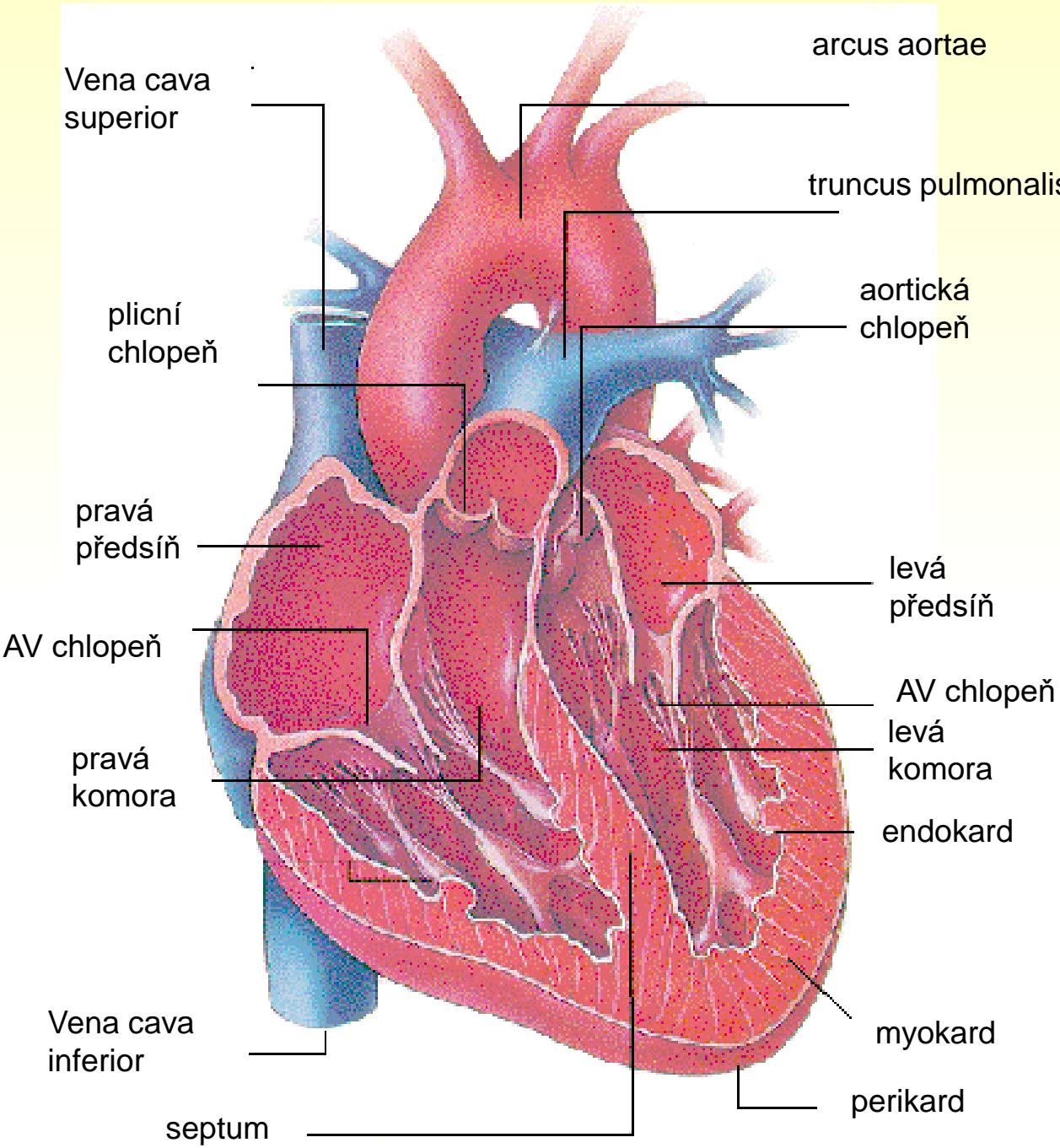


4. PŘEDNÁŠKA – SIGNÁLY SRDCE 1

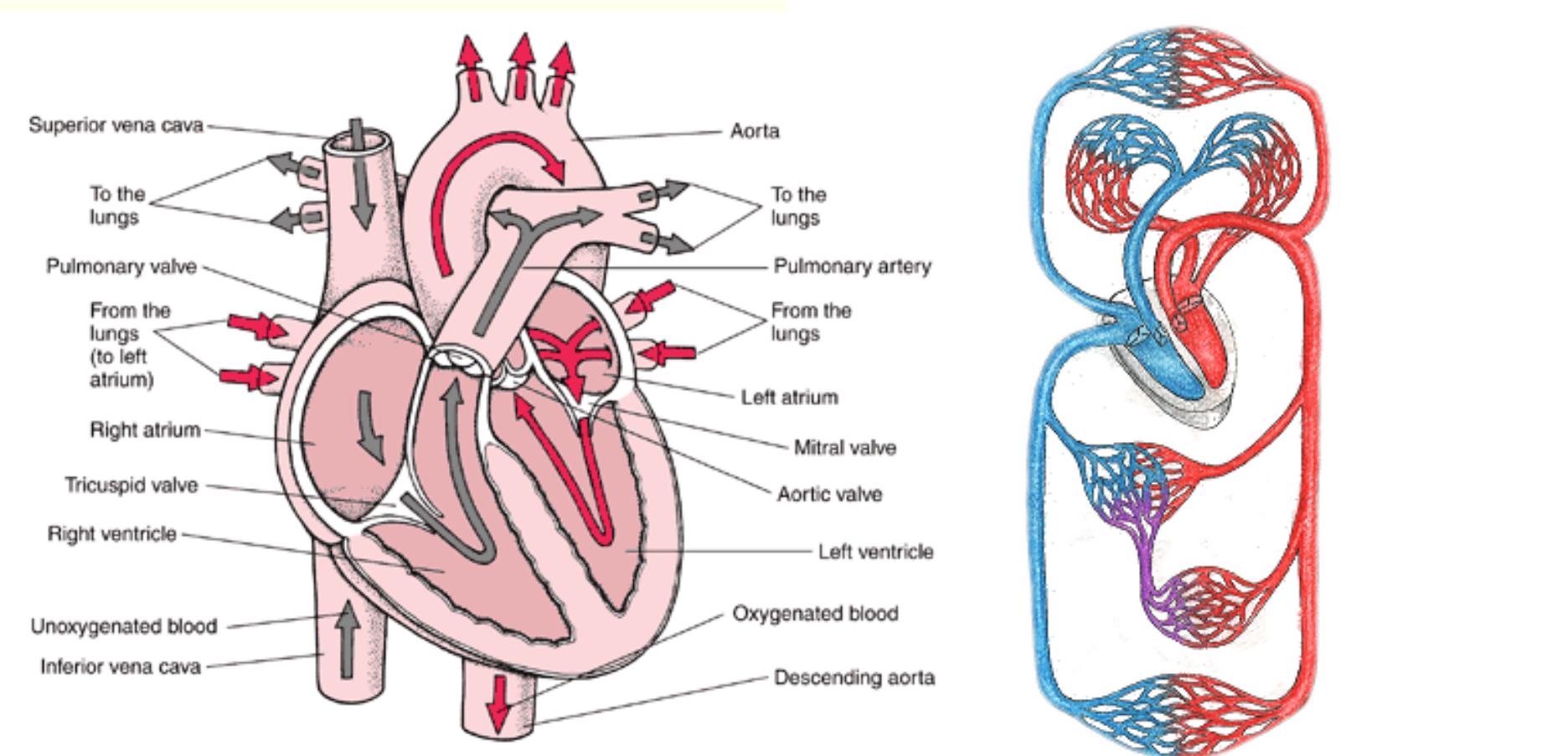
- **Základy EKG**
 - převodní systém srdeční
- **Geneze EKG**
 - svodové systémy
 - vektor depolarizace
- **Analýzy EKG**
 - EKG desatero
 - elektrická osa srdeční
 - Cabrerův kruh

SRDCE

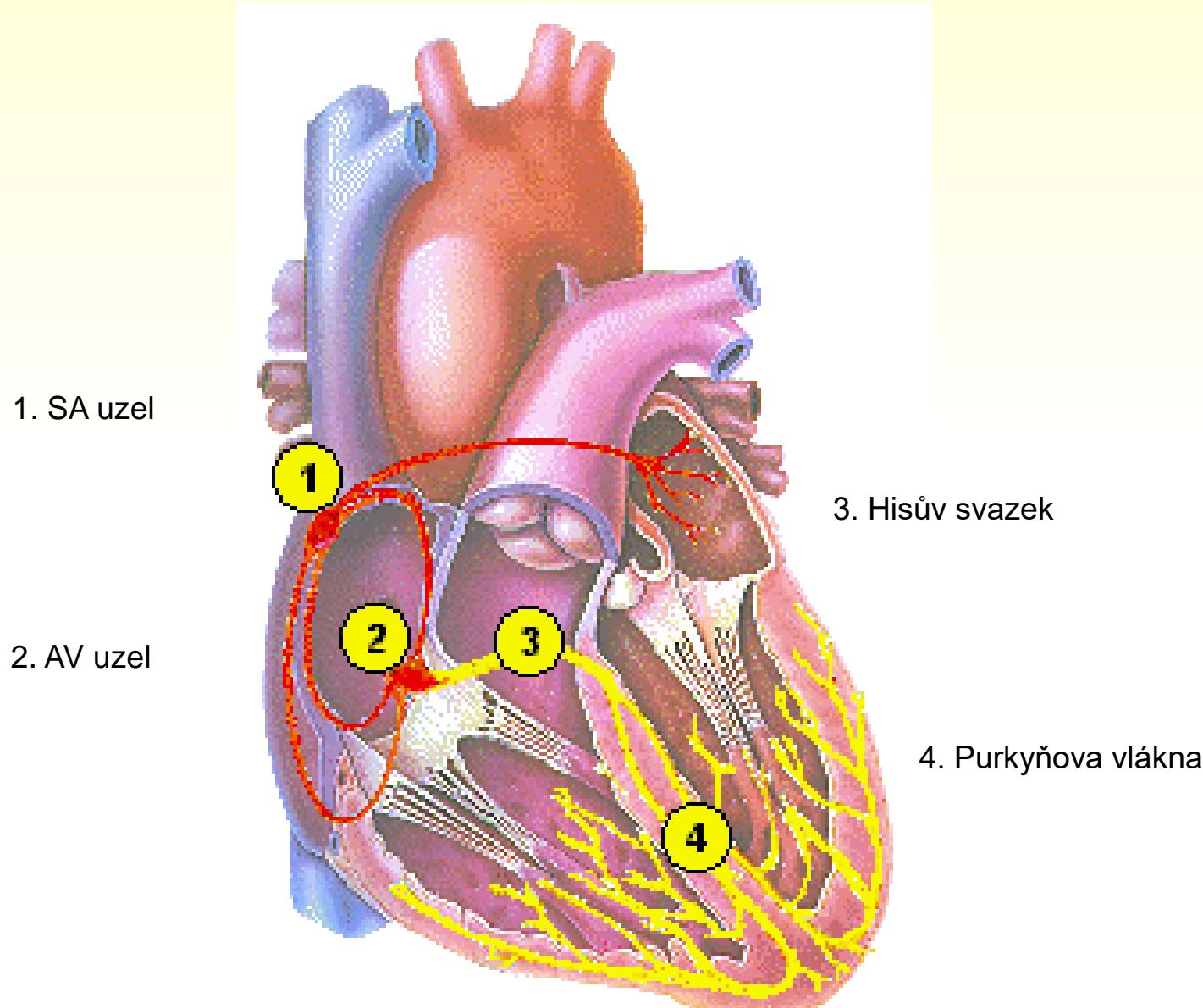


KREVNÍ OBĚH

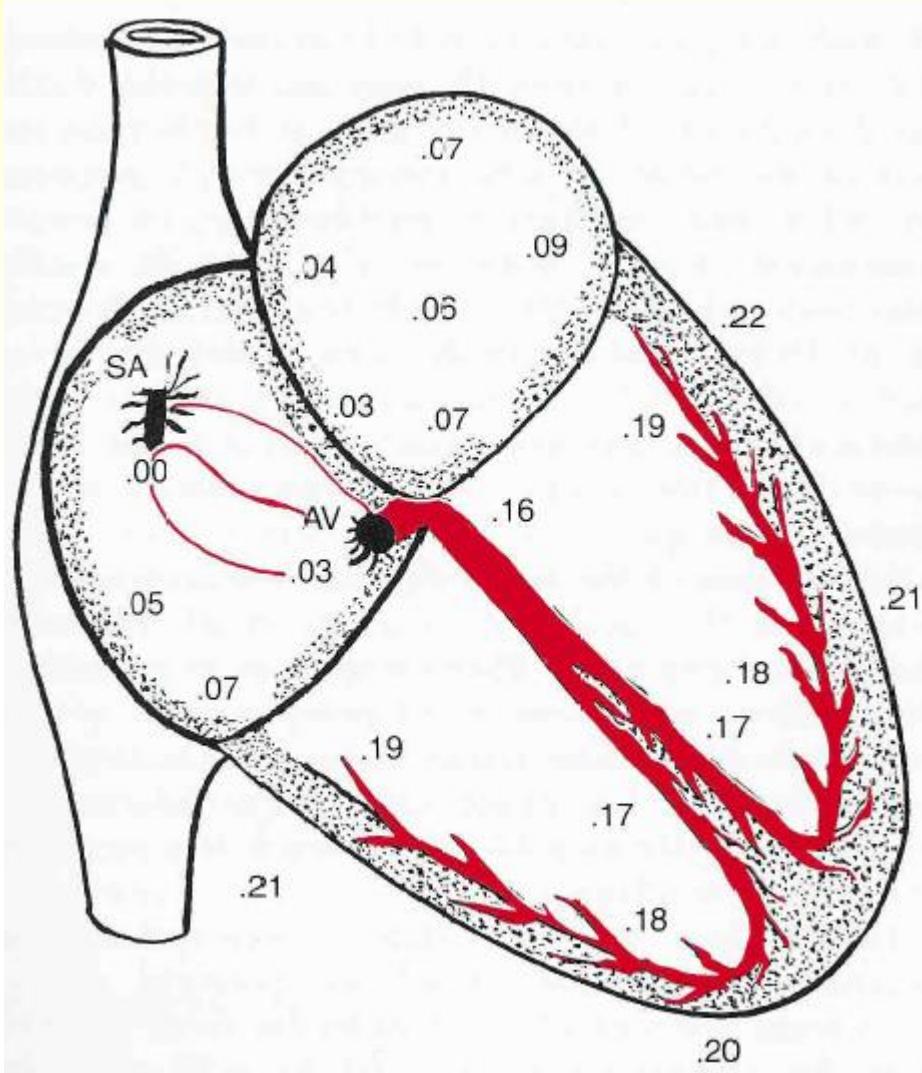
http://pie.med.utoronto.ca/heart_physiology/module/blood-flow.html



PŘEVODNÍ SYSTÉM SRDEČNÍ

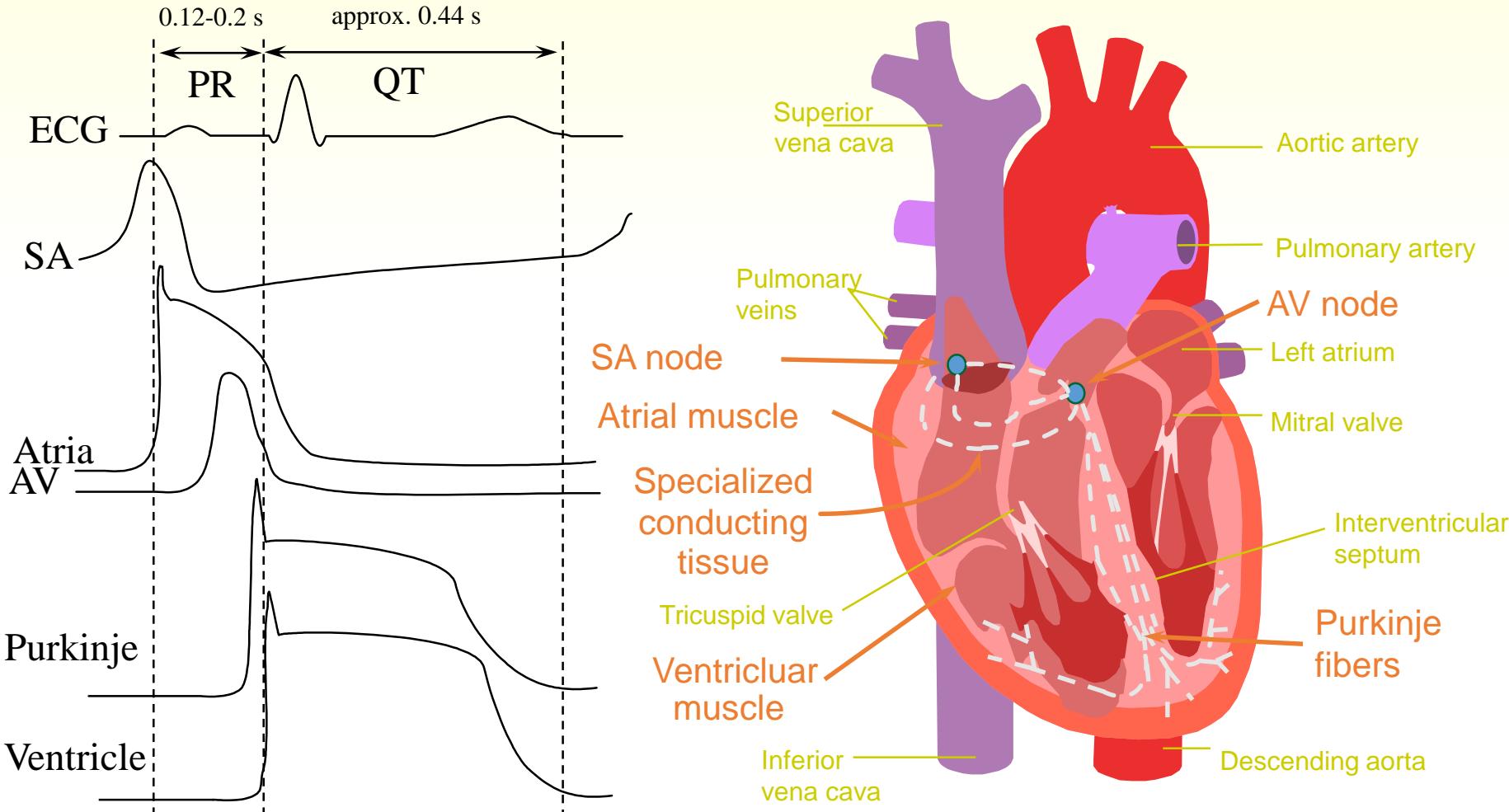


ŠÍŘENÍ DEPOLARIZACE

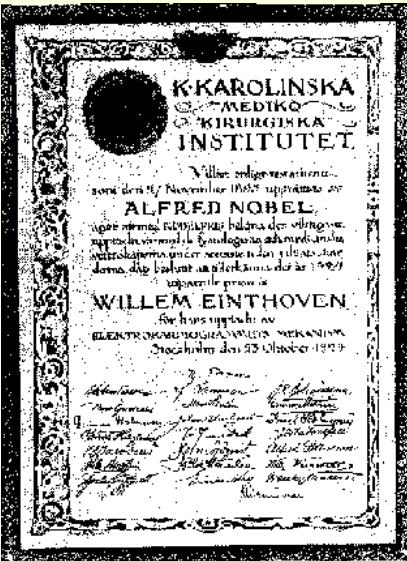


EKG – geneze vzniku

- buňky převodního systému nemají klidový potenciál
- dochází zde ke spontánní depolarizaci



EKG – svodové systémy



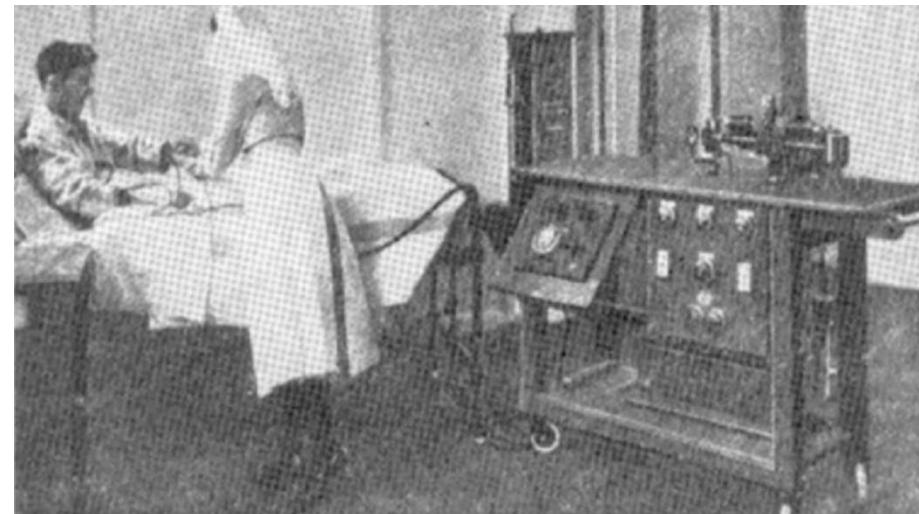
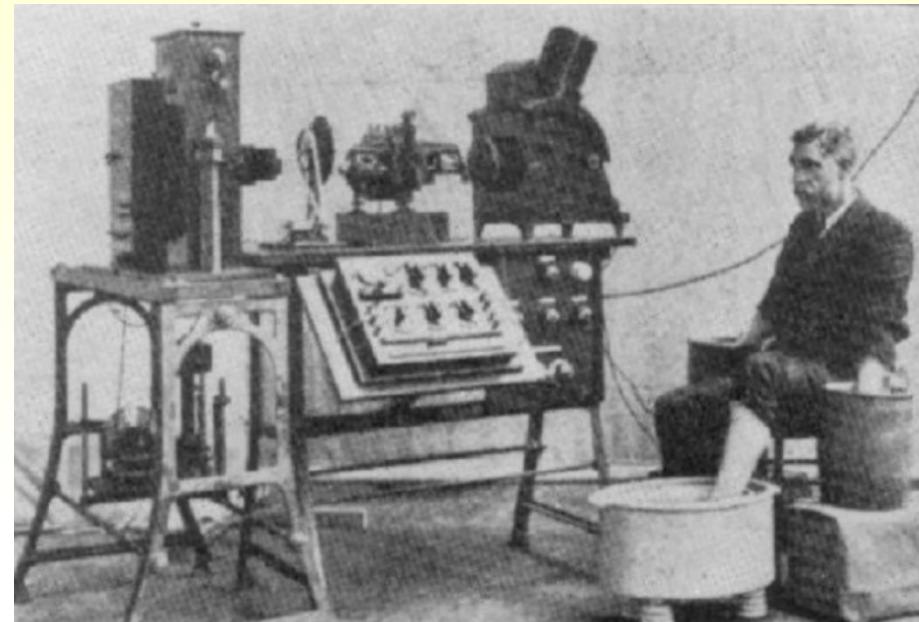
Willem Einthoven

(* 22.V.1860 - † 29.IX.1927)

1924 Nobelova cena za vynález
elektrokardiografu



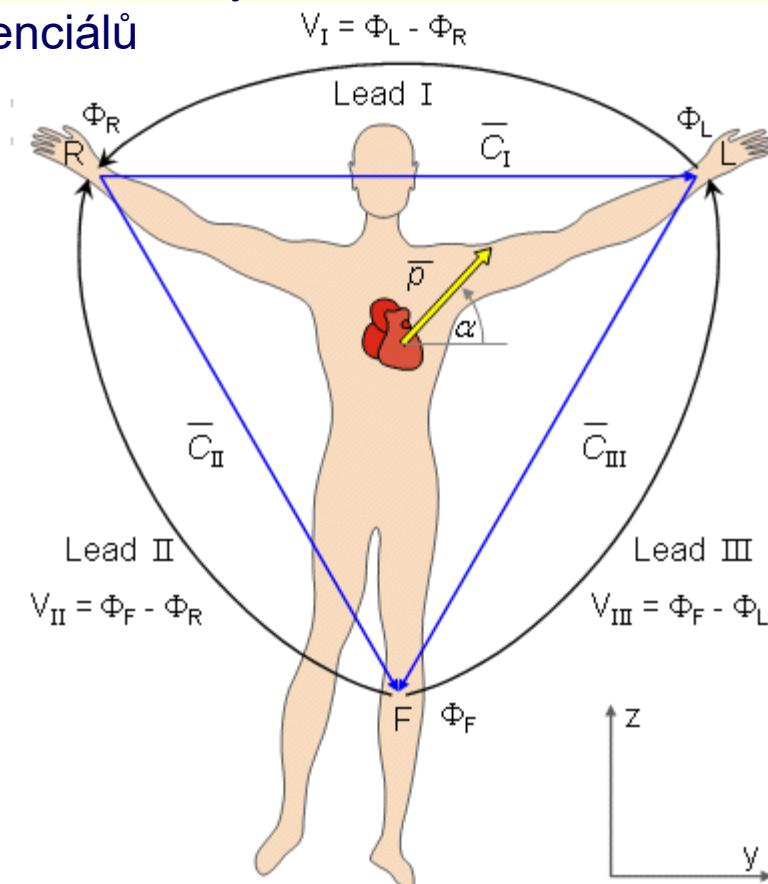
Jeden z typů kovových elektrod



mobilní EKG z roku 1920

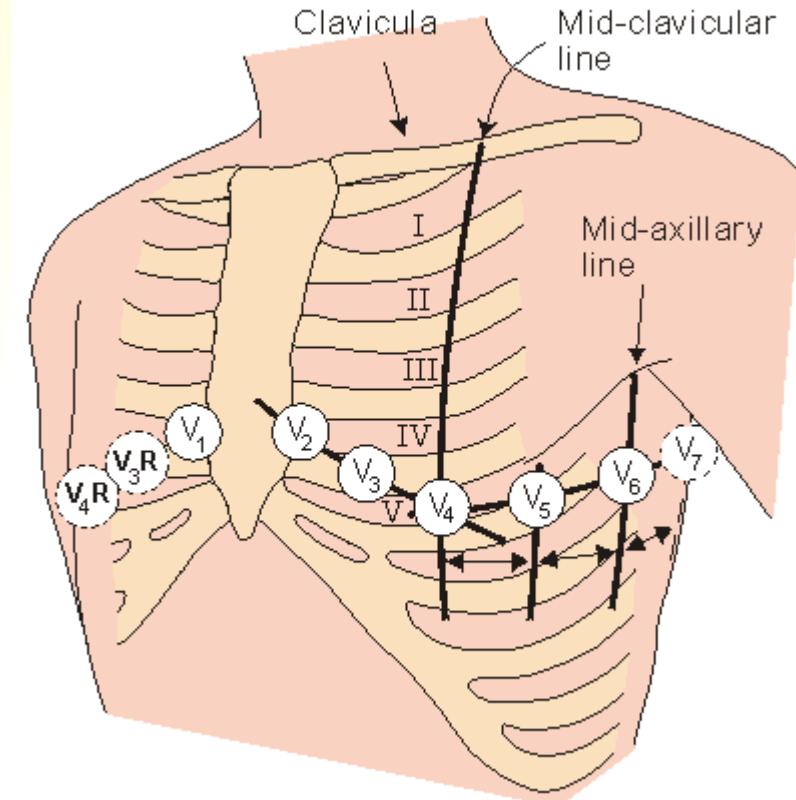
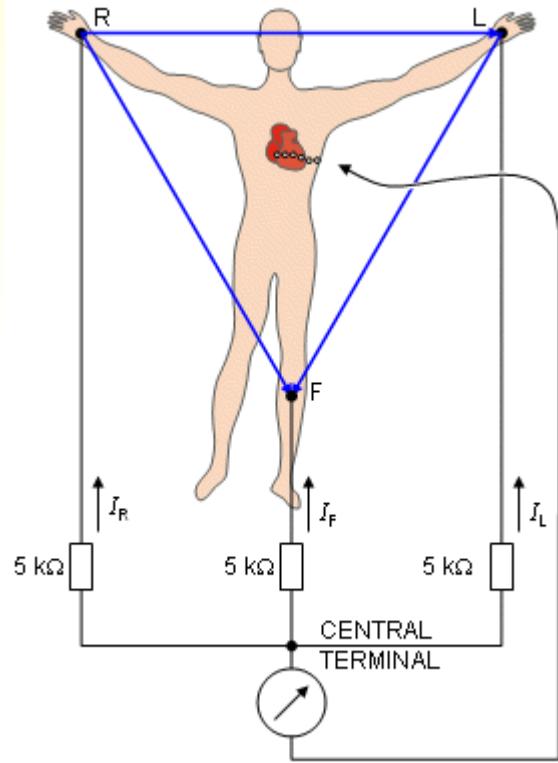
EKG svody

- 3 standardní končetinové svody
- snímáme rozdíl potenciálů

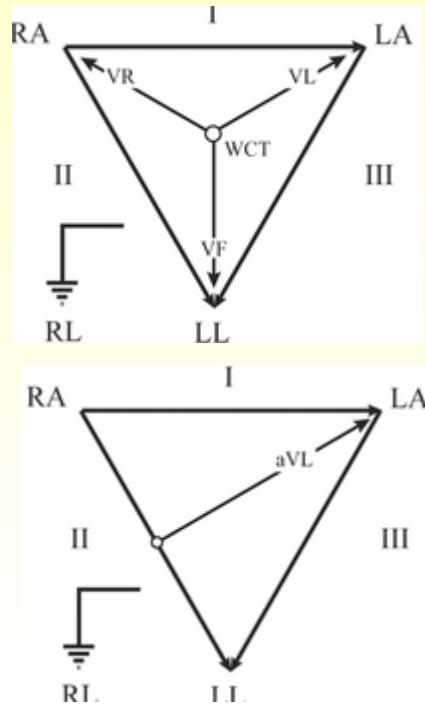


Einthovenovy bipolární končetinové svody

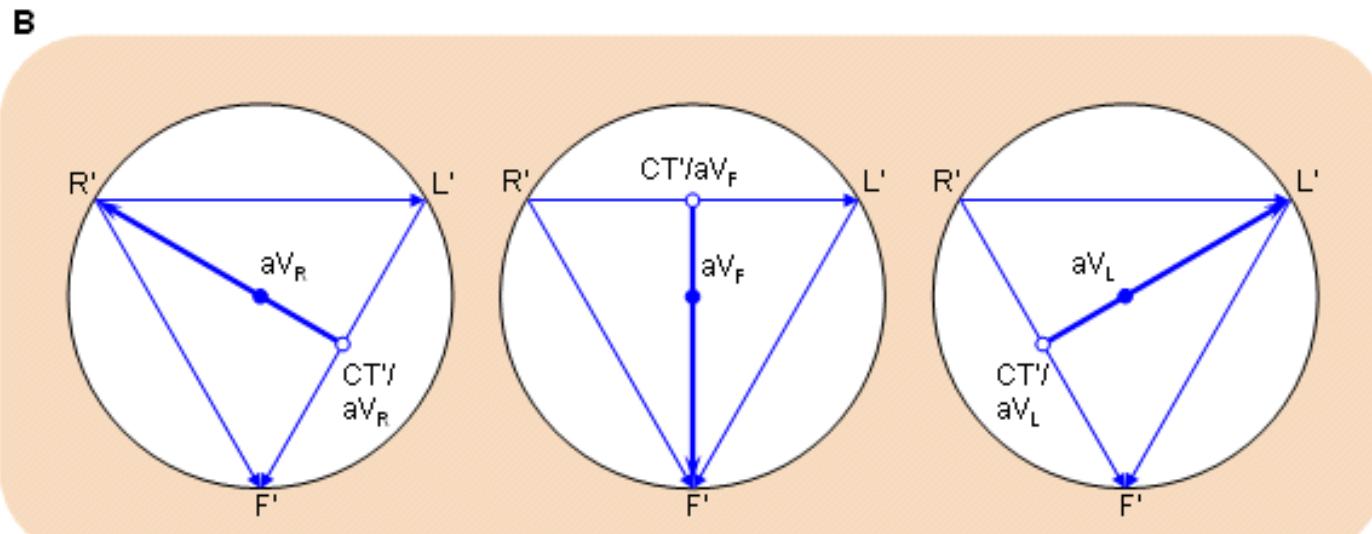
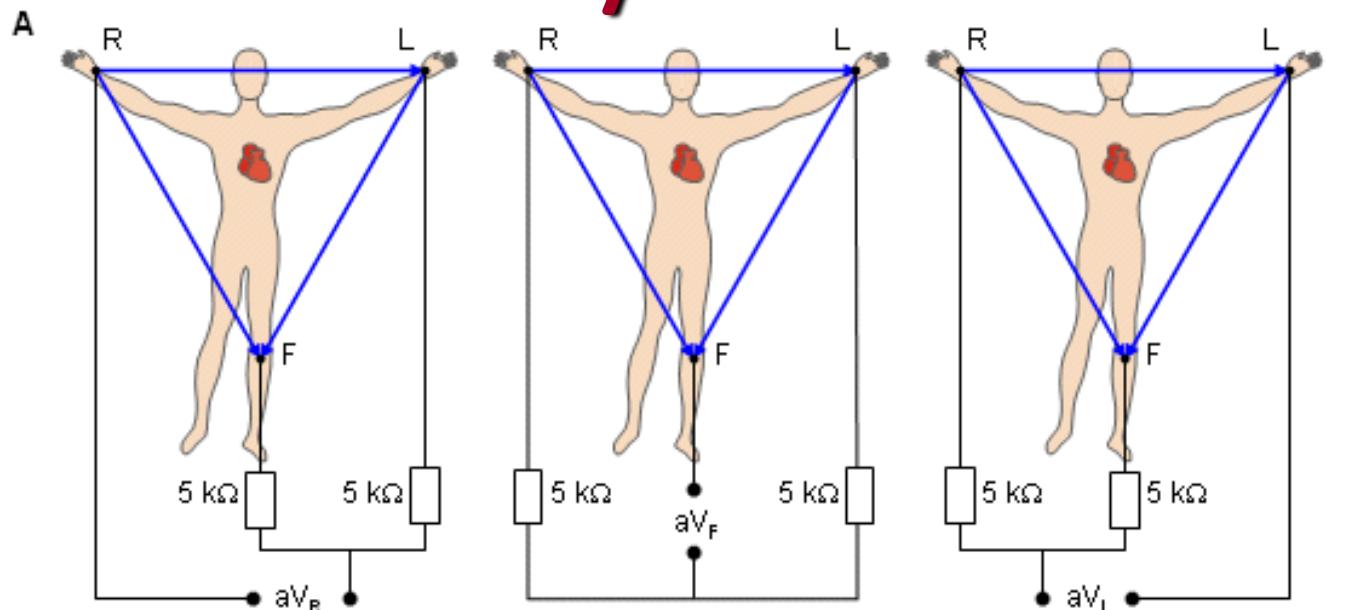
EKG svody



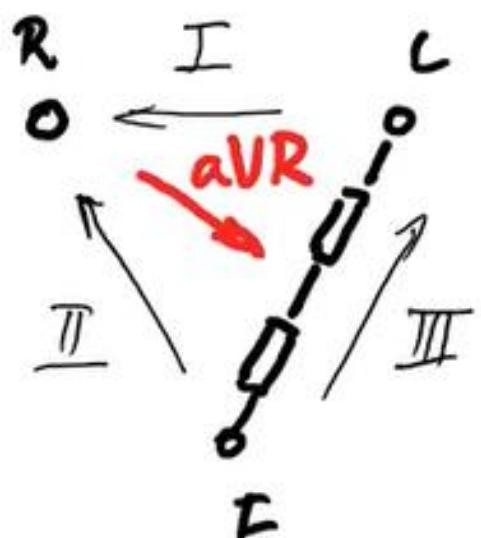
Hrudní unipolární Wilsonovy svody



EKG svody



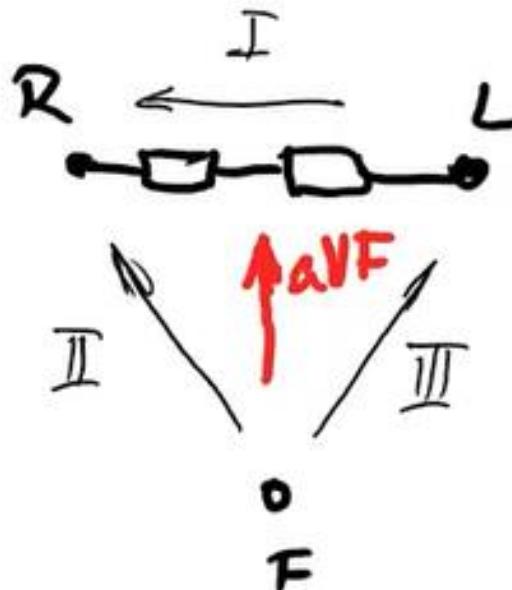
Goldbergerovy zesílené svody



$$aVR - \frac{U_{\text{II}}}{2} + U_{\text{I}} = 0$$

$$aVR + \frac{U_{\text{III}}}{2} + U_{\text{F}} = 0$$

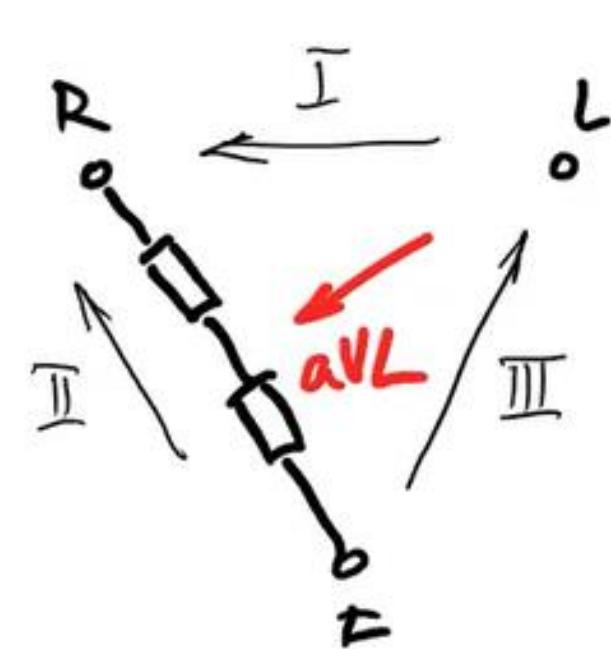
$$aVR = - \frac{U_{\text{I}} + U_{\text{II}}}{2}$$



$$aVF + \frac{U_{\text{I}}}{2} - U_{\text{II}} = 0$$

$$aVF - \frac{U_{\text{I}}}{2} - U_{\text{III}} = 0$$

$$aVF = \frac{U_{\text{I}} + U_{\text{III}}}{2}$$

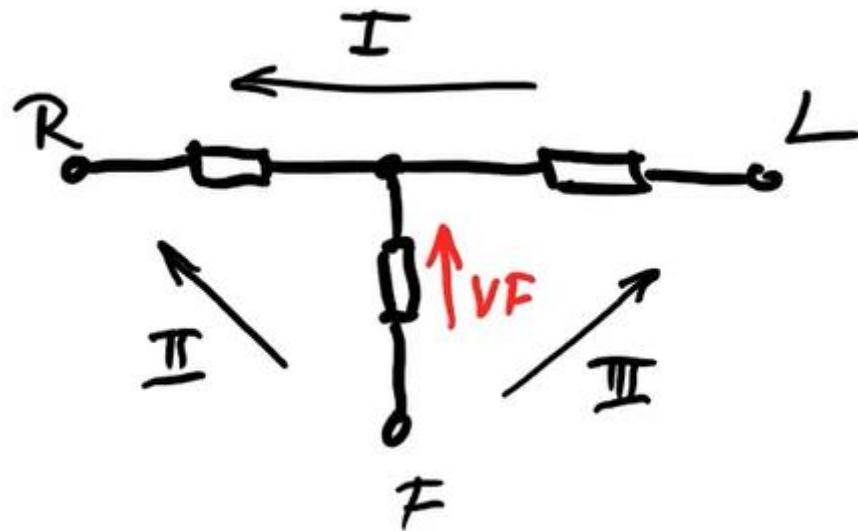


$$aVL + \frac{U_{\text{I}}}{2} - U_{\text{II}} = 0$$

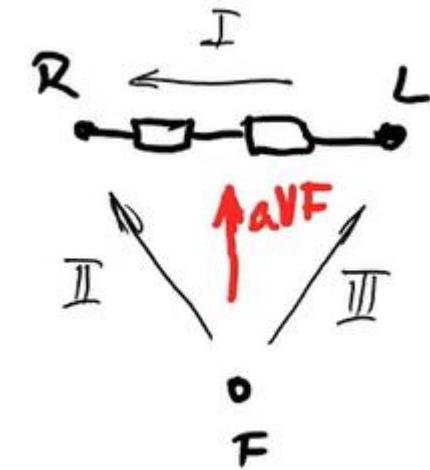
$$aVL - \frac{U_{\text{I}}}{2} + U_{\text{III}} = 0$$

$$aVL = \frac{U_{\text{I}} - U_{\text{III}}}{2}$$

$$\frac{-VF + U_{\text{II}}}{R} - \frac{VF}{R} + \frac{-VF + U_{\text{III}}}{R} = 0$$



$$\alpha VF = \frac{3}{2} VF$$



$$\alpha VF = \frac{U_{\text{II}} + U_{\text{III}}}{2}$$

$$VF = \frac{U_{\text{I}} + U_{\text{II}}}{3}$$

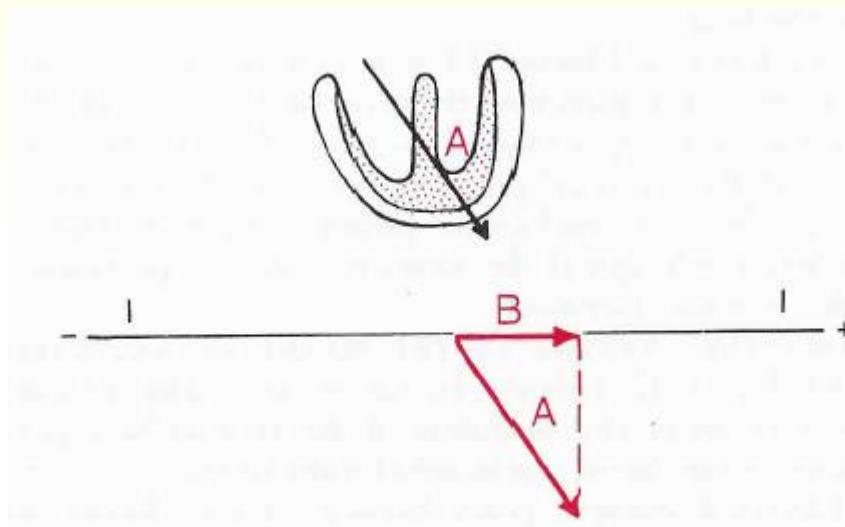
EKG – svodové systémy

STANDARDNÍ 12 SVODOVÝ SYSTÉM

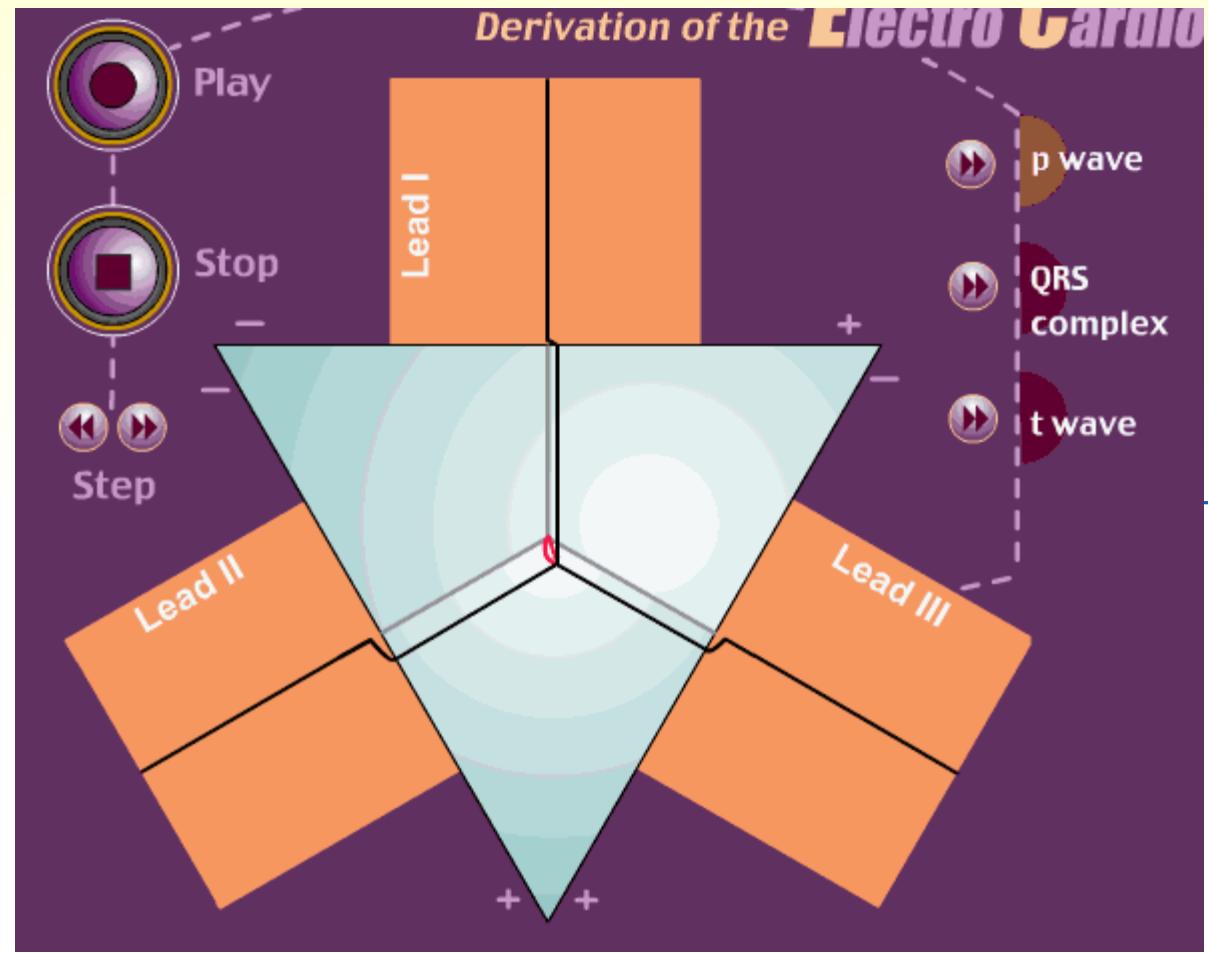
- končetinové svody – I, II, III
- Wilsonovy svody – V₁, V₂, V₃, V₄, V₅, V₆
- Goldbergerovy (zesílené) svody – aVL, aVR, aVF

VEKTOR DEPOLARIZACE

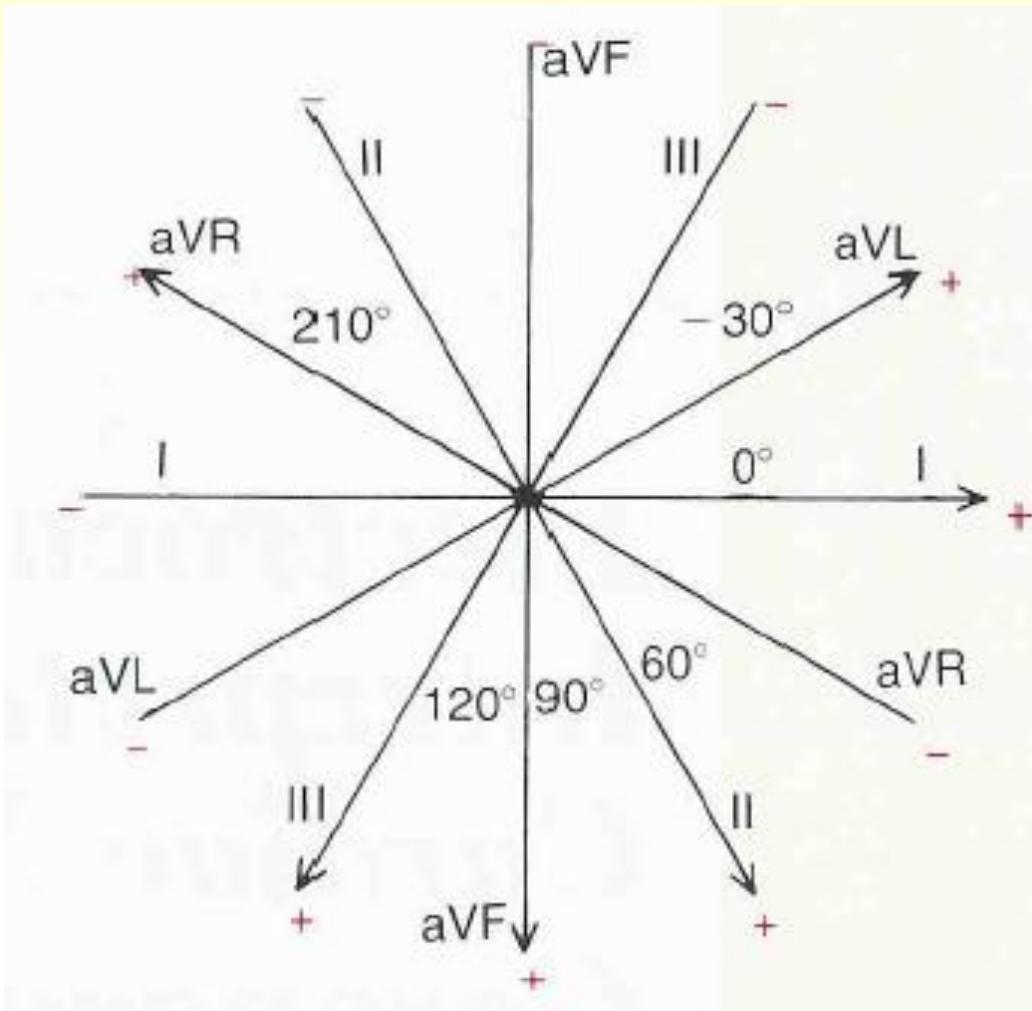
Směr elektrického vektoru při částečné depolarizaci



Znázornění vektoru

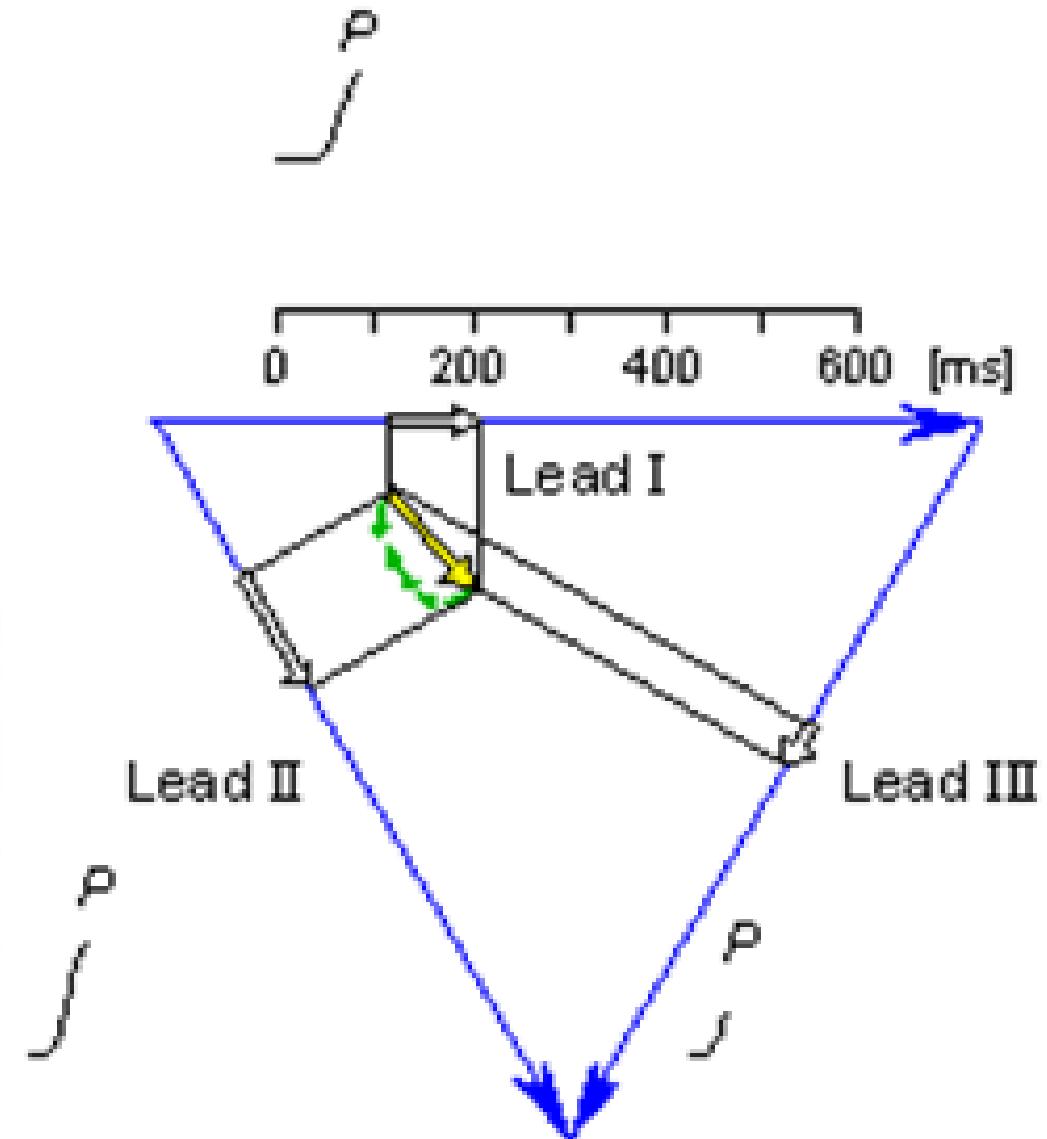
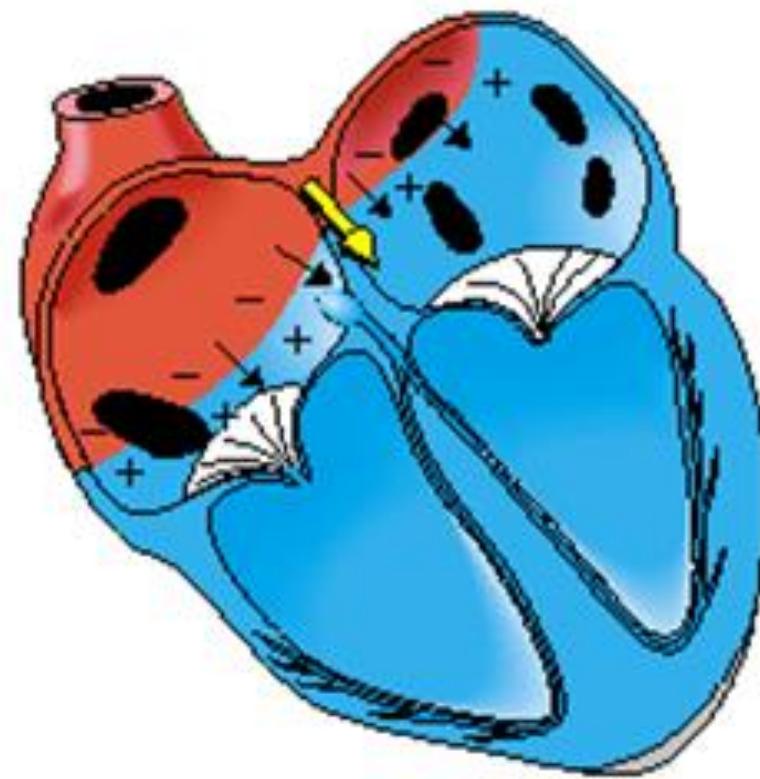


EKG SVODY

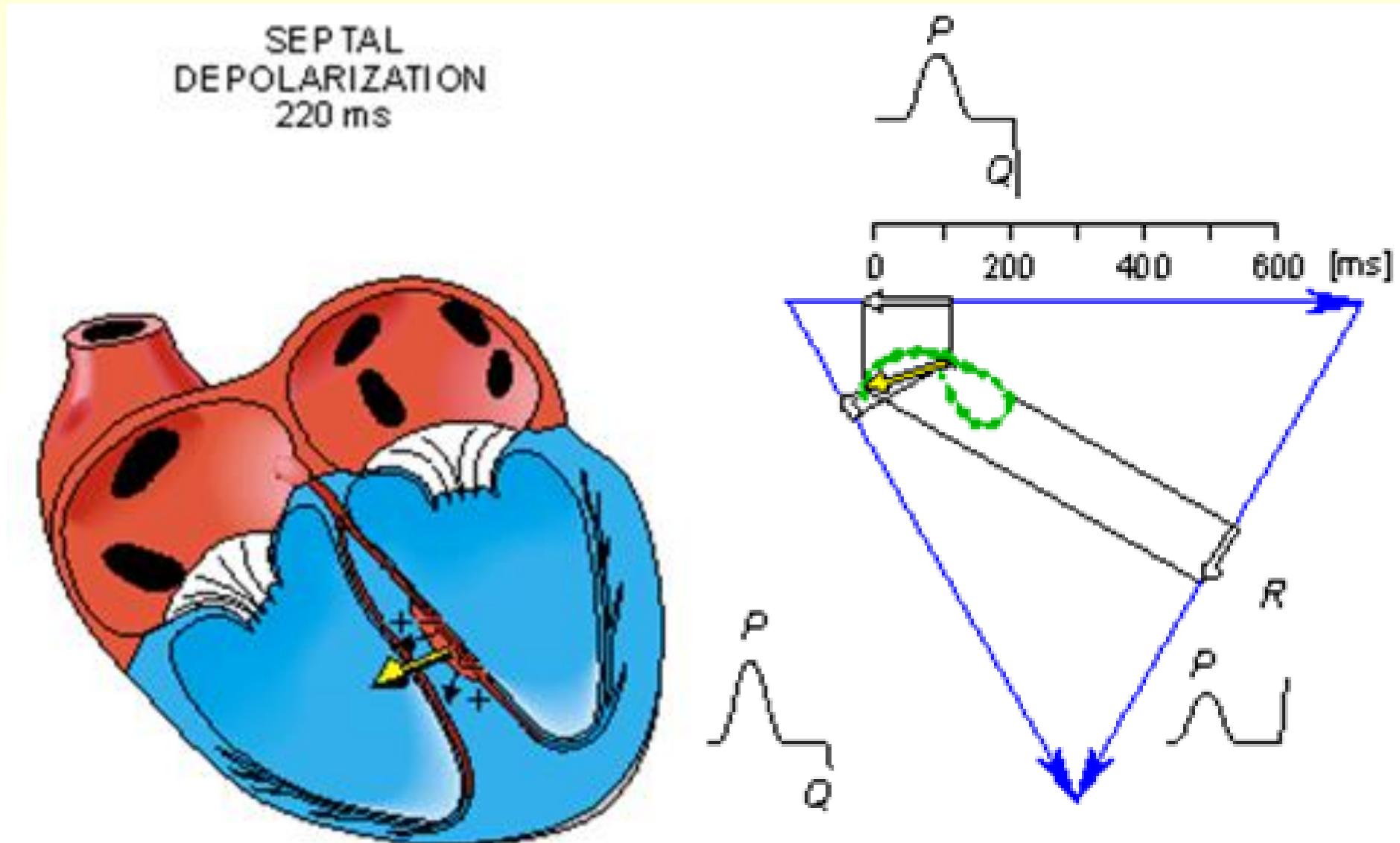


Vzájemné úhlové poměry různých svodových systémů
Cabrerův kruh

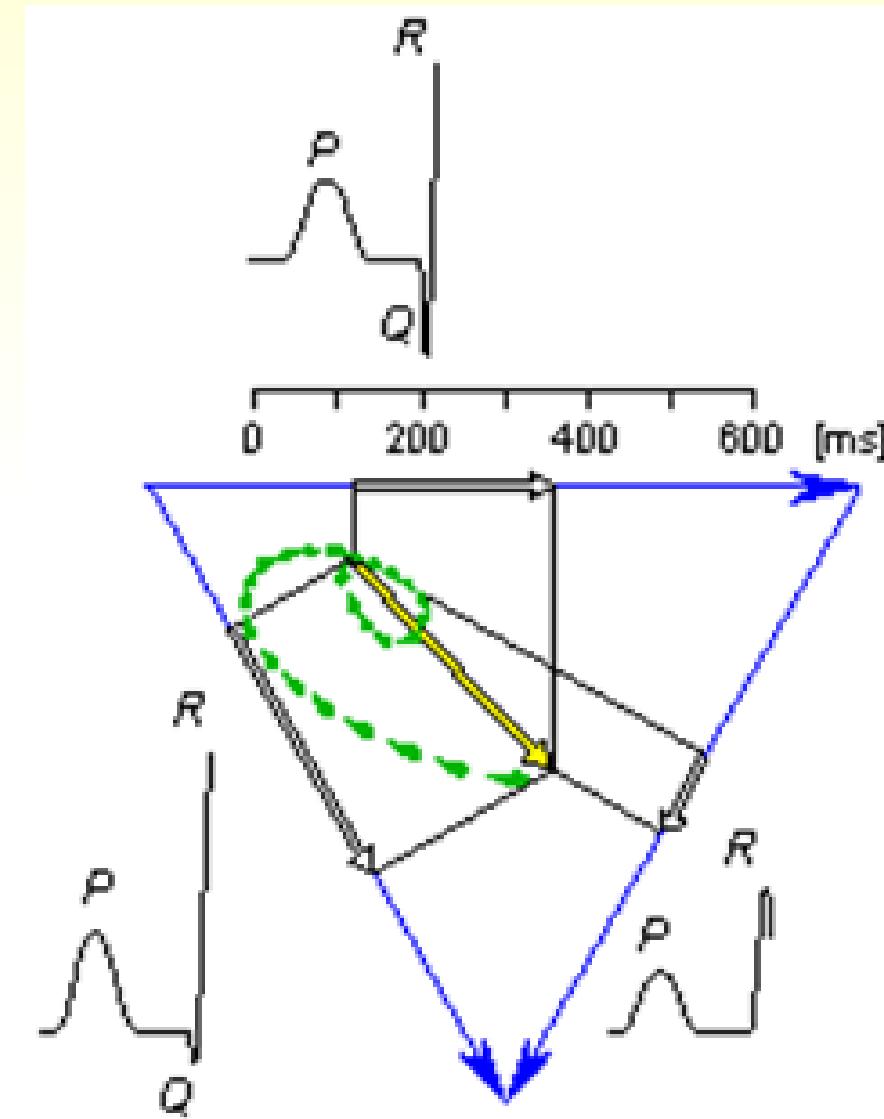
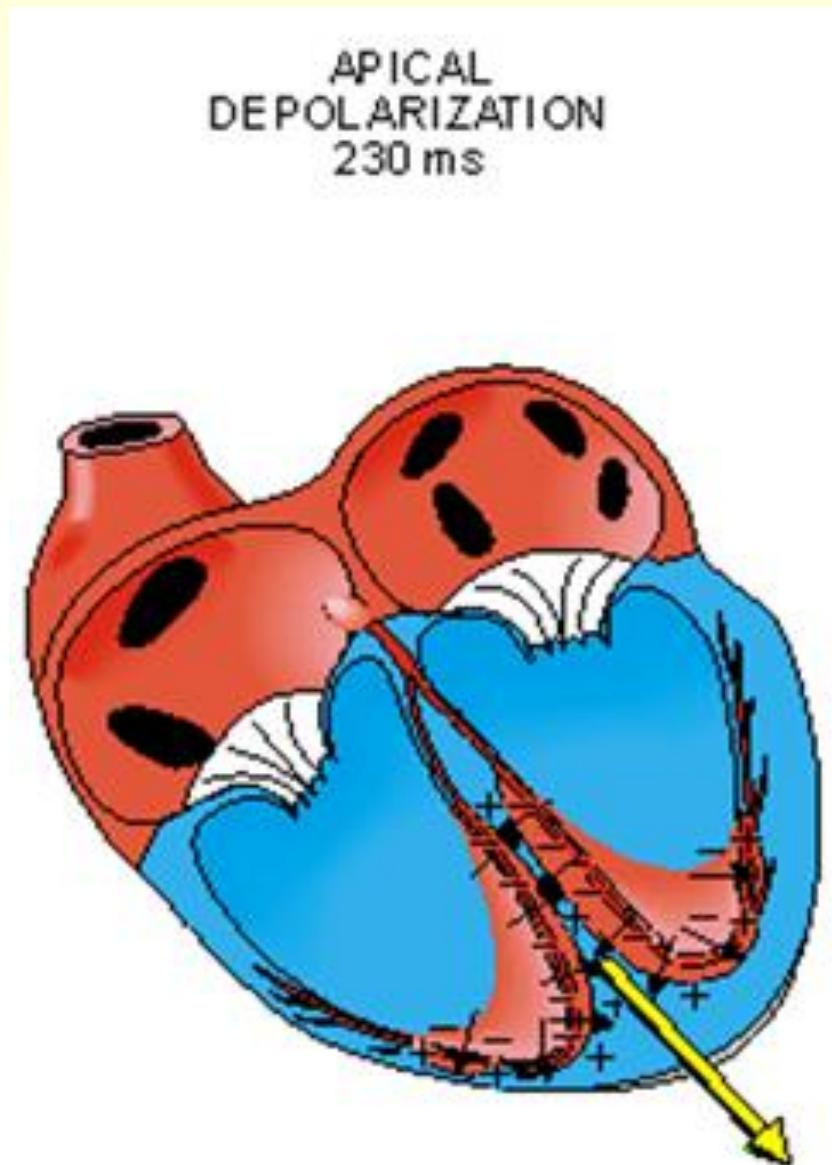
Depolarizace síní



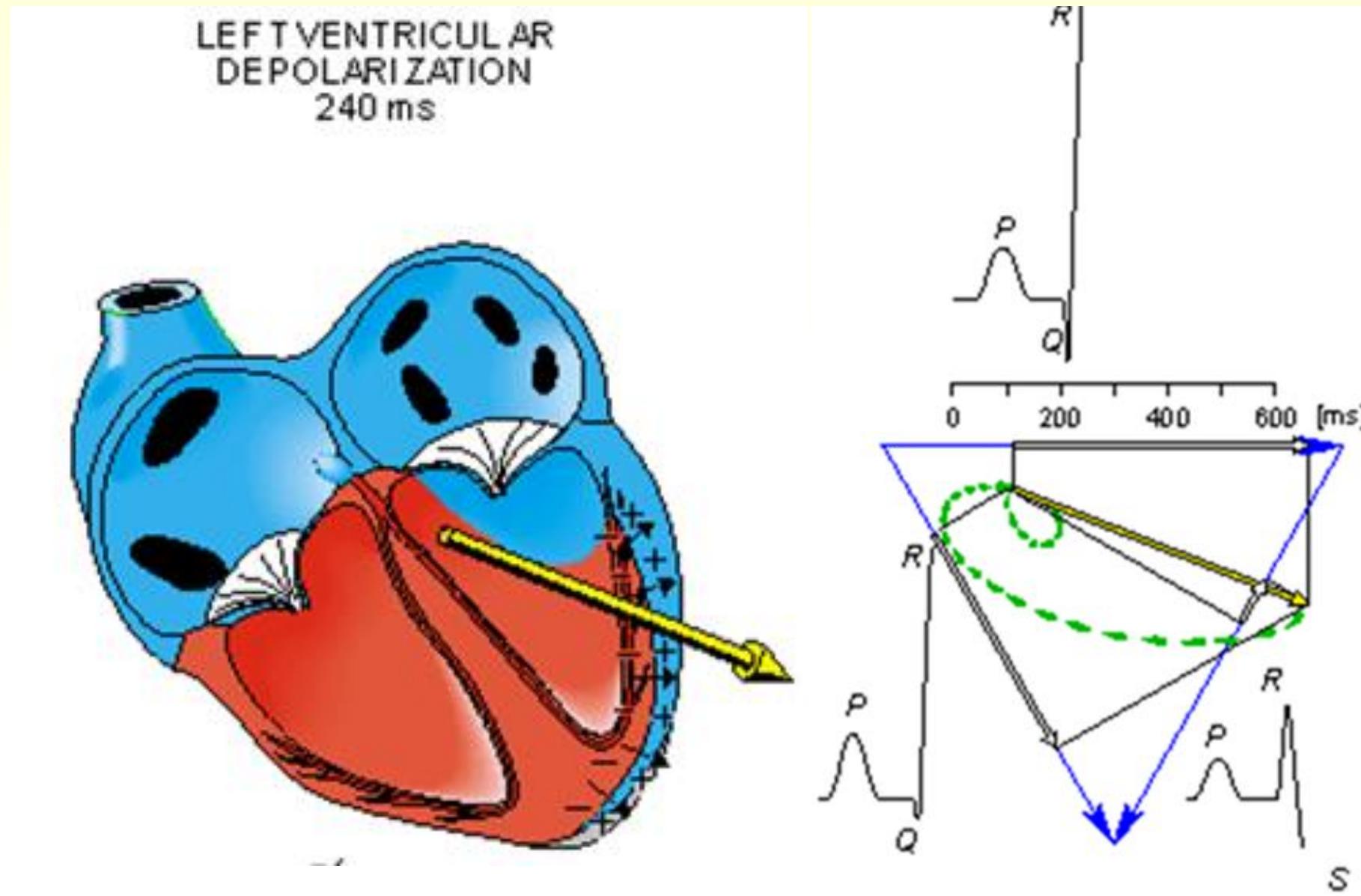
Depolarizace septa



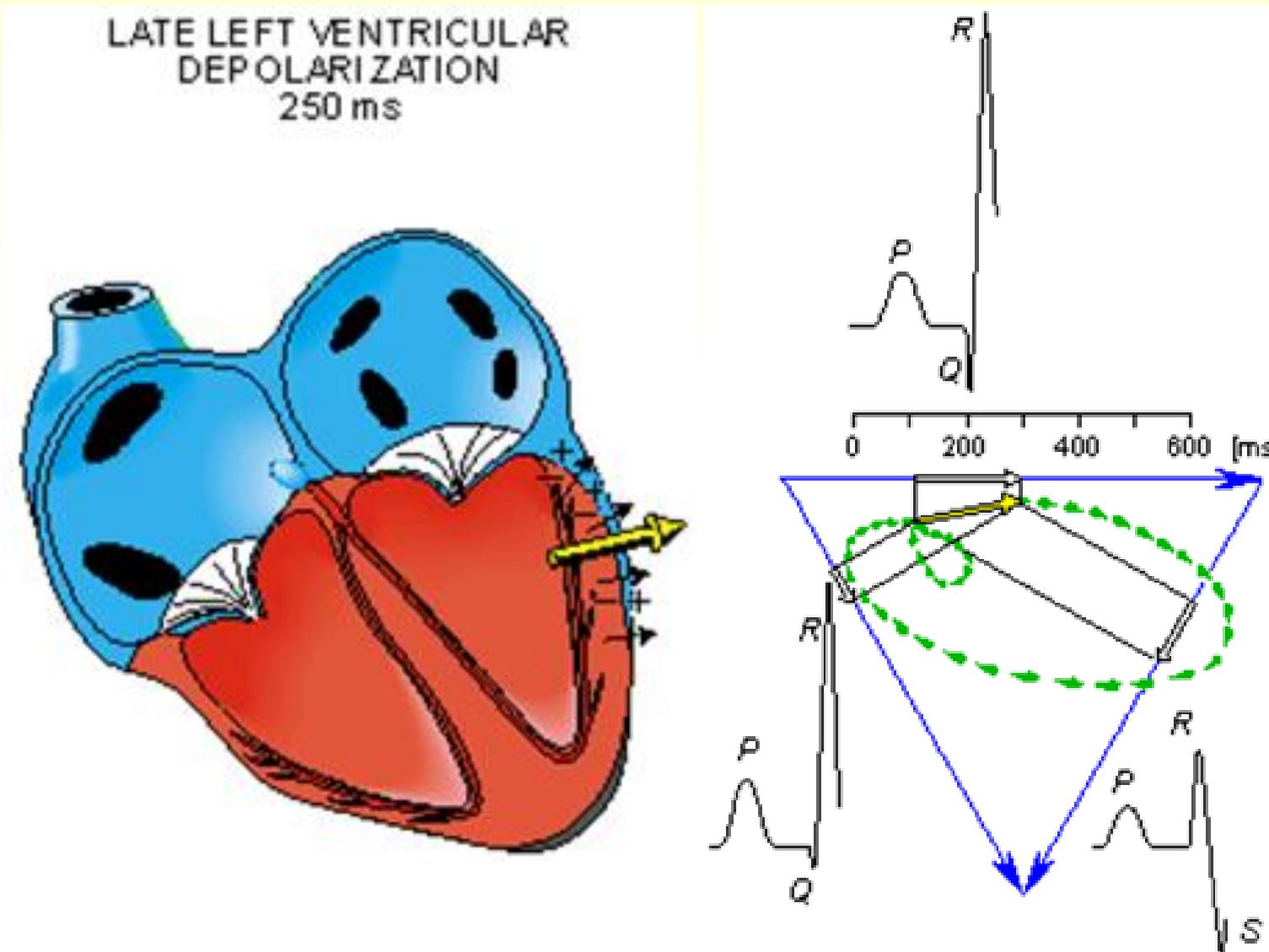
Vrcholná depolarizace



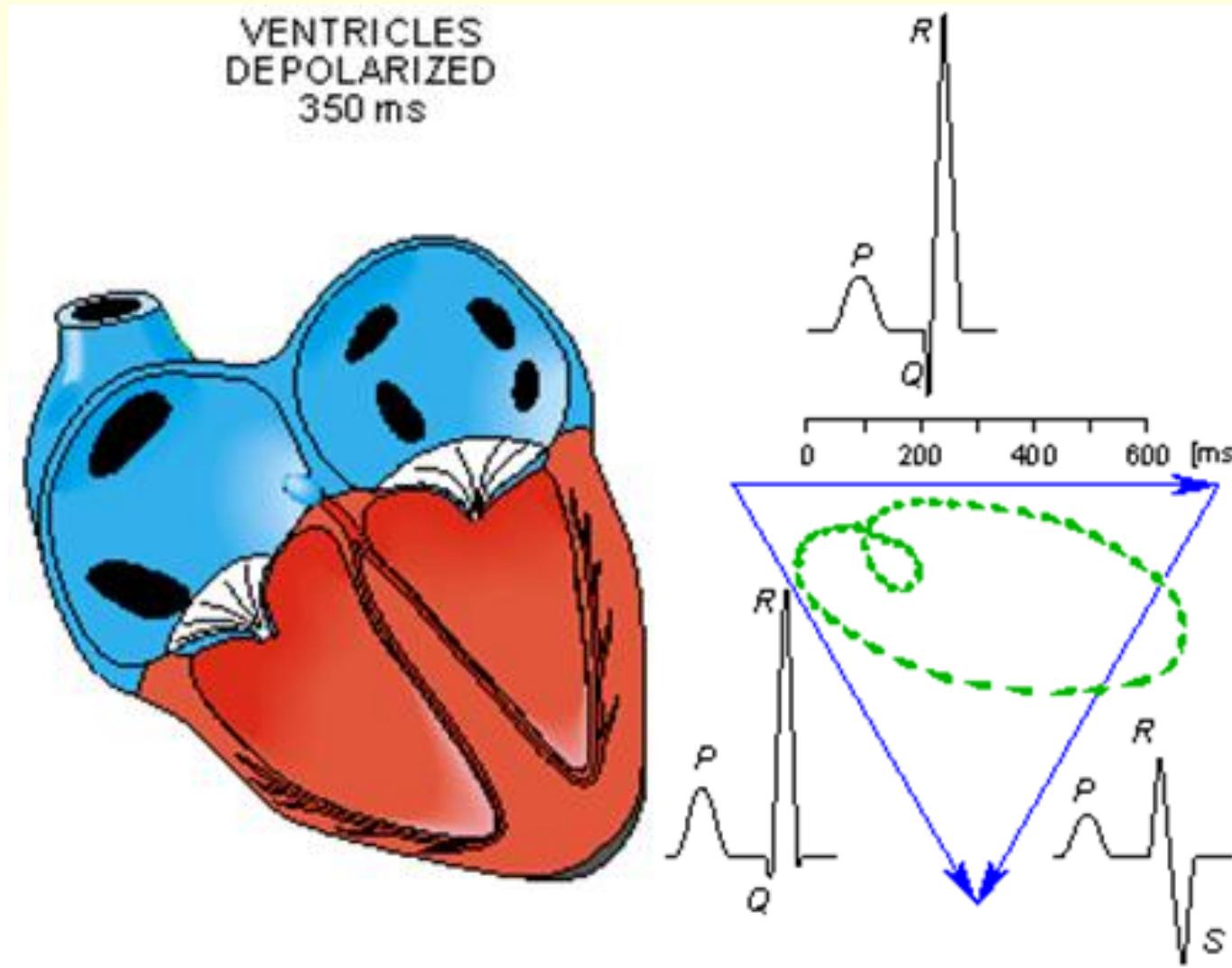
Depolarizace levé komory



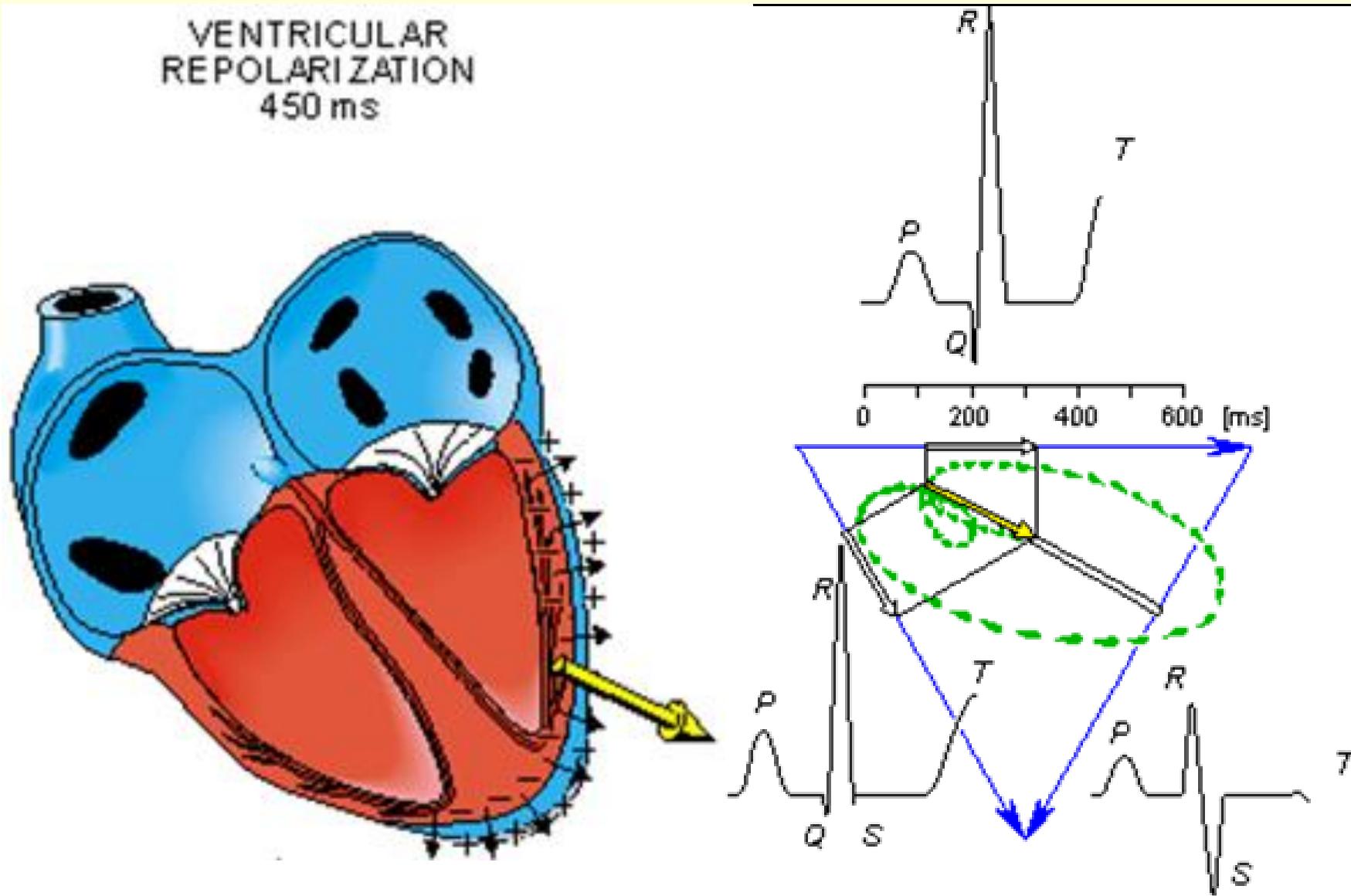
Pozdní depolarizace levé komory



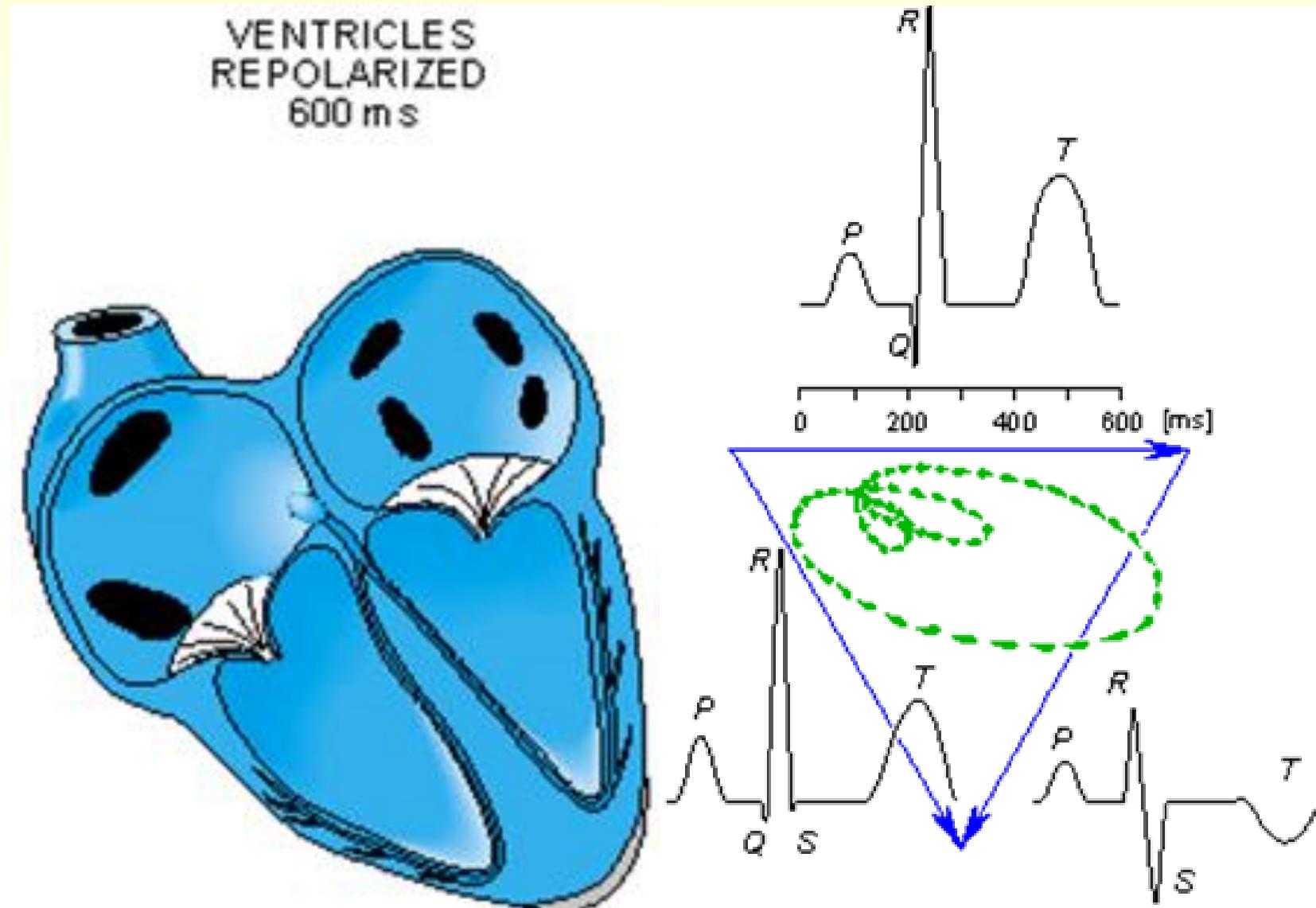
Depolarizace komor



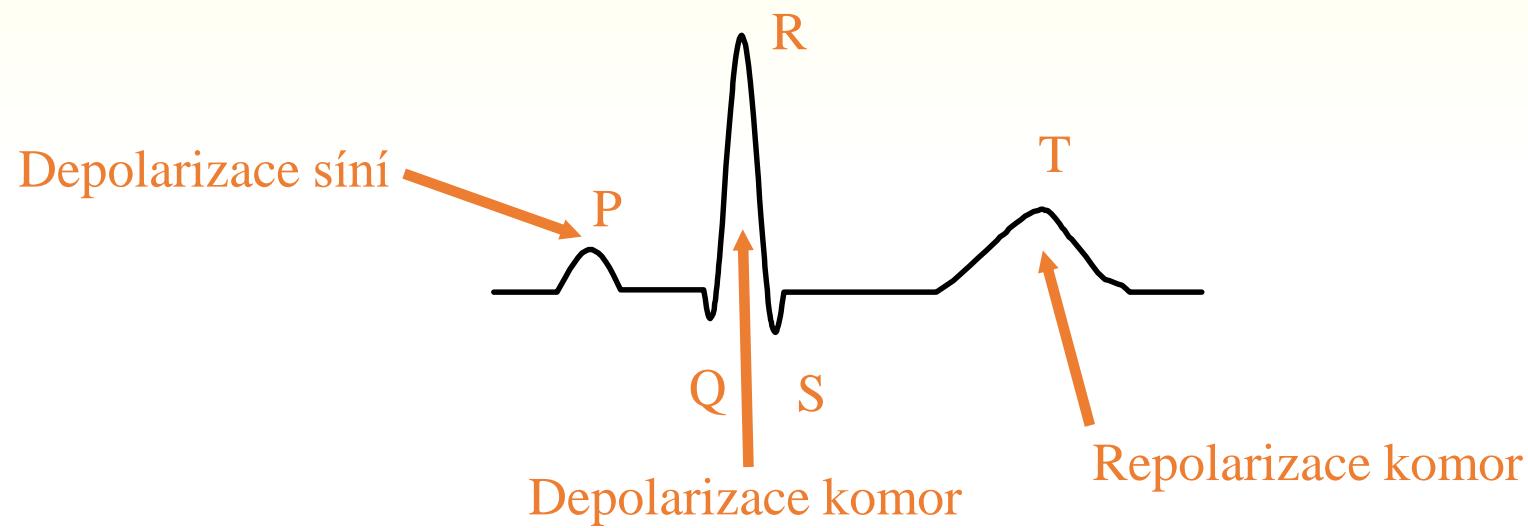
Repolarizace komor



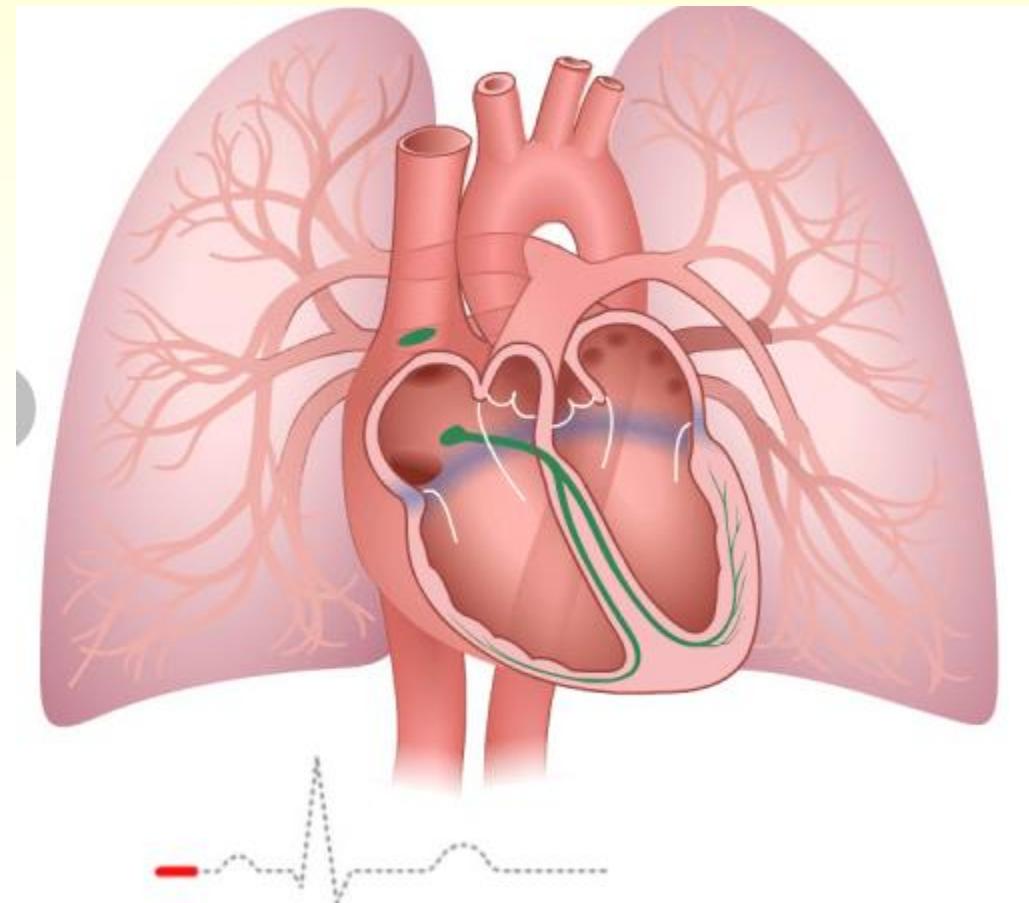
Repolarizace komor



EKG křivka

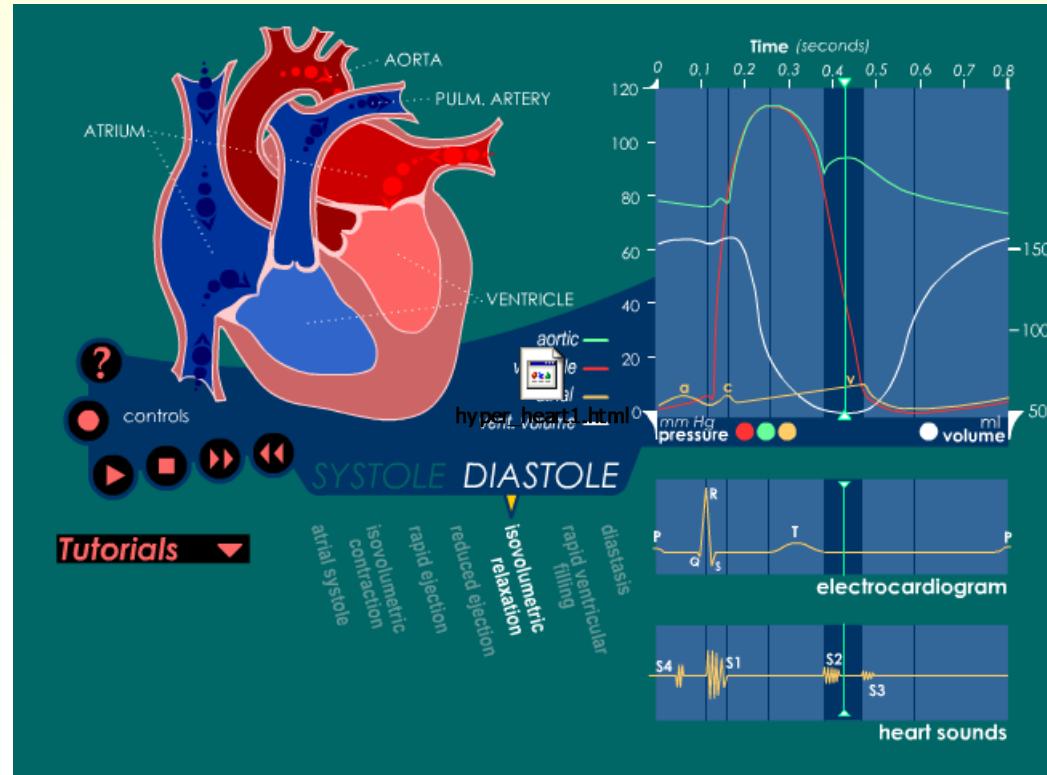


EKG animace



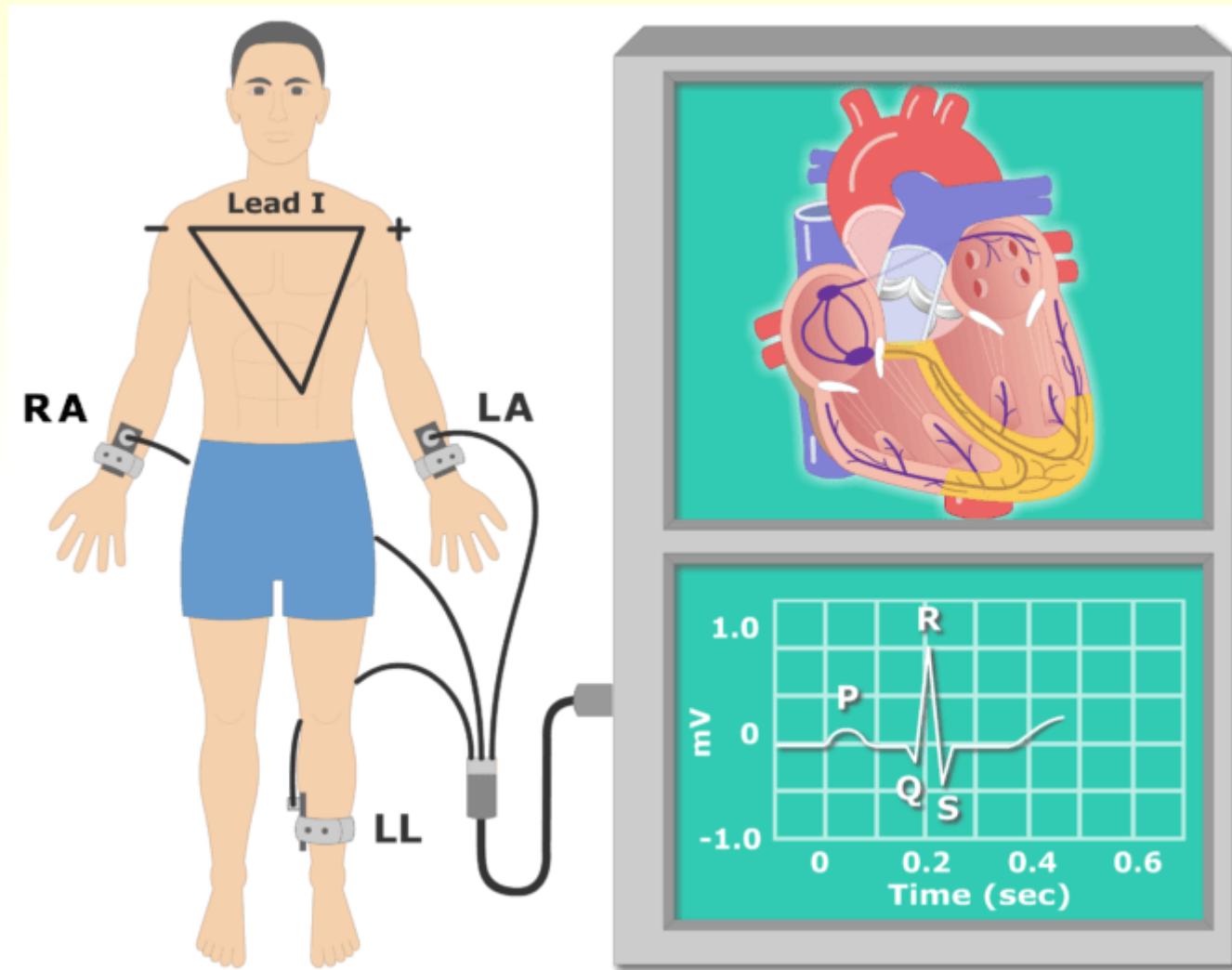
http://pie.med.utoronto.ca/heart_physiology/module/ecg.html

EKG animace



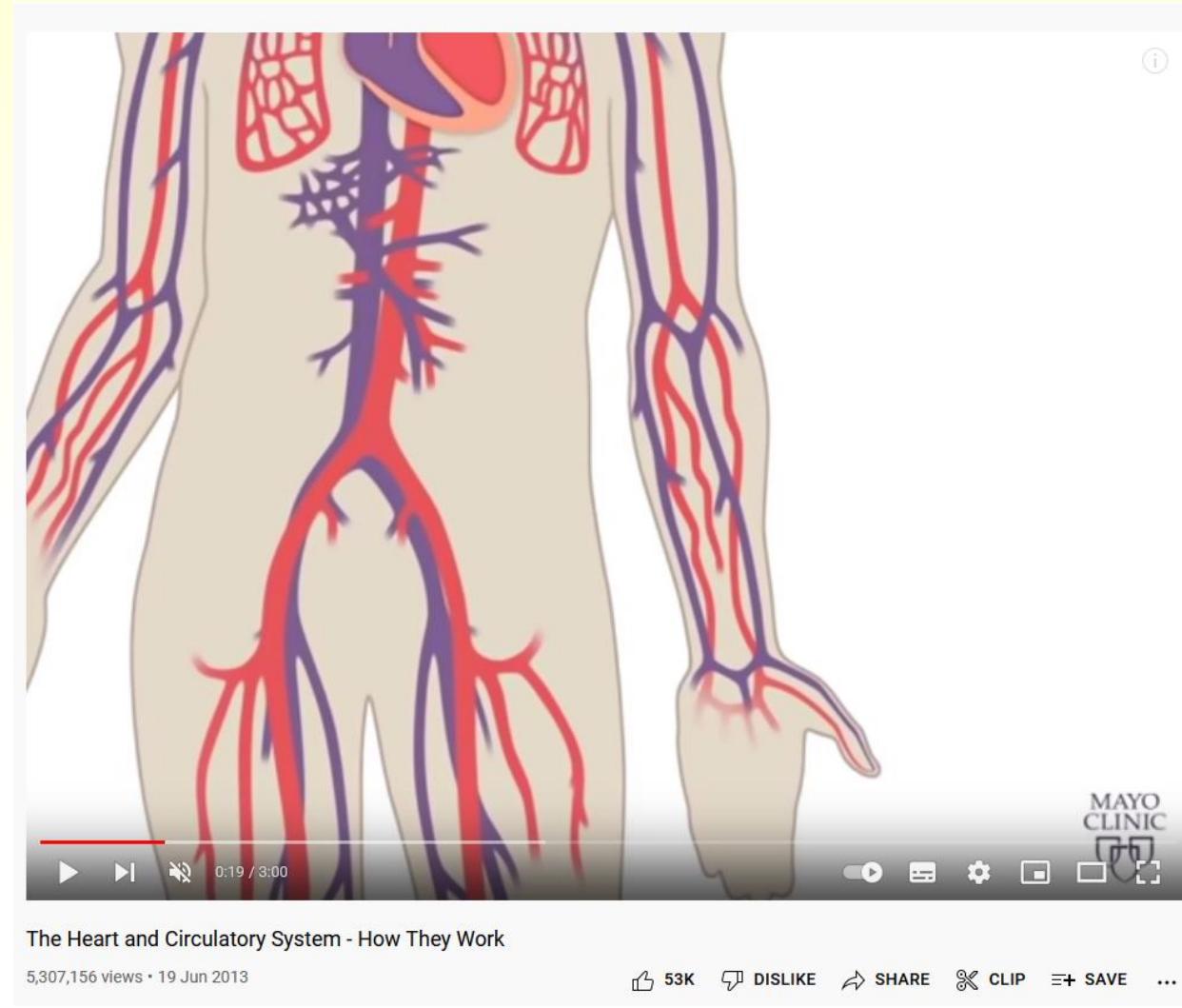
https://library.med.utah.edu/kw/pharm/hyper_heart1.html

EKG animace

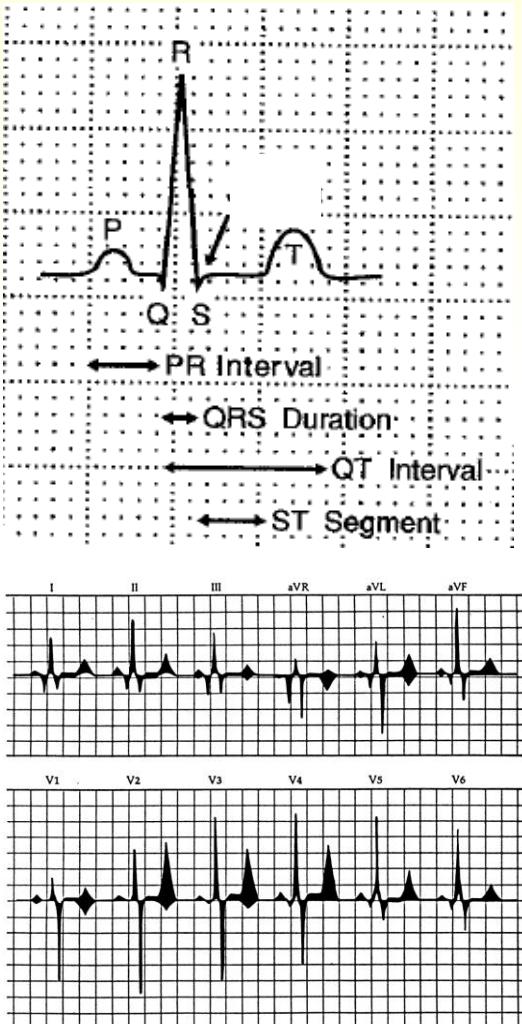


<https://www.getbodysmart.com/circulatory-system/ekg>

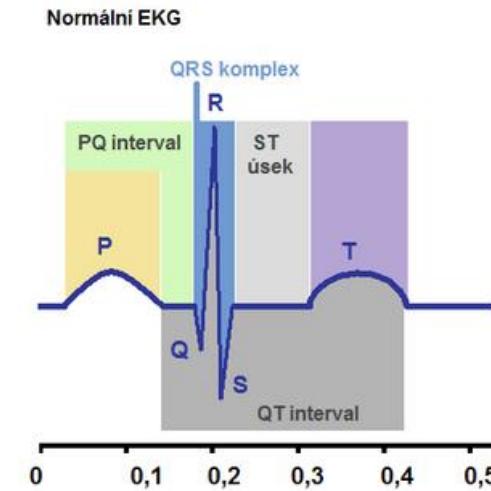
EKG video



Analýza EKG



- Na EKG se hodnotí:
 - srdeční frekvence
 - pravidelnost srdeční akce
 - směr elektrické osy srdeční
 - velikost a délka vln P,Q, R, S, T
 - velikost a délka úseků P-Q, Q-R-S, S-T , Q-T
- Fyziologické EKG ovlivňuje:
 - věk
 - konstituce
 - poloha
 - dýchání
 - fyzická zátěž

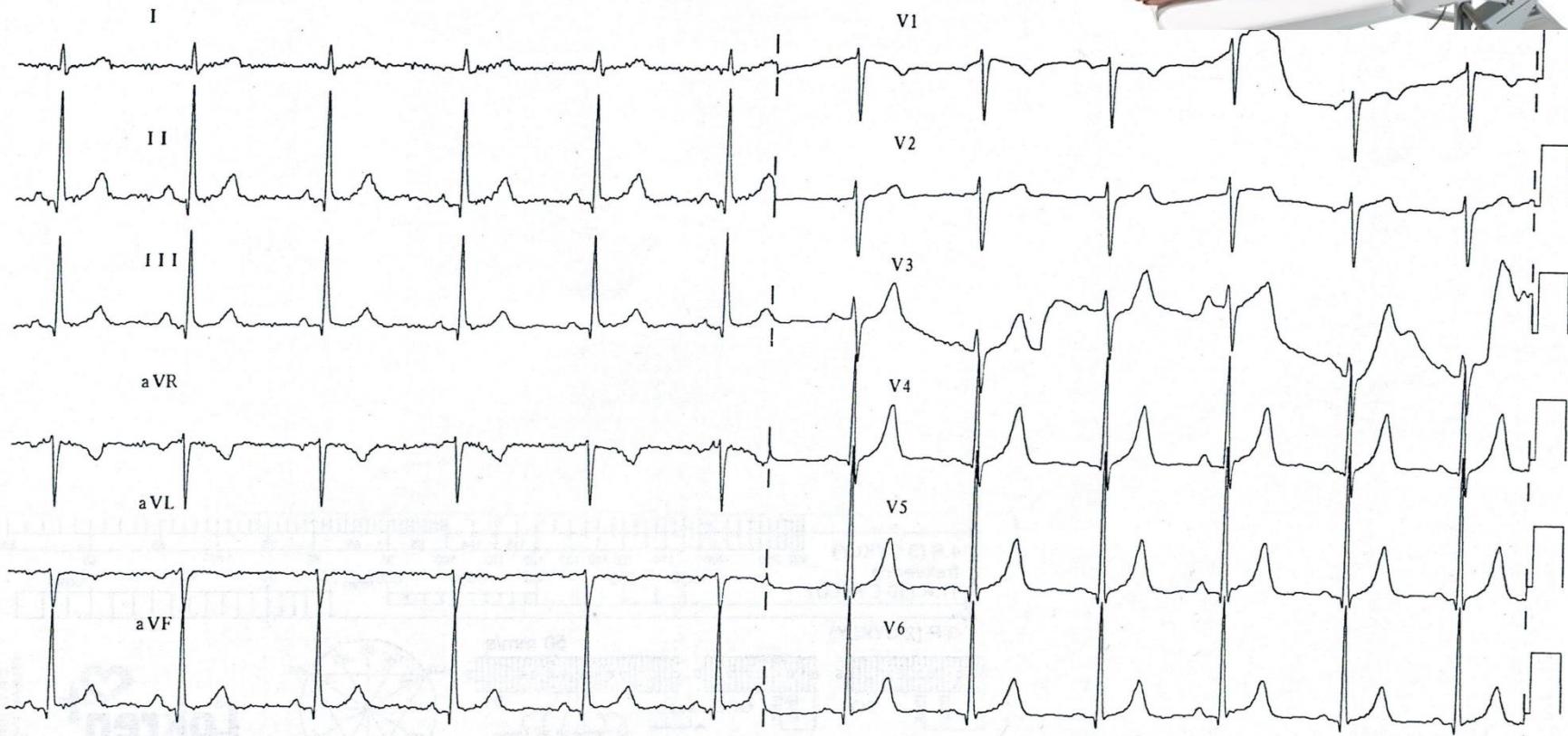


10-Mar-2006 15:49:44

Klidové EKG

Rate 70
PR 141
QRS 96
QT 393
QTc 424

--Axis--
P 70
QRS 88
T 71



25 mm/s 10 mm/mV F-N=0.55 Hz - 40 Hz W HP708 06029

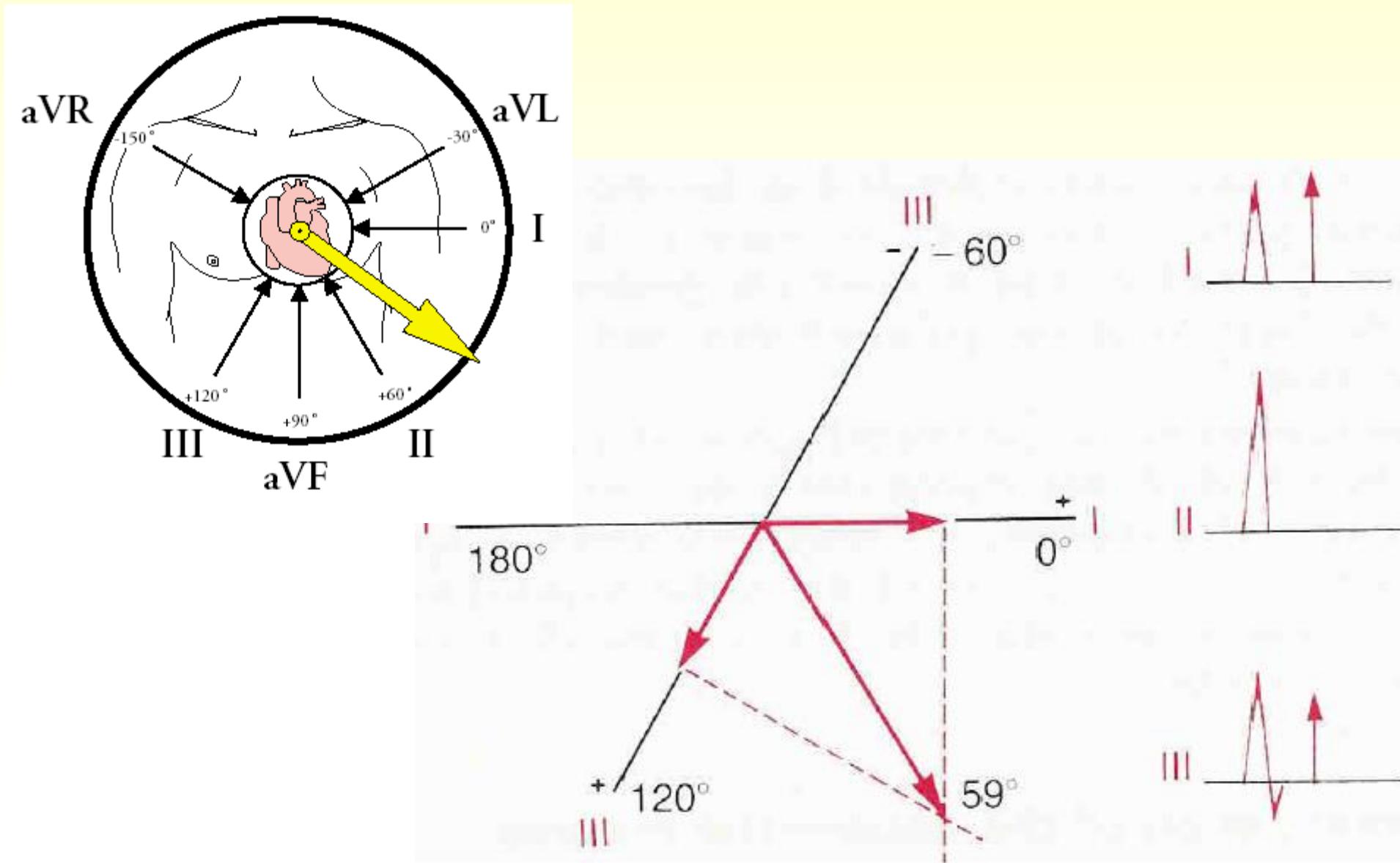
Hodnocení EKG křivky

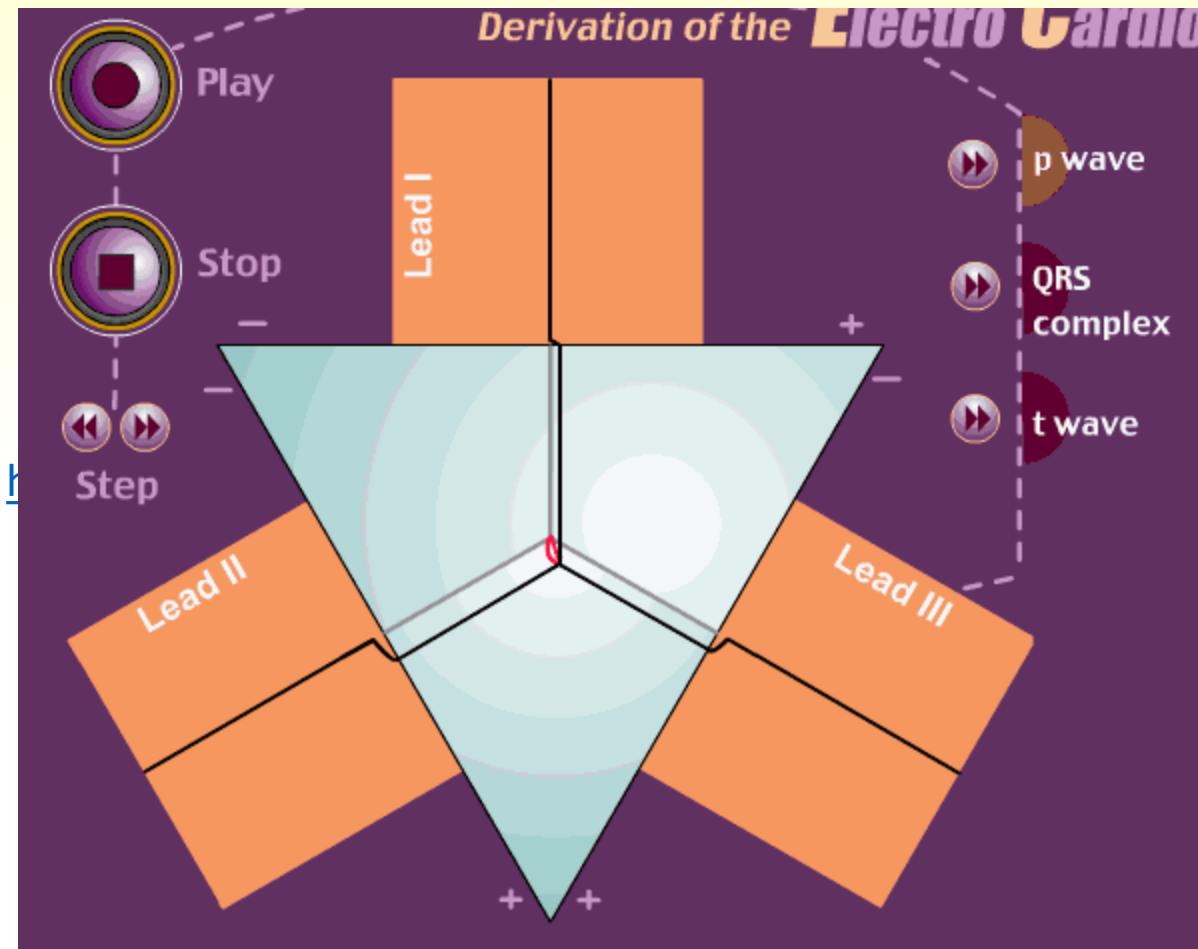
EKG desatero

viz předchozí snímek

1.	srdeční akce	pravidelná
2.	srdeční rytmus	pravidelný sinusový
3.	srdeční frekvence	v normě, 70 cyklů/min
4.	P vlna	normální
5.	PQ interval	v normě, 4 mm, 160 ms
6.	QRS komplex	v normě, 96 ms
7.	ST úsek	normální v izolinii
8.	T vlna	norma
9.	QT interval	norma, 393 ms
10.	elektrická osa srdeční	fyziologicky, 88°

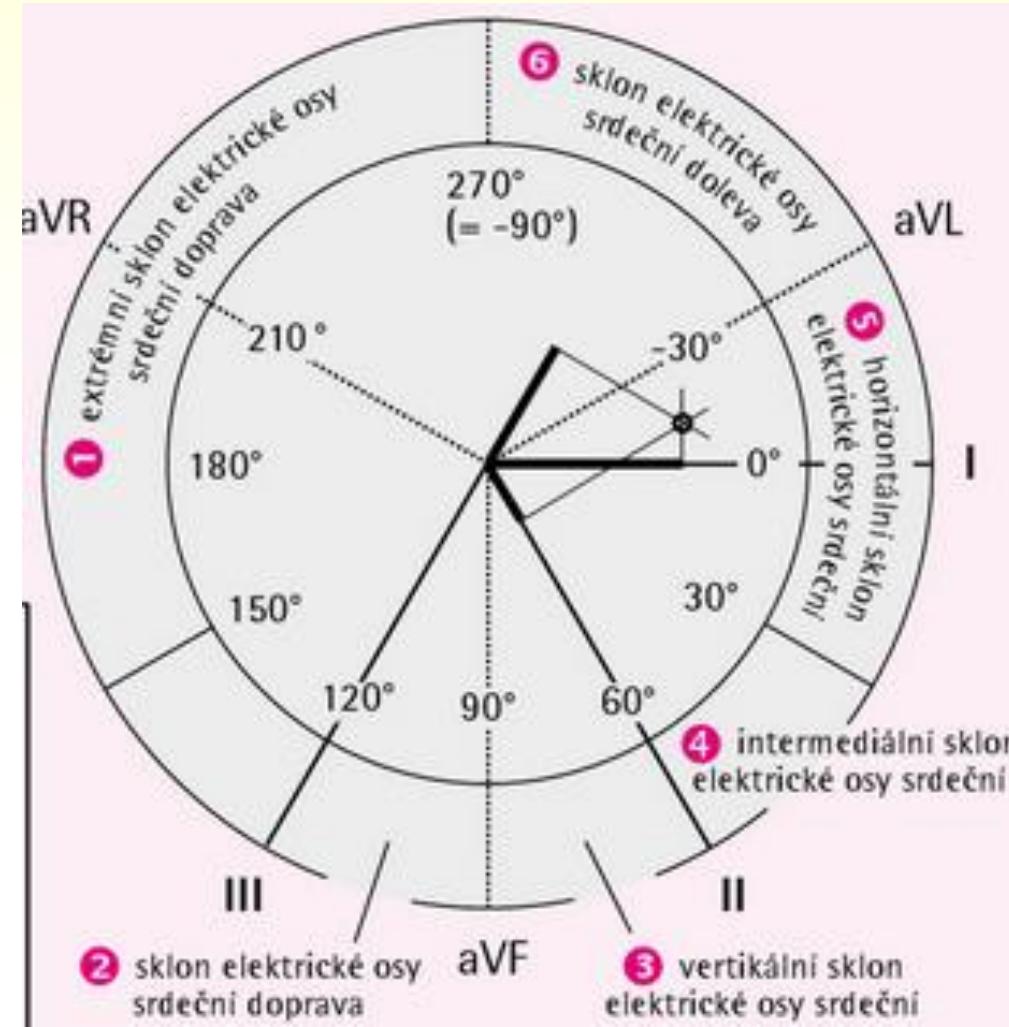
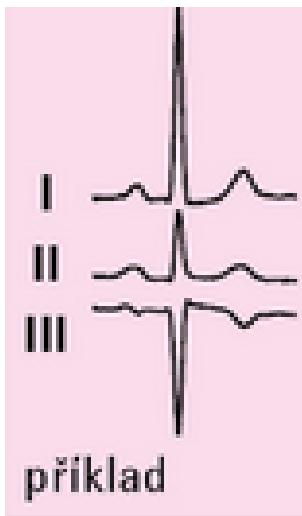
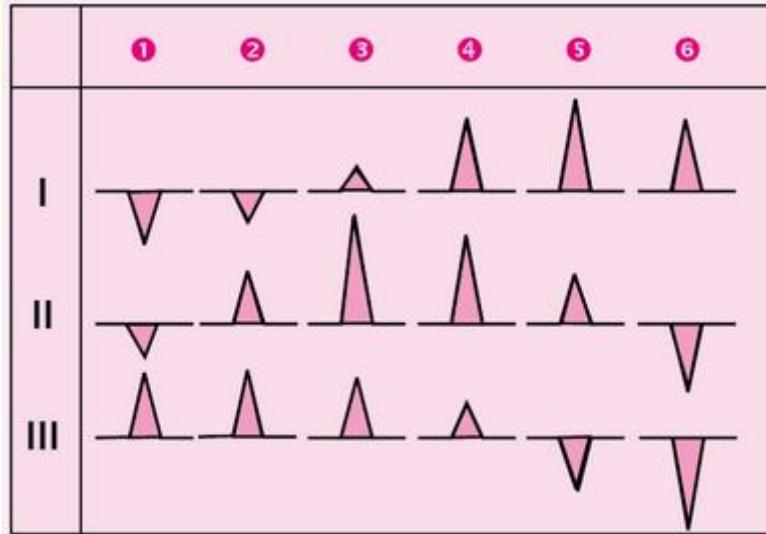
ELEKTRICKÁ SRDEČNÍ OSA





Cabrerův kruh

určení sklonu elektrické osy srdeční



Lokrent®
+
EKG metr
PRAVAL PRINT

The figure shows a detailed technical drawing of an ECG strip. At the top, there is a horizontal scale for frequency (40/min to 200 mm/s) and a vertical scale for amplitude (4 cm). Below this is a circular lead placement chart with leads I, II, III, aVR, aVL, aVF, and V₁ through V₆ arranged in a hexagonal pattern. The drawing also includes several rectangular scales for time and amplitude, such as QRS (0.03 to 0.04 seconds), ST (0.06 to 0.11 seconds), and PQ (0.04 to 0.06 seconds). There are also scales for standardni čas (0.06 to 0.11 seconds) and standardni razdalja (0.12 to 0.20 seconds). The bottom of the drawing features a large frequency scale (55 to 300 mm/min) and a smaller time scale (40 to 55 mm/s).

4.R (3 CYKLY) 300 250 200 170 150 140 130 120 115 105 95 85 80 75 70 65 60 55/min

frekvence

11.R (10 CYKLŮ)

600 500 400 350 300/min 55 50 45 40/min

3.R (2 CYKLY)

50 mm/s

PQ QRS QT

$\pm 0.04s$

standardní časy (s)

	QRS	0.06 - 0.11	
RG	0.12 - 0.20	ST	0.24 - 0.32

aVR aVL I

-120° -90° -60° -30° 0° 30°

-180° -150° -120° -90° -60° -30° 0° 30°

II III aVF

130 70 50/min

Max. QRS QT

PQ

40/min

50 60 60 70 80 90 100 110 120

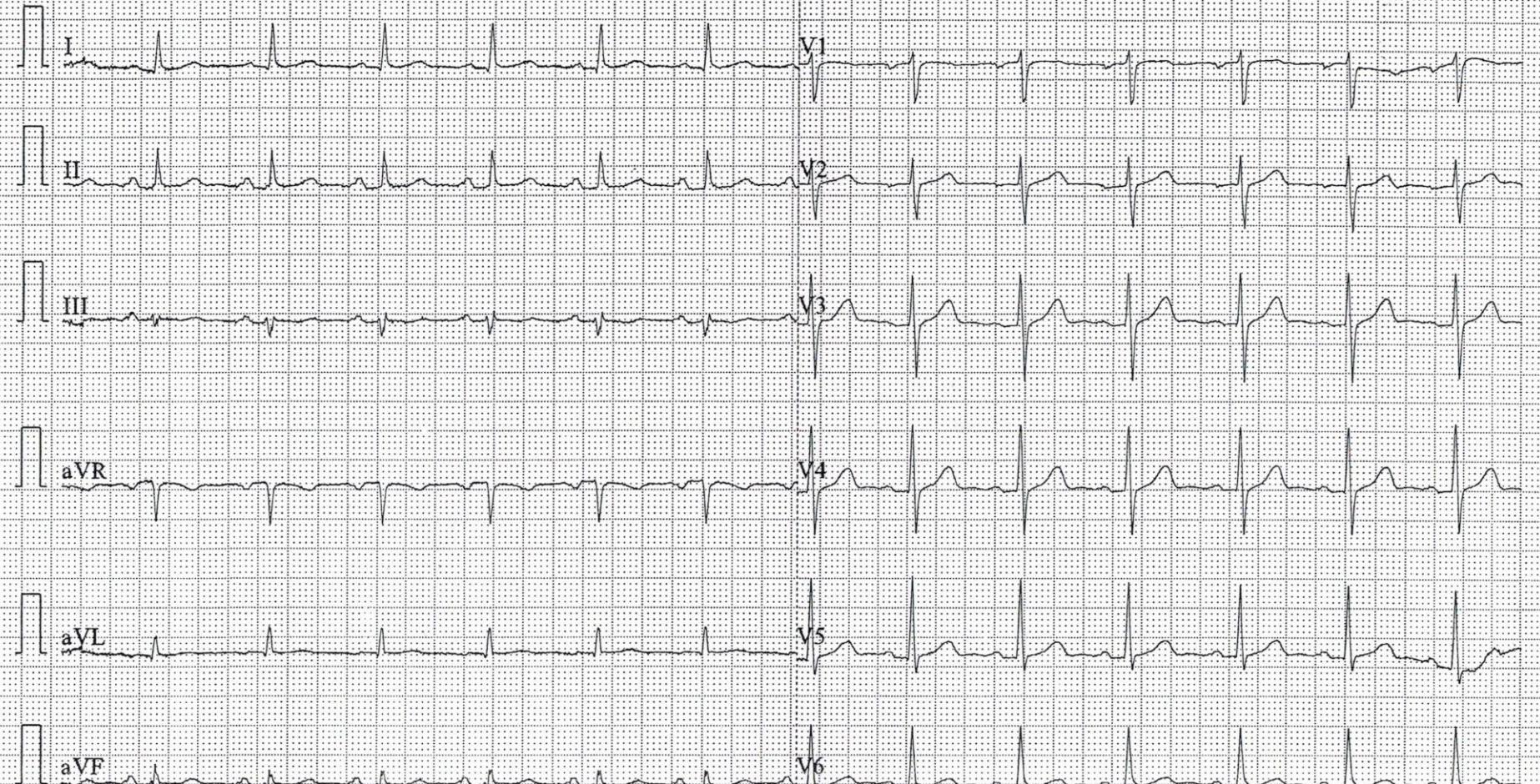
The image consists of three separate elements arranged horizontally. On the right is a metric ruler showing centimeters from 3 to 5. In the center is a black and white photograph of an electrocardiogram (EKG) strip. The strip features the brand name 'Lokrent' in large, bold, sans-serif letters, with a stylized heart symbol integrated into the letter 'o'. Below the brand name is the text 'EKG metr' and 'PRAVAL PRINT'. At the bottom of the EKG strip, there is a scale bar labeled '25 mm/s'. On the left is a horizontal scale bar with markings for '200' and '150'.

Muž Roky

HR: 80 bpm
 P: 119 ms
 PR: 196 ms
 QRS: 84 ms
 QT/QTc: 375/435 ms
 P/QRS/T: 69/27/45 °
 RV5/SV1: 1.282/0.679 mV

Diagnostické informace:
 Sinusový rytmus
 Normální EKG

Report potvrdil:



Corrección. Fórmulas

Bazett modificada por Taran y Szilagyi	$QTc = \frac{QT}{\sqrt{RR}}$
Fridericia	$QTc = \frac{QT}{\sqrt[3]{RR}}$
Framingham-Sagie	$QTc = QT + 0,154 (1 - RR)$
Hodges	$QTc = QT + 1.75 (FC - 60)$
Sarma	$QTc = QT (RR)^{\frac{1}{2}}$
Normograma	$QTc = 237 + 0.158 \times RR \quad (\text{para FC } 60-100 \text{ lpm})$
Cobos	$QTc = \frac{QT}{(1+RR)/2}$

Name :
ID : 2380
Age : years
Height : cm
BP : / mmHg

Gender : Male
Weight : kg
Race : Unknown

HR : 80 BPM
P Dur : 114 ms
PR int : 191 ms
QRS Dur : 105 ms
QT/QTc int : 358/414 ms
P/QRS/T axis : 64/11/38 °
RV5/SV1 amp : 1.459/0.554 mV
RV5+SV1 amp : 2.013 mV
RV6/SV2 amp : 1.380/0.448 mV

Diagnosis Information:
800: Sinus Rhythm
Normal ECG

Minnesota Code:
9-4-1(V3)

Report Reviewed by:





ID:

16-Jan-2010 18:34:26

Vent. rate 126 bpm
PR interval 124 ms
QRS duration 96 ms
QT/QTc 320/463 ms
P-R-T axes 56 88 -6

Sinus tachycardia
Low voltage QRS
Incomplete right bundle branch block
T wave abnormality, consider anterior ischemia
Abnormal ECG

Unconfirmed

150 Hz

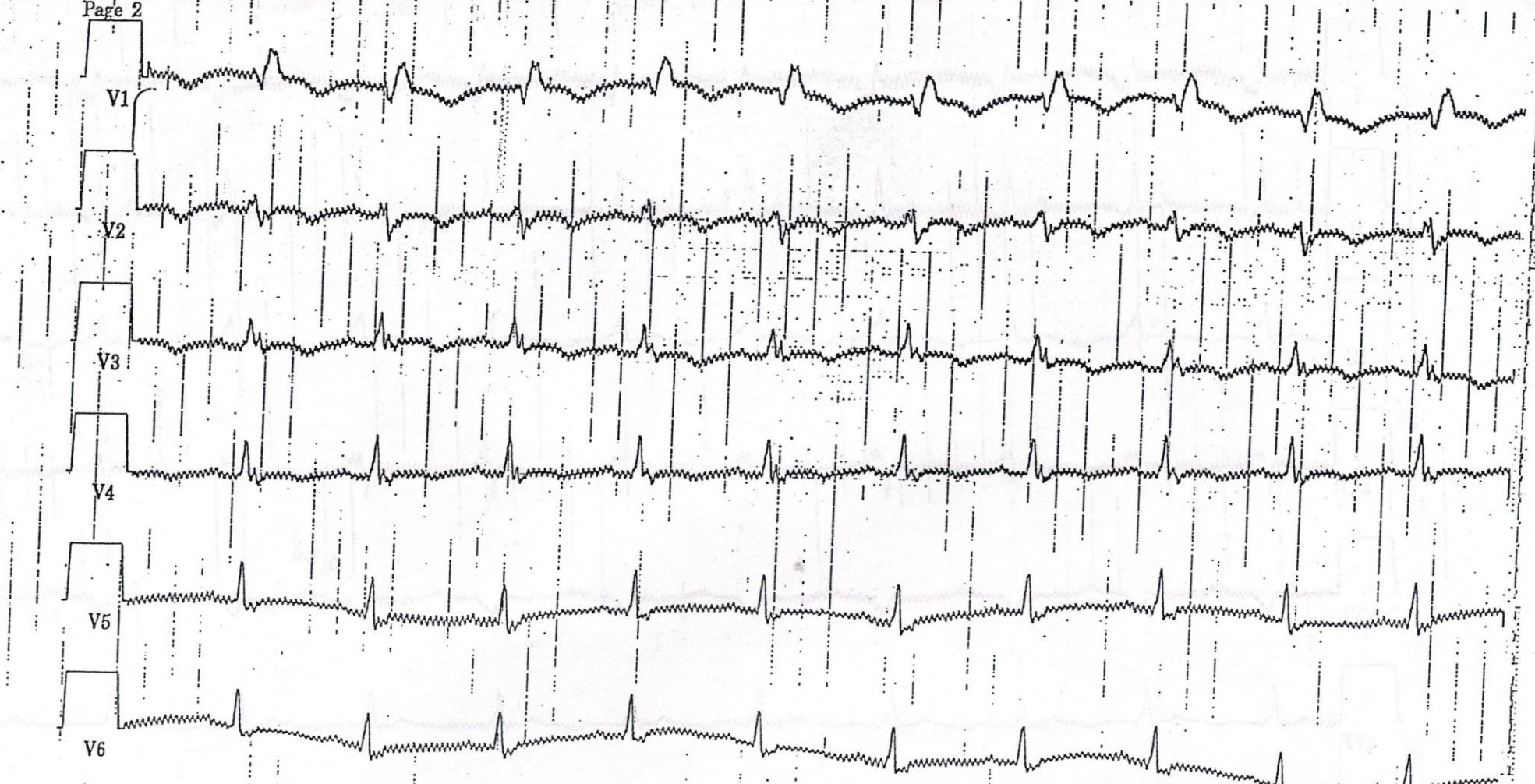
500 mm/s

100 mm/mV

2 hr 5s @50mm/s

MAC5K 007A 2

10.12ST™ v235



ID:

16-Jan-2010 18:34:26

Vent. rate 126 bpm
PR interval 124 ms
QRS duration 96 ms
QT/QTc 320/463 ms
P-R-T axes 56 88 -6

150 Hz 50.0 mm/s 10.0 mm/mV

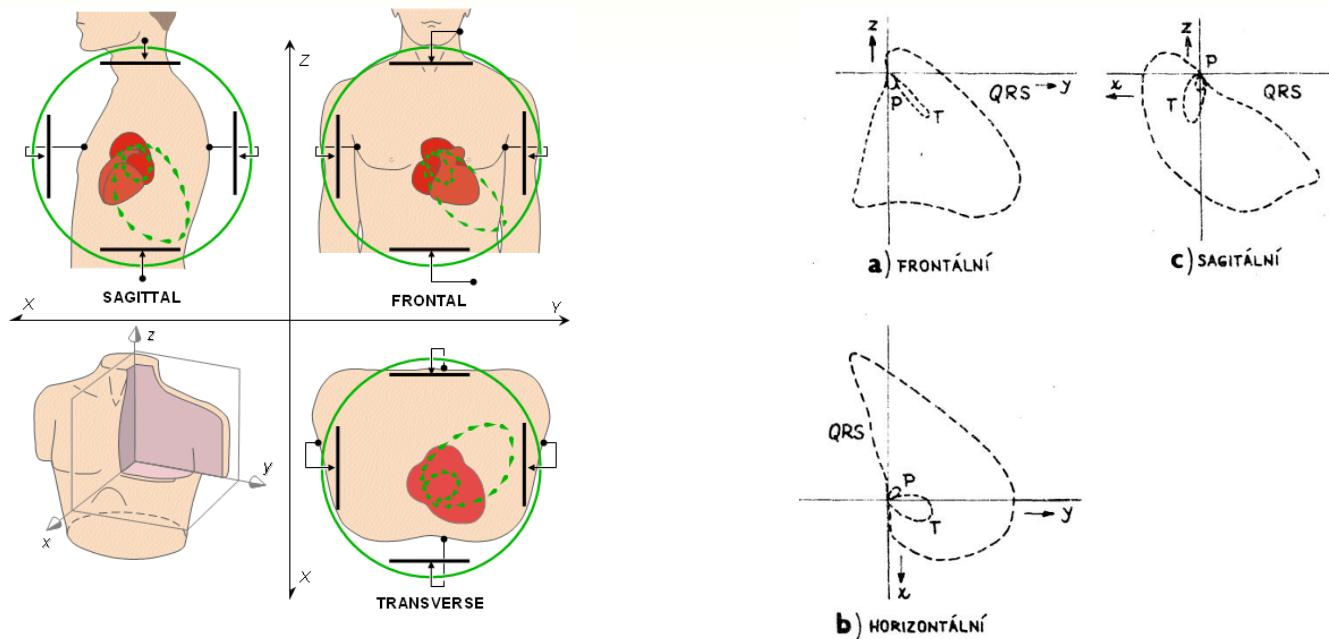
2 hr ECG @50mm/s

MACEK 007A.2 12SL™ 005

Vektorkardiografie

(ortogonální svody)

- vyjadřují prostorové vlastnosti elektrického pole kolem srdce (hrudníku) pomocí tří ortogonálních signálů;
- zobrazení pomocí tří rovinných smyček;



Laboratorní úloha

