An Internet based resource for instruction of cardiac auscultation

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Heart sounds

• Stethoscope invented by Laennæc in 1816
• Initially a simple tube
• Binaural stethoscope invented about 1851
• Sprague-Rappaport 1940s
• Littman 1960s
Equipment variability

• [http://www.forusdocs.com/reviews/Acoustic_Stethoscope_Review.htm](http://www.forusdocs.com/reviews/Acoustic_Stethoscope_Review.htm)

• Differences in size, weight convenience, frequency response
Heart sounds

First heart sound: mitral and tricuspid valve closure

Second heart sound: pulmonary and aortic valve valve closure
Phonocardiography

- Records transmitted sounds
- Used to try to relate sounds to cardiac cycle
- For instruction, a device was needed that:
  - Recorded heart sounds for review
  - Demonstrated the sounds visually as well as audibly for classroom use
  - Looping helpful for review; a concept ahead of its time
Einthoven: ECG and phonocardiogram transmission

Heart sounds

Note phonocardiogram at bottom
Phonocardiography

Advertisement in Circulation Research, 1962
Phonocardiography
Innovative technology

• Portable; could be taken to the patient
• Permanent analog record
• Simultaneous oscilloscope display
• Played back as loops, similar to digital echocardiography decades later
UNC Recordings

- Performed on patients by Robert Herrington, M.D. and Stewart Schall, M.D.
- 1969-1975
- Recordings were then used for instruction of medical students, nurses, and house officers
Patient Recordings

- 70 patients with a variety of cardiac conditions, including several with innocent murmurs
- Congenital heart disease
- 13 with Rheumatic heart disease

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PDA</td>
<td>5</td>
</tr>
<tr>
<td>ASD</td>
<td>3</td>
</tr>
<tr>
<td>VSD</td>
<td>6</td>
</tr>
<tr>
<td>PS</td>
<td>6</td>
</tr>
<tr>
<td>AS +/- AI</td>
<td>5</td>
</tr>
<tr>
<td>ToF</td>
<td>2</td>
</tr>
</tbody>
</table>
Rheumatic heart disease

- Sharp decline in developing world
- Principal confounding diagnosis during IVIG trials for Kawasaki Disease in 1980s
- Role of improved living conditions
- Decline in frequency of rheumatologic strains of Group A Streptococcus
- Severe issue in developing world
- 2-3% of school age children in some countries have RHD
Phonocardiography

Recordings

• Almost all had four recordings performed to demonstrate localization
  • Right upper sternal border (A)
  • Left upper sternal border (B)
  • Left lower sternal border (C)
  • Cardiac apex (D)
Digitization of recordings

- Obtained permission from UNC healthcare to record and display recordings without identifying information
- Recordings performed at the Beasley Multimedia Center of the UNC Music Department
- Recordings vary in quality and are not modified
- Good headphones or speakers are very helpful...like high quality stethoscopes
# UNC Heart Sounds Project

## About

Welcome to the UNC Heart Sounds Project. For more information on the project, click here, or just dive into the archived sounds to the right!

Listening to sounds requires Javascript and Flash 8 or higher. Use the controls below the table to navigate the archives, and click the column headers to re-sort the table.

Special thanks to the Will Bosley and the Beasley Multimedia Center for technical assistance and time digitizing the original recordings.

## Table of Sounds

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Type</th>
<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>1. Fair PDA murmur of premature infant (1400 gm) (&quot;rocky&quot; or &quot;gravely&quot;)</td>
<td>Systolic</td>
<td>Aortic Stenosis</td>
</tr>
<tr>
<td>1972</td>
<td>2. ASD and partial anomalous pulmonary venous drainage - very large L -&gt; R shunt atrial level</td>
<td>Continuous</td>
<td>Patent Ductus Arteriosus</td>
</tr>
<tr>
<td>1969</td>
<td>3. Double outlet RV, pulmonary stenosis, total anomalous venous return</td>
<td>Systolic</td>
<td>Total Anomalous Pulmonary Venous Return</td>
</tr>
<tr>
<td>1971</td>
<td>4. S/P ToF repair with aortic RV fistula</td>
<td>Continuous</td>
<td>Tetralogy of Fallot</td>
</tr>
<tr>
<td>1969</td>
<td>5. No description</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>1972</td>
<td>6. VSD and AI not well heard</td>
<td>Unknown</td>
<td>Ventricular Septal Defect</td>
</tr>
<tr>
<td>1972</td>
<td>7. Post-op A5 (operated 1965) with significant residual stenosis, 15 year old</td>
<td>Systolic</td>
<td>Aortic Stenosis</td>
</tr>
<tr>
<td>1969</td>
<td>8. Freq. Det. Off, recorded at level 5</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>1972</td>
<td>9. 10 year old S/P aortic valve surgery</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>1972</td>
<td>10. PS, PI, s/p pulmonary valvuloplasty, 8 year old girl</td>
<td>Systolic and Diastolic</td>
<td>Pulmonary Stenosis and Insufficiency</td>
</tr>
<tr>
<td>1972</td>
<td>11. ASD with atypical murmur; soft pulmonary ejection murmur, split S2 varies slightly, diastolic murmur loudest at apex</td>
<td>Systolic and Diastolic</td>
<td>Atrial Septal Defect</td>
</tr>
<tr>
<td>1973</td>
<td>12. VSD with valvar and infundibular PS, ejection click appears on expiration</td>
<td>Systolic</td>
<td>Ventricular Septal Defect and Pulmonary Stenosis</td>
</tr>
<tr>
<td>1973</td>
<td>13. RHD with good AI, MI, Austin Flint, aortic ejection murmur</td>
<td>Systolic and Diastolic</td>
<td>Rheumatic Heart Disease</td>
</tr>
<tr>
<td>....</td>
<td>14. 5 year old with aortic stenosis, paradoxical splitting, W.P.W.</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>1970</td>
<td>15. VSD</td>
<td>Systolic</td>
<td>Ventricular Septal Defect</td>
</tr>
</tbody>
</table>
heartsounds.unc.edu

Selecting a patient history brings the user to this page...

Selecting a recording brings up both the recording and a representation of the phonocardiogram.
Second heart sound

- Key auscultatory finding
- Caused by closure of the aortic (A2) and pulmonary (P2) valves
  -Expiration: closure superimposed
  -Inspiration: P2 delayed relative to A2
- Documents presence of the pulmonary and aortic valves
- Persistently single in conditions such as pulmonary hypertension
- Persistently split in atrial septal defects
Normal second heart sound

The first and second heart sounds are labeled “1” and “2”; the intermittent (normal) splitting of the second sound is labeled “SP”. There is high pitched artifact in this recording, but the second heart sound variation is still evident.
The first and second heart sounds are labeled “1” and “2”; the intermittent (normal) splitting of the second sound is labeled “SP”.

55-B
The first and second heart sounds are labeled “1” and “2”; the intermittent (normal) splitting of the second sound is labeled “SP”. There is a suggestion of splitting in some of the sounds labeled “2” as well.
Normal second heart sound

The first and second heart sounds are labeled “1” and “2”; the intermittent (normal) splitting of the second sound is labeled “SP”.

67-B
The first and second heart sounds are labeled “1” and “2”; the vibratory murmur is labeled “M”, and occurs between the first and second sound.
Vibratory murmur

The first and second heart sounds are labeled “1” and “2”; the vibratory murmur is labeled “M”, and occurs between the first and second sound. The occasional (normal) splitting of the second sound is labeled “SP”.
Vibratory murmur

The first and second heart sounds are labeled “1” and “2”; the vibratory murmur is labeled “M”, occurs between the first and second sound, and is more difficult to hear in part due to the patient’s tachycardia.
Vibratory murmur

The first and second heart sounds are labeled “1” and “2”, with the harmonic murmur labeled “M”. Physiologic splitting of the second sound, and background respiratory sounds, are also present.
Vibratory murmur

The first and second heart sounds are labeled “1” and “2”; the innocent murmur is labeled “M”. The second heart sound is frequently split in this recording.
Vibratory murmur

The first and second heart sounds are labeled “1” and “2”; the murmur “M” occurs early in systole.
The first and second heart sounds are labeled “1” and “2”; the innocent murmur “M” is softer than in the other samples.
This patient has an additional sound, an early systolic click, at or near the onset of the systolic murmur. The murmur makes the click difficult to hear with all cycles.
This patient has an additional sound, an early systolic click, following the first heart sound.
This patient has an additional diastolic sound, or S3, following the second heart sound. Typically this sound is best heard over the cardiac apex.
This patient has an additional diastolic sound, or S3, following the second heart sound. Typically this sound is best heard over the cardiac apex.
This is a systolic ejection murmur of pulmonary stenosis; a systolic click is often present, but is not prominent in this recording. The murmur has more variable pitch than the murmur of a VSD.
This is a systolic ejection murmur of right ventricular outflow tract obstruction in tetralogy of Fallot. Note the occasional respiratory arrhythmia associated with the child’s breathing “B”.

Tetralogy of Fallot; RV outflow obstruction
Mitral stenosis

This patient with rheumatic heart disease has a diastolic sound “D” of mitral stenosis, which is heard best over the apex. There is a louder systolic murmur “S” which is not commented on, but in this situation is most likely mitral regurgitation.
This is a holosystolic murmur of mitral stenosis, heard in a patient with a history of rheumatic fever.
The aortic insufficiency murmur is a diastolic (following the second heart sound) decrescendo murmur. This patient also has a softer systolic ejection murmur, possibly mild aortic stenosis. Cause: rheumatic heart disease.
The aortic insufficiency murmur is a diastolic (following the second heart sound) decrescendo murmur. This patient also has a systolic ejection murmur, possibly aortic stenosis. Cause: rheumatic heart disease.
The aortic insufficiency murmur is a diastolic (following the second heart sound) decrescendo murmur. This patient also has a systolic ejection murmur, possibly mild aortic stenosis. Cause: rheumatic heart disease.
There is both a systolic ejection murmur of aortic stenosis “S” and a diastolic decrescendo murmur of aortic insufficiency “D”.

Aortic Stenosis and Insufficiency
This is a harsh holosystolic murmur of a ventricular septal defect.
Strange sounds...

Click to begin

A “honking” sound of a patent ductus arteriosus.

26-C
Strange Sounds...

Click to begin

“Everted mitral valve cusps.”
Strange Sounds...

Click to begin

“Everted mitral valve cusps.”

36-B
Localization

Diastolic filling sounds are best heard at the cardiac apex.

11-C  LLSB

11-D  APEX
Aortic insufficiency murmur best heard at the RUSB; there is an additional S3 at the apex!
Localization

Aortic stenosis murmur best heard at the RUSB

33-A RUSB

33-D APEX
Localization

Pulmonary stenosis: murmur
best heard at the LUSB

38-A  RUSB

38-B  LUSB
Localization

Rheumatic heart disease:
- early diastolic murmur of AI at LUSB
- Systolic murmur of mitral regurgitation at apex

Click to begin
Localization

Ventricular septal defect: best heard at LLSB with radiation to apex, but less intensity at LUSB.
Phonocardiography Recordings

- Interesting archive of pediatric cardiology
- Instructional tool for physical diagnosis, thanks to the inspiration of Drs. Herrington and Schall
- The physical examination continues to be important, and improvement of the skills of trainees is vital
- Potential for telemedicine application for murmur diagnosis in developing countries