift of carotid artery record, we use calculation:
IVC = systole – ejection phase = S1S2 - LVET



How can we measure length of electromechanic systole a preejection period?



How can we measure length of electromechanic systole a preejection period?

Electromechanical systole: QS2

Preejection poriod - calculation:
PEP = QS2 - LVET

Electromechanical latency (EML)
EML = QS2 – S1S2