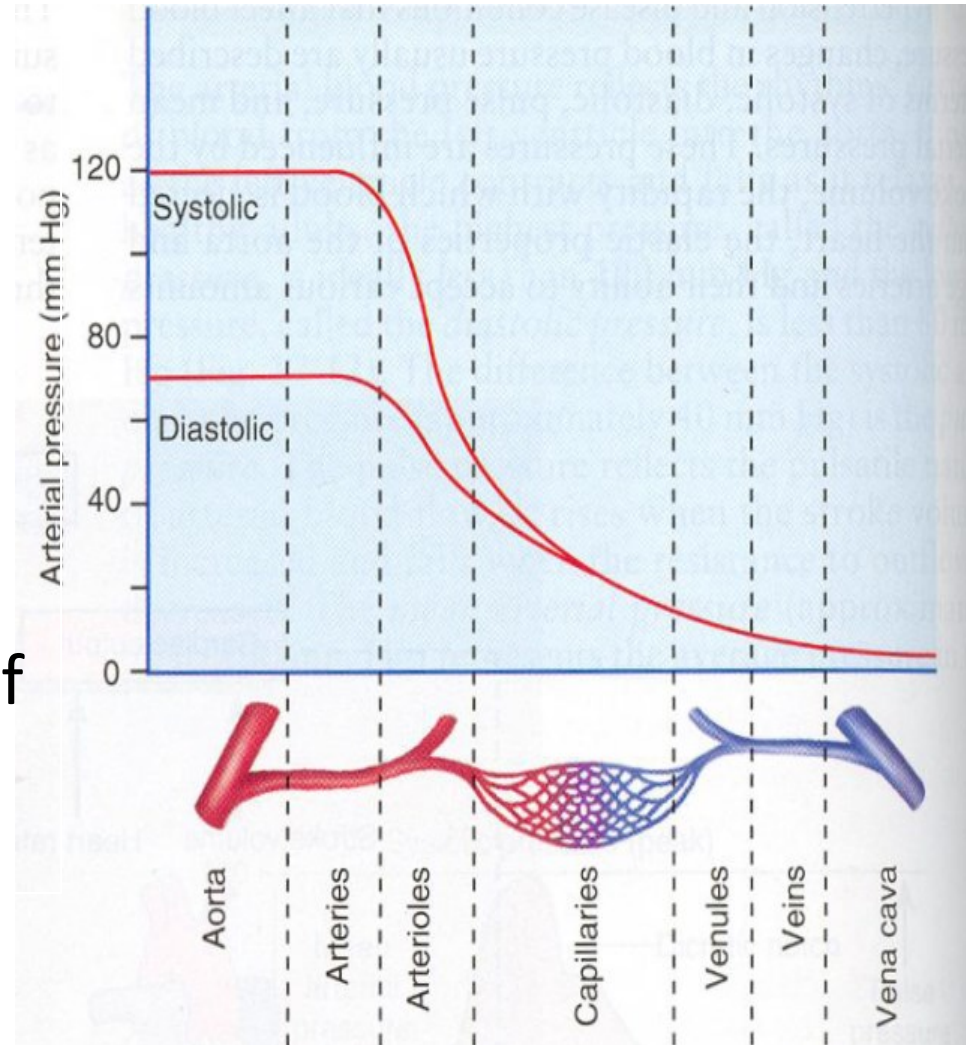


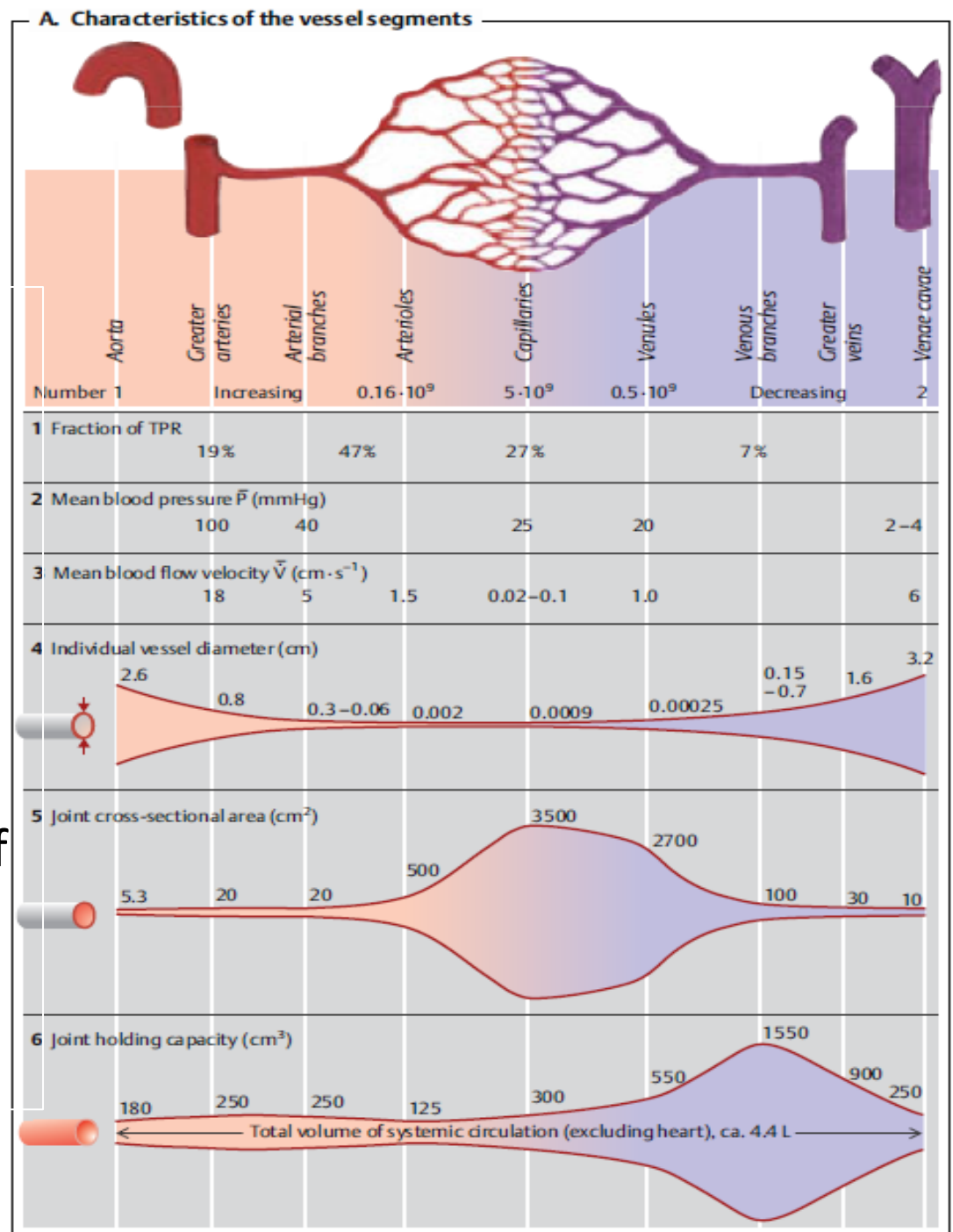
# **I. Blood pressure & plethysmography**

# Blood-vessel system

- **Arteries** – aorta, soften pulse waves, highest pressure
- **Arterioles** – resistance vessels, regulation of blood flow in body parts (→plethysmography)
- **Capillaries** - exchange
- **Veins** – holds up to 75% of blood, almost zero pressure, valves



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# Blood pressure

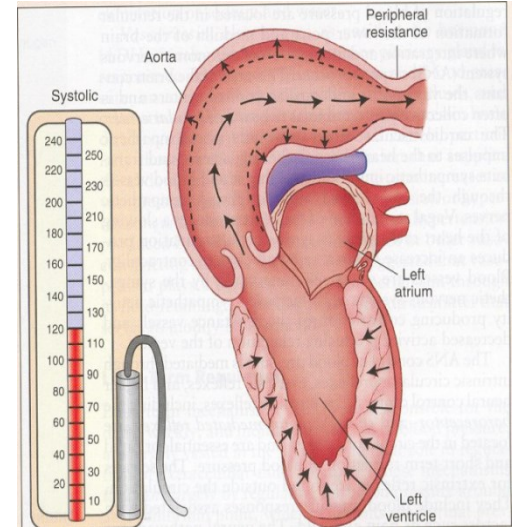
= is the pressure exerted by circulating blood upon the walls of blood vessels

- Systole of left ventricle → 70 – 100 ml of blood goes to aorta, aorta have **to stretch and expand**
- Pulse wave of stretching goes through the cardiovascular system
- Tension of arteries sends blood further

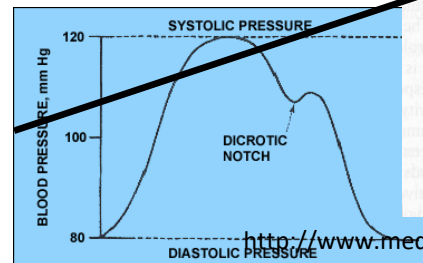
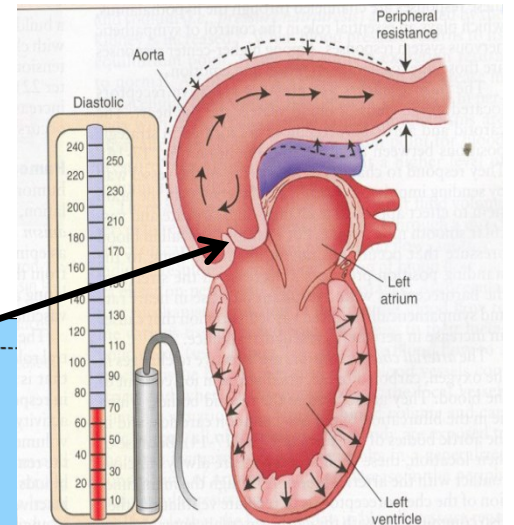
- **Systolic/diastolic** (125-140)/(80-90) mmHg, Torr
  - **systolic** – high pressure wave due to **contraction of the heart**
  - **diastolic** – low pressure wave due to **tension of the aorta** and arteries return to their normal diameter

- **Dicrotic notch** – aortic valve closure

Systolic pressure



Diastolic pressure



# Blood pressure

- BP = cardiac output x peripheral resistance
- Blood pressure can be modulated:
  - Elasticity of arteries and resistance of blood vessels (radius of the vessels)
  - Smoothness of blood vessel walls (fatty deposits etc.), blood volume, viscosity of blood
  - age, sex, diseases, drugs, body position,...

# Blood pressure regulation

- **Accute regulation – baroreceptor reflex**

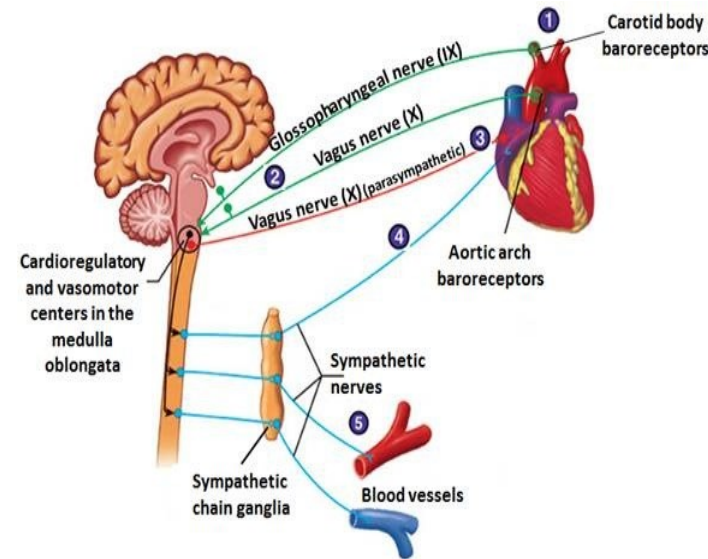
**Drop of pressure:** ↓ artery wall tension, ↓ activity of baroreceptors, ↑ activity of sympathetic, ↑ heart frequency and contractility, peripheral vasoconstriction (e.g. in position change), **blood pressure increase**

- **Long-term (chronic) regulation**

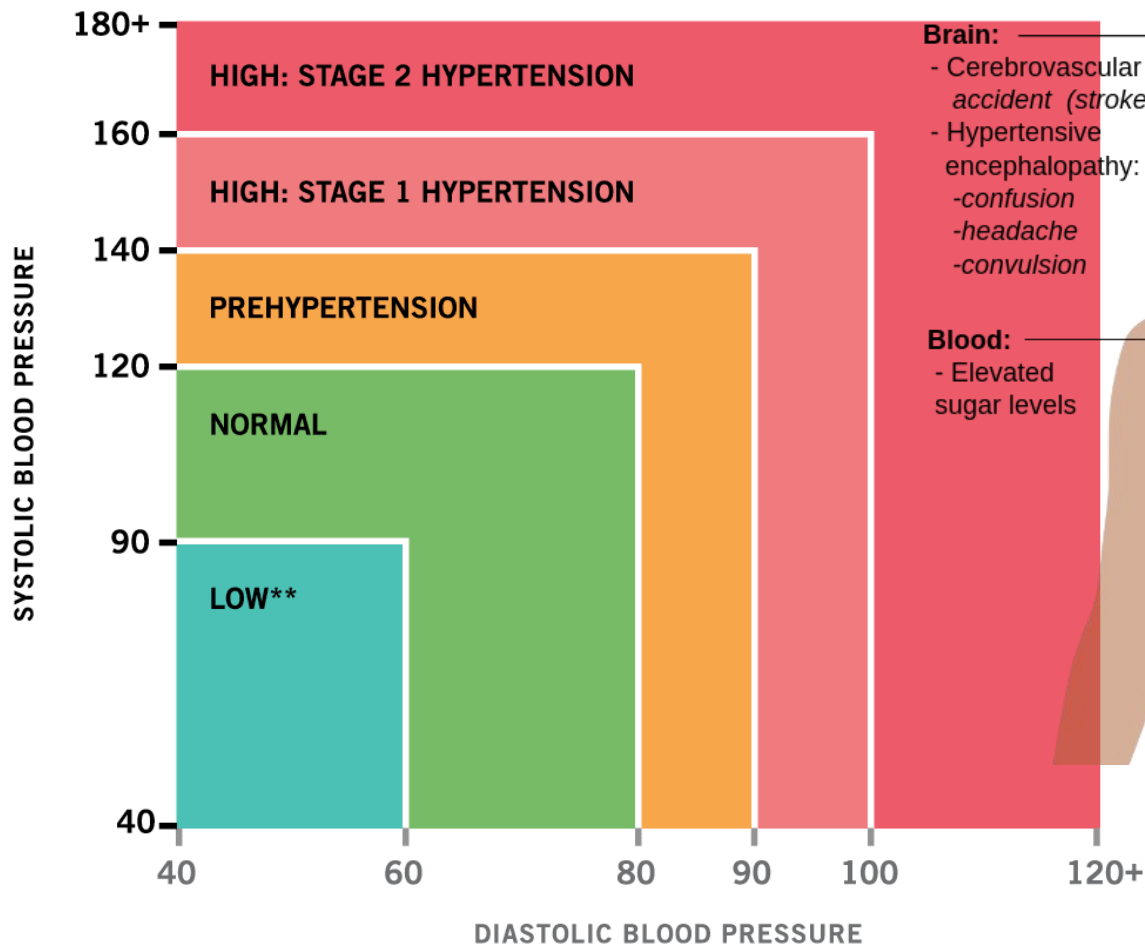
- **Volume of urine produced by kidneys** – increased pressure: ↑ filtration pressure in kidneys, ↑ urine volume, ↓ blood volume, decreased BP
- **ADH, aldosteron, renin-angiotenzin** – increased back resorption of water in kidneys ↑ BP

- **Local control of BP**

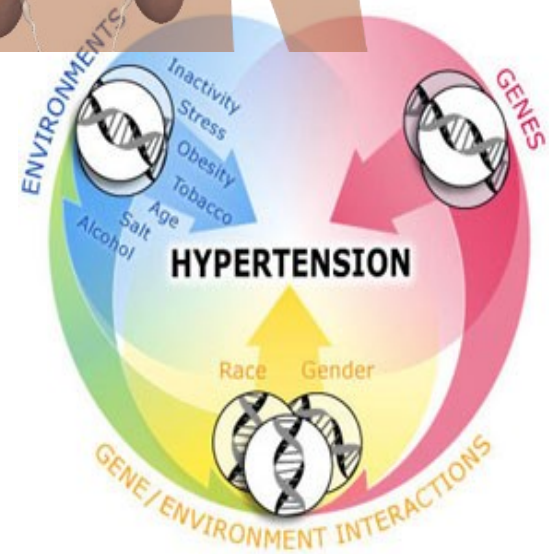
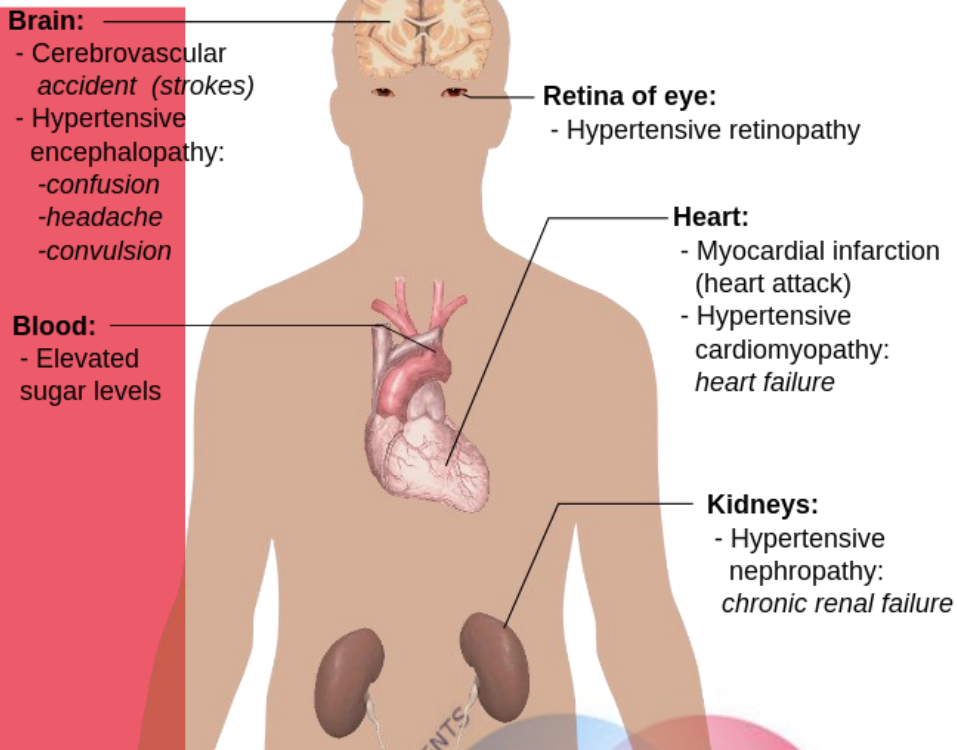
- **Autoregulation** – force onto vessel wall induces vasoconstriction, vasodilators promote dilatation, **methabolic factors like CO<sub>2</sub>, local hormones**; e.g. inflammation → histamin and bradykinin → **vasodilatation**; Serotonin, Vasopresin → **constriction**



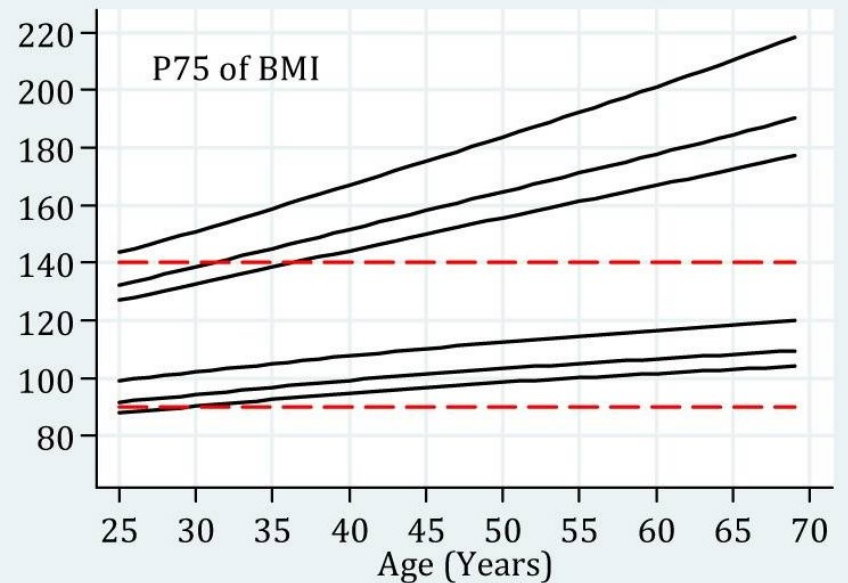
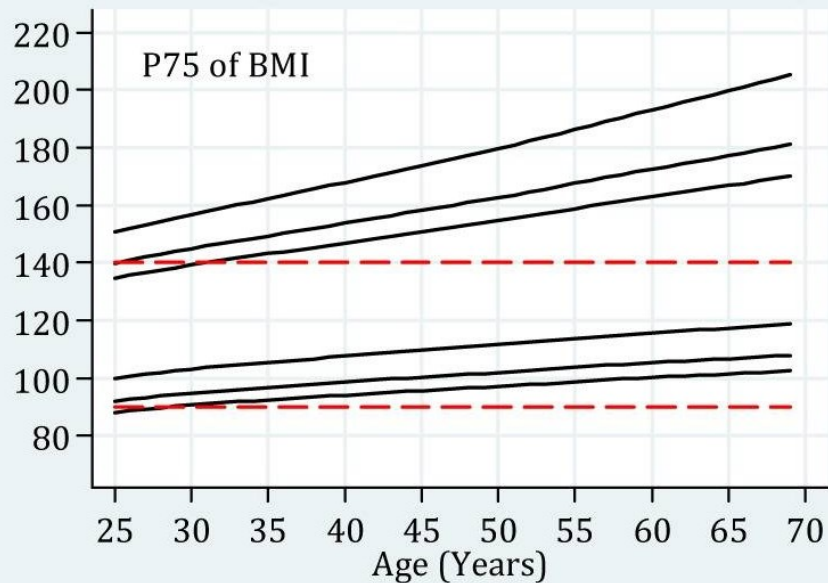
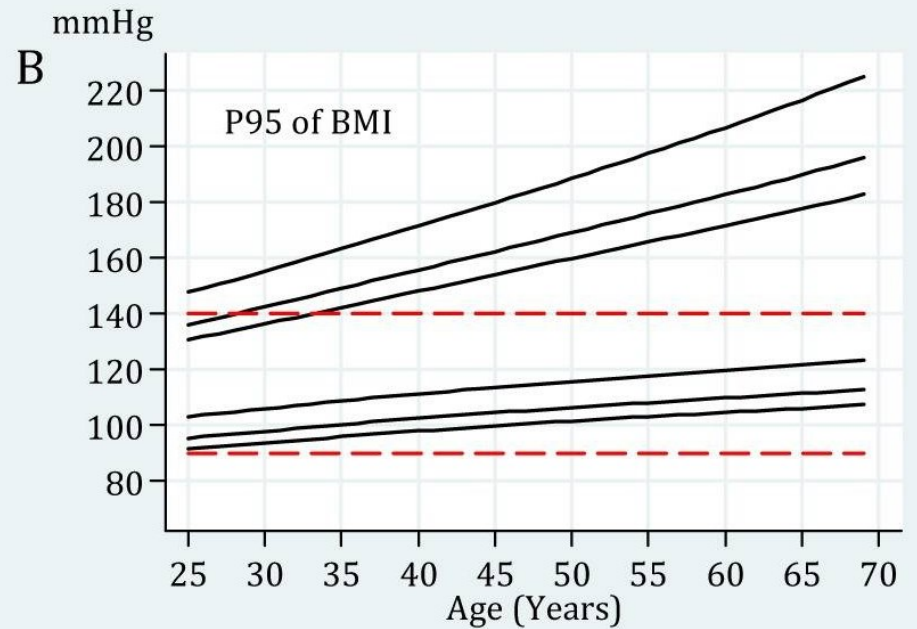
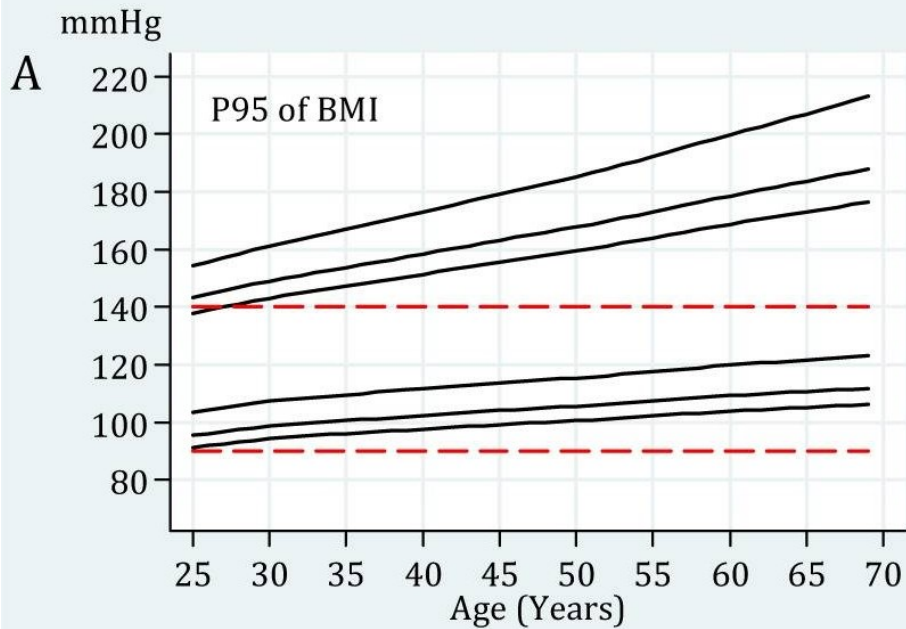
# Blood Pressure Chart\*



## Main complications of persistent High blood pressure



# BP increases with age



P90, P95, and P99 of SBP and DBP of Men and Women (solid lines)



# Measurement of BP:

- **Diastolic pressure** – condition and elasticity of vessels
- **Systolic pressure** – condition of heart

- **Invasive methods:**

S. Hales - 1733 – length of blood spray

- **Non invasive methods:**

auscultatory - listening of blood in vessels

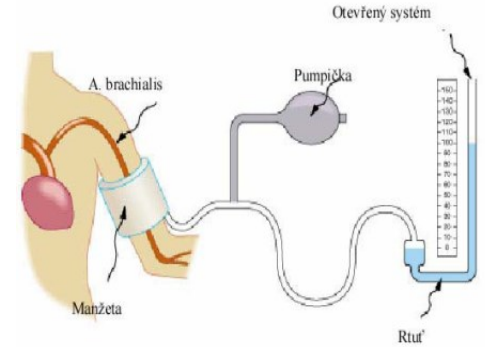
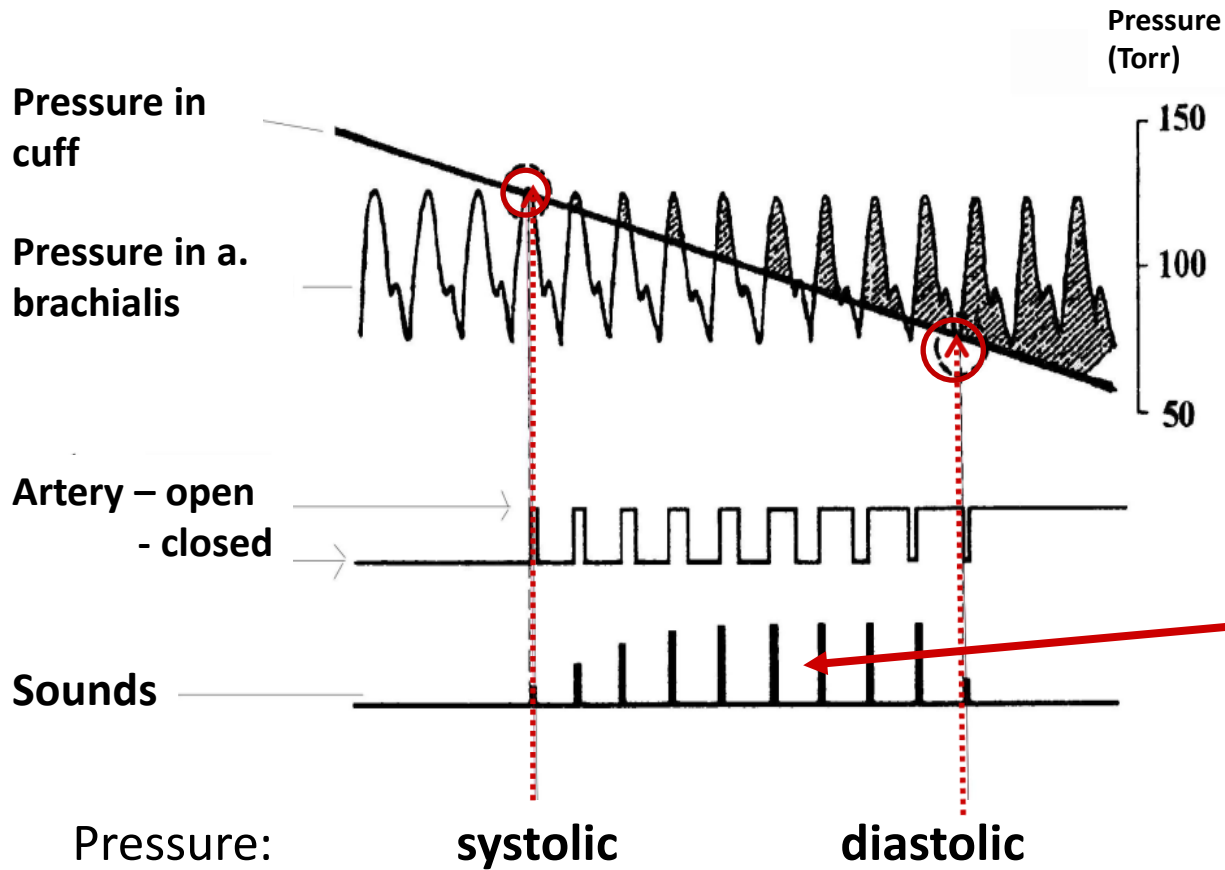
- **Sphygmomanometers** (*sphygmos* = pulse) – mercury manometers, digital manometers, aneroid m. etc.



# How to use a manometer:

- A cuff is fitted smoothly and snugly, then inflated manually by **repeatedly squeezing a rubber bulb** until the artery is completely occluded.
- **Listening with the stethoscope** to the brachial artery at the elbow, the examiner slowly **releases the pressure** in the cuff.
- When blood just starts to flow in the artery, the turbulent flow creates a "whooshing" or pounding (first Korotkoff sound). The **pressure at which this sound is first heard is the systolic blood pressure**. The cuff pressure is further released until **no sound can be heard** (fifth Korotkoff sound), **at the diastolic arterial pressure**.

# Principle of manometer:



Laminary vs. turbulent flow



Korotkoff sounds  
= blood turbulences

# Experiment n.1

## Determination of blood pressure and comparisson between several types of medical blood pressure gauges

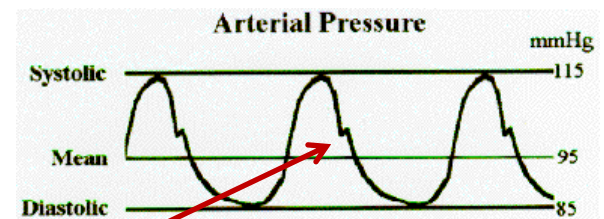
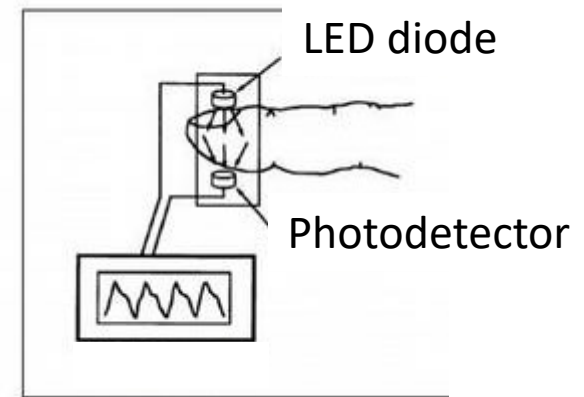
- mercury manometer vs. digital manometer

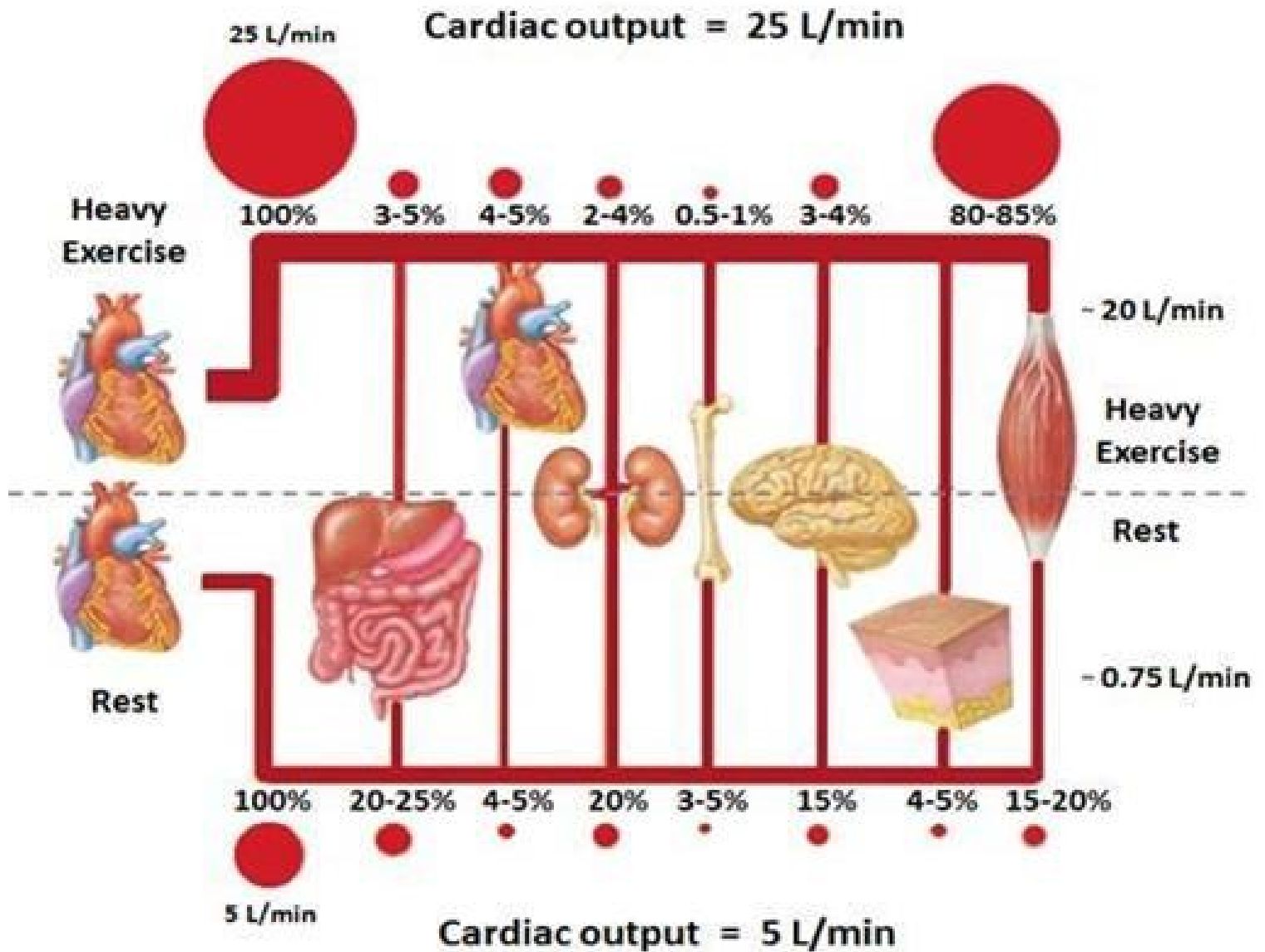


# Plethysmography



- Determination of **optical parameters of translucent tissue**, depends of blood volume in capillaries under the skin, **modulated by arterioles** → reflexive changes in arterial radius (two layers of smooth muscle in arterioles wall)
- Measurement on middle finger or index finger, detecting amount of light passing through a finger (contraction of arterioles → smaller radius → lower amount of light)
- **Pulse wave** in arterioles: dicrotic notch





# Vasomotoric reactions

Various chemicals or physical stimuli causes reflexive reactions:

## ➤ **Vasoconstriction**

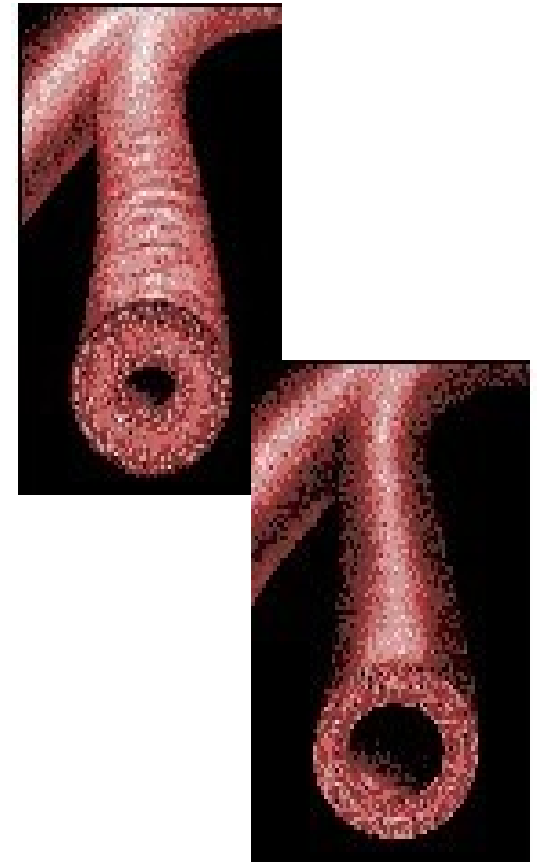
**Contraction** of smooth muscle cells  
Sympaticus; adrenalin, vasopresine,...

➤ Narrow vessel- lower wave in graph

## ➤ **Vasodilatation**

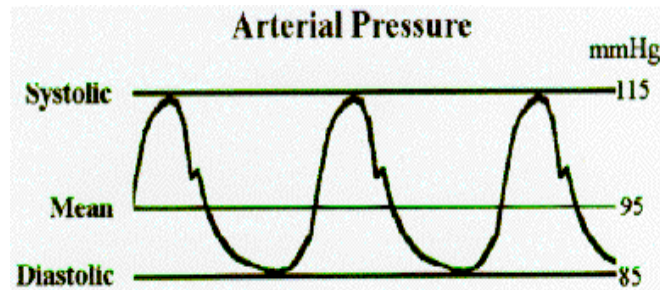
**relaxation** of smooth muscle cells  
Parasympaticus; acetylcholin, metabolites, NO, ...

➤ Dilated vessel – higher wave in graph



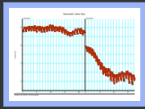
# Experiment n.2

1. Pulse wave
2. Change of body position (sitting - standing)
3. Reactive hyperemia (brachial artery strangulation)
4. Valsalva experiment - increase in intrathoracic pressure
5. Effect of temperature (cold - heat)

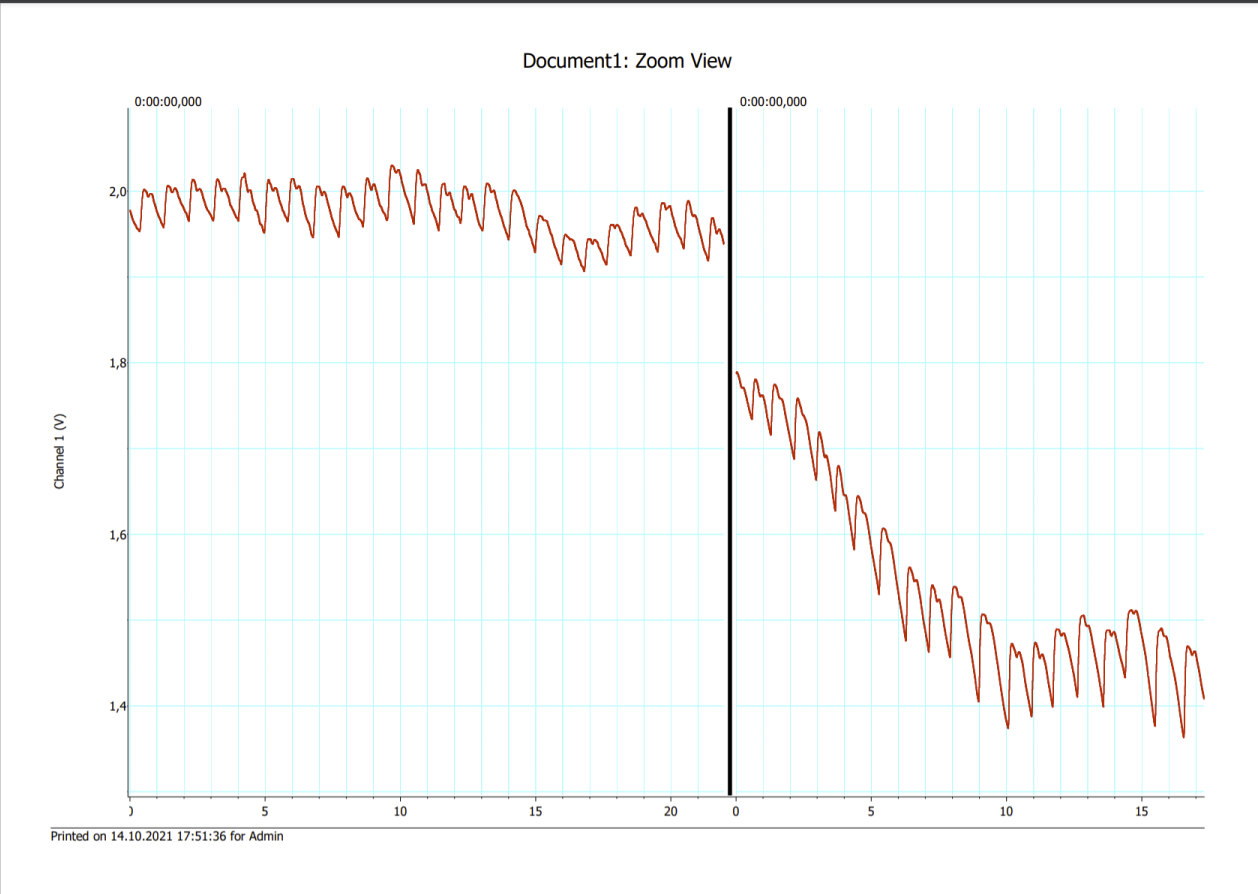




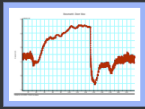
# Finger heated



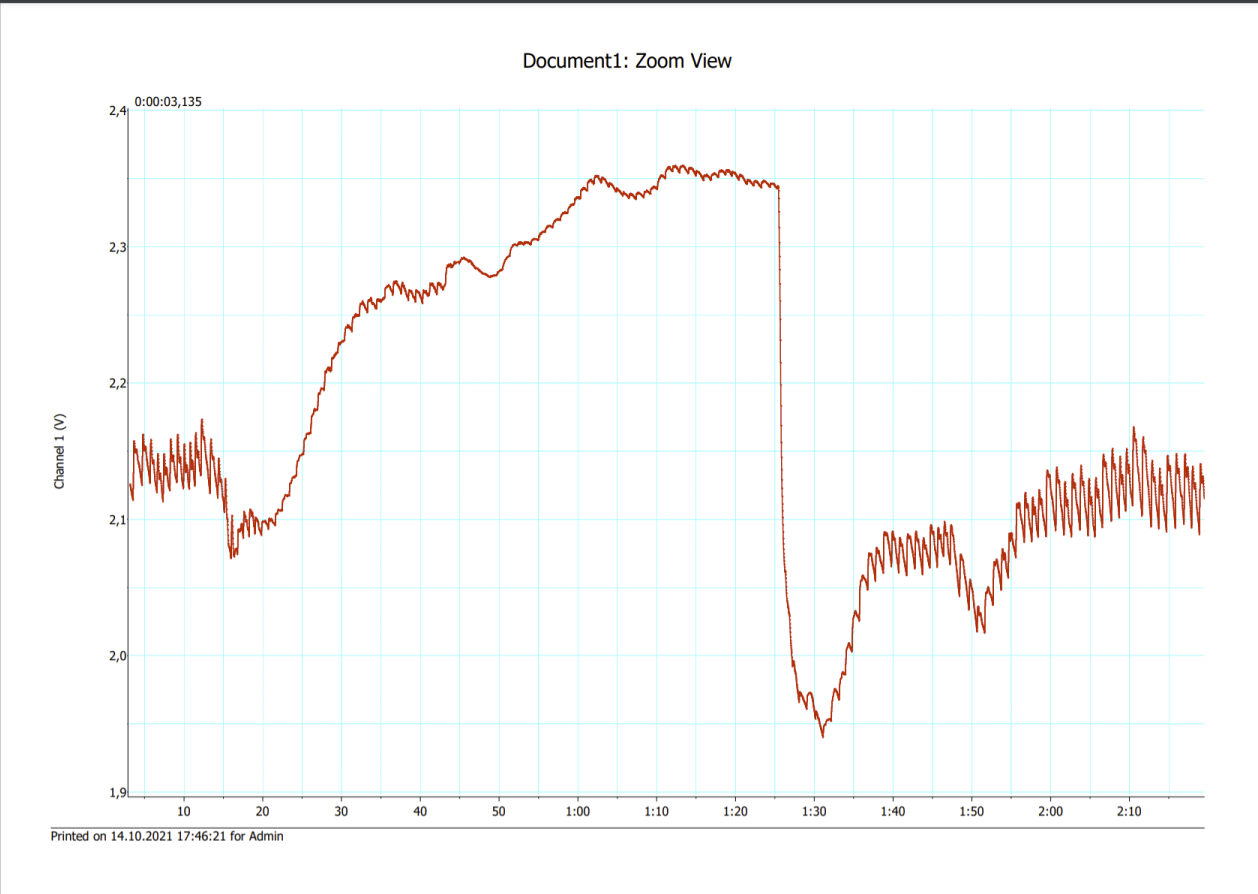
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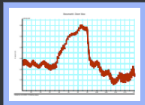
# Artery strangulation and reperfusion



1



# Valsalva experiment



1

