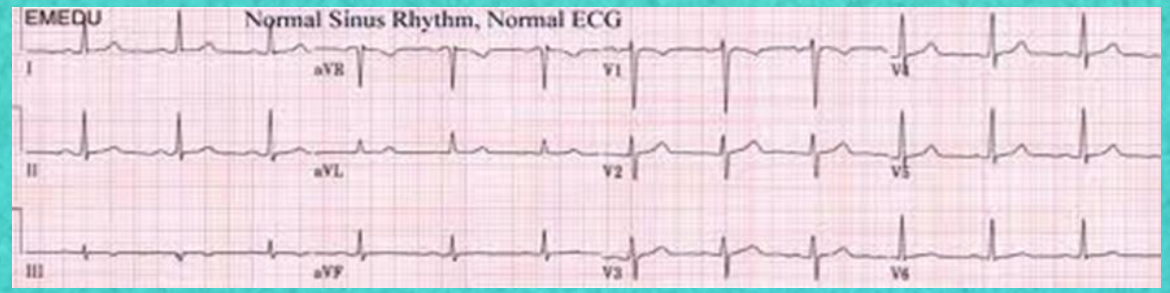
Remedial Physical Education

Cardiovascular disorders and Physical Education

Department of Adapted PE
and Sports Medicine



Heart in numbers

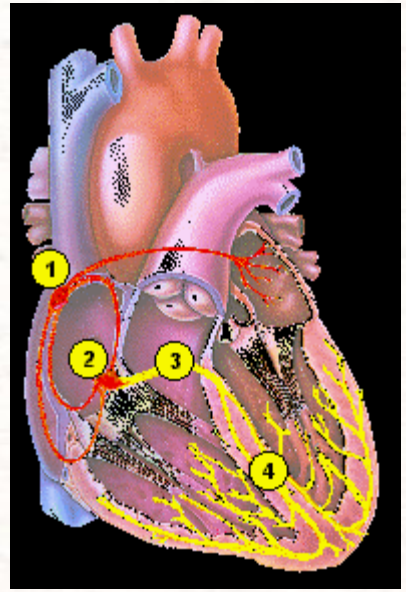
- weighs between 7 and 15 ounces (200 to 425 grams)
- little larger than the size of your fist (cca 12 x 9 cm)
- each day
  - –the average heart beats 100,000 times (cca 70 / min)
  - –pumping about 2,000 gallons (7571 l) of blood

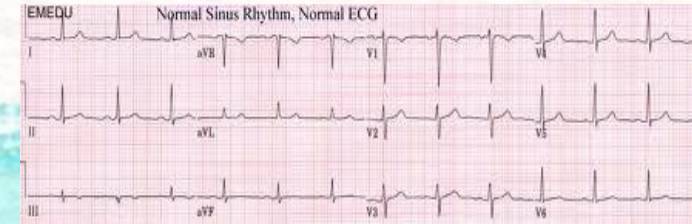
- *Quiz: Do you know which of these animals´ resting HR is highest?*


Before we start to look at heart diseases and exercise, let´s remind some physiology ☺

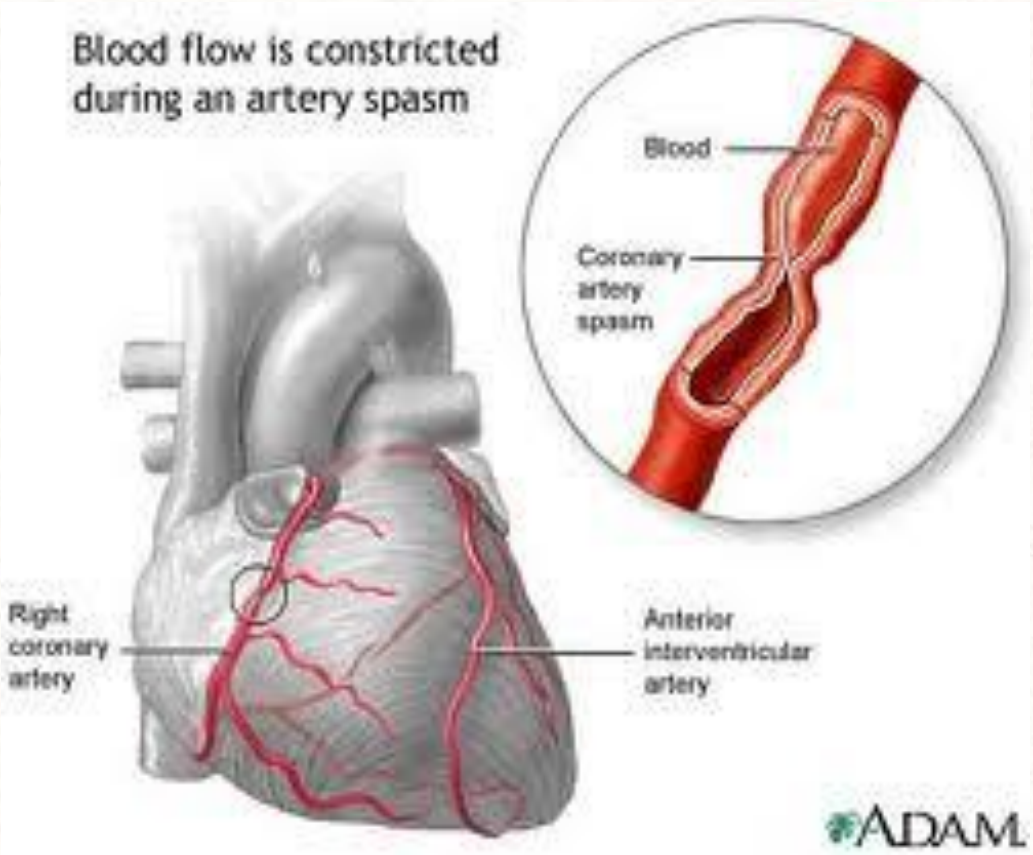
Heart work management

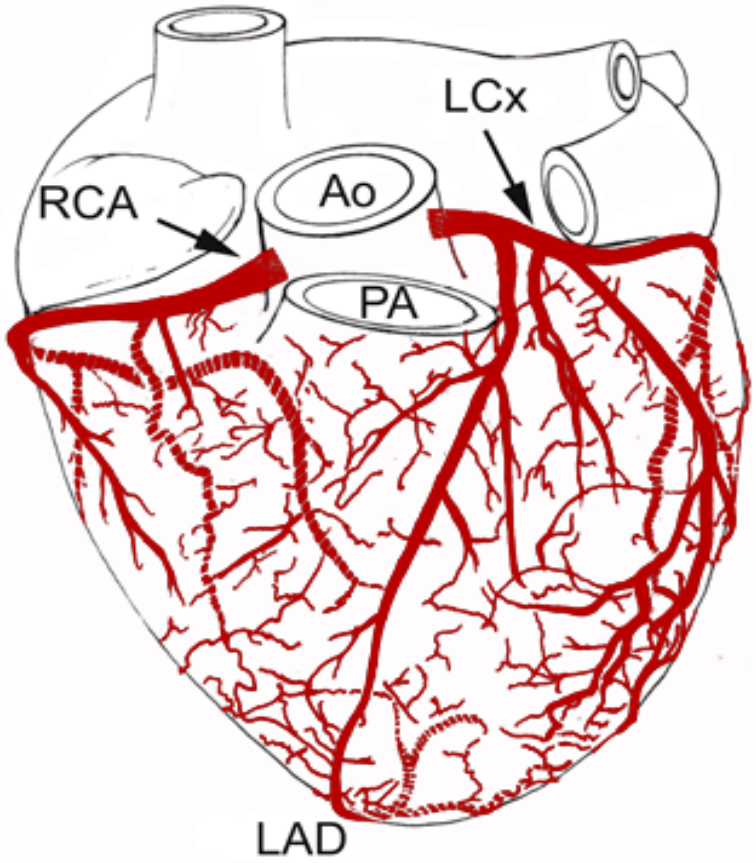
- <u>cardiac muscle automaticity</u>
- Electrical conduction system
  - Sinoatrial node (SA node)
  - Atrioventricular node (AV node)
  - Common AV Bundle
  - Right & Left Bundle Branches
- Autonomic nervous system (sympathetic, parasympathetic)
- Baroreceptors in aorta
- Hormonal: epinephrin, norepinephrin, glucagon, insulin,...





Heart nutrition – coronary arteries

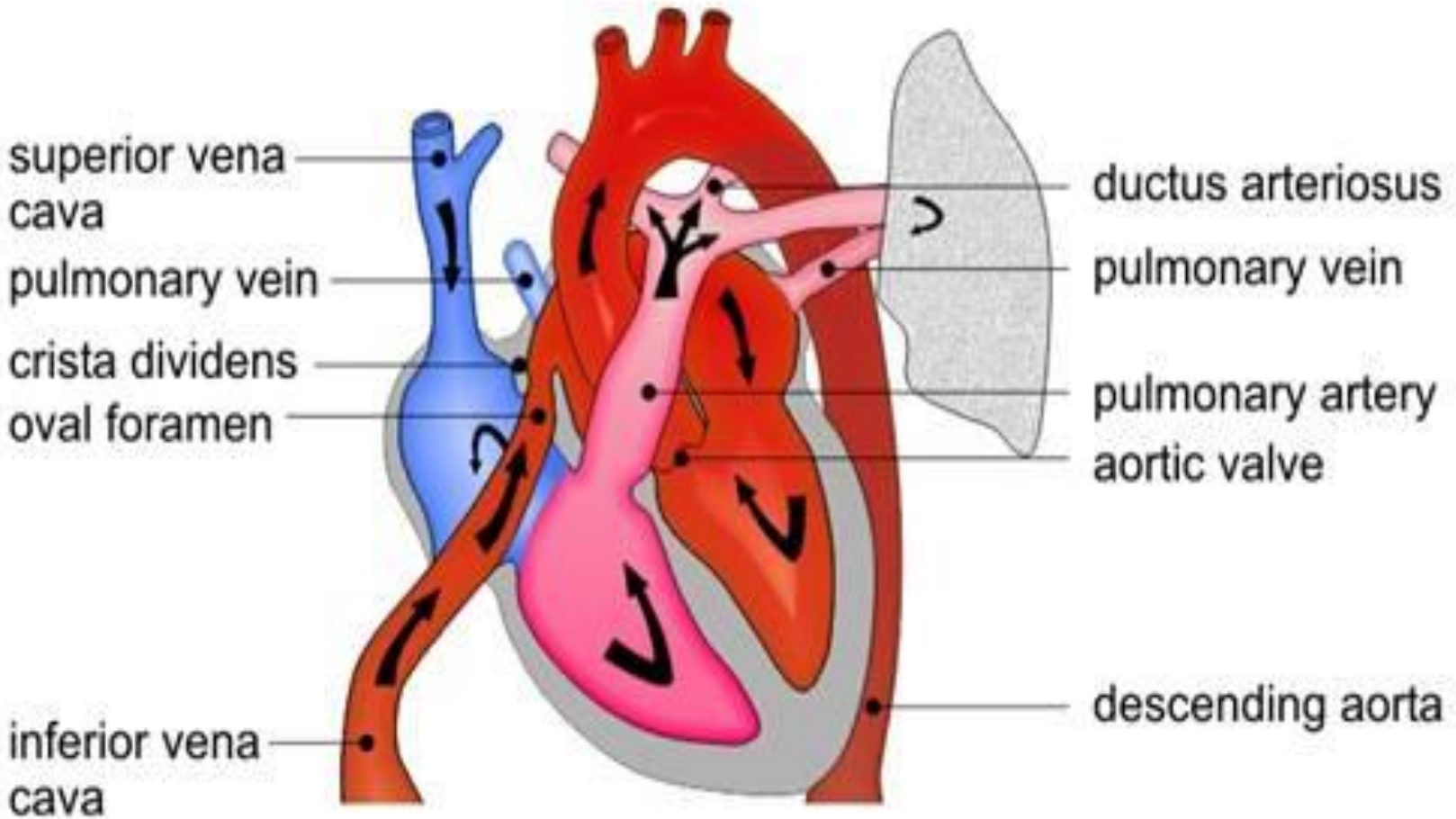




Cardiovascular system in a lifespan
FETAL CIRCULATION

Why is this important?

If we understand fetal circulation, we are then able to understand what happens in most congenital heart diseases



Resting heart rate (HR) through the lifespan – physiological changes

Through HR we feel that we are alive, that our heart is beating…

CHILDHOOD

- **HR decreases with age:**
  - Newborn: 100–180 r.p.m.
  - Infant: 80–150 r.p.m.
  - Toddler: 80–130 r.p.m.
  - Preschool: 80–120 r.p.m.
  - Elementary school: 60–100 r.p.m.
- **Blood pressure increases with age** (the younger the child, the lower blood pressure), **blood volume** (according to weight) is higher in children

AGEING

- blood vessels aging – thicker, stiffer, and less flexible (smooth muscle hypertrophy, increase in the amount of collagen, calcification, decrease in metabolism)
- degeneration and calcification of heart valves
- SA node loses some of its cells
- baroreceptors are less sensitive

↓

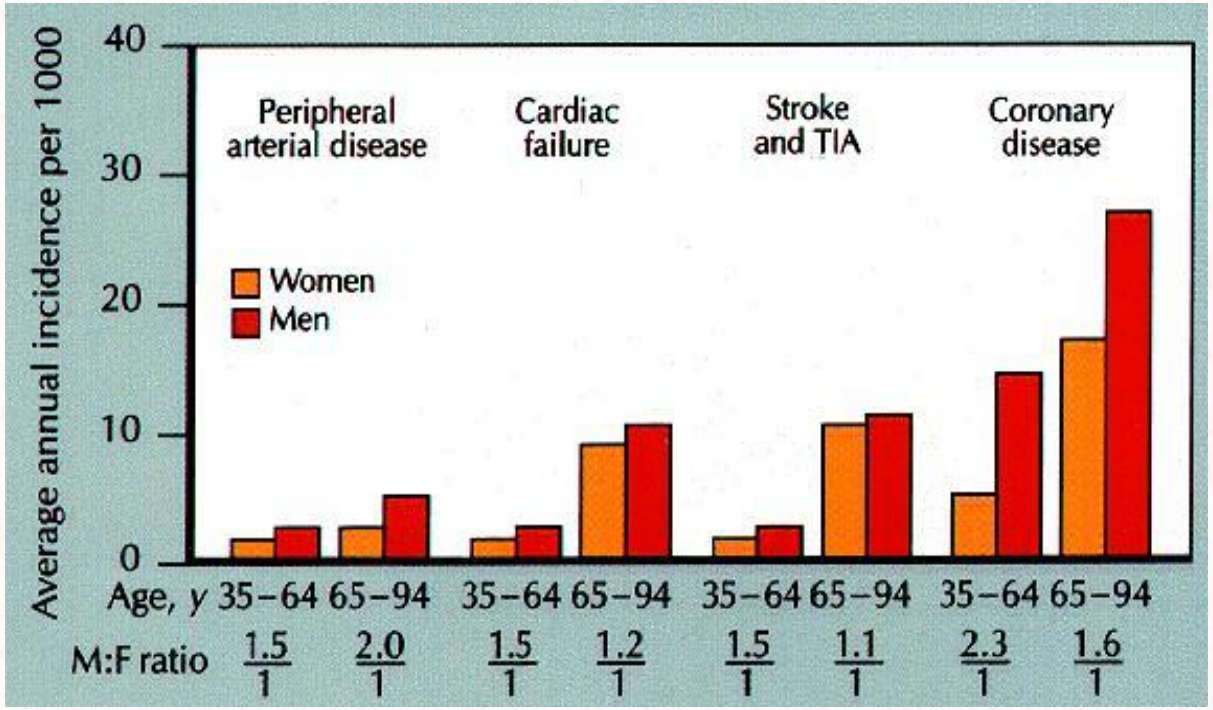
blood pressure increase, slight hypertrophy of left ventricle, slower filling of the heart, decrease in cardiac output etc.

Why should we care of the cardiovascular disorders topic?

- high morbidity and mortality worldwide
- connection with risk factors, e.g. lifestyle
- physical activity - both prevention and treatment
- however, physical activity may also bring risks as it puts some strain on „weak“ cardiovascular system

Most prevalent forms

- hypertension
- coronary artery disease (CAD)
- peripheral vascular disease
- valvular heart disease
- cardiomyopathy
- dysrhytmias (disorders of rate, rhytm and conduction)
- congenital heart disease
- heart failure



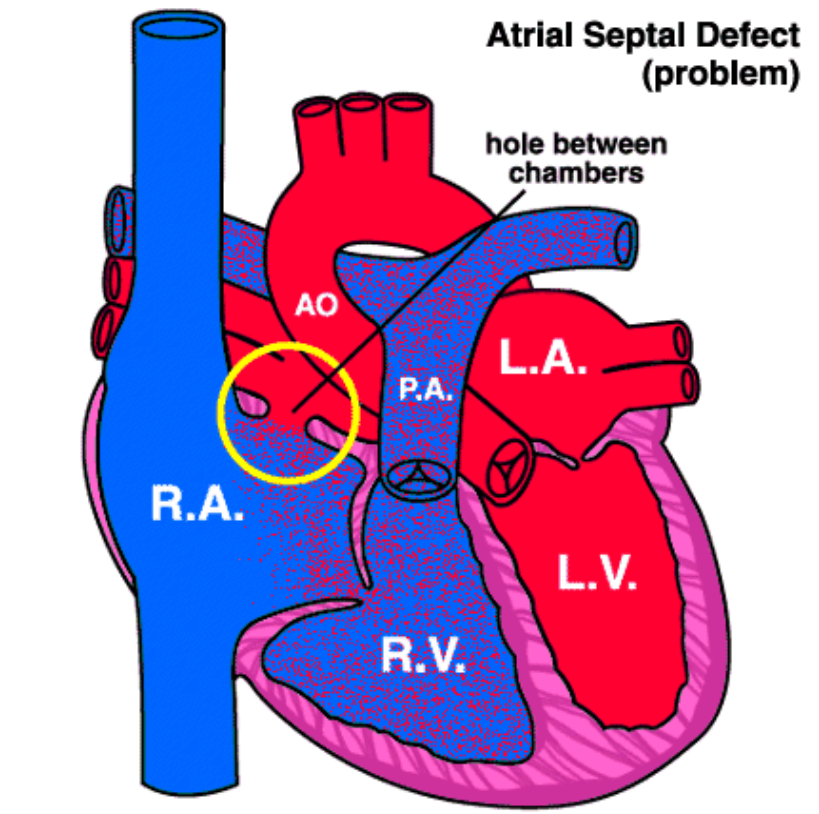
http://www.fauxpress.com/kimball/med/heart/hcst/chart.htm

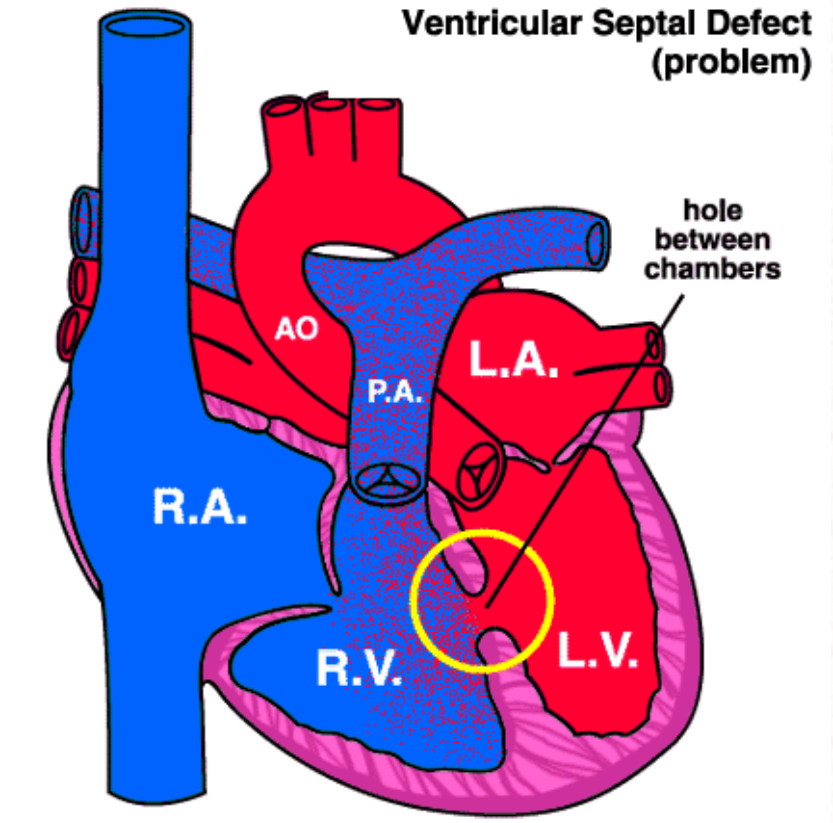
Cardiovascular disease in childhood - Congenital heart disease

Congenital heart disease (CHD) = heterogeneous group of conditions that are present at birth due to a congenital heart malformation / structural anomalies of the heart present at birth

- CHD **usually diagnosed at a young age** and, whenever possible, **corrected surgically** at that stage
- a number of children with CHD remain physically inactive – often **overprotected by their parents**
- **regular checks** should be done by cardiologist and sport medical doctor - to monitor these children at least on a yearly basis, as rapid changes in their cardiac haemodynamics might occur due to growth
- recommendations on exercise capacity should consider the self-discipline of the young patient together with the social environment (school, parents)
- if surgical corrections were carried out sufficiently early in childhood, many patients improve exercise tolerance and can attain the levels of children with no cardiac anatomy problems
- **General recommendation for health-enhancing / remedial PE: usually light dynamic exercises should be tolerated after careful individual evaluation, beneficial are breathing and relaxation exercises, in case of upper crossed syndrome, compensatory exercise to correct muscle imbalance, exercise unit should always include with warm-up and cool-down phase**
- **In some children should be avoided: maximal intensity, racing, positions with head upside down, high intensity static exercise – strengthening, activities with risk of chest bounce etc.**

Examples of congenital disease and their consequences for exercise

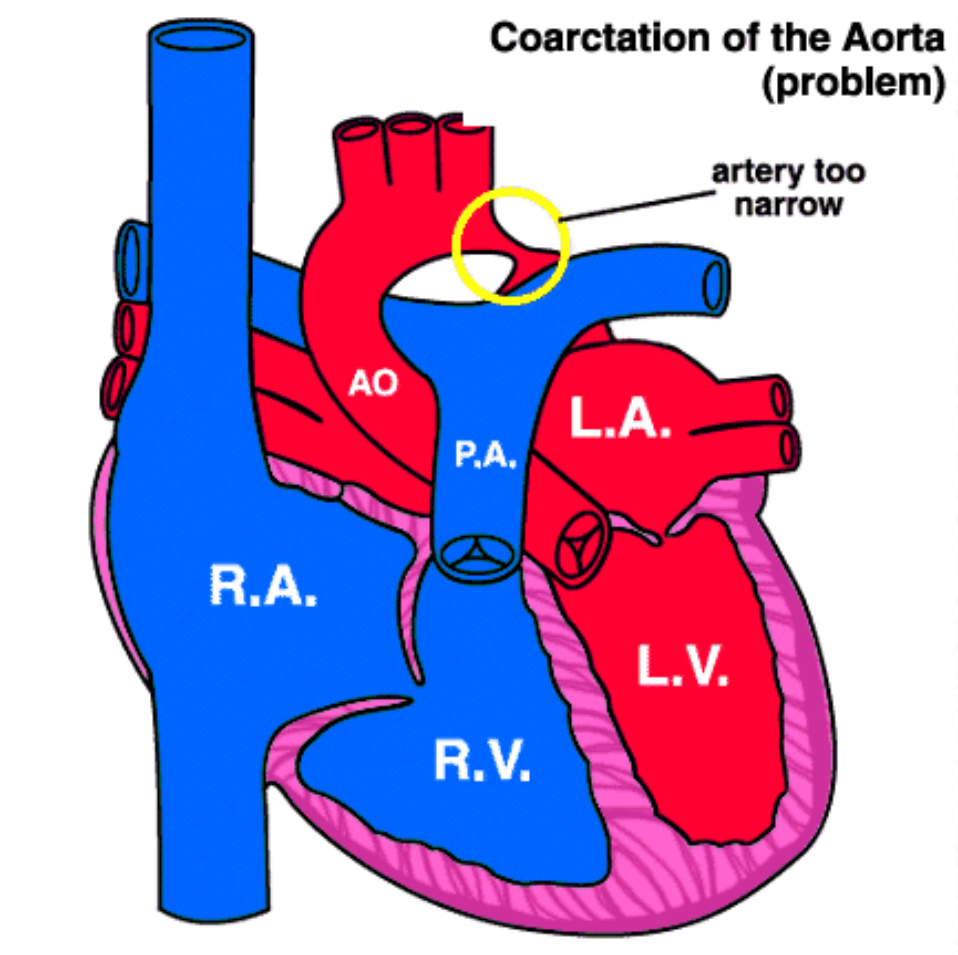




ASD = connection between the two atriae in the middle or upper part of the septum, left-to-right shunt, may cause enlargement of the right atrium, right ventricular overload with subsequent pulmonary hypertension

VSD - classified according to the magnitude of their shunt volume, symptoms depend on the amount of shunted blood which is influenced by the pressure and resistance of the pulmonary vasculature, people with moderate VSD (shunt 30- 50%) should only perform light PA, people with large defects, associated with a marked increase in pulmonary pressures should avoid any physical exertion exceeding the every-day routine.

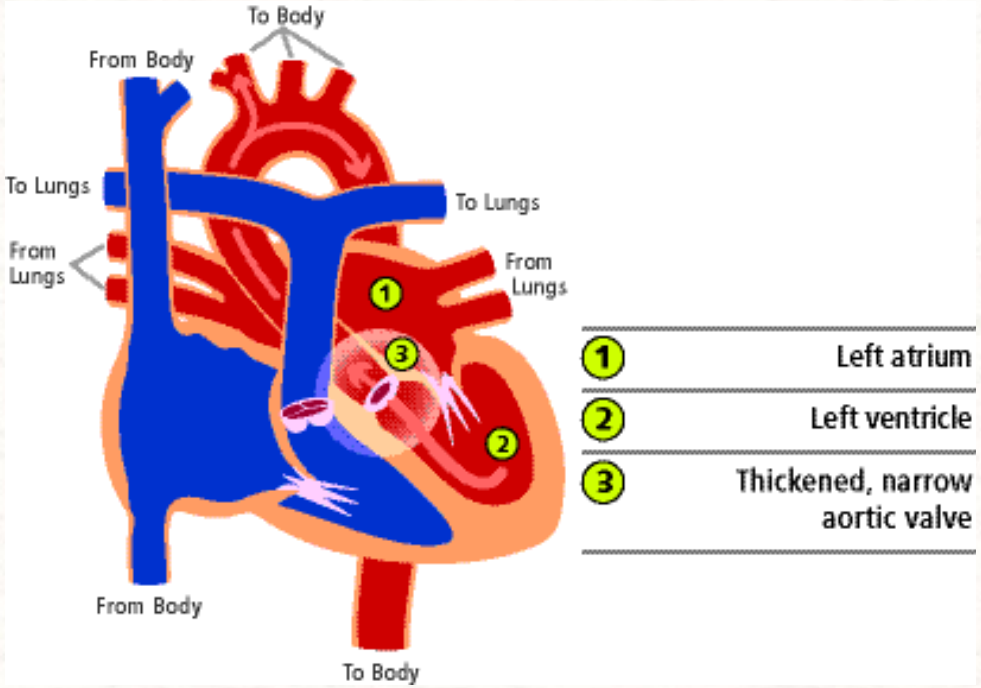
Examples of congenital disease and their consequences for exercise



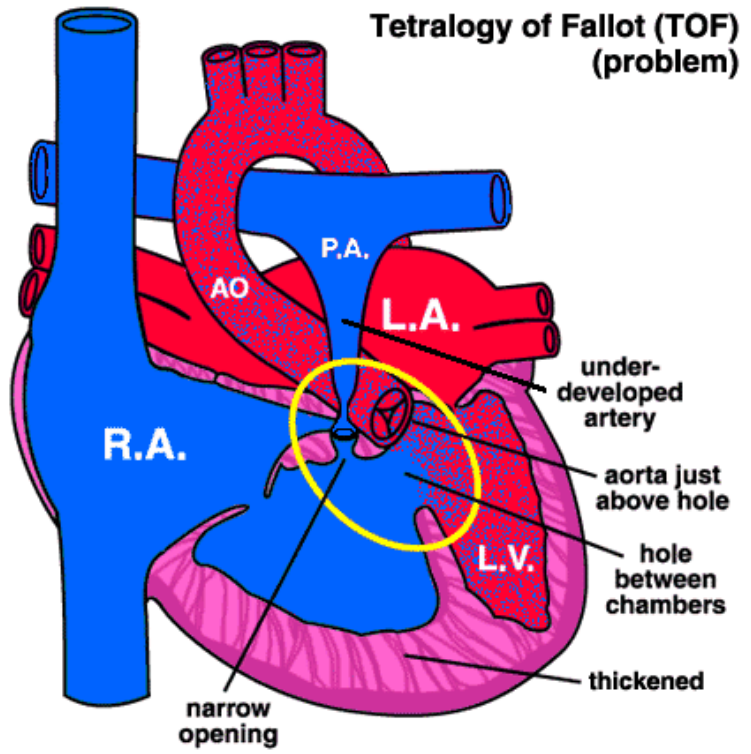
Even after surgical correction, there can be pathological pressure gradients, cardiac hypertrophy or peripheral hypertension, thus blood pressure regulation during exercise is important, light dynamic, health-orientated exercise is recommended BUT intensive static workload should be avoided as well as chest bumps (e.g. hitting the heart area with a ball)

Examples of congenital disease and their consequences during exercise

aortic stenosis – needs a monitoring on a regular basis, as rapid changes in the severity of their condition can occur during growth, there is higher incidence of sudden cardiac death, especially in severe cases, where exercise might trigger potential fatal outcomes, people with moderate AS should only be active at low intensities, severe cases, even if asymptomatic, are not suited for any PA



- very important is warming up and cooling down
- static workload (strengthening) should be rather avoided



TOF: there is higher incidence of sudden cardiac death, rhythm disturbances rather common

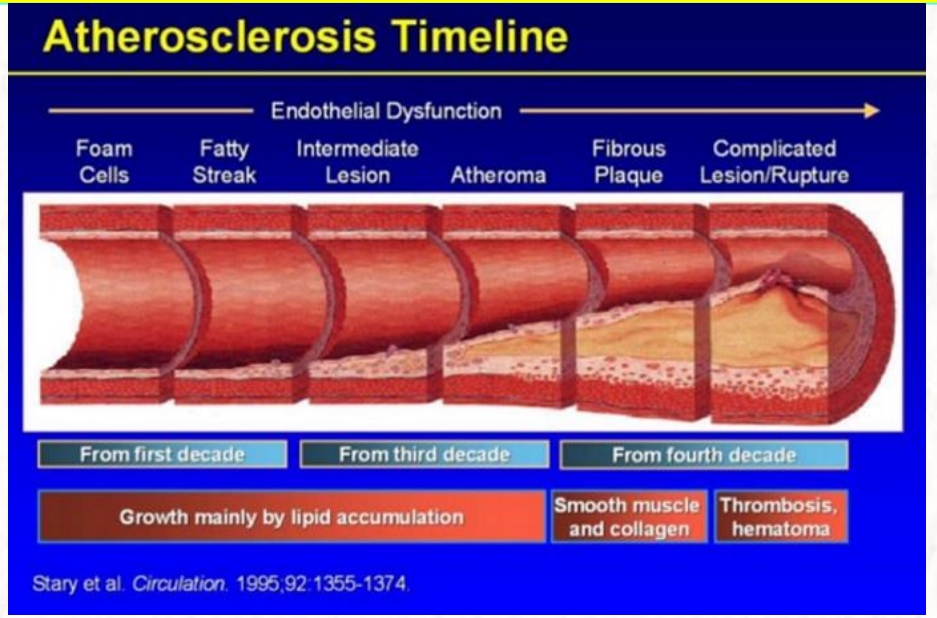
Please look at the video which explains the Tetralogy of Fallot:
https://www.youtube.com/watch?v=Be3tuYMgA9I&ebc=ANyPxKrARz4qjcP4aE3gWZQ-gmZ1gFS8QvNYGrAhj9LQP0NSkjIfZayGtIbB58liTSXEjSN7g51-ru5w3K6Z0QFvHmEsbkmHmg

Cardiovascular disorders in adulthood – coronary artery disease

= condition **affecting blood supply to the heart**

(reduction of coronary blood flow related to narrowing or blocking of the blood vessels from **cholesterol plaques** on their walls), based on atherosclerosis, which is connected with „risk factors“

- *indicators may be:*
  - chest pain with / without radiation
  - palpitations (feeling of heart beat)
  - irregular or rapid pulse
  - shortness of breath
  - cough
  - fatigue. weakness, faintness
  - overall sweating
- *manifestations /forms of appearance/*
  - **angina pectoris**
  - **myocardial infarction**
  - **sudden death**



New York Heart Association (NYHA) Classification of Heart Failure

Class	Patient Symptoms
Class I (Mild)	No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class II (Mild)	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class III (Moderate)	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class IV (Severe)	Unable to carry out any physical activity without discomfort. Symptoms of fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea) are present at rest. If any physical activity is undertaken, discomfort increases.

Risk factors of CAD

non-ifluenceable

- male gender
- age
- heredity

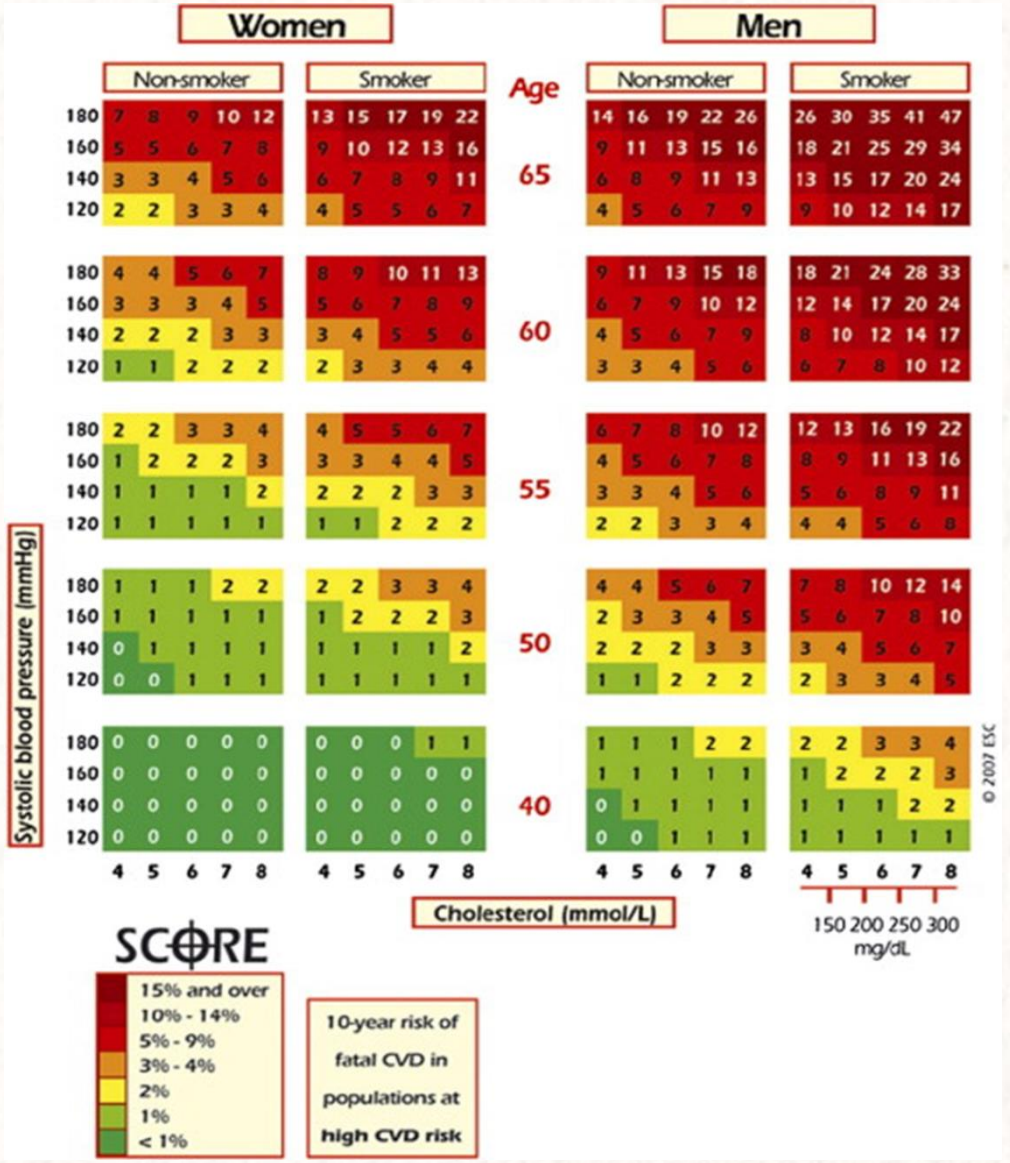
influenceable

- cigarette smoking
- inactivity
- poor nutrition
- stress

- diabetes
- hypertension
- dyslipidemias
- obesity
- homocystein metabolism

These disorders are also connected with above-mentioned factors and themselves are a risk factor for development of CAD as well

The risk can be estimated from „SCORE“ tables, see below:



Benefits of regular physical activity in people with cardiovascular disorders

- better cardiac and pulmonary function
- improved lipid metabolism
- weight control
- better ability to perform activities of daily living (functional and work capacity)
- enhanced feeling of well-being (QL)
- improvement of anxiety and depression
- metabolic, peripheral and central adaptations:

METABOLIC

↓ LDL-CHOL
↑HDL-CHOL
↓ TG
↓ CHOL-t
↑ insulin sensitivity

PERIPHERAL
(i.e. in the vessels)

↓ catecholamines
↓ resting HR
↓ HR in middle exercise
↓ systolic BP
↑ a-v difference
↑ VO2max
↑ rate-pressure product

CENTRAL
(i.e. on the heart)

↑ perfusion
↑ EF
↑ contractility

Exercise prescription for people with coronary artery disease

MODE: large muscle groups, continuous exercise + light strength training

FREQUENCY: minimum 3 non-consecutive days per week

DURATION: warm-up + cool-down periods at least 10 min, followed 20-40 min cardiovascular exercise continuously or through interval training

INTENSITY: moderate, comfortable intensity, generally 40-85% VO_2max or maximal heart rate reserve, or 55-90% HRmax, RPE 11-16, below the level that provokes myocardial ischemia, arrhytmias, or exercise intolerance

Guidelines for exercising from American College of Sports Medicine:

- https://journals.lww.com/acsm-msse/Fulltext/2004/03000/Exercise_and_Hypertension.25.aspx
- https://journals.lww.com/acsm-msse/Citation/1994/03000/Exercise_for_Patients_with_Coronary_Artery_Disease.24.aspx

Remarks to exercise with a heart disease - SAFETY

Contraindications = do not exercise in case of:

- acute ilness - infectious disease
- the disease is unstable or severe
- resting blood pressure is too high (above 160/90)
- the person feels strange, weak etc.
- weather conditions are too strenuous (too hot, too cold etc.)

Do not forget:

- warm-up period
- cool-down period
- regular breathing
- fluid replacement

Stop exercise when feeling:

- discomfort
- pain /esp. chest pain/
- shortness of breath
- nausea
- dizziness
- lightheadness
- fatigue

Do not apply:

- high static exercise - strengthening
- emotional exercise (competition)
- maximal intensity exercise
- activities with risk of hitting the chest
- positions with head upside down
- sudden exercise (quick start)

Example of good practice - exercise program in Motol hospital in Prague

- open to all patients who could benefit from exercise
- usually lasts 3 months
- always determined by exercise test and overall assessment
- bicycle and rowing ergometers (2-3 patients at one time)
- measured parameters (pre – during – post exercise):
  - HR (in exercise every 5 min)
  - BP (at least twice during exercise)
  - ECG (in selected post MI pts or heart failure pts.)
  - glycemia (in DM patients)
  - subjective feelings
- education during "trainings" – talking about lifestyle and risk factors ☺

- 1. week: 20 min of exercise only – the people have to adapt to exercise
- every training add 5 min up to 50 minutes in total
- warm-up (5-10 min) – main part – cool-down (5-10)

Example of good practice - club level activities - Klub Kardia Motol (KKM)

= non-government organization providing out-patient rehabilitation and remedial physical education for elder people with cardiovascular impairment, over 300 members

activities:

- **group exercise in the gym: 1 -2 / week, 60 min**
- **group exercise in the water: once / week, 30 min**
- **regular trainings on cycle ergometer: 2-3 / week, 45 min**
- **one-week reconditioning camps: 3 / year**
- **education (lectures for patients): 1 / month**

- mostly females (social function as well), all-year round: September to June
- 1 exercise unit: 45,- Kč for retired people (55,- Kč for employed) + support by grant projects
- mostly exercise for muscle tension release, improvement of joint mobility, improvement of muscle imbalance, posture, strengthening, movement coordination, breathing etc.
- mostly in horizontal (lying) position (+ all other positions according to age and movement abilities of people in the group)

Case study – example of exercise intervention

- 47 years old man, height = 181 cm, weight = 111 kg
- diagnosis: post-infection cardiomyopathy with EF = 37 % and LV dilatation
- HR rest = 76, HR max = 155, BP rest = 140 / 100, BP max = 230 / 115
- VO2max = 20.3 ml/kg/min, W max = 220 Watts, METs = 5.8

↓

3 months exercise programme:

cycle ergometer, 2-3 / week, 50 min,

60 % VO2max (load 35 min, 10 min warm-up, 5 min cool-down)

↓

- weight loss: 10 kg
- EF = 45 %, LV dilatation decreased
- HR rest = 61, HR max = 150, BP rest = 120 / 85, BP max = 200 / 100
- VO2max = 24.9 ml/kg/min, W max = 270, METs = 7.1

Relaxation as one possibility of exercise in CVD

For people with cardiovascular disease, relaxation techniques can be beneficial. Especially for people with hypertension and people who suffer from big stress, relaxation is recommended.

Tasks for distant study

1. Please go through the **presentation and read about relaxation exercises** in the study material (the one from prof. Strnad, chapter 4.4.2), **try some of them**, try to evaluate how you personally are able to relax and please give me the feedback what was easy or difficult for you.

2. Please **try to relax also according to some online relaxation** techniques:

https://www.youtube.com/watch?v=t3uK039WdaM

https://www.youtube.com/watch?v=E_sdaDwa2Ek Which one did you like more?

3. Bonus: Please answer the quiz at slide 2. ☺