

**AUSCULTATION OF
PEDIATRIC HEART
SOUNDS**

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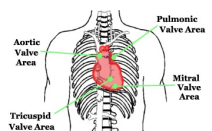
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BASIC ANATOMY

Most heart mass is left of midline
 “Right” and “Left” heart actually is “Anterior” and “Posterior” heart
 Important to be aware of internal position/orientation of the cardiac valves
 Surface anatomy: auscultatory areas for various heart valves, “best” areas for different murmurs, clicks, etc.

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BASIC ANATOMY



The diagram shows the heart in relation to the chest wall. Labels indicate the following areas: Aortic Valve Area (top left), Pulmonic Valve Area (top right), Mitral Valve Area (middle right), and Tricuspid Valve Area (middle left).

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PALPATION

Palpate to Assess

- Precordial activity
- Femoral Pulses

Increased precordial activity = increased RV and/or LV stroke volume (i.e. ASD, VSD, PDA)

- other non-cardiac reasons
 - Anemia
 - Anemia
 - Hyperthyroidism

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PALPATION

Both brachial pulses

Right brachial and femoral simultaneously

- If timing and intensity equal and right arm BP normal = coarctation not likely
- Coarctation suspected if
 - Brachial femoral delay
 - Poor femoral pulses
 - >20 mmHg SBP gradient from right arm to lower extremity

Thrills: felt when increase pressure gradient

- VSD in LL3B
- Severe pulmonary stenosis in LU3B
- Aortic stenosis in suprasternal notch

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AUSCULTATION

- Valve closures:
 - First heart sound (S1)
 - Second heart sound (S2)
 - Third Heart sound (S3)
 - Fourth Heart sound (S4)
- Murmurs
 - Systolic
 - Diastolic
 - Continuous
- Other Heart Sounds (clicks, rubs, pericardial knock)

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FIRST HEART SOUND (S1)

- Closure of AV valves (Mitral and Tricuspid)
- Best heard at apex/LLSB
- Intensity
 - Louder with increased HR, high output state (anemia, fever, exercise)
- Splitting of S1
 - Can be normal
 - Right bundle branch block (RBBB), Ebstein's anomaly
 - sometimes difficult to distinguish from S3 or S4
 - Ejection click
- Inaudible/obscured
 - VSD, AV valve regurgitation, PDA, severe pulmonary stenosis

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SECOND HEART SOUND (S2)

Two components: Aortic (A2) and Pulmonic (P2)

Best heard at USB

- A2 best in apex/RLUSB
- P2 best in LLSB

Intensity

- A2 LOUDER with hypertension, SCFTB, with AI
- P2 LOUDER with pulmonary hypertension, SCFTB with P2/P1

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SECOND HEART SOUND (S2)

Time interval between A2 and P2 varies with respiration

- Inspiration delays P2 ("physiologic splitting of S2")

Narrowly split S2: late A2 (AS) or early P2 (pulm HTN)

Widely split S2:

- ASD
- RBBB
- RV outflow obstruction

Loss

- Pulmonary hypertension
- Pulmonary atresia

Clicks

- Aortic / Pulmonary Stenosis

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THIRD HEART SOUND (S3)

- Low frequency sound
- Early diastole
- rapid filling of left ventricle
- NORMAL finding in healthy children (compliant ventricle)
- Can be pathologic:
 - dilated ventricle/decreased compliance (large VSD)

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FOURTH HEART SOUND (S4)

ALWAYS abnormal in children

Late diastole

Sound caused by atrial contraction forcing blood against a stiff, noncompliant ventricle

- Congestive Heart Failure
- Ventricular hypertrophy

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HEART MURMURS

Audible noise due to turbulent blood flow, longer duration than a normal heart "sound"

Does not necessarily indicate structural heart disease

- Emphasize this point to the family

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HEART MURMURS

Many characteristics (should be used to describe all murmurs)

- Location
- Timing (systolic, diastolic, continuous)
- Intensity (loudness)
 - Grade I-VI
- Duration
- Frequency
 - High...diaphragm
 - Low...bell

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HEART MURMURS

Characteristics of murmurs

- Radiation
- Effect of respiration
- Response to maneuvers
 - mitral murmur get louder with supine position

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HEART MURMURS

Grading system

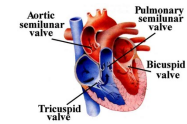
- **SYSTOLIC** Grade I - VI
- Grade I Barely audible with stethoscope and careful listening
- Grade II Readily heard but not loud
- Grade III Loud, obvious, NO THRILL
- Grade IV Loud, obvious, + THRILL
- Grade V Loud enough to hear with stethoscope held partially off chest, + THRILL
- Grade VI Heard with stethoscope completely off chest, + THRILL

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HEART MURMURS

SYSTOLIC MURMURS

- Abnormalities of blood flow while the ventricle is contracting
- Aortic Stenosis
- Pulmonic Stenosis
- Mitral Regurgitation
- Tricuspid Regurgitation
- Ventricular Septal Defect



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SYSTOLIC MURMURS

- **SYSTOLIC EJECTION** murmur
 - Between S1 and S2
 - Ventricular outflow obstruction (AS and PS)
- **HOLOSYSTOLIC**
 - Obscure S1
 - MR mitral regurgitation
 - Tricuspid Regurgitation
 - Mitral Regurgitation
 - Ventricular Septal Defect

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HOLOSYSTOLIC MURMURS

VENTRICULAR SEPTAL DEFECT (VSD)

- harsh, usually at least Grade II/VI
- louder murmur usually indicates smaller defect
- best heard at left lower sternal border
- +/- palpable thrill
- Larger defects can be associated with diastolic rumble due to increased volume across the mitral valve (left-to-right shunting)

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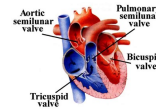
DIASTOLIC MURMURS

Occur between S2 and S1

Almost always PATHOLOGIC
• careful assessment and usually referral to cardiologist

CAUSES

- AV (tricuspid/mitral) valve stenosis
- Increased flow across AV valve
- aortic/pulmonary valve insufficiency
- Decreased ventricular compliance



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INNOCENT MURMURS

S1 clearly audible, <Grade 2/6, Normal S2, normal pulses

INNOCENT causes:

- Still's (vibratory) murmur
- Pulmonary flow murmur
- Venous Hum

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INNOCENT MURMUR

Still's Murmur

- low to medium frequency
- harmonic, musical, buzzing, twangy, violin string
- best heard lower left sternal border
- DISAPPEARS with sitting or standing
- Common in preschool age
- No referral/further testing/treatment necessary
- Most will "grow out of it" by teenage years
- REASSURE !!

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INNOCENT MURMUR

Peripheral Pulmonary Stenosis of the newborn

- Infant 1-3mo
- High pitched, systolic
- LUSB with radiation to axilla and back
- Unless infant is dysmorphic, watch and wait
- Usually resolves by 6 month of age

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INNOCENT MURMUR

Pulmonary Flow Murmur - INNOCENT

- best heard at second/third intercostal space
- mid-frequency, mid-systolic
- usually less than Grade III/VI
- Common with increased cardiac output states
 - Anemia, fever, hyperthyroidism
- "innocent" by itself
 - BE SURE NOT ASSOCIATED WITH ATRIAL SEPTAL DEFECT (ASD)

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INNOCENT MURMUR

Venous Hum

- Innocent cause of continuous murmur
- Often associated with Still's murmur
- Heard above the clavicle on either side
- Disappears with compression of jugular vein
- Press with stethoscope or have patient turn head to side

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CONTINUOUS MURMURS

Present in both systole and diastole

Many CAUSES

- Persistent Ductus Arteriosus (PDA)
- Coronary fistula
- Surgical shunts (e.g. Blalock-Taussig shunt)
- Venous hum (INNOCENT)

Almost always pathologic and warrant referral to a pediatric cardiologist

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PERSISTENT DUCTUS ARTERIOSUS

PDA

- Normal in newborns but should not be present after 2 weeks
- Usually diagnosed at first well-visit, not in NBN
- Girls:boys 3:2
- More common in preemies, high altitudes, maternal rubella
- Continuous machinery-like, louder in systole, obscures S2
- Louder = larger defect
- Best heard over first and second left intercostal spaces
- Increased precordial activity and bounding pulses

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SYSTOLIC EJECTION CLICKS

A "click" is a high-frequency sound of short duration

Can be due to opening of a stenotic semilunar valve (e.g. bicuspid aortic valve) or due to a large ejection volume

PULMONIC CLICK:

- Early in systole, left upper sternal border
- **Respiratory variation** - becomes softer during inspiration
 - the only right heart sound which is softer with inspiration
 - Inspiration **INCREASES** blood return to RV
 - Inspiration **DECREASES** pulmonary vascular resistance
 - **NET EFFECT** easier for pulmonary valve to open (less "click")

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SYSTOLIC EJECTION CLICKS

AORTIC CLICK

- Early in systole
- Listen in apex - may be difficult to hear in normal aortic area (RUSB) due to accompanying loud aortic stenosis murmur
- **NO respiratory variation**

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MID-SYSTOLIC CLICK

Mid-systolic Click = MITRAL VALVE PROLAPSE

- High-frequency, short duration
- Due to tensing of chordae of mitral valve
- Best heard at the apex
- **Maneuvers:**
 - Supine \rightarrow Standing Click will occur **EARLIER** in systole
 - Squatting Click will occur **LATER** in systole

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HYPERTROPHIC CARDIOMYOPATHY

Systolic murmur loudest at LLSB

Murmur will get **LOUDER** with **STANDING**

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MURMUR 3

Any age
Grade 2-4/6
Continuous or Machine-like
Best heard at LUSB
Radiates to back
Bounding pulses (wide pulse pressure)

PATENT DUCTUS ARTERIOSUS

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MURMUR 4

Any age
Grade 2-3/6
Systolic ejection murmur or pulmonary flow murmur
Best heard at LUSB in supine position
Widely split and fixed S2
Murmur absent in infants

ATRIAL SEPTAL DEFECT

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MURMUR 5

Age varies
Grade 2-5/6
High-pitched holosystolic murmur
Best heard at LLSB
Mid-diastolic rumble at apex
Often absent in newborns

VENTRICULAR SEPTAL DEFECT

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MURMUR 6

Age varies
Grade 2-3/6
Systolic ejection murmur
Best at LUSB with radiation to the back
May hear a click
May have loud or widely split S2

PULMONARY STENOSIS

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MURMUR 7

Age varies
Grade 2-5/6
Harsh systolic ejection murmur
Best heard at 2nd RICS radiating to left back
May hear click at apex, 2nd RICS
Thrill at 2nd RICS and right neck

AORTIC STENOSIS

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CONCLUSIONS

Develop a systematic approach to auscultation
Use all clues from physical exam
Be suspicious on everybody
Practice, practice, practice !!!
Know when to refer
• Diastolic murmur, pathologic systolic or continuous murmur, any murmur > Grade III, symptomatic patients with murmur

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