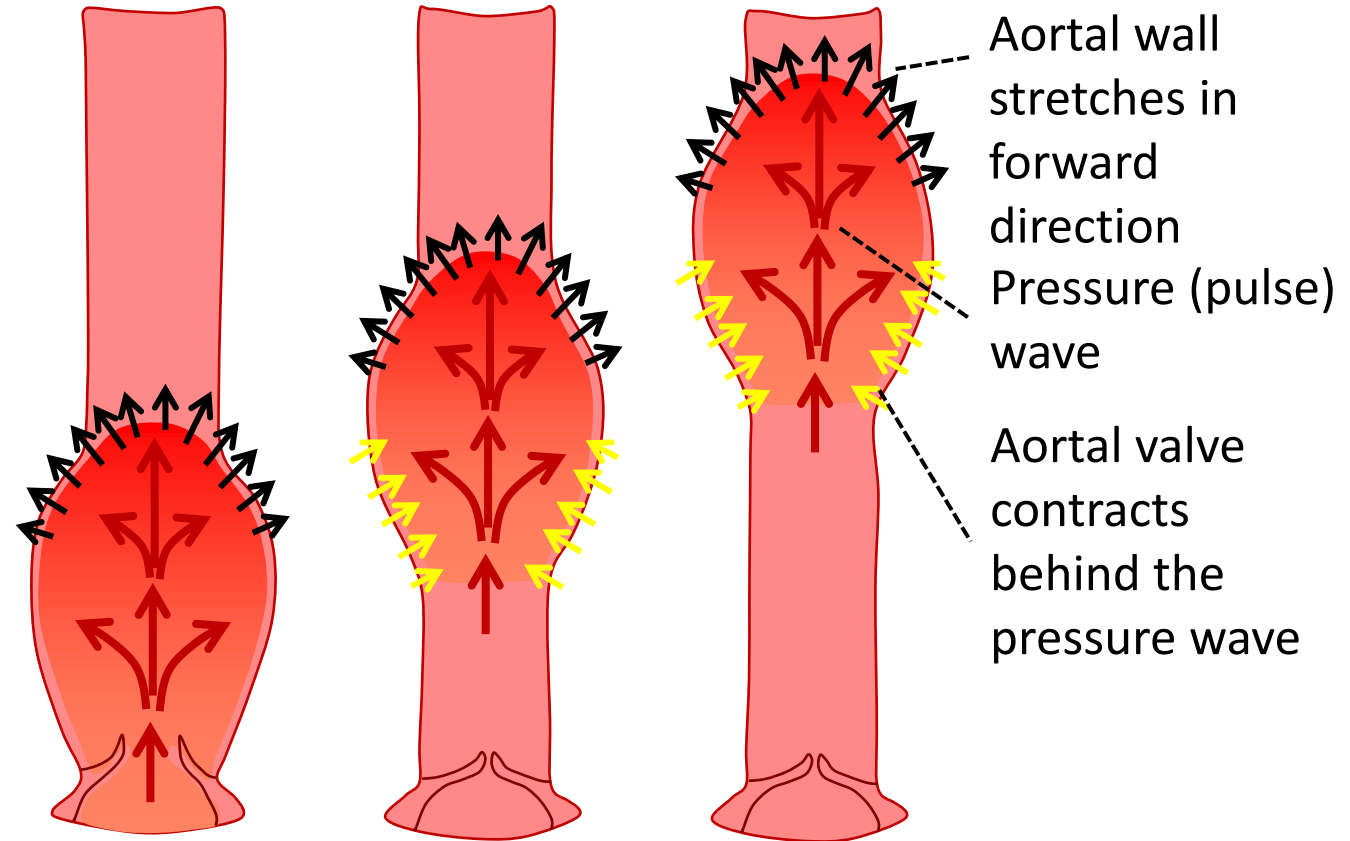


(VII.) Examination of pulse by palpation

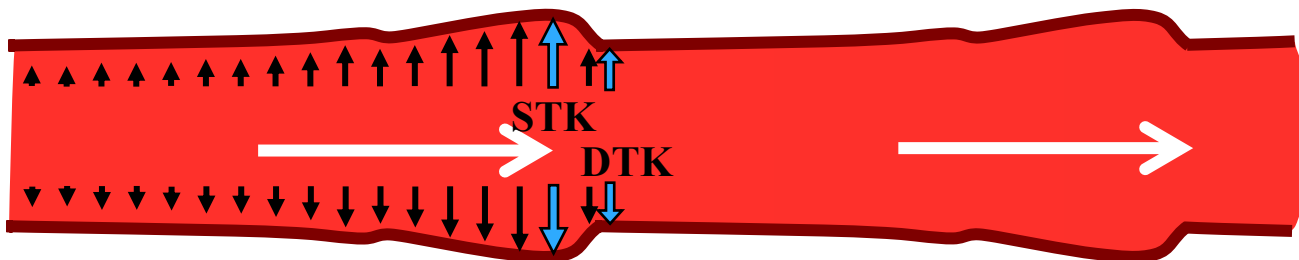
Physiology I - practicals

Pulse (*pulsus*)

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



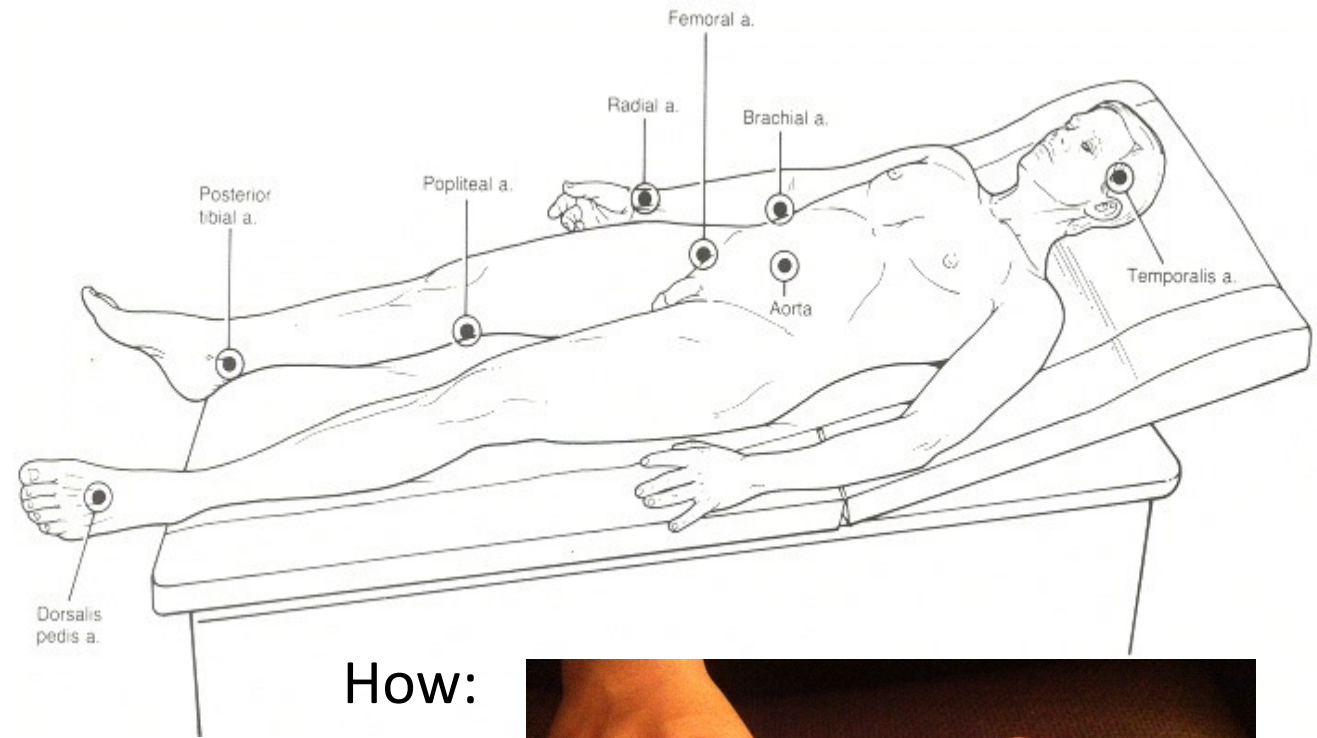
Ejection phase of systole (open aortal valve) **Diastole** (closed aortal valve)



Palpation of pulse

- Where:

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



How:

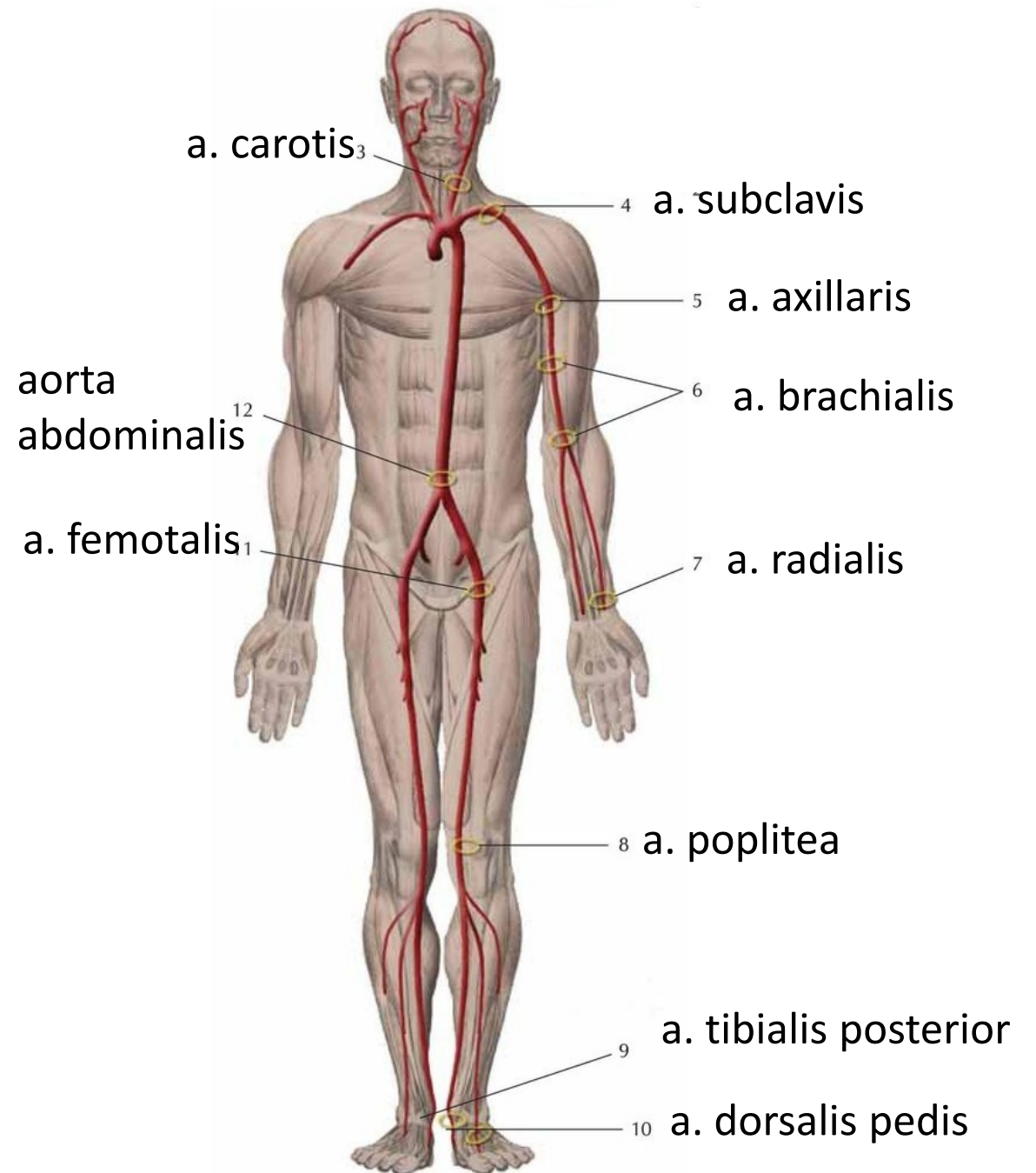


Palpation of pulse

- 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) 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 β 1 receptors
 - Positive chronotropic effect
 - Increased sympathetic activity = increased HR
 - Sympathetic and parasympathetic systems are active simultaneously, but in different intensity...

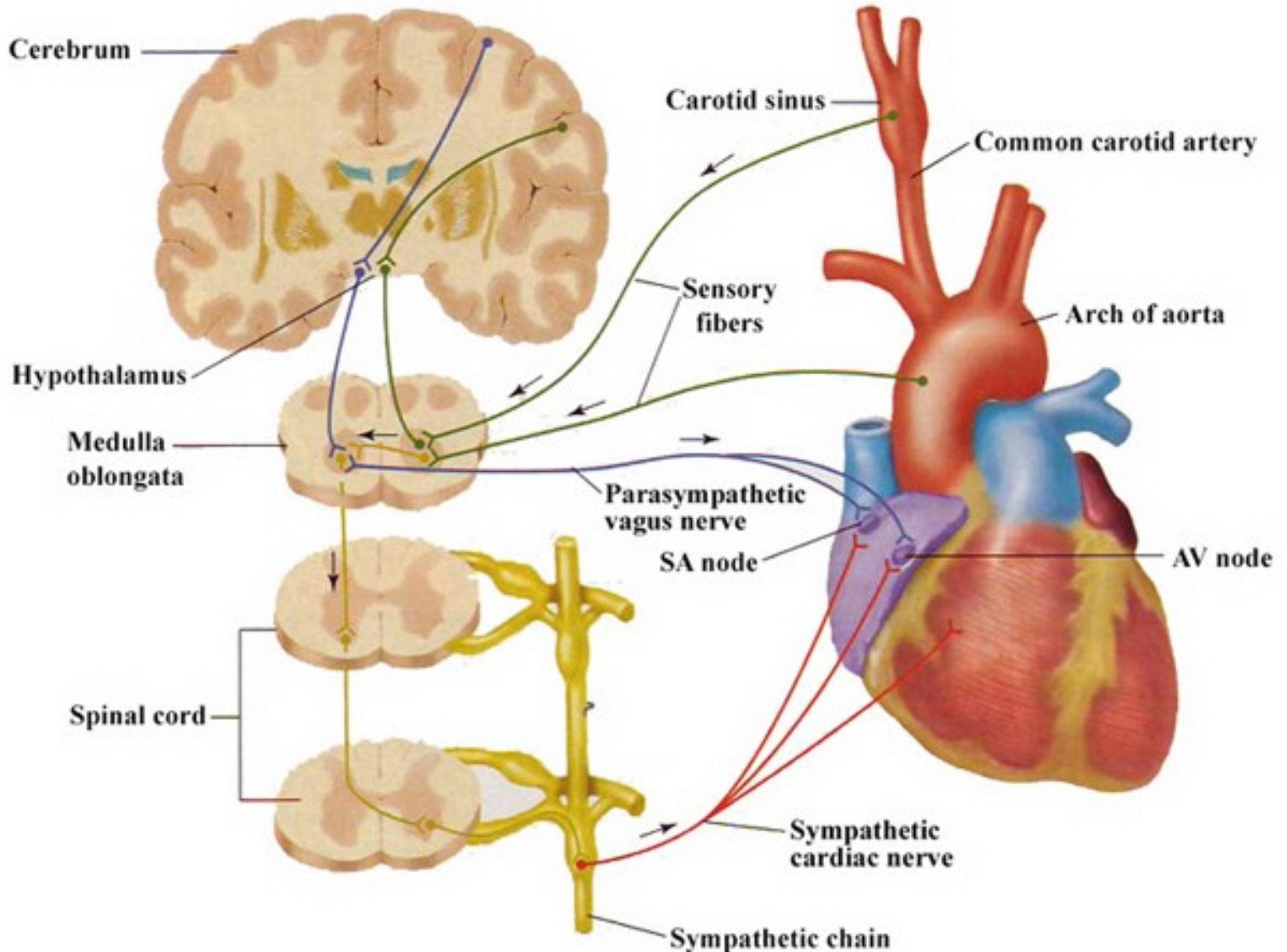
Baroreflex

- 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. glosopharyngeus
- 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

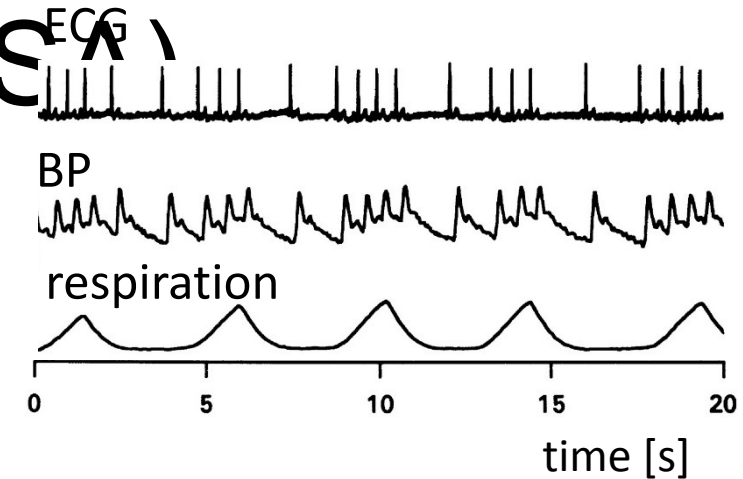
- Mechanism:
 - ↓MAP
 - ↓afferentation from baroreceptors processing
- ↓vagus activity and ↑sympathetic activity
- ↑HR and ↑TPR
($MAP = HR * SV * TPR$)
- ↑MAP

... 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 – \downarrow intrathoracic pressure \rightarrow \uparrow venous return (due to \uparrow pressure gradient) \rightarrow \uparrow systolic volume \rightarrow \uparrow MAP \rightarrow baroreflex (2 s lag) \rightarrow \downarrow HR \rightarrow \uparrow (balance of) MAP
- **Central origin:** irradiation of respiratory centre to cardiomotoric centre in the medulla oblongata
- **Bainbridge reflex:** \uparrow 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 $p\text{CO}_2$, $p\text{O}_2$, pH)

- How to record pulse wave due to finger pulse transducer and estimate of heart rate
 - at rest,
 - during respiratory arrhythmia,
 - in changes of posture,
 - and during muscular load
- see textbook Physiology and neuroscience practicals, 2013, pg. 32 – 34.

References

- 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]