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Cardiovascular system I

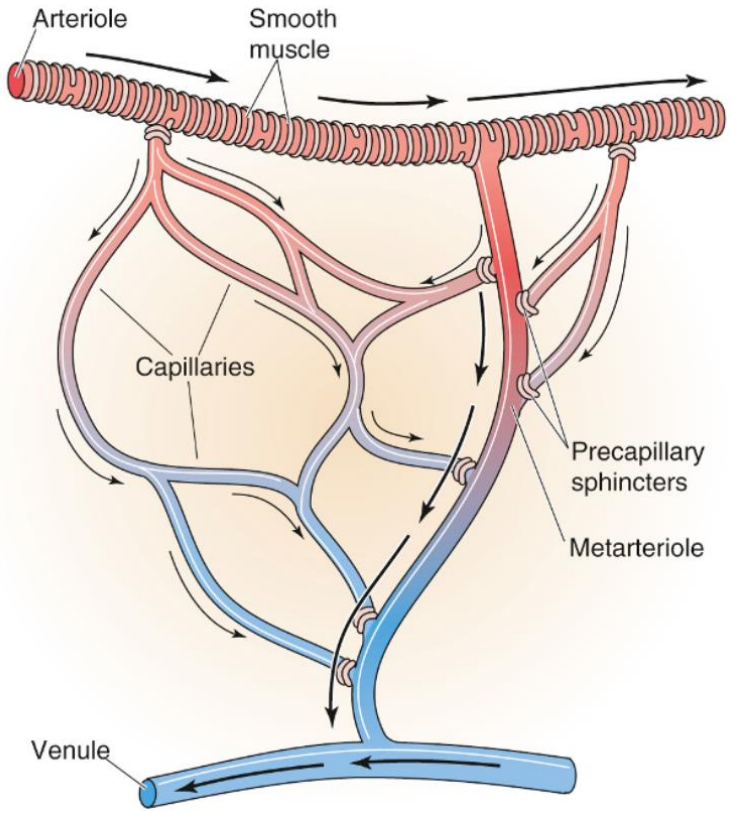
Organization of cardiovascular system. Blood. Arteries and veins. Microcirculation. Cardiac electrophysiology and ECG.

Compendium of Physiology – autumn 2020

Tibor Stračina

1 Department of Physiology, Faculty of Medicine, Masaryk University, Brno

Organization of CVS



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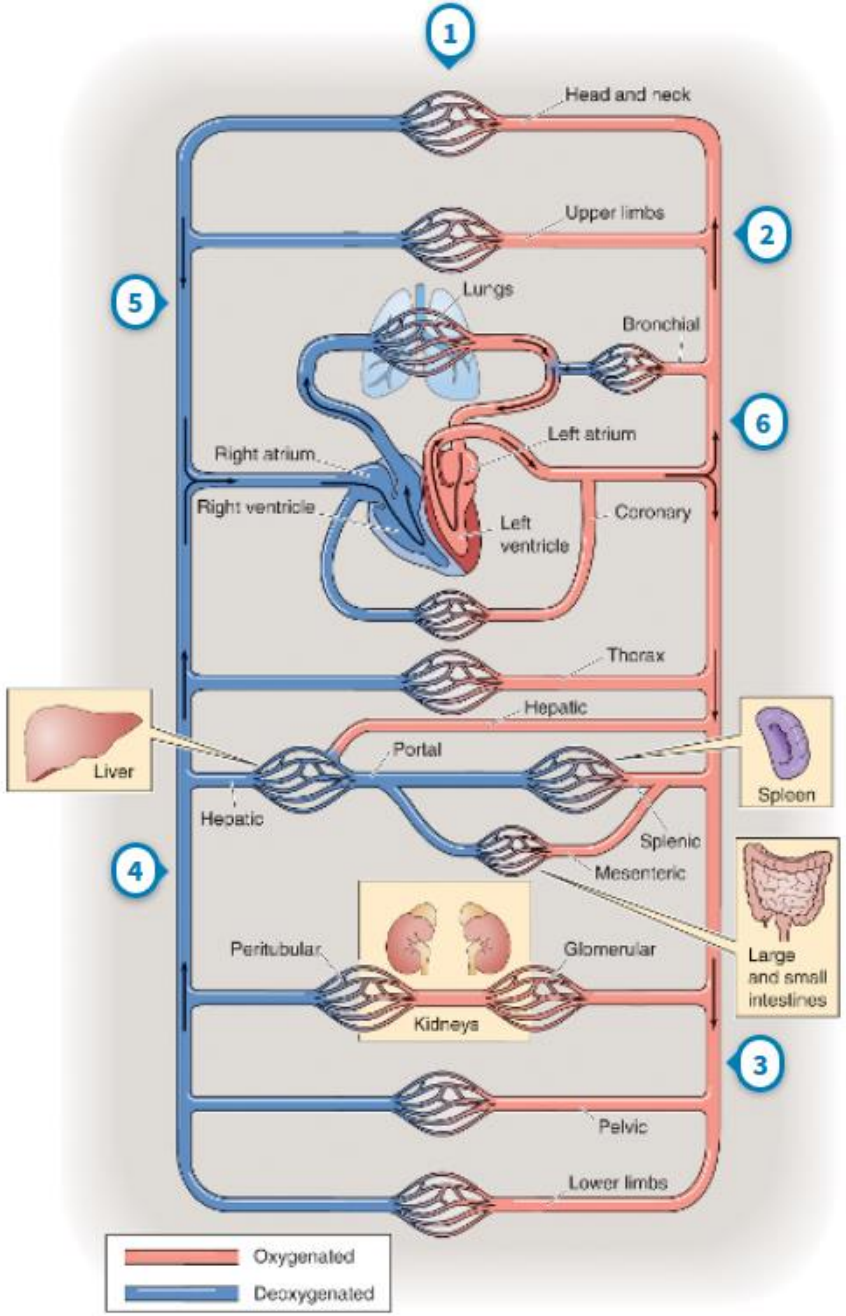

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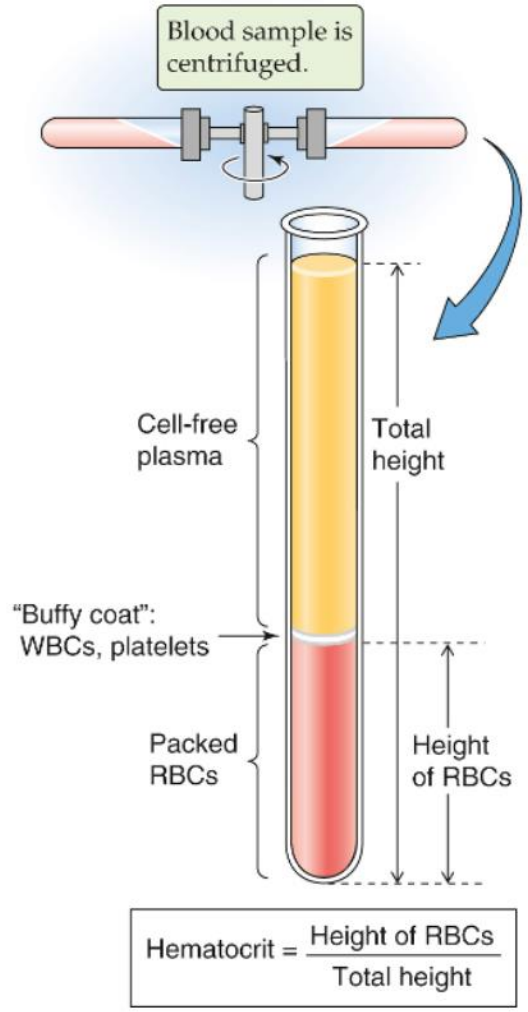
Blood

- Blood plasma
  - Water
  - Ions
  - Proteins
  - Urea, glucose, etc.
- Erythrocytes
- Leukocytes
- Platelets



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Red blood cells. Haemolysis

- Erythropoiesis
- Life span
- Degradation
- Function
  - Transport (O2, CO2)
  - Buffer (hemoglobin)

Haemolysis

- Physical
  - Mechanical
  - Osmotic
  - Thermic
- Chemical
- Biological
  - Immune responce

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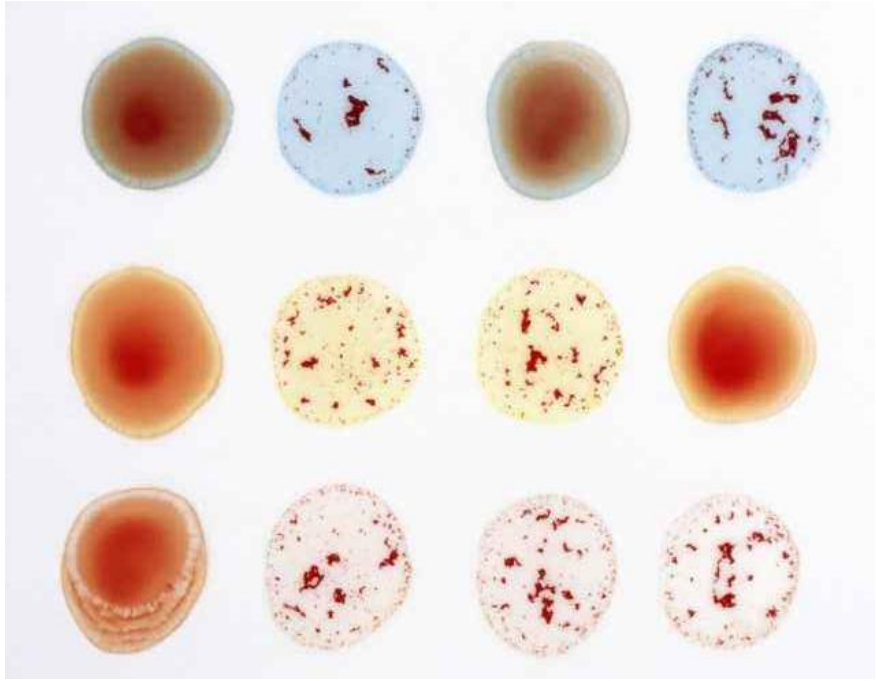
Blood groups. AB0 system

- Surface antigents on the RBCs
- AB0 system
  - The highest imunoactivity
  - 2 surface antigens (A, B), co-dominance
  - 4 blood groups: A, B, AB, 0
  - Antibodies constantly produced
- Other systems: Rh, MNS, P, Kell, Lewis, Duffy, Diego

AB0 system – slide method

Serum (antibodies)



Legend:

Negative reaction

Positive reaction

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Rh system and other systems

- Rh system
- Antigen D
- Anti-D antibodies
- Rh incompatibility (Rh- mother vs. Rh+ fetus)

Arteries: blood pressure, R, blood flow

- Systemic arteries – high-pressure system
  - Elastic arteries (low resistance, high compliance)
  - Resistance arteries (high and regulable resistance)
- Pulmonary arteries – low-pressure system

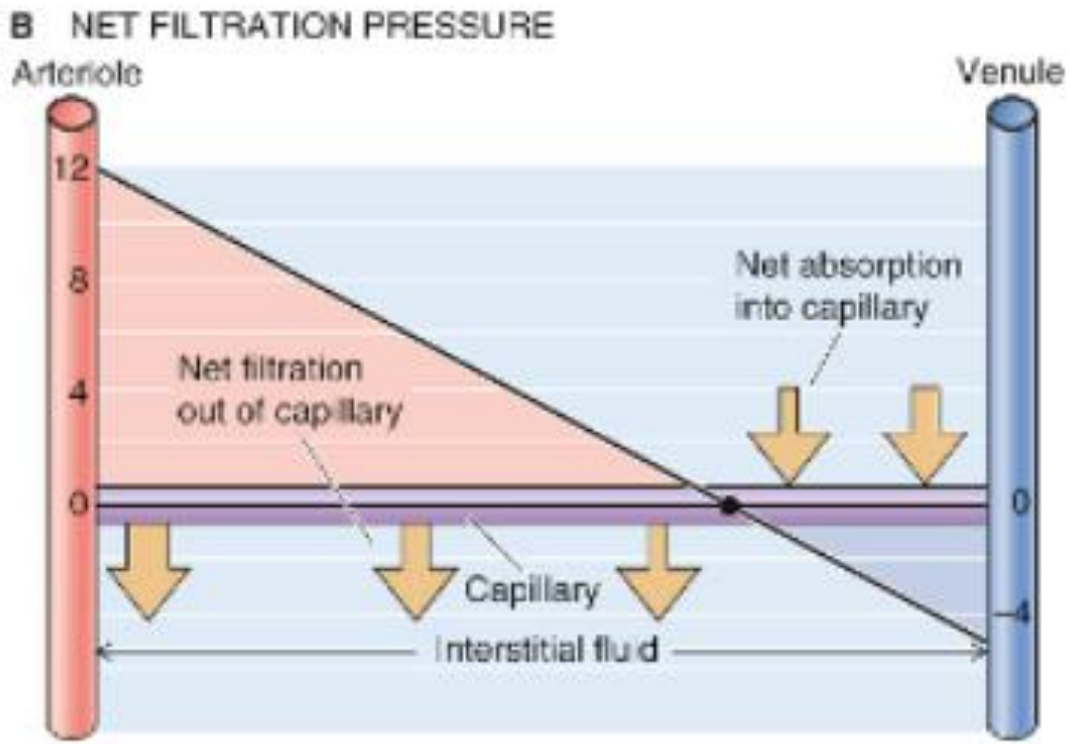
Veins: blood pressure, R, blood flow. Venous return. Venostasis.

- High capacity - volume reserve
- Low pressure gradient
- Mechanisms of venous return
  - Muscle pump
  - Valves
  - Blood flow (pressure) through capillaries – *vis a tergo* = force from behind
  - Suction force of ventricular systole – *vis a fronte* = force from the front
  - Suction force of inspiration

Microcirculation

- Net filtration pressure

  (Starling forces)
  - Hydrostatic (blood) pressure in capillary
  - Hydrostatic pressure in interstitium
  - Osmotic pressure in capillary
  - Osmotic pressure in interstitium



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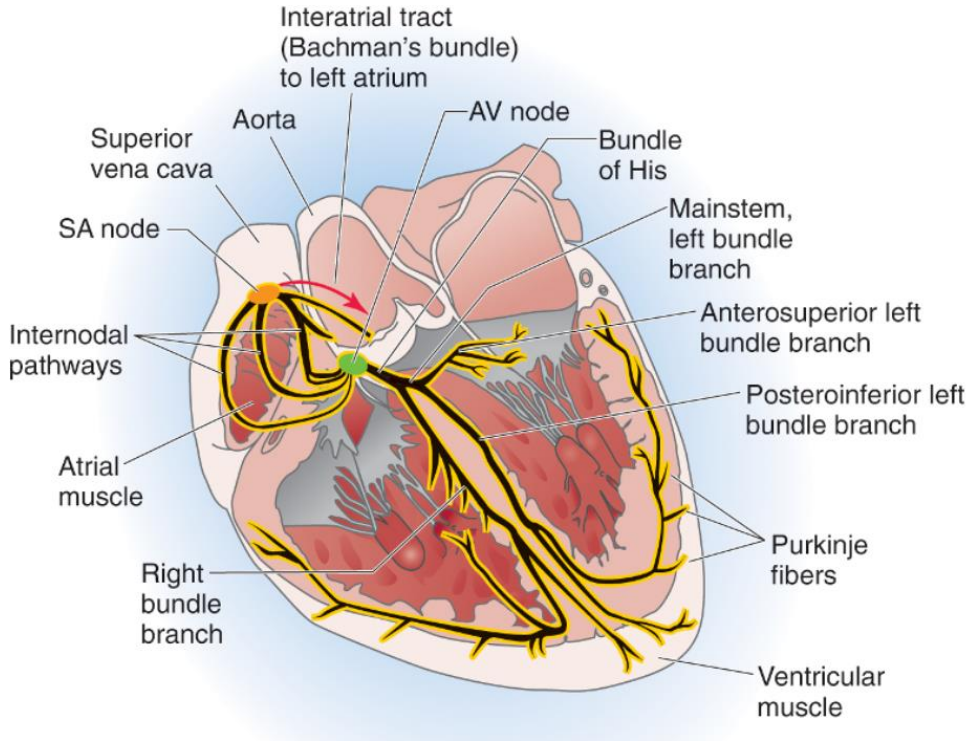
Heart. Cardiac muscle as an excitable tissue

– Excitability



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– *Task: Draw AP of working ventricular cardiomyocyte.*

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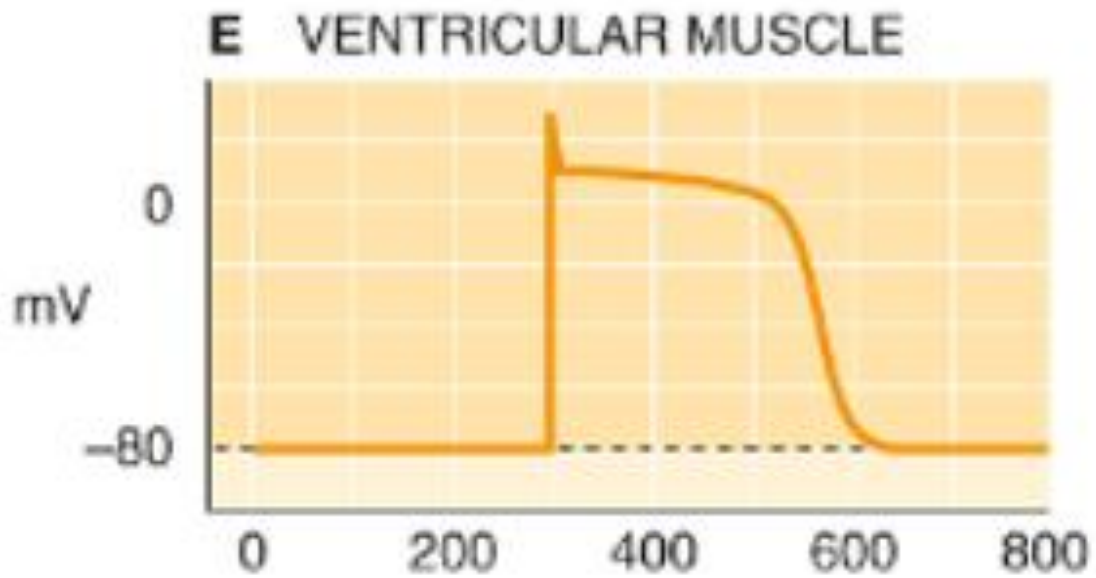
Action potential: Ventricular muscle cells



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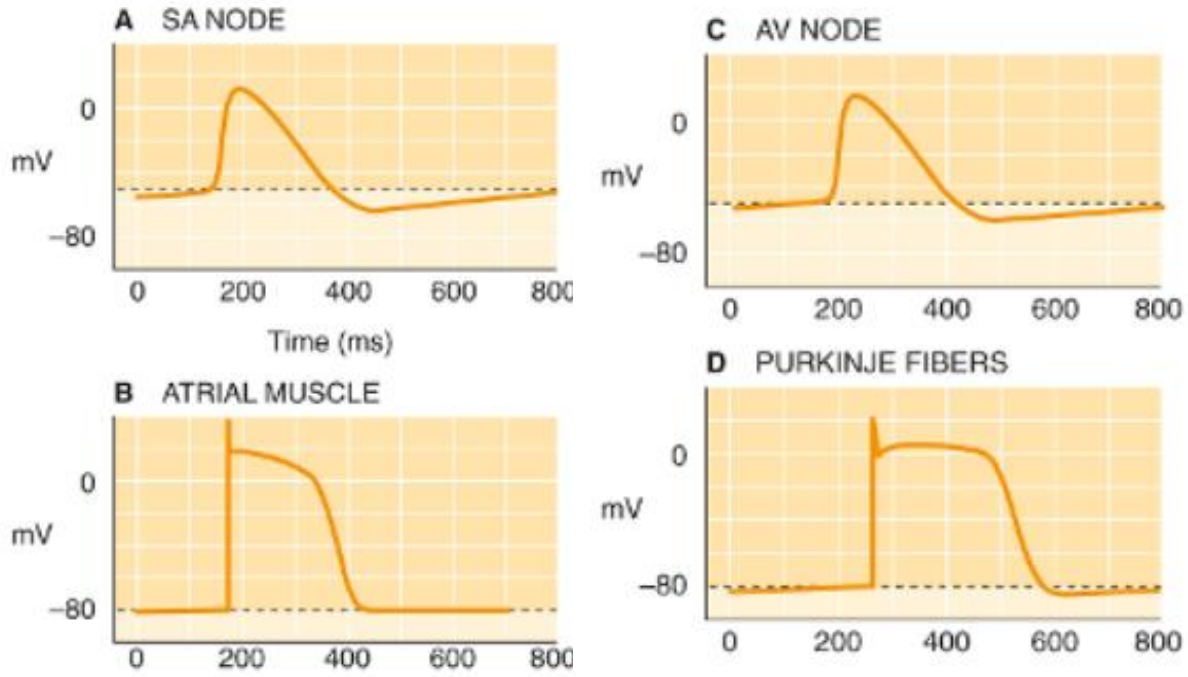
Cardiac automaticity. Condactive system

- Pacemaker aktivity
  - SA node >> AV node >> Purkinje fibres
- Condactive system
  - Fast conduction
  - Delay (AV-His)



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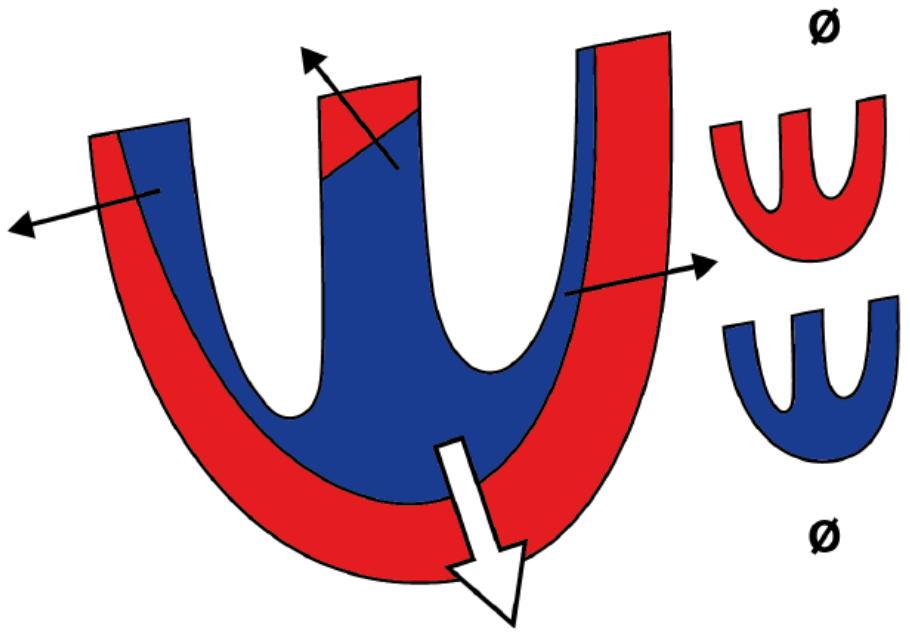
Electric vector of the heart. ECG

- Potential differences
- Summary of all partial vectors
- Changes in time



Author: MN; https://is.muni.cz/auth/el/med/jaro2020/aVLFY0422p/um/ECG-2020-GM.pdf

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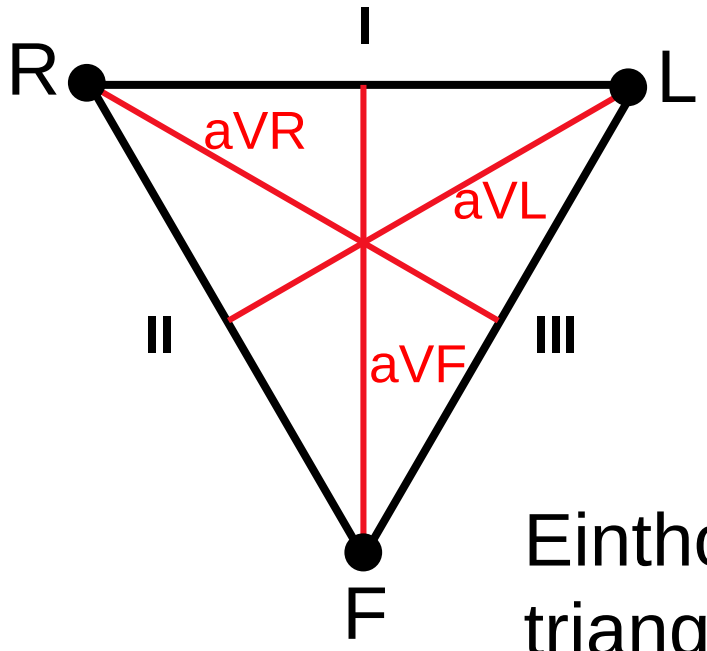
ECG electrodes. ECG leads

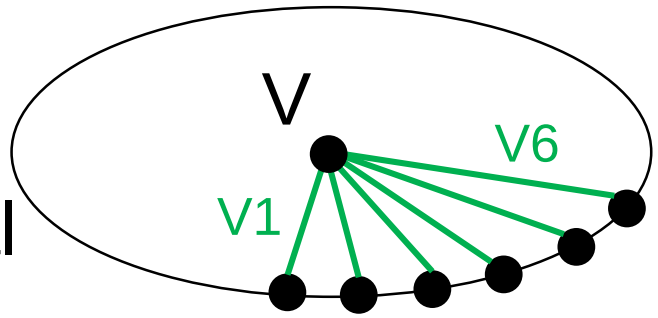
- ECG electrode
- ECG lead – connection of two active exploring electrodes (bipolar lead) or one exploring electrode and one reference electrode/clamp (unipolar lead)

Standard 12-lead ECG

- 3x bipolar limb leads
  - I, II, III
- 3x unipolar augmented limb leads
  - aVR, aVL, aVF
- 6x unipolar chest leads
  - V1, V2, V3, V4, V5, V6



Einthoven triangle – frontal plane



horizontal plane

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Standard 12-lead ECG record

Patient‘s name; date and time of measurement

Time and voltage scale

Bipolar limb leads (I, II, III)

Unipolar augmented limb leads (aVR, aVL, aVF)

Lead II in long time scale

Values from automatic analysis (TF – heart rate)

Unipolar chest leads (V1 – V6)

Calibration mark

Fyziologie
LF-MU

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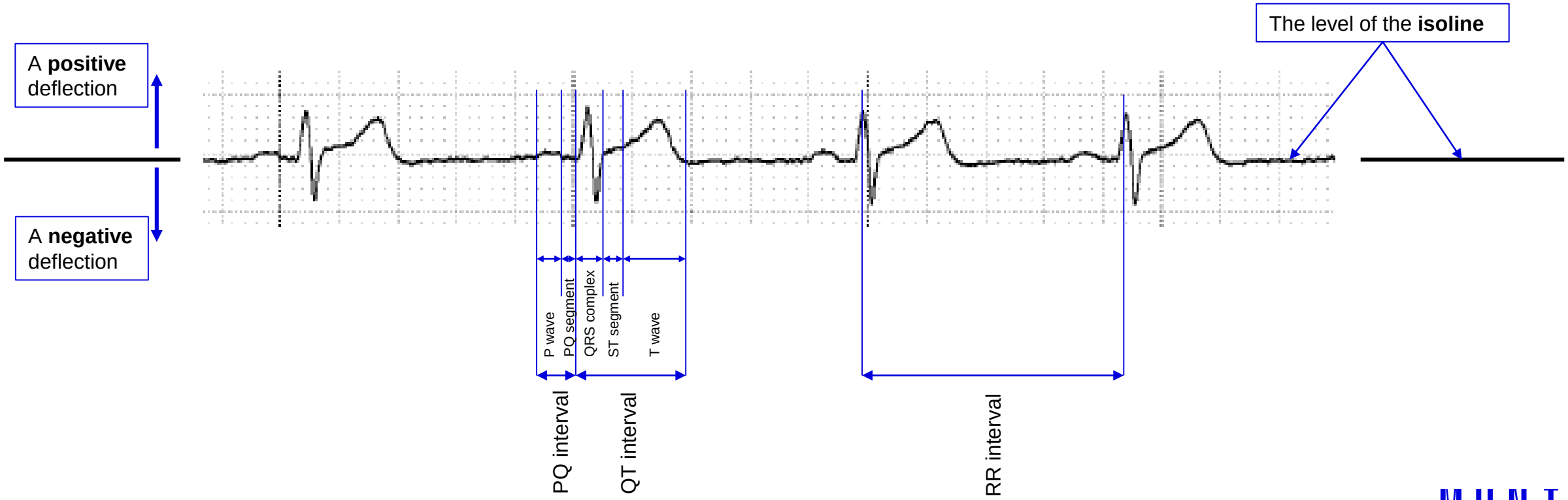
Normal ECG curve - nomenclature

– Changes of voltage (mV) in time



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ECG evaluation – basic algorithm

1. Heart rhythm (regular/irregular; sinus/junctional/ventricular/other)
2. Heart rate (a value in bpm)
3. The duration of the P wave, the PQ interval, the QRS complex, and the QT interval (in ms)
4. Position of ST segment (in isoline/elevated/depressed)
5. Transitional zone (position; lead V1 – V6)
6. Electric axis of the heart (position in degrees)


EKG Praktik SEIVA
8s1 - 2007/11/27 [SEIVA A01.002]
25 mm/s 10 mm/mV [35 Hz][AC 50 Hz][ad 0.3 Hz]
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
0:05
0:05
25 mm/s 10 mm/mV [35 Hz][AC 50 Hz][ad 0.3 Hz]
II
0:05
0:10

TF [1/min]

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