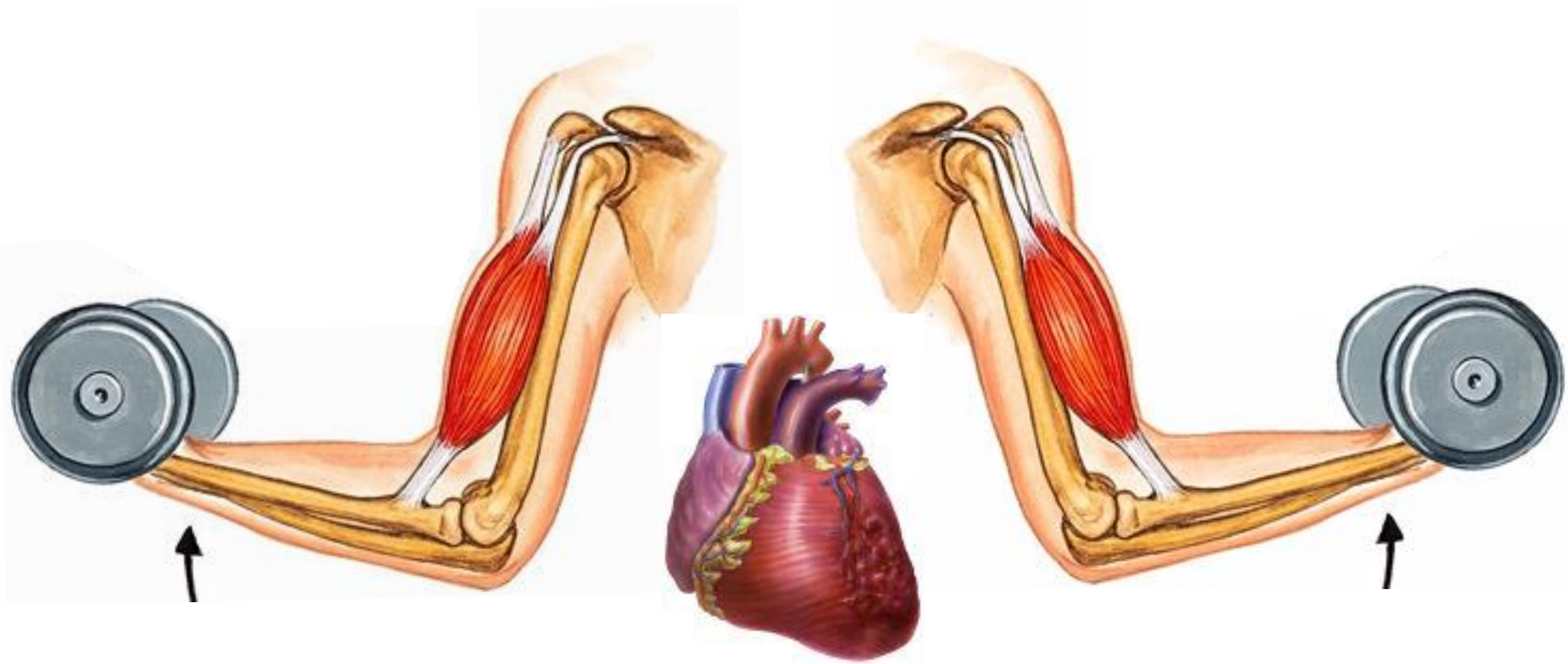
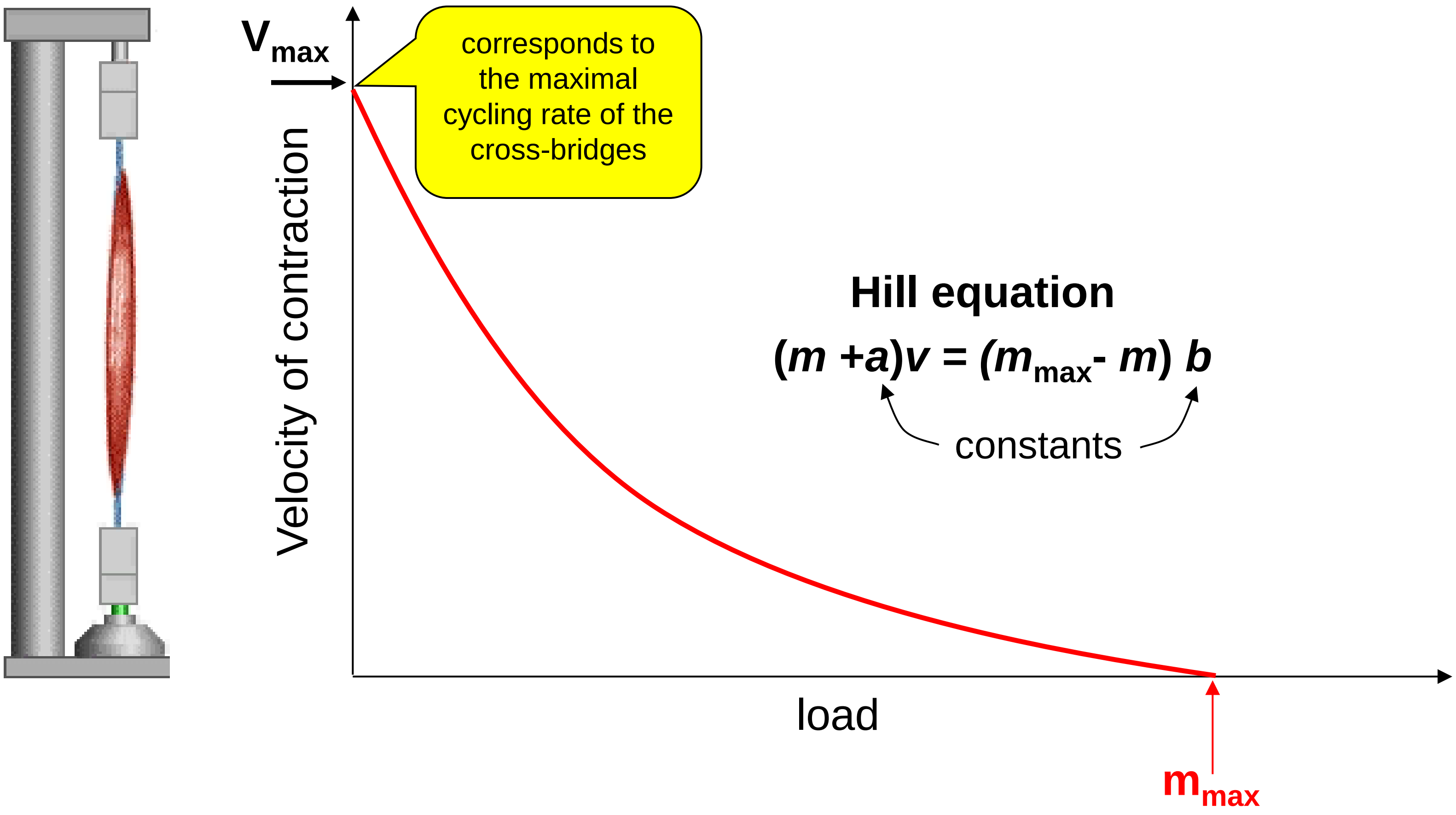
EVALUATION OF MUSCLE CONTRACTION



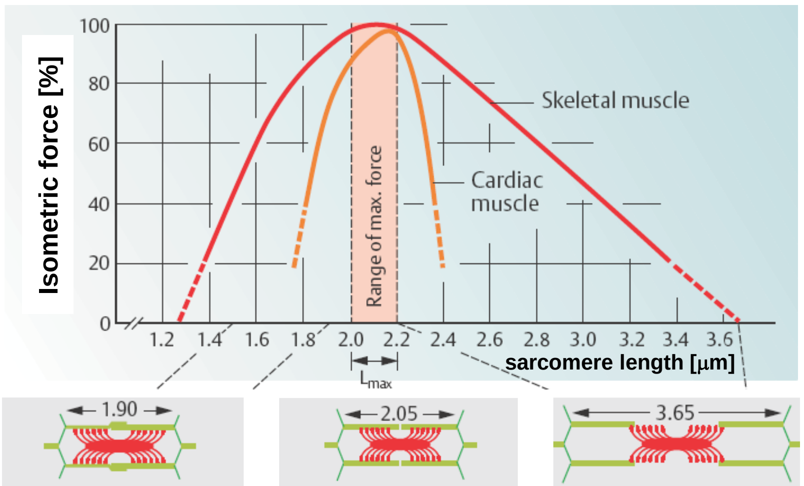
EVALUATION OF CONTRACTION IN SKELETAL MUSCLE

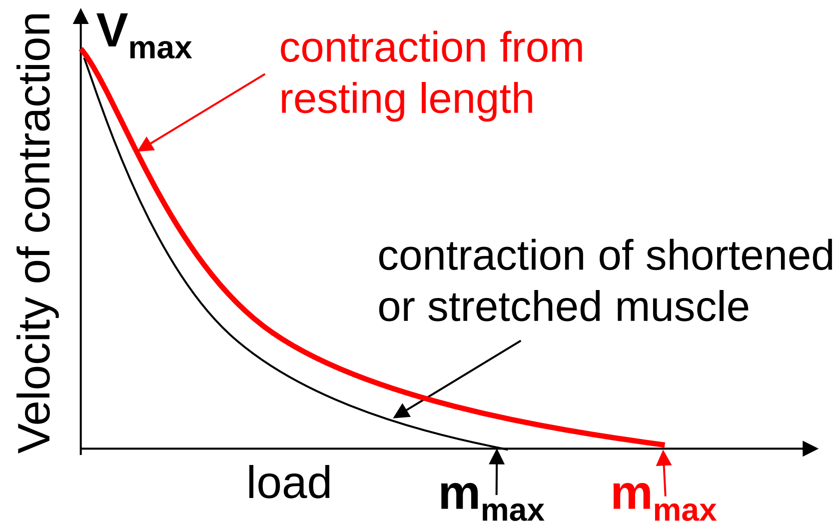
Relationship between load and contraction velocity of skeletal muscle



Physiological factors affecting relationship between load and contraction velocity of skeletal muscle

1) Initial length of muscle (sarcomeres)

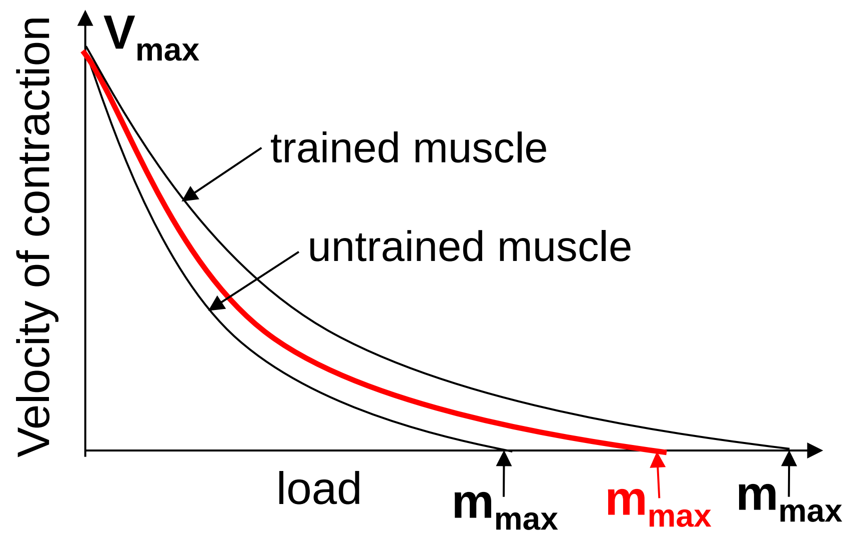




2) Number of active sarcomeres

trained muscle

untrained muscle



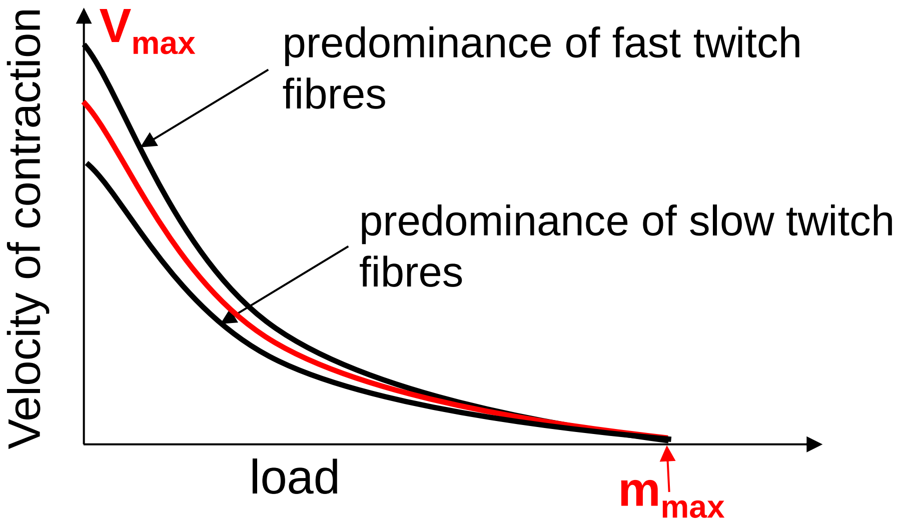
3) Type of muscle fibres

slow twitch muscle fibres

aerobic metabolisms, slow rate of contraction, can be active long time before they fatigue

fast twitch muscle fibers

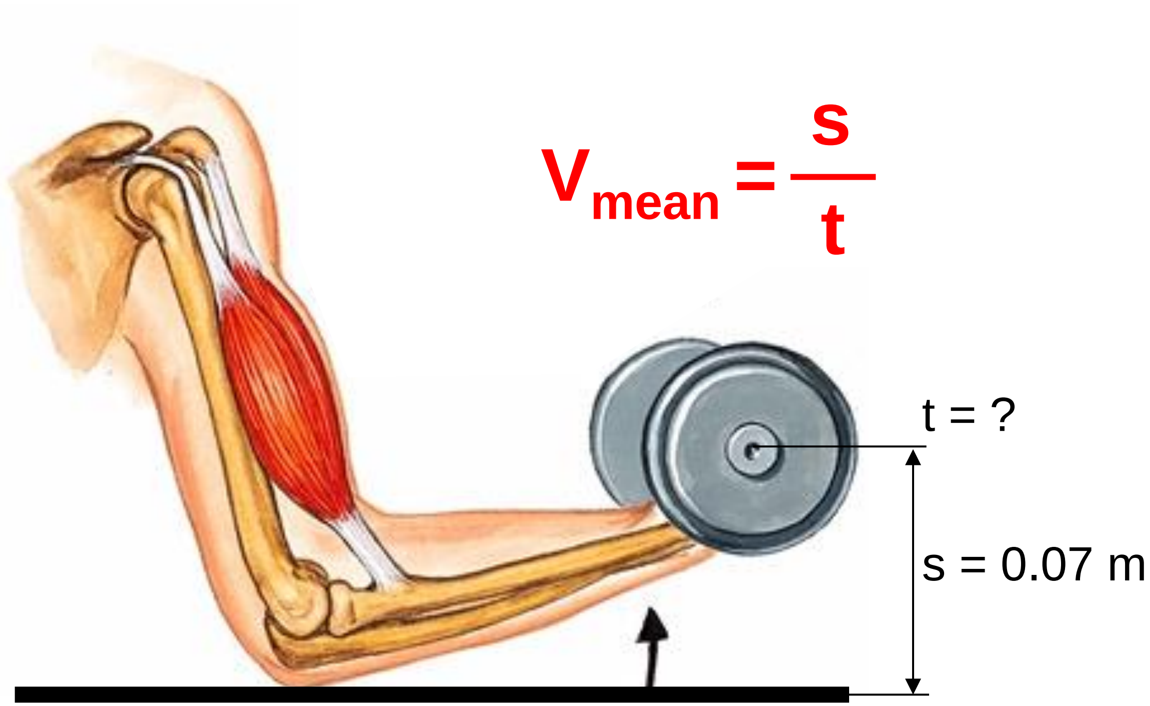
anaerobic metabolismus, high rate of contraction, fatigue quickly



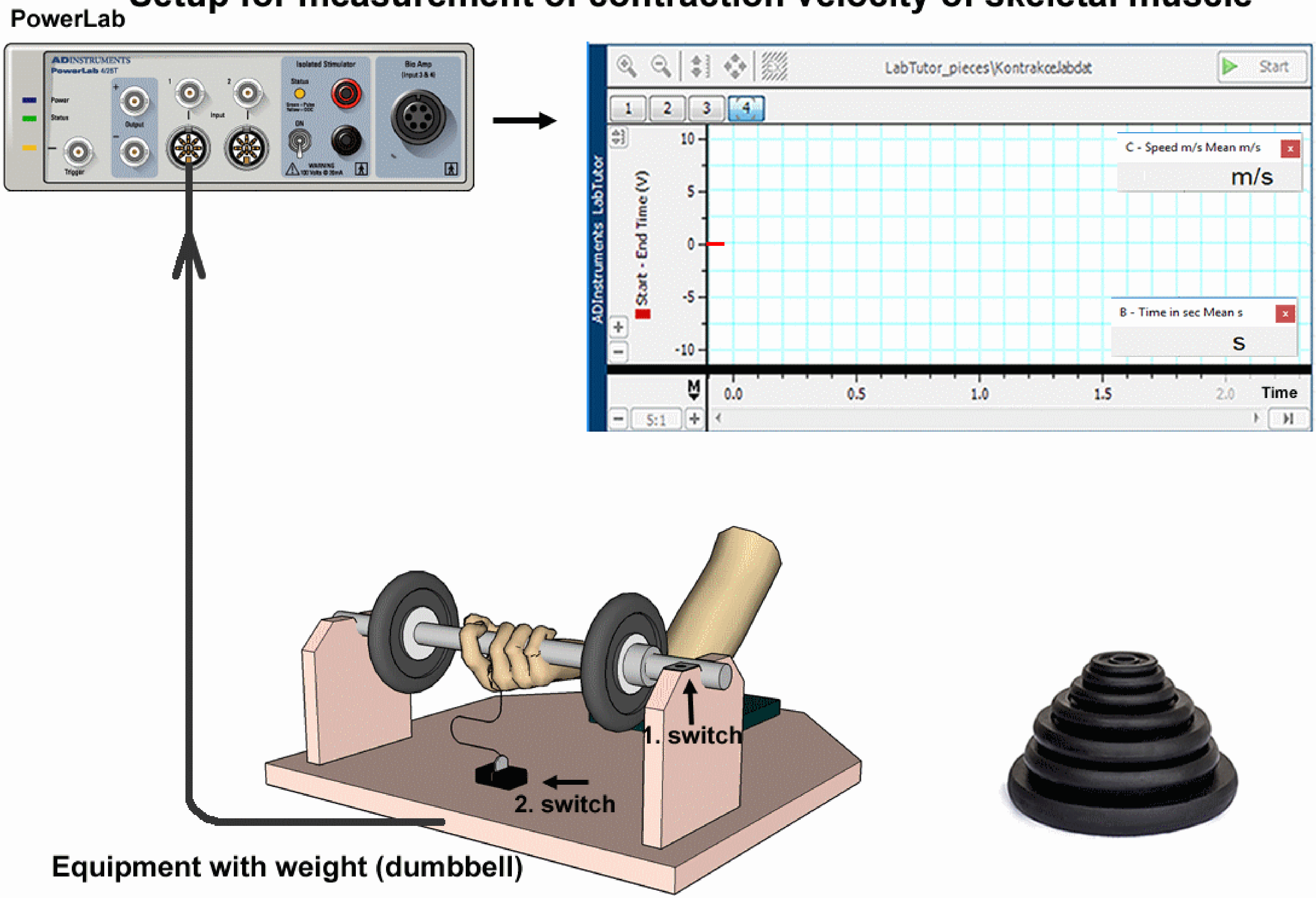
Note: Depending on the intensity of muscle contraction only certain types of muscle fibbers are activated.

Exploration of dependence of contraction velocity on skeletal muscle load

$$V_{mean} = \frac{s}{t}$$



Setup for measurement of contraction velocity of skeletal muscle

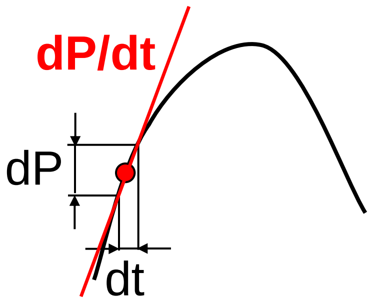


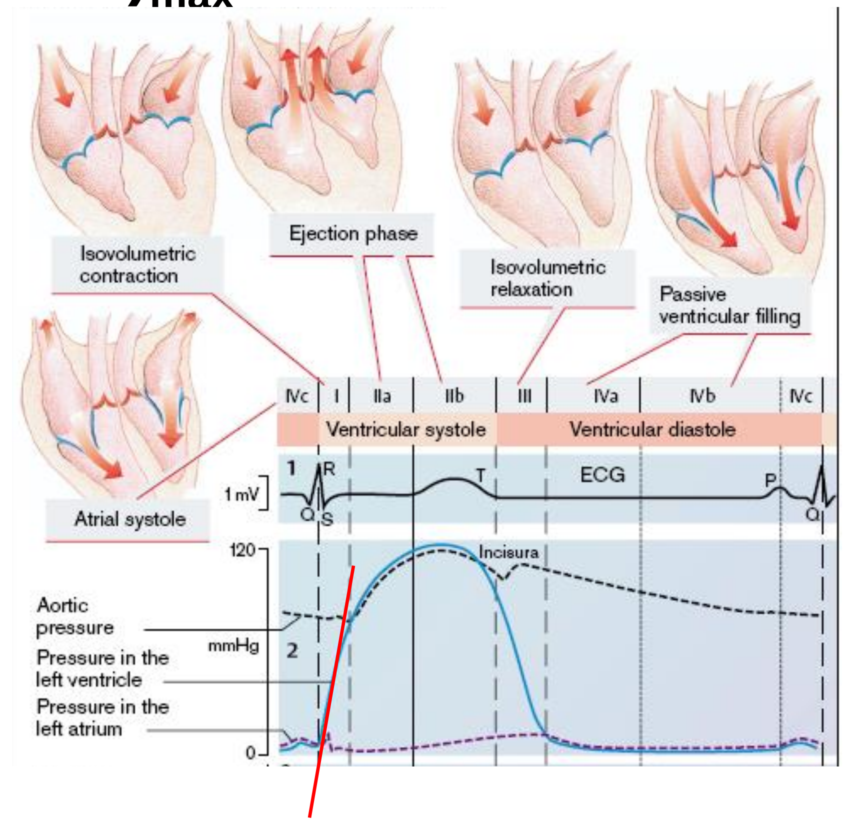
EVALUATION OF CARDIAC MUSCLE CONTRACTILITY

1

Index $(dP/dt)_{max}$

Index $(dP/dt)_{max}$ represents maximum velocity of left ventricle pressure rise





$(dP/dt)_{mean}$

Normal values:
<u>1300-1900 mmHg/s</u>

Assessment: by means of cardiac catheterization

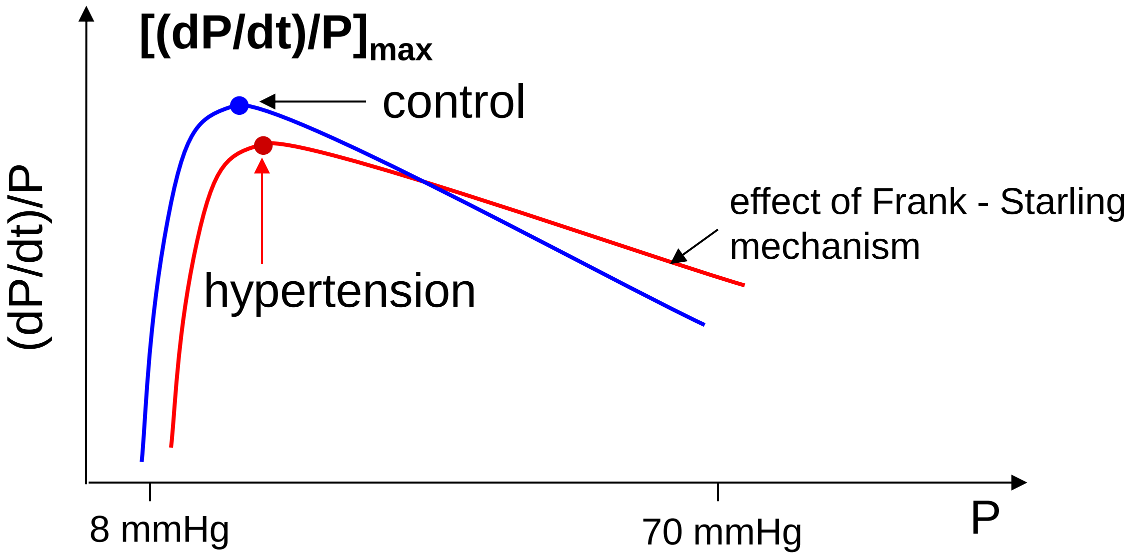
Use: mainly for research purposes (difficult and expensive invasive method)

Note.: this index may be affected by the Frank-Starling mechanism (e.g. at hypertension when end-diastolic volume is increased)!

2

Index $[(dP/dt)/P]_{max}$

Index $[(dP/dt)/P]_{max}$ represents maximum velocity of cardiac muscle contraction



Assessment: by means of cardiac catheterization

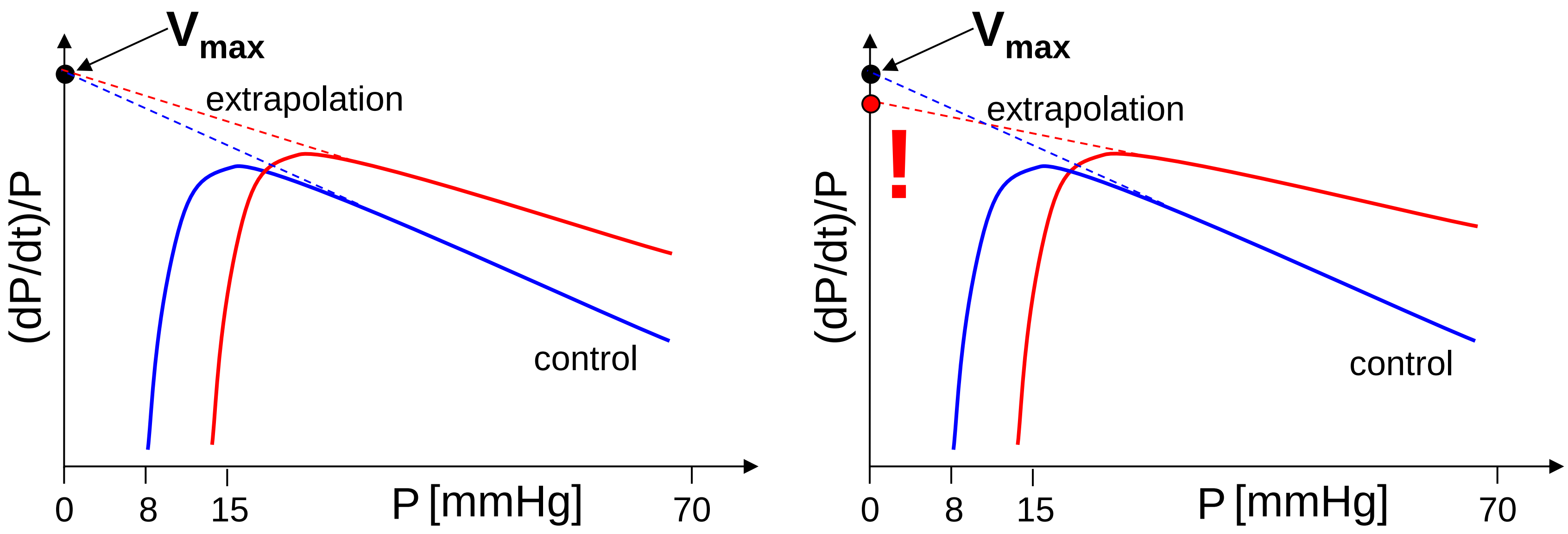
Use: mainly for research purposes (difficult and expensive invasive method)

Note.: this index may be affected by high end-diastolic pressure in left ventricle!

3

Index V_{max}

Index V_{max} represents velocity of cardiac muscle contraction at zero pressure



Assessment: by means of cardiac catheterization

Use: mainly for research purposes (difficult and expensive invasive method)

Note.: This index may be affected by inaccurate extrapolation!

4

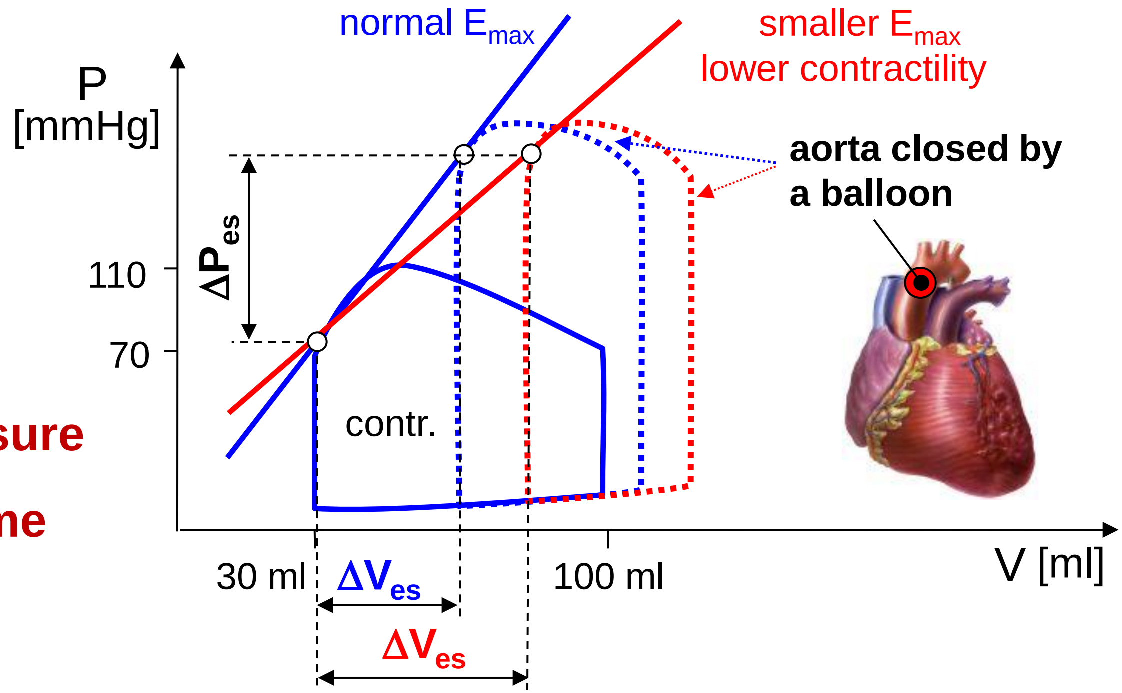
Index E_{max}

Index E_{max} represents slope of the line determined from end-systolic values of P-V diagrams

$$E_{max} = \frac{\Delta P_{es}}{\Delta V_{es}}$$

P_{es} - end-systolic pressure

V_{es} - end-systolic volume



Assessment: by means of cardiac catheterization

Use: mainly for research purposes (difficult and expensive invasive method)

Note.: most exact method for evaluation of cardiac muscle contractility independent on preload and afterload of left ventricle!

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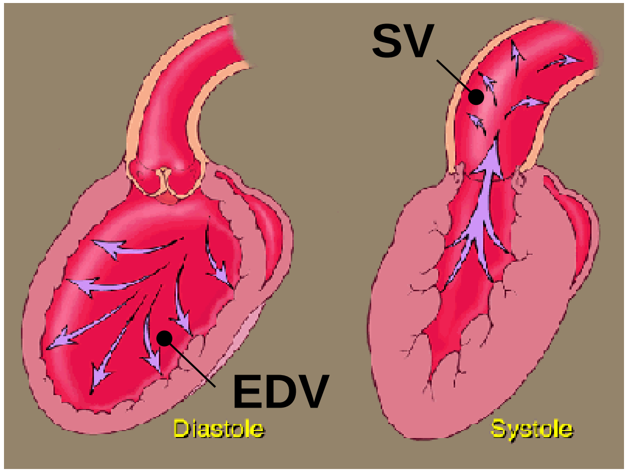
5

Ejection fraction (EF)

$$EF = \frac{SV}{EDV}$$



SV – stroke volume

EDV – end-diastolic volume

Normal values: SV ≈ 70 ml, EDV ≈ 100 ml, EF = 50 - 70%

EF increases under sympathetic stimulation and with increasing inotropic state
EF lower than 40 % indicates decreased contractility of cardiac muscle (systolic dysfunction)

Assessment: by means of magnetic resonance or echocardiography

Use.: Assessment of EF is a non-invasive method commonly used in clinical practice to estimate left ventricular contractility and systolic performance!

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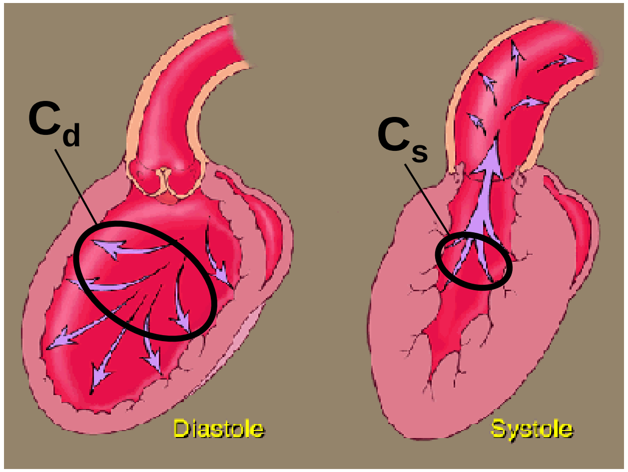
6

Velocity of circumferential fiber shortening (V_{cf})

$$V_{cf} = \frac{(C_d - C_s)}{C_d \cdot t_{ef}}$$



C_d – length of inner circumferential left ventricle fibre in diastole

C_s – length of inner circumferential left ventricle fibre in systole

t_{ef} – duration of ejection fraction

Normal value: 1.09 $\pm$ 0.12 circ $\cdot$ s^{-1}

Assessment: by means of echocardiography

Use.: Assessment of V_{cf} is a non-invasive method commonly used in clinical practice to estimate left ventricular contractility!