Signs and symptoms in cardiovascular problems

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Agenda

1. Examination of the **heart**
- Heart sounds
- Heart murmurs (systolic, diastolic)
2. **Cyanosis**
3. **Clubbing**
4. **Heart failure-** signs & symptoms
5. **Practical approach** to examination of cardiac system

History taking in cardiac problems

- **Prenatal** history
  - previos prenatal US/scans,
  - prenatal echocariography
- **Neonatal period- echocardiography**
- **Eating problems (breastfeeding?)-** neonatal pediod, infancy
- **Excesive sweating** of the child
- **Physical activity-** compare to peers, NYHA scale
- **Fainting? / Syncope?-** anytime? In what conditions?
- **Condition of teeth !**
- **Family history** of
  - congenital heart defects,
  - cardiac arrest,
  - sudden deaths
  - arrythmia?

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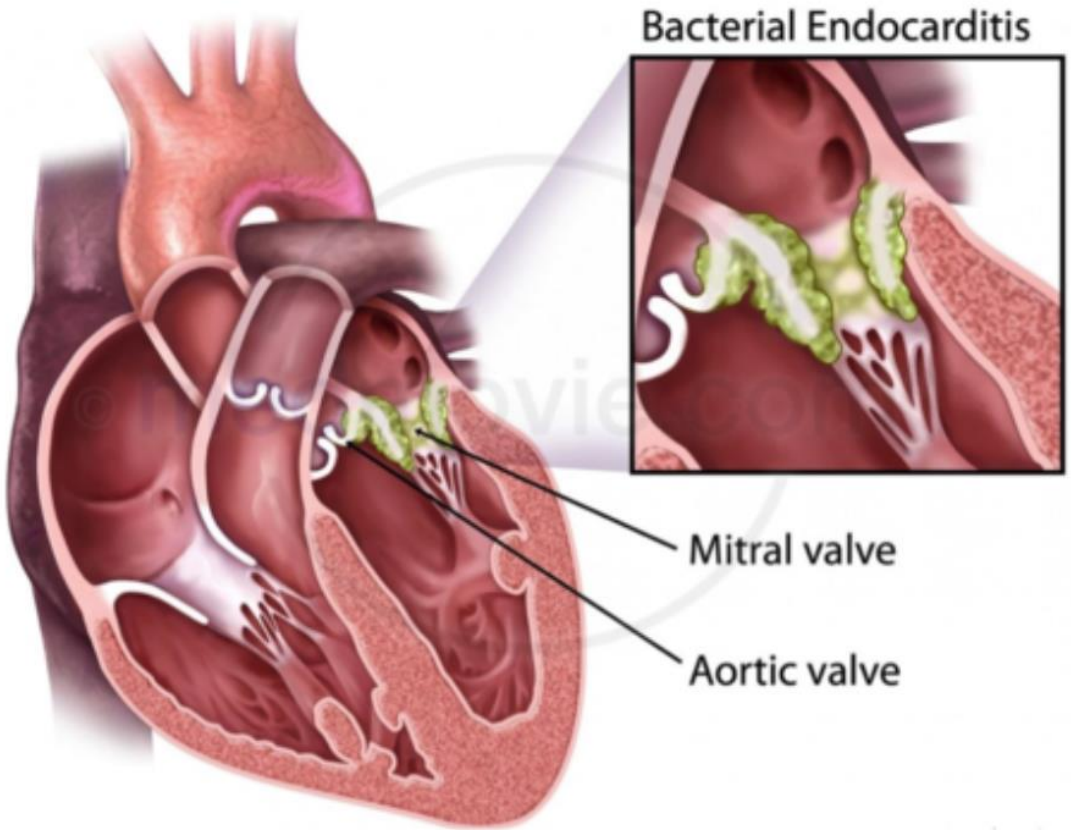
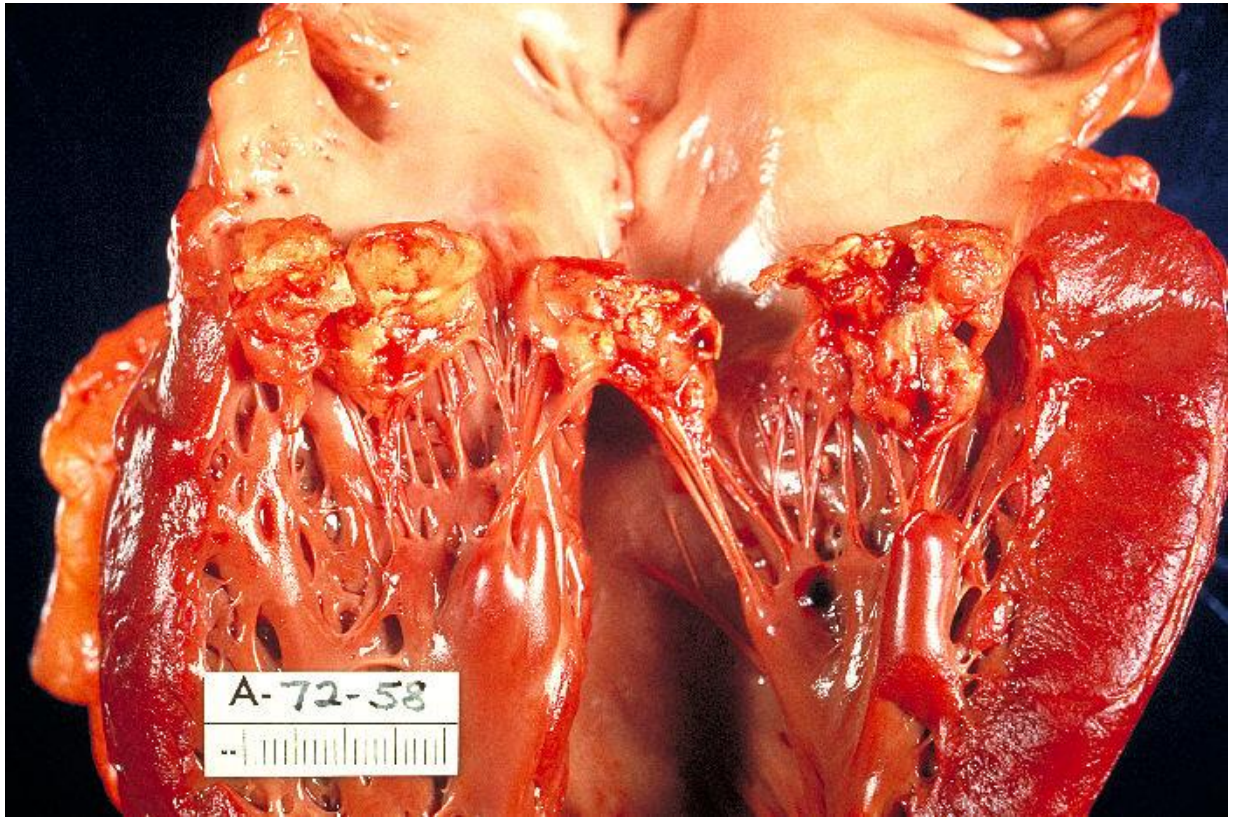
Infective endocarditis





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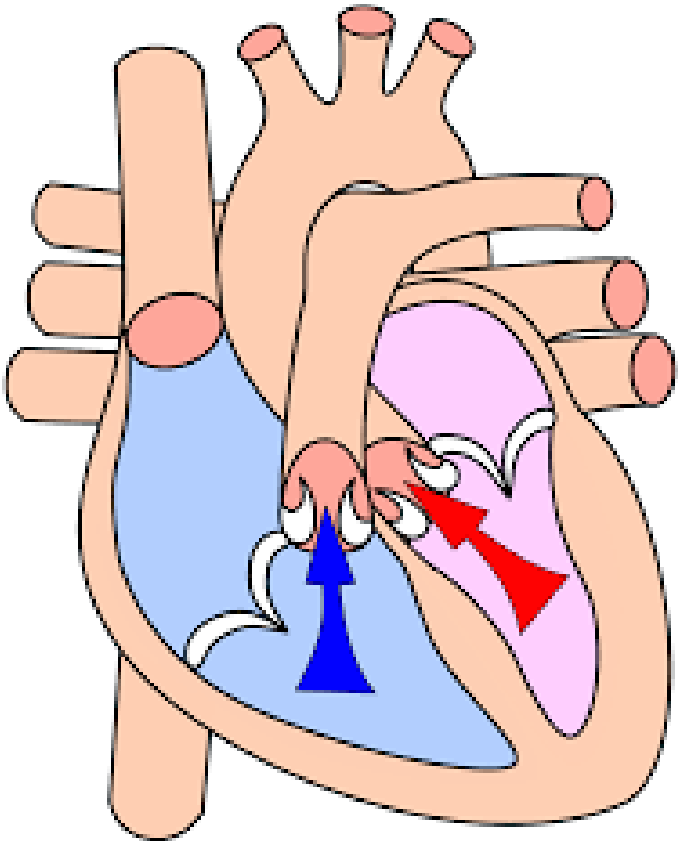
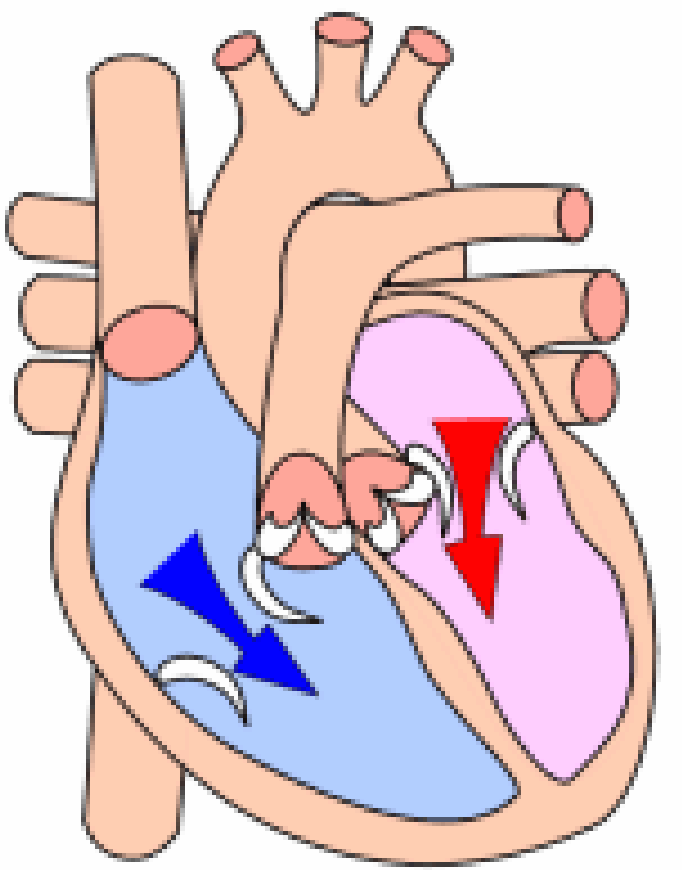
EXAMINATION OF THE HEART SOUNDS & MURMURS

THE CARDIAC CYCLE



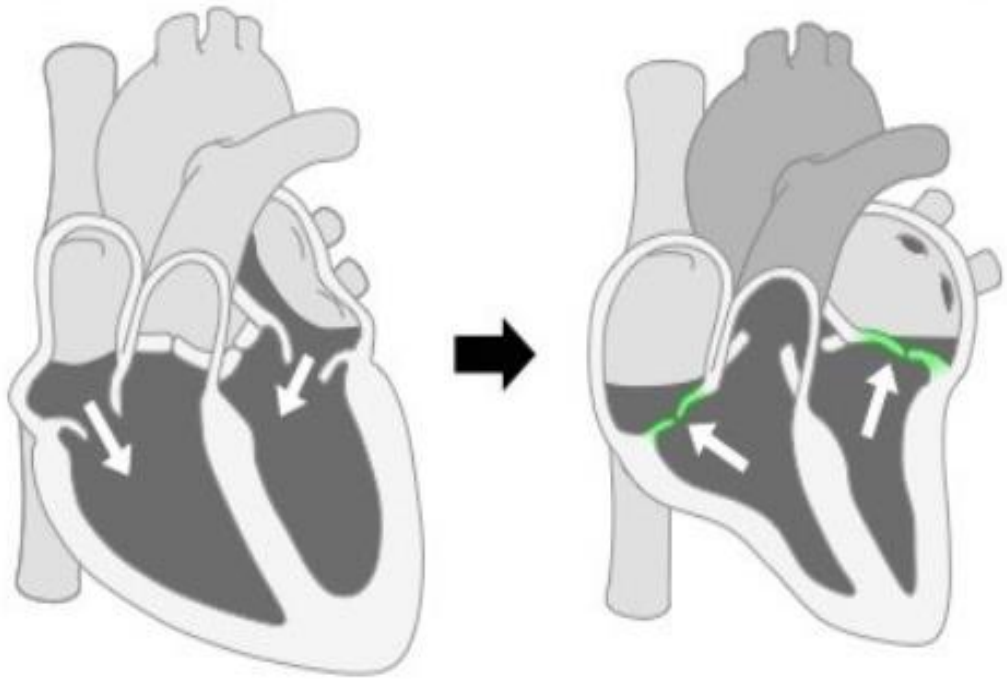
SYSTOLE



DIASTOLE

Heart Valves and Heart Sounds

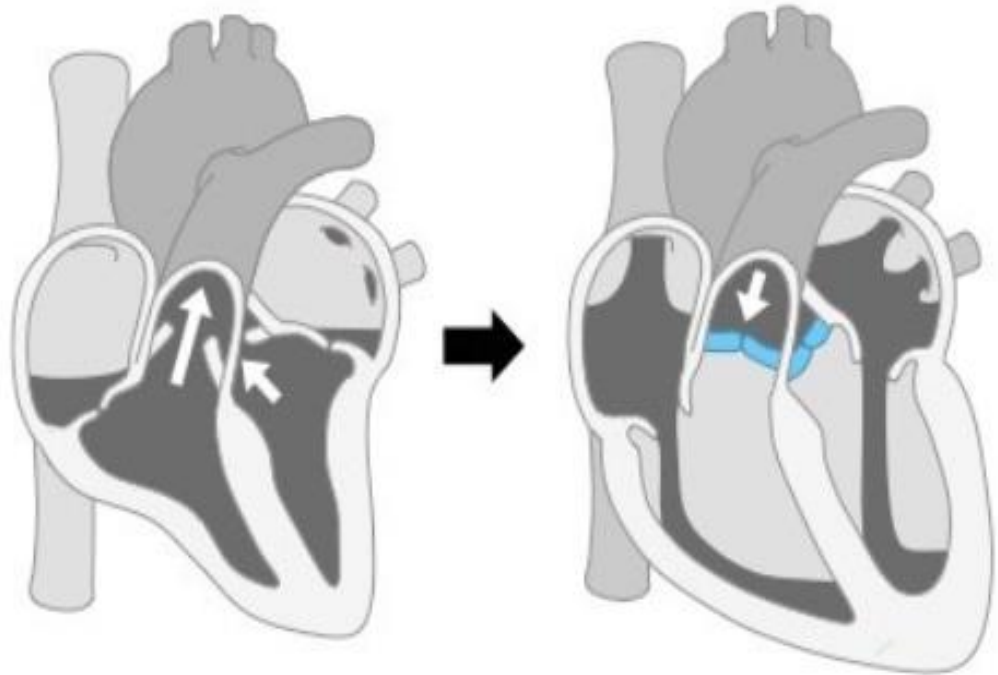
First Heart Sound ('Lubb')
Closure of the *atrioventricular valves*



Atrial Systole

Ventricular Systole

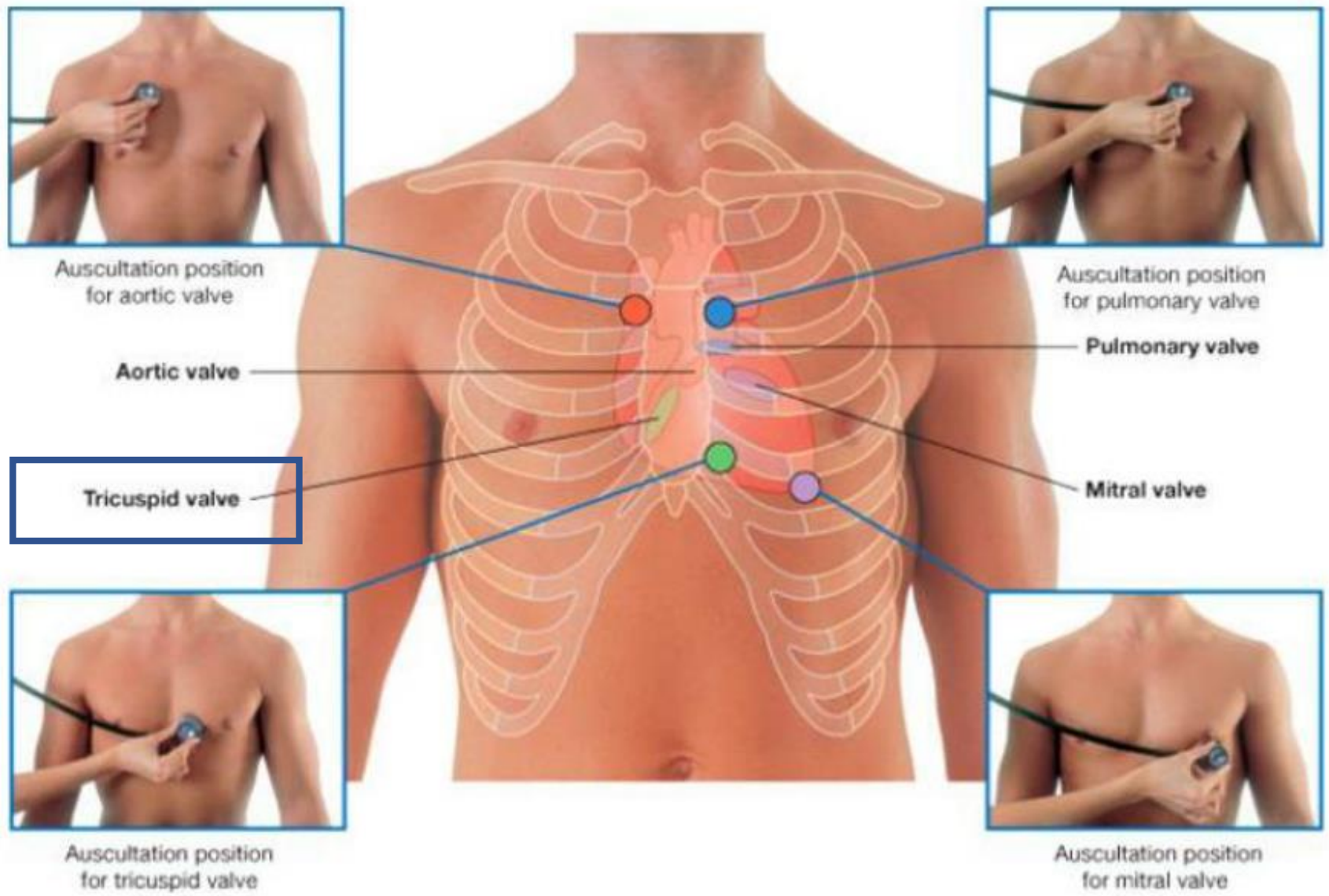
Second Heart Sound ('Dupp')
Closure of the *semilunar valves*

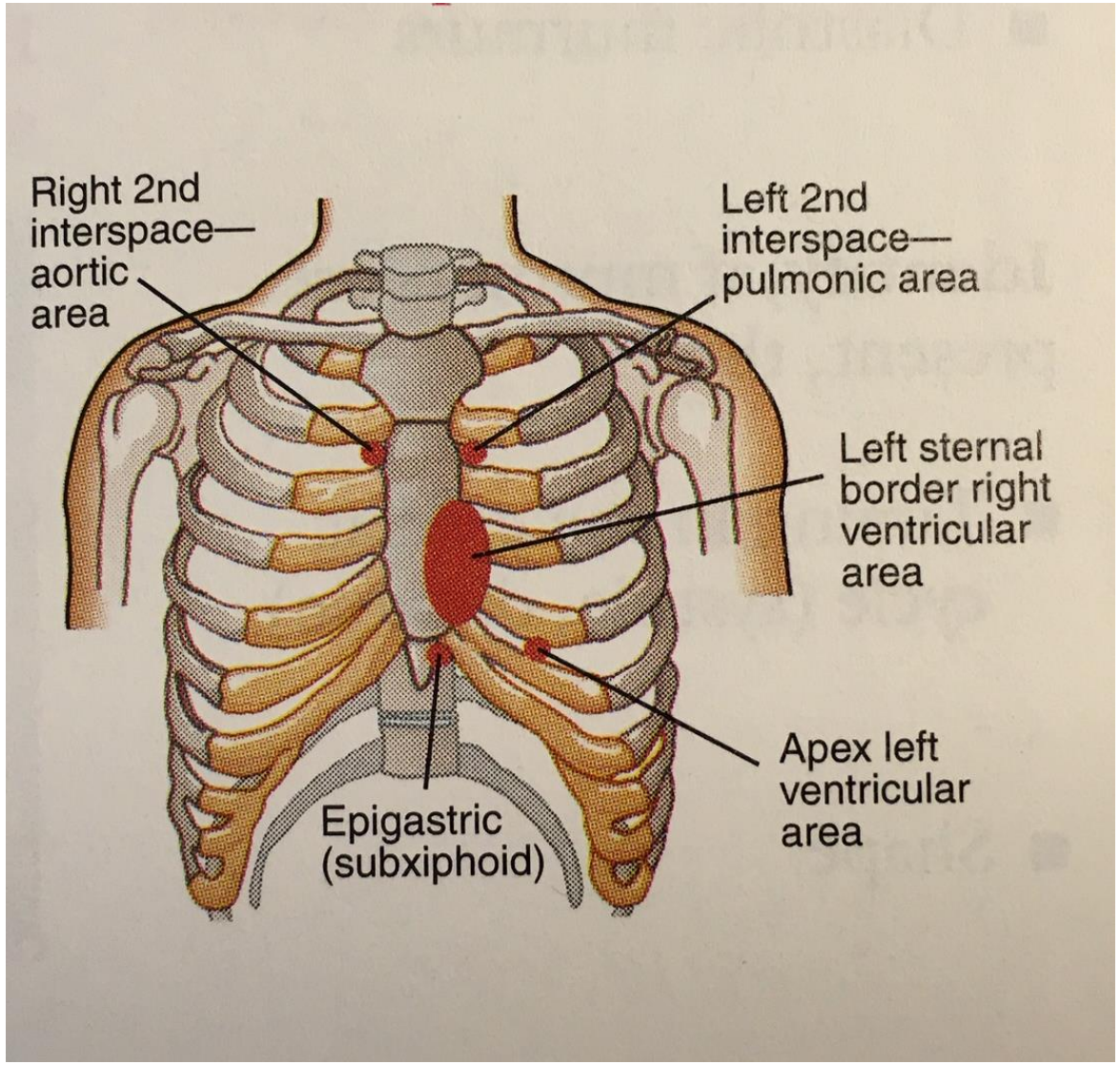


Ventricular Systole

Ventricular Diastole

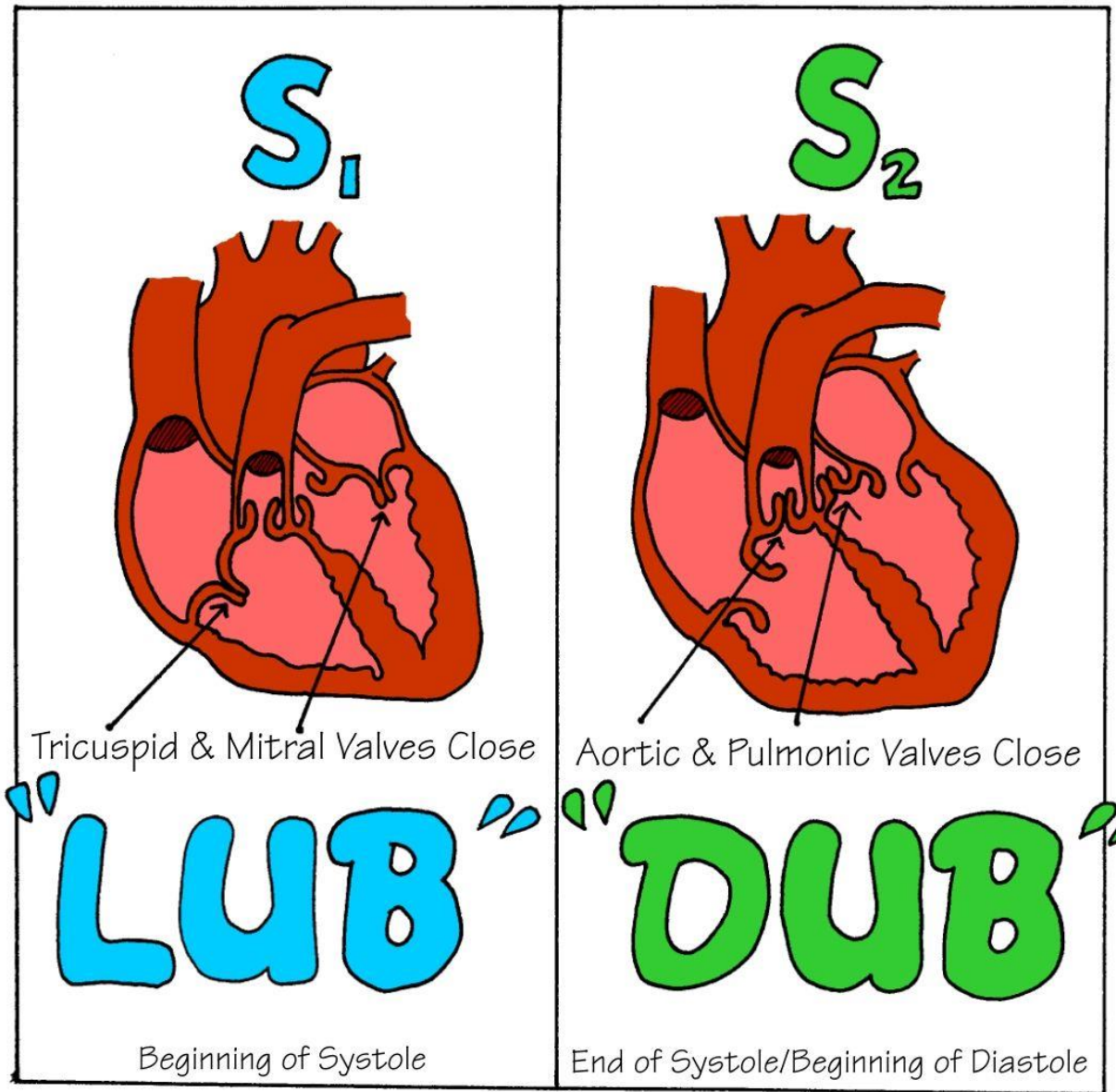
WHERE DO WE AUSCULTATE HEART SOUNDS?

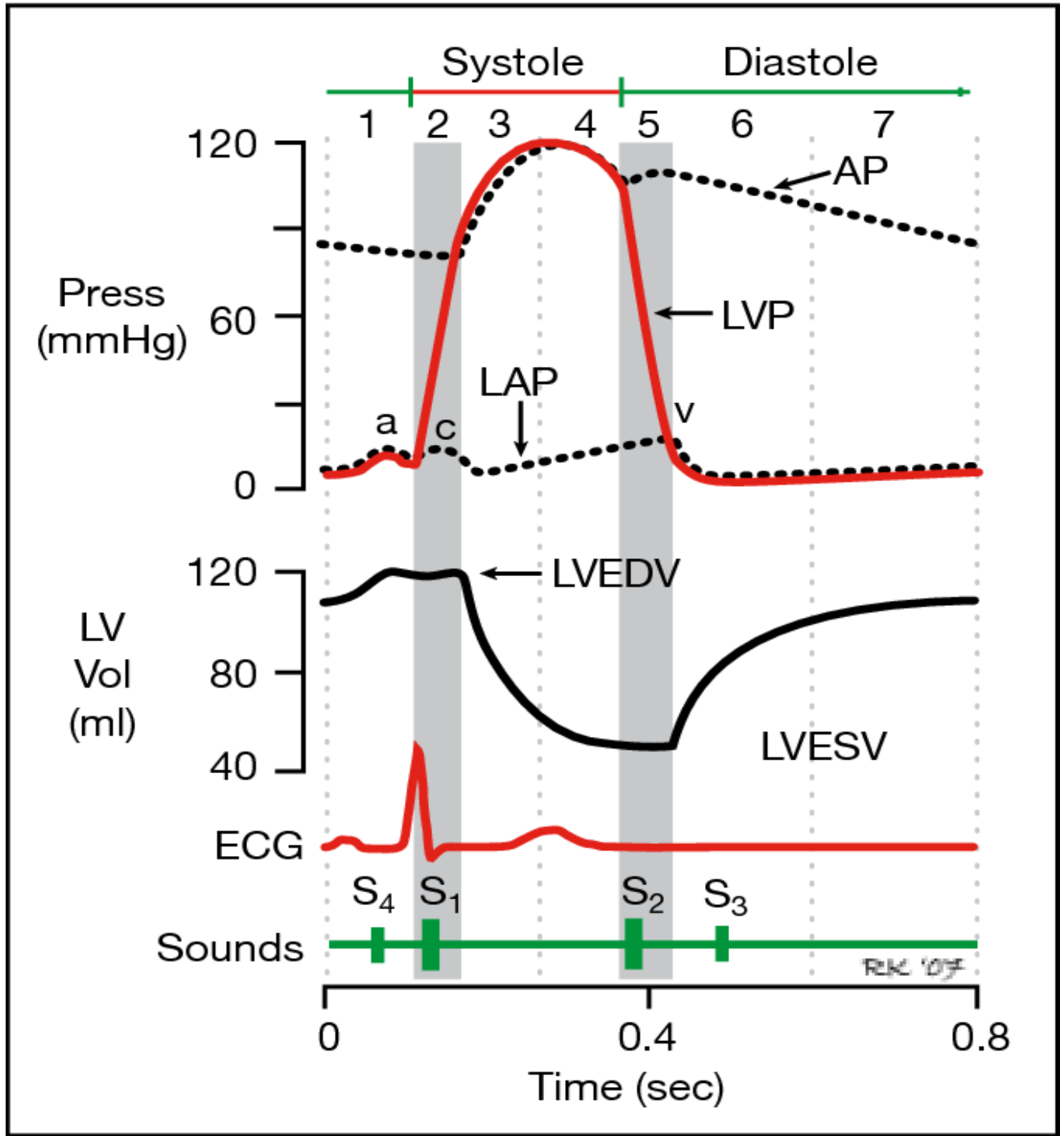




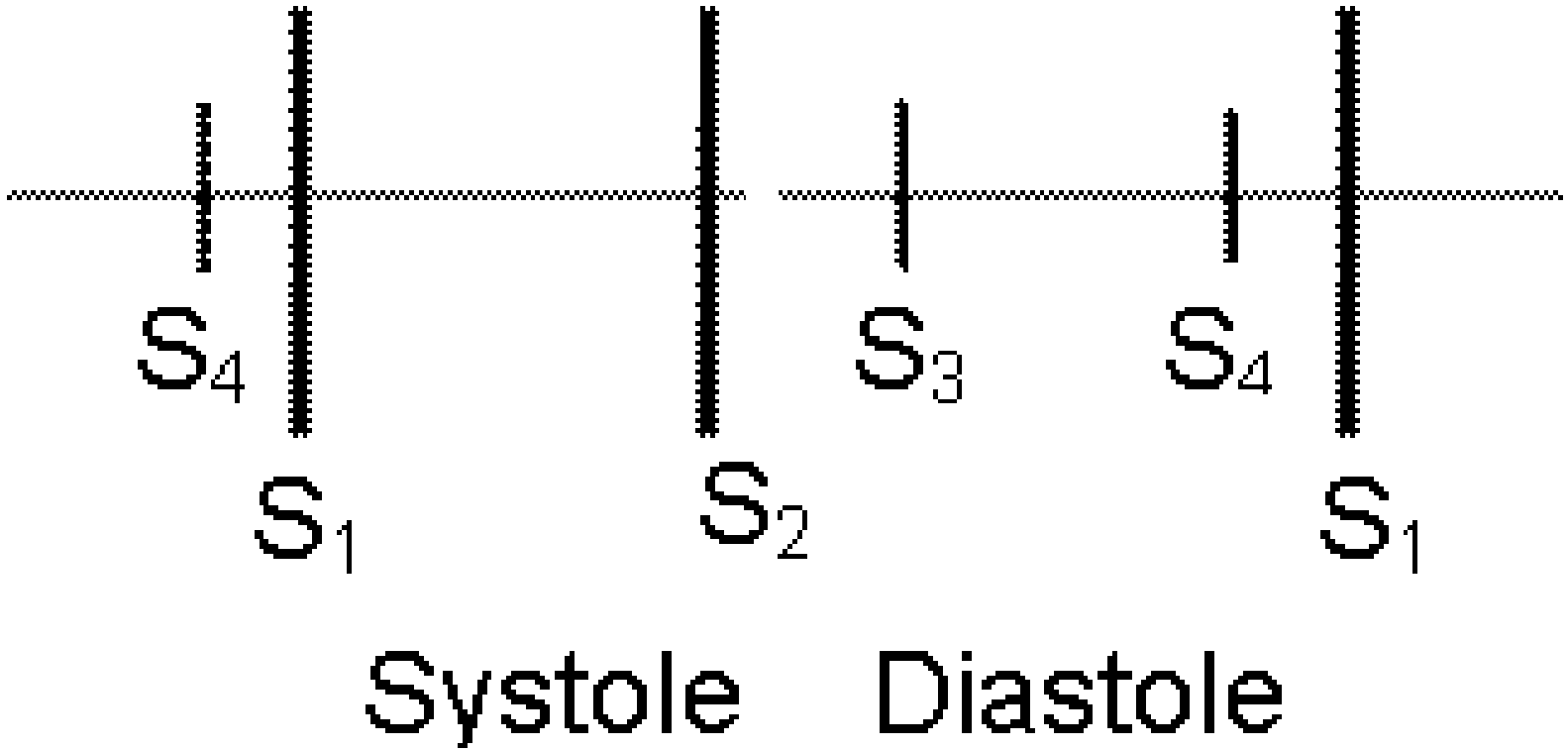
Bates' Pocket Guide to Physical Examination and History Taking

HEART SOUNDS




Systole
Diastole
1
2
3
4
5
6
7
120
60
0
Press
(mmHg)
AP
LVP
LAP
a
c
v
120
80
40
LV
Vol
(ml)
LVEDV
LVESV
ECG
S4
S1
S2
S3
Sounds
0
0.4
0.8
Time (sec)

NORMAL HEART SOUNDS =WHAT DO I HEAR?



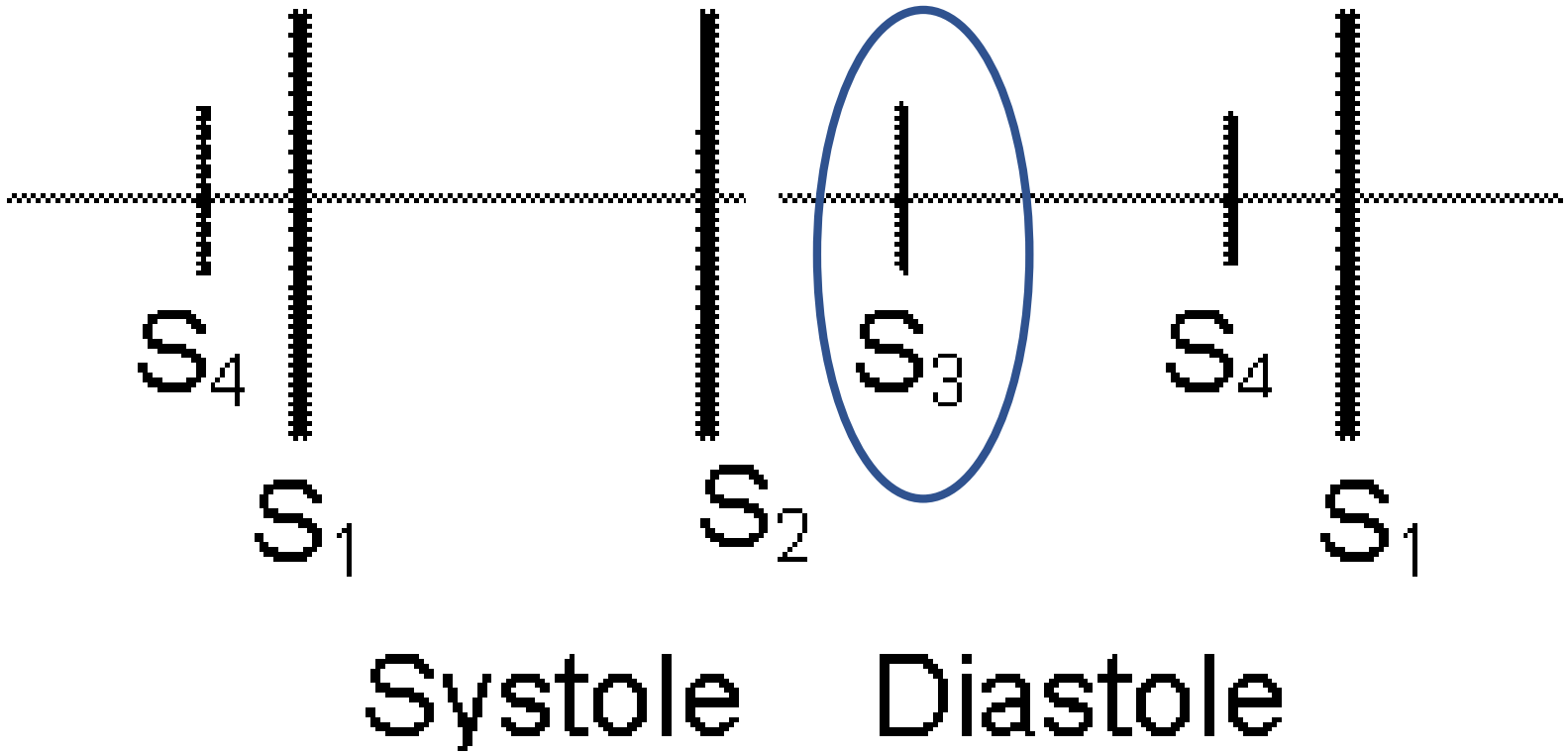
Normal heart sound

https://www.youtube.com/watch?v=FtXNnmifbhE

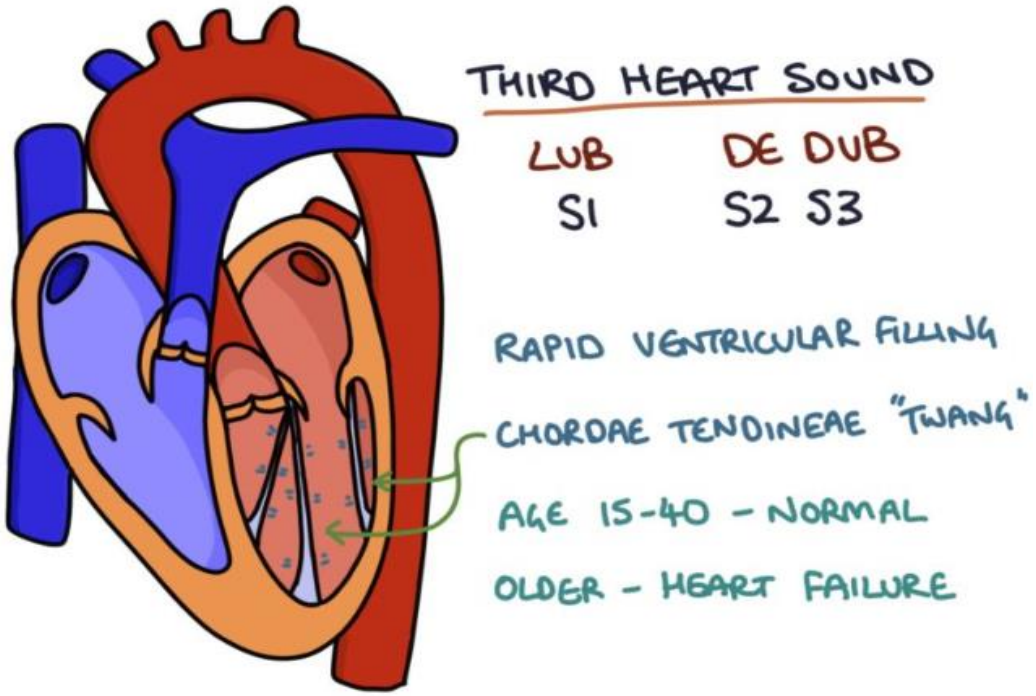
ABNORMAL HEART SOUNDS & MURMURS

1. Extra heart sounds (S3, S4)
2. Spliting of S1 & S2
3. Alteration in intensity
4. Additional heart sounds (extrasystoly)
5. Murmurs

NORMAL HEART SOUNDS =WHAT DO I HEAR?



A third heart sound (S3)

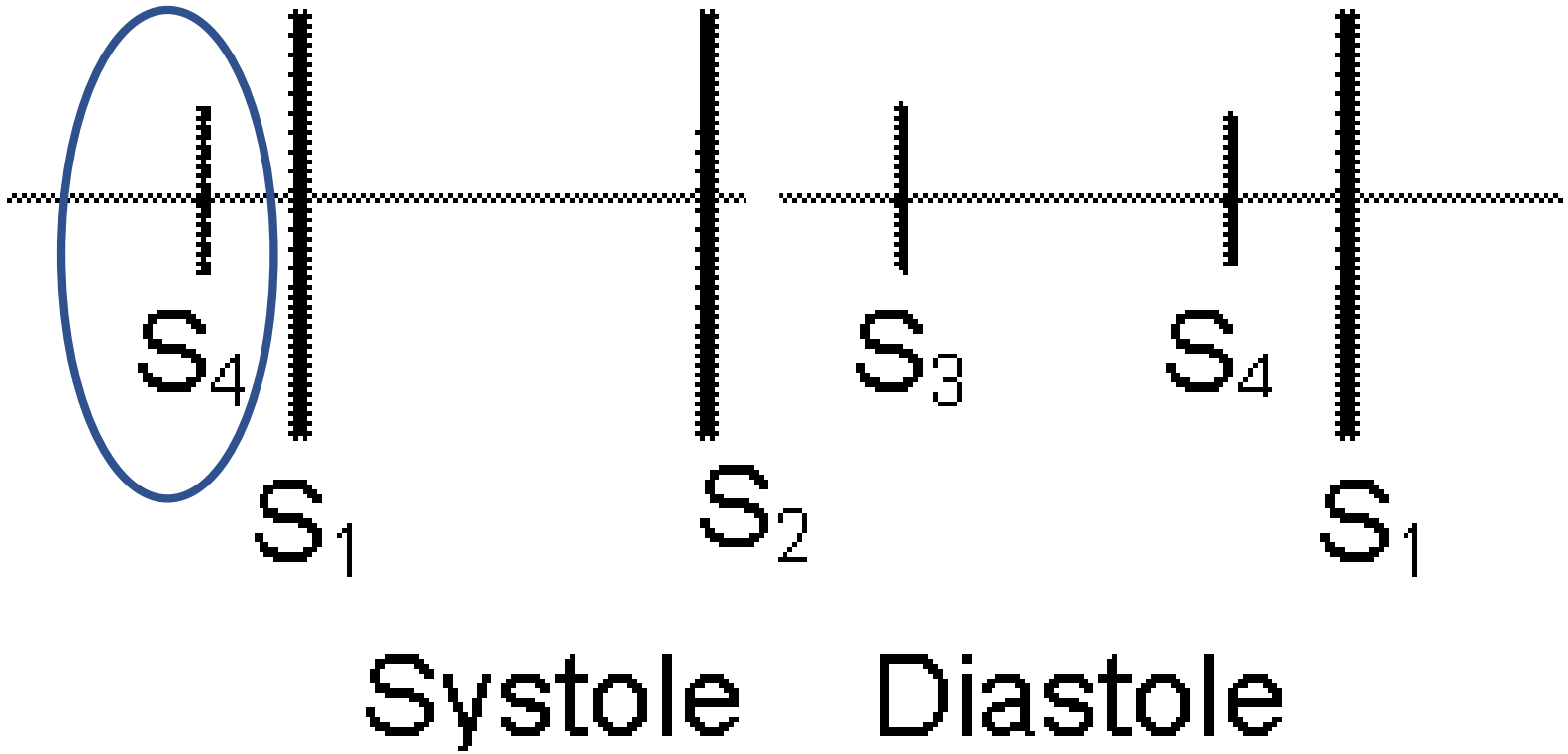


- is heard roughly 0.1 seconds after the second heart sound.
- **Due to rapid ventricular filling** causing the ***chordae tendineae*** to pull to their full length &
- „twang **like a guitar strin**g”
- **can be normal in children**, teenagers and young healthy adults (15-40 years) - **because the heart functions so well that the ventricles easily allow rapid filling**
- In older patients it can indicated heart failure, as the ***ventricles*** and ***chordae*** are stiff and weak so they reach their limit much faster than normal.

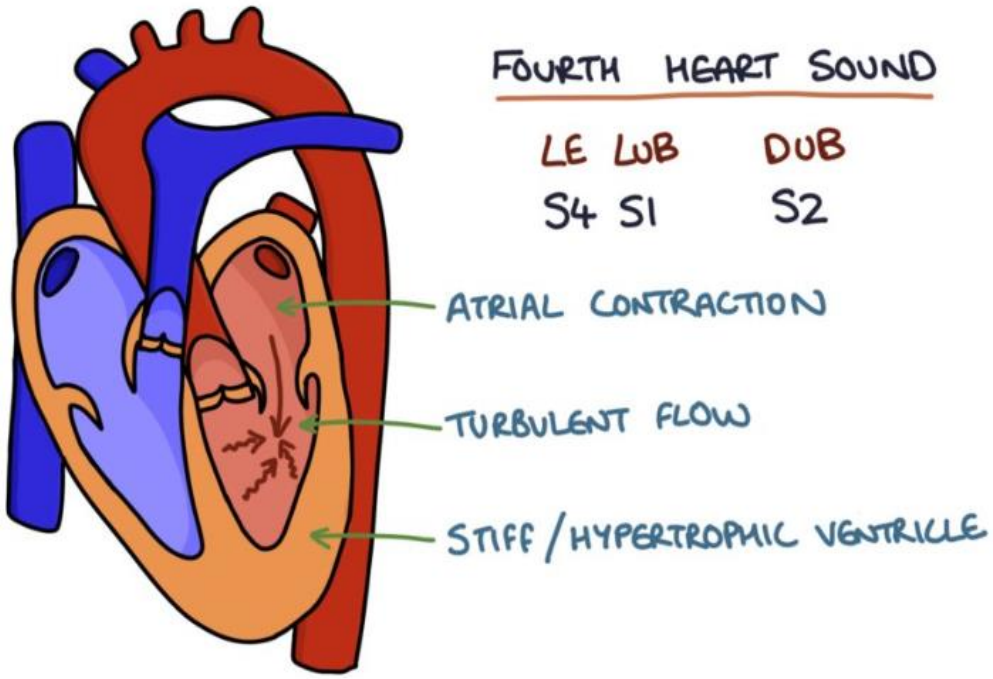
S3 słuchamy

https://www.youtube.com/watch?v=_i2D1KZkN1w

NORMAL HEART SOUNDS =WHAT DO I HEAR?



A *fourth heart sound* (*S4*)

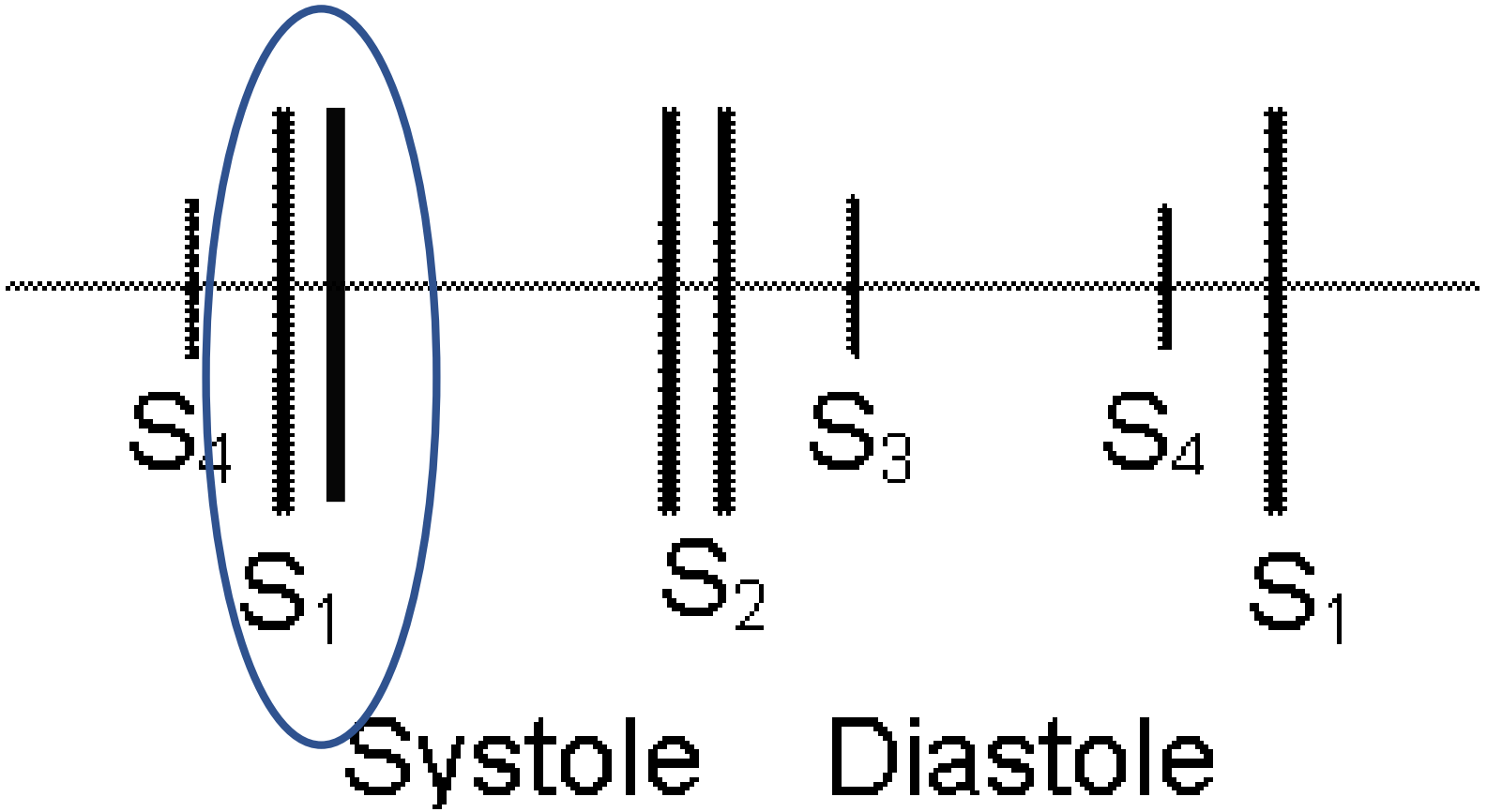


- is heard directly before ***S1***.
- is always <u>abnormal</u>
- relatively <u>rare</u> to hear
- indicates a <u>stiff or hypertrophic ventricle</u> and is caused by **turbulent flow from an atria contracting against a non-compliant ventricle**

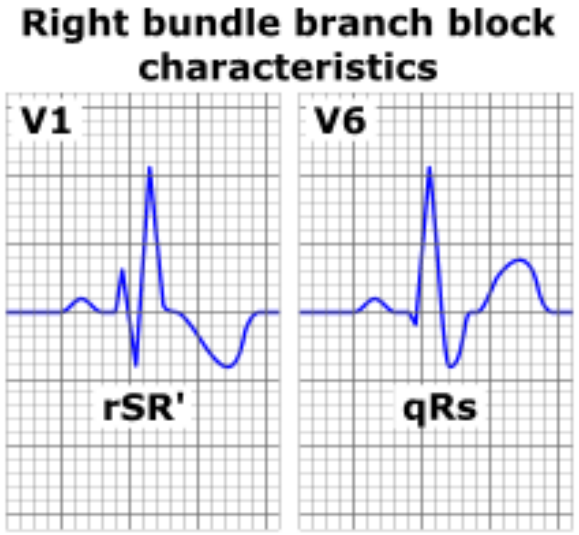
S4- słuchamy

https://www.youtube.com/watch?v=KcMF8rJDTIk

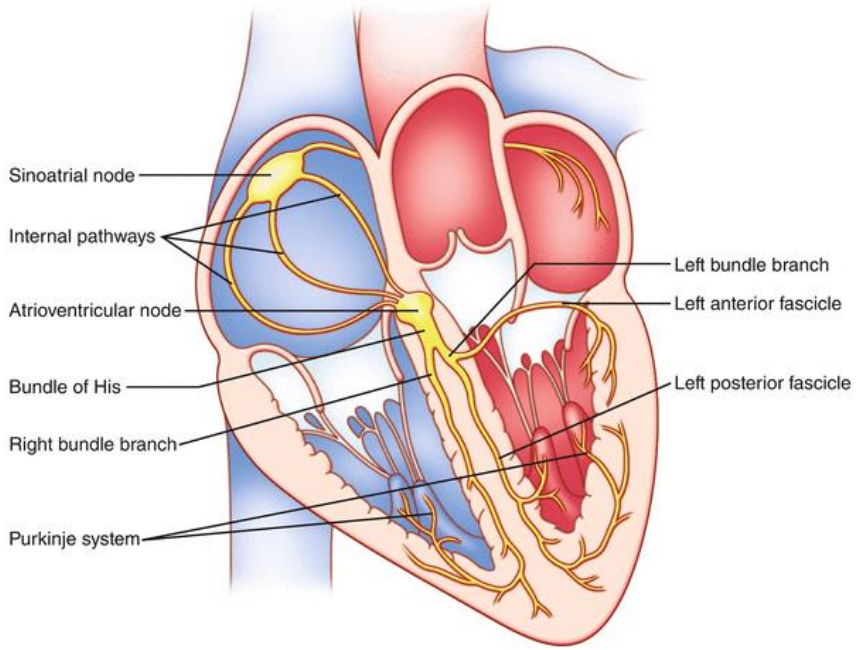
NORMAL HEART SOUNDS =WHAT DO I HEAR?



Split of S1



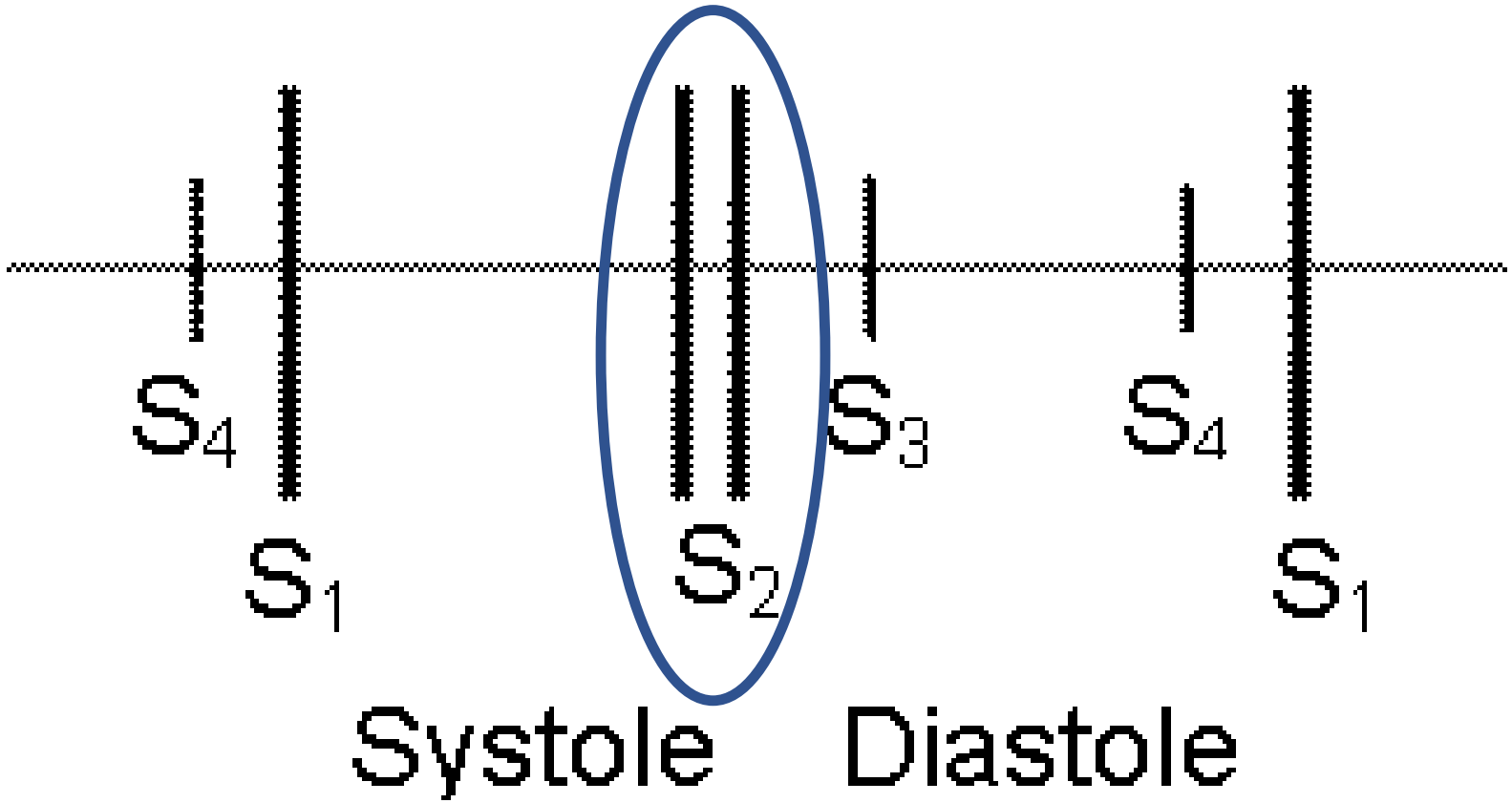
- You will listen to S1 split **when MV and TV do not close exactly at the same time**
- M1 usually closes first (M1), then the TV (T1)
- S1 split is **usually normal finding**
- **May be heard in RBBB**



Split S1-słuchamy

https://www.youtube.com/watch?v=kvQ2IU3ILRo

NORMAL HEART SOUNDS
=WHAT DO I HEAR?

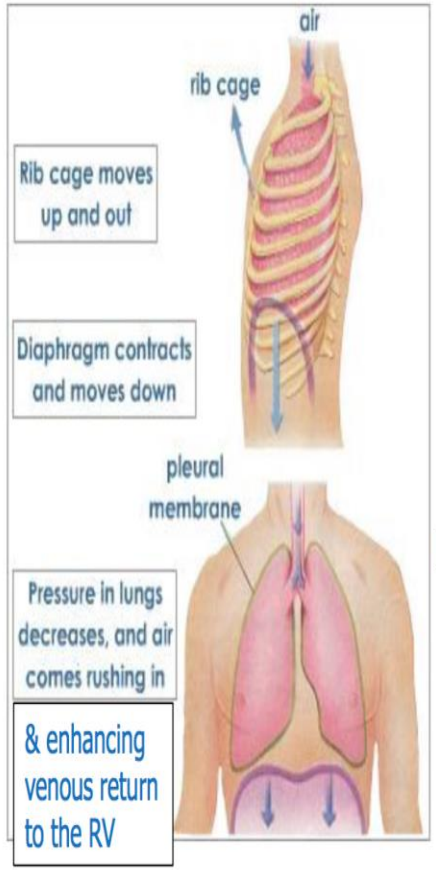


Split S2

- Split od S2 can be normally heard **on deep inspiration**
- because **when a person takes a deep breath, a decrease of intrathoracic pressure causes an increase of venous blood (VCS &VCI)…**
- This **rapid venus return** on the right side of the heart **may cause a slight delay RV emptying and a slight delay of PV closure** (in comparison to Ao valve)

During the isovolumetric relaxation, the aortic valve closes before the pulmonary valve

Inspiration causes splitting of S_2 (A_2, P_2), delaying closure of the pulmonic valve.



Intrathoracic pressure decreases

⇩

Increases venous return to the RV

⇩

Increases RV preload (RVEDV)

⇩

Results in increased stroke volume and prolongs RV ejection time

⇩

Delays closure of P_2

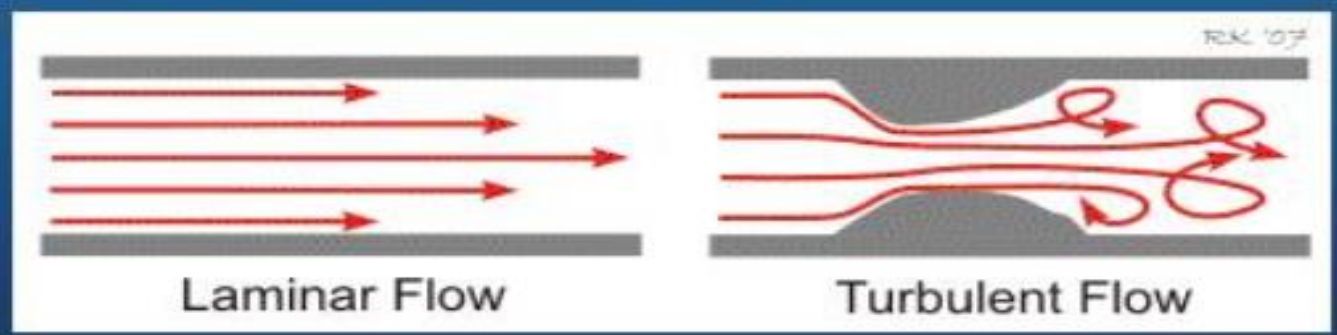
Split S2 – słuchamy

https://www.youtube.com/watch?v=98HM1fr3cq4

HEART MURMURS

Physiology: Sounds

- Murmurs:
  - Cause: Turbulence / Non-laminar flow
    - Reynold's number
      = inertial force / viscous force
      = (length X velocity X density) / (viscosity)
      = length X velocity X constant
      - Reynold's number > 30: turbulent or non-laminar flow
    - When:
      - High flow rate through normal or abnormal orifice
      - Flow through constricted or irregular orifice into dilated area
      - Backwards or regurgitant flow



Assessing a Murmur (SCRIPT mnemonic)

S – **S**ite: where is the murmur loudest?

C – **C**haracter: soft / blowing / crescendo (getting louder) / decrescendo (getting quieter) / crescendo-decrescendo (louder then quieter)

R – Radiation: can you hear the murmur over the carotids (AS) or left axilla (MR)?

I – **I**ntensity: what grade is the murmur?

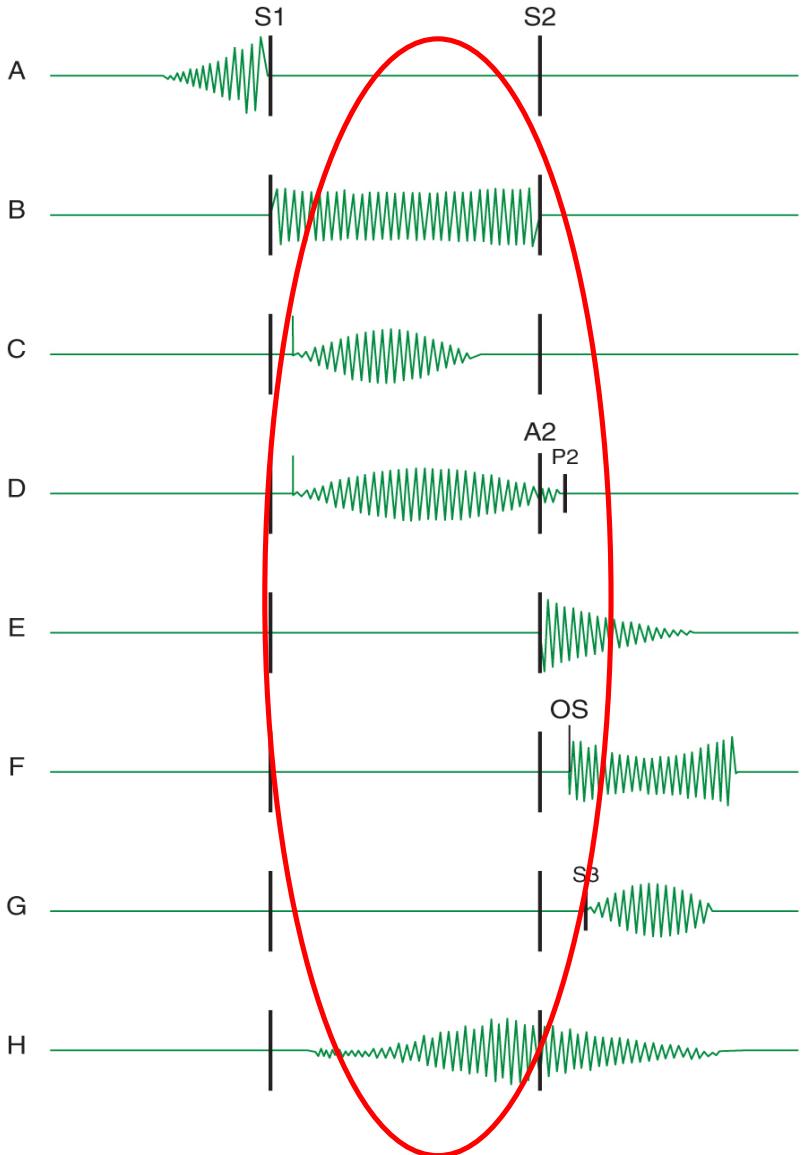
P – **P**itch: is it high pitched or low and grumbling? Pitch indicates velocity.

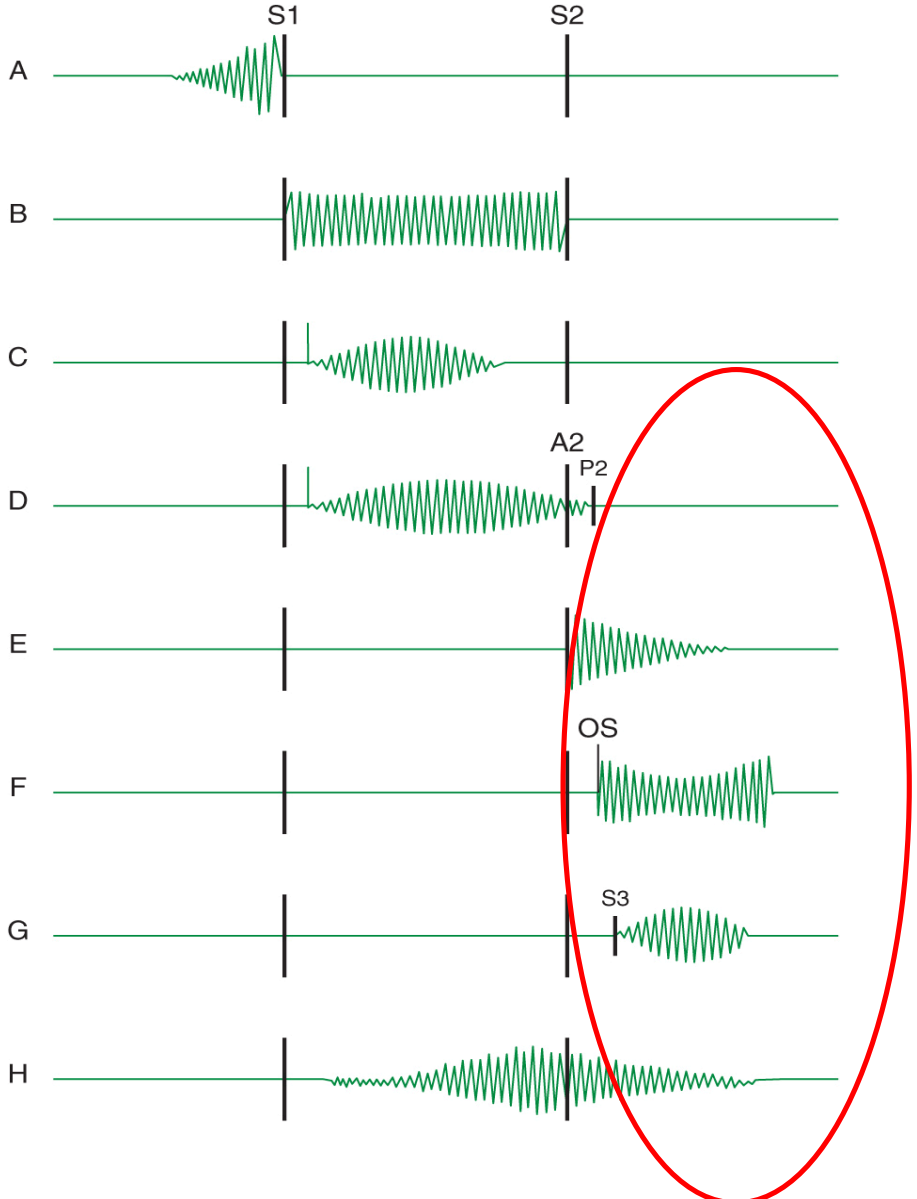
T – **T**iming: is it systolic or diastolic?

MURMURS

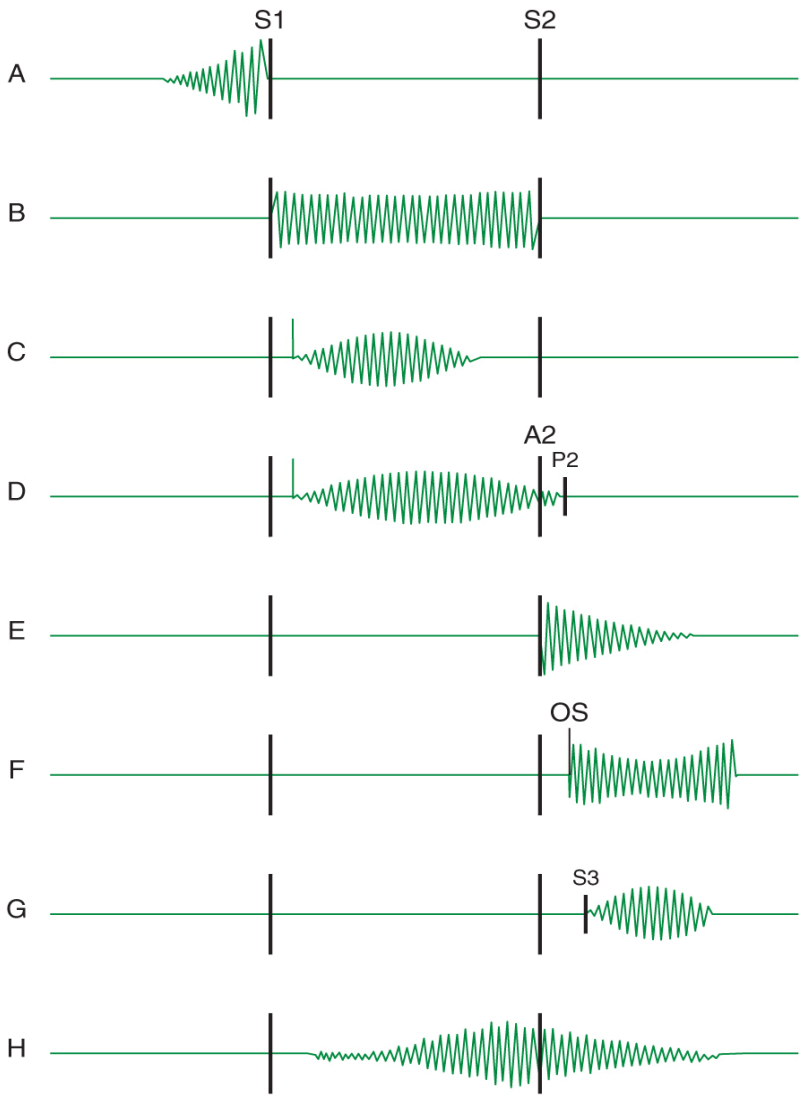
SYSTOLIC

DIASTOLIC



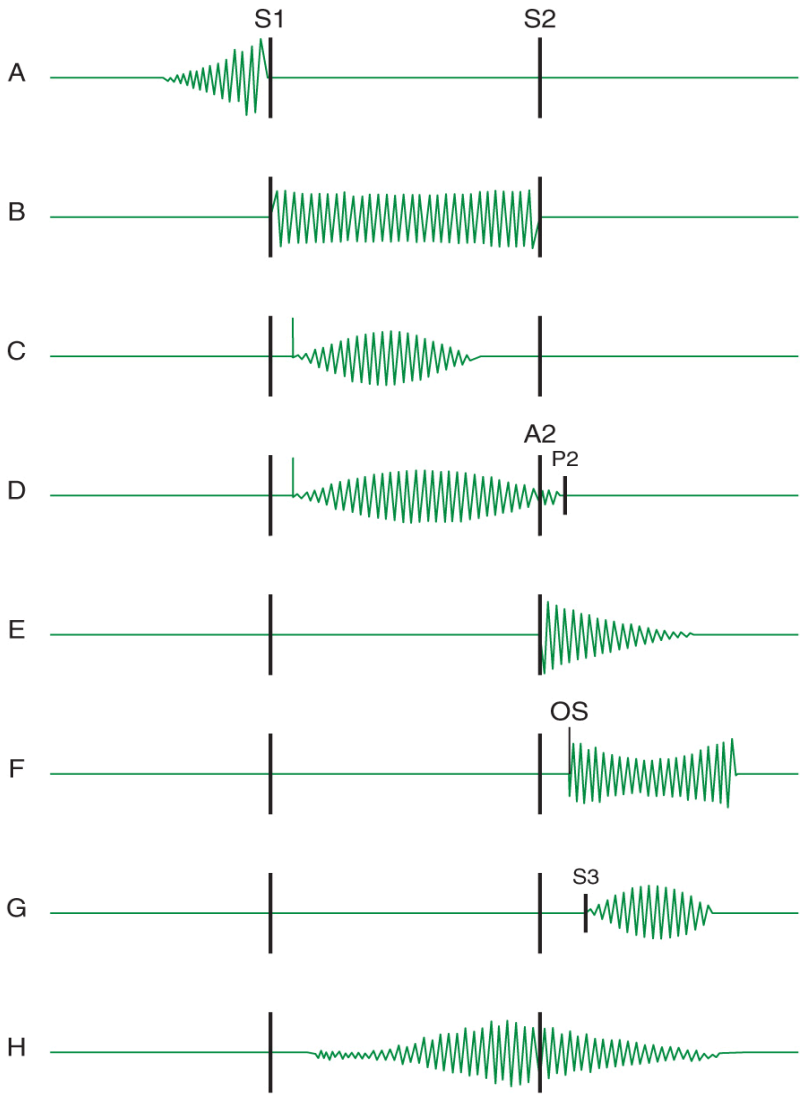


MURMURS

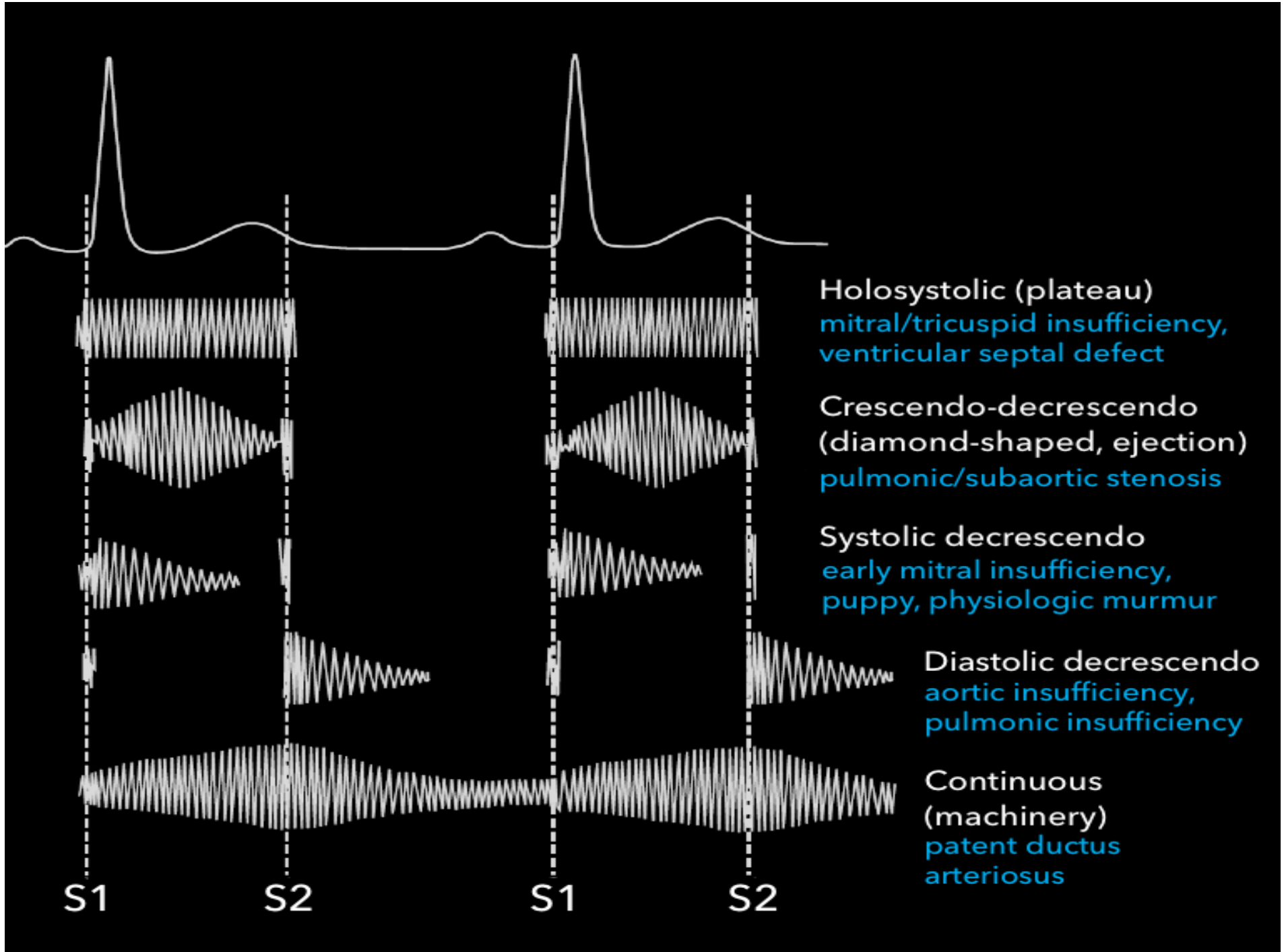


- **Holo**- systolic= **Pansystolic**
- **Early**- systolic
- **Mid**- systolic
- **End**- systolic

MURMURS



- **End**-diastolic
- **Early**- diastolic
- **Holo**- diastolic
- **Mid**- diastolic


Holosystolic (plateau)
mitral/tricuspid insufficiency,
ventricular septal defect
Crescendo-decrescendo
(diamond-shaped, ejection)
pulmonic/subaortic stenosis
Systolic decrescendo
early mitral insufficiency,
puppy, physiologic murmur
Diastolic decrescendo
aortic insufficiency,
pulmonic insufficiency
Continuous
(machinery)
patent ductus
arteriosus
S1
S2
S1
S2

Systolic Murmurs

- Early systolic
  - Mitral
    - Acute MR
  - VSD
    - Muscular
    - Nonrestrictive with pulmonary hypertension
  - Tricuspid
    - TR with normal pulmonary artery pressure
- Mid-systolic
  - Aortic
    - Obstructive
      - Supravalvular—supravalvular aortic stenosis, coarctation of the aorta
      - Valvular—AS and aortic sclerosis
      - Subvalvular—discrete, tunnel or HOCM
    - Increased flow, hyperkinetic states, AR, complete heart block
    - Dilation of ascending aorta, atheroma, aortitis
  - Pulmonary
    - Obstructive
      - Supravalvular—pulmonary artery stenosis
      - Valvular–pulmonic valve stenosis
      - Subvalvular–infundibular stenosis (dynamic)
    - Increased flow, hyperkinetic states, left-to-right shunt (e.g., ASD)
    - Dilation of pulmonary artery
- Late systolic
  - Mitral
    - MVP, acute myocardial ischemia
  - Tricuspid
    - TVP
- Holosystolic
  - Atrioventricular valve regurgitation (MR, TR)
  - Left-to-right shunt at ventricular level (VSD)

Early Diastolic Murmurs

Aortic regurgitation
- Valvular: congenital (bicuspid valve), rheumatic deformity, endocarditis, prolapse, trauma, post-valvulotomy
- Dilation of valve ring: aortic dissection, annulo-aortic ectasia, cystic medial degeneration, hypertension, ankylosing spondylitis
- Widening of commissures: syphilis

Pulmonic regurgitation
- Valvular: post-valvulotomy, endocarditis, rheumatic fever, carcinoid
- Dilation of valve ring: pulmonary hypertension; Marfan syndrome
- Congenital: isolated or associated with tetralogy of Fallot, VSD, pulmonic stenosis

Mid-Diastolic Murmurs

Mitral
- Mitral stenosis
- Carey-Coombs murmur (mid-diastolic apical murmur in acute rheumatic fever)
- Increased flow across nonstenotic mitral valve (e.g., MR, VSD, PDA, high-output states, and complete heart block)

Tricuspid
- Tricuspid stenosis
- Increased flow across nonstenotic tricuspid valve (e.g., TR, ASD, and anomalous pulmonary venous return)

Left and right atrial tumors (myxoma)
Severe AR (Austin Flint murmur)

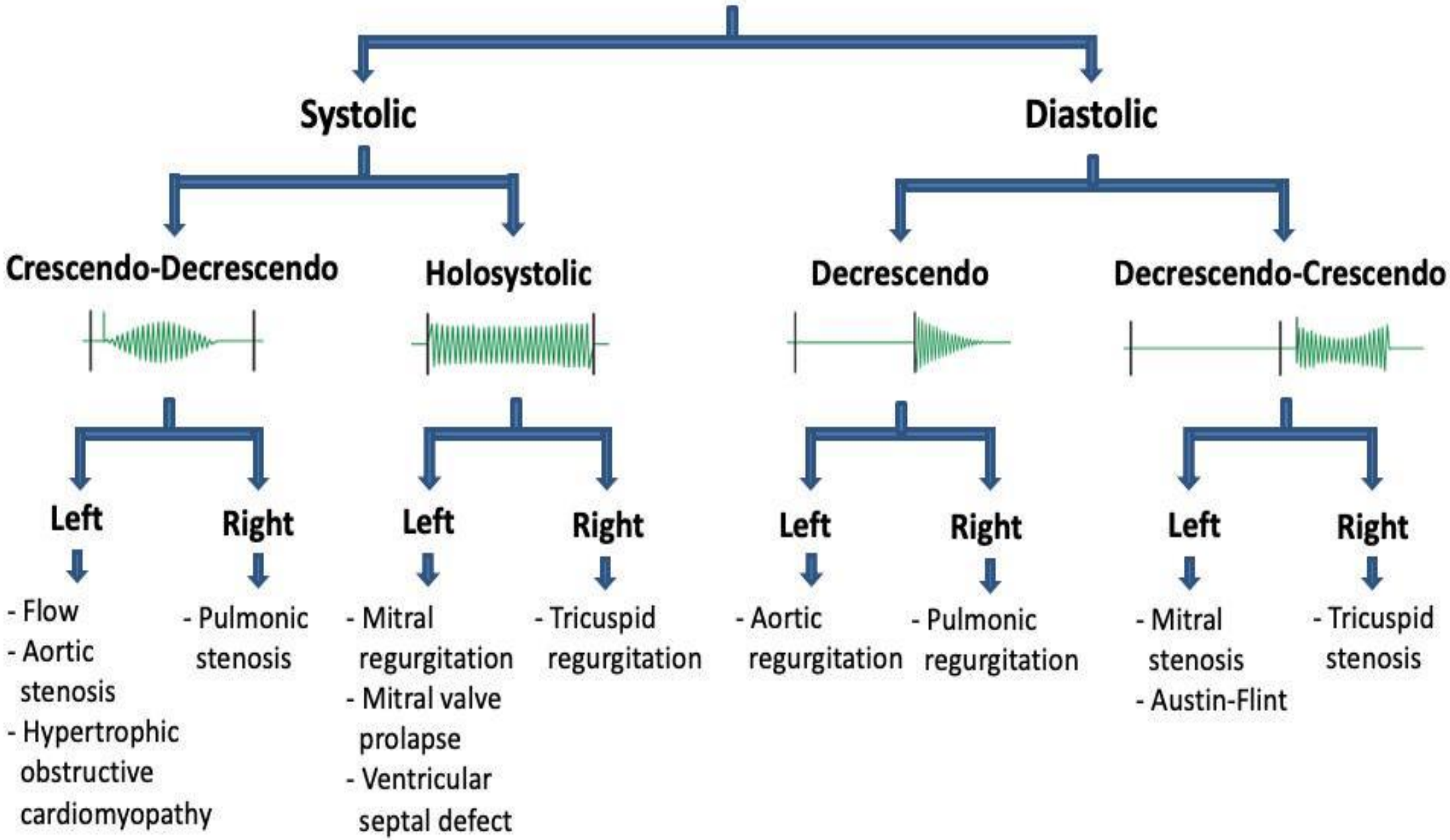
Continuous Murmurs

Patent ductus arteriosus
Coronary AV fistula
Ruptured sinus of Valsalva aneurysm
Aortic septal defect
Cervical venous hum
Anomalous left coronary artery
Proximal coronary artery stenosis
Mammary souffle of pregnancy
Pulmonary artery branch stenosis
Bronchial collateral circulation
Small (restrictive) ASD with MS
Intercostal AV fistula

Abbreviations: AR, aortic regurgitation; AS, aortic stenosis; ASD, atrial septal defect; AV, arteriovenous; HOCM, hypertrophic obstructive cardiomyopathy; MR, mitral regurgitation; MS, mitral stenosis; MVP, mitral valve prolapse; PDA, patent ductus arteriosus; TR, tricuspid regurgitation; TVP, tricuspid valve prolapse; VSD, ventricular septal defect.

Source: E Braunwald, JK Perloff, in D Zipes et al (eds): *Braunwald's Heart Disease*, 7th ed. Philadelphia, Elsevier, 2005; PJ Norton, RA O'Rourke, in E Braunwald, L Goldman (eds): *Primary Cardiology*, 2nd ed. Philadelphia, Elsevier, 2003.

Heart Murmurs Adults

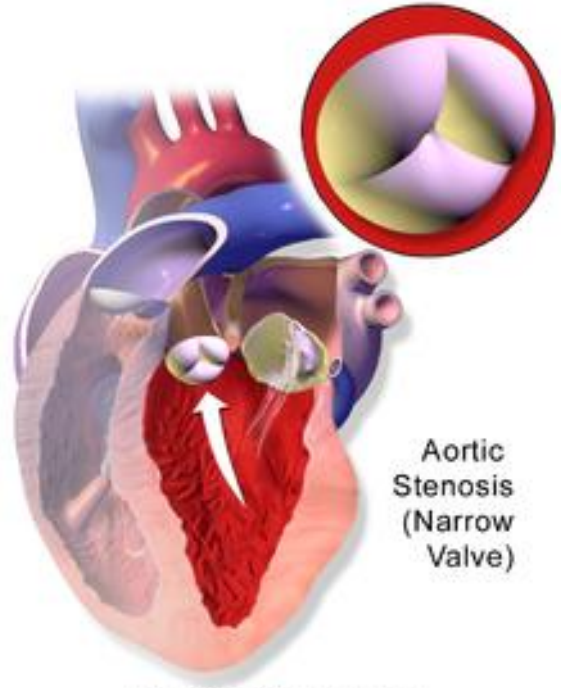


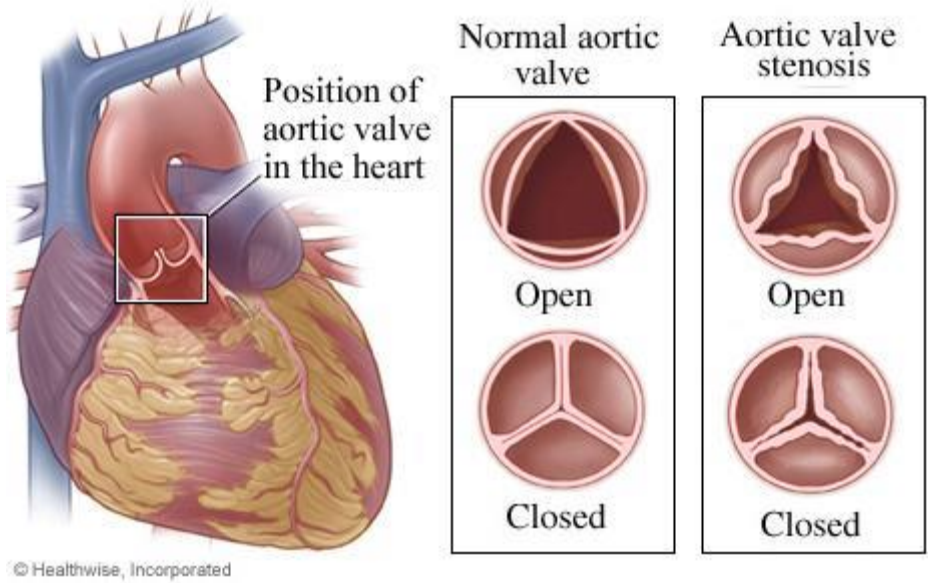
Aortic stenosis (AoS)

- In a child with AoS,because the AoV is very narrow, **the pressure in LV is much higher** than normal and the **heart must work harder** to pump blood out into the body arteries

- Over time this CHD can cause **hypertrophy and damage to the overworked heart muscle**- should be treated (baloon or surgery)

- On examination- **<u>systolic</u> ejection murmur** due to **turbulent flow through the AoV**



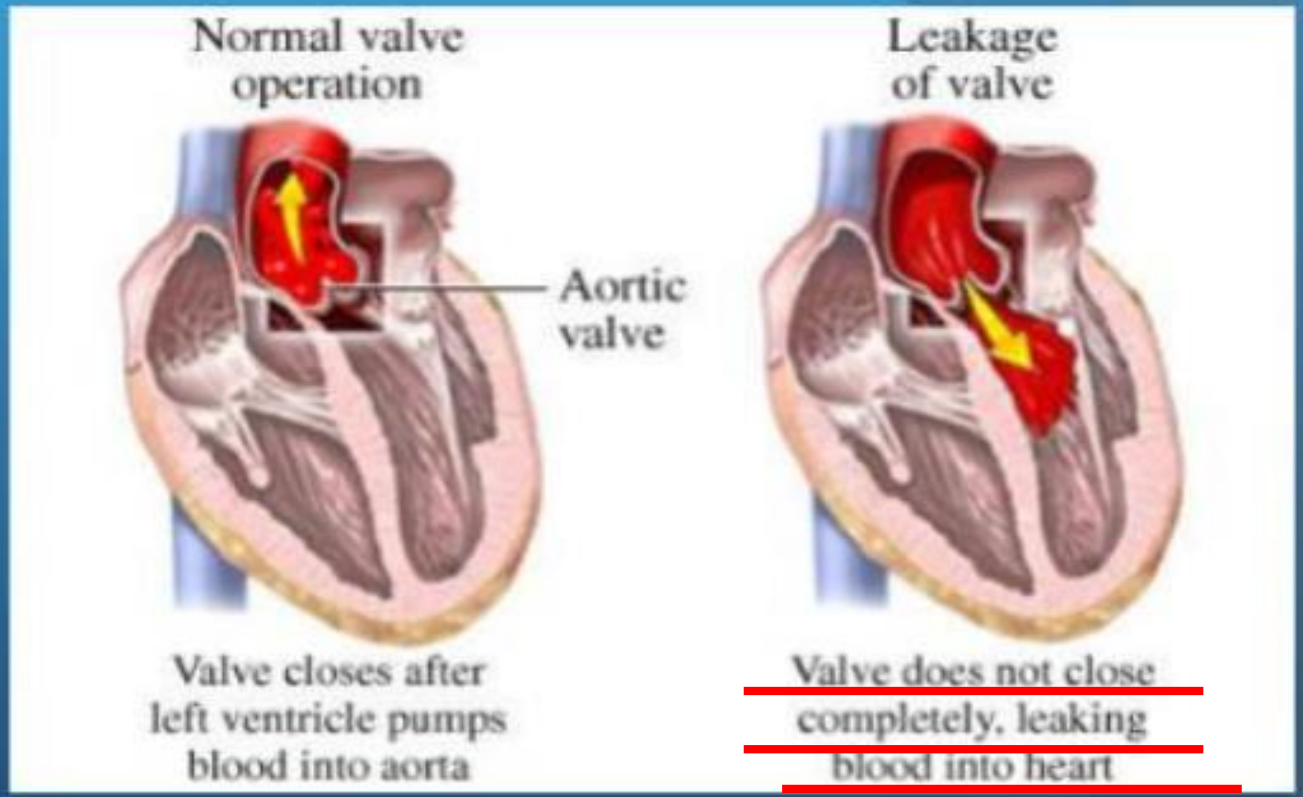


Aortic stenosis- słuchamy

https://www.youtube.com/watch?v=pgDWz1JybzE&t=15s

Pathology: Aortic Valve Regurgitation

- Incompetent aortic valve
- Maybe in conjunction with aortic stenosis
- Maybe associated with dilated aorta root

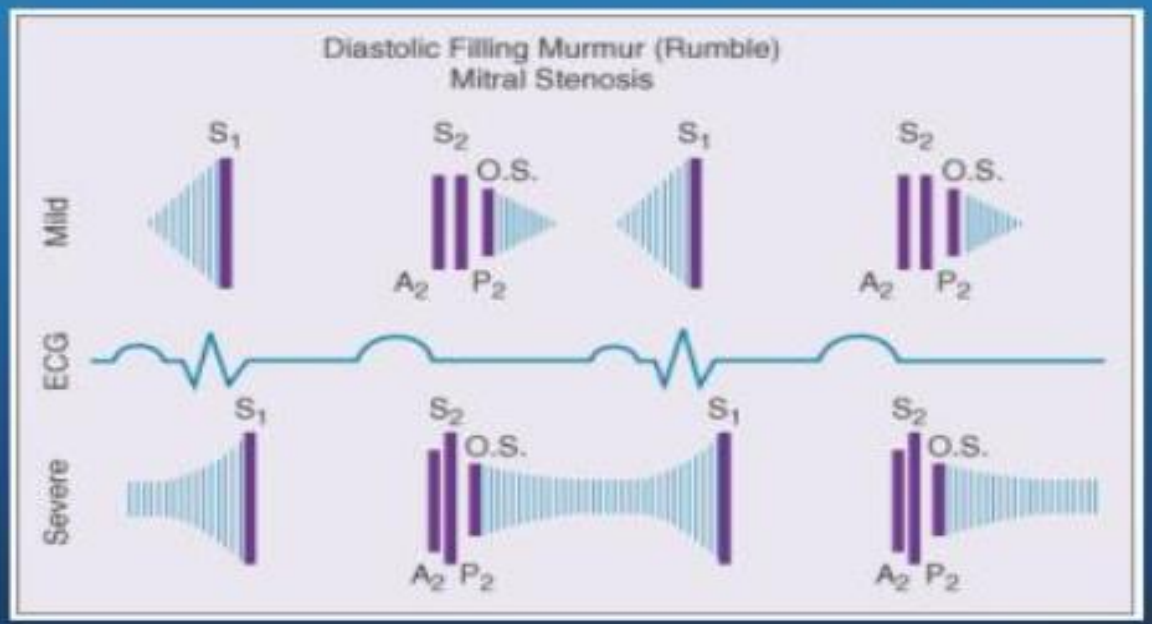


Ao regurgitation- słuchamy

https://www.youtube.com/watch?v=uZysrKXHJMM

Pathology: Mitral

- Mitral stenosis
  - Mid-diastolic and pre-systolic low frequency "rumble"
  - Murmur after mitral opening snap
  - Opening snap: depend on calcification α 1/valve mobility
  - Often difficult to hear as soft and low frequency
  - Aerobic exercise and left lateral decubitus position accentuate

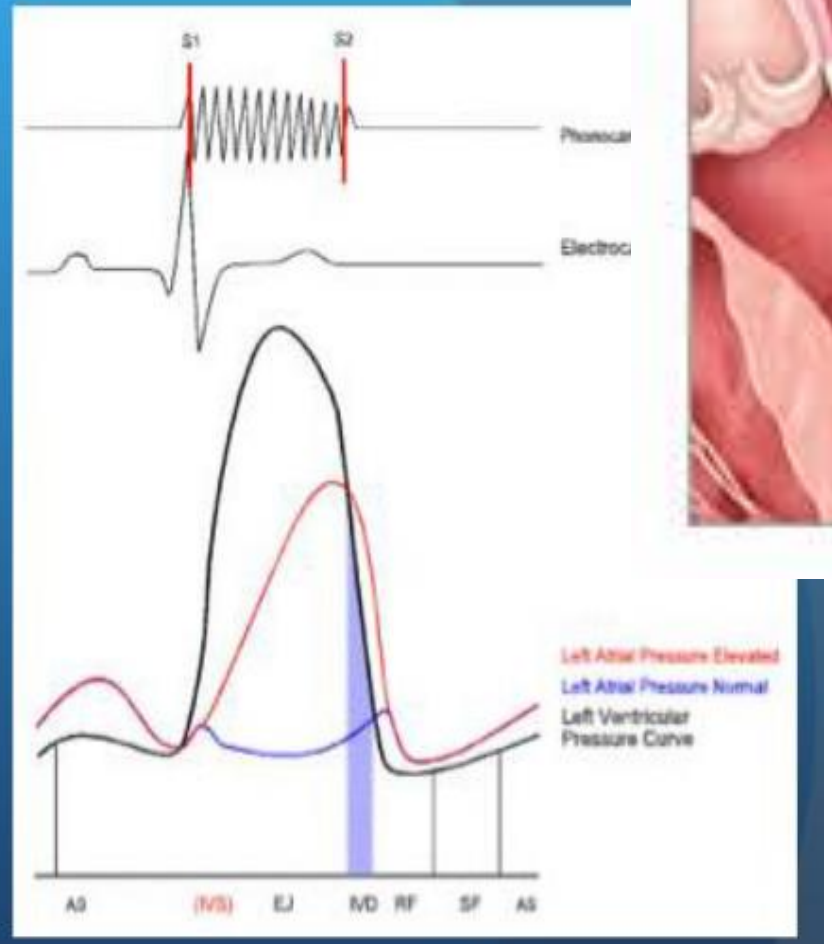


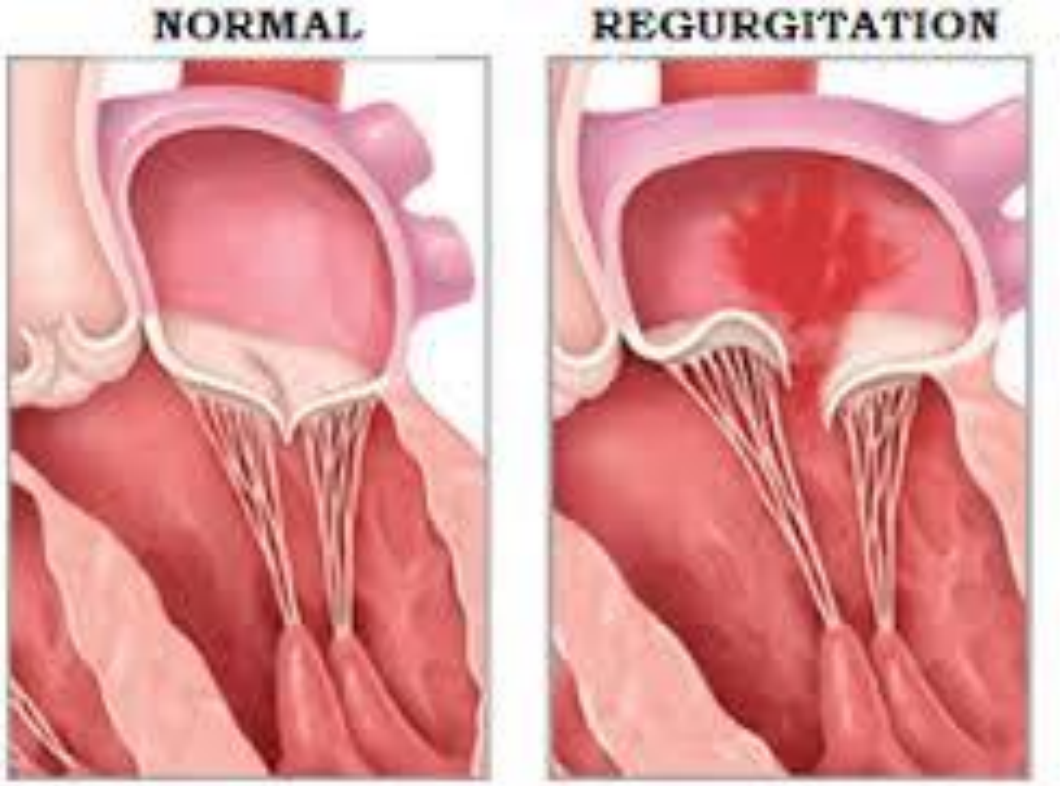
Mitral stenosis- słuchamy

https://www.youtube.com/watch?v=5oCPtZo4pUY

Pathology: Mitral

- Mitral regurgitation
  - Holosystolic constant high-frequency
- Maneuvers:
  - Typical MR and Rheumatic MR:
    - Increase with increase afterload
    - Not effected much by respiration
  - Mitral valve prolapse:
    - Significant changes with respiration



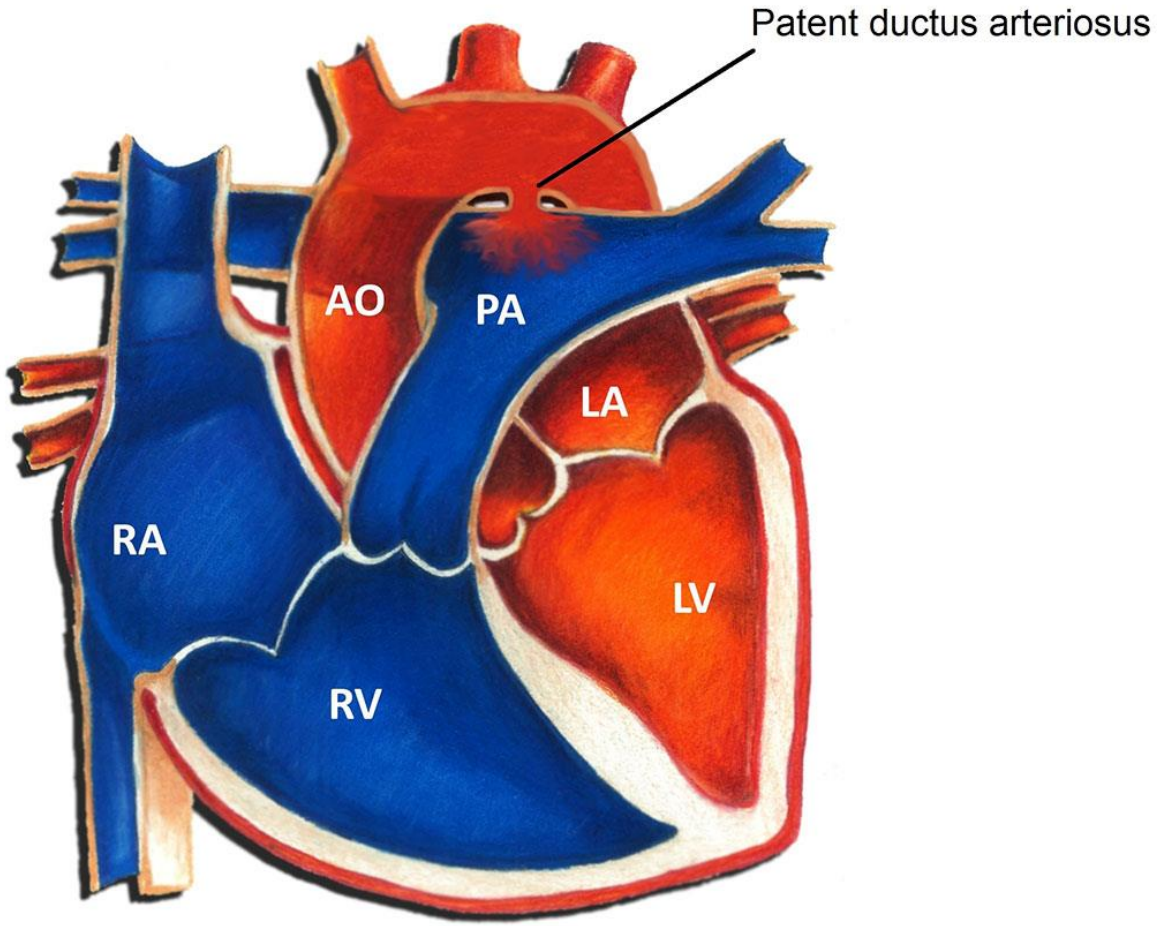


→ **MV cannot close completely causing leakge of the blood during systole of the heart cycle**

Mitral- Tricuspid Valve Regurgitation Holosystolic Murmur

https://www.youtube.com/watch?v=MzORJbyHTT0

Continuous machinery murmur- PDA (Gibson's murmur)

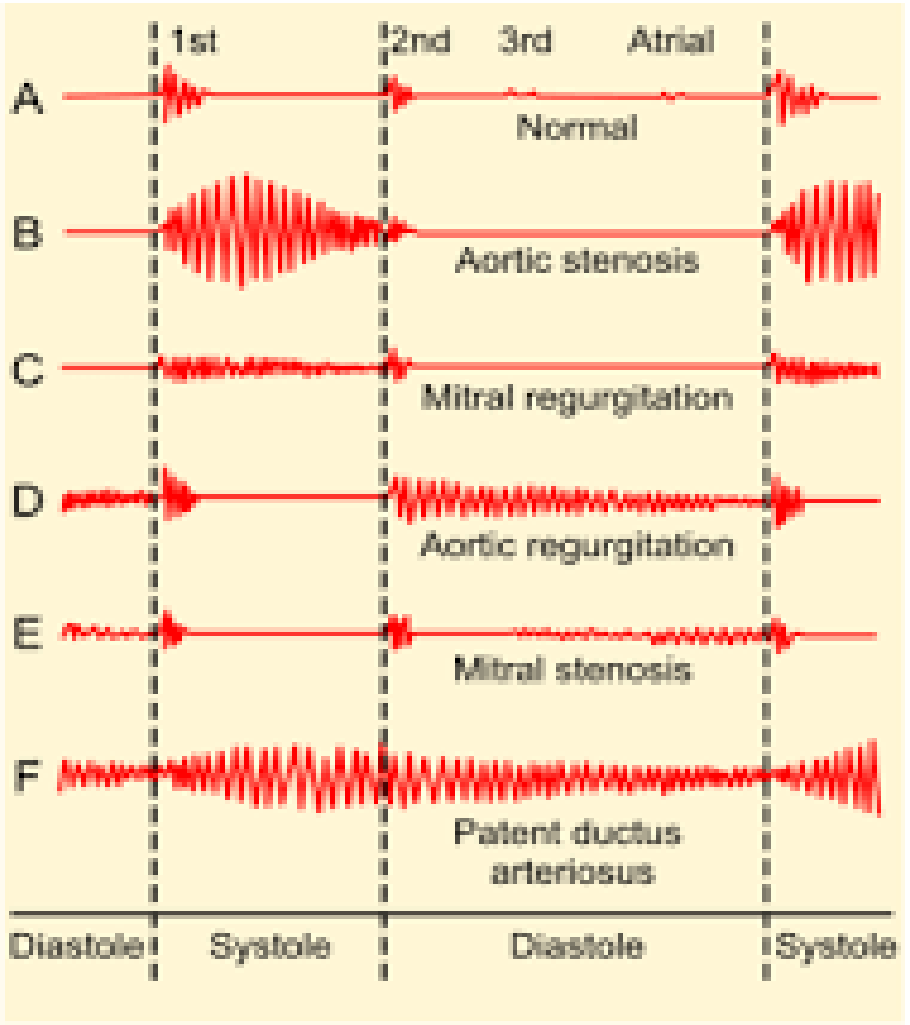


- **In PDA, abnormal blood flow occurs between Ao and pumonary trunk**
- **Typical machinery systolic-diastolic murmur**

Continuous murmur- PDA

https://www.youtube.com/watch?v=LduIjbtF7kA

Heart murmurs- summary



Phonocardiograms from normal and abnormal heart sounds

Murmur Grade- Levine's grading

1. **Difficult to hear**
2. **Quiet**
3. **Easy to hear with sthetoscope, but no palpable thrill**
4. **Easy to hear with a palpable thrill**
5. **Can hear with stethoscope barely touching chest**
6. **Can hear with stethoscope off the chest**

→ Grading a murmur is quite subjective but is helpful is assessing the severity of the defect and will make you sound clever.

→ If in doubt it is probably grade 2 or 3.

Assessing a Murmur (SCRIPT mnemonic)

S – **S**ite: where is the murmur loudest?

C – **C**haracter: soft / blowing / crescendo (getting louder) / decrescendo (getting quieter) / crescendo-decrescendo (louder then quieter)

R – **R**adiation: can you hear the murmur over the carotids (AS) or left axilla (MR)?

I – **I**ntensity: what grade is the murmur?

P – **P**itch: is it high pitched or low and grumbling? Pitch indicates velocity.

T – **T**iming: is it systolic or diastolic?

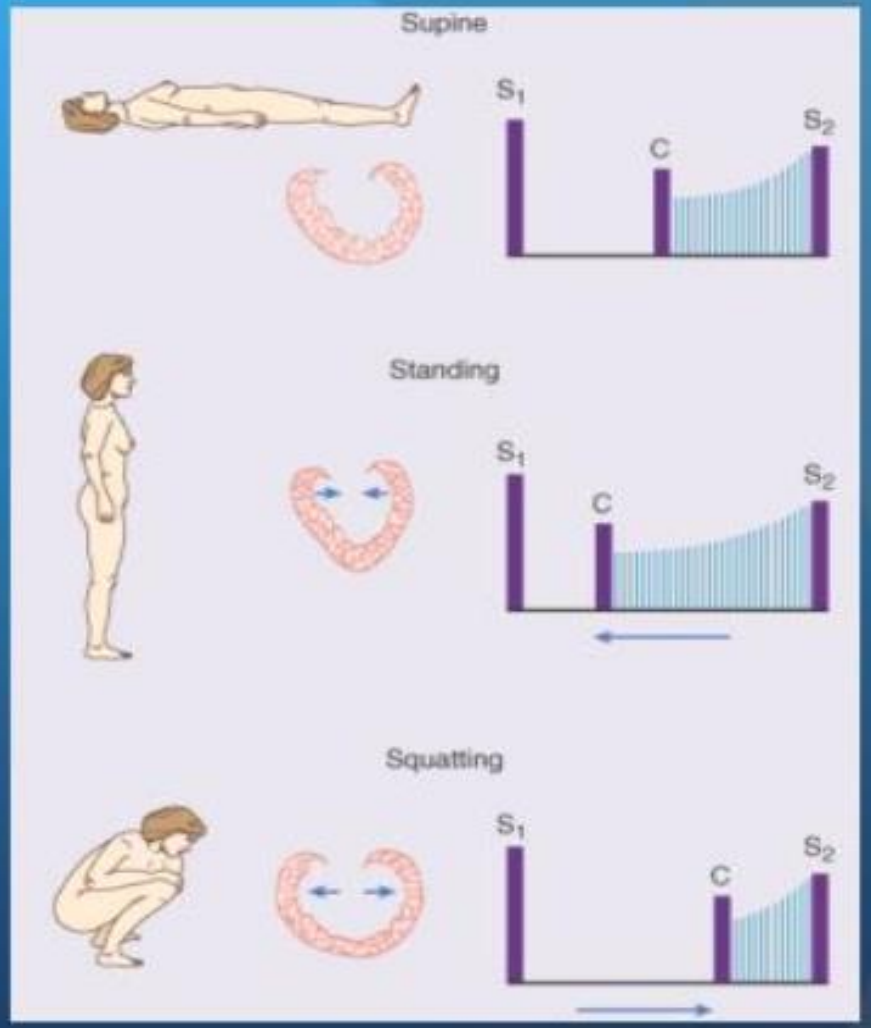
Special manoeuvres

- can be used to emphasise certain murmurs:

- Patient on their left side → ***mitral stenosis***
- Patient sat up, learning forward and holding exhalation → ***aortic regurgitation***

Physiology: Maneuvers

- Position
  - Supine:
    - Increase preload: increased blood volume in heart
  - Rapid standing:
    - Decrease preload: decreased blood volume in heart
  - Valsalva (bear down)
    - Decrease venous return (preload)
- Breathing
  - Deep breath in: Increased preload
  - Deep breath out: Decrease preload



But….

… not every murmur is a pathology

Innocent murmurs

- In healthy children
- Caused by turbulent blood flow through **anatomically healthy heart**
- **Asymptomatic**
- Always **systolic**
- **Postural**- volume varies with siting/ standing
- Intensifies with **increased cardiac output** (eg.fever, emotions, excercise)
- **Short** duration
- **Soft** and **quite** in quality < 3 grade
- **No radiation**
- Otharwise **normal physical examination-** no palpble thrill, no SOB, no FTT, normal BP, HR, SaO2

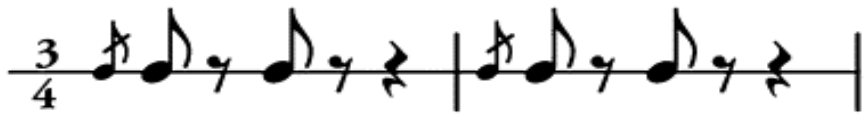
Innocent murmur- słuchamy

https://www.youtube.com/watch?v=uFyWHPfrRak

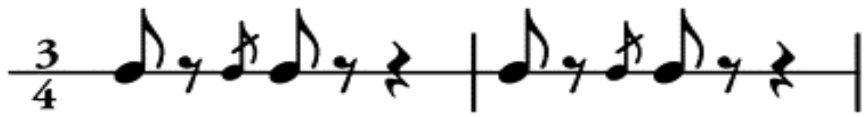
Heart sounds

Normal 1st and 2nd heart sounds

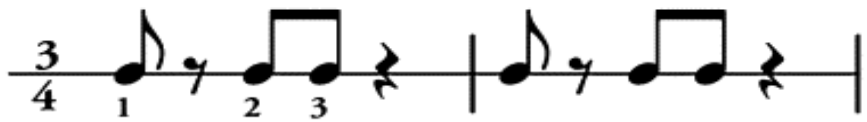
Split 1st heart sound



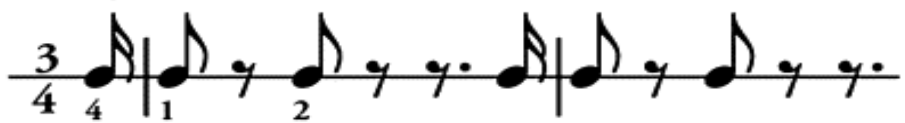
Split 2nd heart sound



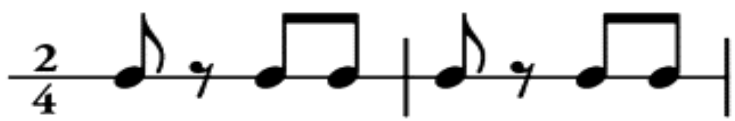
Added 3rd heart sound



Added 4th heart sound

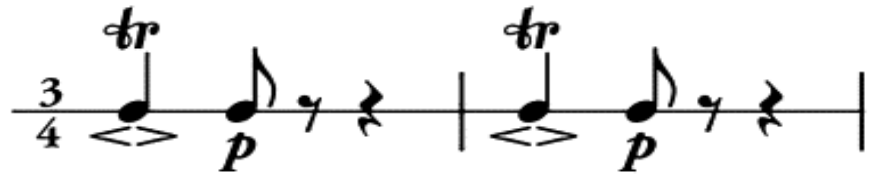


Summation gallop

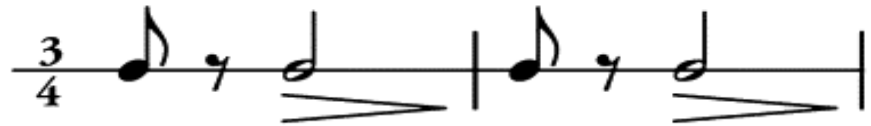


Left-sided murmurs

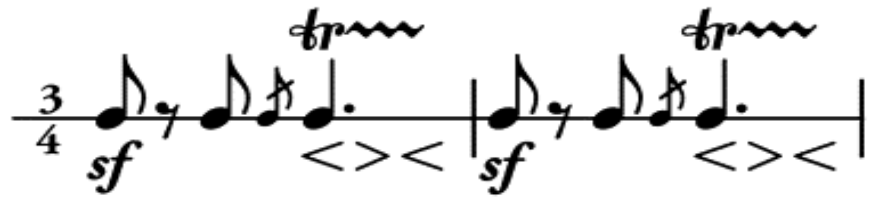
Aortic stenosis



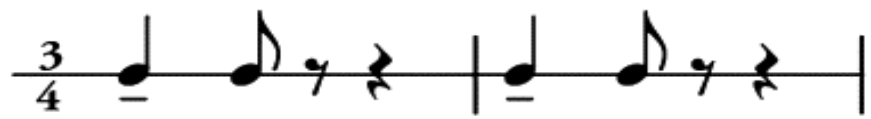
Aortic regurgitation



Mitral stenosis



Mitral regurgitation



CYANOSIS

CYANOSIS

- the bluish or purplish **discoloration** of the **skin or/ and mucous membranes** due to **low oxygen saturation of** the tissues near the skin surface
- Is a result of **deoxygenated haemoglibin** or **abnormal haemoglobin** in the blood
- Is apparent **when there is ≥ 5 g/dl of reduced haemoglobin**
- Anemic patients may not become cyanotic even in the presence of marked arterial desaturation
- In the light-skinned patients cynanosis is usualy noted with arterial SaO2 < 85%, whereas:
- In the dark-skinned patients, the Sa02 may be lower

CYANOSIS

CENTRAL

is due to a circulatory or ventilatory problem that leads to poor blood oxygenation in the lungs

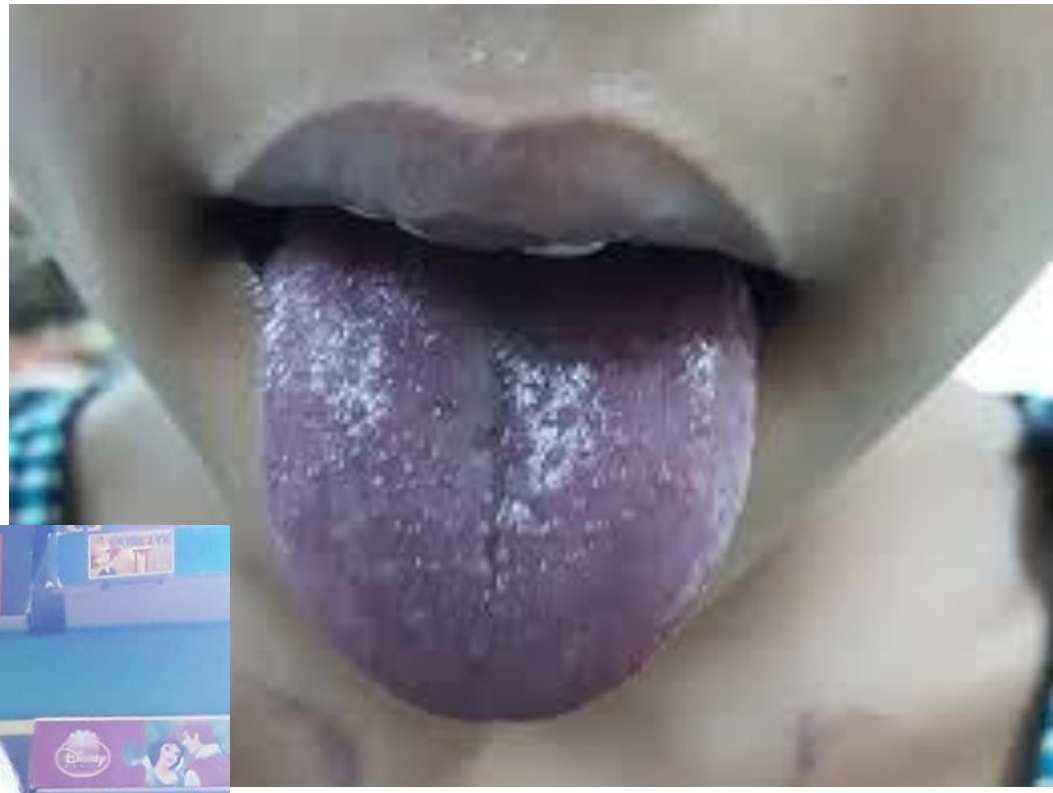
- lips
- tongue

PERIFERAL

Is due to an inadequate or obstructed circulation

- only the extremities or fingers

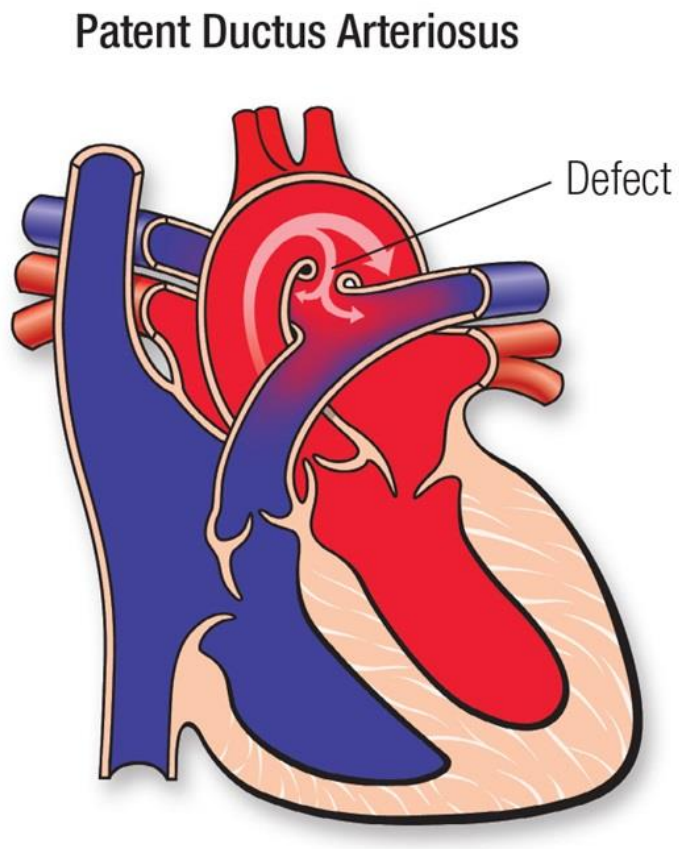

HOOK
BEN 10
ALIEN FORCE
LINK
Disney
Ravensburger



Causes of central cyanosis

1. **<u>Cardiovascular diseases</u>:**

- Congenital heart disease with R-L shunt
- Heart failure
- Valvular heart disease
- Myocardial infarction



Causes of central cyanosis

2. <u>Respiratory system:</u>

- Severe pneumonia
- Bronchiolitis
- Bronchospasm
- Pulmonary hypertension
- Pulmonary embolism
- Hypoventilation
- Chronic obstructive pulmonary disease
- Cystic fibrosis

Causes of central cyanosis

3. <u>Central nervous system</u> (impairing normal ventilation):

- Intracranial **hemorrhage**
- **Drug overdose** (e.g. heroin) → **apnea** or/ and **airway obstruction**
- **Tonic–clonic seizure** (e.g. grand mal seizure)

Causes of central cyanosis

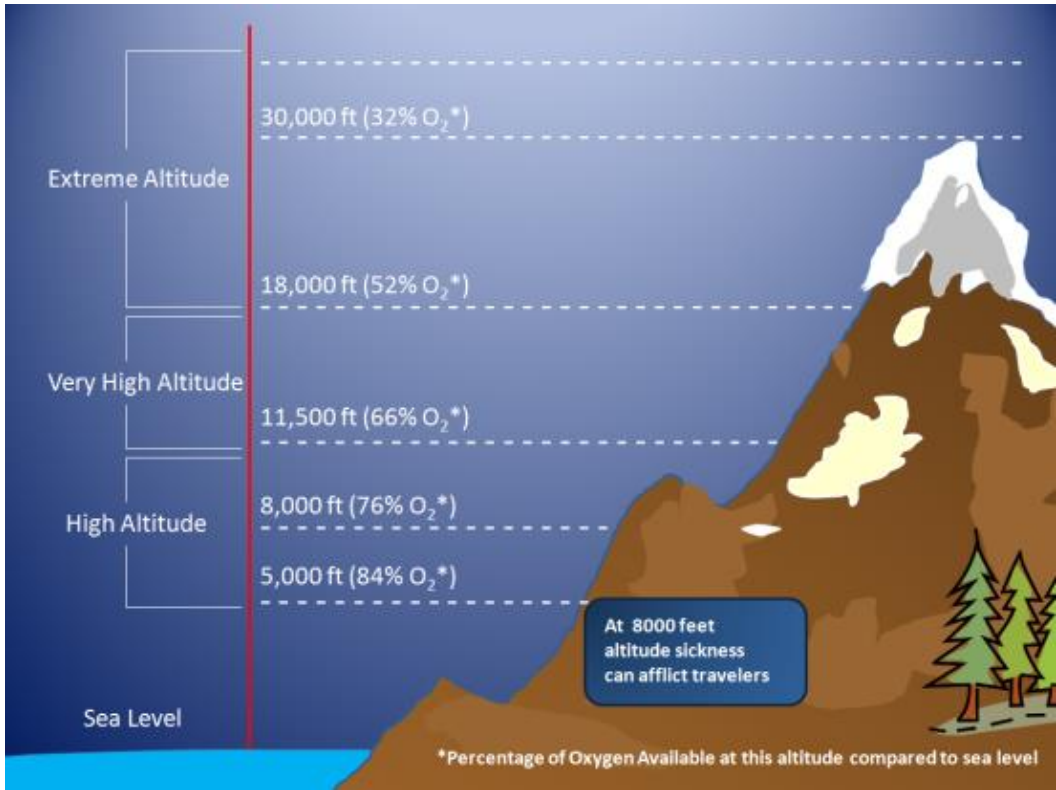
4. <u>Blood :</u>

- **Congenital cyanosis** (HbM Boston) arises from a mutation in the α-codon which results in a change of primary sequence
- **Methemoglobinemia-** patient appears cyanosed even in the presence of a normal arterial oxygen level due to conversion of iron in hemoglobin from the ferrous [Fe2+] to the ferric [Fe3+] → aquired (drugs, chemicals & toxins eg. <u>aniline</u> dyes, chlorates, and <u>bromates</u>)
- **Polycythaemia**

Causes of central cyanosis

5. Others:

- **High altitude**, cyanosis may develop in ascents to altitudes >2400 m.
- **Hypothermia**
- Severe obstructive sleep apnea (**apnea**)



Peripheral cyanosis

<u>may be due to the following causes:</u>

- All common causes of central cyanosis
- Reduced cardiac output (e.g. heart failure or hypovolaemia)
- Cold exposure
- Chronic obstructive pulmonary disease (COPD)
- Arterial obstruction (e.g. Raynaud phenomenon)
- Venous obstruction (e.g. deep vein thrombosis)

Is it cyanosis?

Is it cyanosis?

Argyria or **argyrosis** is a condition caused by excessive exposure to chemical compounds of the **element silver** or to **silver dust**

- skin turns purple or purple-grey
- **Generalised (with mucus membranes, eyes) or local**
- Argyria **worsens** and builds up as exposure to silver continues, and **does not resolve once exposure stops**

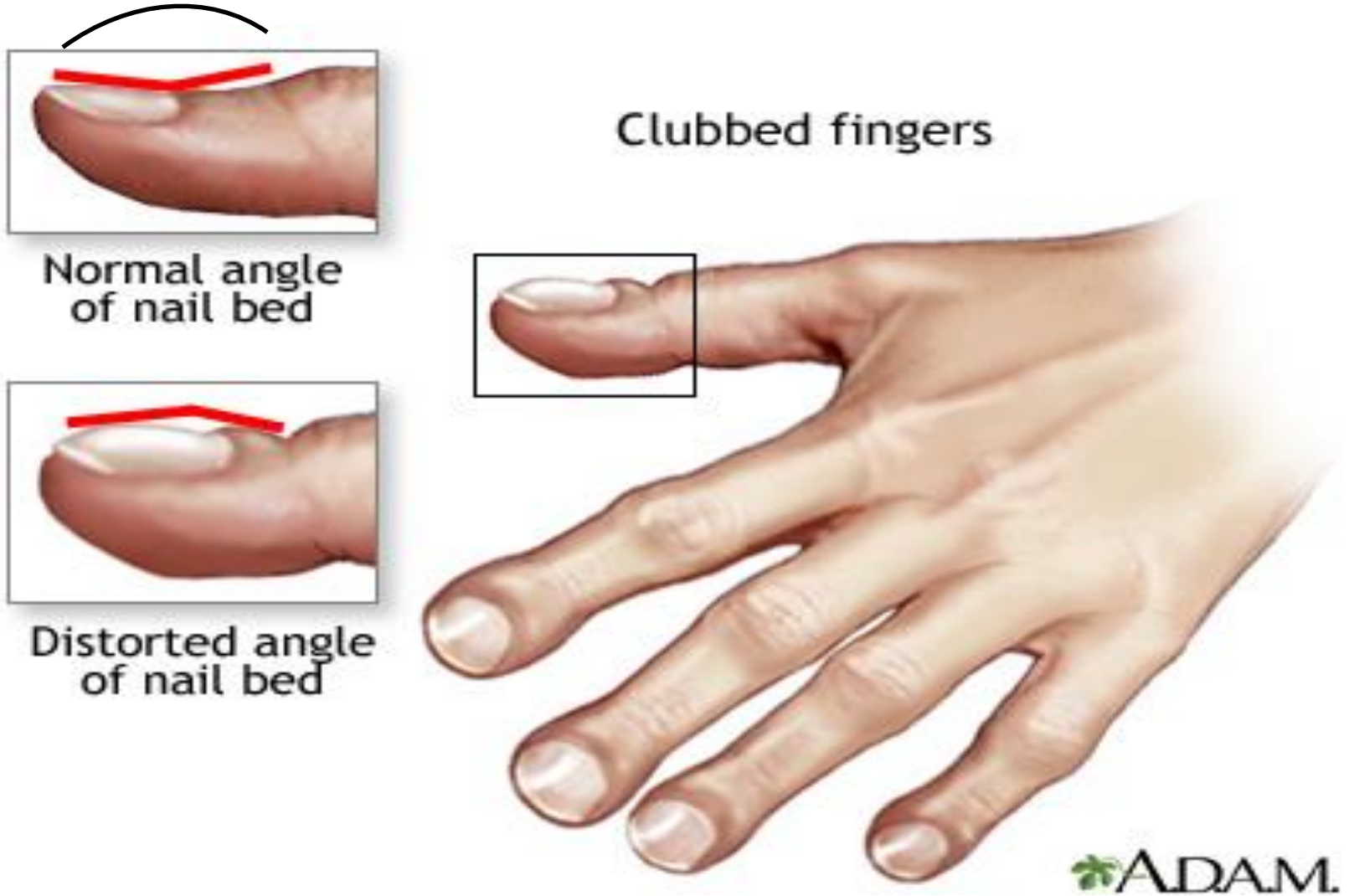
CLUBBING

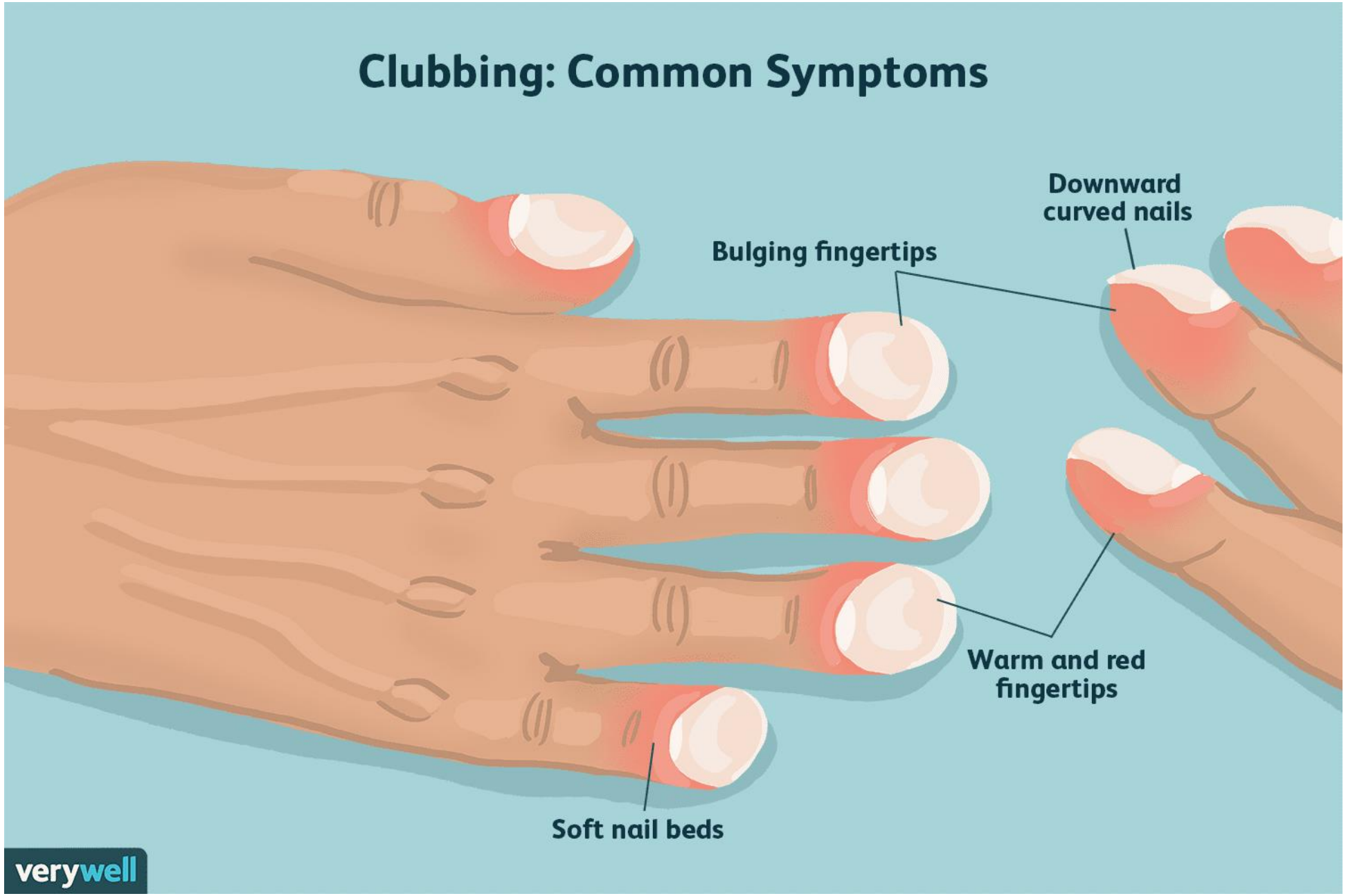
NAIL CLUBBING

NAIL CLUBBING

- is a deformity of the **fingers** and/or **toes nails** associated with a number of diseases, mostly of the heart and lungs
- occurs when **the tips of the fingers enlarge and the nails curve around the fingertips,**
- usually over the course of years
- is often **the result of low oxygen** in the blood and could be a sign of various types of heart and/ or lung disease
- Patomechanism- unknown

< 180 ° NAIL CLUBBING



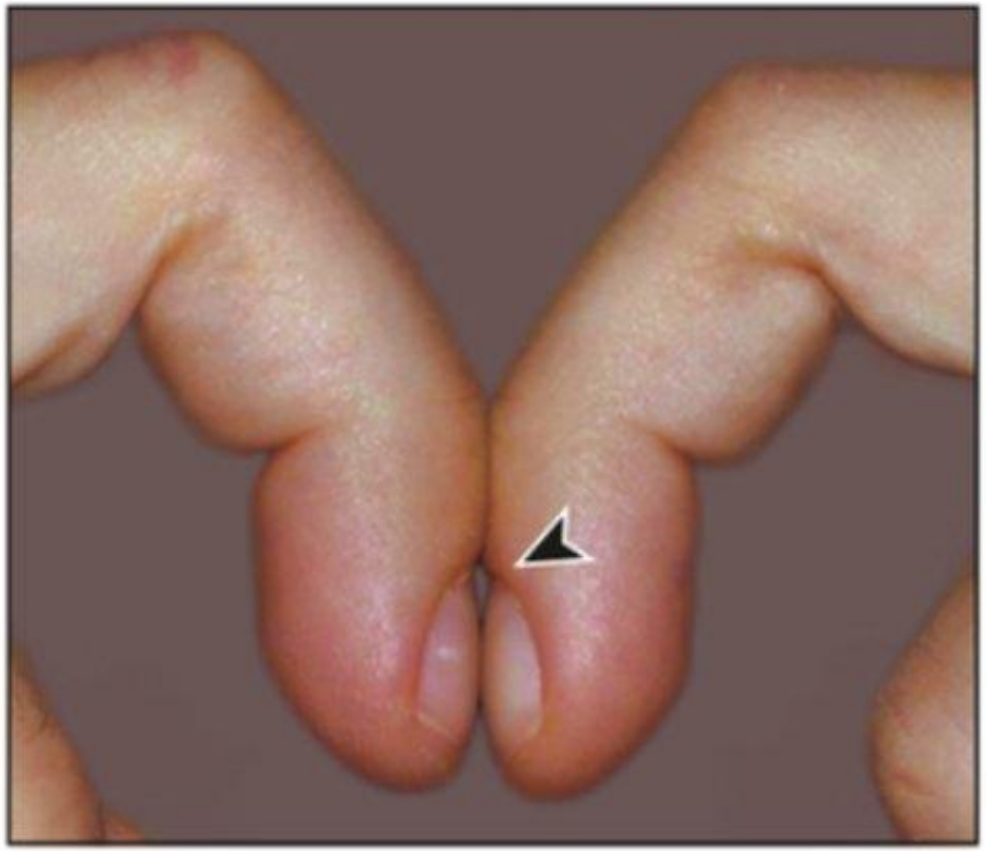

Clubbing: Common Symptoms
Downward curved nails
Bulging fingertips
Warm and red fingertips
Soft nail beds
verywell

NAIL CLUBBING- TEST (Schamroth sign)

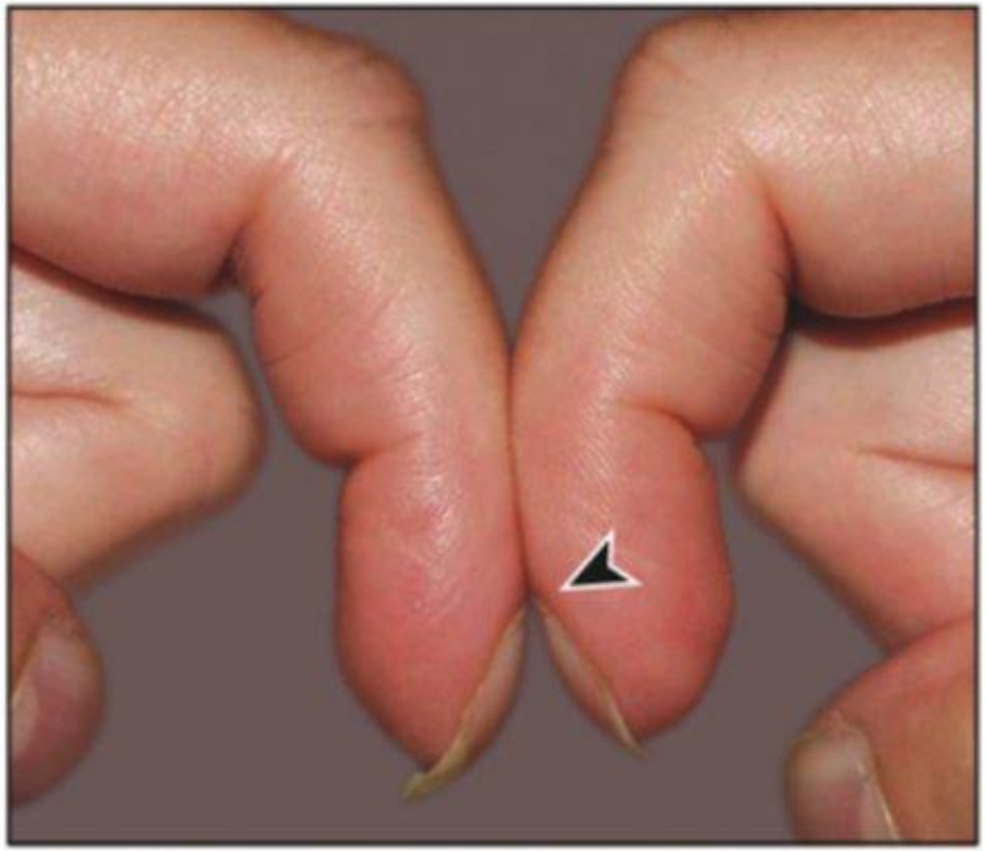
NAIL CLUBBING- TEST

Schamroth sign

Normal



Clubbed



https://www.grepmed.com/images/1644/physicalexam-sign-schamroths-clinical-diagnosis-clubbing

NAIL CLUBBING

NAIL CLUBBING
↔ DRUMSTICS

NAIL CLUBBING

NAIL CLUBBING

NAIL CLUBBING

NAIL CLUBBING

NAIL CLUBBING- COMMON CAUSE

1. **Congenital cyanotic heart defects**
2. Any heart disease featuring **chronic hypoxia**
3. **Infective endocarditis**
4. **Pulmonary conditions** (eg CF, pulmonary hypertension)

- **Lung cancer** mainly non-small-cell (54% of all cases), not seen frequently in small-cell lung cancer (< 5% of cases)
- **Interstitial lung disease** most commonly idiopathic pulmonary fibrosis
- **Complicated tuberculosis**
- Suppurative lung disease: lung abscess, empyema, bronchiectasis, **cystic fibrosis**
- **Mesothelioma** of the pleura
- **Arteriovenous fistula** or malformation
- **Sarcoidosis**

NAIL CLUBBING- COMMON CAUSE

5. **Hereditary**

6. **GI disease** (Crohn's disease, ulcerative cllitis, cirrhosis, especially in primary billiary cirrhosis)

7. **Idiopathic**

HEART FAILURE

HEART FAILURE IN ADULTS

New York Heart Association (NYHA) Functional Classification

Classifying the extent of heart failure

NYHA Class	Symptoms
I	Cardiac disease, but no symptoms and no limitation in ordinary physical activity, e.g. no shortness of breath when walking, climbing stairs etc.
II	Mild symptoms (mild shortness of breath and/or angina) and slight limitation during ordinary activity.
III	Marked limitation in activity due to symptoms, even during less-than-ordinary activity, e.g. walking short distances (20–100 m). Comfortable only at rest.
IV	Severe limitations. Experiences symptoms even while *at rest*

Heart failure in children

- May be manifested by symptoms of **poor tissue perfussion alone** (eg. fatigue, poor excercise tolerance, cinfusion) or
- by symptoms of **congestion of circularion** (e. SOB, pleural effusion, pulmonary or peripheral oedema, hepatomegaly) without evoking compensatory mechanisms
- **Underlying pathophysiology mechanisms** leading to HF include

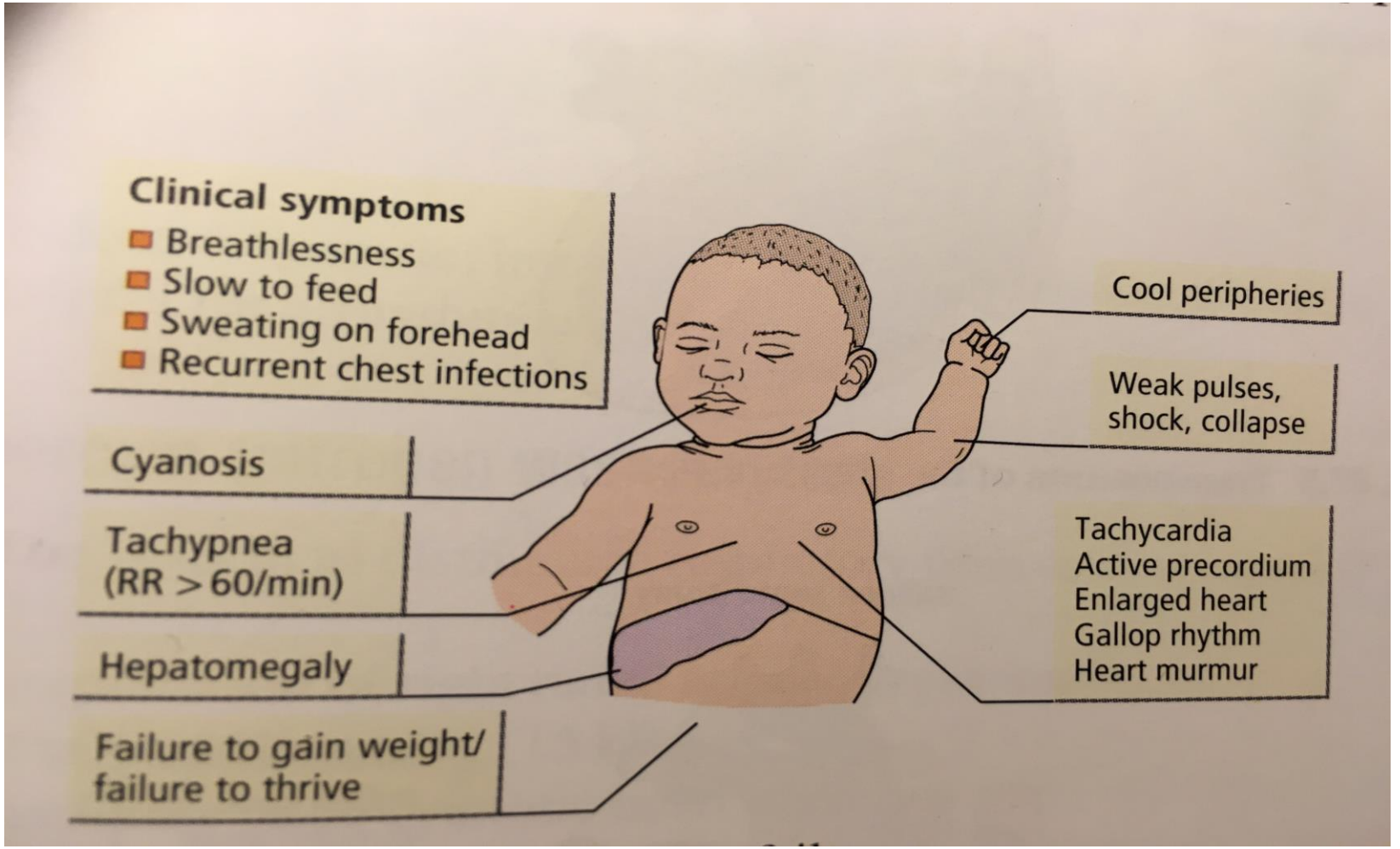
➢ increased afterload (preassure work) eg. valves stenosis

➢Increased preload (volume work) eg. shunts

➢Myocardial abnormalitries (eg. Cadiomiopathies)

➢Tachyarhhythmias

HEART FAILURE IN CHILDREN



Tom Lissauer, Avroy Fanaroff, *Neonatology at a Glance*

Common causes of HF in children

Left to right shunting (high-output failure)

Patent ductus arteriosus

Atrioventricular septal defect (AVSD)/large ventricular septal defect (VSD)

Left ventricular outflow obstruction

(duct-dependent systemic circulation)

Severe coarctation of the aorta

Critical aortic valve stenosis

Hypoplastic left heart syndrome

Myocarditis/cardiomyopathy

Arrhythmias

Supraventricular tachycardia (SVT)

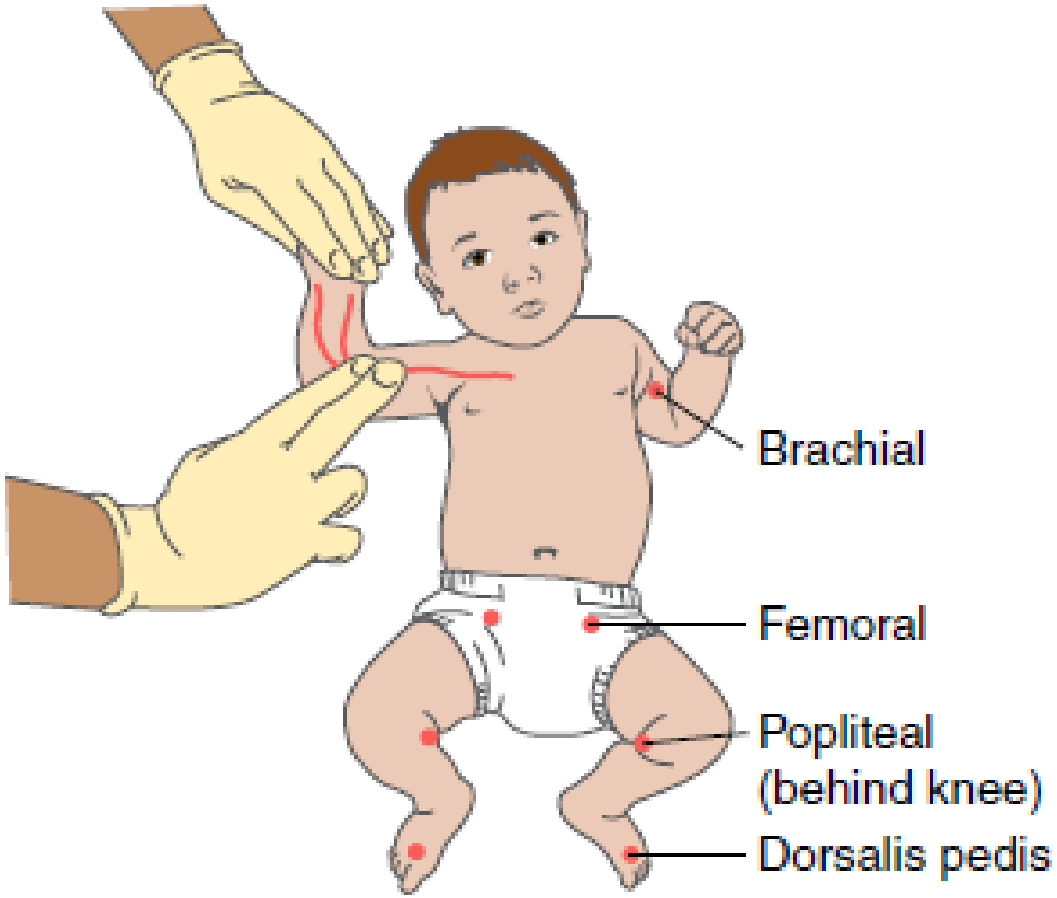
Non-cardiac

Severe anemia, polycythemia, arteriovenous malformation, e.g. vein of Galen malformation

Practical approach to physical examination of circulation

- **Airway**
- **Breathing**
  - Respiratory Rate
  - Tidal Volume
  - Work of extra muscles
  - Oxygenation
- **Circulaton**
  - HR
  - BP
  - PULSE (PRESENT? AMPLITUDE?)
  - PERFUSSION (CRT, SKIN- COLUOR- CYANOSIS?, WARM? / COLD?, SWEATY?)
  - PRELOAD (JUGULAR VEINS, HEPATOMEGALY, CRACLES IN LUNGS)
  - DIURESIS (RENAL PERFUSSION)

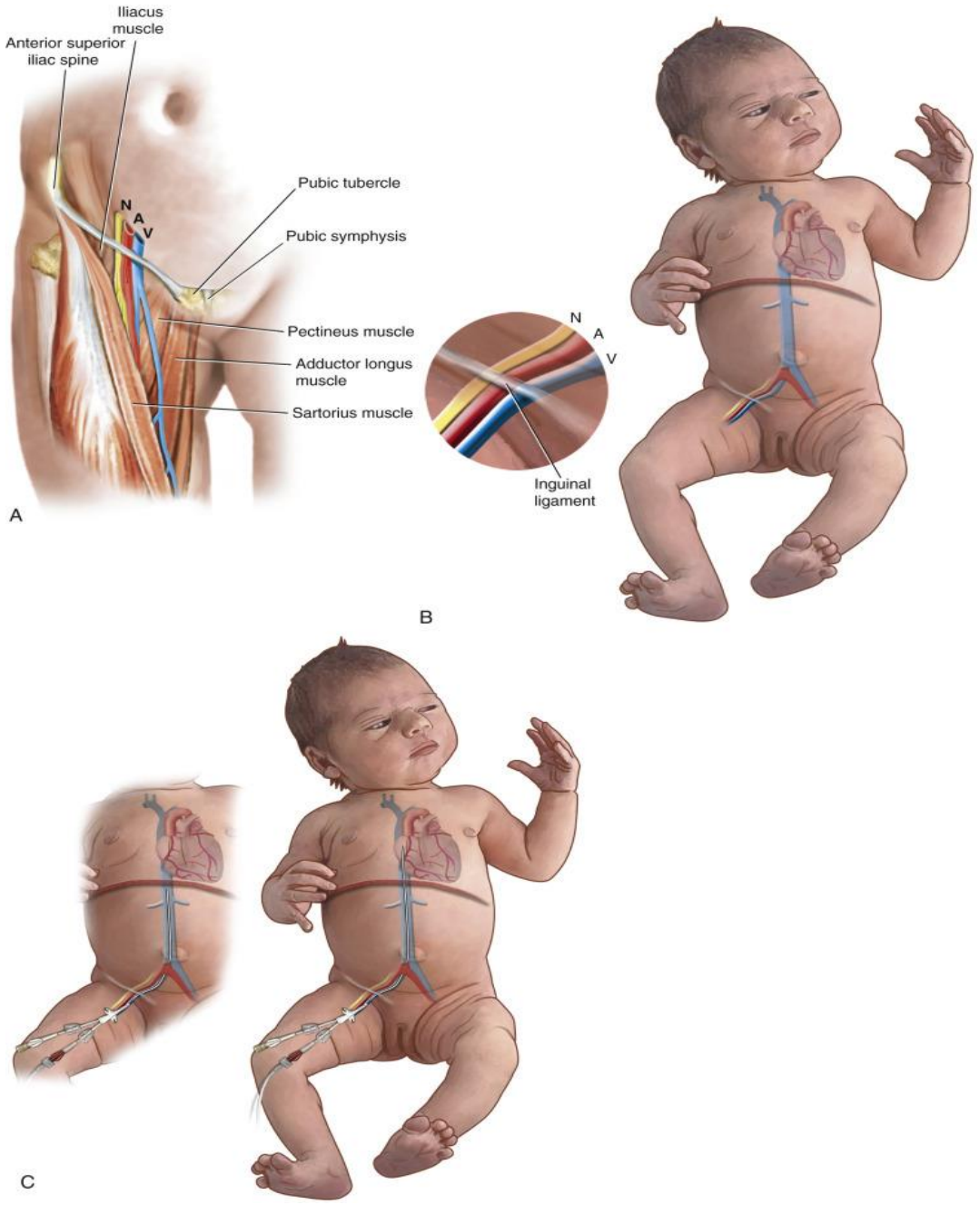
Checking the pulse in children



Pulse - Brachial

- Used for infants and small children
- Place fingertips of first 2 or middle 3 fingers over the brachial pulse area
  - Inside of the elbow
- Lightly press your fingertip on the pulse area

Checking the pulse in neonates



Thank you for your attention!

"It's got a nice beat and it's easy to dance to!"