Blood pressure measurement:

- We measure it using a sphygmomanometer
- The most common type is the arm type; you tie a cuff around the middle part of your arm.
- There are newer devices, which are used on the wrist. These devices should be put at the level of the heart. If you put them at a lower level, you get a higher reading. If you put them at a higher level, you get a lower reading. This positioning is not particularly important with the arm device.
- We measure systolic and diastolic pressures:
    - Systolic: Normal range → 100-140 mmHg
    - Diastolic: Normal range →60 (critical pressure) – 90 mmHg
- An increase in systolic, diastolic, or both pressures is called hypertension.
- How do we measure the blood pressure?
    - Put the cuff around the arm (make sure it is in the middle)
    - Increase the blood pressure above the systolic blood pressure (usually, we increase it up to 150)
    - Start decreasing the pressure gradually
    - The first sound you hear is the systolic blood pressure
        - Before you hear the first sound, there is no blood flow in the artery.
        - The sounds you hear are called Korotkoff sounds; they are due to the turbulent flow of blood in the artery.
    - Once the blood pressure reaches the diastolic pressure, you stop hearing sounds.
        - The artery is no longer under pressure making blood flow laminar; laminar blood flow is silent
- To measure blood pressure you need a stethoscope and a sphygmomanometer. This method is called the auscultatory method. However, if you do not have access to a sphygmomanometer, use your senses to palpitate. You wait from the moment you feel the first pulse until it disappears.
- Auscultation: Hearing sounds using a stethoscope.

Pulse:

- Your heart rate can be measured through the pulses that can be felt in different areas of your body.
- You can count the heart rate using ECG, but this is not practical
- To measure the heart rate or pulse we use any artery
- If there is no pulse in an artery this indicates low flow due to atherosclerosis, a cut in the artery or any other problem.

- Common places for pulsation:
    - Antecubital artery
    - Axillary artery
    - Radial artery
    - Carotid artery (especially in comatose)

- To sense the radial pulsation, you use three fingers:
    - The first and third fingers are used to measure the flow of the blood (strength of the flow). The first is used to block the flow to that area. Removing the finger causes an increase in the flow which can be felt by the third finger
    - The second finger is used to count the pulses.
- To measure the heart rate, you sense the pulse for a minute. However, you can do it for 30 seconds or less. The less the time, the greater the error
- When you measure the pulse you have to look out for:
    - Regularity
    - Strength (flow)
    - Rate
- A drop in the beat (palpitation), if sensed, can mean a variety of things. It can indicate an AV block; however, this is not always true. The only diagnostic tool for AV block is the ECG reading. Other causes of the sensed palpitation might include stress, increased caffeine intake, or thyrotoxicosis.
- Normal pulse is between 60 and 100 bpm
- Below 60 bpm: bradycardia
- Above 100 bpm: tachycardia

Heart sounds:

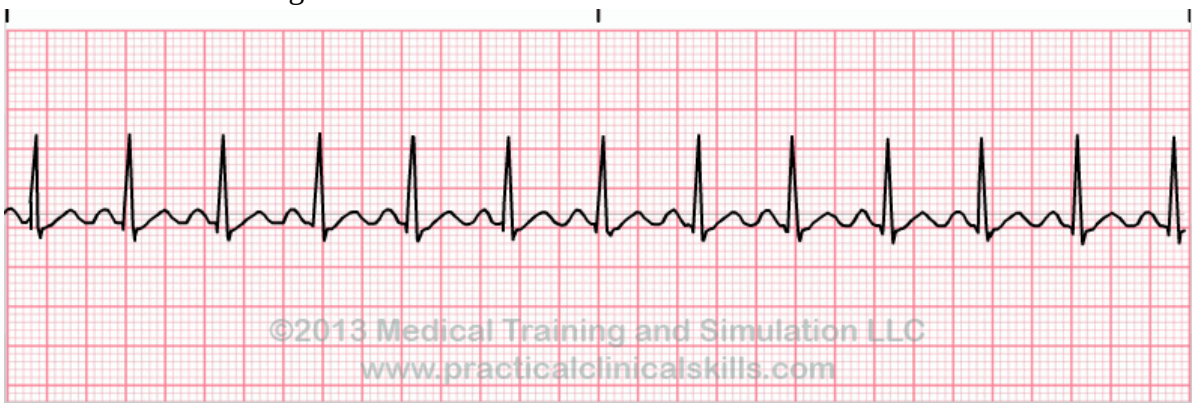
- We normally hear two sounds:
    - S1
    - S2
- You auscultate at the apex of the heart for all sounds. However, for a clearer voice for the S2 sounds, you can place your stethoscope on the pulmonary valve auscultation area on the left side or the aortic valve auscultation area on the right side.
- The first heart sound is concurrent with the pulse. The second one is 0.3 seconds after the first one. There are 0.5 seconds before we hear S1 again.
- The wave of pulsation goes through the wall of the artery at a very high speed (about 30m/s in small arteries).
- As you increase the heart rate, the time between the two sounds decreases. The decrease is usually more significant in the diastolic component.
- If there is a sound between S1 and S2 or between S2 and the next S1, this is called a murmur; it is abnormal. If it is between S1 and S2 it is called a systolic murmur. If it is

between S2 and the next S1, it is called a diastolic murmur. The systolic murmur indicates a problem in the AV node or aortic stenosis. A diastolic murmur indicates aortic regurgitation.

Arrhythmias:

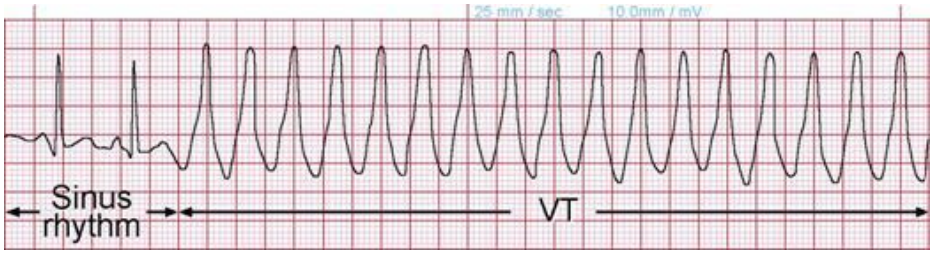
- Abnormal rhythm, and it is divided into many types:
  - Tachycardia
  - Bradycardia
  - Atrial fibrillation
  - Ventricular fibrlllation
  - AV block

- Causes of arrhythmia:
  - An aberrant pacemaker.
  - Abnormal electricity
  - Ectopic pacemaker
  - Block at different areas
    - AV block
    - AV bundle branch block
    - SA block
- **Tachycardia:** Heart rate > 100 bpm
  - Sinus tachycardia
    - Normal waves (PQRST)
    - High rate of the waves



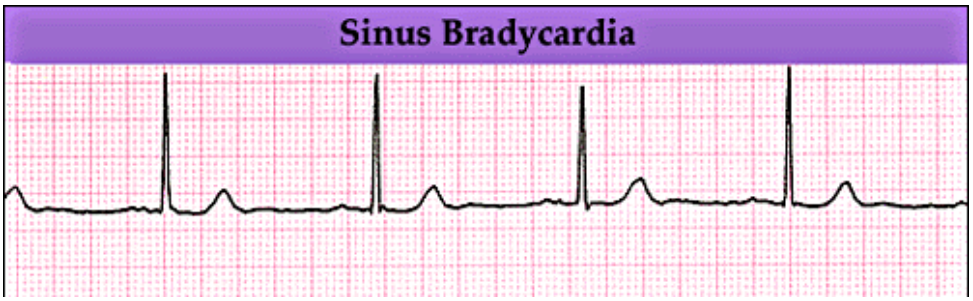
  - Ventricular tachycardia
    - Arises when a focus in the ventricle gives impulses at a very high rate (a premature impulse)

- Characterized by many QRS complexes without any P's



- Causes of sinus tachycardia:
  - High temperatures (fever)
  - Sympathetic stimulation
  - Hyperthyroidism or thyrotoxicosis
  - Toxic conditions of the heart

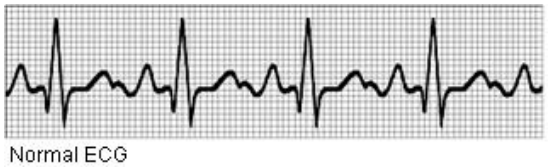
- **Bradycardia**: Heart rate < 60
  - Sinus bradycardia
    - SA node depolarizes at a lower than normal rate.
    - Normal waves



  - Non-sinus bradycardia
    - AV block

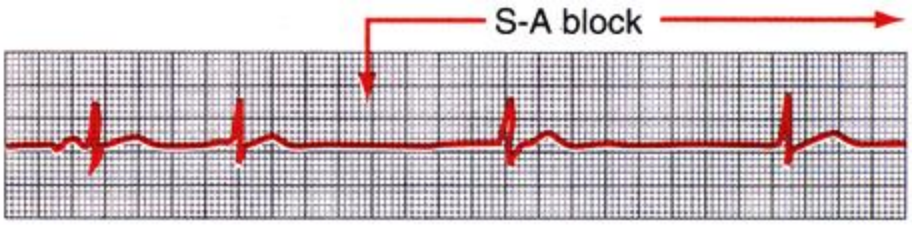
Bradycardia in first degree AV block is not common; however it is apparent in second (heart rate 40-60 bpm) and third (heart rate 15-40 bpm) degrees.

- **Atrial fibrillation**: No atrial contraction
  - Characterized by no P waves.
  - QRS is normal


Normal ECG


Atrial Fibrillation

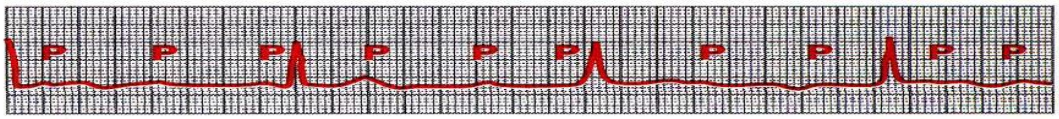
- **<u>SA block:</u>** SA node does not conduct
    - no P's (sometimes)
    - QRS is there, but at the rate of the AV node
    - Inverted P wave (sometimes)
        - Why?
            - The AV node gives a retrograde impulse from the AV node to the atrium



- **<u>AV block:</u>** The AV node does not conduct a signal properly. AV node is the slowest conducting fiber. It delays the signal to separate atrial systole from ventricular systole.
    - <u>First degree: incomplete</u>
        - The impulse passes the whole time, but at a slightly slower rate (prolonged PR)
        - Every P is followed by a QRS

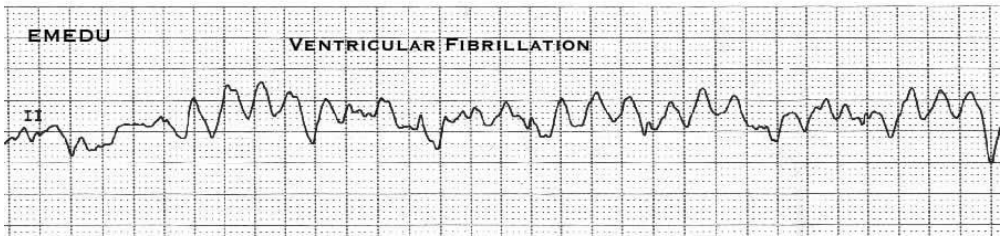
    - <u>Second degree: incomplete</u>
        - Prolonged PR interval
        - Not every P is followed by a QRS
        - Regular irregularity rate (1:3, 2:3, 3:2, etc… P:QRS)

- Third degree: complete
  - Irregular irregularity
  - Prolonged PR
  - Not every P is followed by QRS



All of the degrees are characterized by a prolonged PR interval (> 0.2 sec)

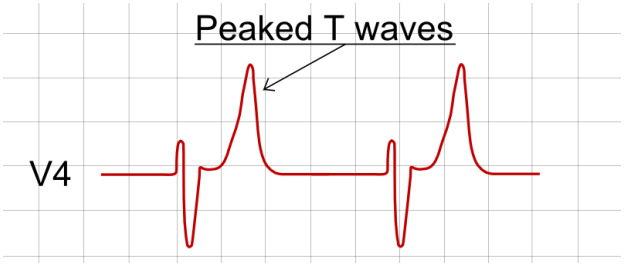
- Causes of AV block:
  - Ischemia to AV node or bundle fibers
  - Compression of the AV bundle
  - Inflammation of the AV bundle
  - Excessive vagal stimulation
- **Ventricular fibrillation:** the ventricles do not contract properly, lethal
  - Saw shaped ECG
  - Absent QRS



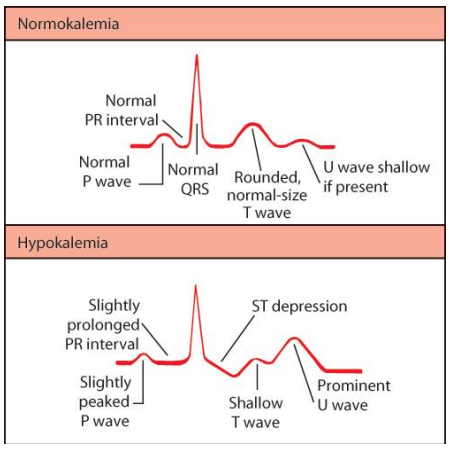
- **Stoke-Adams syndrome:**
  - Compression of the vagi by the carotid artery.
  - Compression causes excessive stimulation of the vagi causing a block.
  - The heart stops for 15-30 seconds, then it resuscitates in a process called ventricular escape (heart rate 15-50 bpm)
- **Electrical axis deviation:** Review the angles from the previous lab + review calculating the mean electrical axis

- Right axis
  - Hypertrophy of the right ventricle
  - Late depolarization of the right ventricle
  - Right bundle branch block (accompanied by prolonged QRS)
    - Due to the block, the electrical signal is conducted through the ventricular muscle fibers instead of Purkinje fibers; this causes a prolonged QRS.
  - Pulmonary hypertension
  - Pulmonary regurgitation or stenosis
  - Ventricular Septal Defect (VSD) → blood is shunted from the LV to the RV
- Left axis
  - Hypertrophy of the left ventricle (caused by hypertension)
    - Increased afterload forces the ventricle to pump at a higher force. This causes hypertrophy.
    - Increased muscle size, increases depolarization time
    - Increased voltage, as well
  - Late depolarization of the left ventricle
  - Left AV bundle branch block (accompanied by prolonged QRS)
  - Short and obese individuals
  - Aortic stenosis and regurgitation

- **T elevation:** in cases of electrolyte imbalances, especially potassium.
  - A small change is significant, because potassium is found in minute amounts in the body.
  - Hyperkalemia → tall T waves



  - Hypokalemia → flat T waves



- **Increased voltage:** sum QRS from leads I, II, and III above 4mV
    - Can be caused by hypertension
- **Decreased voltage:**
    - Emphysema
    - Pleural effusion
    - Pericarditis
    - Temponade and infarcts.

Please refer to the slides; there are extra information! :D