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ASSESSING AND MONITORING VITAL SIGNS

Training for Students

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Vital signs

- Pulse
- Respiratory rate
- Body temperature
- Blood pressure

PULSE

◎ Definition

- The pulse is a pressure wave that is transmitted through arterial tree with each heart beat following the expansion and recoil of arteries during each cardiac cycle (Marieb, Hoehn 2007).
- The rhythmical throbbing of arteries produced by the regular contractions of the heart
- the rhythmic contraction and expansion of an artery at each beat of the heart

Pulse

⦿ Indications

- To gather information on the heart rate, pattern of beats (rhythm) and amplitude (strength) of pulse.
- To determine the individual's pulse on admission as a base for comparing future measurements.
- To monitor changes of pulse.

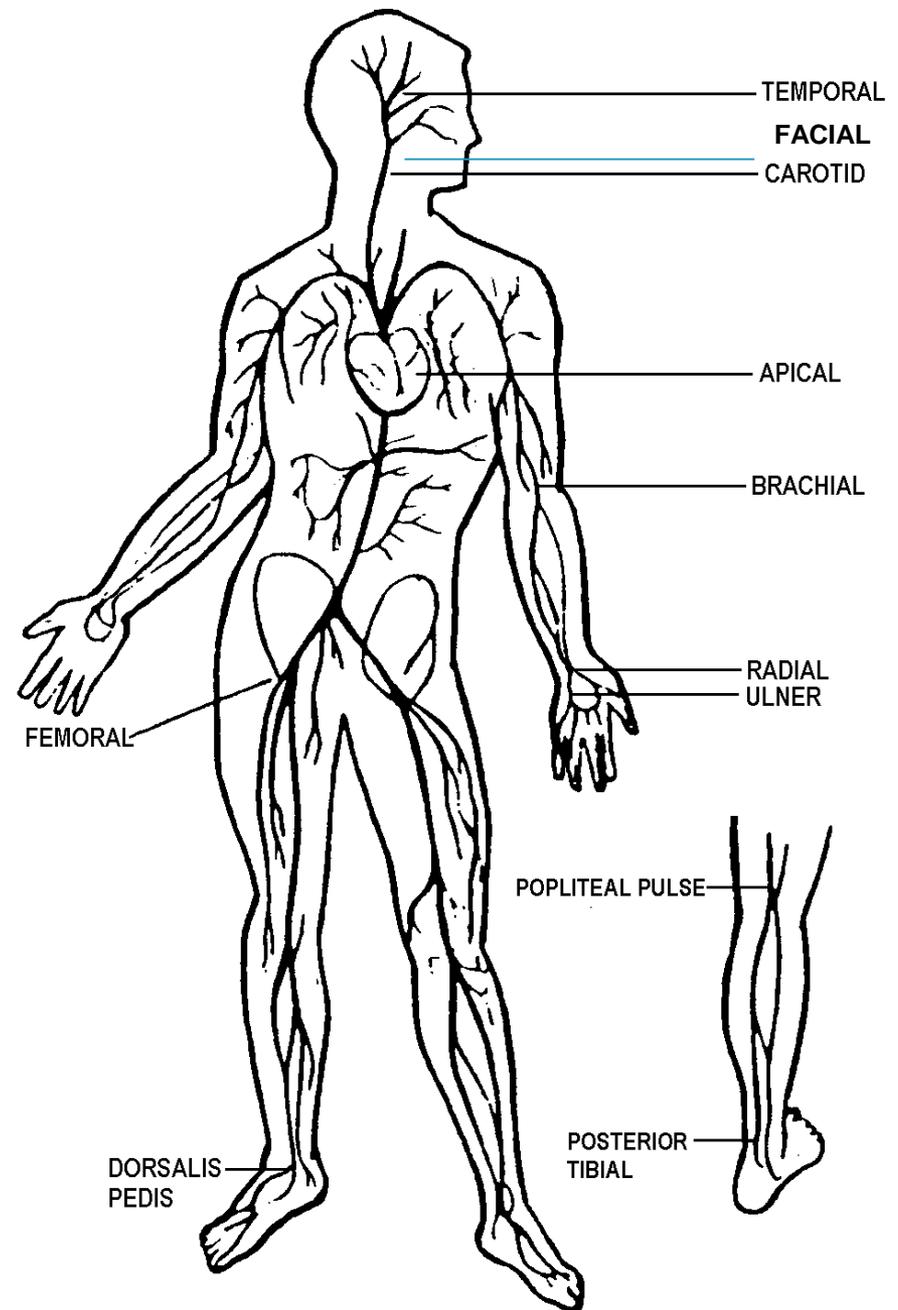
(Marieb, Hoehn 2007).

Pulse

- ⦿ Conditions where a patient's pulse may need careful monitoring:
 - Postoperative, critically ill patients
 - Invasive procedure (Blood transfusion)
 - Local or systemic infections, inflammations (sepsis)
 - Cardiovascular conditions
 - ...

Pulse

- Areas to take the pulse
 - a location where an artery crosses a bony area.



Pulse

⦿ Assessment

- Rate (frequency) per minute
- Rhythm
- Amplitude (strength, quality)

Pulse rate – the number of beats per minute (bpm)

Normal pulse rates at rest per minute at various ages

Age	Approximate range	Approximate average
Newborn	120 – 160	140
1 – 12 months	80 – 140	120
12 months – 2 years	80 - 130	110
2 – 6 years	75 - 120	100
6 – 12 years	75 - 110	95
Adolescent, adults	60 - 90	80

Pulse rates

Normal pulse rates at rest per minute at various ages according to [U.S. Department of Health and Human Services - National Institutes of Health](#) **Pulse**

- Newborns 0 - 1 month old: 70 - 190 beats per minute
- Infants 1 - 11 months old: 80 - 160 beats per minute
- Children 1 - 2 years old: 80 - 130 beats per minute
- Children 3 - 4 years old: 80 - 120 beats per minute
- Children 5 - 6 years old: 75 - 115 beats per minute
- Children 7 - 9 years old: 70 - 110 beats per minute
- Children 10 years and older, and adults (including seniors): 60 - 100 beats per minute
- Well-trained athletes: 40 - 60 beats per minute

Pulse rate – abnormal findings

⊙ Tachycardia

- an abnormally fast heart rate; over 100 beats/min in adults (Marieb, Hoehn 2007).
- this may result from:
 - increased sympathetic response due to physical/emotional stress
 - pregnancy
 - sepsis, fever, anemia, hypoxia, dehydration, hemorrhage, shock, hyperthyroidism, cardiomyopathy, valvular heart diseases, acute radiation syndrome
 - some drugs,
 - ...

⊙ Bradycardia

- > an abnormally slow heart rate; slower than 60 beats/min in adults (Marieb, Hoehn 2007).
- > this may result from:
 - rest, sleep,
 - a low body temperature, hypothermia,
 - parasympathetic nervous system activation
 - decreased thyroid activity, hyperkalemia, an irregular cardiac rhythm,
 - drugs (digoxin)
 - ...

Pulse - rhythm

- ⦿ Rhythm is the sequence of beats.
- ⦿ Regular (pulsus regularis)
 - results from coordinated contractions of the heart
 - sinus rhythm
- ⦿ Irregular (pulsus irregularis) – arrhythmias
 - results from uncoordinated contractions of the heart
 - Fibrillation: rapid, irregular contractions

Pulse - strenght

- Is a reflexion of pulse strenght and the elasticity of the arterial wall
 - A bounding pulse is one that is easily detected due to the exceptionally large amount of blood being pumped with each heartbeat.
 - A normal, regular pulse is easy to feel and has even beats of good force.
 - A weak pulse is difficult to detect due to a decreased amount of blood flowing through the arteries, usually due to bleeding or shock.
 - An absent pulse cannot be detected. Lack of a detectable pulse may indicate that the artery is blocked or injured.

Pulse amplitude abnormalities

Pulse amplitude	Characteristics	Conditions
Pulsus magnus	a large, full pulse	arterial hypertension
Pulsus parvus et tardus	a weak/small pulse and very slow, late, that rises and falls gradually	aortic stenosis
Pulsus alternans	alternation of large and small waves	left ventricular dysfunction
Pulsus durus	a hard pulse	atherosclerosis
Pulsus mollis	a soft, easily compressible pulse	hypotension
Pulsus filiformis	a thready pulse, thin as a thread, difficult to detect, usually very fast	bleeding, shock
...		

Radial pulse measurement

- ◉ Wash hands
- ◉ Collect equipment (wrist watch with second hand, pen, piece of paper/documentation)
- ◉ Explain procedure
- ◉ Position patient
- ◉ Place 3 fingers along appropriate artery
- ◉ Apply light pressure on -//-
- ◉ Count pulse 60 s.
- ◉ Record the PR on documentation



Contraindications

- ⦿ Generally no
- ⦿ Relative:
 - Local injury, inflammation, infection, ...
 - A-V fistula,
 - ...

Assessing apical pulse rate



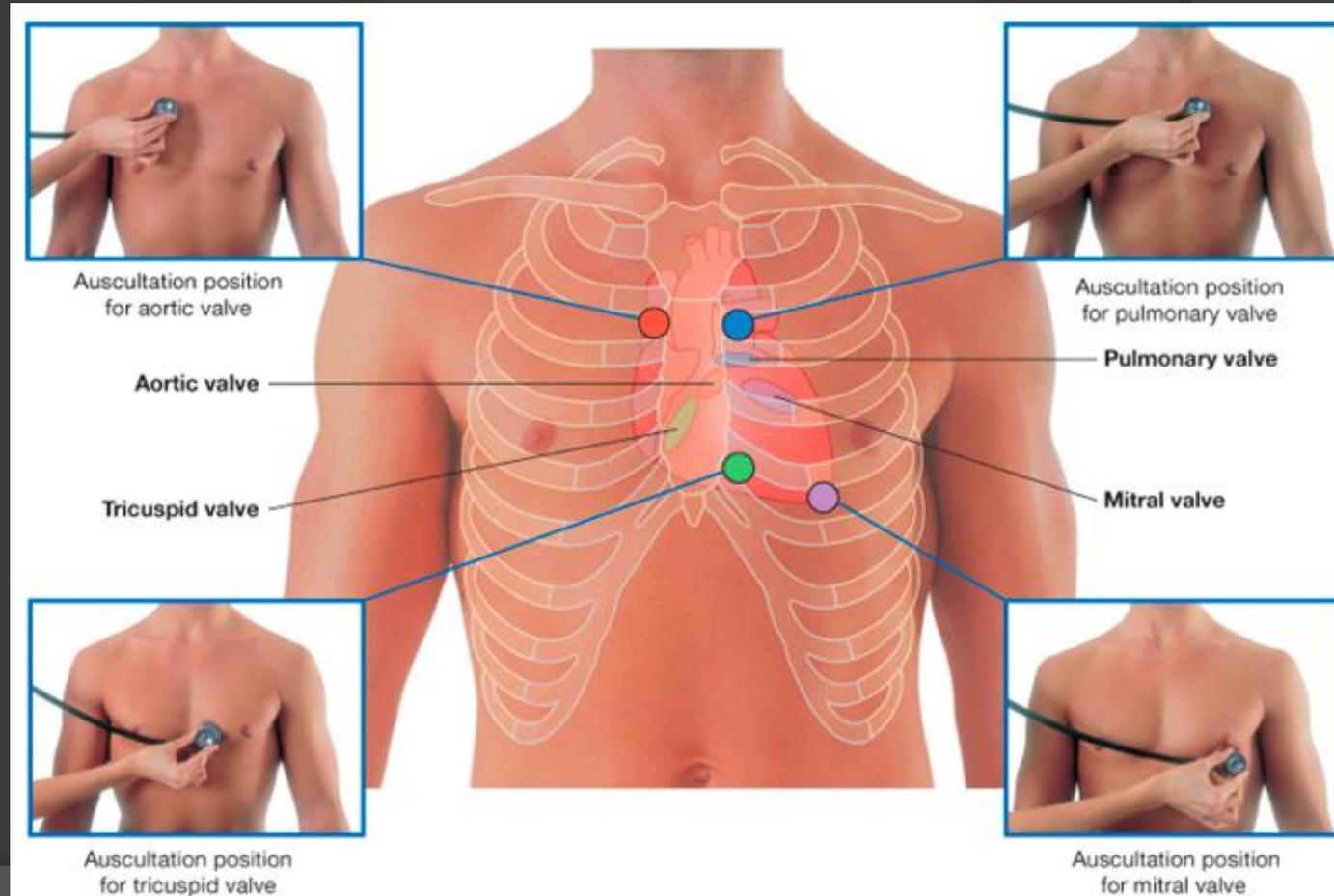
- Apical PR is the most reliable noninvasive way to assess cardiac function.
- Each pulsation is a combination of two sounds, S1 and S2.
- Indication – the preferred method in:
 - critically ill,
 - a history of heart-related health problems,
 - cardiovascular medications.

Auscultation position for apical pulse rate

5th intercostal space midclavicular line

(point for maximal impulse PMI) for:

- apical pulse,
- mitral valve .



Assessing apical pulse rate

- Wash hands
- Collect equipment (stethoscope, wrist watch with second hand, pen, paper, alcohol swab)
- Explain procedure
- Position patient
- Provide privacy
- Count the apical pulse rate while the patient is at rest.
- If the patient has been active, wait at least 5 to 10 minutes before beginning.
- Disinfect earpieces and diaphragm of stethoscope.
- **Place the diaphragm of your stethoscope over the PMI and auscultate for normal S1 and S2 heart sounds. You will usually hear them as "lub-dub." If the apical pulse is regular, count for 30 seconds, then multiply that number by 2. If the apical pulse is irregular or the patient is taking cardiovascular medications, count for 1 full minute to ensure an accurate measurement.**
- Record the APR on documentation



Bibliography

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Dougherty, L., Lister, S. The Royal Mardsen Hospital Manual of Clinical Nursing Procedures. U.K. : Wiley & Blackwell, 2008.

Marieb, E.M., Hoehn, K. Human anatomy and physiology. Pearson Benjamin Cummings, San Francisco, 2007.

Basal heart rate

The basal or **resting** heart rate (HR_{rest}) is measured while the subject is:

- relaxed but awake, in a neutrally temperate environment,
- without stress, surprise.

Maximum heart rate

⦿ HR_{max} is the highest heart rate an individual can achieve without severe problems through exercise stress, and depends on age.

⦿ Formulas:

- $220 - \text{age}$

Tanaka, Monahan, & Seals (2001) "Age-predicted maximal heart rate revisited". *Journal of the American College of Cardiology* **37** (1): 153–6.

- $220 - (0.9 * \text{age})$ for women
- $220 - (0.8 * \text{age})$ for men

Optimal heart rate

- The best heart rate to burn body fat during exercise = optimal heart rate = 60% to 80% (85) of maximum heart rate.

- ***Age-Adjusted Method***

- Lower limits for training:

$$\text{HR}_{\text{opt}} = 0.60 * \text{HR}_{\text{max}}$$

$$= 0.60 * (220 - \text{age})$$

$$= 0.60 * 220 - (0.9 * \text{age}) \quad \text{W}$$

$$= 0.60 * 220 - (0.8 * \text{age}) \quad \text{M}$$

- Upper limits

$$\text{HR}_{\text{opt}} = 0.80 * \text{HR}_{\text{max}}$$

$$= 0.80 * (220 - \text{age})$$

The Karvonen Formula for HRopt.

● Target Heart Rate

**= ((max HR – resting HR) × %Intensity)
+ resting HR example**