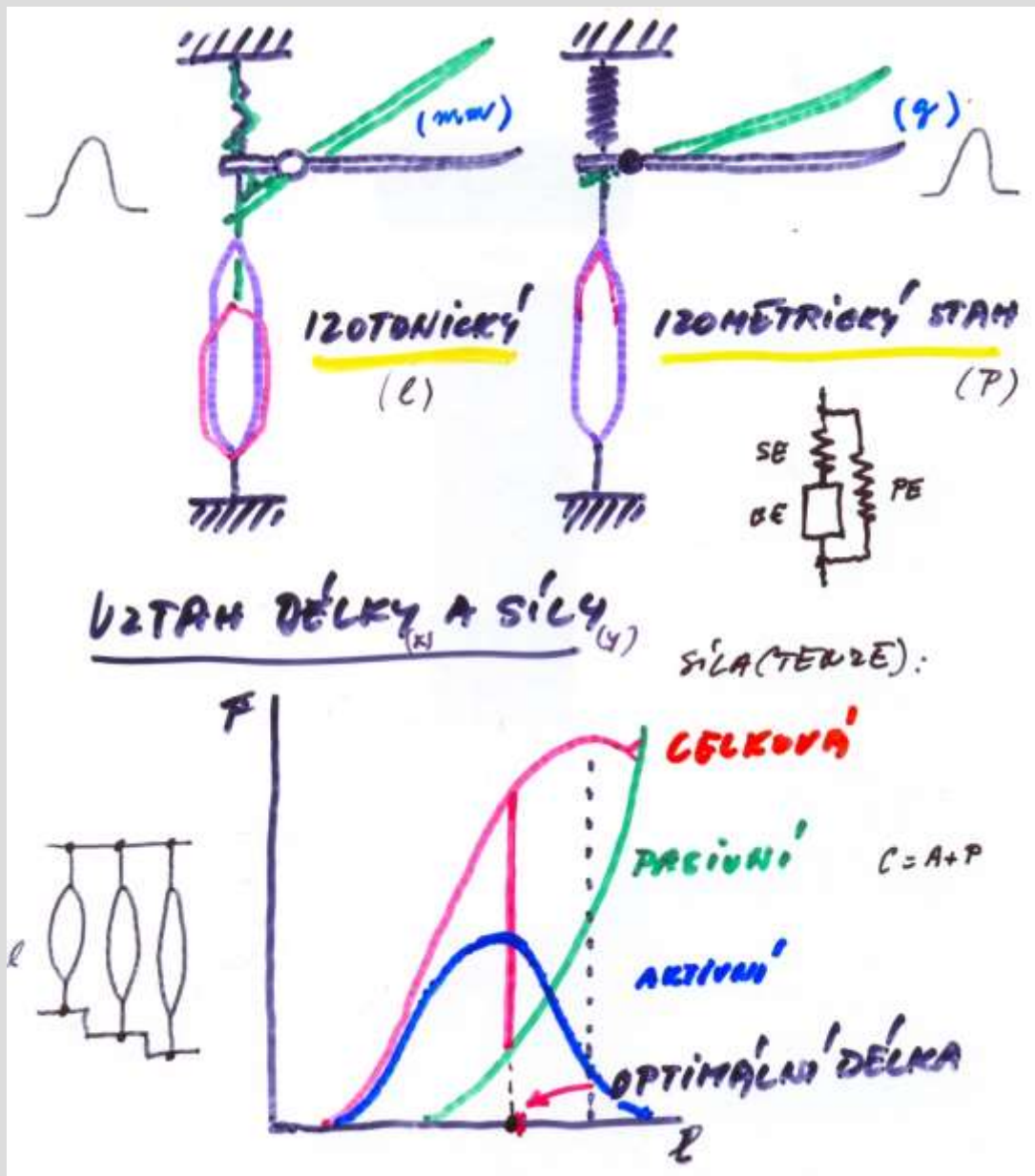


CARDIAC MECHANICS
CARDIAC CYCLE
HEART FAILURE

PASSIVE STRETCH

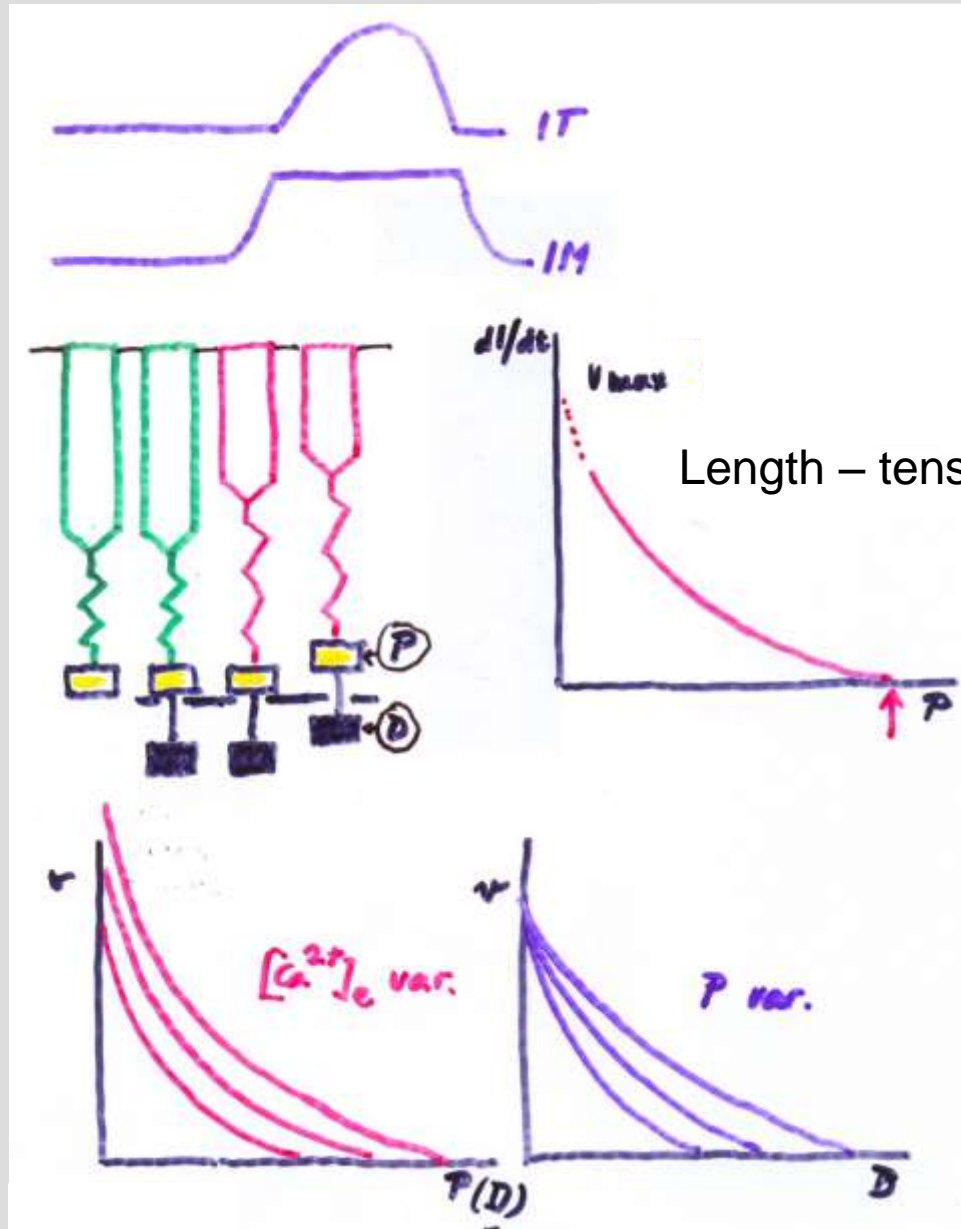
ACTIVE STRETCH



STARLING PRINCIPLE (heterometric autoregulation)

AFTERLOADED CONTRACTION

PRELOAD, AFTERLOAD



Length – tension relationship

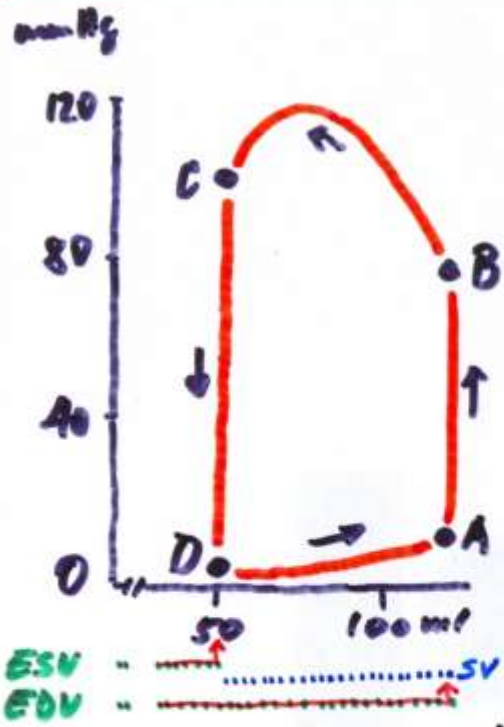
LAPLACE LAW

$$T = P \cdot r / h$$

$$\uparrow P = T \cdot \uparrow h / \downarrow r$$

HYPERTROPHY

1. $\uparrow T = \uparrow VO_2$
2. $\uparrow h$

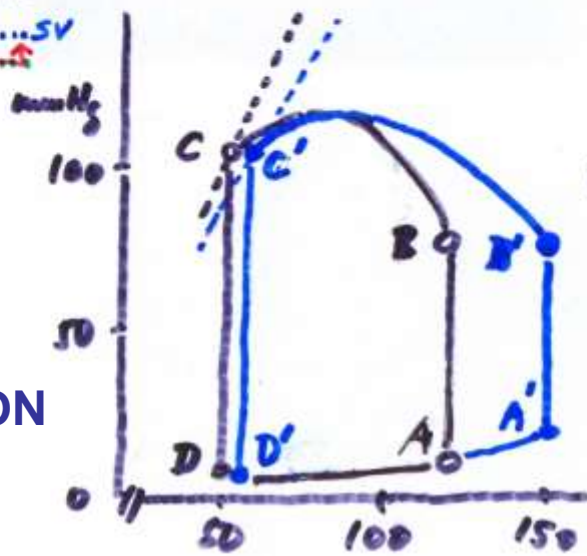


AB - izovol. kontrakce
 BC - ejekce
 CD - izovol. relaxace
 DA - plnění (filling)
 • ABCD = srd. práce = $\dot{V}O_2$
 (H. WORK)

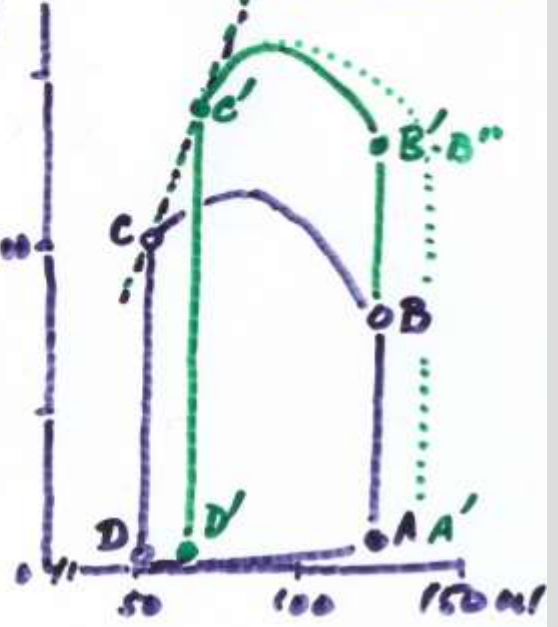
$$EF = \frac{EDV - ESV}{EDV}$$

EJECTION FRACTION

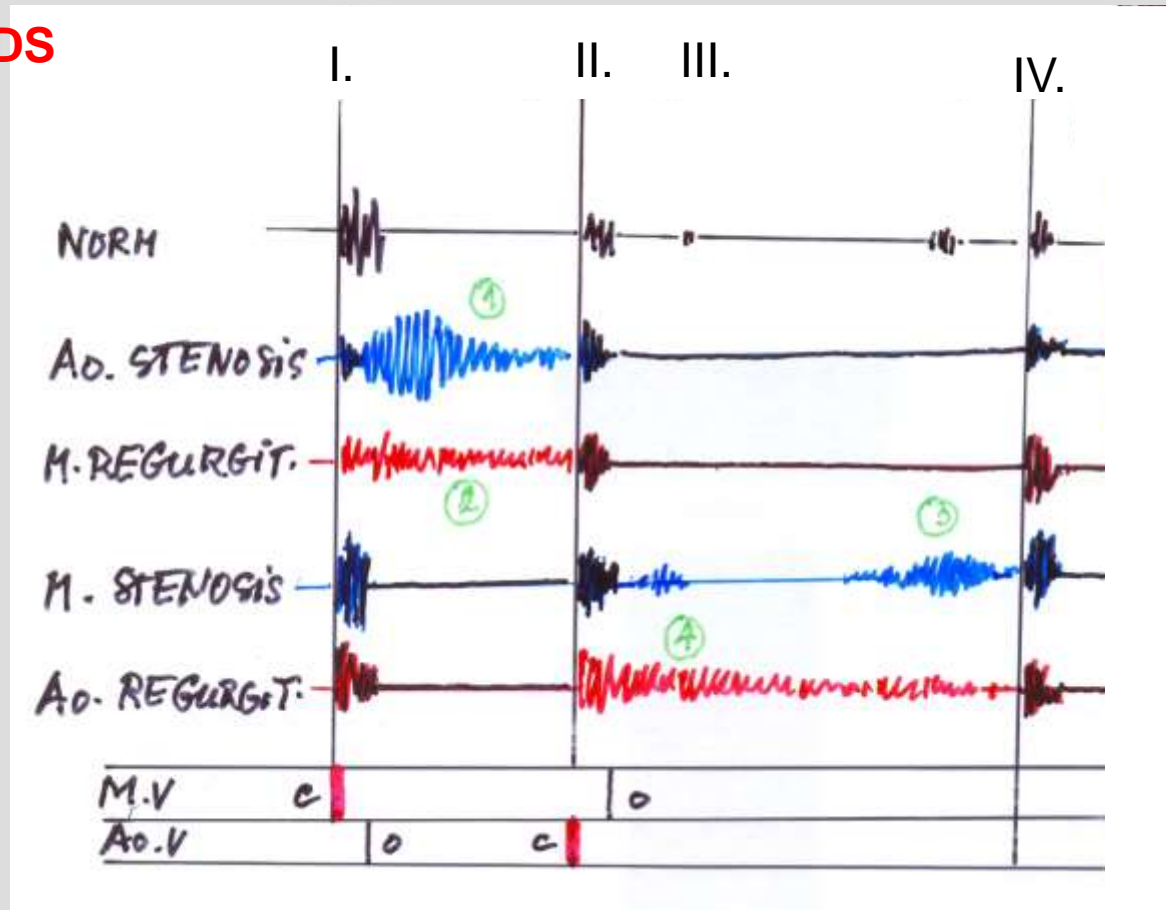
Δ NAPĚTÍ (PRELOAD)
 (PŘETÍŽENÍ)



Δ ODPOR (ARTERU)
 (DOTÍŽENÍ)



HEART SOUNDS



- I. - mitral (+ tricuspidal) valve closure
- II. - aortal (+ pulmonary) valve closure
- III. - fast filling of ventricles - pathological
- IV. - contraction of atria - mostly pathological

Caused by vibration of:

- Closure and stretching of valves
- Isovolumic contraction of heart muscle (papill. muscles, tendons)
- Turbulent blood flow

Vibration of ventricular wall

MURMURS – pathological phenomena

TURBULENT BLOOD FLOW

1. SYSTOLIC:

- Stenosis – aortal, pulmonary (1)
- Regurgitation – mitral, tricuspidal (2)

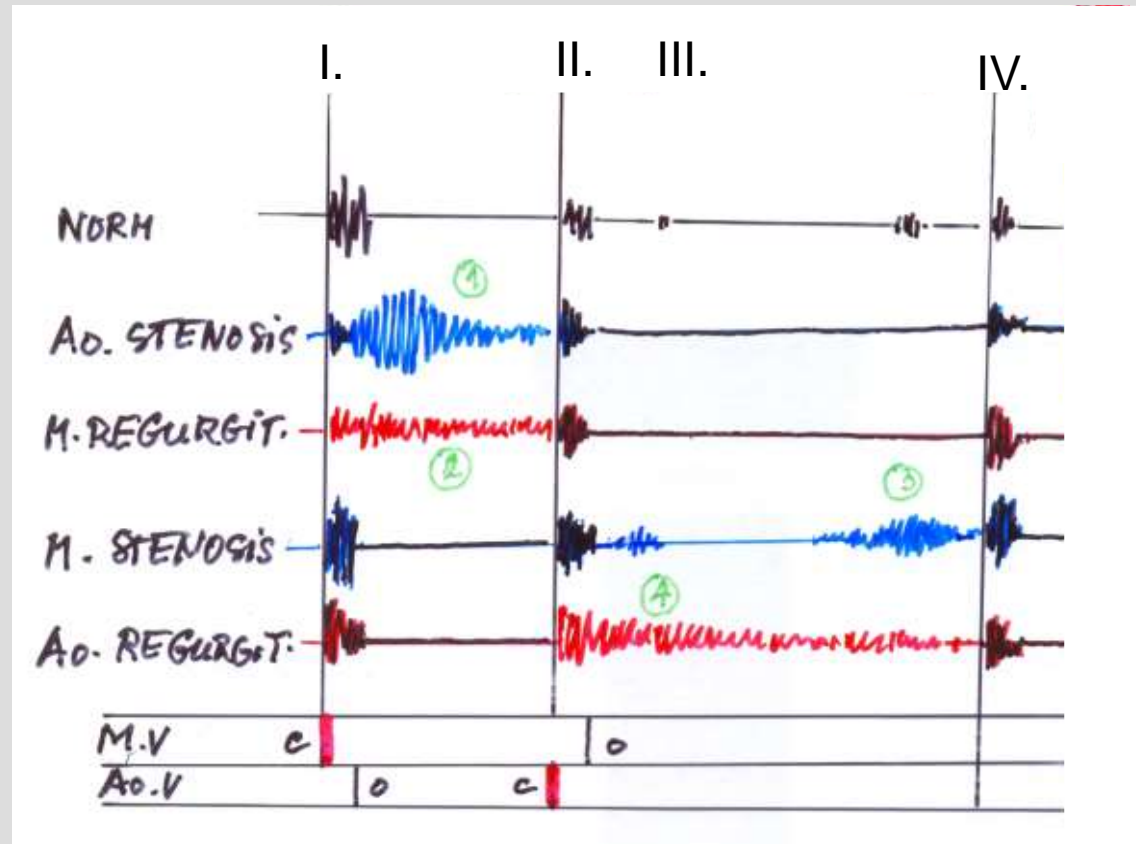
2. DIASTOLIC:

- Stenosis – mitral, tricuspidal (3)
- Regurgitation – aortal, pulmonary (4)

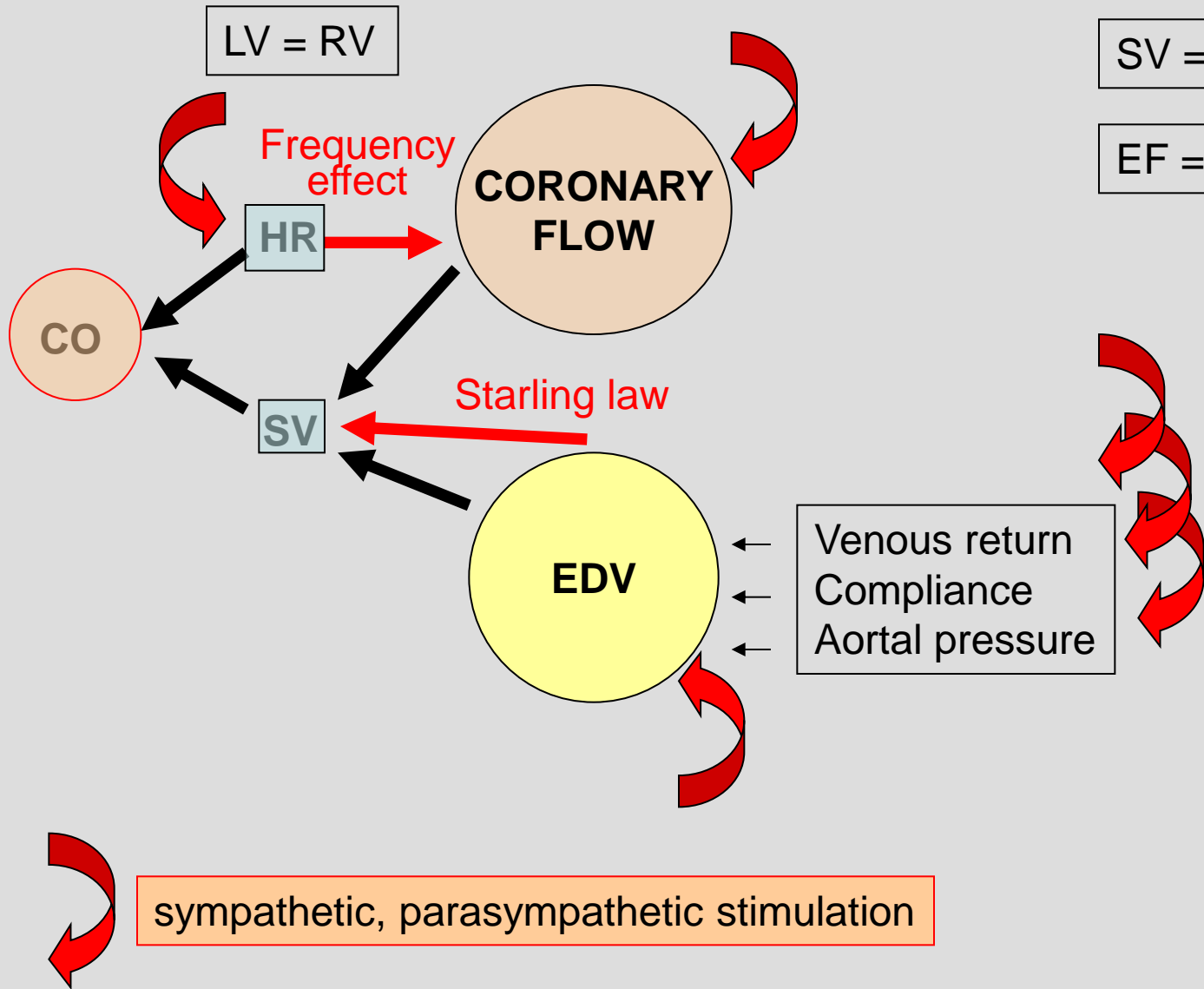
3. SUSTAINED:

- Defects of septum

Splitting of I. or II. sound:
asynchronous closure of
M - T valve (I.)
or Ao - P valve (II.)
(inspiration,
hypertension....)



CARDIAC OUTPUT



$$CO = HR \times SV \quad 5\text{l/min}$$

$$SV = EDV - ESV \quad 70\text{ml}$$

$$EF = \frac{EDV - ESV}{EDV}$$

>60%

CARDIAC RESERVE = maximal CO / resting CO

4 - 7

CORONARY RESERVE = maximal CF / resting CF

3,5

CHRONOTROPIC RESERVE = maximal HR / resting HR

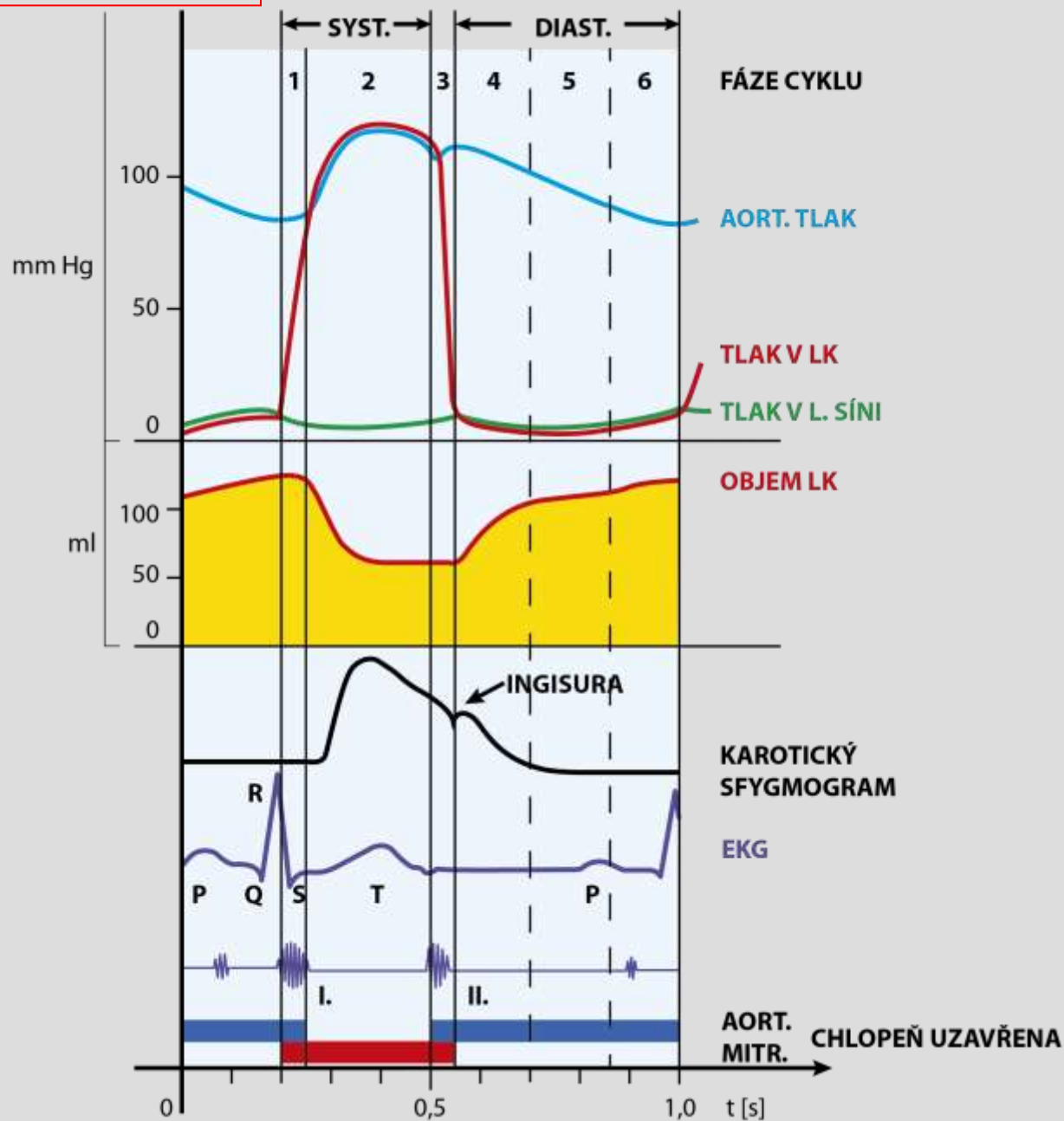
3 - 5

VOLUME RESERVE = maximal SV / resting SV

1,5

CARDIAC INDEX = CO / body surface

POLYGRAPHY (polygram)



CARDIAC RESERVE

CO (l/min)

30

20

10

ATHLETES HEART

PHYSIOLOGICAL RESPONSE

HEART FAILURE

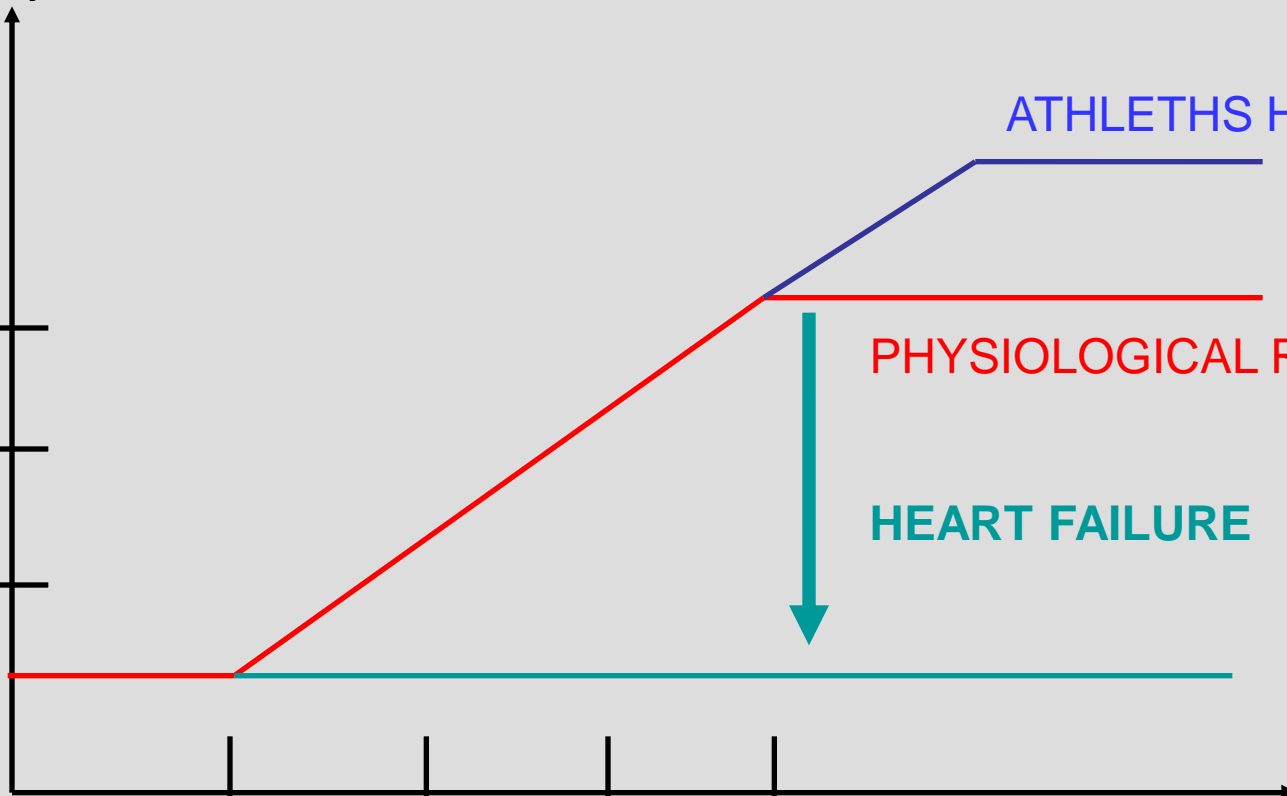
WORKLOAD (W/kg)

1

2

3

4



HEART FAILURE

The heart is not able pump sufficient amount of blood into periphery at normal venous return.

MOST OFTEN CAUSES:

- Severe arrhythmias
- Overload – *volume* (aortal insufficiency, a-v shunts) or *pressure* (hypertension and aortal stenosis – left overload, pulmonary hypertension and stenosis of pulmonary valve – right overload)
- Cardiomyopathy

SYMPTOMS: fatigue, oedemas, venostasis, dyspnoea, cyanosis

ACUTE x CHRONIC. COMPENSATED x DECOMPENSATED.