

Cardiovascular exam

Introduction

- Knowing cardiac cycle is fundamental to understand what you see and hear during cardiac exam.

Vital sign:

- BP: SBP/DBP (MAP, PP, equally both arms?, orthostasis hypotension?, lower limb BP, pulsus paradoxus)
- RR: pattern? (tachypnea, Cheyne-Stokes, apnea, kussmaul's)
- HR, PR: regular, irregularly (totally) irregular, regularly irregular?
 - Pulse: radial, brachial, carotid, femoral, popliteal, PT, DP arteries

Pulse Character
- Weak/ hypokinetic = low SV
- Strong/ bounding/hyperkinetic = high SV
- Parvus et tardus = AS
- Bisferiens = HCM, AR
- Collapsing/water hammer = AR
- Paradoxus = tamponade
- Alternans = severe LV dysf.
- Corrigan's = severe AR

Inspection:

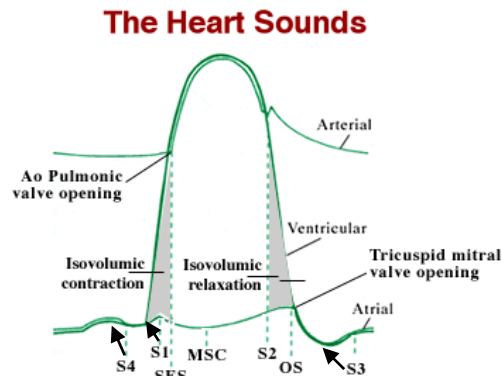
- General appearance: cyanosis (central? Peripheral? Differential?), clubbing, surgical scar
- Chest wall size/diameter, deformity
- JVP = ___ cm (vertical distance) from sternal angle at ___ degree.
- Waveform morphology/pattern (large V, cannon A, deep Y, deep X, Kussmaul's sign)
 - Others: Anemia, jaundice, crepitation, wheezing, pleural effusions, hepatomegaly, ascites, edema, cold mottle clammy skin, 6P for PAD, marfan's, splinter hemorrhage, osler's node, janeway lesion, xanthoma, telangiectasia

Palpation:

- Apical impulse or apex beat (PMI) - location, sustained? diffused?
- Heave (RV, LV)
- Thrills (systolic, diastolic, continuous) (+ thrills = murmur \geq 4/6 graded)
- Palpable P2, etc.

Auscultation

- Heart sounds decrease in insulation of the heart: air (COPD, pneumothorax), fluid, fat.
- \uparrow Heart sounds with left lateral decubitus or leaning forward position



S1 – closure of MV and TV

- High-pitched, sharp, at the same time or slightly earlier than arterial pulses.
- At LLPSB (for TV) and apex (for MV).
- marked the onset of systole

S2 – closure of AV and PV

- High-pitched, sharp, after apical impulse.
- At LUPSB (for PV) and RUPSB (for AV).
- marked the onset of diastole

S3 – rapid ventricular filling

- A soft low-pitched sound at early diastole, at LLPSB (RV) or apex (LV). Bell only

S4 – filling from atrial contraction

- Very soft, low-pitched sound right before S1, at LLPSB (RV) or apex (LV). Bell only

Extra heart sound

Loud S1	<ul style="list-style-type: none"> S1 may be louder than S2 at PVA or AVA Cause - Calcified thicken rheumatic MS; \uparrow leaflets distance "slammed shut" in short PR, tachycardia; hyperdynamic LV.
Soft S1	<ul style="list-style-type: none"> Cause - Hard to close in markedly calcified MV; fail to close leaflet in MVP; \downarrow leaflet distance in AI, prolong PR; \downarrow LV function.
Split S1	<ul style="list-style-type: none"> TV close after MV Cause - RBBB. Ddx with ejection click
Loud S2	<ul style="list-style-type: none"> Cause - \uparrowP2 in PH . \uparrowA2 in HTN
Soft S2	<ul style="list-style-type: none"> Cause - AS, PS, hypotension
Normal (physiologic) split S2	<ul style="list-style-type: none"> During Inspiration, there is a split S2 from delaying P2 (A2 then P2) Inspiration \rightarrow \uparrowvenous return \rightarrow \uparrowRV preload \rightarrow delay P2 closure after A2
Fixed splitting S2	<ul style="list-style-type: none"> fixed, not varies w respiration Cause - ASD, TAPVR, any causes that obliterate resp. variation of ventricular filling
Wide split S2	<ul style="list-style-type: none"> Wide, non-fixed, still varies w inspiration but never come together Cause - Delay P2 closure eg. RBBB, PS, PR, PH, PE, VSD, straight back, pectus excavatum. Early A2 closure eg. severe MR, VSD.
Paradoxical split S2	<ul style="list-style-type: none"> Split w expiration: something cause delay closure of AV so P2 move closer A2 during inspiration \rightarrow no split with inspiration. Cause: severe AS, LBBB, paced, HTN, HF, severe TR
(+) S3	<ul style="list-style-type: none"> LV systolic dysfunction \uparrow Rapid early diastolic filling flow (severe MR, VSD, PDA), hyperdynamic heart (young < 40 yo, high CO, pregnancy, anemia, exercise, or thyrotoxicosis). Have to Ddx with split S2 and OS
(+) S4	<ul style="list-style-type: none"> LV diastolic dysfunction eg stiff ventricle, ventricular hypertrophy, HCM, AS, HF, MI RV S4: PH, PS, TS

Systole

Early ejection (systolic) clicks

- High-pitched, early systolic sound, after S1 (S1 to ejection sound = isovolumic contraction time). Sound of opening AV or PV.
- Cause - Aortic ejection click: hard+snap open AV (bicuspid), Ao dilatation (aneurysm, AI, coarction, HTN, ToF)
- Cause - Pulmonic ejection click: hard+snap open PV (PS), PA dilatation (PH, post stenotic dilatation of PS)

Mid systolic clicks

- High-pitched, mid systolic sound of a redundant MVP leaflet motion.
- S1 to mid systolic click = time to prolapse. Any maneuver which decreases LV preload (make LV smaller), will move the click closer. Valsalva, standing \rightarrow shorter. Hand grip, squatting \rightarrow longer
- Rare TV click in Ebstein's anomaly

Diastole

Opening snap

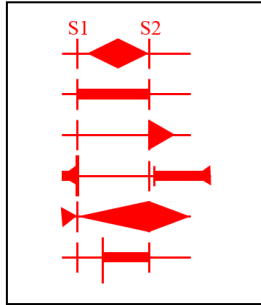
- Soft, sharp, high-pitched sound of an opening of the thickened MV leaflet in MS. Early diastole at the apex.
- S2 to ejection sound = isovolumic relaxation time.
- The more severe MS, the shorter S2 to OS. Have to Ddx with split S2 or S3.

Other:

- Pericardial rubs (3-phase thick sounds at atrial contract, ventricular contract and ventricular relaxation),
- Pericardial knock (diaphragm, early diastole, medium-pitched, seen in constrictive pericarditis)
- Metallic click (mechanical valve)
- Tumor plop (myxoma)
- IABP sounds

Murmurs:

- A turbulent flow from stenosis or regurgitation. Can be from increased flow or aneurysmal area.
- Describe by
 - Location
 - Timing/ Duration (systolic, diastolic, continuous, pan/holo, early, mid, short, long)
 - Configuration (crescendo-decrescendo (diamond shape), decrescendo, crescendo, plateau/flat)
 - Quality (high-pitched, low-pitched, ejection, coarse, harsh, musical, rumble, blowing, flat)
 - Intensity (grade I-VI): thrills = at least grade 4
 - Radiation (follow the direction of murmur flow)
 - Dynamic changes
- “listen with bias”: Use clinical setting, palpation (apical beat, heave, thrill), S1 and S2 to give clues about the murmurs and diagnosis



		Dx and Note
Systolic pan/holo plateau medium pitched	Apex to axillar or to sternum	<u>MR</u> - PSM, dilate LV, soft S1, wide splitting S2, S3, relative MS murmur - Blood from LV to LA. Volume load to LA and LV - ↑ afterload will ↑ murmurs
Systolic mid to late crescendo medium pitched	Apex to axillar or to sternum	<u>MVP</u> - SEM, mid systolic click - MR that sounds more “ejected”, happen after redundant prolapse leaflet was “click”- pushing back
Systolic pan/holo plateau low/Medium pitched	LLPSB to sternum	<u>TR</u> - PSM (same as MR but LLPSB), ↑JVP, large CV wave, pulsatile liver, RV heave - Blood from RV to RA, Volume load to RA and RV - ↑ inspiration will ↑ murmurs due to ↑ systemic venous return and blood flow in the right side (carvallo’s sign)
Systolic early/Mid-systolic (slightly after S1 = isovolumic contraction) ejection (cresc- decrescendo mod to high-pitched coarse/harsh	RUPSB To carotid	<u>AS</u> - SEM, ↓ A2, sustained apical pulse - Gradient between LV and AS, high pressure chamber has to “eject” to high pressure chamber. Pressure load to LV. - Severe AS: late peaking, soft A2, paradoxical split S2, parvus et tardus, delay upstroke carotid pulse, S4 - High-pitched, musical, systolic murmur at apex = Gallaverdin’s - if AS + early systolic click = bicuspid or dilate AO DDX - HCM: less harsh, SEM, lower in LLPSB, not radiate to neck, double impulse, S4, bisferiens pulse. Manuver! - SEM + MR (or MVP) murmurs thinks HCM! - Flow murmurs: high output, AR, Innocent
Systolic mid-systolic ejection (cresc- decrescendo high-pitched harsh	LUPSB	<u>PS</u> - SEM, RV S4, A wave, RV S4, soft/loud S2, wide splitting S2 - Pressure load to RV - DDX: isolate PA dilatation = Pulsatile pulmonary artery without loud P2 or RV heave; Straight back syndrome: ↓ AP diameter of chest, loss of dorsal curvature of spine or pectus excavatum cause PA obstruction.

Diastolic early (right after S2) decrescendo blowing high-pitched	RUPSB to RLPSB (root) to LLPSB (valve)	<u>AR</u> - DBM, apical shift, decrease S1, S3 - Volume load to LV - The length of the murmur depends upon the severity and the compliance of the ventricle. - Relative MS (mid diastolic rumbling) = Austin Flint - Shorter = severe, or acute - ↑ with expiration or ↑ afterload eg. handgrip
Diastolic mid late low pitch	LUPSB	<u>PR</u> - Valvular PR +/- PH (↑S2, RV heave) - in repair ToF - Graham steel murmur: PH causing PR - early, high-pitched diastolic blowing murmur.
Diastolic Mid, decrescendo rumbling low-pitch	Apex In left lateral or lean forward position	<u>MS</u> - ↑S1, OS +/- PH (↑P2, RV heave) - Pressure load to LA, PA, RV - Shorter S2-OS interval = more severe MS - in sinus, brief crescendo immediately before S1 (presystolic accentuation) DDx: LA myxoma, increased flow (VSD, PDA)
Diastolic	LLPSB	<u>TS</u> – very uncommon
Systolic mid-systolic ejection (cresc- decrescendo high-pitched	LUPSB	<u>ASD</u> (murmurs of PV flows) - Wide fixed split - Volume load to LA, RA, RV +/- PH, pulmonic flow murmur, relative TS, RV failure (RV heave, loud P2, RV S3, A wave, PSM, CV wave), TR
Systolic pan/holo or decrescendo high-pitched loud, blowing musical	LLPSB to RLPSB UPSB if supracristal	<u>VSD</u> - Severe if wide split S2, LV S3, LV dilate, wide splitting - Volume load to LV, PA - DDX with TR: Unchanged with inspiration - any murmur that ↑ LV pressure will ↑murmur eg hand grip
Continuous high-pitched peak before S2	Subclavicular To high sternum	<u>PDA</u> - ↑S2 - Volume load to LV, PA - Murmur during systole is shorter with higher PH

DDx: continues murmurs

- PDA: high position, more systole
- Rupture of sinus of Valsalva: more diastole, to LLPSB
- Coronary artery venous fistula
- Cervical venous hum
- Mammary soufflé
- Coarctation of aorta

Dynamic changes “thinking not remembering”

	Valsalva (strain phase)	Hand grip	Squatting	Standing	
SEM in AS	↓	↓	↑	↓	<ul style="list-style-type: none"> • Hand grip = ↑ afterload • Standing = ↓ preload • Squat = ↑ preload, ↑ afterload • Inhale = ↑ RV return, ↑ RV flow • Exhale = ↑ LV filling, ↑ LV flow • Valsalva (strain phase) = ↓ preload, ↑ contractility
SEM in HCM	↑	↓	↓	↑	
PSM in MR	↑	↑	↑	↓	
Ejection click in MVP	earlier	Later	Later	Early	