Intermediate Bedside Cardiac Examination

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UTHSCSA and STVAHCS

References

- O'Rourke RA et al. "The history, physical examination and cardiac auscultation." Chapter 12, in Hurst's The Heart, 12th ed. 2008.
- Fowler NA. Physical signs in Cardiology. 1999.
- Perloff JK. Physical Examination of the Heart and Circulation. 3rd ed. 2000.
- Marriott HJL. Bedside Cardiac Diagnosis. 1993.
- Constant J. Bedside Cardiology, 5th ed. 1999.

Cardiovascular H and P

- CC
- HPI
- ROSS
- PMH
- Social
- Medications

- VS
- Fundi
- Neck: carotid and jugular
- Lungs
- Heart
- Abd
- Extremities

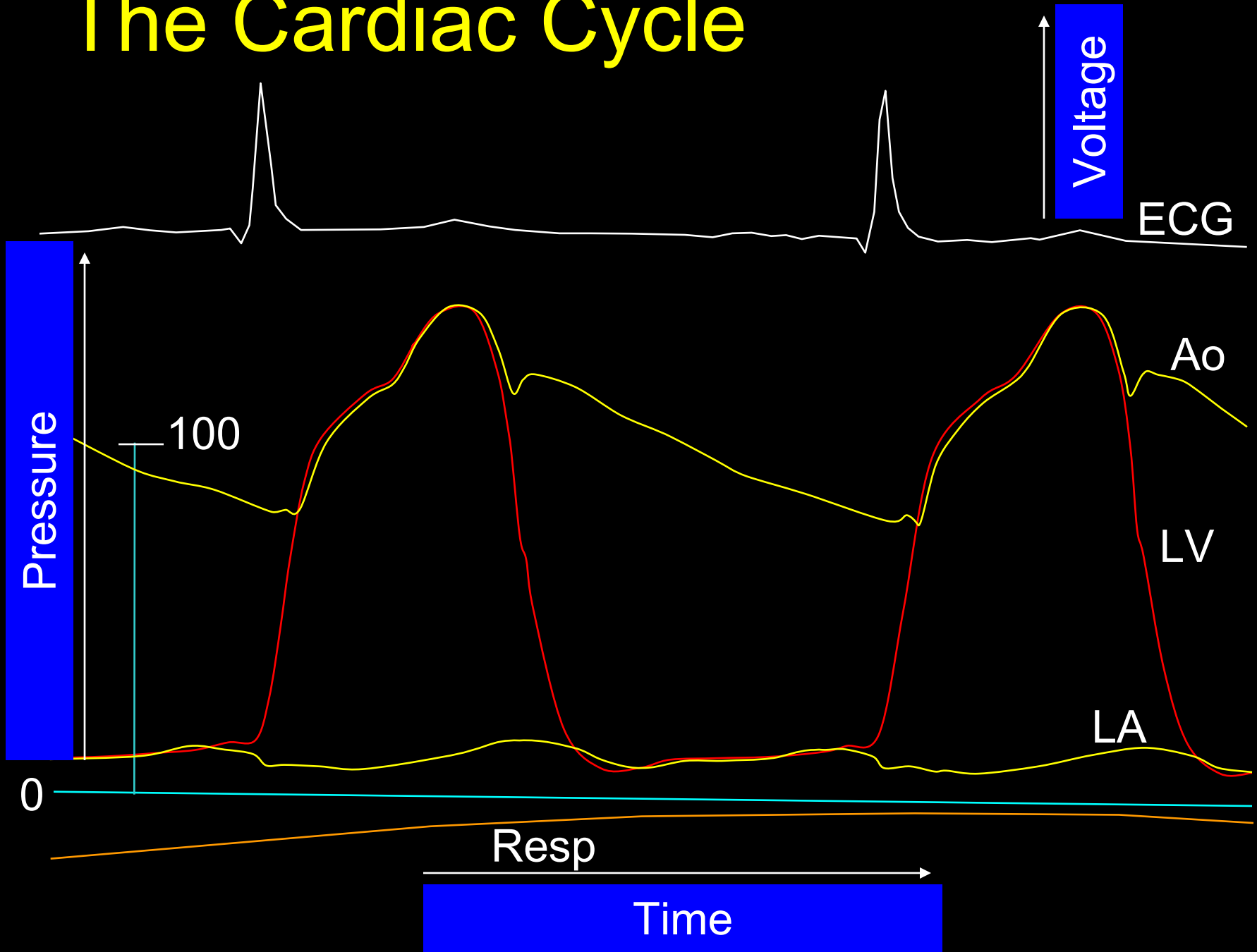
History

- ROSS
  - Chest discomfort, ischemic symptoms, exertional symptoms
  - CHF, exercise intolerance, class IV symptoms
  - Arrhythmia: palpitations, dizzy/syncope/near syncope
  - Hypertension, murmur, rheumatic fever
  - Diabetes
- PMH
  - Prior tests, procedures, cardiac events
- Social: alcohol, tobacco
- Family history of premature CAD or SCD
- Medications (current, former, intolerances)

Physical Examination

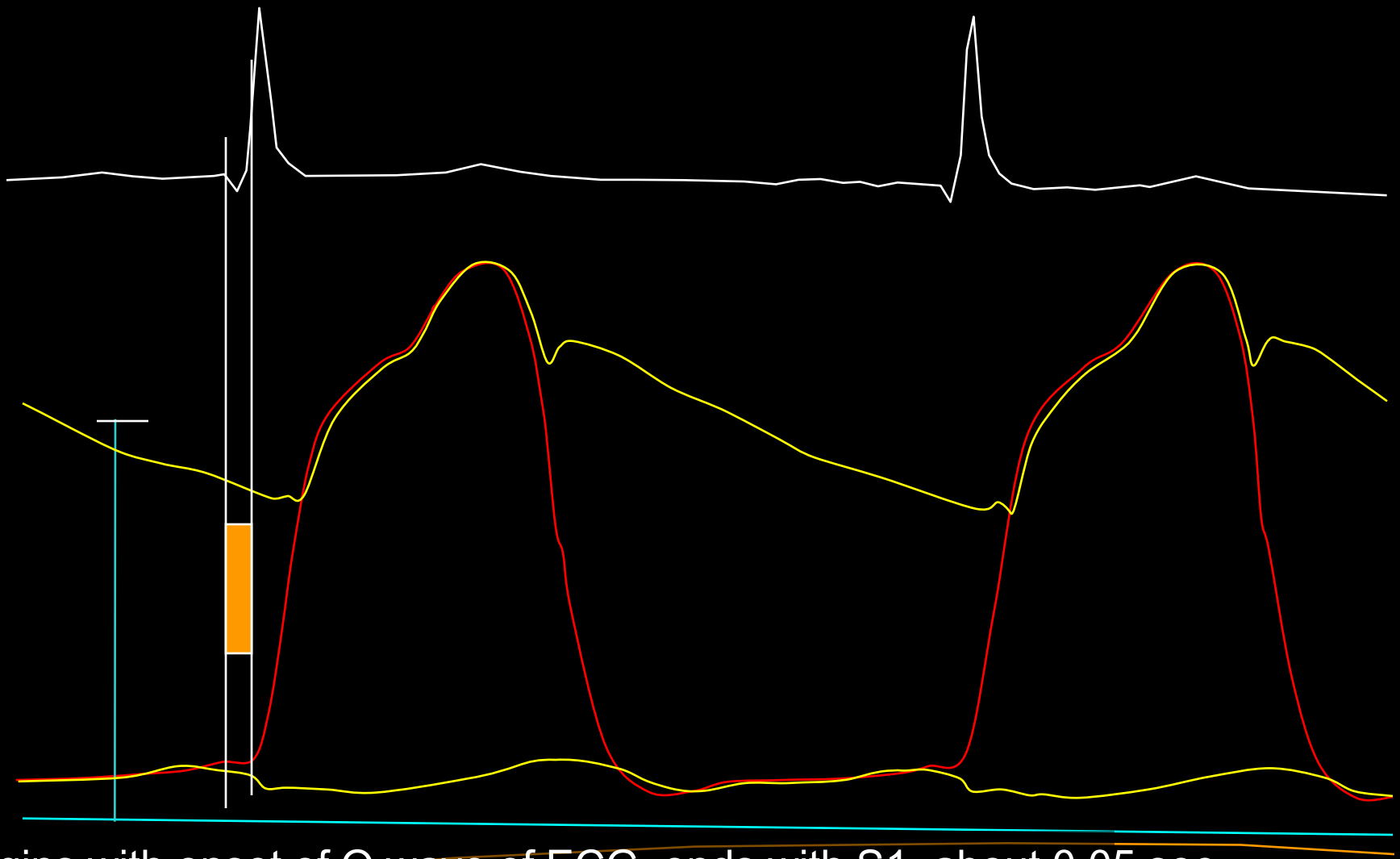
- The context is the Cardiac Cycle, must always be in consideration whenever assessing cardiac findings
- Phases:
  - Pre-ejection period (electromechanical delay plus isovolumic contraction period)
  - Systolic ejection period
  - Isovolumic relaxation period
  - Rapid ventricular filling
  - Diastasis (slow ventricular filling)
  - Atrial contraction

The Cardiac Cycle



The Cardiac Cycle

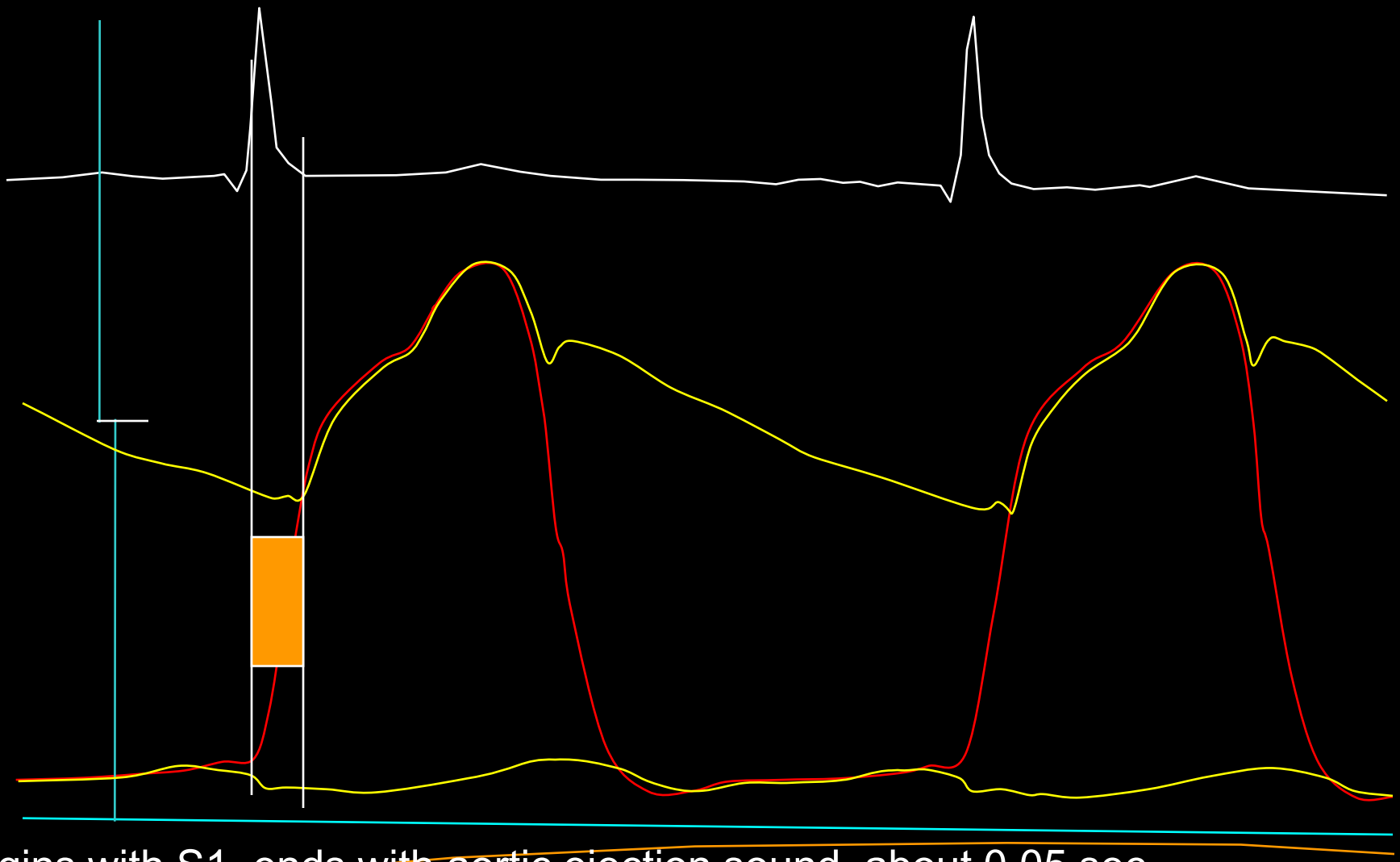
1. Electromechanical delay, Q-M1



Begins with onset of Q wave of ECG, ends with S1, about 0.05 sec
Prolonged in mitral stenosis, reported prolongation in systemic hypertension, WPW, MR, VSD, PDA, Ebstein's

The Cardiac Cycle

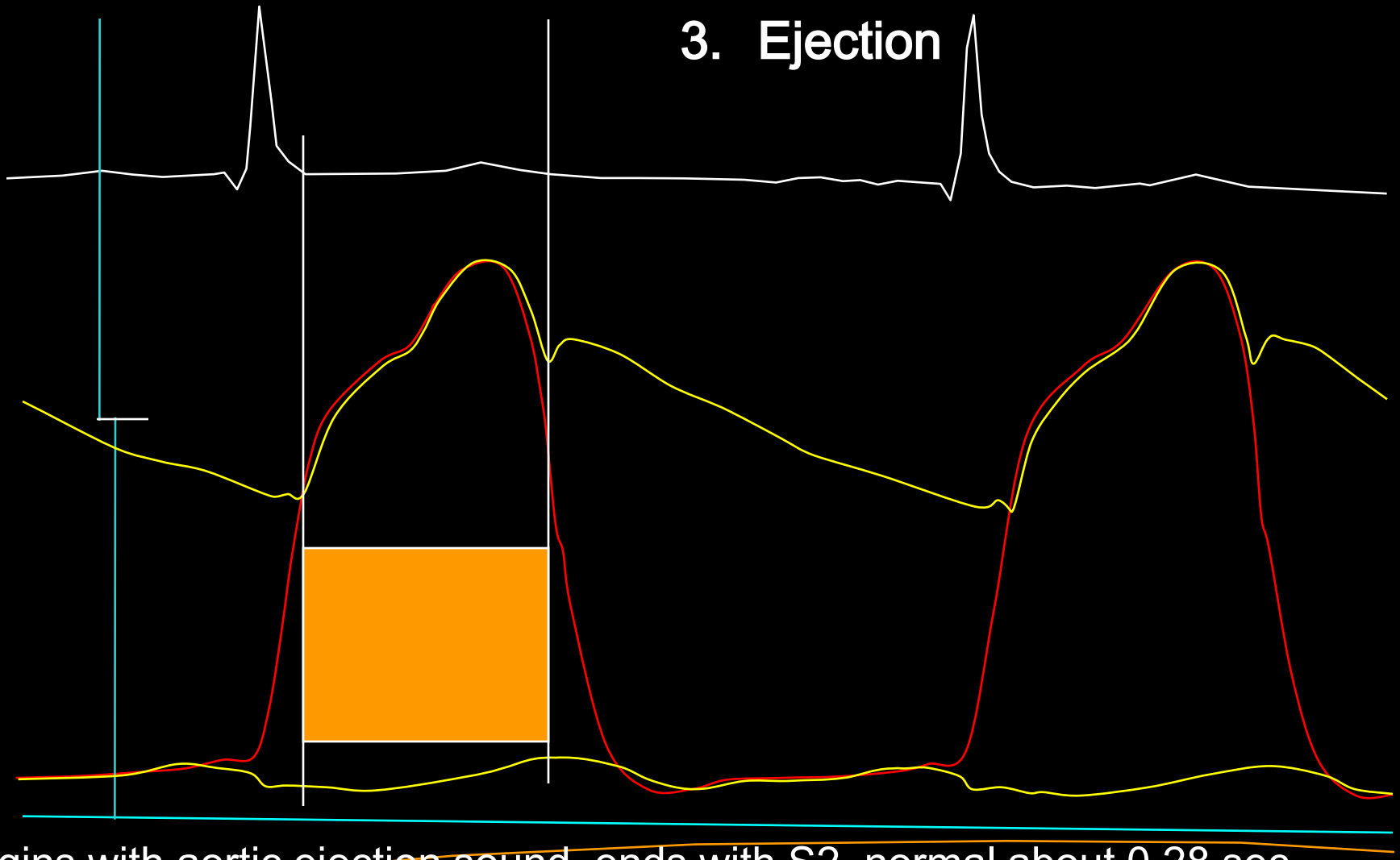
1. Electromechanical delay, Q-M1
2. **Isovolumic contraction time**



Begins with S1, ends with aortic ejection sound, about 0.05 sec
Shortened in increased contractility, increased EDV or SV (AR)
Prolonged in decreased contractility or CO, acute HTN, LBBB

The Cardiac Cycle

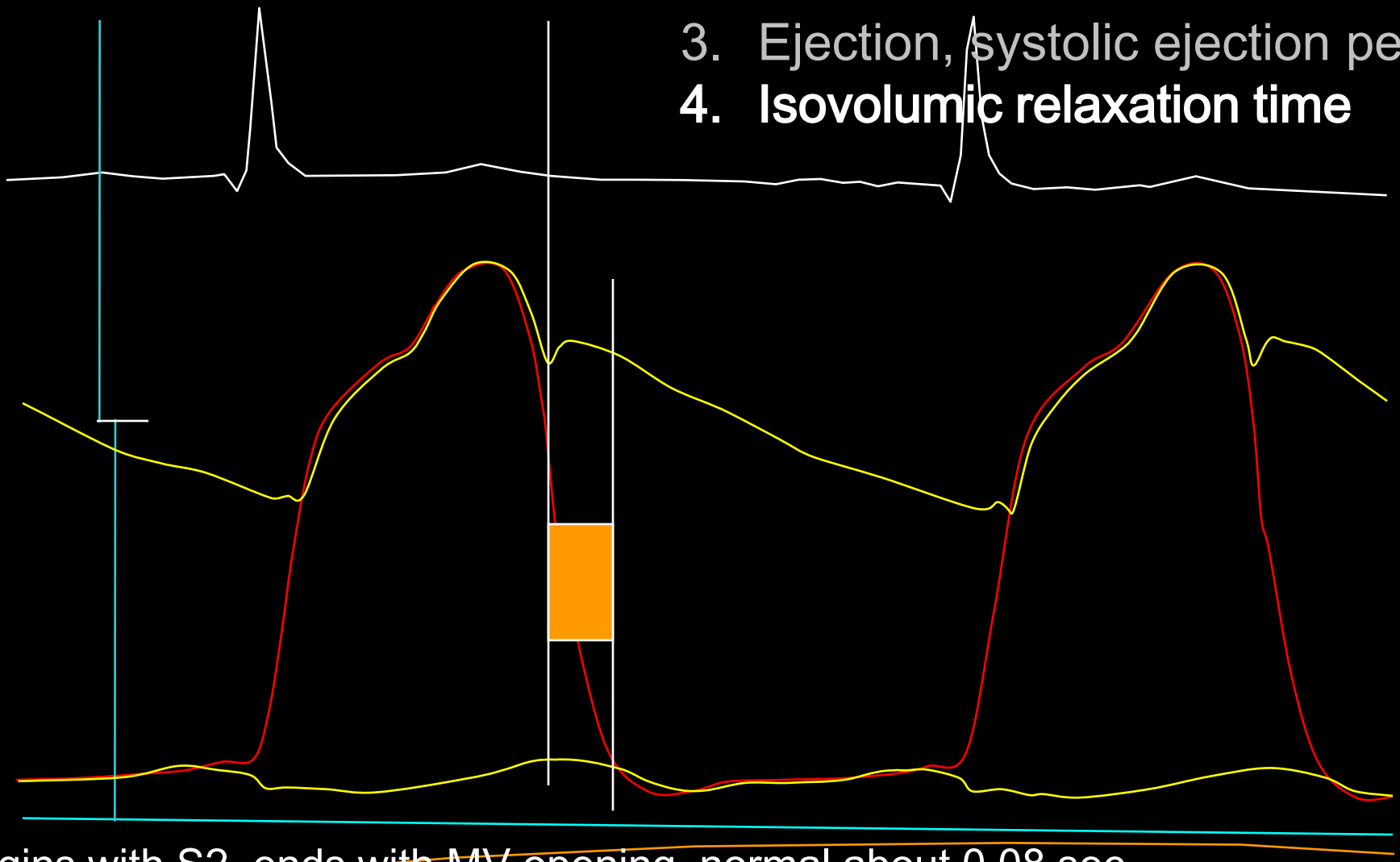
1. Electromechanical Delay, Q-M1
2. Isovolumic Contraction time
3. **Ejection**



Begins with aortic ejection sound, ends with S2, normal about 0.28 sec
Shortened in myocardial failure, MR, and increased contractility (thyrotoxicosis)
Prolonged in aortic stenosis, HCM, but not necessarily aortic regurgitation or PDA

The Cardiac Cycle

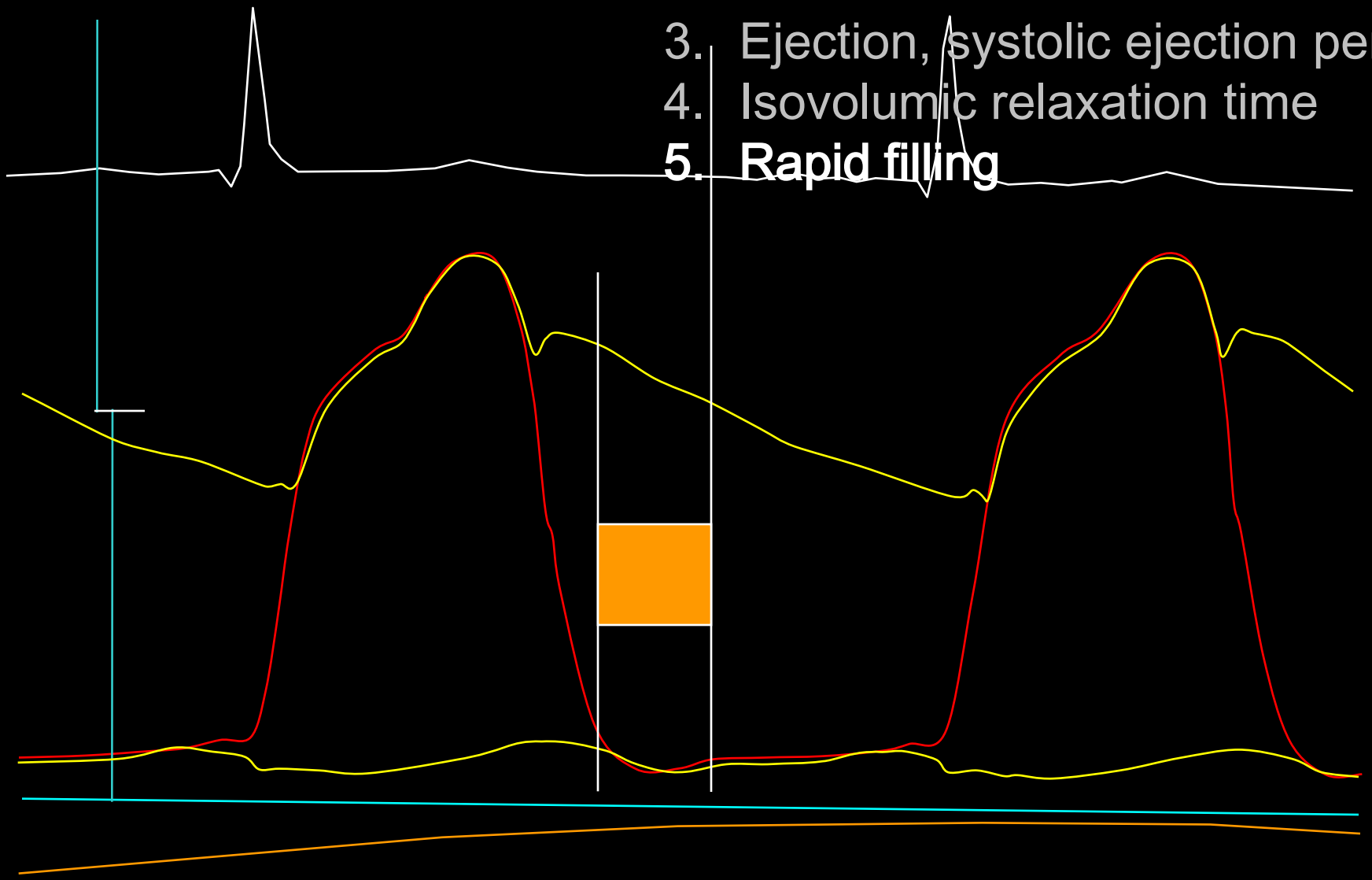
1. Electromechanical delay, Q-M1
2. Isovolumic contraction time
3. Ejection, systolic ejection period
4. **Isovolumic relaxation time**



Begins with S2, ends with MV opening, normal about 0.08 sec
Shortened in elevated LV filling pressures, mitral stenosis
Prolonged in impaired relaxation

The Cardiac Cycle

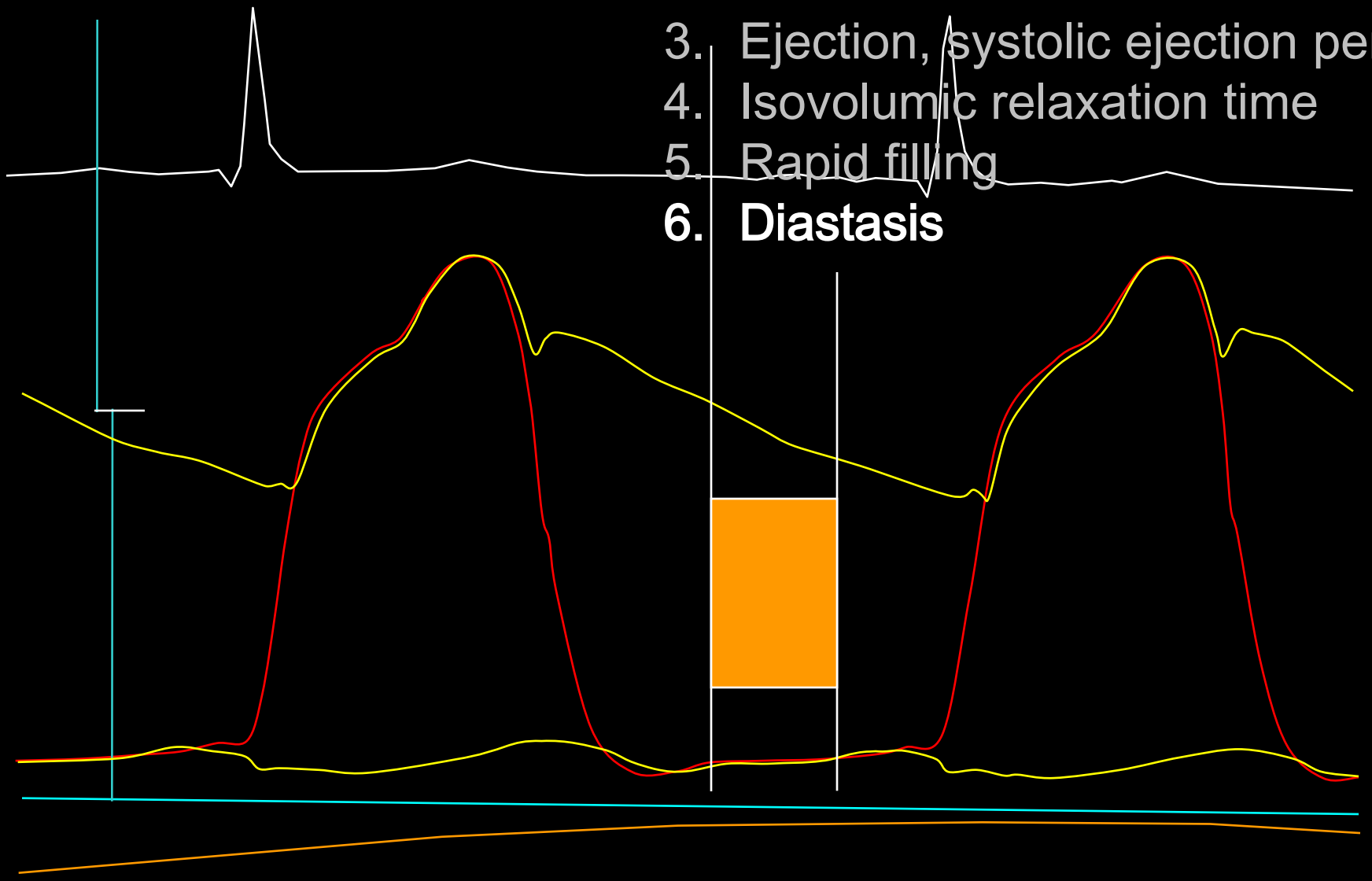
1. Electromechanical delay, Q-M1
2. Isovolumic contraction time
3. Ejection, systolic ejection period
4. Isovolumic relaxation time
5. **Rapid filling**



Begins with mitral opening, ends with S3, normal about 0.10 sec

The Cardiac Cycle

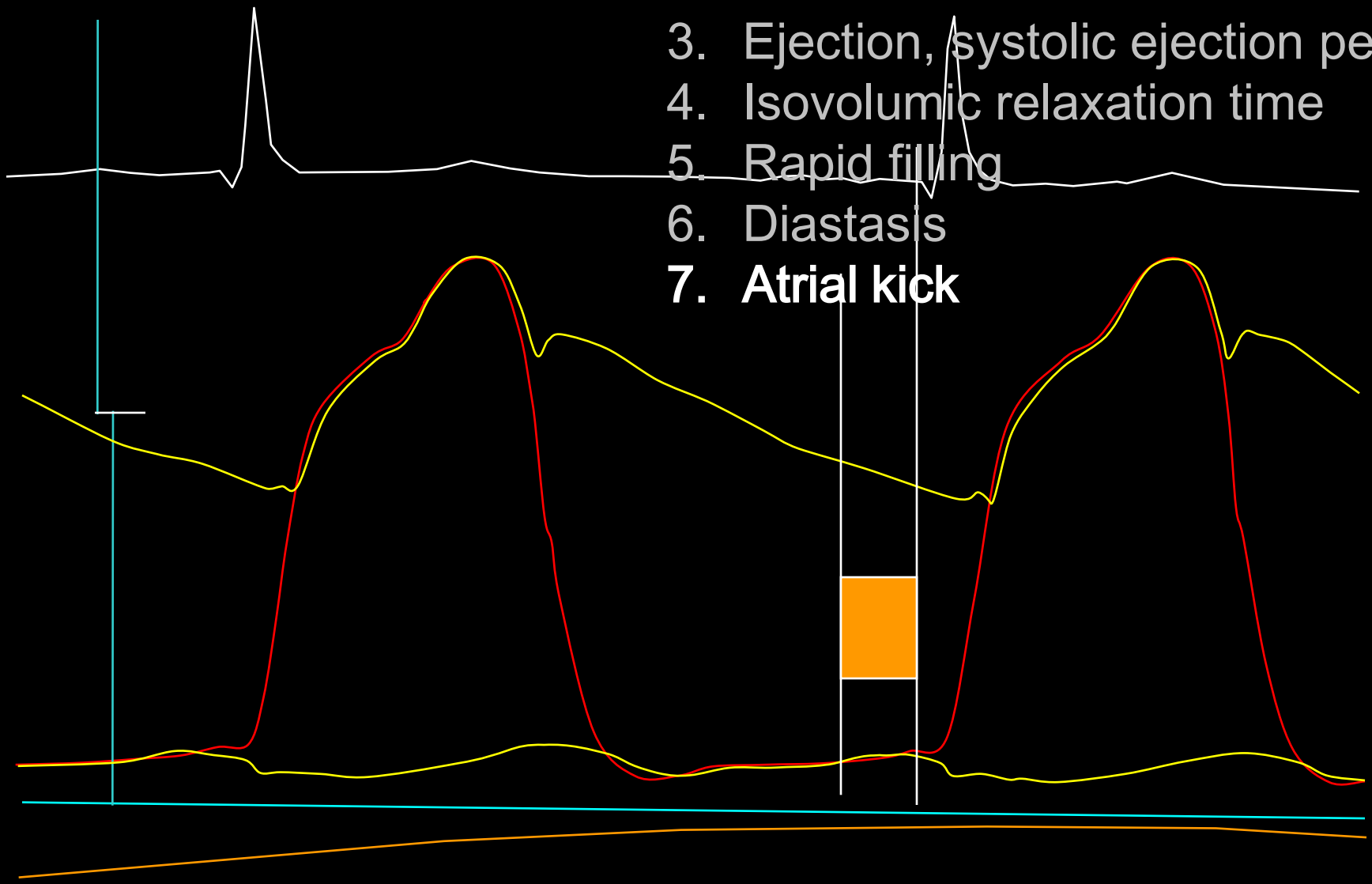
1. Electromechanical delay, Q-M1
2. Isovolumic contraction time
3. Ejection, systolic ejection period
4. Isovolumic relaxation time
5. Rapid filling
6. **Diastasis**



Begins with S3, ends with onset of atrial pressure rise, normal quite variable

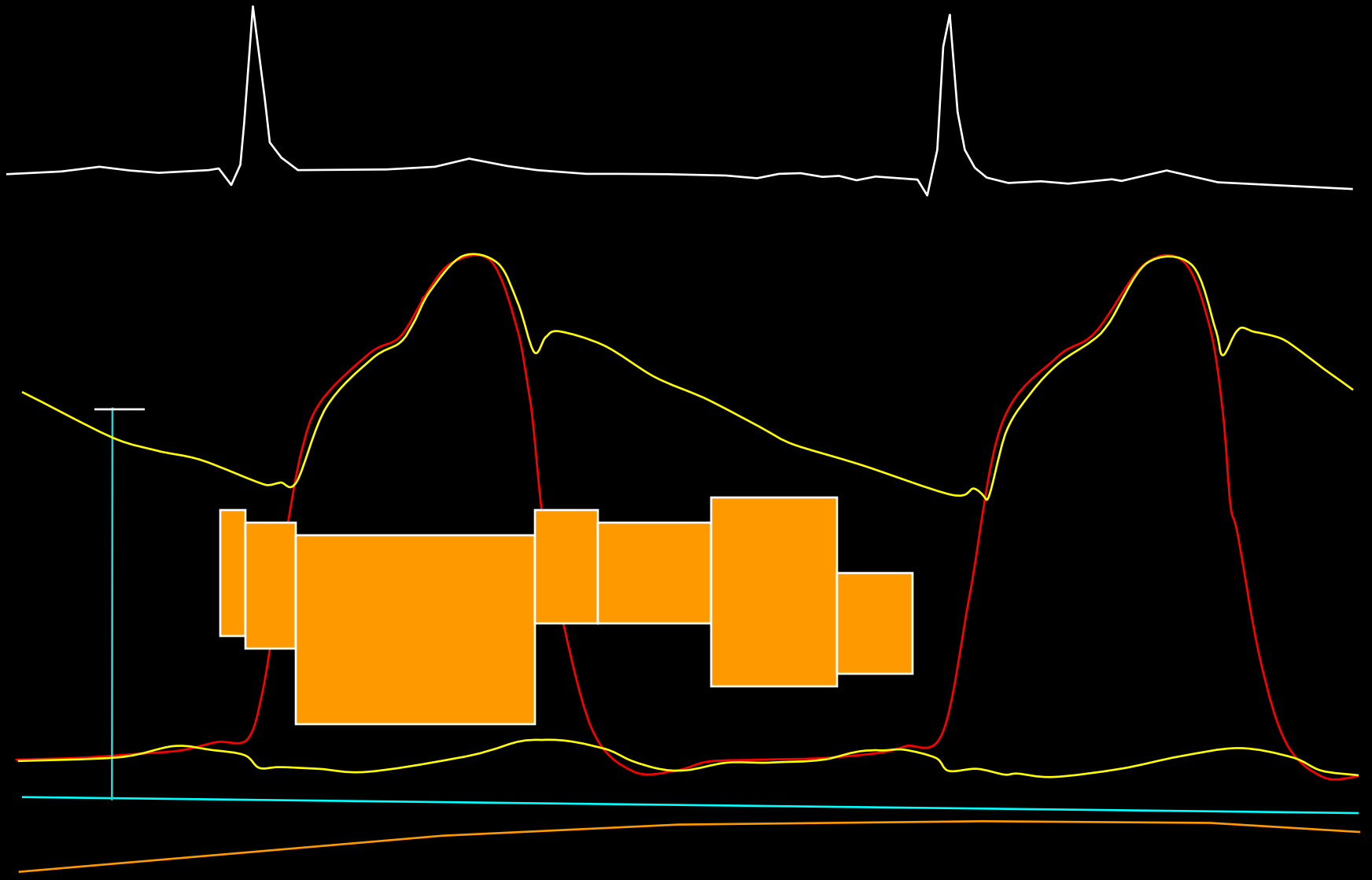
The Cardiac Cycle

1. Electromechanical delay, Q-M1
2. Isovolumic contraction time
3. Ejection, systolic ejection period
4. Isovolumic relaxation time
5. Rapid filling
6. Diastasis
7. **Atrial kick**



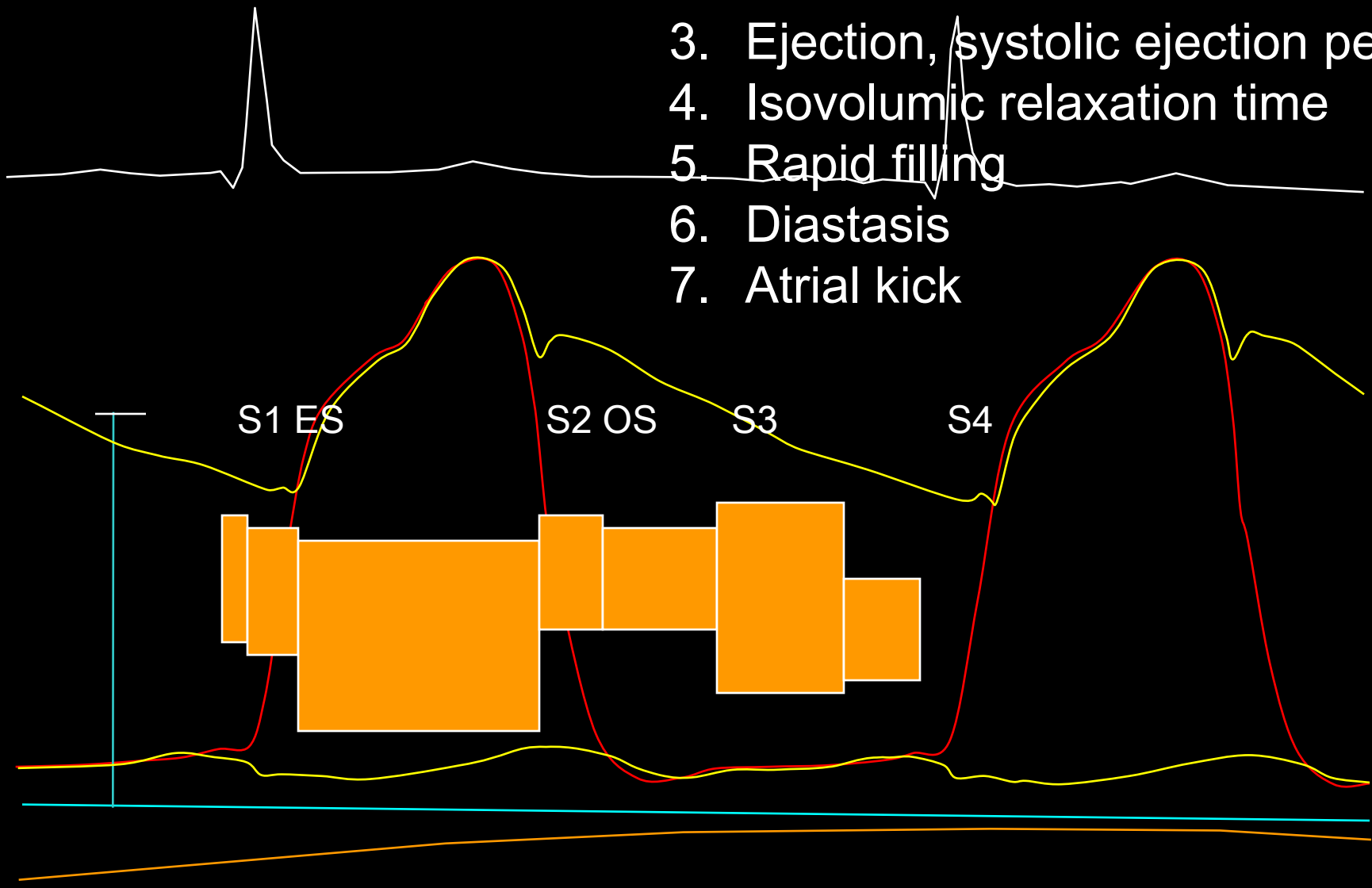
Begins with onset of pressure rise, ends with onset of QRS

The Cardiac Cycle



The Cardiac Cycle

1. Electromechanical delay, Q-M1
2. Isovolumic contraction time
3. Ejection, systolic ejection period
4. Isovolumic relaxation time
5. Rapid filling
6. Diastasis
7. Atrial kick



Cardiac Cycle

Systole

- **Heart rate** increase causes shortening of systole, but even greater shortening of diastole
- Electromechanical delay from QRS to AV valve closure
- Isovolumic contraction period: from AV valve closure to semilunar valve opening
- Ejection period: from opening to closure of semilunar valve

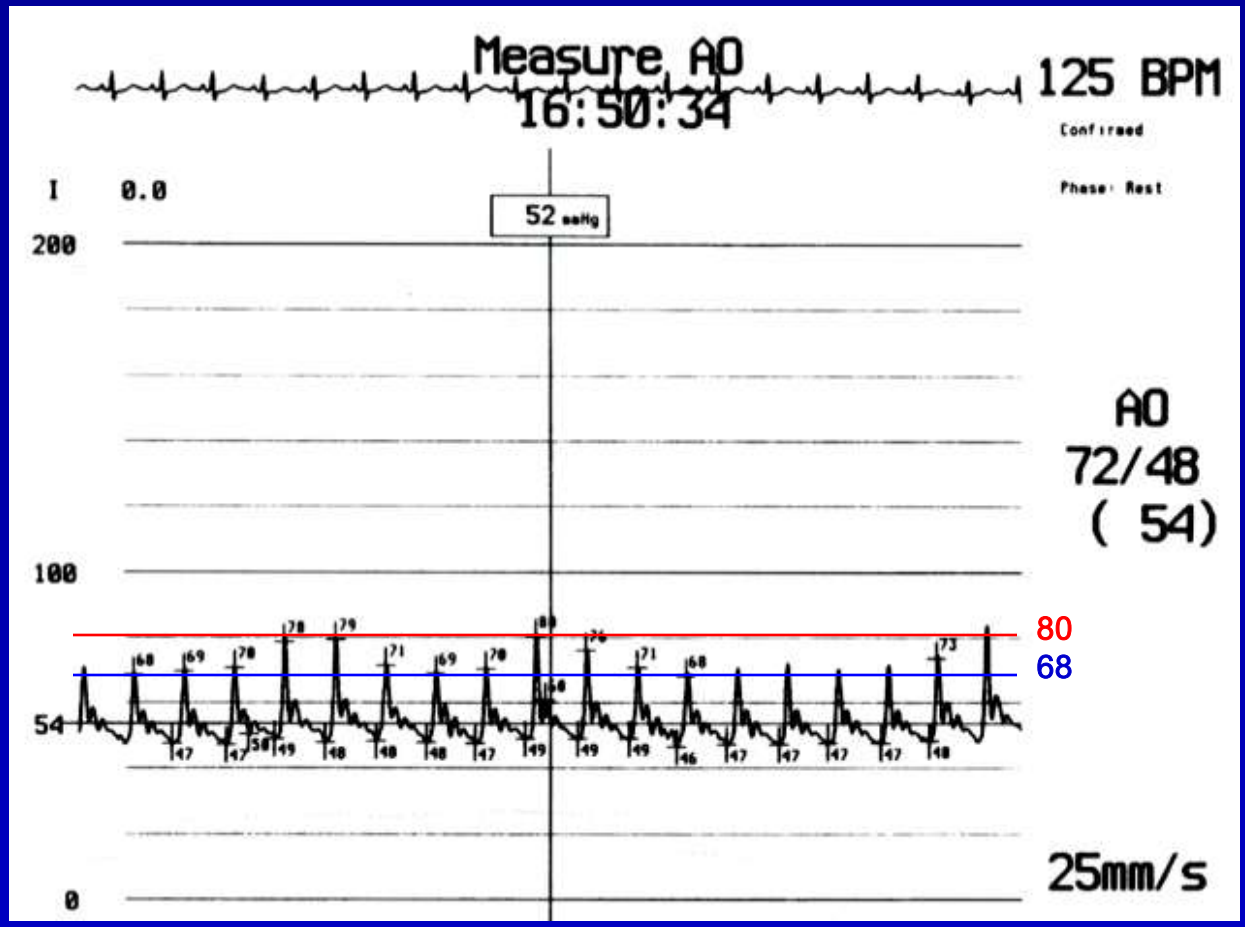
Diastole

- Isovolumic relaxation period: from closure of semilunar valve to opening of AV valve
- Rapid filling period: from opening of AV valve to end of rapid ventricular pressure rise
- Diastasis: from end of rapid filling to onset of atrial contraction
- Atrial contraction: from beginning of ventricular A wave to QRS complex

Vital Signs

- Blood Pressure
  - Check both arms if chest pain (aortic dissection, peripheral stenosis esp. of left subclavian)
  - Check for auscultatory gap, paradoxical pulse (pulsus paradoxus), pulsus alternans
- Pulse: rate and regularity

Pulsus Paradoxus

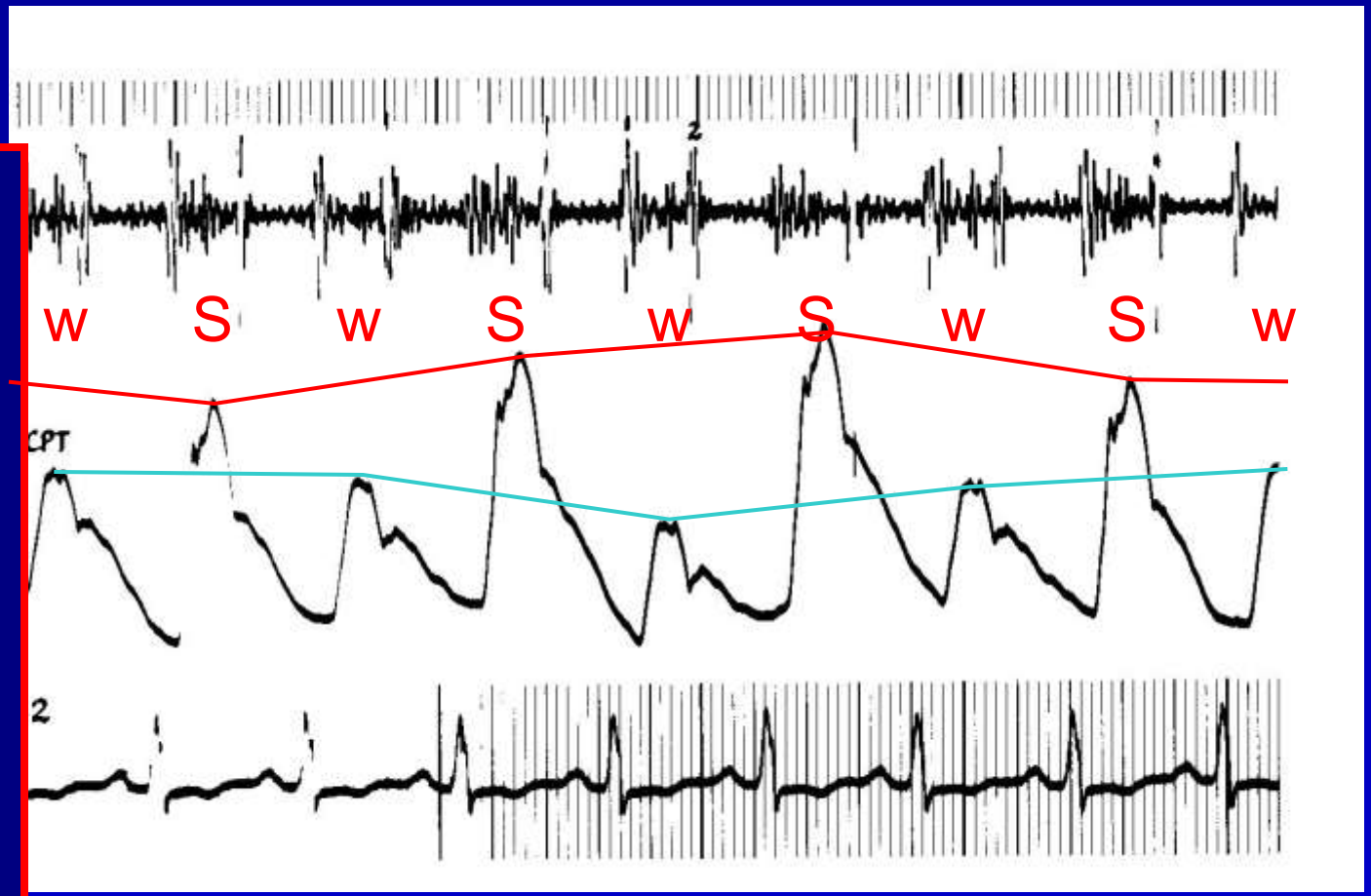


- Pulsus paradoxus is not paradoxic, but exaggerated
- Pulsus paradoxus, a decrease in systolic BP of more than the normal 10-12 mmHg with inspiration
- Asthma, dyspnea, cardiac tamponade

Attribution unclear

Pulsus Alternans

- Note: <u>sinus rhythm</u> (bigeminy can give alternans)
- Alternans indicates CHF
- Heart rate doubles as cuff measurement decreases



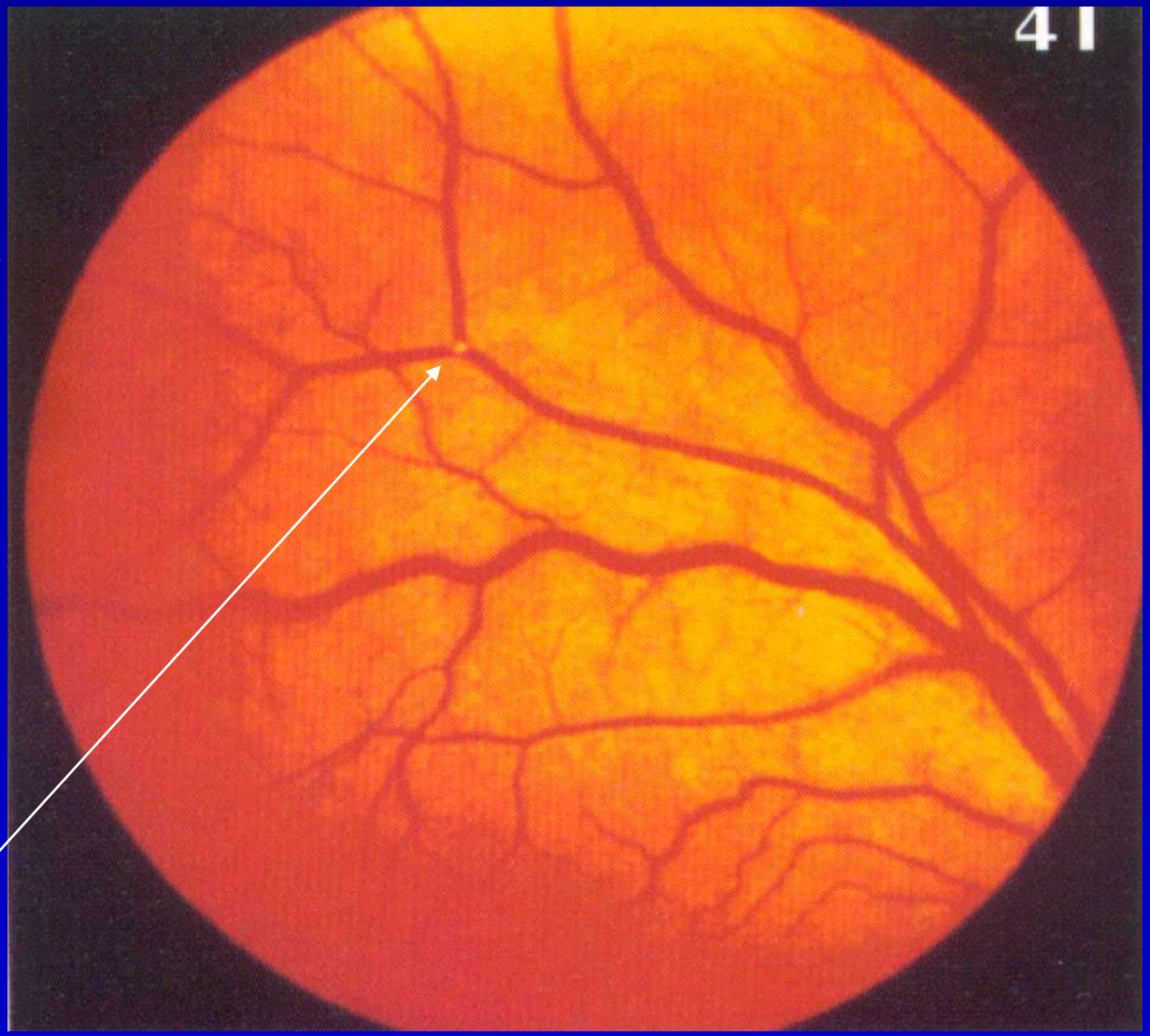
Marriott, p. 23

Bedside Cardiovascular Examination

- Eye – fundoscopic
- Neck – jugular venous pulsation, carotid pulsation
- Lungs
- Precordium (Inspection, Palpation, Percussion, Auscultation)
- Abdomen – hepatic pulsation, abdominojugular reflux, abdominal aortic aneurysm
- Extremities – pulses, cyanosis, clubbing, edema, capillary refill

Fundi

- AV crossing changes
- Change in AV ratio
- Hemorrhages



Cholesterol embolism

Rosen SD et al. Self-Assessment Color Review of Cardiology, 1997. p. 39

Fundi

- AV crossing changes
- Change in AV ratio
- Hemorrhages

Cholesterol embolism
Fowler NO. Physical Signs in Cardiology, p.87

Neck

JVP – internal jugular

- Mean level of oscillations
- Morphology of the venous waves
- Respiratory variation

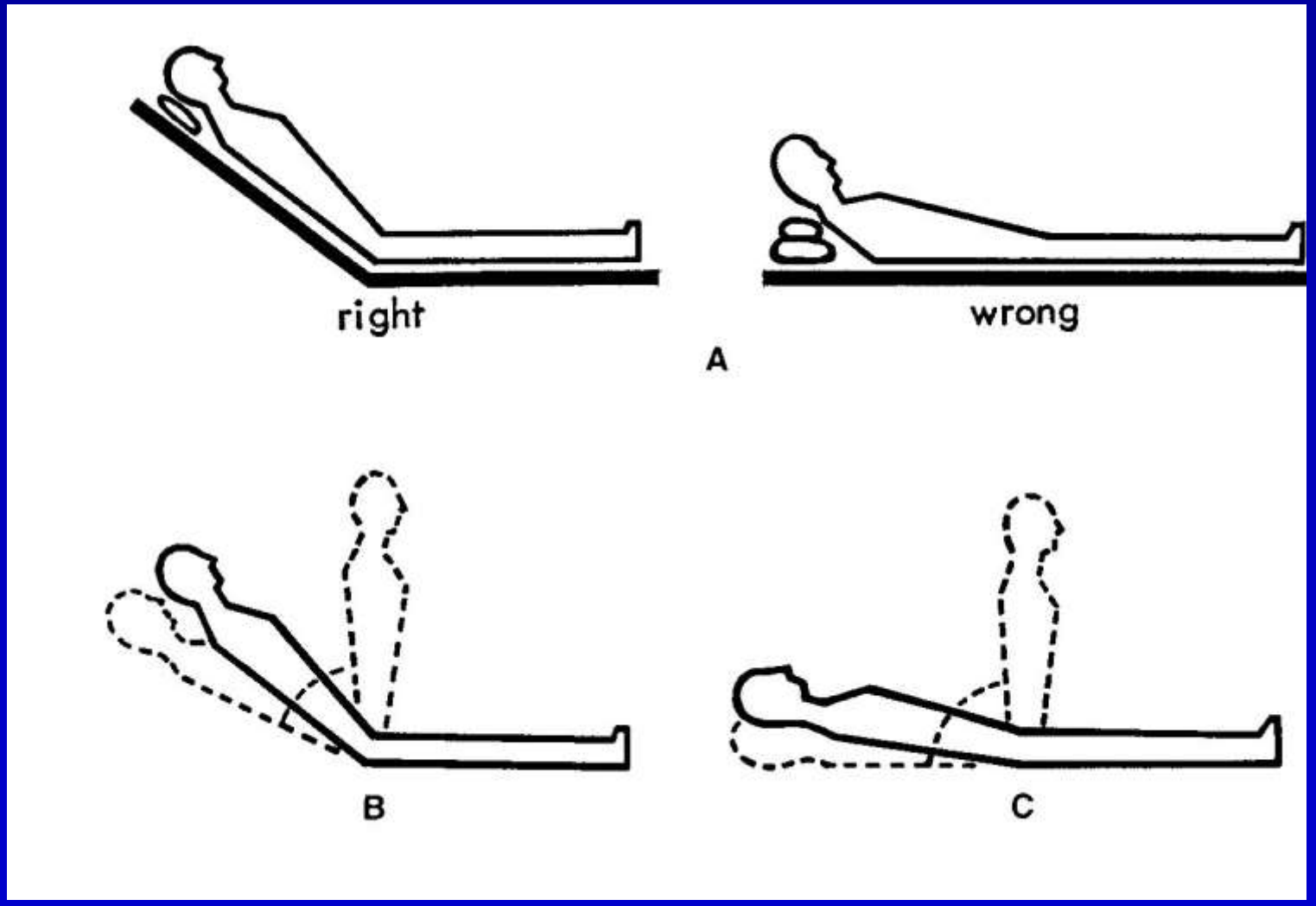
Carotid

- Volume
- Upstroke
- Thrill

Jugular Venous Pulsation

- Technique
  - Body position
  - Head (chin) position
  - Lighting
  - Evocative maneuvers
- Assessment
  - Level of venous pressure
  - Presence and characteristics of pulsations
  - Respiratory variation

Jugular Venous Pressure



Marriott, p. 14

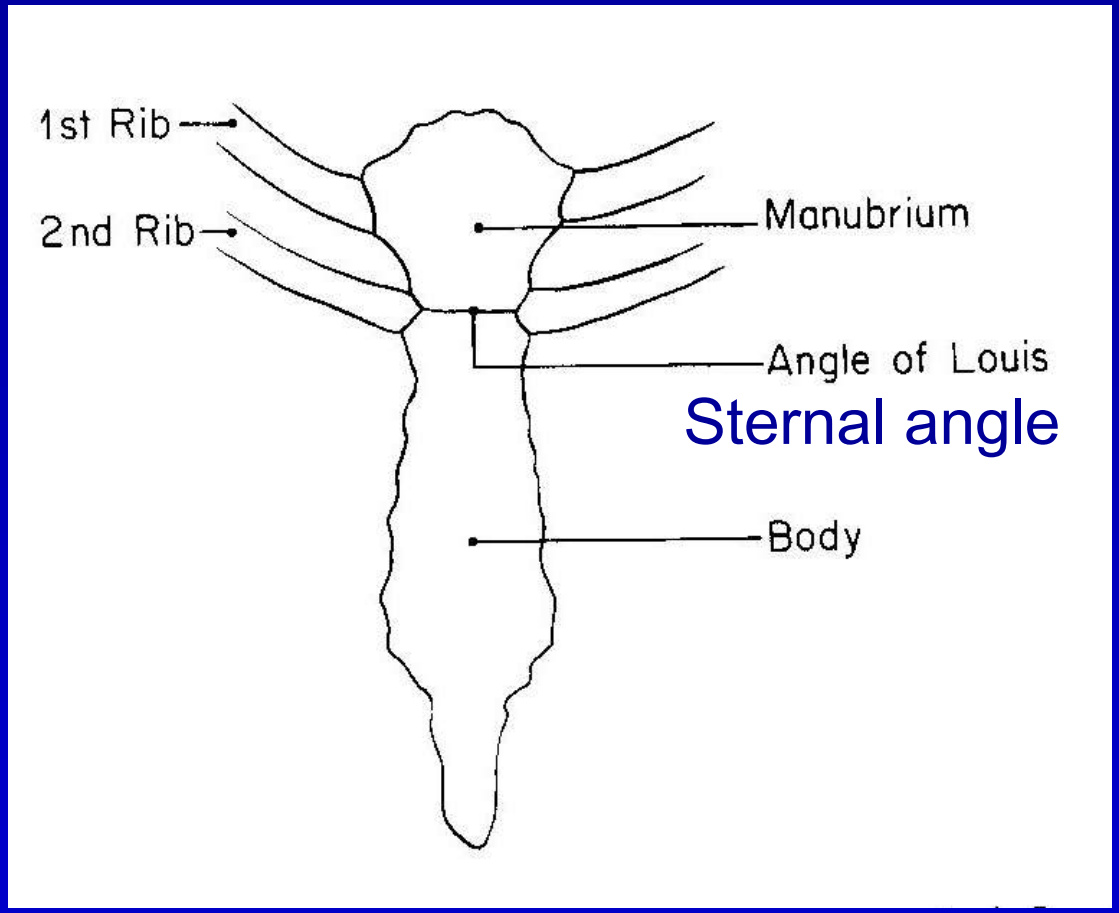
JVP Technique - Respiration

- JVP should decrease with inspiration and A and V waves become more prominent
- Measurement of JVP should be during which phase of respiration?
  - Mean through respiratory cycle?
  - End expiration? … usual technique for CVP in cath lab
  - Inspiration – Jules Constant text p. 71

JVP Technique

- Measurement of JVP level should be
  - Mean of the oscillating waves Harvey-Chisner p. 67
  - Crest of the external JV - Perloff p. 122
  - Crests of the internal JVP waves - Constant text p. 71, Perloff p. 127, O'Rourke 2001 Hurst p. 227 (top of the oscillating venous column), Braunwald and Perloff p. 48, 2001 (height of the oscillating top of the distended proximal portion of the internal jugular vein, which reflects right atrial pressure)
    - Less than 3 cm above angle of Louis - Perloff p. 128, O'Rourke
    - Less than 4 cm above angle of Louis – Perloff and Braunwald, p. 48
  - Overall height of the pulsating column - Crawford AHA text p.4
  - Highest point of pulsation in the right internal jugular vein – Bates p. 267
  - Average level of pulsations in the neck veins – Chisner p. 317

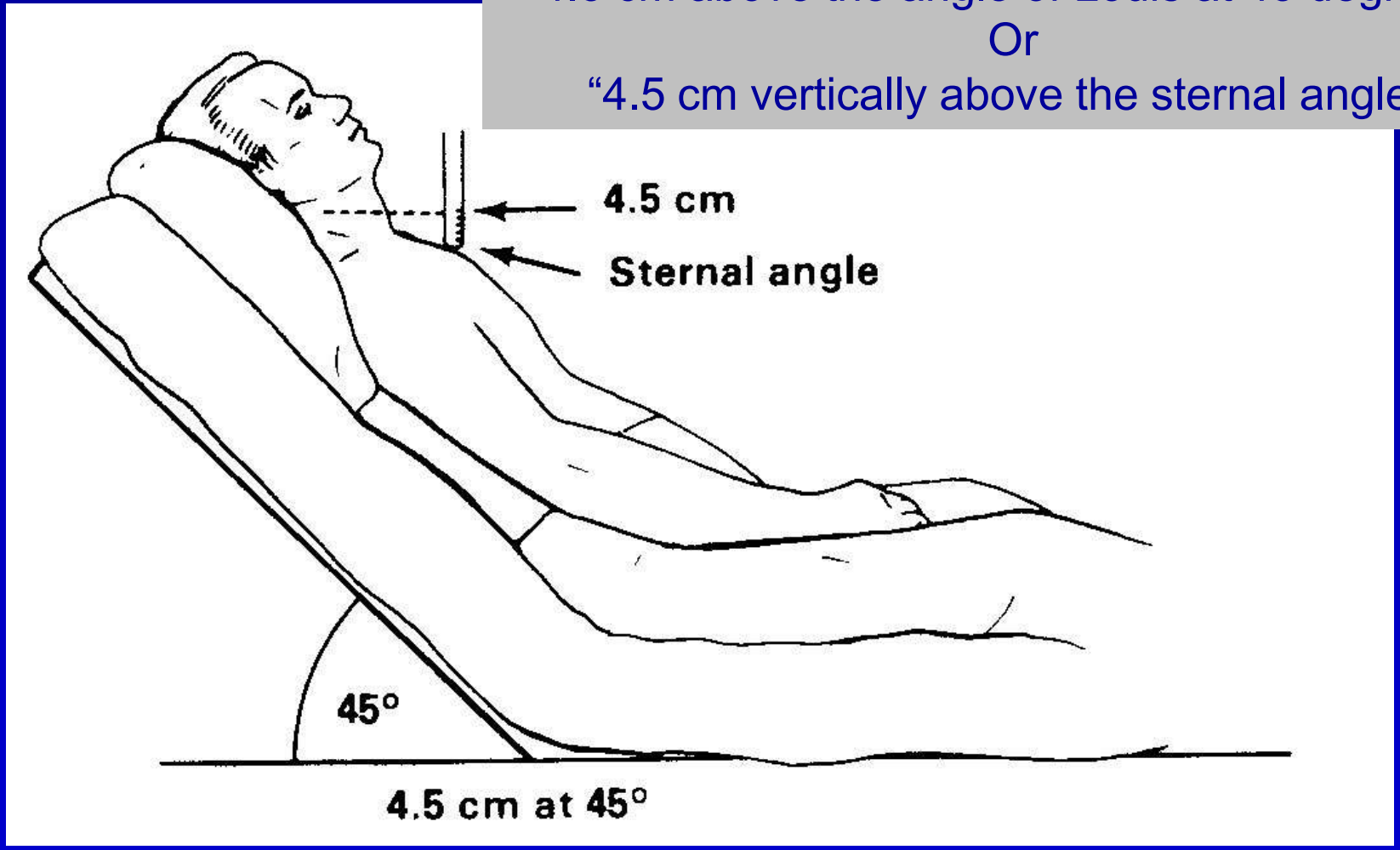
Jugular Venous Pressure



Perloff, p. 127

Jugular Venous Pressure

"4.5 cm above the angle of Louis at 45 degrees."
Or
"4.5 cm vertically above the sternal angle."



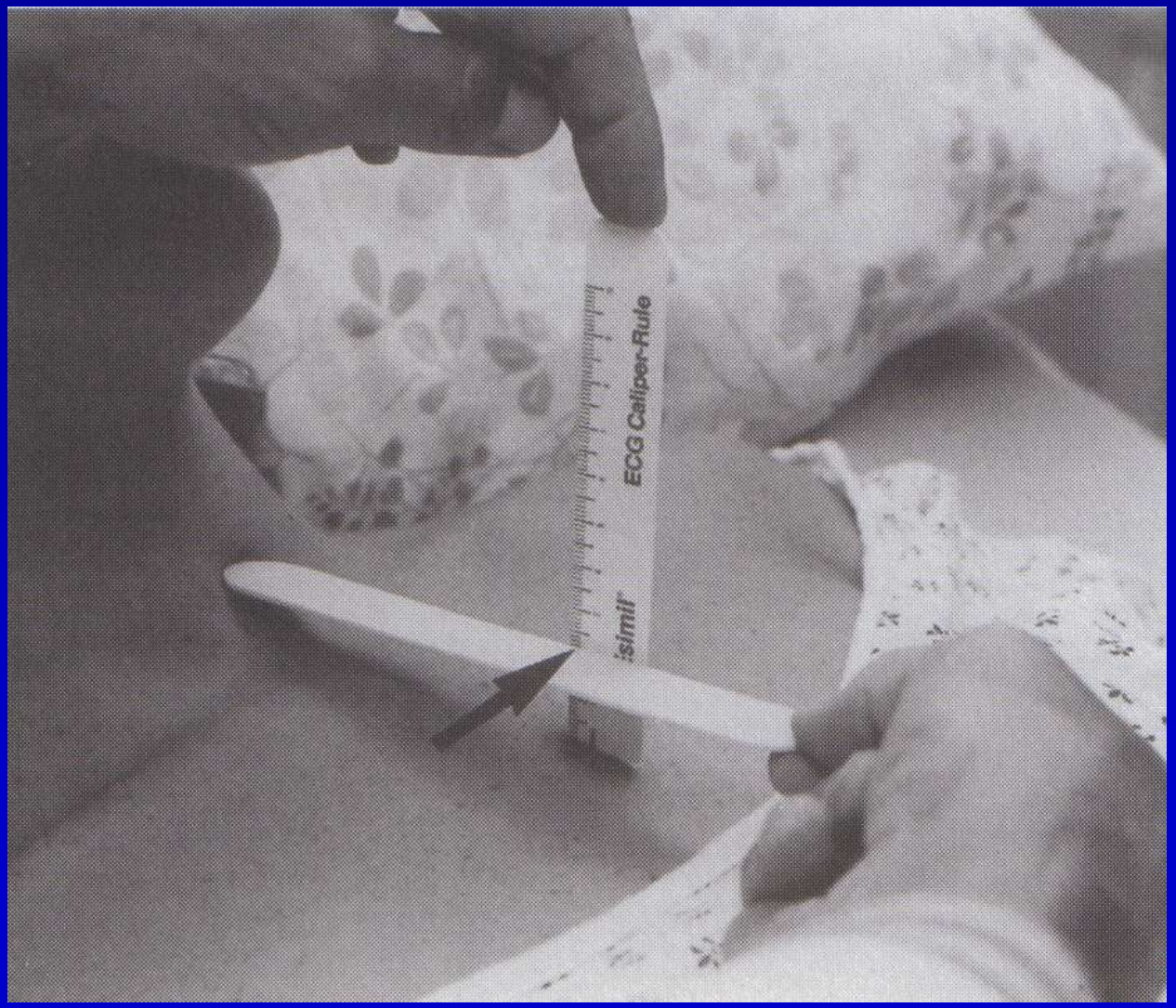
Constant, p. 69.

Jugular Venous Pressure

1. Use tangential lighting
2. Simultaneous timing with carotid pulse

Perloff, p.120

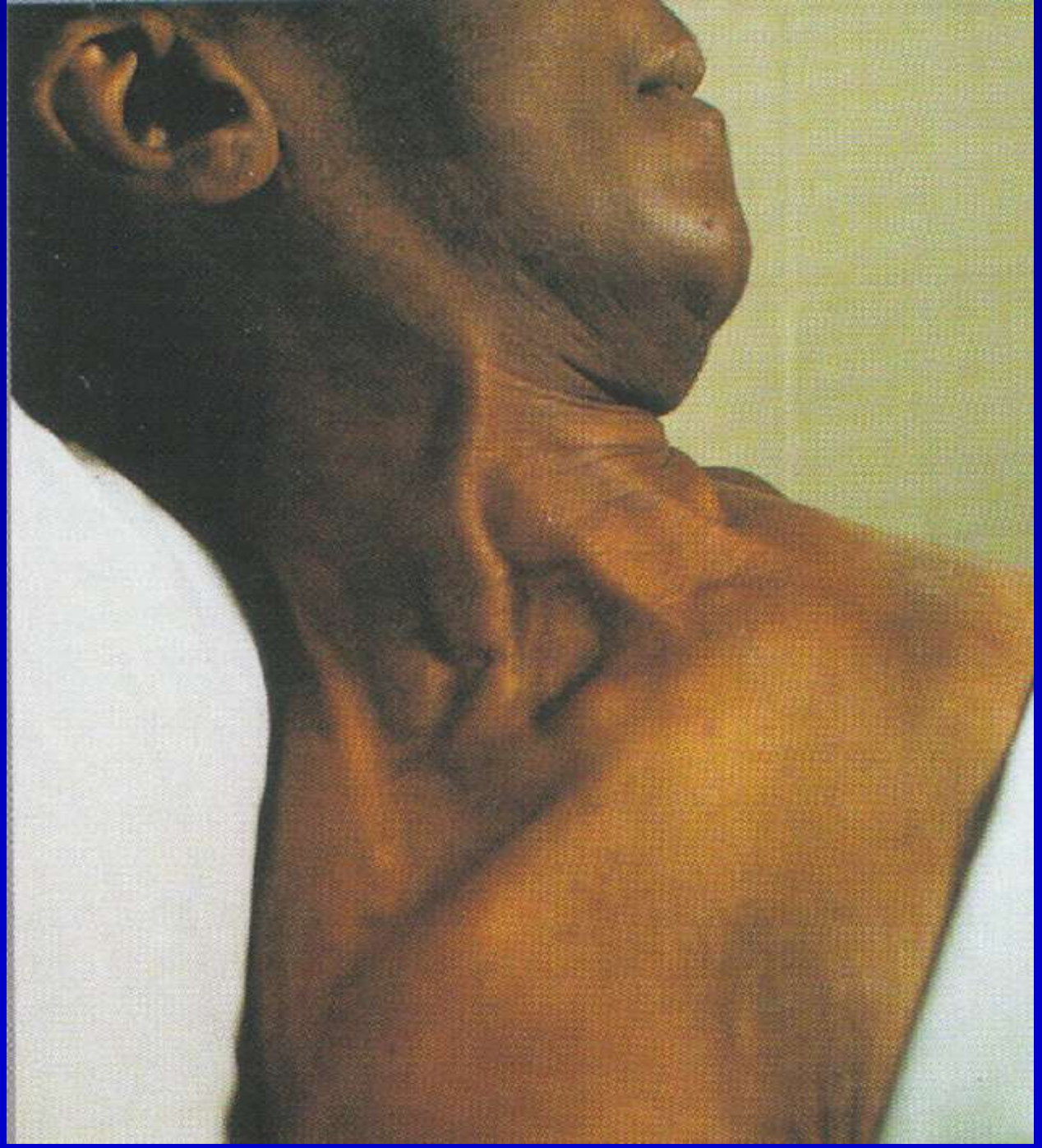
Jugular Venous Pressure



Perloff, p. 128

JVP

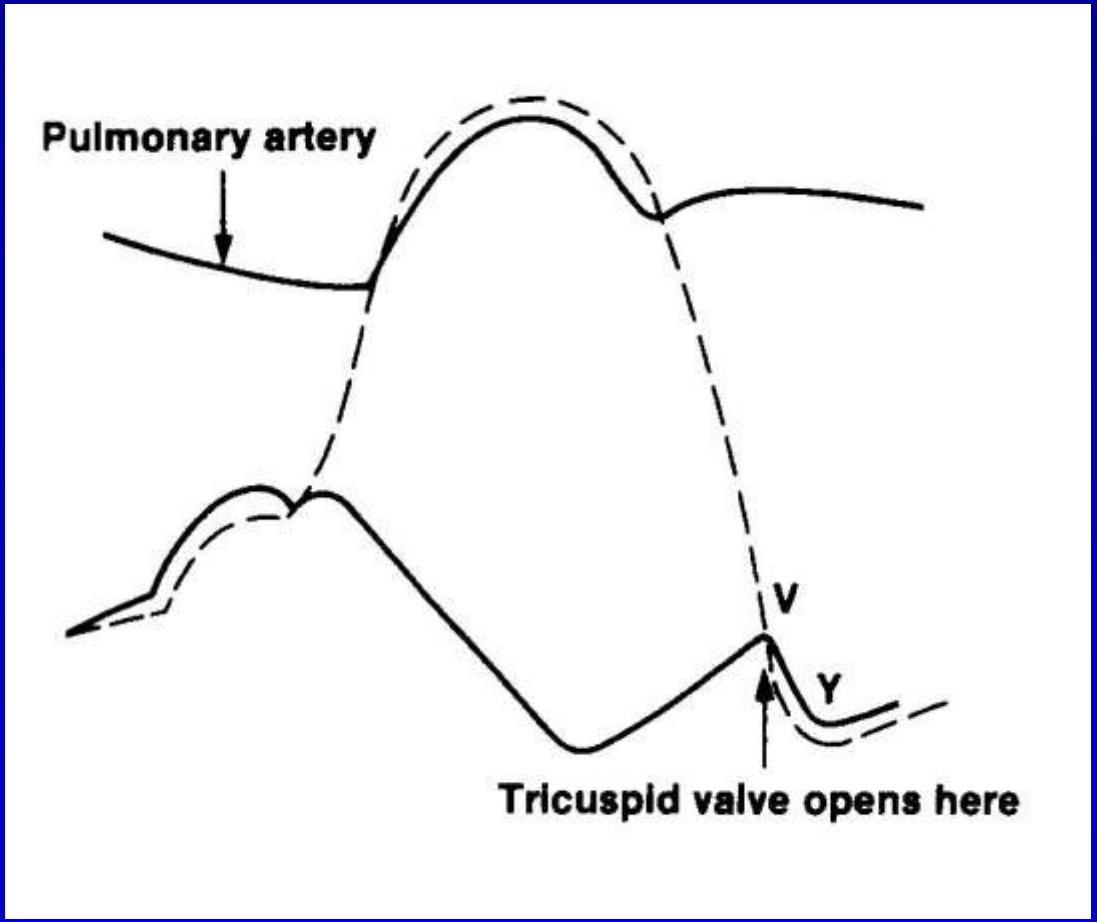
- Distended external jugular



Fowler, p.98

RA Pressure

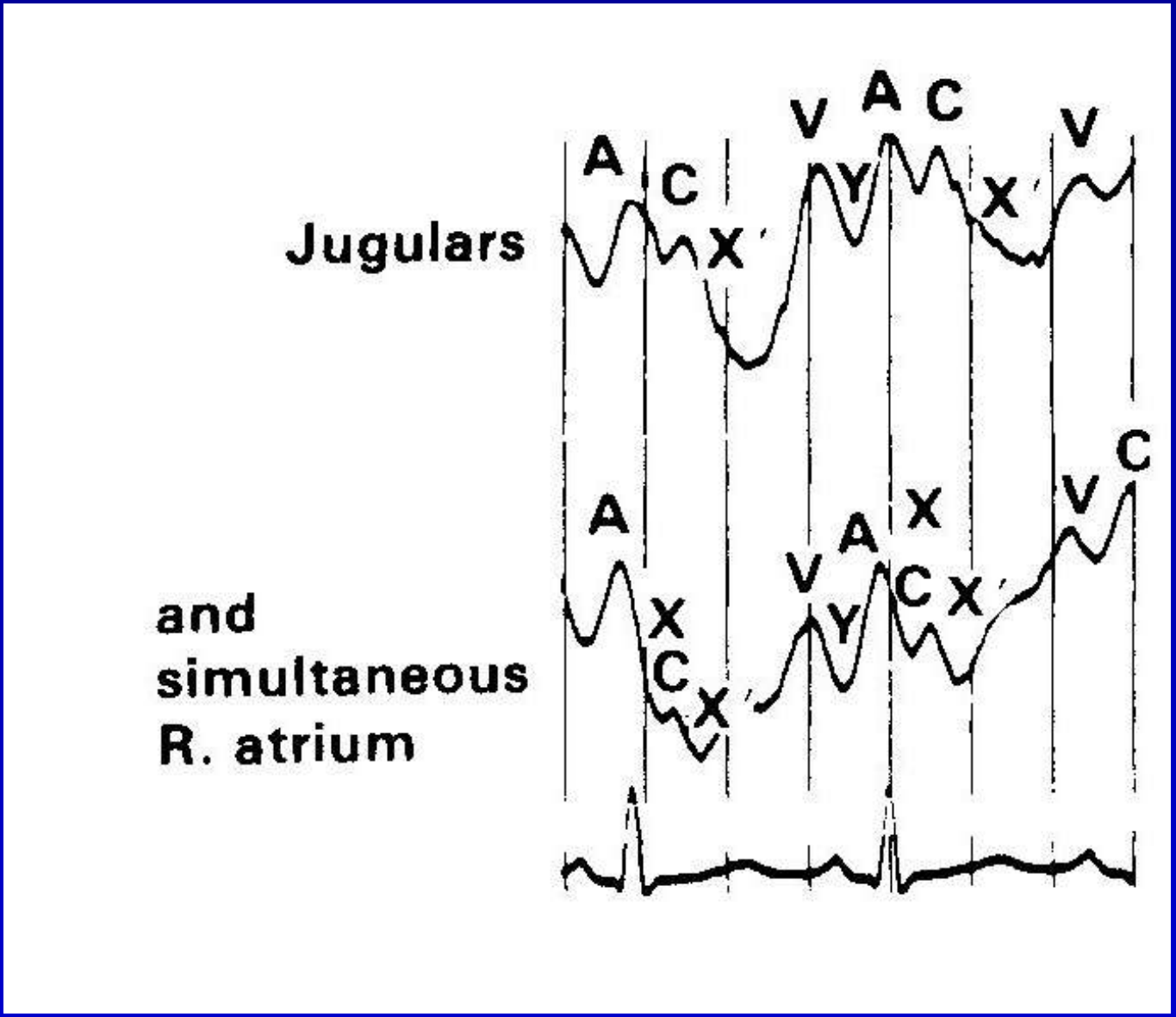
- Similar to JVP
- Expected relationship to RV pressure



Constant, p. 79

JVP

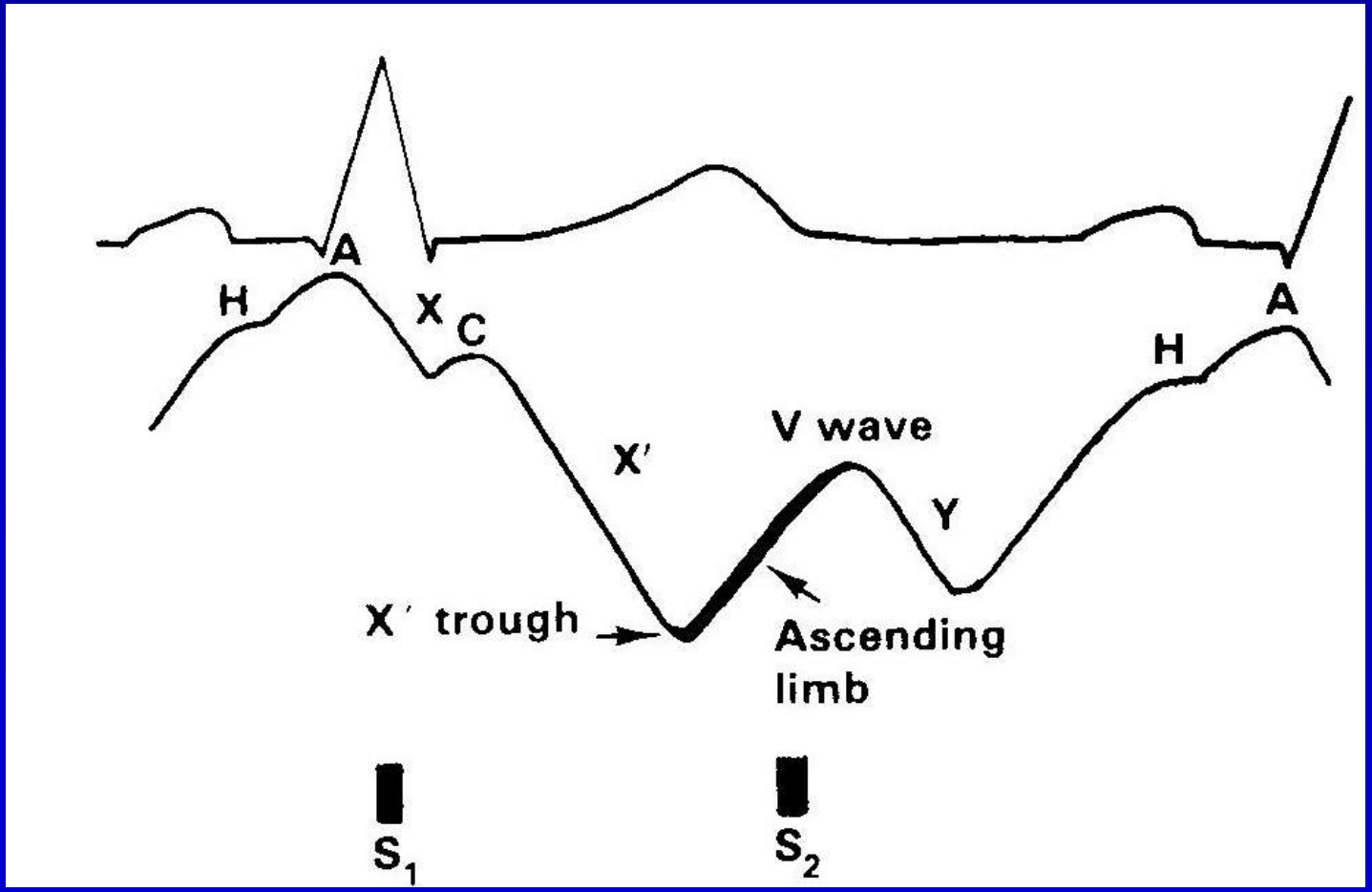
- Similar to RA pressure
- Slight delay



Constant, p. 76

JVP

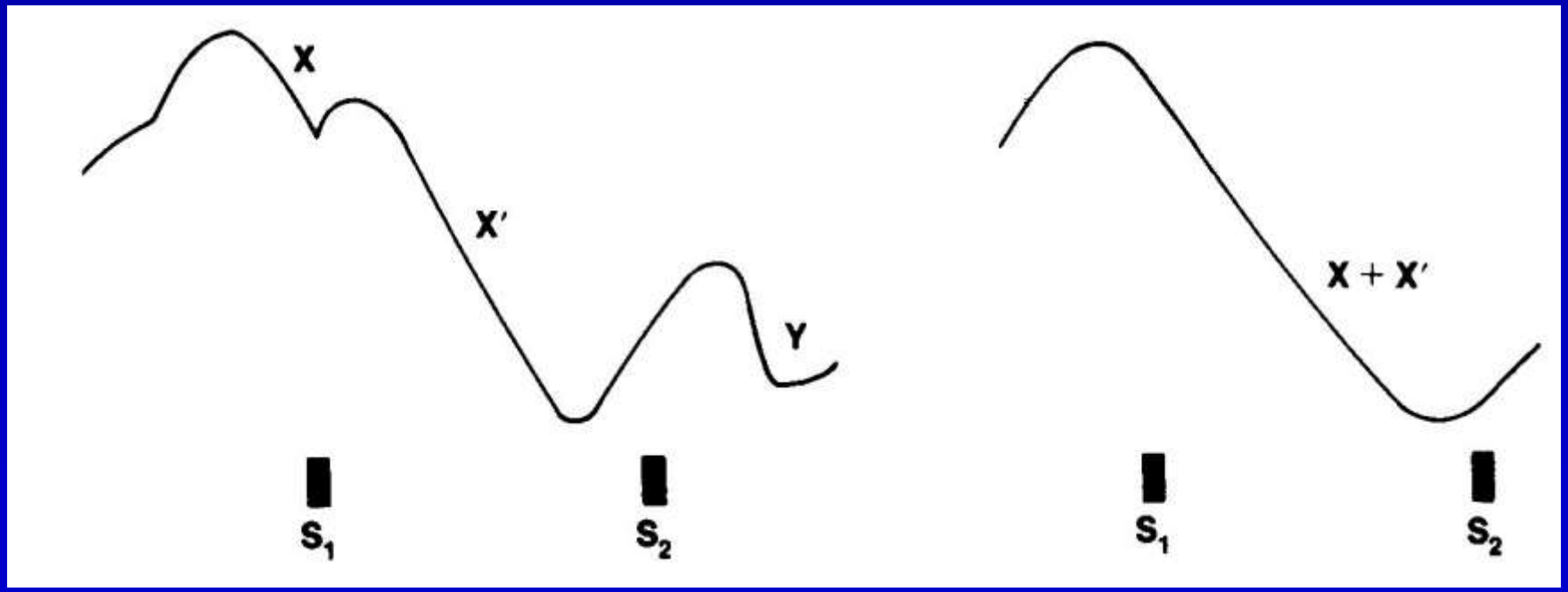
- Labels and terminology



Constant, p. 80

JVP

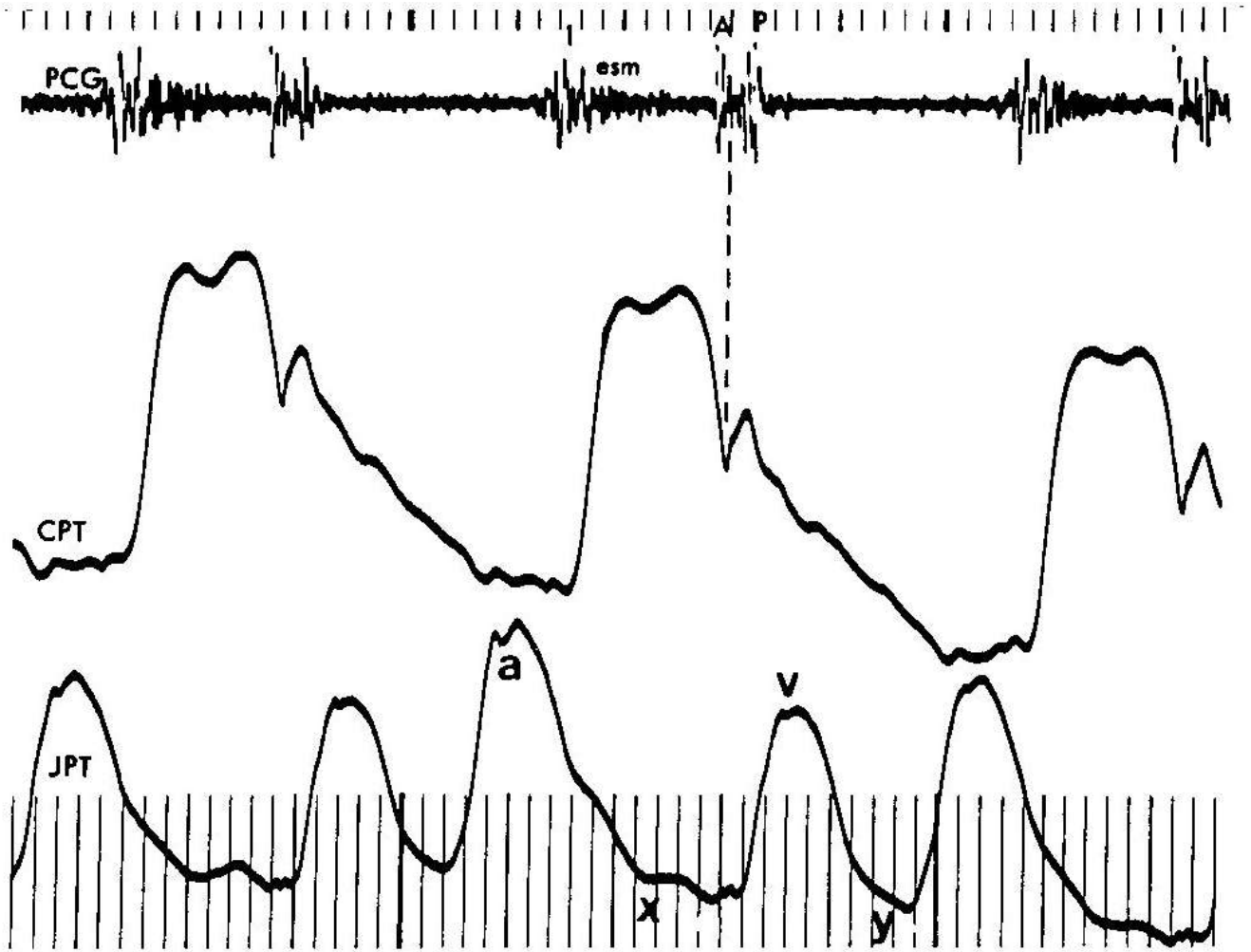
- X prime and C waves usually not important



Constant, p. 80

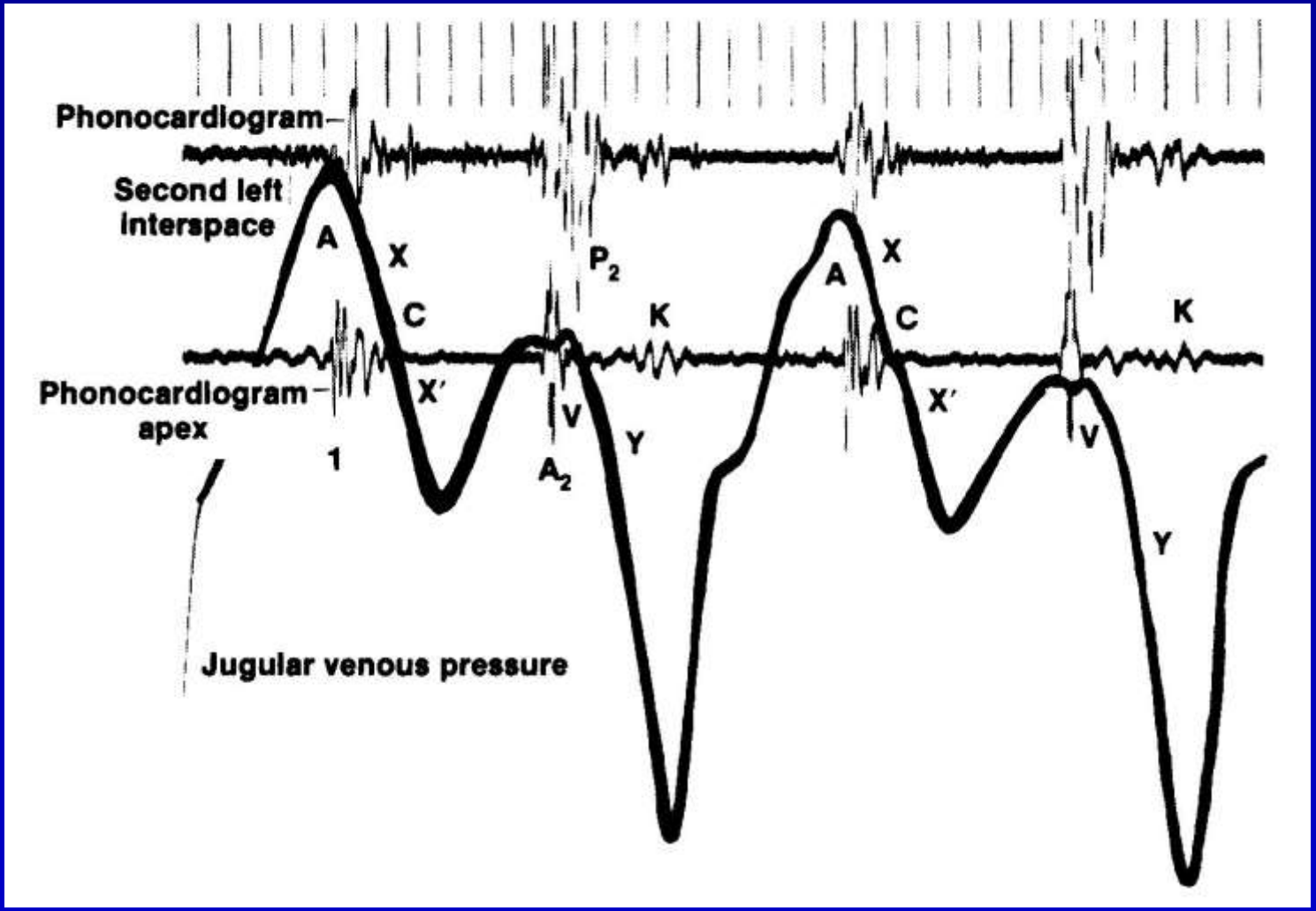
JVP

- A wave comes before carotid pulse
- V wave comes after carotid pulse
- C wave unseen



Marriott, p. 14

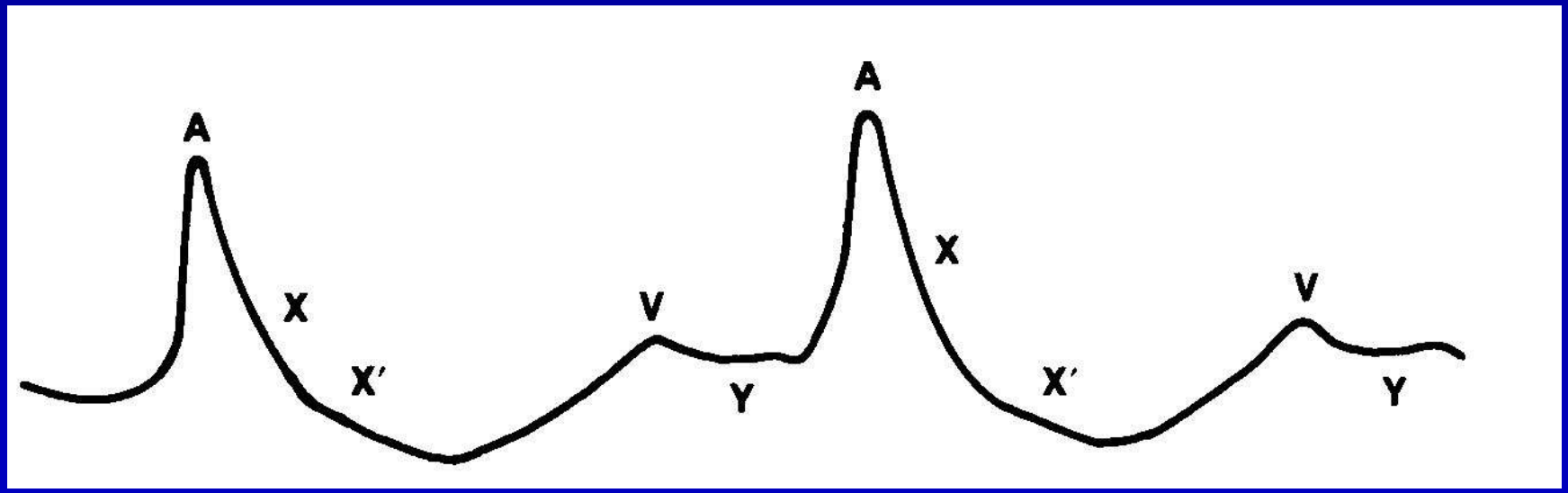
JVP



- Constrictive pericarditis
- Prominent X and Y descents

Constant, p. 89

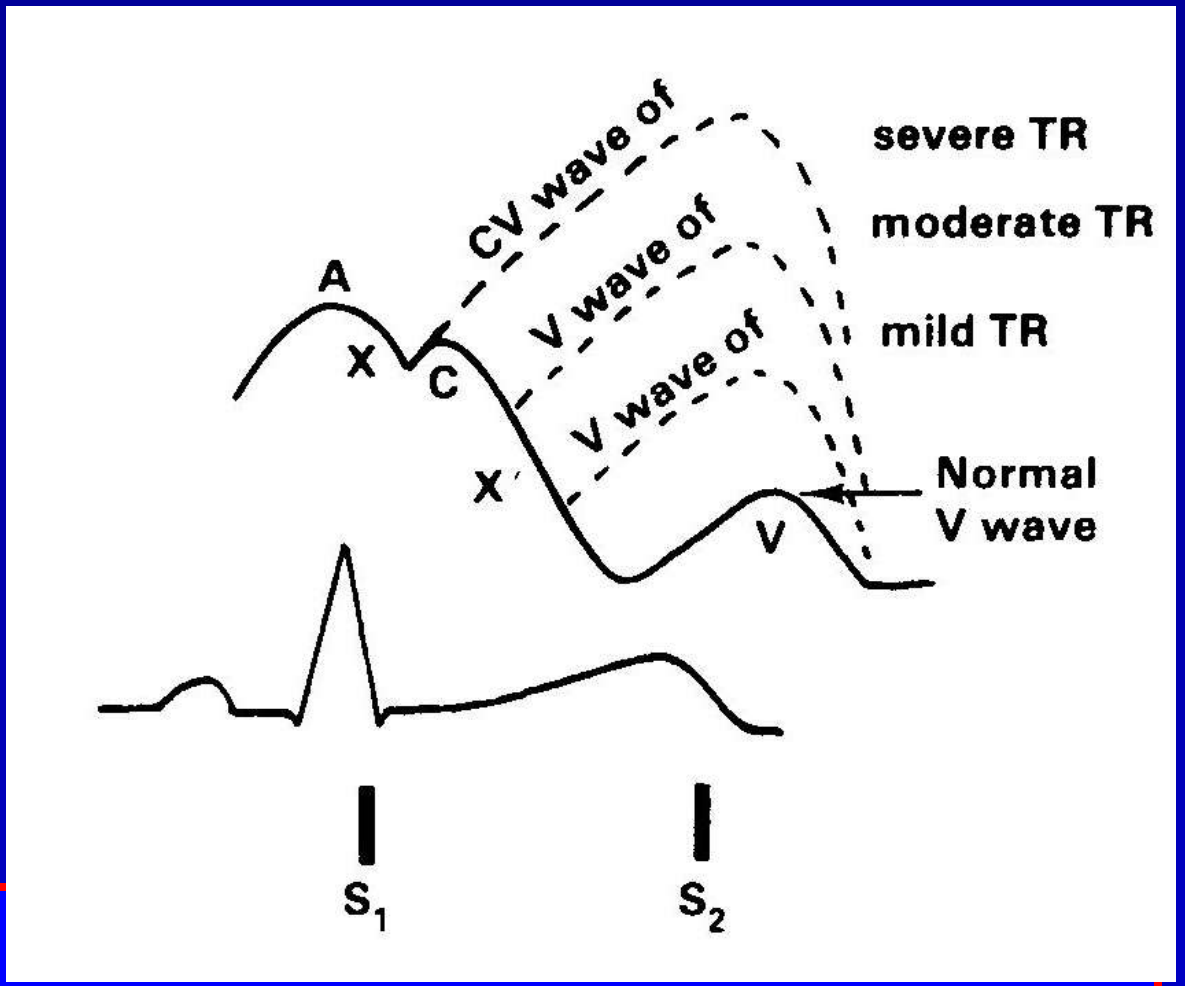
JVP



- Absent Y descent
  - Tricuspid stenosis
  - (Pericardial tamponade)

Constant, p. 83

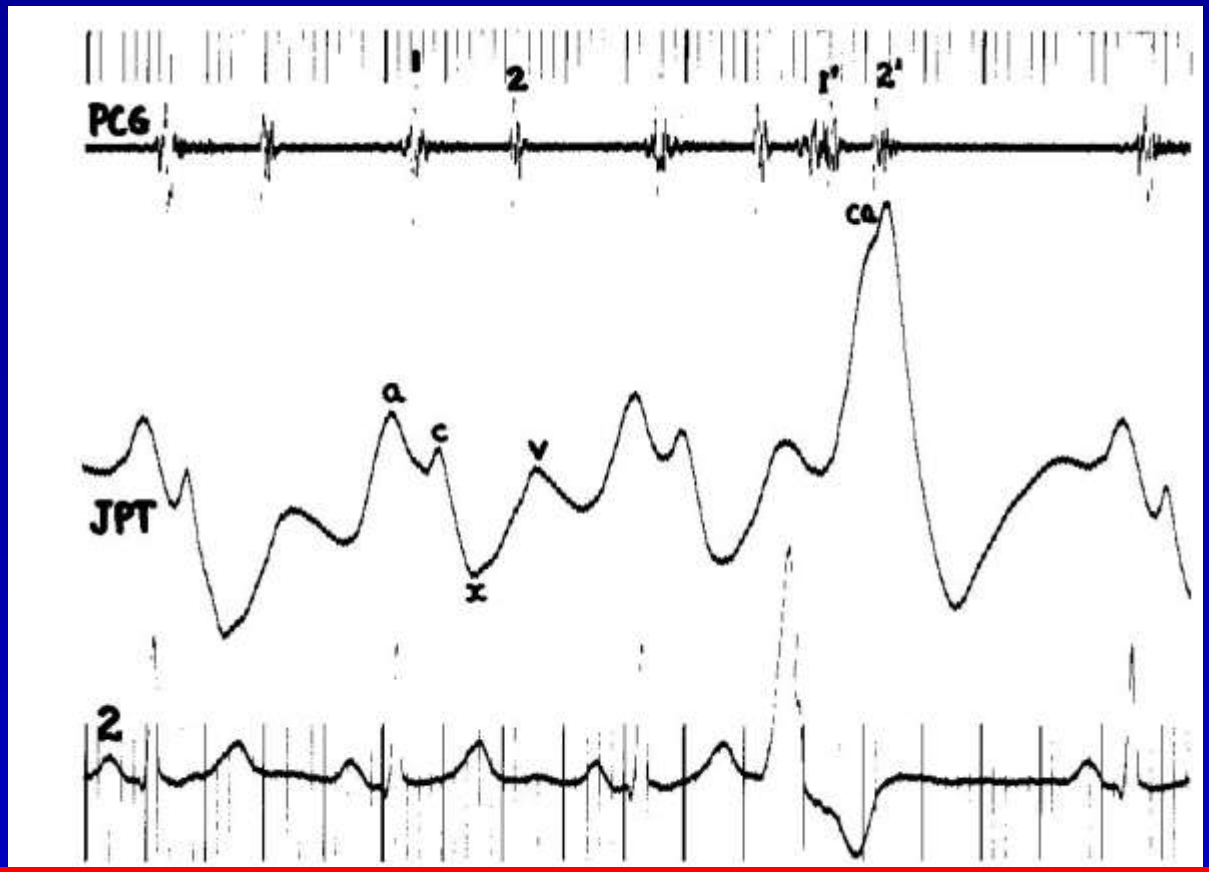
JVP



- Large V wave
- Tricuspid regurgitation
- Accompanying: Carvallo's sign (murmur increases with inspiration) and pulsatile liver

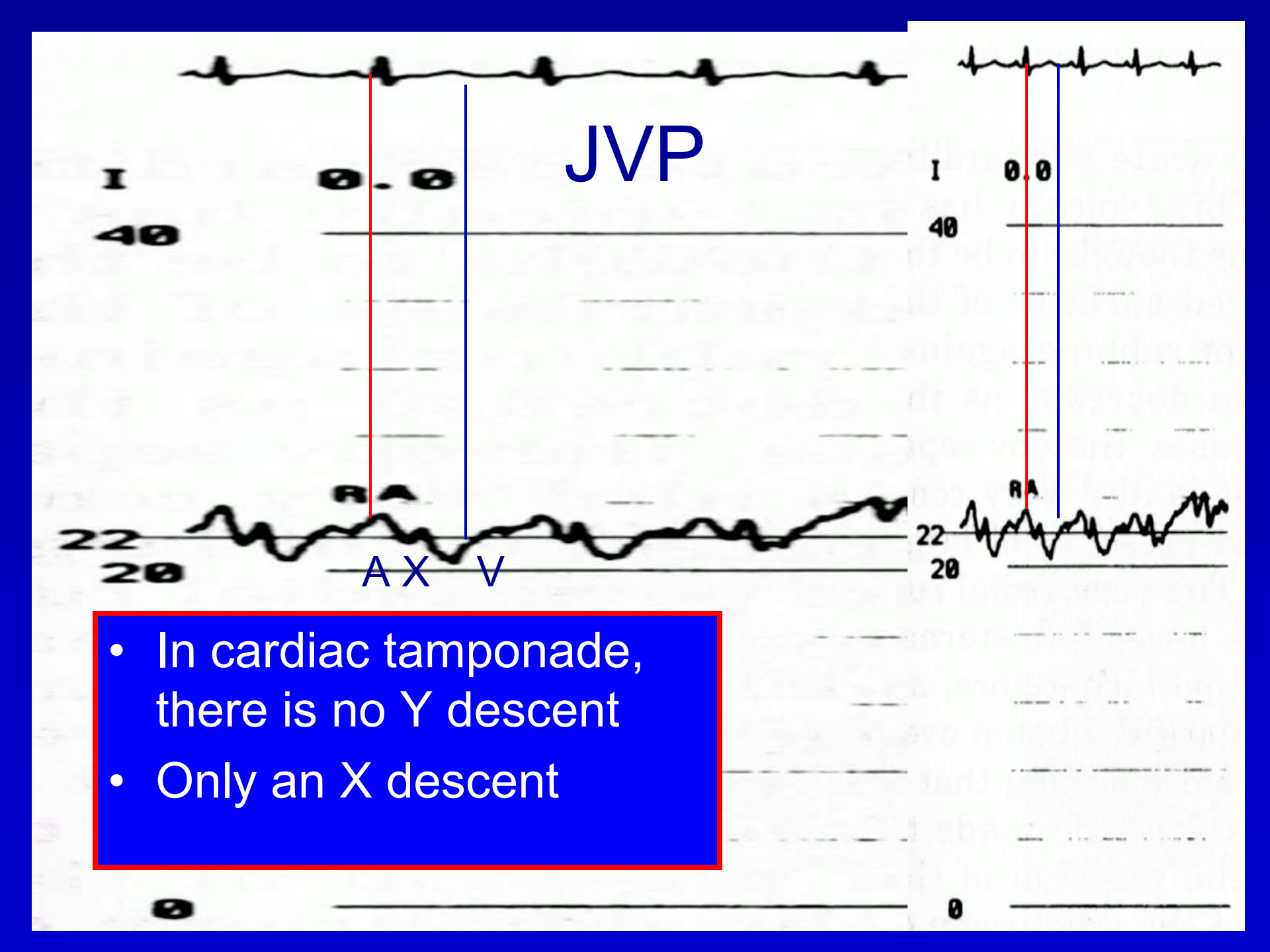
Constant, p. 88

JVP



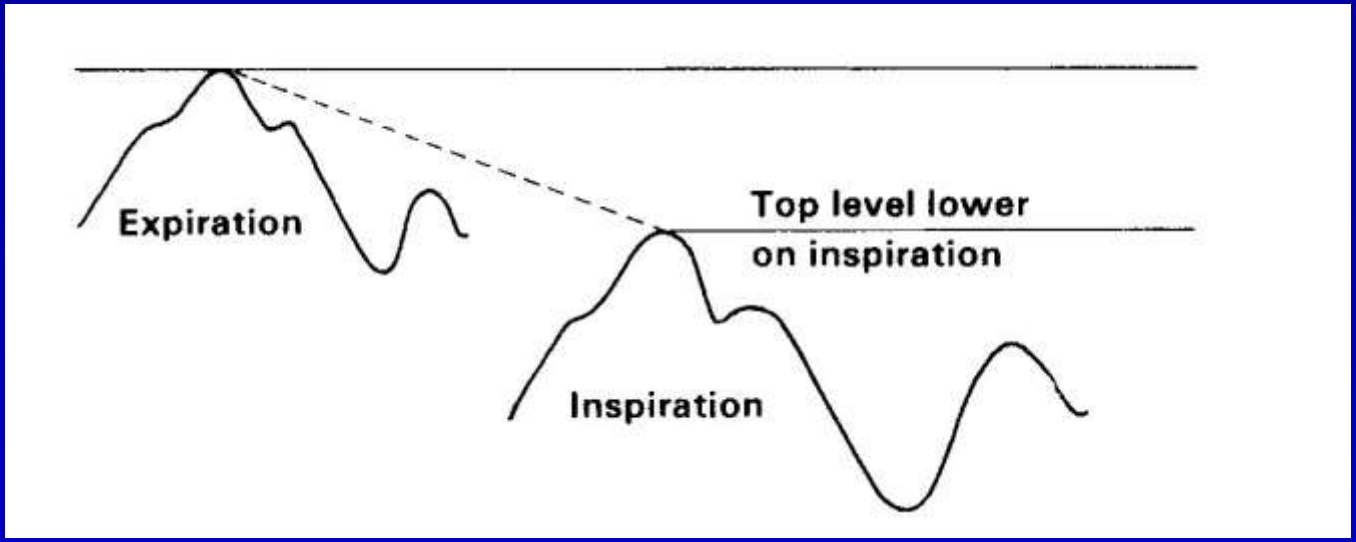
- Rhythm abnormalities affect morphology
- When the RA contracts **after** the RV, it contracts against a closed tricuspid valve, so all the RA contractile force is directed retrograde, causing a **"cannon A wave"**

Marriott, p. 266



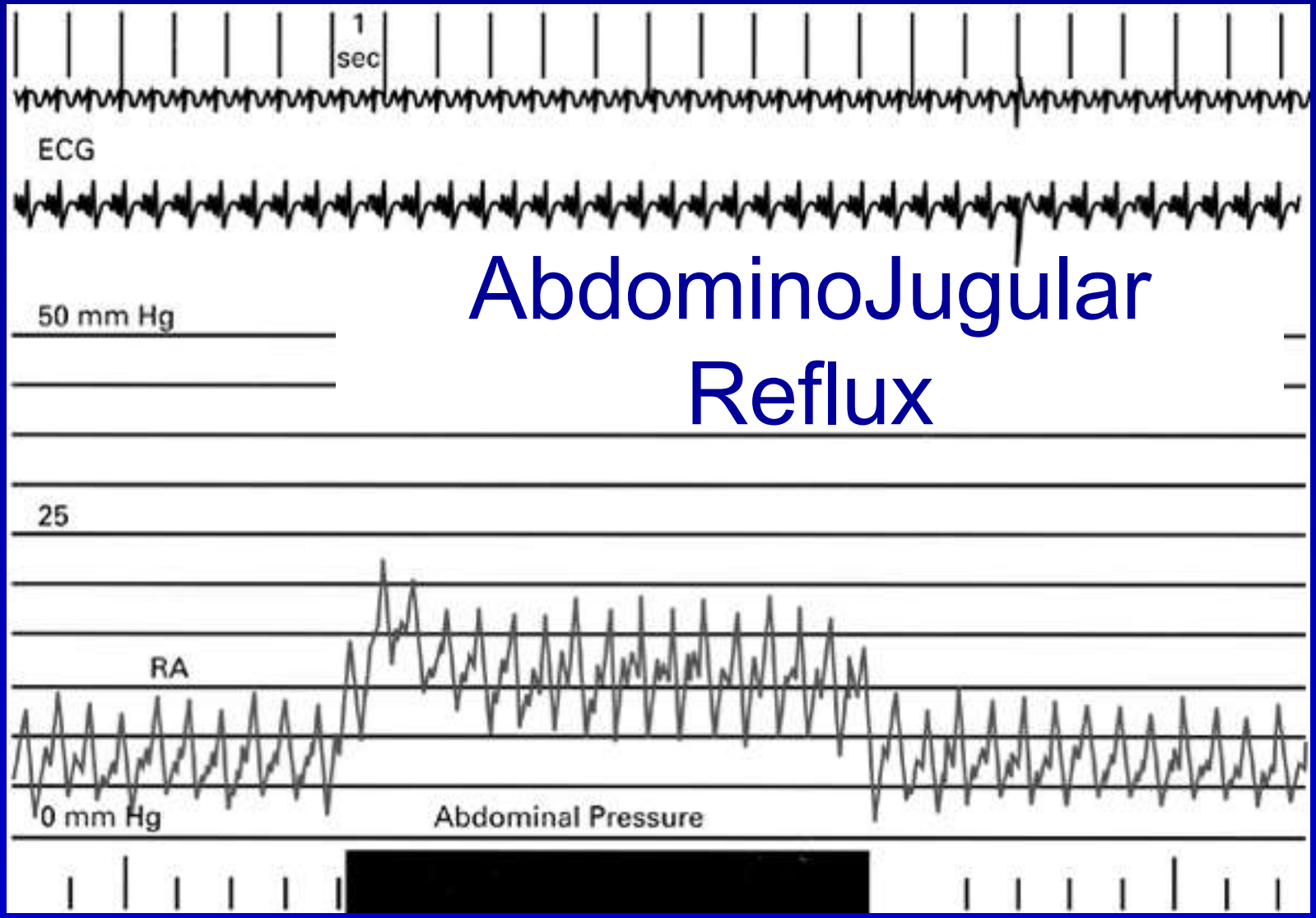
- In cardiac tamponade, there is no Y descent
- Only an X descent

JVP Respiration



- Normal, decrease with inspiration
- Failure to fall with inspiration is Kussmaul's sign, indicates
  - Constrictive pericarditis
  - Right ventricular failure of any cause

Constant, p. 71

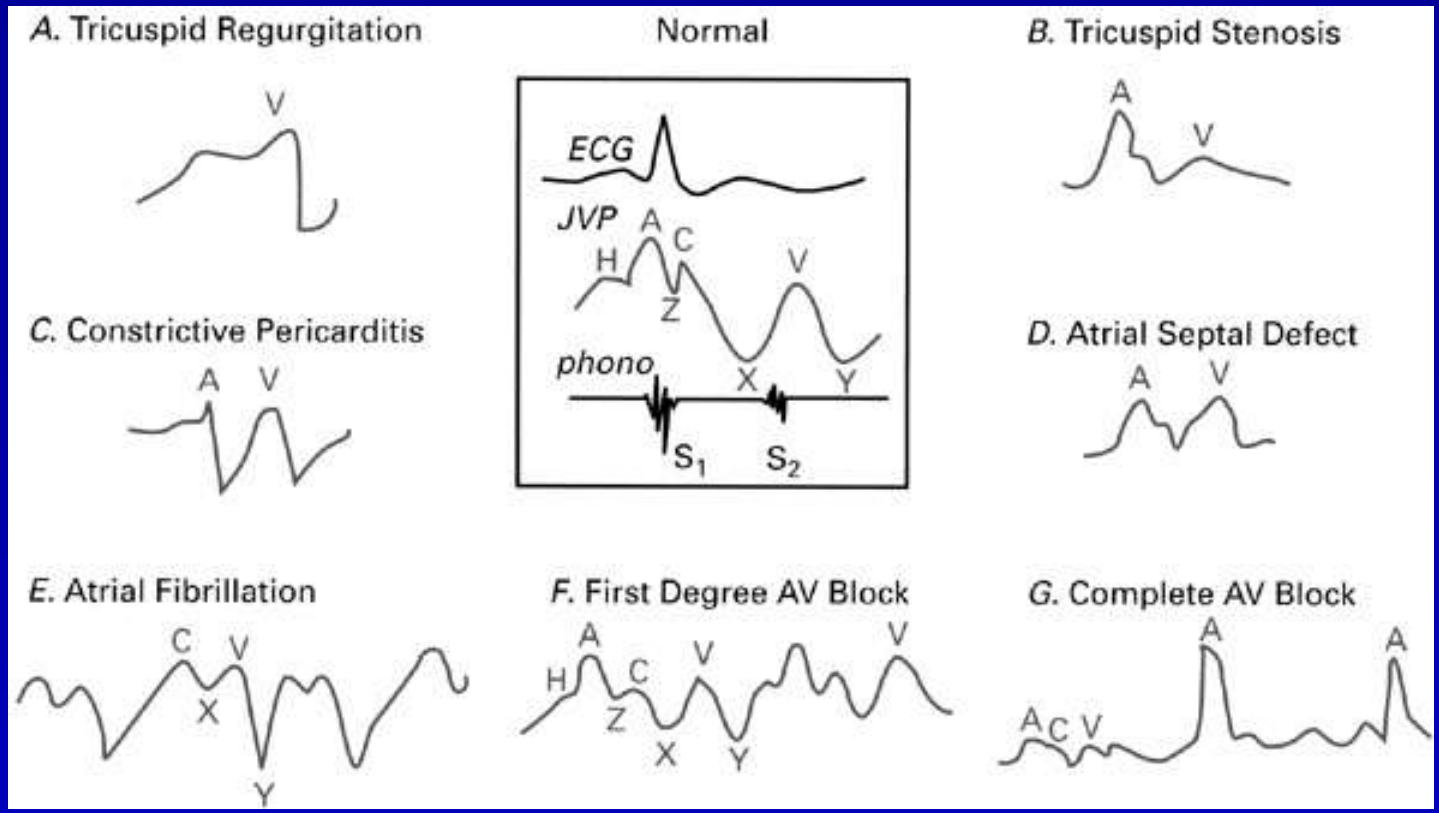


AbdominoJugular Reflux

- Definitive identification of jugular waveforms
- Evaluation of right ventricular failure

Hurst, p. 246

JVP

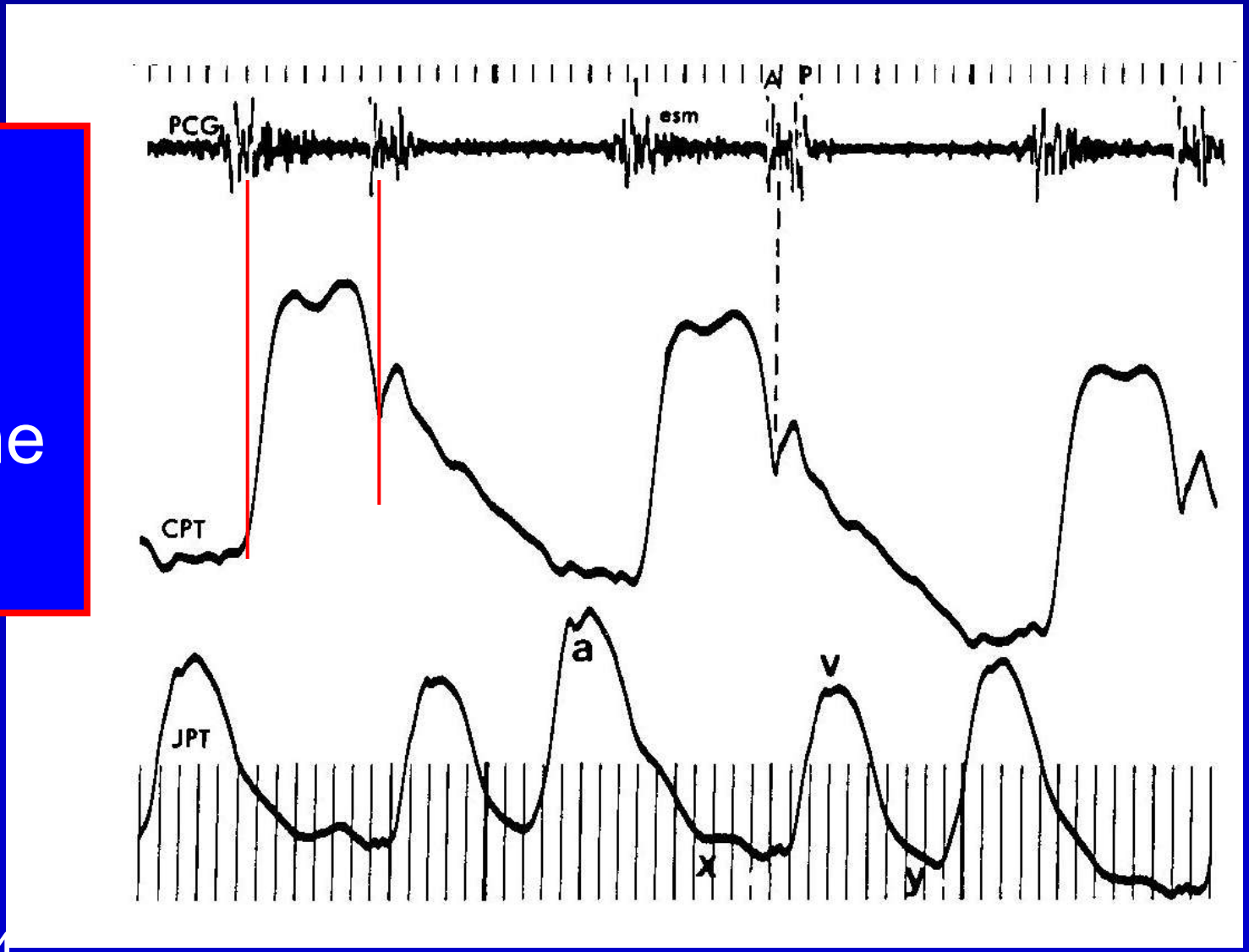


- Similar to RA pressure
- Expected relationships with different diseases

Hurst, p. 247

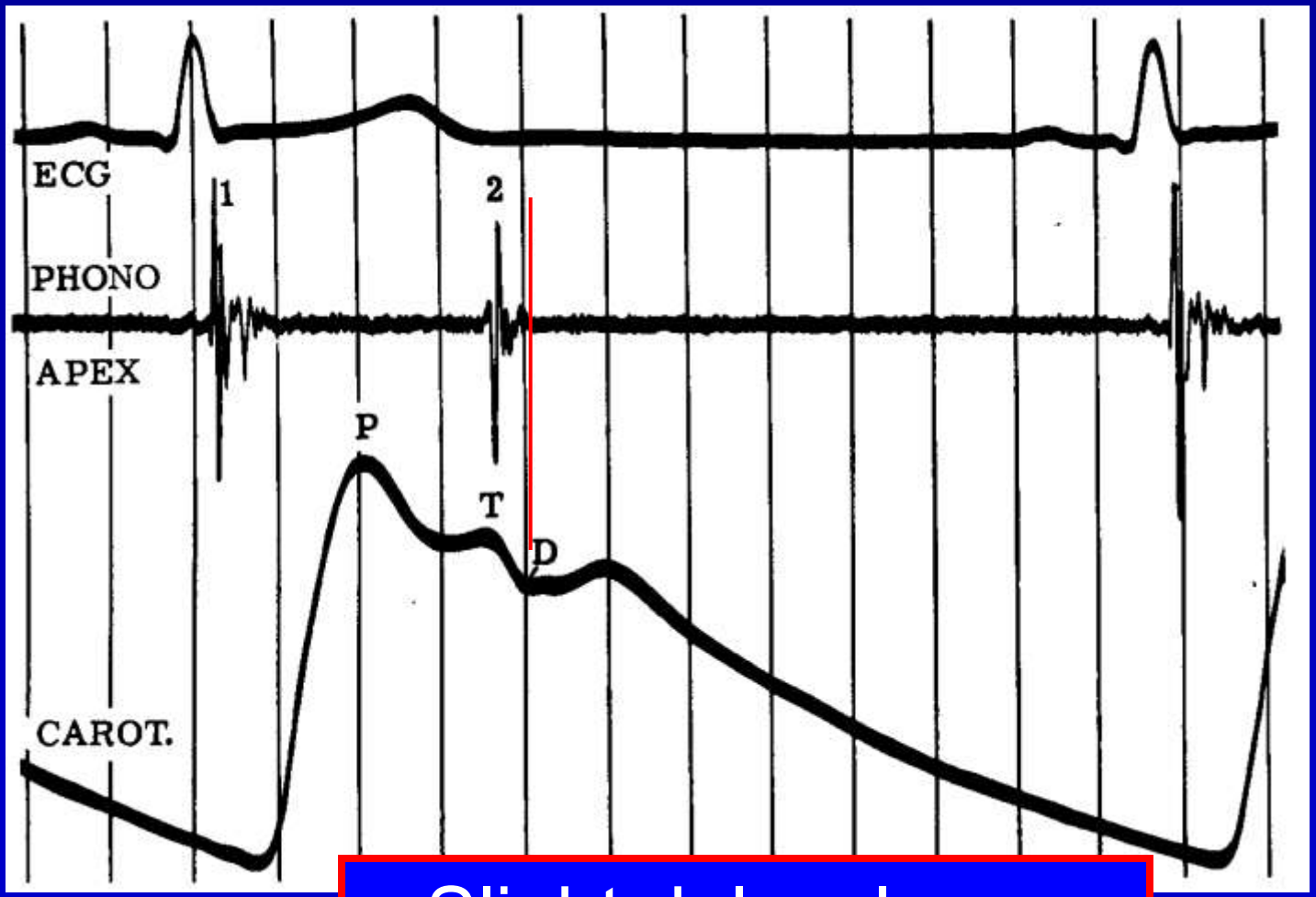
Carotid Pulse Tracing

- Slight delay, less than the JVP



Marriott, p. 14

Carotid Pulse Tracing

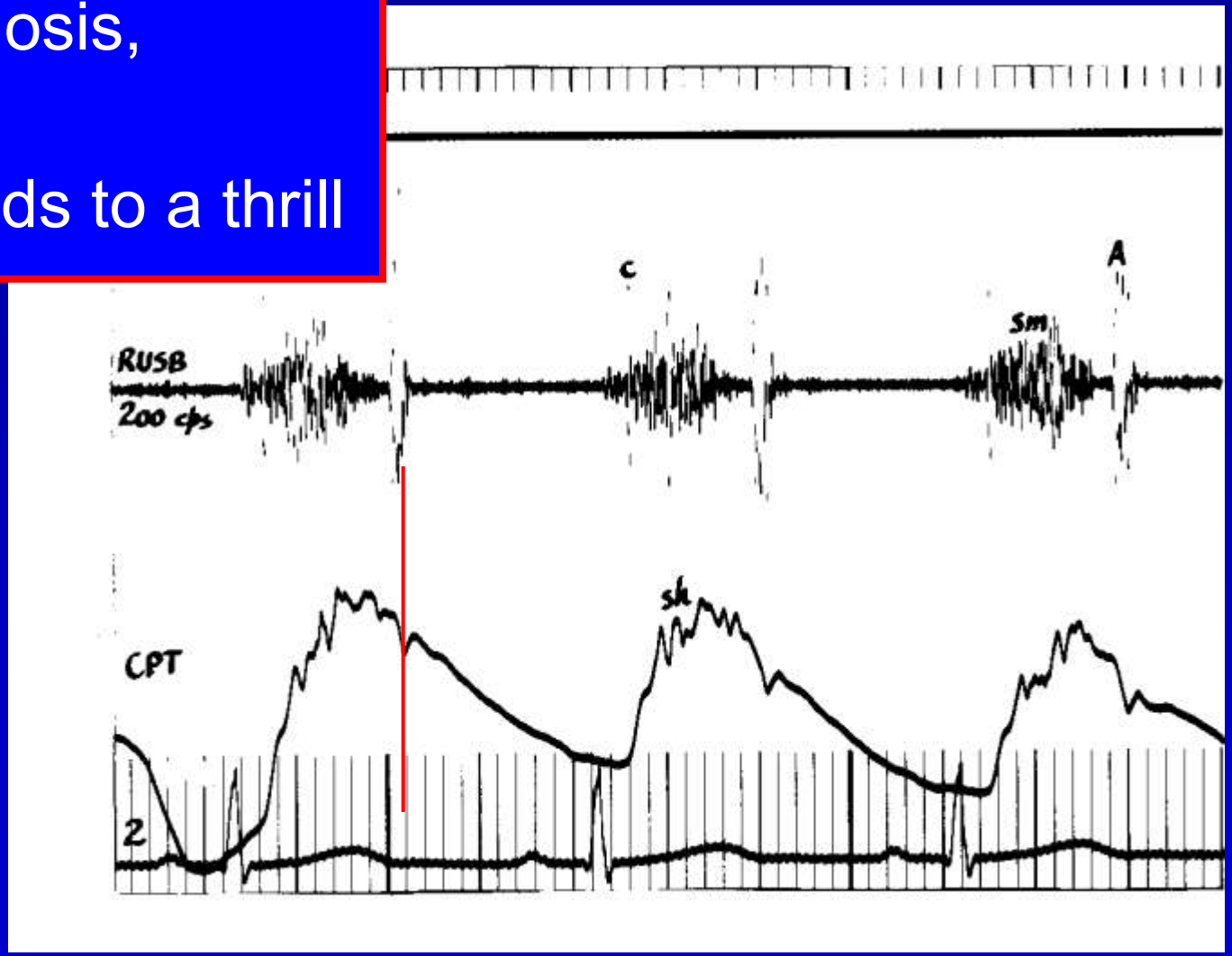


- Slight delay, less than the JVP

Tavel, p. 44

Carotid Pulse Tracing

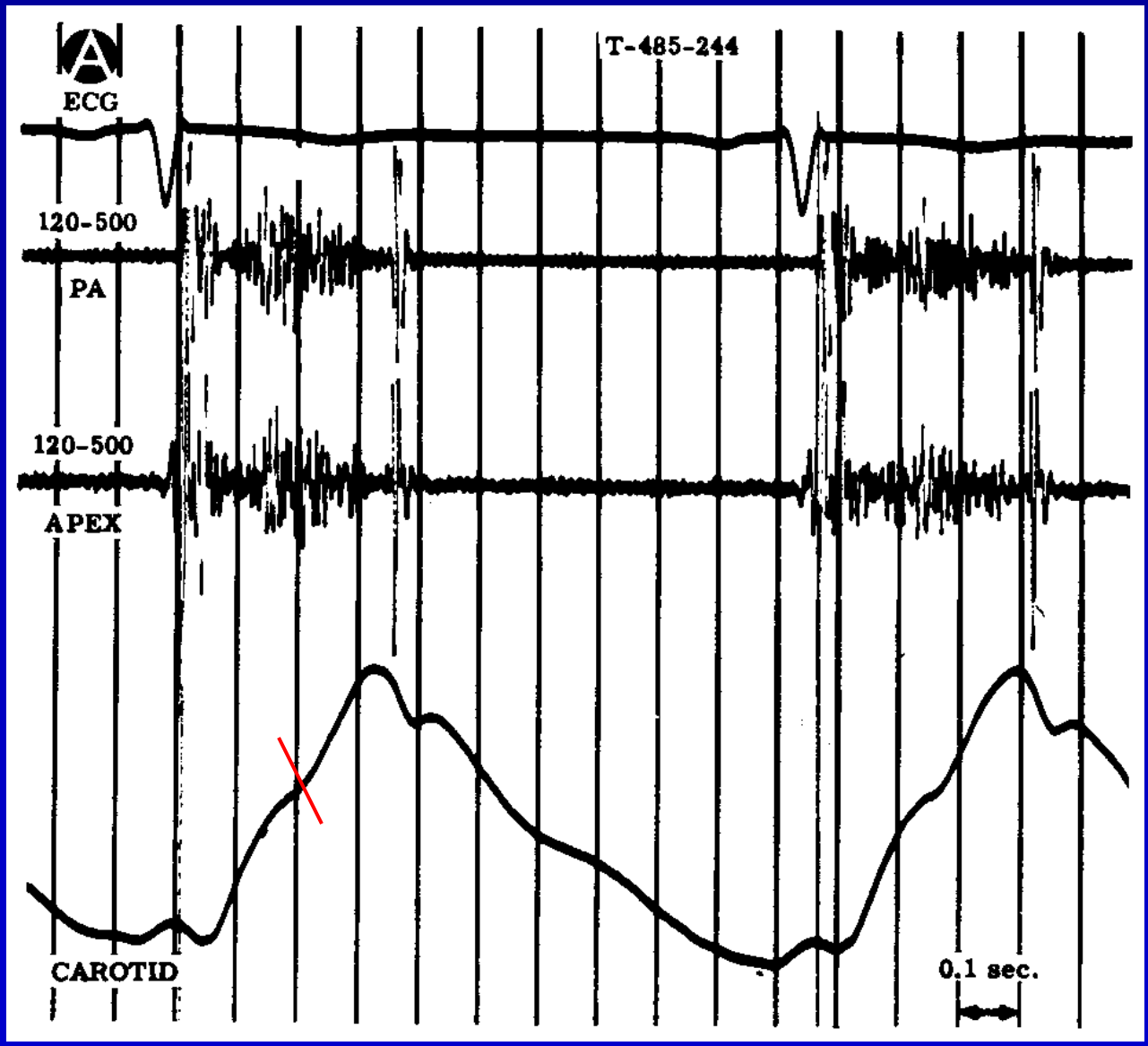
- Aortic stenosis, shudder
- Corresponds to a thrill



Marriott, p. 110

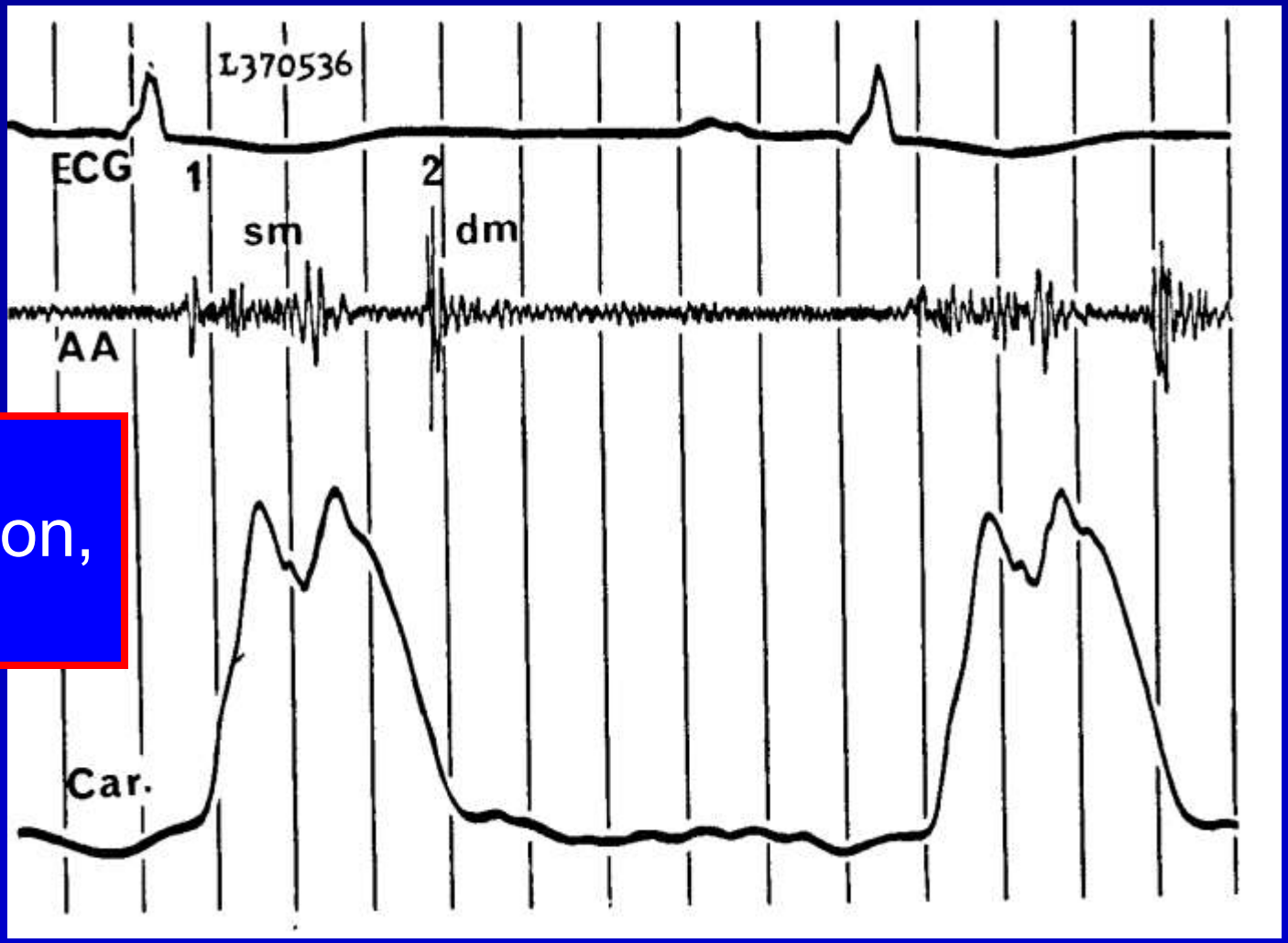
Carotid Pulse Tracing

- Aortic stenosis, severe
- Anacrotic notch?



Tavel, p. 275

Carotid Pulse Tracing

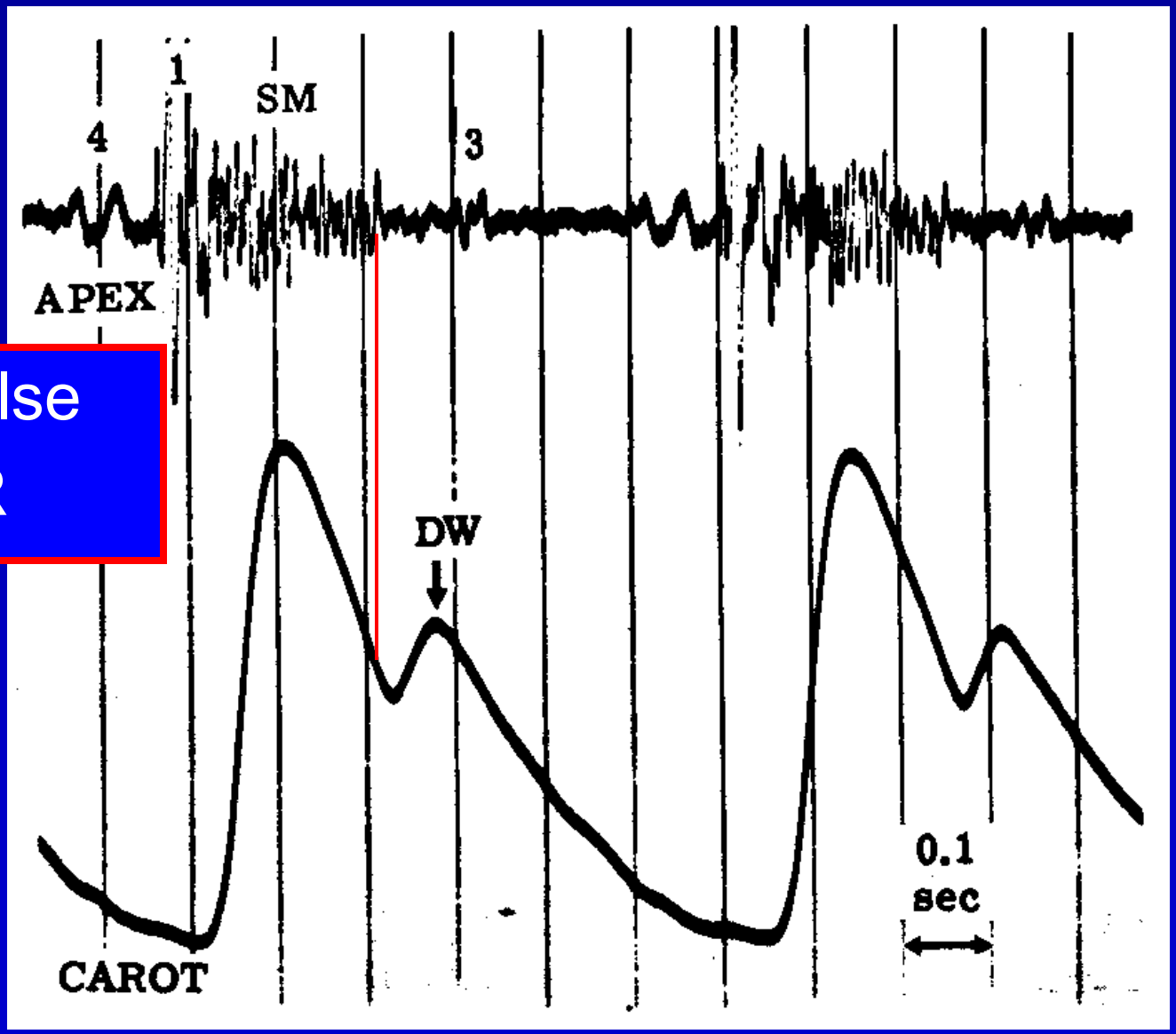


- Aortic regurgitation, severe

Tavel, p. 179

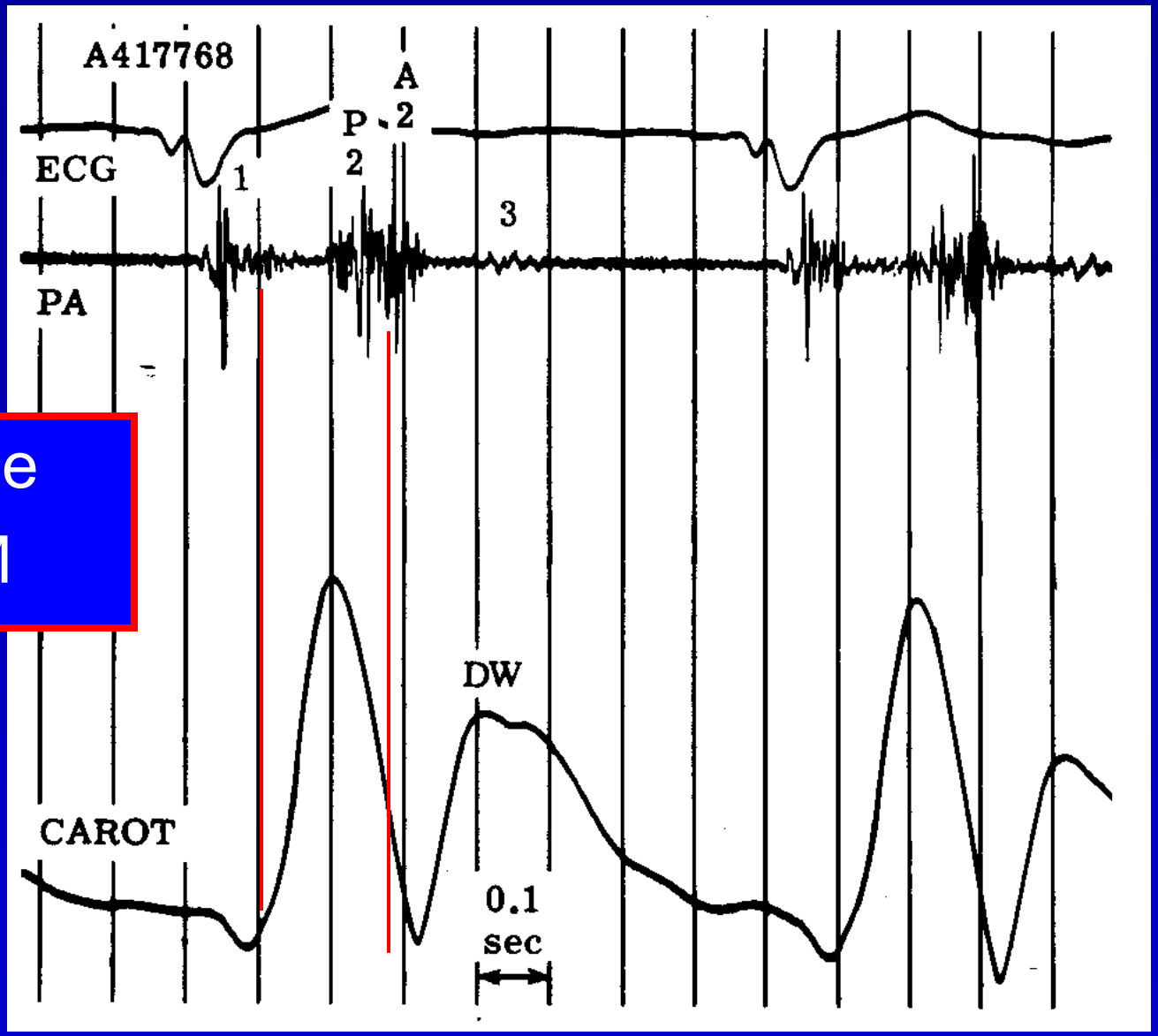
Carotid Pulse Tracing

- Dicrotic Pulse
- Severe MR



Tavel, p. 178

Carotid Pulse Tracing

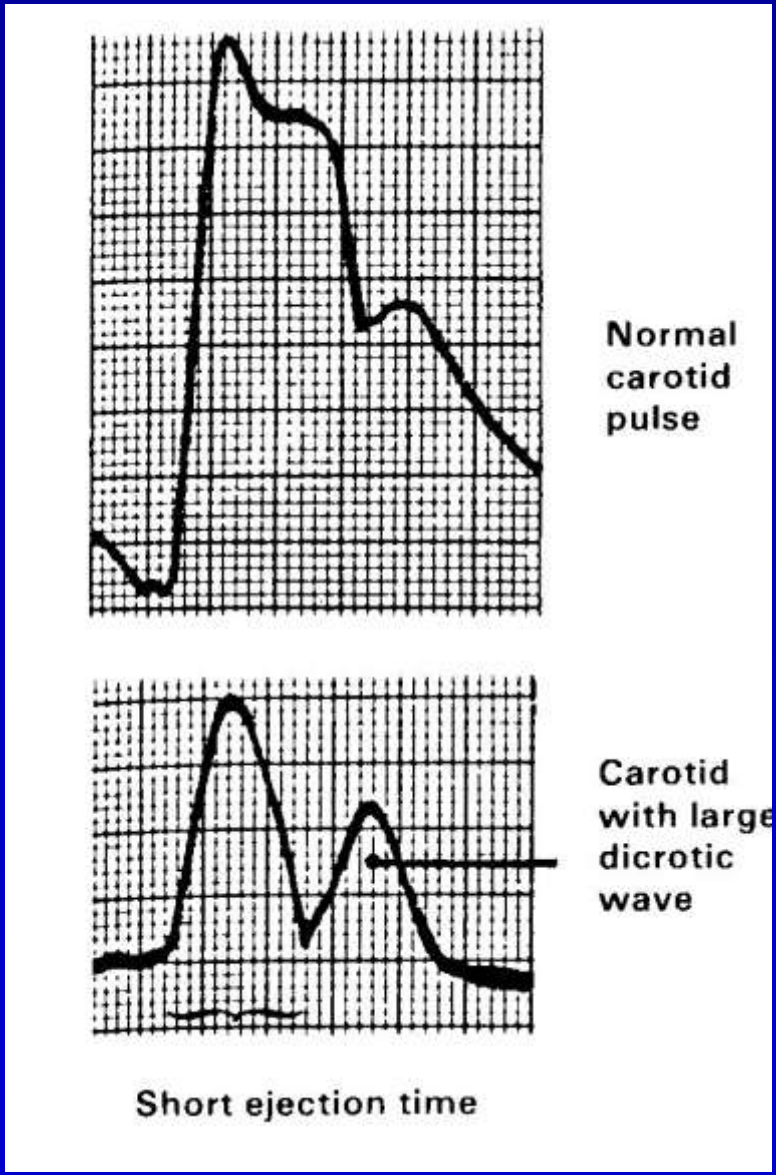


- Dicrotic Pulse
- Severe DCM

Tavel, p. 180

Carotid Pulse Tracing

- Dicrotic Pulse



Constant, p. 40

Chest and Lungs

- Chest symmetry, spine
- Mainly auscultation but diaphragmatic motion
  - Rales (crackles)
  - Wheezes

Cardiac Examination

- Inspection
  - Symmetry, sternal shape, habitus, visible pulsations
- Palpation
  - Palpable impulses, sounds and murmurs
- Percussion (I don't use)
- Auscultation
  - Audible sounds and murmurs

Precordial Palpation of Impulses

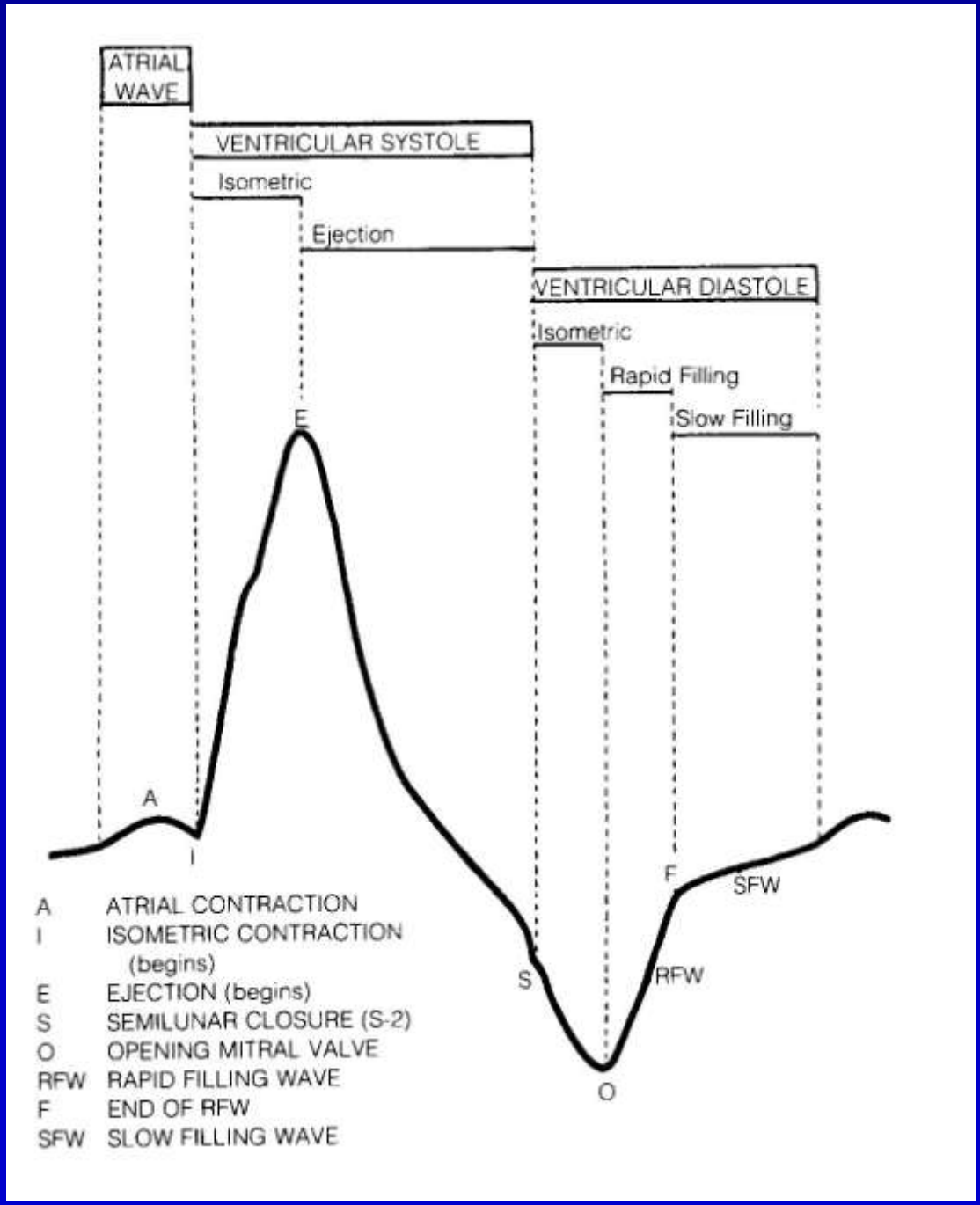
- LUSB: pulmonary artery impulse
- RUSB: dilated ascending aorta
- LLSB: right parasternal lift, RVH
- Apex: location (supine), size, character
  - Displaced downward and to the left (supine)
  - Enlarged (>3 cm)
  - Sustained (more than 1/3 of systole)
  - Dyskinetic (all of systole, late bulge)
  - Presystolic filling wave, rapid filling wave

Apical Impulse

- Normal location supine: 5th ICS in MCL (<10 cm from MSL)
- Not palpable supine in some normal individuals
- Character best appreciated in left lateral recumbent (decubitus) position
- Best in held expiration

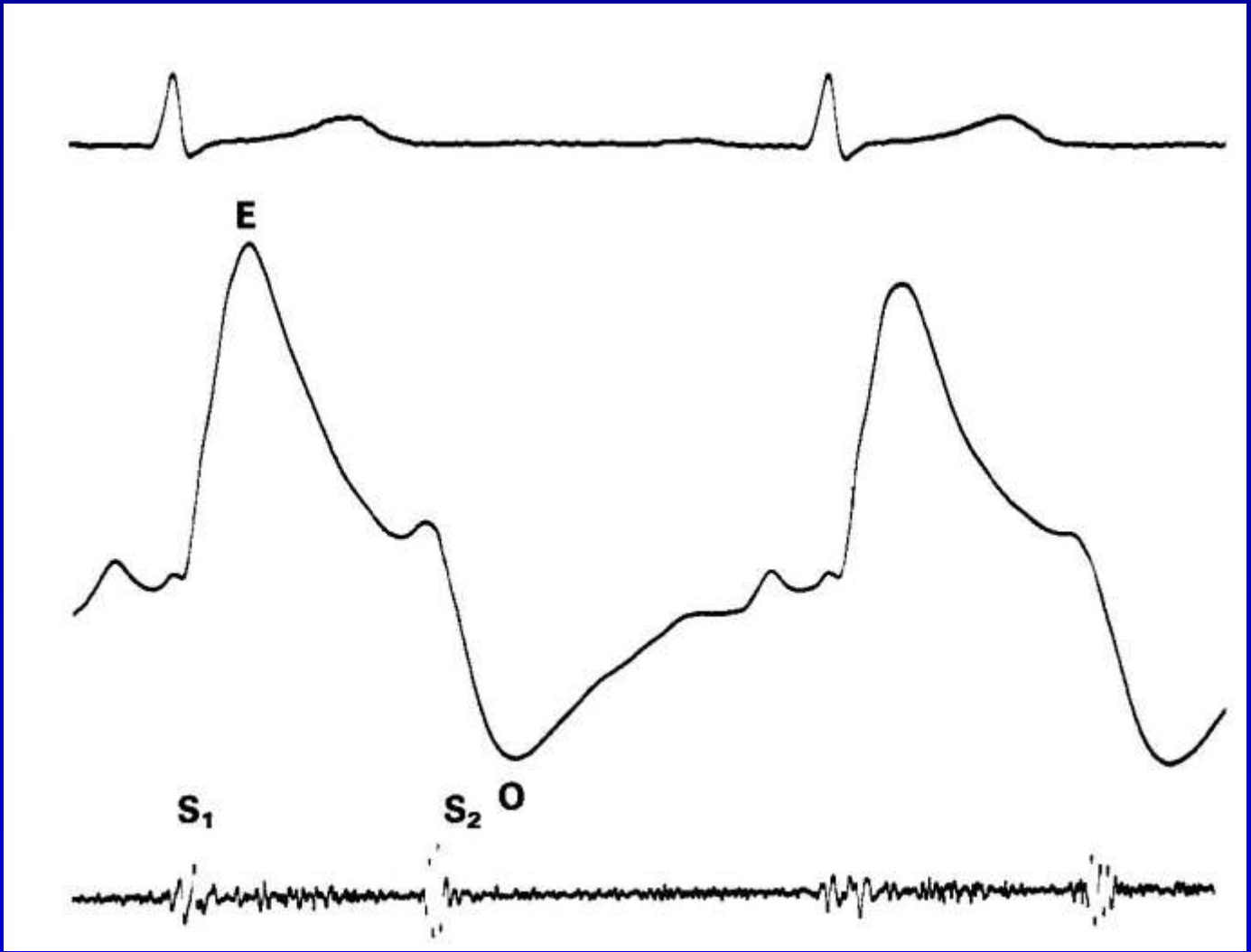
Apical Impulse

- Normal, diagram



Marriott, p. 31

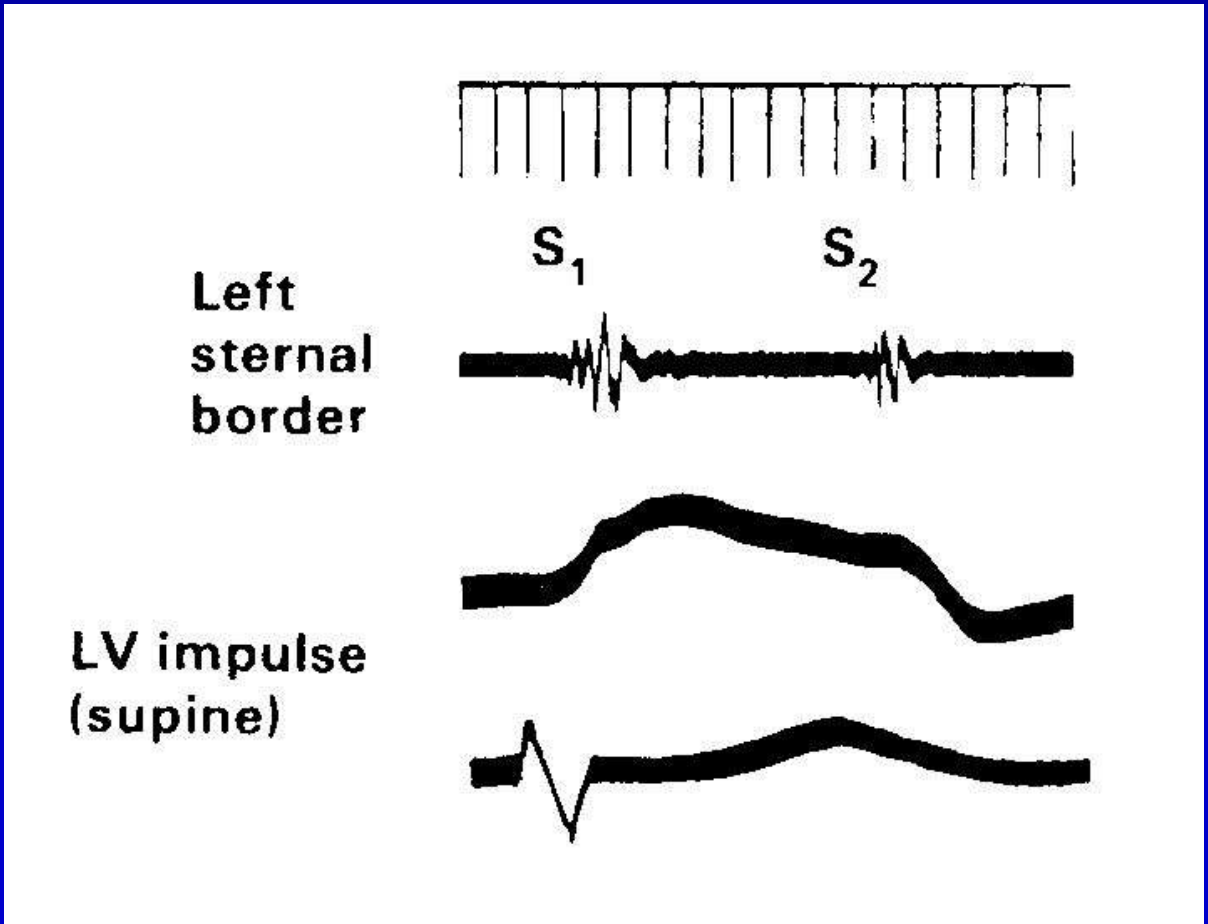
Normal Apical Impulse



Constant, p. 110

Apical Impulse

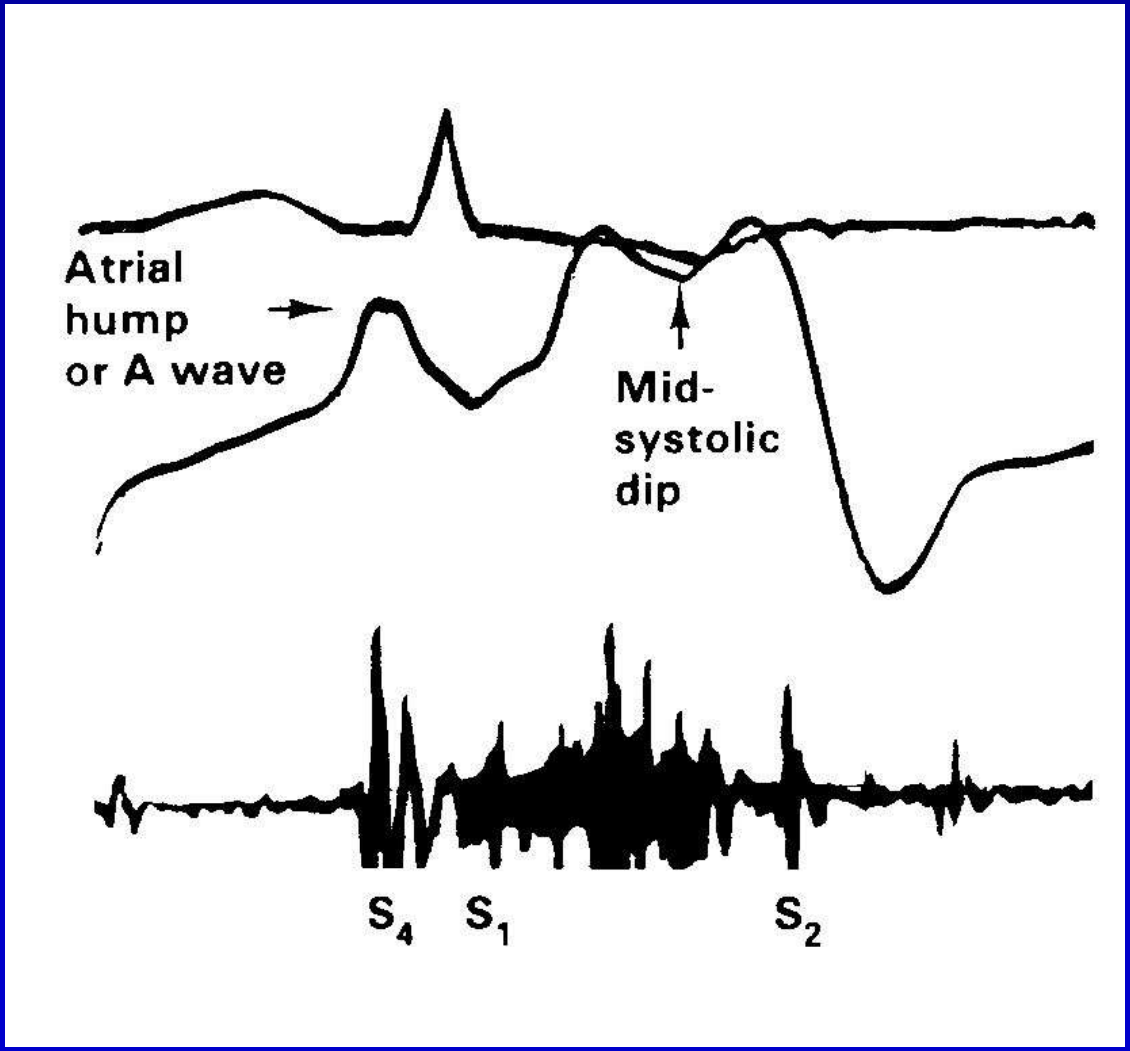
- Abnormality, sustained impulse



Constant, p. 111

Apical Impulse

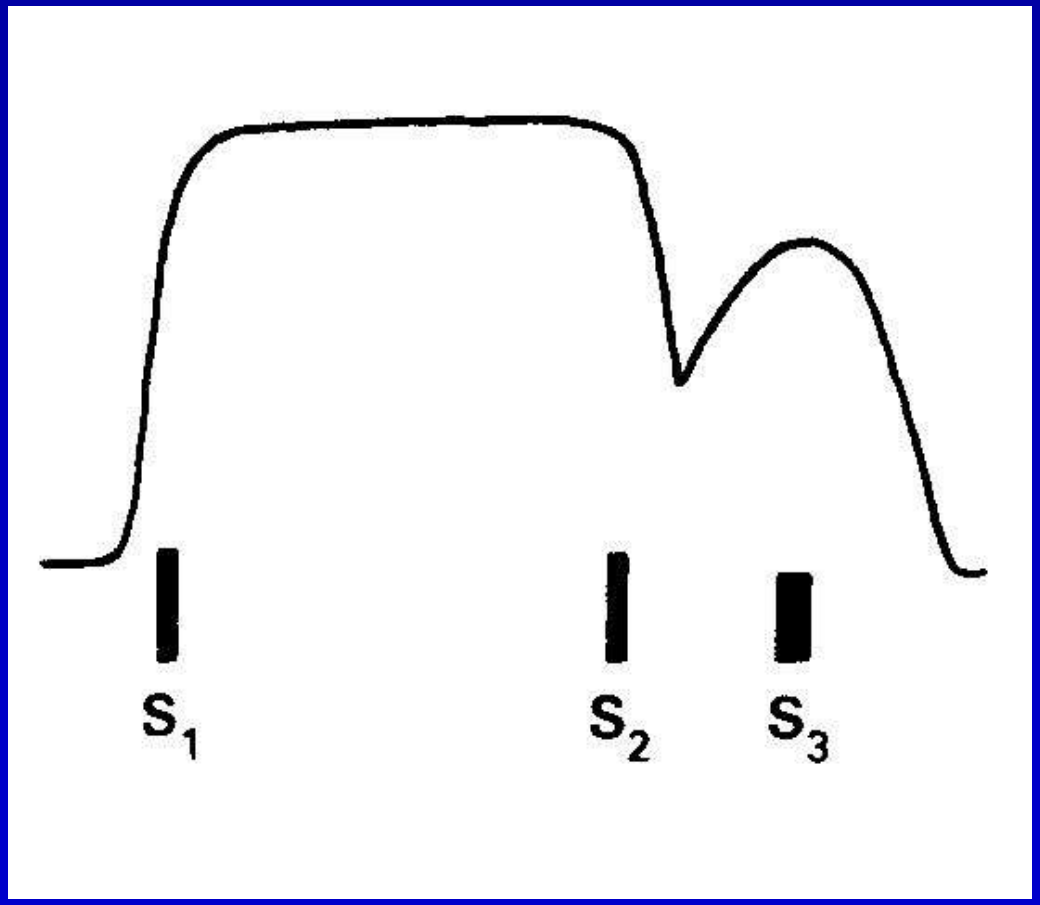
- Abnormality, hypertrophic cardiomyopathy



Constant, p. 117

Apical Impulse

- Abnormality with rapid filling wave
- Usually corresponds to an S3



Constant, p. 117

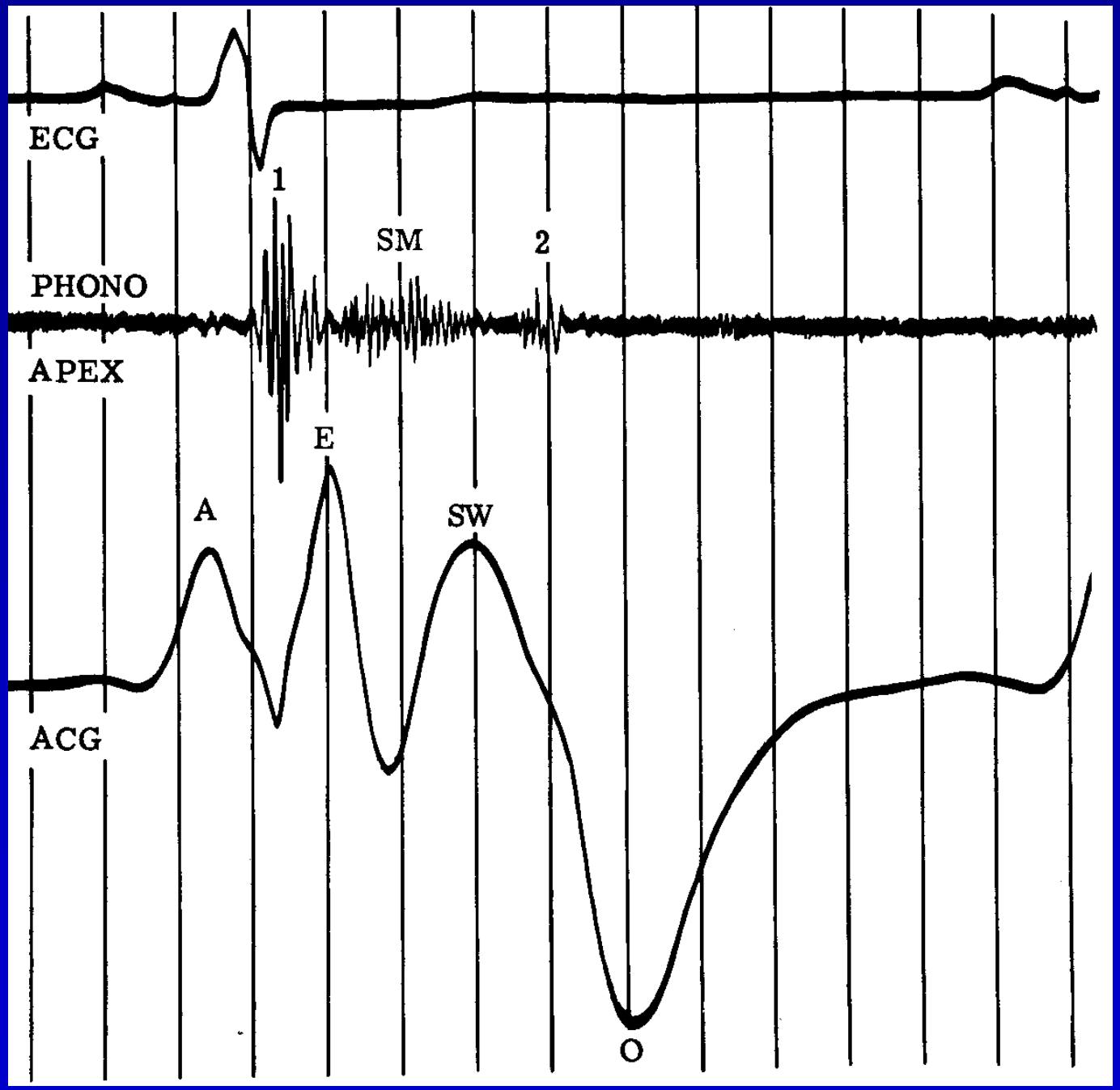
Apical Impulse

- Prominent presystolic filling wave
- Often associated with S4

Marriott, p. 225, patient with recent inferior wall MI

Apical Impulse

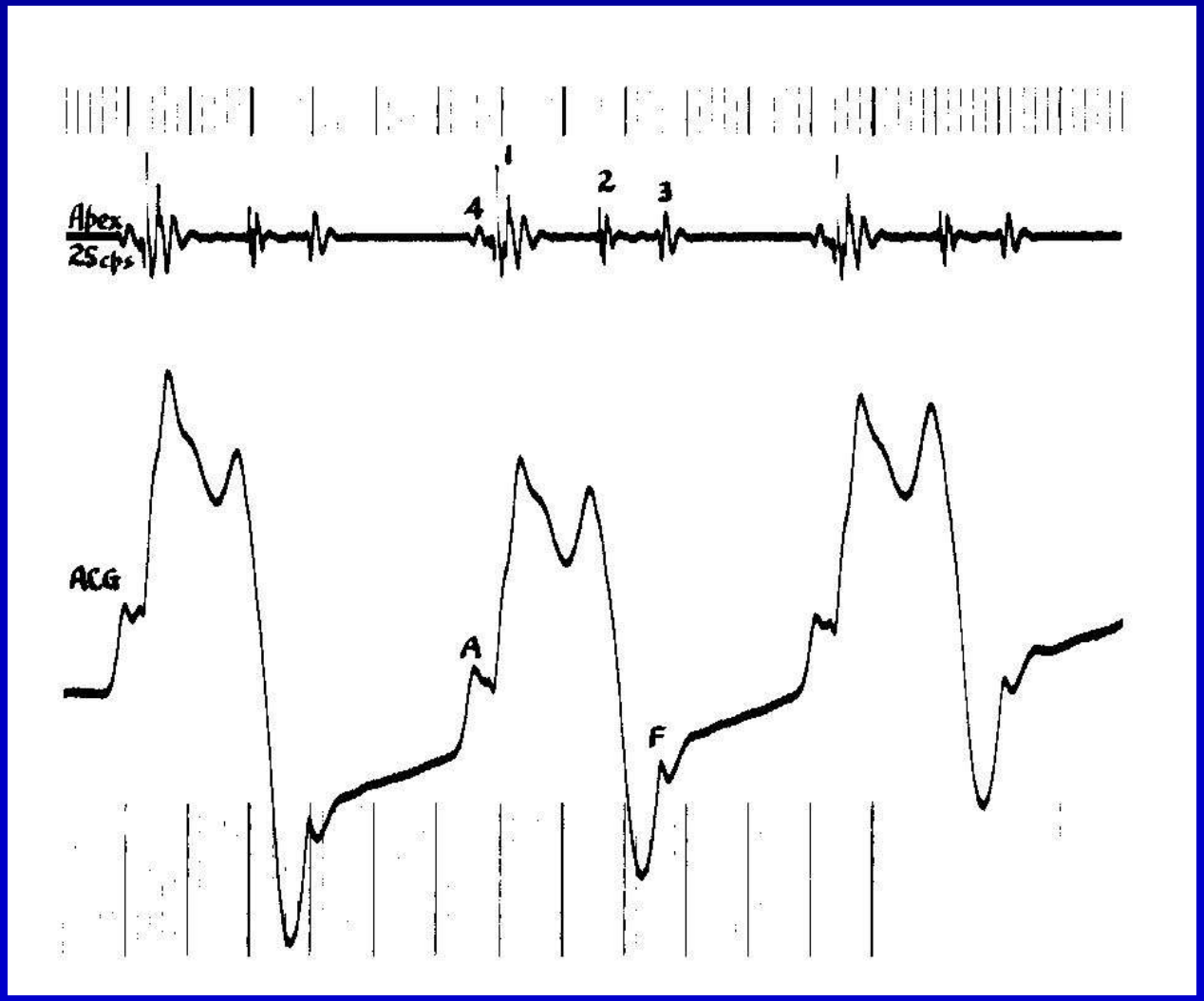
- "Triple ripple" in HCM with presystolic wave and normal impulse and late systolic wave



Tavel, p. 197

Apical Impulse

- Abnormal with prominent presystolic filling wave and also prominent rapid filling wave, associated with S3 and S4



Marriott, p. 119 35-year-old man with HCM

Cardiac Auscultation

- Hearing, and the stethoscope
- Auscultation and the cardiac cycle
- Clinical heart sounds
- Cardiac murmurs
- Bedside maneuvers

Auscultation Environment

- Patient warm and comfortable
- Minimize ambient noise
  - TV
  - Loud talking
  - Fans and cooling devices

Terminology in Auscultation

- Duration: time from onset to end
- Quality: examples
  - harsh
  - buzzing
  - blowing
  - cooing
  - musical
  - rough
  - honking
- Crescendo: increasing intensity with time
- Decrescendo: decreasing intensity
- Plateau-shaped: steady intensity

Terminology in Auscultation - 2

- Intensity: loudness, measure in standard grades
- I - audible after tune-in
- II - faint but immediate
- III - louder
- IV - louder, often thrill
- V - audible with edge of diaphragm on chest
- VI - audible without stethoscope touching chest

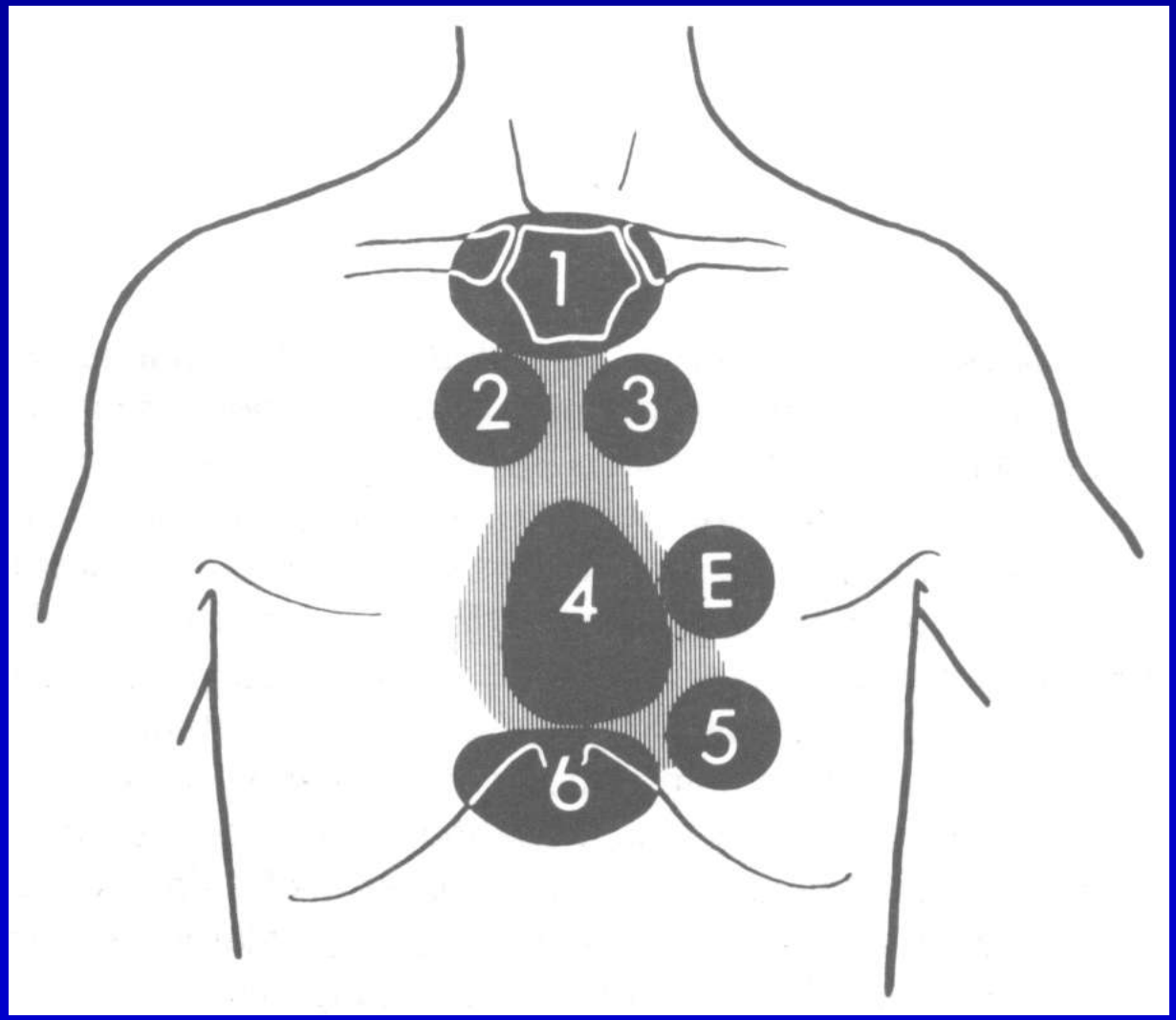
- Pitch: related to pressure differences
  - High pitch is high pressure difference: AR
  - Low pitch is low pressure difference: MS

Precordial Auscultatory Areas

Aortic	RUSB	Right sternal border, second i.c.s.
Pulmonic	LUSB	Left sternal border, second i.c.s.
Tricuspid	LLSB	Left sternal border, fourth i.c.s.
Mitral	Apex	LV apical impulse

Auscultatory Areas

1 – Sternoclavicular
2 – Aortic Area
3 – Pulmonic Area
4 – Right Ventricular
Tricuspid
5 – Apical Area
Mitral
6 – Epigastric Area
E – Ectopic Areas



AHA Schlant, 1990

Hearing and the Stethoscope

- Sound has
  - Loudness (intensity, decibels)
  - Pitch (frequency, Hertz, Hz)
- Hearing
  - 20-20,000 Hz
  - Best at 1000 Hz
  - Distinguish 0.02-0.03 sec apart
- Stethoscope
  - sound filter, not amplifier
  - tubing, bell, diaphragm
  - airtight fit of earpieces into the ear of the auscultator

First heart sound (S-1)

- Mitral (M-1) and tricuspid (T-1) closure
- Intensity
  - Normally louder than S-2 at apex, softer than S-2 at RUSB
  - Loud with MS, short PR interval, high adrenergic tone
  - Soft with poor contractility, long PR interval, LBBB, MR, AR
- Splitting: normally increase with inspiration, and normally increased in RBBB and Ebstein's anomaly

Sounds near the First Heart Sound

- First heart sound (S-1)
- Ejection sound (Aortic, Pulmonic)
- Midsystolic click (Mitral valve prolapse)
- Fourth heart sound (S-4)
- Order: S-4, S-1, ejection sound, mitral click

S1

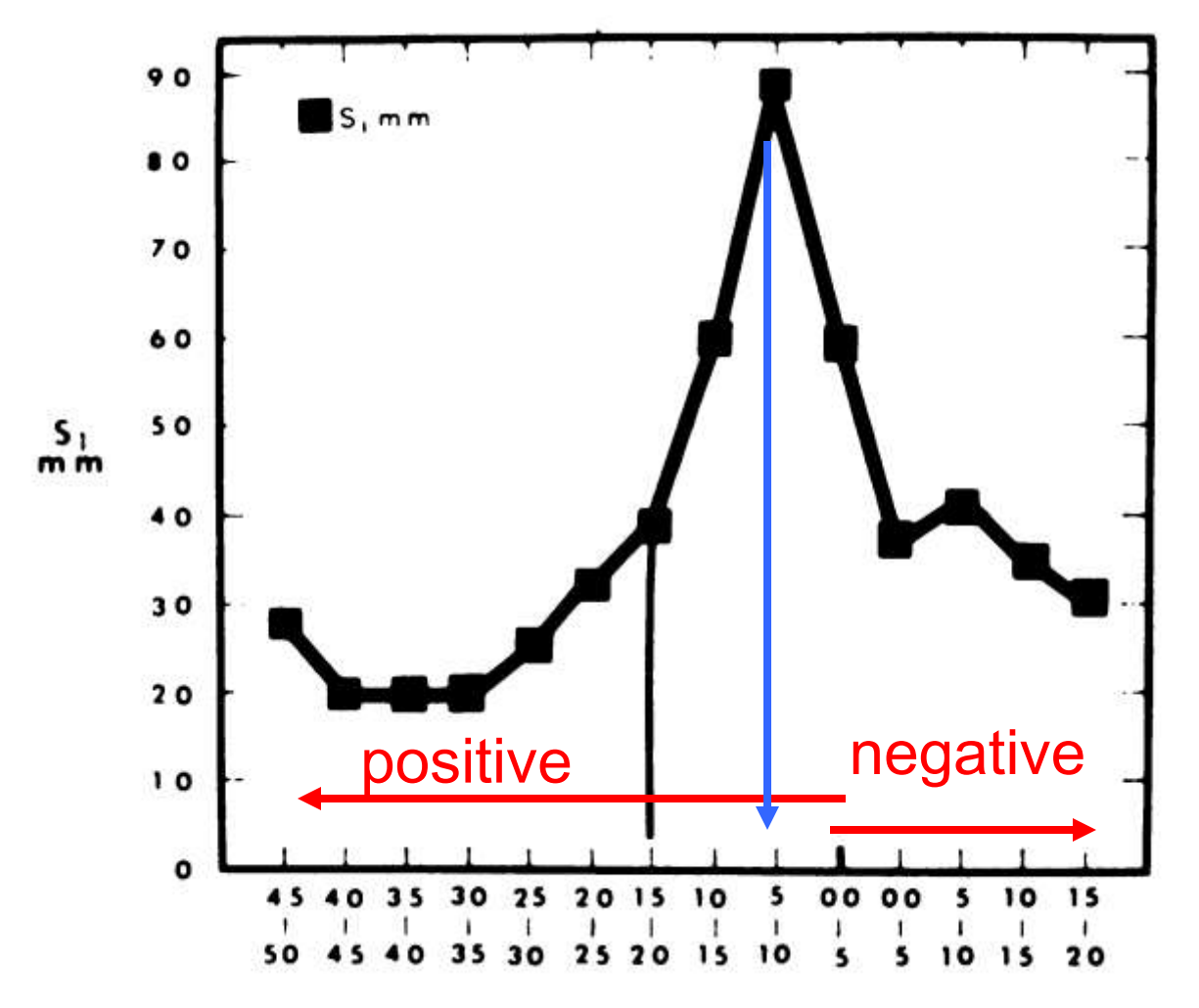
- Intensity related to dP/dt (contractility, mitral integrity, and QRS morphology) and PR interval and mitral pliability (MS)
- Splitting varies with respiration, affected by similar things as S2, but Ebstein's is wide S1 with late loud tricuspid component (Sail sound)

S1 and PR interval

Patient with complete heart block and normal QRS duration

CHB
VT
AV diss
Afib
  paced
Aflutter

Mitral stenosis



AHA monograph, 1974, Thompson, et al.

Second heart sound (S-2)

- Aortic (A-2) and pulmonic (P-2) closure
- Intensity: louder if arterial hypertension (A-2 for systemic, P-2 for pulmonary)
- Splitting: respiratory variation
  - Physiologic: split with inspiration, close with expiration (normal, A-2 before P-2)
  - Paradoxic: split with expiration, close with inspiration (abnormal, P-2 before A-2)
  - Fixed: split without respiratory variation

Sounds near the Second Heart Sound

- Second heart sound (S-2)
- Opening snap (MS or TS)
- Third heart sound (S-3)
  - Tumor plop
  - Pericardial knock
- Order: S-2, OS, S-3

Third heart sound (S-3)

- Ventricular gallop
- Physiologic in youth, pregnancy, athlete
- Pathologic in CHF
- RV S-3 increases with inspiration
- Other sounds at the end of rapid filling
  - Tumor plop of atrial myxoma (RA or LA)
  - Pericardial knock of constrictive pericarditis

Fourth heart sound (S-4)

- Atrial gallop
- Physiologic in youth, athletes
- Pathologic in hypertension, ASHD, AS, implies stiff ventricle (diastolic dysfunction)
- May sum with S-3, for summation gallop in tachycardia

Ejection sound

- Abnormal sound with opening of semilunar valve
- Aortic: bicuspid aortic valve, systemic hypertension
- Pulmonic: congenital pulmonic stenosis, pulmonary hypertension, dilated pulmonary artery (the only right-sided auscultatory event that decreases with inspiration)

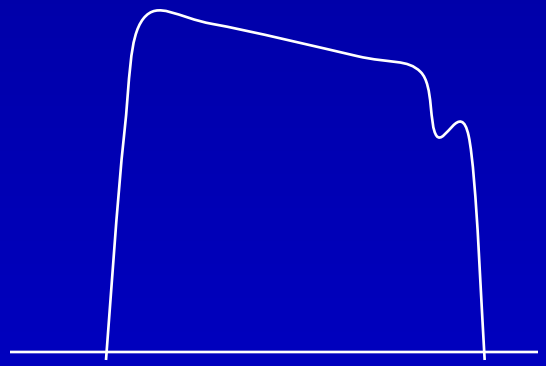
Ejection Sounds

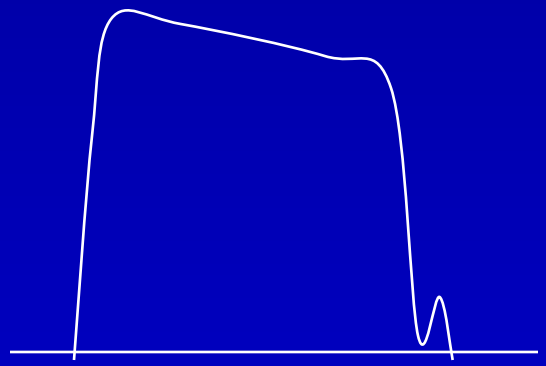
- Aortic
  - Occurs at time of peak opening of aortic valve, common theme in valve sounds
  - Causes: aortic stenosis with pliable leaflets, bicuspid valve, aortic root dilation, and less in hypertension
- Pulmonic
  - Decrease with inspiration – unique
  - Causes: valvular pulmonic stenosis, pulmonary hypertension, idiopathic dilation of the pulmonary artery

Pulmonary Ejection Sound - Inspiration

- Enhanced venous return
- Increased RA volume and RA ejection
- Increased RV end-diastolic volume from RA augmentation
- Decreased PA diastolic pressure
- In normal PA pressure, the PA diastolic pressure may drop below RVEDP, causing late diastolic opening of the pulmonary valve
- Seen in PV M-mode as increased A-dip
- Seen in PV Doppler as PR velocity of zero

Pulmonary Regurgitation





Expiration

Inspiration

Absent variation in severe right heart failure (respiratory variation is impaired), and in pulmonary hypertension

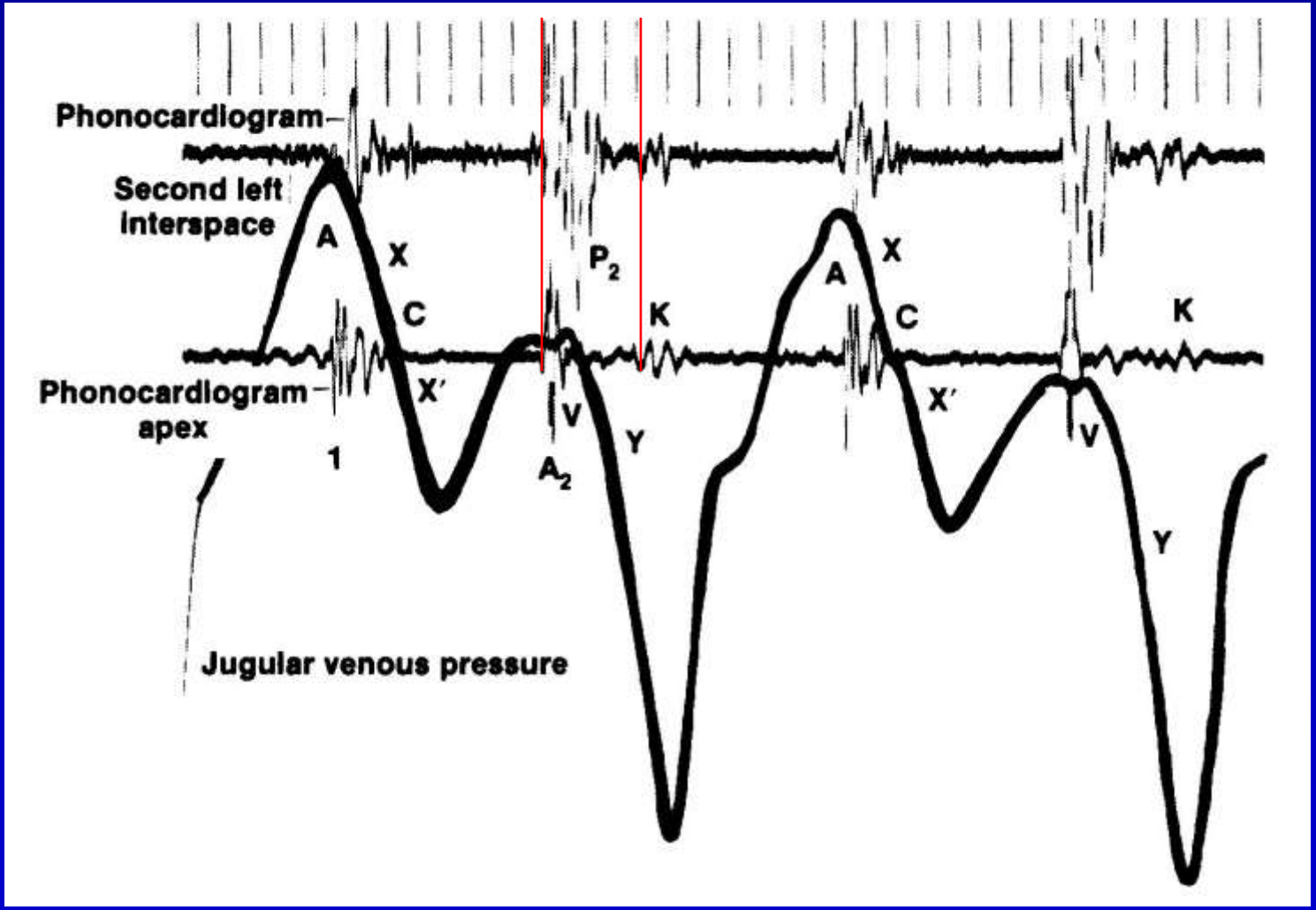
Midsystolic click of Mitral Prolapse

- Timing related to ventricular size, click moves with maneuvers earlier in systole as ventricle is smaller, and later if ventricle enlarges
- May be multiple
- May be associated with MR murmur or late systolic murmur

Opening snap (OS)

- Abnormal sound associated with AV valve opening
- Mitral or tricuspid stenosis
- Shorter time from S-2 to OS means more severe stenosis
- Listen for associated mid-diastolic murmur, diastolic rumble of stenosis

Pericardial Knock



- Constrictive pericarditis

Types of Murmurs

- Holosystolic: begins at S-1 and ends at or after S-2
- Midsystolic: begins after ICP and ends before S-2
- Mid-diastolic: begins after IRP and ends by S-1
- Early diastolic: begins at S-2 and ends by S-1
- Continuous: spans systole and diastole

Mid-Systolic Murmur

- Ejection-stenosis
- Longer and later peaking and louder and higher pitch correlate with more stenosis or turbulence
- Causes: AS, PS, HCM, physiologic, high cardiac output or stroke volume

Systolic Regurgitant Murmur

- Holosystolic
- Causes: MR, TR, VSD
- Acute severe MR may be only early systolic
- Late systolic regurgitant murmur may be from mitral prolapse or mitral papillary muscle dysfunction

Diastolic Regurgitant Murmur

- Generally high-pitched, decrescendo
- Begins at S-2
- AR, PR
- Longer generally means worse chronic regurgitation
- Acute severe regurgitation murmur may be short

Diastolic Flow/Stenosis Murmur

- Begins after S-2 (after isovolumic relaxation period)
- Low-pitched rumble
- Often presystolic accentuation
- MS, TS, Austin Flint rumble, mitral rumble from severe MR
- CORONARY STENOSIS murmur, generally soft, with diastolic flow

Continuous Murmur

- Patent ductus arteriosus (PDA), peaks around S-2
- Atrioventricular connection
- Venous hum (physiologic, increased cardiac output)
- Mammary souffle (physiologic)

Pericardial Friction Rub

- Three components
- Loudest is systolic
- Others may not be present
- Early diastolic and rapid filling
- May increase with inspiration

Respiratory variation

- Inspiration increases venous return
- More venous return means more RA and RV filling and more RV stroke volume
- All right-sided murmurs increase with inspiration
- All right-sided gallops increase with inspiration
- Pulmonary ejection sound decreases
- Left-sided murmurs show no change or mild decrease

Handgrip Exercise

- Increase in blood pressure
- Variable effect in cardiac output or stroke volume
- Usually increase in heart rate
- Increases murmurs of MR and AR and VSD
- May increase MS murmur

Postural Changes

- Upright posture increases the degree of respiratory variation of sounds and murmurs
- Standing decreases venous return, decreasing right-sided murmurs
- Squat causes increased afterload and venous return, increasing murmurs of MR and AR and VSD

Amyl nitrite Inhalation

- Vasodilator
  - first 15 seconds, drop in BP
  - afterward, increase in HR and cardiac output with lower BP
- MR and AR decrease
- MS and HCM increase
- Austin Flint rumble decreases

Arrhythmia and Auscultation

- PR interval strongly affects S-1 intensity
- Intraventricular conduction affects S-2 splitting and can affect S-1 intensity
- After a PVC, contractility and ventricular volume increase, with increase in aortic flow murmurs, but MR does not increase

A Worthy Aphorism:

We see only what we look for,
We recognize only what we know.

Merril C. Sosman

A Worthy Aphorism:

Diligent

We see only what we look for,

We recognize only what we know.

Informed

Merril C. Sosman

Midsystolic Murmur: When NOT to Echo

- No cardiac symptoms
- Normal carotid (AS)
- No RV lift (PS, ASD, ToF), normal apex (HCM)
- No ES (AS, PS), normal S2 splitting (ASD, PAPVR)
- Grade $\leq$ 2 (-3?), early systole
- Decrease with Valsalva (HCM, R vs L)
- Normal ECG and CXR

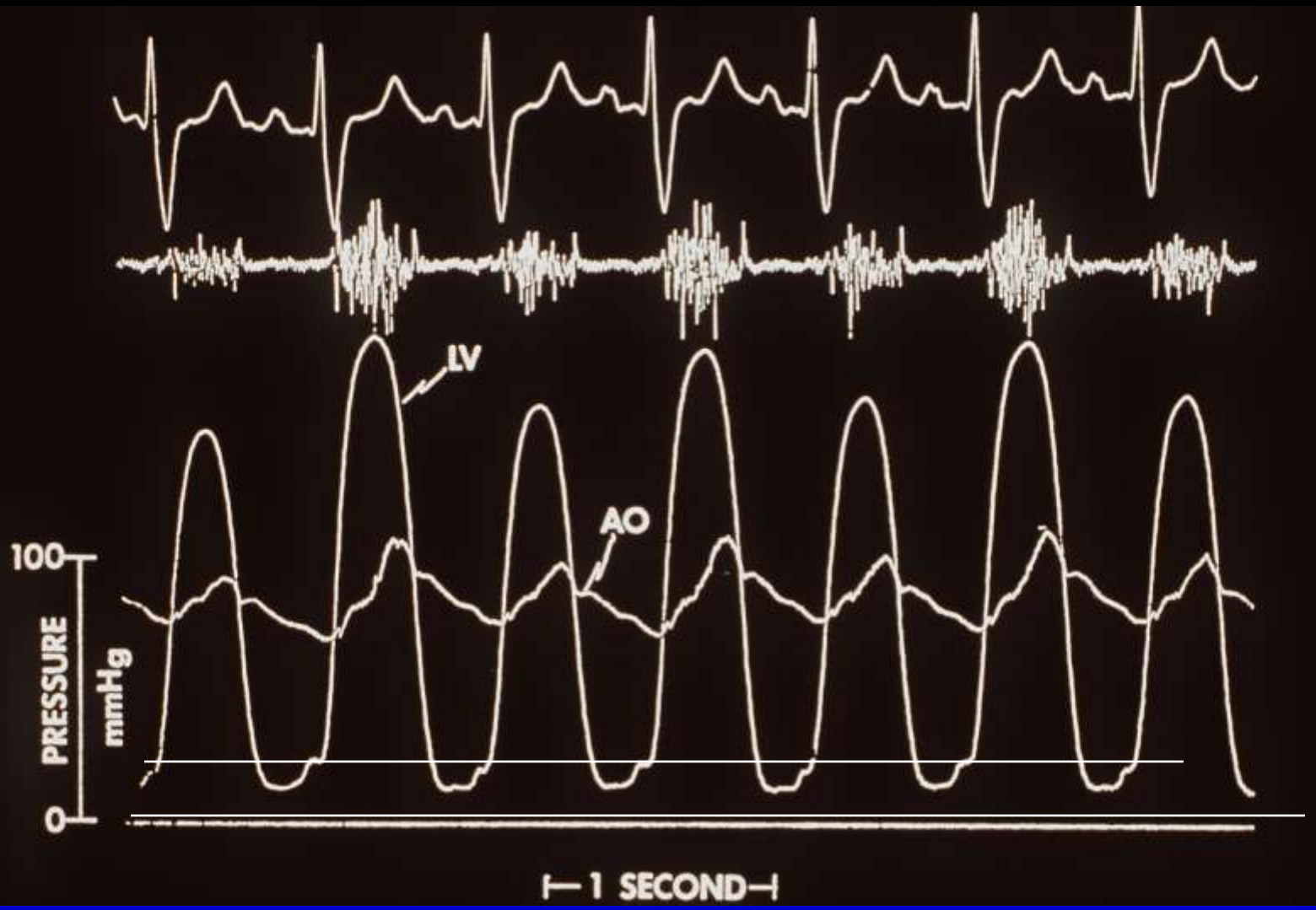
Aortic Stenosis vs. Mitral Regurgitation

- Location and radiation
- Shape or time-course
- Handgrip
- Post PVC or cycle-length variation
- Of course, echoDoppler cardiogram

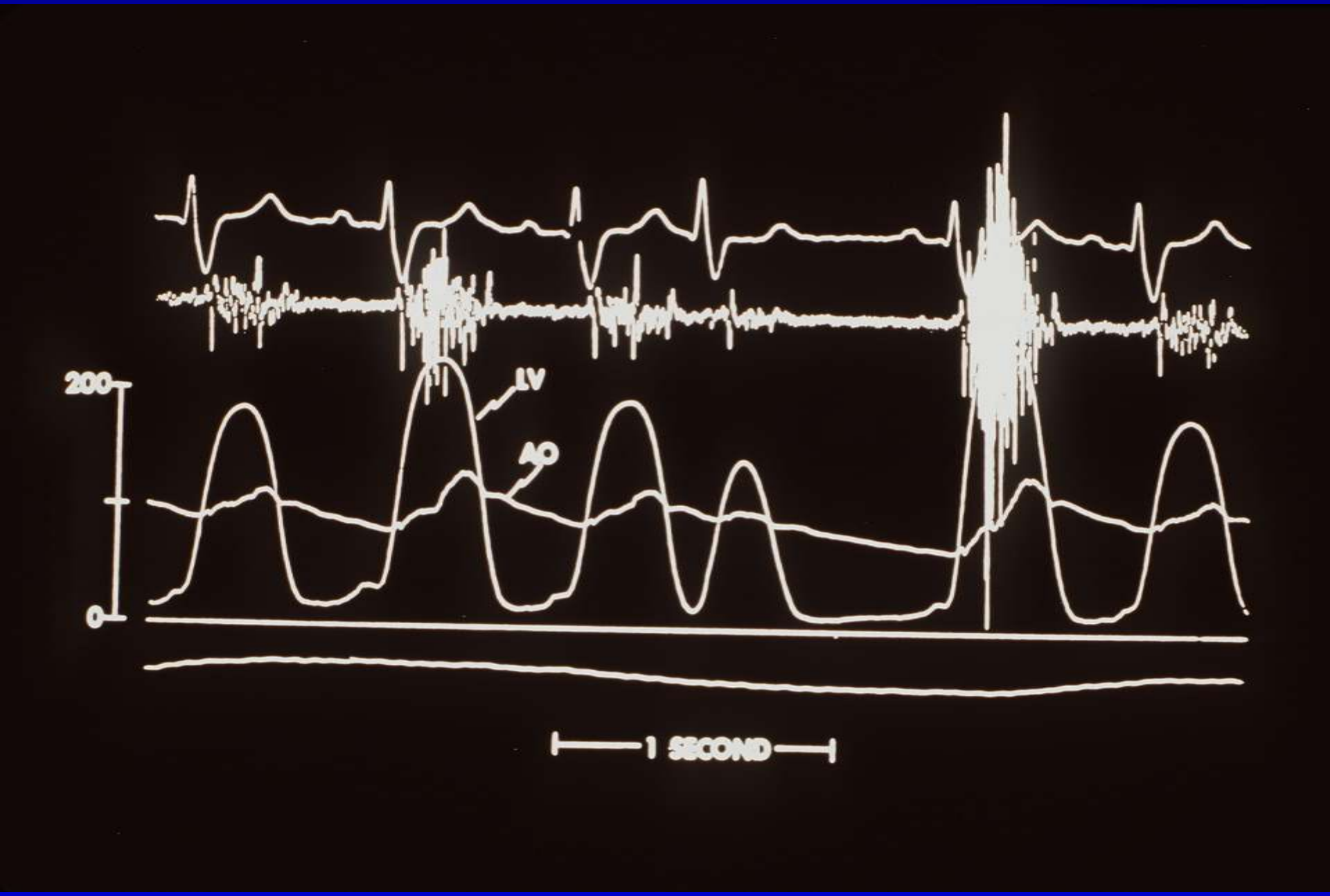
Aortic Stenosis

- Radiation to apex: Gallavardin phenomenon
- L. Gallavardin et P. Ravault
- 16 Dec 1925.. Societe Medicale des Hopitaux
- “Le souffle de retrecissement aortique peut changer de timbre et devenir musical dans sa propagation apexienne”
- 76 yo woman, 60 yo woman, 71 yo woman, each with autopsy, and in each, the murmur was considered due to aortic stenosis

Severe LV Dysfunction



S3 can also alternate, and other phenomena


200
0
LV
Ao
1 SECOND

Cardio-respiratory Murmur

- Innocent murmur, named and recognized many decades, lately not emphasized
- Best heard at LLSB or apex
- May be better heard in left lateral recumbent position
- My experience: perhaps 5 patients, relatively dramatic increase with inspiration, can manipulate murmur by controlling respiration
- My assessment: breath sounds augmented by cardiac systole … a testable hypothesis

Rytand Murmur

- Rytand, David A. An auricular diastolic murmur with heart block in elderly patients. Am Heart J 1946; 32:579
  - 9 patients
  - Apical blowing murmur, distinct from diastolic sounds
  - Murmur onset was 0.14-0.23 sec after P onset

Rytand Murmur

- Schnittger, I, et al. Diastolic mitral and tricuspid regurgitation by Doppler echocardiography in patients with atrioventricular block: new insight into the mechanism of atrioventricular valve closure. J Am Coll Cardiol 1988; 11:83-8.
  - 22 patients, 19 had murmurs
  - Murmur onset 0.14-0.19 sec after P onset
  - Murmur near end of antegrade AV valve flow
  - Diastolic AV valve regurgitation is after murmur

Other Physical Findings

- Kussmaul's sign: RV MI
- Location of AR murmur Left or Right
- Causes of Dicrotic pulse
- Causes of Midsystolic click

Heart

- Precordial inspection
- Precordial palpation
  - Impulses, sounds and thrills
  - PA, left parasternal, apical
  - Apical, left lateral decubitus position
  - Characteristics of the apical impulse – location, duration, filling waves (rapid filling and atrial filling)

Heart

- Percussion not helpful
- Auscultation – systematic
  - S1 and S2, intensity and splitting
  - S3 or S4 or other adventitious sounds
  - Murmurs
    - Systolic (regurgitant or stenotic)
    - Diastolic (regurgitant or stenotic)

Abdomen

- Organomegaly
  - Liver pulsatile
- Abdominal aortic aneurysm

Extremities

- Color
  - Pallor
  - Cyanosis
  - Nail clubbing
- Edema
- Hair loss or nail deformity
- Capillary refill