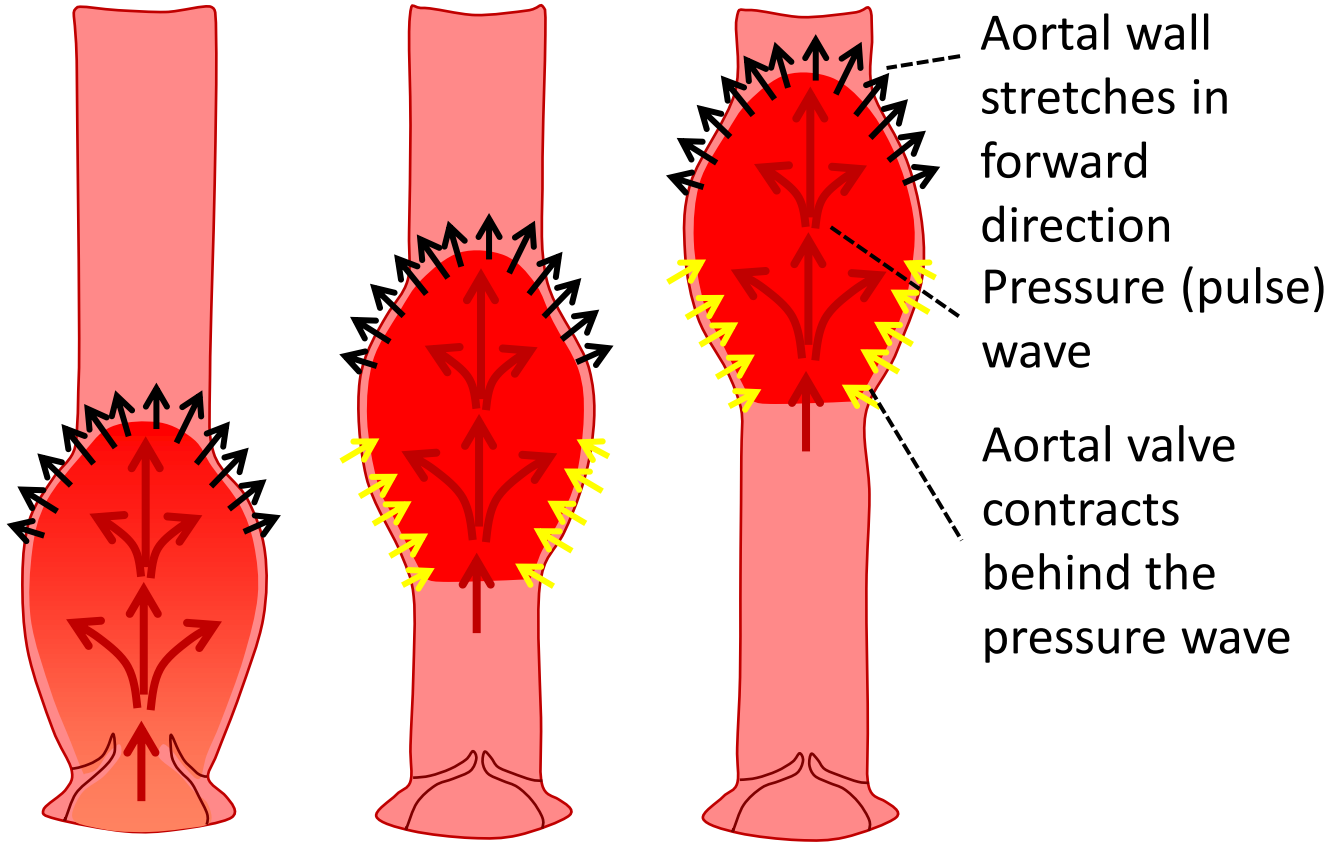
(V.) Signal detection by PowerLab system - instruction
(VII.) Examination of pulse by palpation

Physiology I - practicals

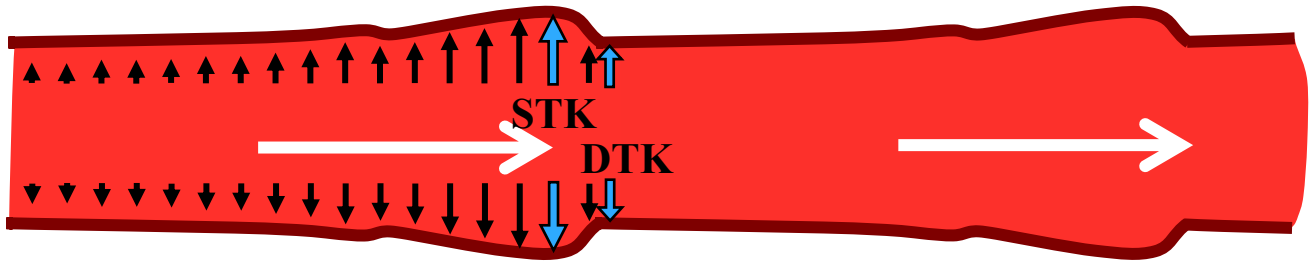
Pulse (*pulsus*)

- Mechanical manifestation of heart activity
- Mechanical wave (**pulse wave**) arises after each contraction of LV and propagates along the arterial wall



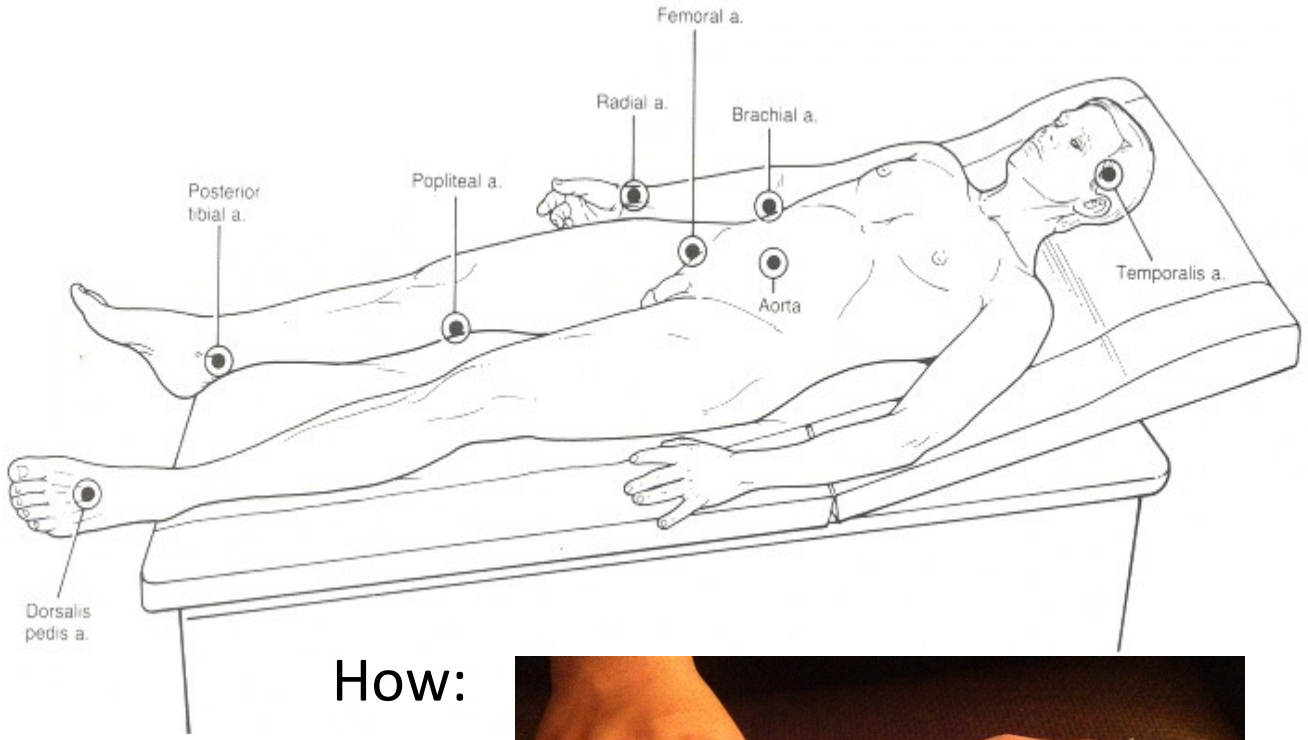
Ejection phase of systole
(open aortal valve)

Diastole (closed aortal valve)



Palpation of pulse

- Where:
  - *A. radialis*
  - *A. carotis*
  - *A. femoralis*
  - *A. brachialis*
  - *A. poplitea*
  - *A. tibialis posterior*
  - *A. dorsalis pedis*



How:

Palpation of pulse

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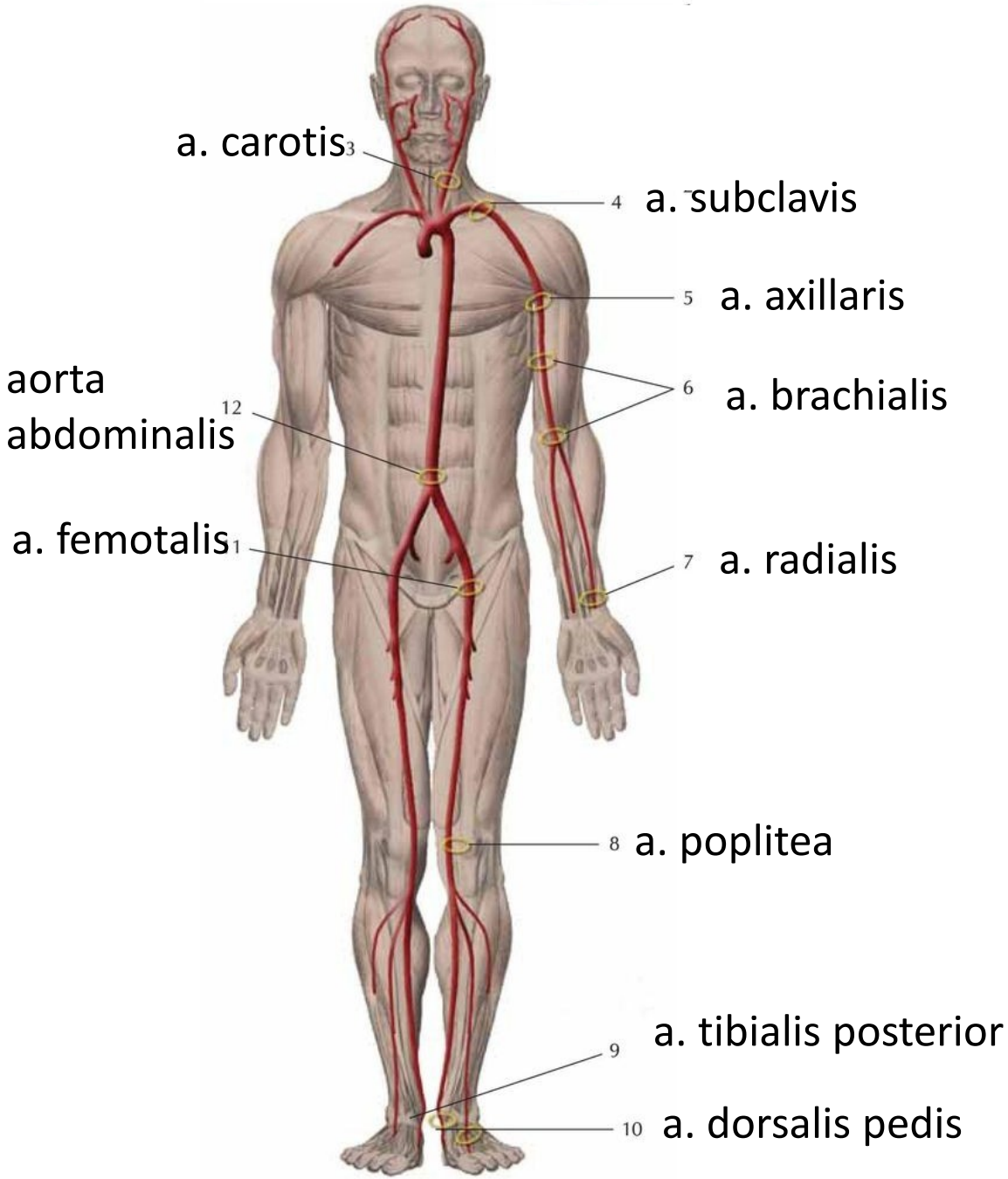
How:



http://docplayer.cz/docs-images/40/13777908/images/page_5.jpg

Examination of pulse

- Frequency: number of pulses per one minute = **pulse rate**
- Qualities: regularity, compressibility
- According qualities, we can describe:
  - *Pulsus regularis*
  - *Pulsus irregularis*
  - *Pulsus celer (Corrigan´s pulse: P. celer, altus, frequens*)
  - *Pulsus tardus*
  - *Pulsus durus* – hardly compressible pulse – hypertension
  - *Pulsus mollis* – easily compressible pulse – hypotension
  - *Pulsus magnus* – high amplitude of pulse
  - *Pulsus parvus* – small amplitude of pulse
  - *Pulsus filiformis* – threadlike pulse – circulatory failure

Heart rate

- Physiological values: 60 – 100 beats per minute (BPM) at rest
- Tachycardia: increased heart rate (> 100 at rest)
- Bradycardia: decreased heart rate (< 60 at rest)
- Arrhythmia: an abnormality in the heart's rhythm, or heartbeat pattern.
  The heartbeat can be too slow, too fast, have extra beats, skip a beat, or otherwise beat irregularly

Heart rate vs. pulse frequency

- Heart rate (HR) is a number of cardiac cycles per minute
  - computed from ECG
- Pulse frequency is a number of pulse cycles per minute
  - Computed from sphygmography, blood pressure or by palpation of artery

- Usually: heart rate = pulse frequency

Modulation of HR by autonomic nervous system (ANS)

- ANS modulates heart automaticity by modulation of SA node activity
  - Parasympathetic system – vagus nerve – „*nervi retardantes*“
    - Via M2 receptors
    - Negative chronotropic effect
    - Decreased tonus of vagus nerve = increased HR
  - Sympathetic system – sympathetic cardiac nerves – „*nervi accelerantes*“
    - via β1 receptors
    - Positive chronotropic effect
    - Increased sympathetic activity = increased HR
  - Sympathetic and parasympathetic systems are active simultaneously, but in different intensity…

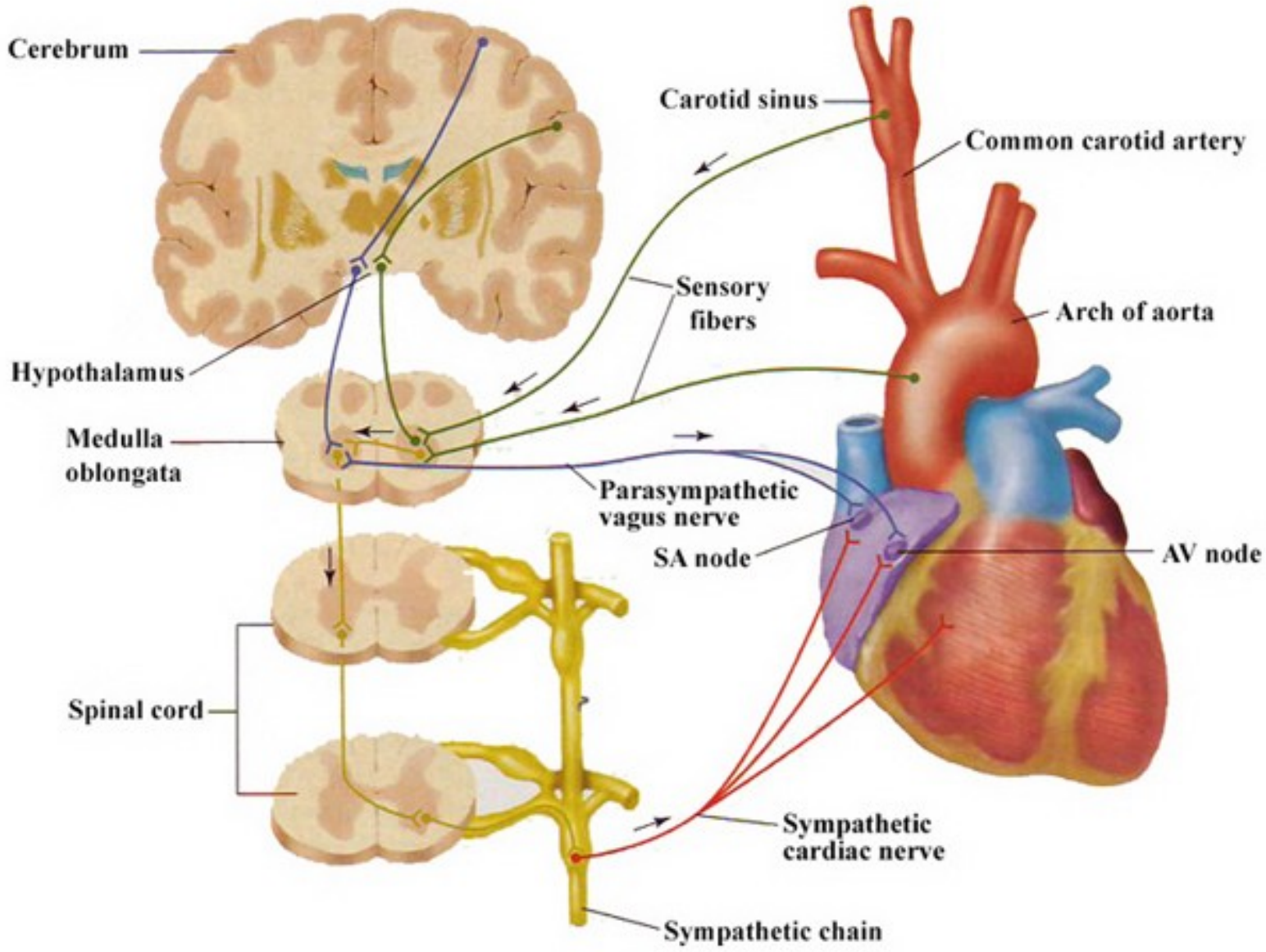
Baroreflex

- Short-time control of arterial pressure
- Mean arterial pressure (MAP) is detected by **baroreceptors** in **aortic arch** and **carotic sinus**
  - stretch-receptors (mechanoreceptors)
- Afferent fibres: vagus nerve (n. X.) and n. glosopharingeus
- Centre: rostral part of nucleus solitarius in **medulla oblongata**
- Efferent pathways:
  - Cardiac branch: n. vagus (+ SS) – heart rate changes
  - Peripheral (vascular) branch: sympathetic vascular innervation – changes of total peripheral resistance (TPR)

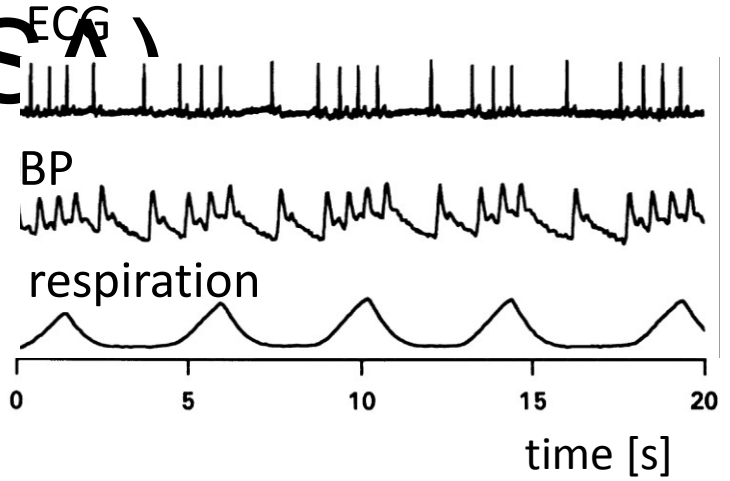
Baroreflex

- Mechanism:
  ↓MAP
  ↓afferentation from baroreceptors processing
- **↓vagus activity and ↑sympathetic activity**
- **↑HR and ↑TPR**
  (MAP = HR * SV * TPR)
- **↑MAP**

… and conversely in case of MAP increase



Respiratory sinus arrhythmia (RSA)



- Changes of heart rate in accordance with breathing: increase of HR during inspirium, decrease of HR during expirium
- The most evident in young people, associated with vagal activity
- RSA disappears with HR increase (stress, exercise, high age)

Mechanisms of RSA formation:

- **Baroreflex:** during inspiration – ↓ intrathoracic pressure → ↑venous return (due to ↑ pressure gradient) → ↑systolic volume → ↑MAP → baroreflex (2 s lag) → ↓HR → ↑ (balance of) MAP
- **Central origin**: irradiation of respiratory centre to kardiomotoric centre in the medulla oblongata
- **Bainbridge reflex:** ↑venous return during inspirium – stretch of atria – activation of stretch-receptors – stimulation of n. vagus – stimulation of SA node
- Local source: mechanical stretch of SA node accelerates its depolarization (weak RSA is presented in transplanted heart)
- Another reflexes influencing vagal activity, chemoreflex (oscillation of pCO_2, pO_2, pH)

Zdroje obrázků

- Slide 6 - https://www.pinterest.com/pin/144537469264742090/ [cited 31.8.2015]
- Slide 6 - http://www.angiologist.com/general-medicine/pulse-palpation-and-pulse-location/ [cited 31.8.2015]
- Slide 12 - http://corposcindosis.wikia.com/wiki/File:Baroreflex.jpg [cited 31.8.2015]
- Slide 14 - http://www.cardiachealth.org/postural-orthostatic-tachycardia-syndrome-pots [cited 31.8.2015]