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?, othostasis hypotension?, lower limit 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

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 (PAMI) - location, sustained? diffused?
- Heave (RV, LV)
- Thrills (systolic, diastolic, continuous) (+/thrills = murmur ≥ 4/6 graded
- Palpable P2, etc.

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

<table>
<thead>
<tr>
<th>Pulse Character</th>
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</thead>
<tbody>
<tr>
<td>Weak/ hypokinetic = low SV</td>
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<tr>
<td>Strong/ bounding/hyperkinetic = high SV</td>
</tr>
<tr>
<td>Parvus et tardus = AS</td>
</tr>
<tr>
<td>Bisferiens = HCM, AR</td>
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<tr>
<td>Collapsing/water hammer = AR</td>
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<tr>
<td>Paradoxus = tamponade</td>
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<tr>
<td>Alternans = severe LV dysf.</td>
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<tr>
<td>Corrigan’s = severe AR</td>
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The Heart Sounds

S1 – closure of MV and TV
- High-pitched, sharp, at the same time or slightly earlier than arterial pulses.
- At LLSP (for TV) and apex (for MV).
- Marked the onset of systole

S2 – closure of AV and PV
- High-pitched, sharp, after apical impulse.
- At LUPS (for PV) and RUPS (for AV).
- Marked the onset of diastole

S3 – rapid ventricular filling
- A soft low-pitched sound at early diastole, at LUPS (RV) or apex (LV). Bell only

S4 – filling from atrial contraction
- Very soft, low-pitched sound right before S1, at LUPS (RV) or apex (LV). Bell only

Extra heart sound

<table>
<thead>
<tr>
<th>Loud S1</th>
<th>S1 may be louder than S2 at PVA or AVA</th>
</tr>
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<tbody>
<tr>
<td>Cause</td>
<td>Calcified thicken rheumatic MS; ↑ leaflets distance “shammed shut” in short PR, tachycardia; hyperdynamic LV.</td>
</tr>
</tbody>
</table>

Soft S1
- Cause - Hard to close in markedly calcified MV; fail to close leaflet in MVP; ↓ leaflet distance in A, prolong PR; ↓ LV function.

Split S1
- TV close after MV
- Cause - RBBB. Ddx with ejection click

Loud S2
- Cause - TP2 in PH, TA2 in HTN

Soft S2
- Cause - AS, PS, hypotension

Normal (physiologic) split S2
- During Inspiration, there is a split S2 from delaying P2 (A2 then P2)
- Inspiration → venous return → RV preload → delay P2 closure after A2

Fixed splitting S2
- S2 to inspiration = something cause delay in closure of AV and RV delayed after MV closure.
- 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
- Split w expiration: something cause delay closure of AV so P2 move closer A2 during inspiration → no split with inspiration.
- Cause: severe AS, LBBB, paced, HTN, HF, severe TR

(+ S3)
- LV systolic dysfunction
  - 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)
- 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 → shorter. Hand grip, squatting → longer.
- Rare TV click in Ebstein’s anomaly

Diastole

Opening snap
- Soft, sharp, high-pitched sound of an opening of the thicken 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

Pearls at fullpulse.weebly.com by aekarcha.a@gmail.com
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

<table>
<thead>
<tr>
<th>Systolic</th>
<th>Dx and Note</th>
</tr>
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<tbody>
<tr>
<td>pan/holo</td>
<td>Apex to axillar or to sternum</td>
</tr>
<tr>
<td>plateau</td>
<td>- PSM, dilate LV, soft S1, wide splitting S2, S3, relative MS murmur</td>
</tr>
<tr>
<td>medium pitched</td>
<td>- ↑ afterload will ↑ murmurs</td>
</tr>
<tr>
<td>mid to late</td>
<td>Apex to axillar or to sternum</td>
</tr>
<tr>
<td>crescendo</td>
<td>- SEM, mid systolic click</td>
</tr>
<tr>
<td>medium pitched</td>
<td>LLCPSB to sternum</td>
</tr>
<tr>
<td>pan/holo</td>
<td>- PSM (same as MR but LLCPSB), ↑VP, large CV wave, pulsatile liver, RV heave</td>
</tr>
<tr>
<td>plateau</td>
<td>- ↑ inspiration will ↑ murmurs due to ↑ systemic venous return and blood flow in the right side (carvallo's sign)</td>
</tr>
<tr>
<td>low/Medium pitched</td>
<td>RUPSB To carotid</td>
</tr>
<tr>
<td>early/Mid-systolic</td>
<td>- SEM, ↓ A2, sustained apical pulse</td>
</tr>
<tr>
<td>(slightly after S1 = isovolumic contraction)</td>
<td>- Severe AS: late peaking, soft A2, paradoxical split S2, parvus et tardus, delay upstream carotid pulse, S4</td>
</tr>
</tbody>
</table>
| ejection (cresc-decrescendo) | - 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. Manuever!
| mod to high-pitched coarse/harsh | LLPSB | P5 |
| | - SEM, MR (or MVP) murmurs thinks HCM! |
| | - Flow murmurs: high output, AR, innocent |
| Systolic mid-systolic ejection (cresc-decrescendo high-pitched | LUPSB | P3 |
| harsh | - SEM, RV S4, A wave, RV S4, soft/low 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. |

Dynamic changes "thinking not remembering"

<table>
<thead>
<tr>
<th>Valsalva (strain phase)</th>
<th>Hand grip</th>
<th>Squatting</th>
<th>Standing</th>
</tr>
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<tbody>
<tr>
<td>SEM in AS</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>SEM in HCM</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>PSIM in MR</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Ejection click in MVP</td>
<td>earlier</td>
<td>Later</td>
<td>Later</td>
</tr>
</tbody>
</table>

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 souffle
- Coarctation of aorta

Dynamic changes "thinking not remembering"
- Hand grip = ↑ afterload
- Standing = ↓ preload
- Squat = ↓ preload, ↑ afterload
- Inhale = ↑ RV return, ↑ RV flow
- Exhale = ↓ LV filling, ↓ LV flow
- Valsalva (strain phase) = ↓ preload, ↑ contractility

PEARLS at fullpulse.weebly.com by aekarach.a@gmail.com V2015.7.03