

(V.) Signal detection by PowerLab system -  
instruction

(VII.) Examination of pulse by palpation

Physiology I - practicals

# Biosignal

- Signal which is produced by living systems
- According to physical properties:
  - Mechanical (e.g. pulse wave, arterial blood pressure)
  - Electrical (e.g. electrocardiography, electroencephalography)
  - Acoustic (e.g. heart sounds)
  - Chemical (e.g. partial pressure of CO<sub>2</sub>)
  - Optical (e.g. saturation of haemoglobin by pulse oximetry)

# Biosignal detection and recording

## Teaching system PowerLab

- PowerLab is complete system for acquisition and assessment of biosignals
- Fundamental part of the system is **amplifier** connected to various **sensors**
- **Examined person** should be informed about the procedure and be prepared for examination

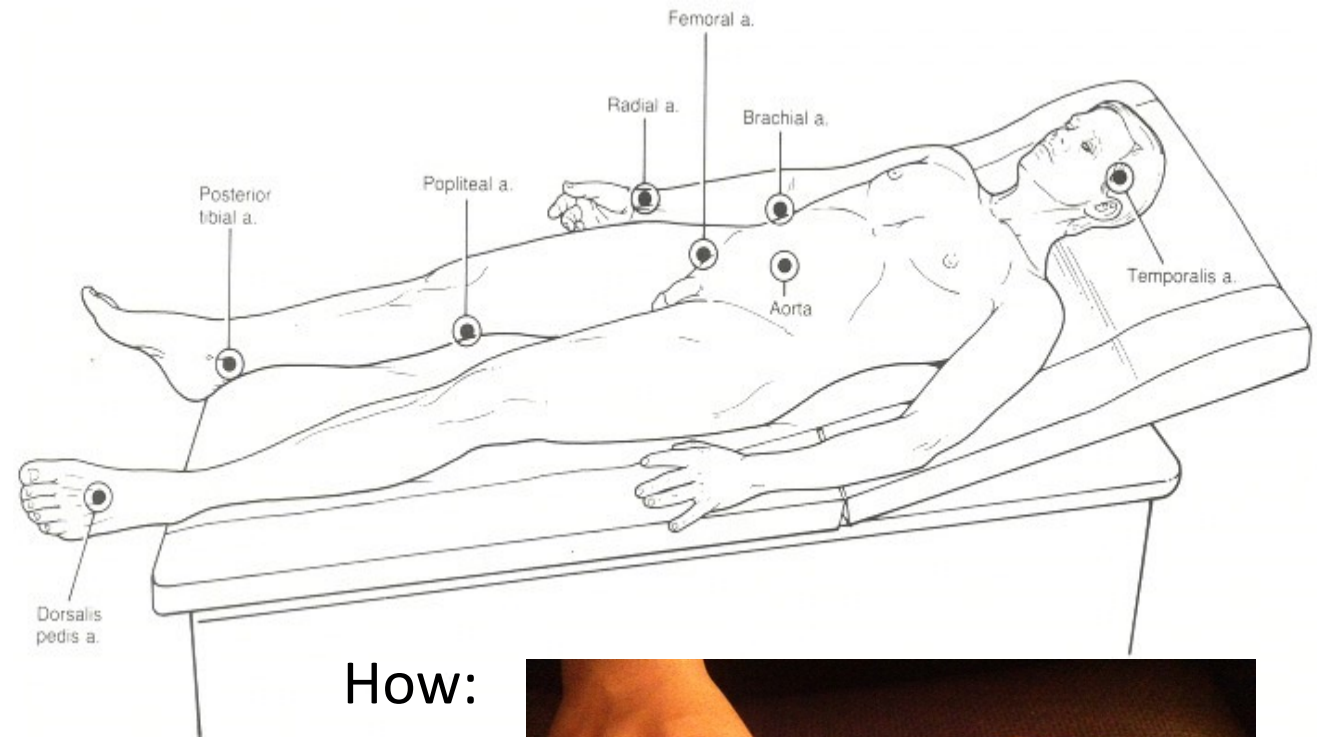
# Pulse (*pulsus*)

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

# Palpation of pulse

- Where:

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



How:



# 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)
- Tachycardia: increased heart rate
- Bradycardia: decreased heart rate

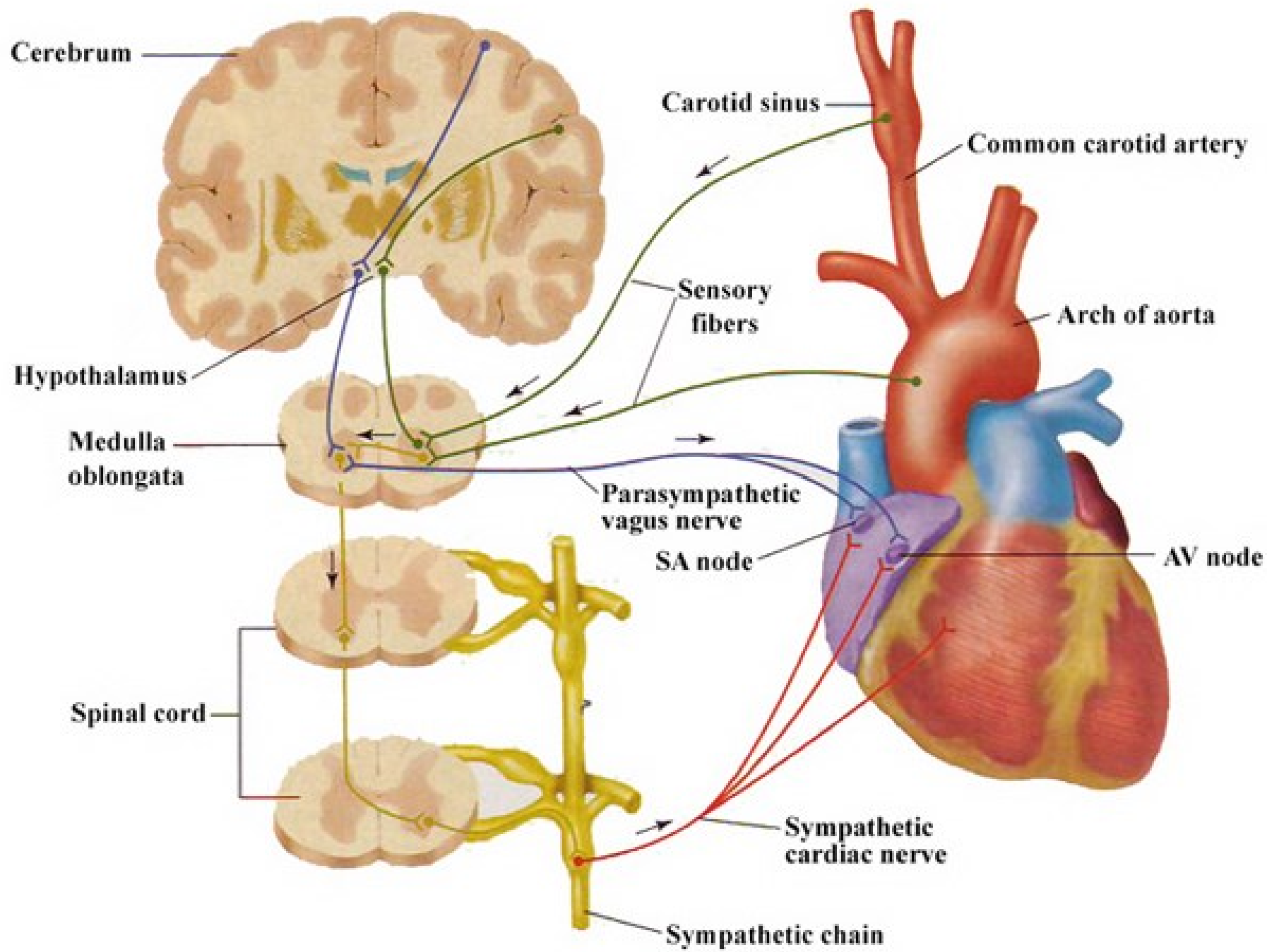
# Modulation of HR by autonomic nervous system (ANS)

- 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  $\beta_1$  receptors
    - Positive chronotropic effect
    - Increased sympathetic activity = increased HR



# Baroreflex

- Mechanism for rapid 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.)
- Centre: rostral part of nucleus solitarius in **medulla oblongata**
- Efferent fibres: **parasympathetic fibres of vagus nerve** (+ SS)
- Mechanism: **↓MAP** - ↓afferentation from baroreceptors – processing - **↓vagus tonus** (+ ↑sympathetic tonus) - **↑HR** - **↑MAP**



# Respiratory arrhythmia

- Changes of heart rate in accordance with breathing
- During **inspiration** – ↓ intrathoracic pressure → ↑ venous return (due to ↑ pressure gradient) → ↑ systolic volume → ↑ MAP → baroreflex → ↓ HR → ↑ (balance of) MAP
- During **expiration**, all changes are reversed (↑ HR)
- **Time shift of the effect:** Discrepancy between expected and measured changes of heart rate may be caused by reaction time of baroreflex, which is approx. 2 sec. In case of resting breathing, both of inspiration and expiration take approx. 2 sec, as well. Therefore, measured changes of HR may seem to be inverse (phase shifted).

# 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]