1. Auscultatory findings have modest sensitivity and specificity for cardiac hemodynamic parameters:
   a) S3: ~ 95% specificity & 30%-50% sensitivity for EF<50% or LV filling pressures>15mmHg. S4 is less diagnostic.
   b) Crackles on pulm exam in pts w/ dyspnea is not specific for ↑ LV filling pressures; may be absent in chronic CHF.
   c) In VHD, auscultation helps establish disease, not severity. Severe AS may be missed on PE.
2. Auscultatory skills are difficult to teach and skill levels are low: 20%-24% of cardiac findings recognized by trainees in internal or family medicine; & 35% after intensive training.
3. Acoustic stethoscopes rely on transmission of sound from the pt's chest wall, through the stethoscope tubes, and to the ear: a process prone to sound loss and resonance effects.
4. Electronic stethoscope has a receiver with filtering circuitry to ↓ ambient noise and amplification control to ↑ recognition of low-amplitude signals; with a choice of frequency range, providing better separation of high-frequency (100-500 Hz) and low-frequency (<200 Hz) signals than an acoustic stethoscope. Complex models allow storage & playback, external digital recording and transmission of heart sounds to other stethoscopes.

### Cardiac Auscultation

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>Murmur heard with stethoscope, but not at first</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Faint murmur heard with stethoscope on chest wall</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Murmur heard with stethoscope on chest wall, louder than grade 2 but without a thrill</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Murmur associated with a thrill</td>
</tr>
<tr>
<td>Grade 5</td>
<td>Murmur heard with just the rim of the stethoscope held against the chest</td>
</tr>
<tr>
<td>Grade 6</td>
<td>Murmur heard with the stethoscope held away and in from the chest wall</td>
</tr>
</tbody>
</table>

**Maneuver** | **Hemodynamic Effect** | **Murmur Effect**
---|---|---
Normal respiration | Transient increase in venous filling during inspiration | Increases right-sided murmurs
Passive leg elevation | Increases venous return (transient increase in LV size and preload) | Increases right-sided murmurs; decreases murmur of HOCM and MVP
Stand to squat | Increases venous return (transient increase in LV size and preload) | Increases right-sided murmurs; decreases murmur of HOCM and MVP
Squat to stand | Decreases venous return (transient decrease in LV size and preload) | Increases murmur of HOCM; moves midsystolic click of MVP closer to S1 and increases murmur of MVP; decreases AS murmur
Valsalva | Decreases venous return (transient decrease in LV size, preload, and relative systemic hypotension) | Increases murmur of HOCM; moves midsystolic click of MVP closer to S1 and decreases murmur of MVP
Isometric handgrip exercise | Increases afterload | Increases murmur of MR and VSD; decreases murmur of HOCM; decreases AS murmur
Inhaled amyl nitrate | Decreases afterload | Decreases murmur of MR and VSD; no change to AS murmur
Systolic Cardiac Sounds

**Normal Physiologic Splitting**

Exhibition: A2 > P2

Audible Expiratory Splitting

*Wide physiologic splitting*

Expiration: A2 < P2

Inspiration: A2 > P2

**Reversed splitting**

LBBB, RV pacing; HOCM; Severe AS, CHF

**Narrow physiologic splitting (↑ P2)**

PH

**Midsystolic Click of MVP**

**Ejection Clicks**

A dilated aorta or pulmonary artery

or

A flexibly stenotic aortic or pulmonic valve or a bicuspid aortic valve

Ejection clicks are early systolic sounds found in association with
### Systolic Cardiac Murmurs

<table>
<thead>
<tr>
<th>Diagram</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Functional systolic ejection murmur</td>
</tr>
<tr>
<td>B</td>
<td>Mild aortic valvular stenosis</td>
</tr>
<tr>
<td>C</td>
<td>Severe aortic stenosis</td>
</tr>
<tr>
<td>D</td>
<td>Hypertrophic obstructive cardiomyopathy</td>
</tr>
<tr>
<td>E</td>
<td>Severe pulmonary valvular stenosis</td>
</tr>
<tr>
<td>F</td>
<td>Atrial septal defect</td>
</tr>
<tr>
<td>G</td>
<td>Uncomplicated mitral regurgitation</td>
</tr>
<tr>
<td>H</td>
<td>Mitral valve prolapse</td>
</tr>
<tr>
<td>I</td>
<td>Tricuspid regurgitation due to pulmonary hypertension</td>
</tr>
<tr>
<td>J</td>
<td>Uncomplicated ventricular septal defect</td>
</tr>
</tbody>
</table>

- **A**: Note early peaking
- **B**: Note relatively early peaking and systolic ejection click
- **C**: Note late peaking and decreased intensity of A2
- **D**: Hypertrophic obstructive cardiomyopathy
- **E**: Note late peaking with murmur extending through A2 and delayed appearance of P2
- **F**: Note wide splitting of S2
- **G**: Note holosystolic murmur extending through A2
- **H**: Note late systolic murmur ushered in by midsystolic click
- **I**: Note holosystolic murmur beginning with T1 and early, loud P2
- **J**: Note loud, holosystolic murmur with mid-systolic accentuation and slightly delayed P2
Presystolic accentuation of the murmur of mitral stenosis with sinus rhythm

Opening snap and mid-diastolic rumble of mitral stenosis

Early decrescendo diastolic murmur of aortic or pulmonic regurgitation

Diastolic filling sound ($S_3$) and mid-diastolic murmur associated with severe mitral regurgitation, tricuspid regurgitation, or atrial septal defect with significant left to right shunt

Continuous murmur of patent ductus arteriosus that envelops $S_2$
Carotid Pulses

A. Hyperkinetic Pulse

B. Bisferiens Pulse

F. Bifid pulse characteristic of IHSS

C. Hypokinetic Pulse

D. Parvus et Tardus Pulse

E. Dicrotic Pulse + Alternans

Apical impulse

CONTOUR

1. Normal
2. Sustained
3. Bifid or double
4. Diastolic expansion

CAUSES

1. Left ventricular hypertrophy
2. Hypertrophic cardiomyopathy
3. LVH with atrial gallop
4. LV dysfunction (dilatation) with ventricular gallop
5. Constrictive pericarditis

Palpable portion of impulse
Jugular Vein Pressure

Positioning of the penlight with respect to the patient's neck. Placement of the right third finger over the left carotid artery

Proper technique to obliterate the venous pulse by digital compression

Measurement of the mean venous pressure with regard to the sternal angle of Louis

Phonocardiogram and jugular venous pulse tracing from a middle-aged man with pulmonary hypertension (pulmonary artery pressure 70 mm Hg) caused by cardiomyopathy. The jugular venous pulse tracing demonstrates a prominent a wave without a c or v wave being observed. The phonocardiograms (fourth left interspace and cardiac apex) show a murmur of tricuspid insufficiency and ventricular and atrial gallops

A. Tricuspid Regurgitation

B. Tricuspid Stenosis

C. Constrictive Pericarditis

D. Atrial Septal Defect

E. Atrial Fibrillation

F. First Degree AV Block

G. Complete AV Block