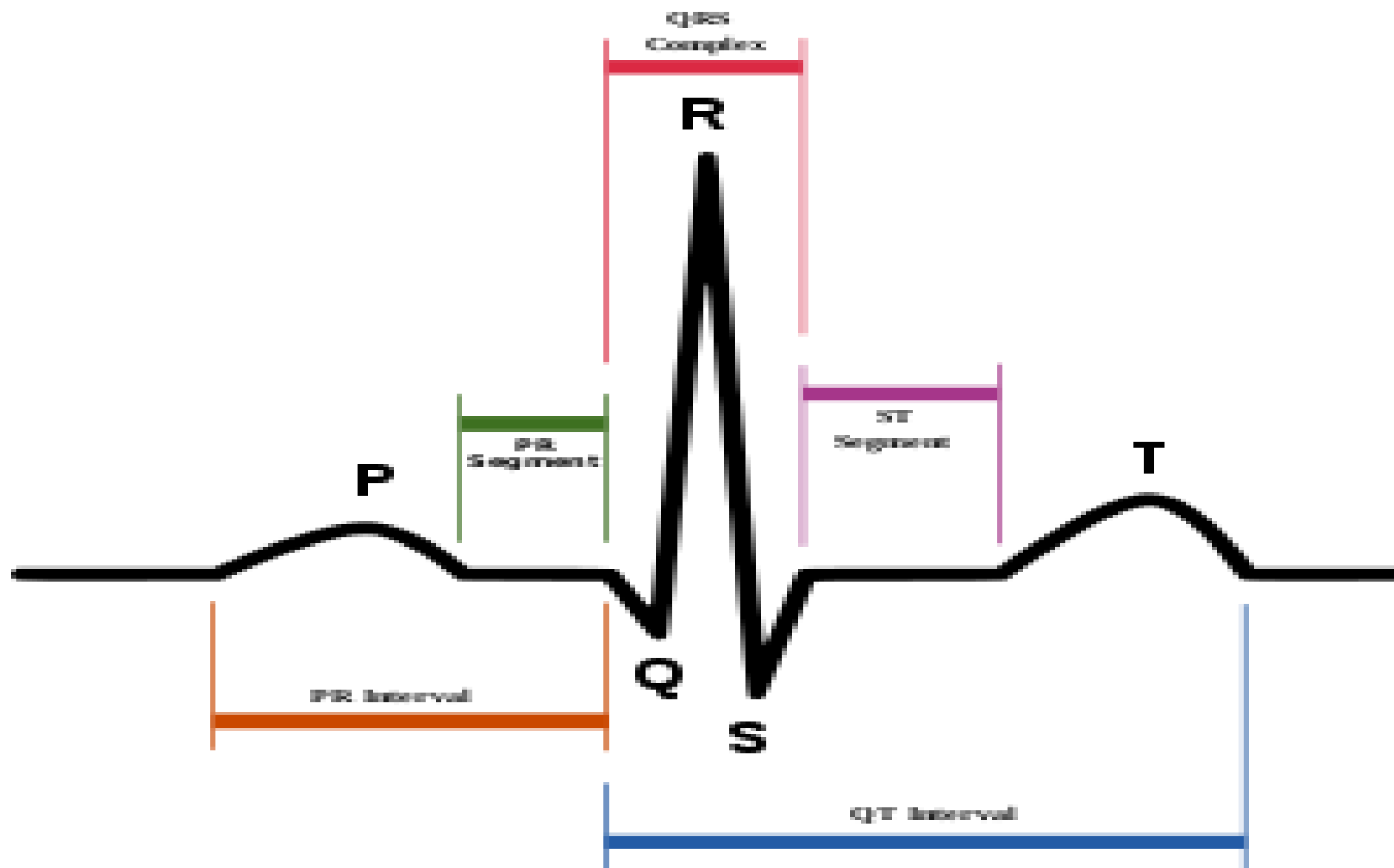
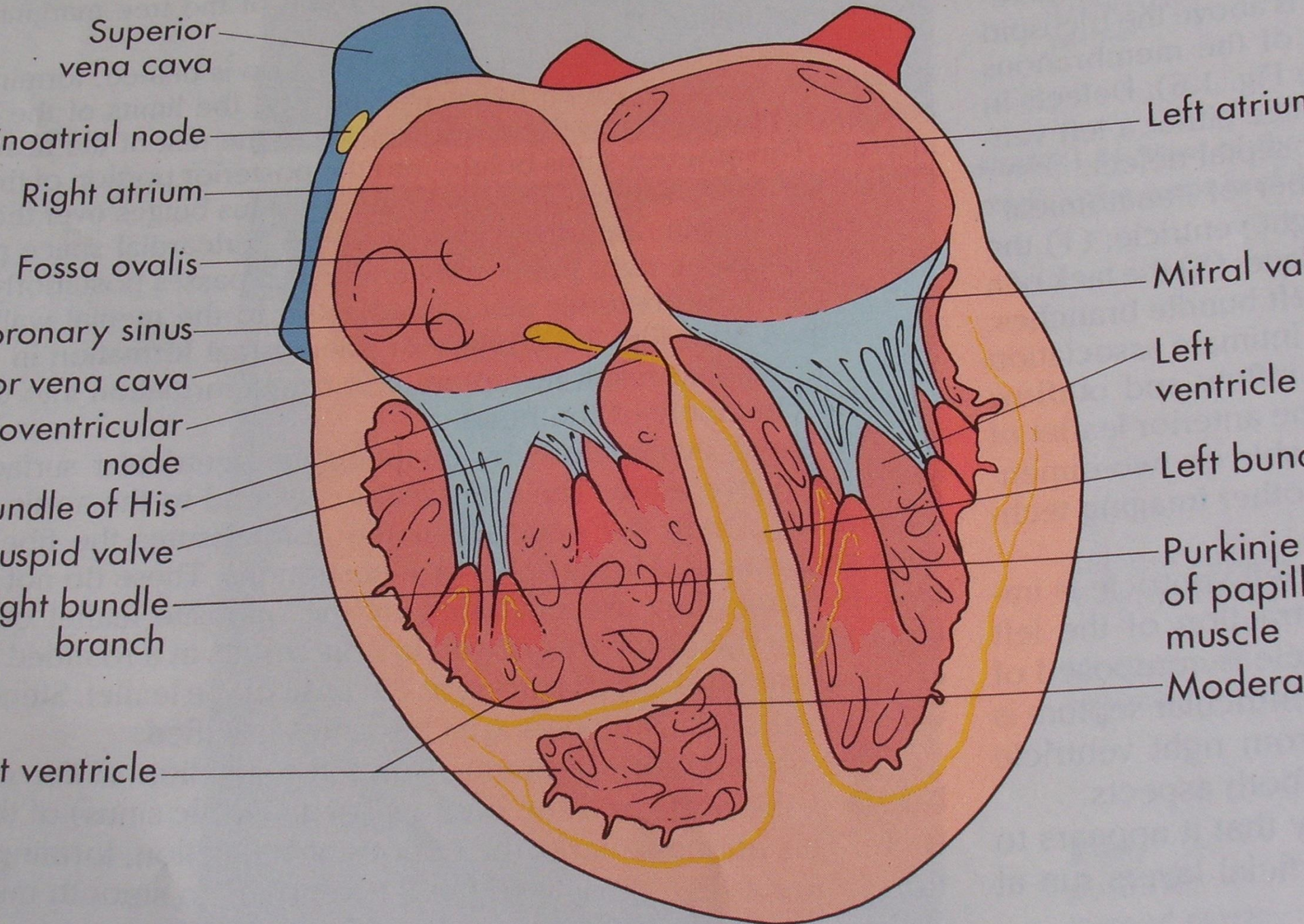




EKG **normală**

Alexandra Grejdieru
conferențiar universitar
doctor în medicină



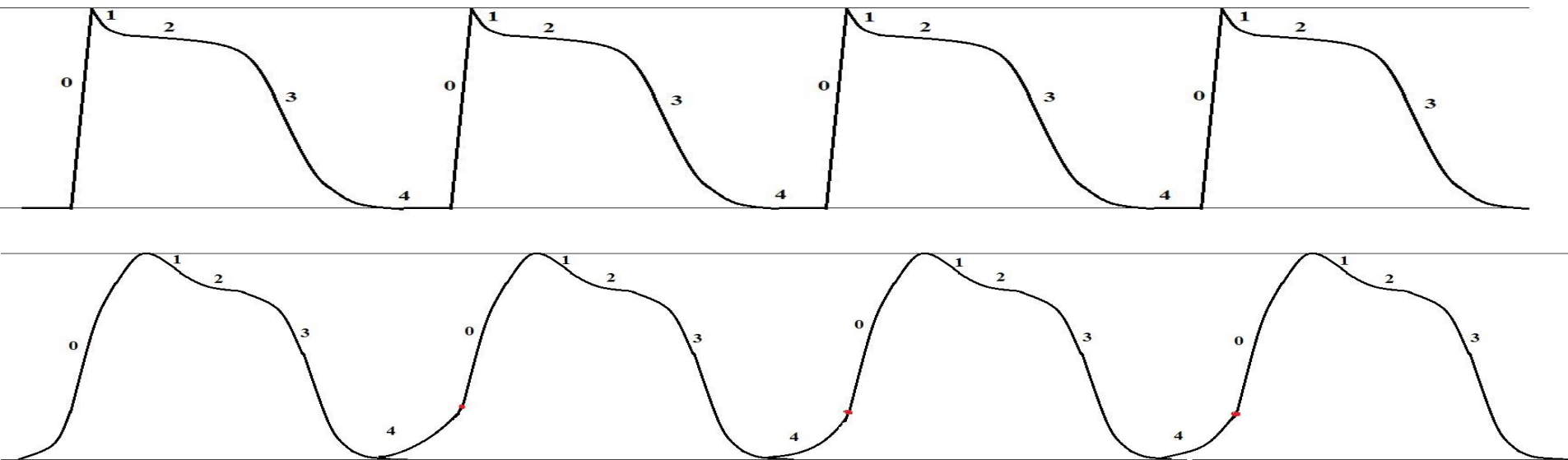


Funcțiile inimii

- Automatism (pacemaker, centre de automatism de nivel I, II, III);
- Conductibilitate (nod SA, atri, nod AV, fascicul Hiss, fibre Purkinje, miocard contractil);
- Excitabilitate;
- Contractilitate
- Funcția de pompă

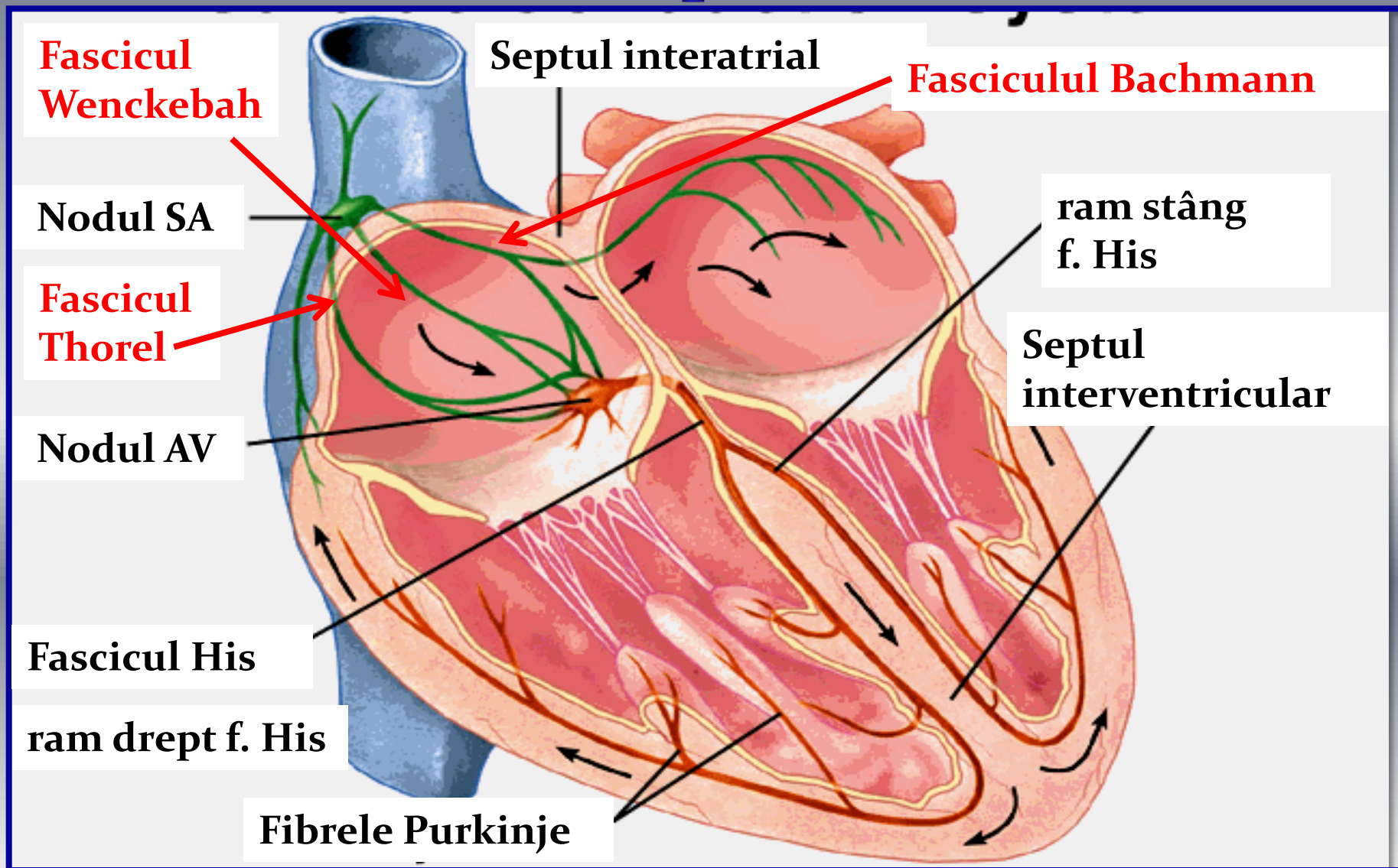
Funcțiile inimii - automatism

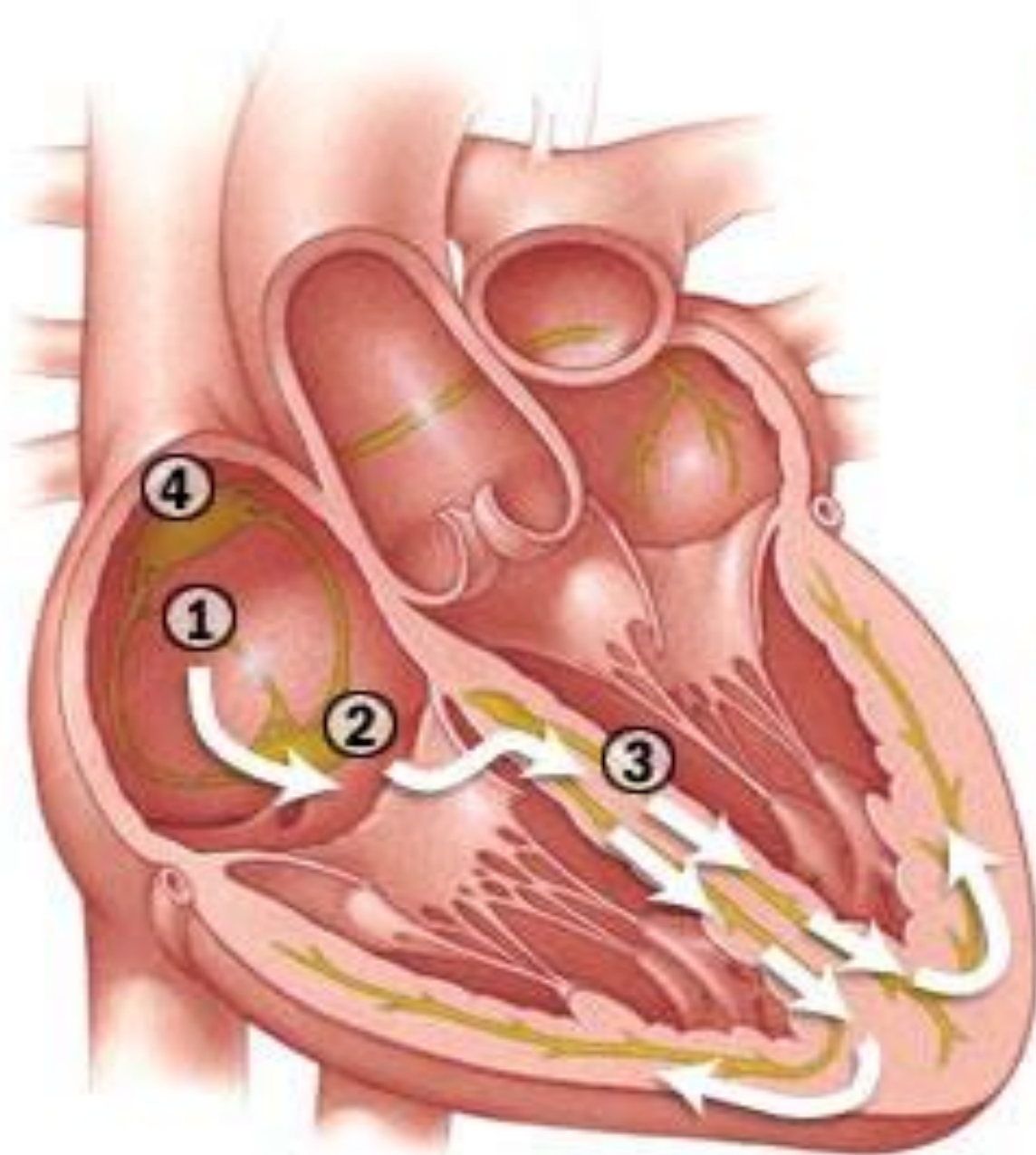
- Capacitatea inimii de a genera impulsuri electrice în absența oricăror excitanți externi.



- Nodul SA - 60-80 imp/min - centru de automatism de nivelul I;
- Sistemul conductor al atriilor, nodul AV - 40-60 imp/min – centre de automatism de nivelul II;
- Fasciculul Hiss și fibrele Purkinje – 25-45 imp/min – centre de automatism de nivelul III.

Sistemul de automatism și conducere a impulsului cardiac





1.
Sinus node
impulse



2.
Impulse passes
through
atrioventricular
node

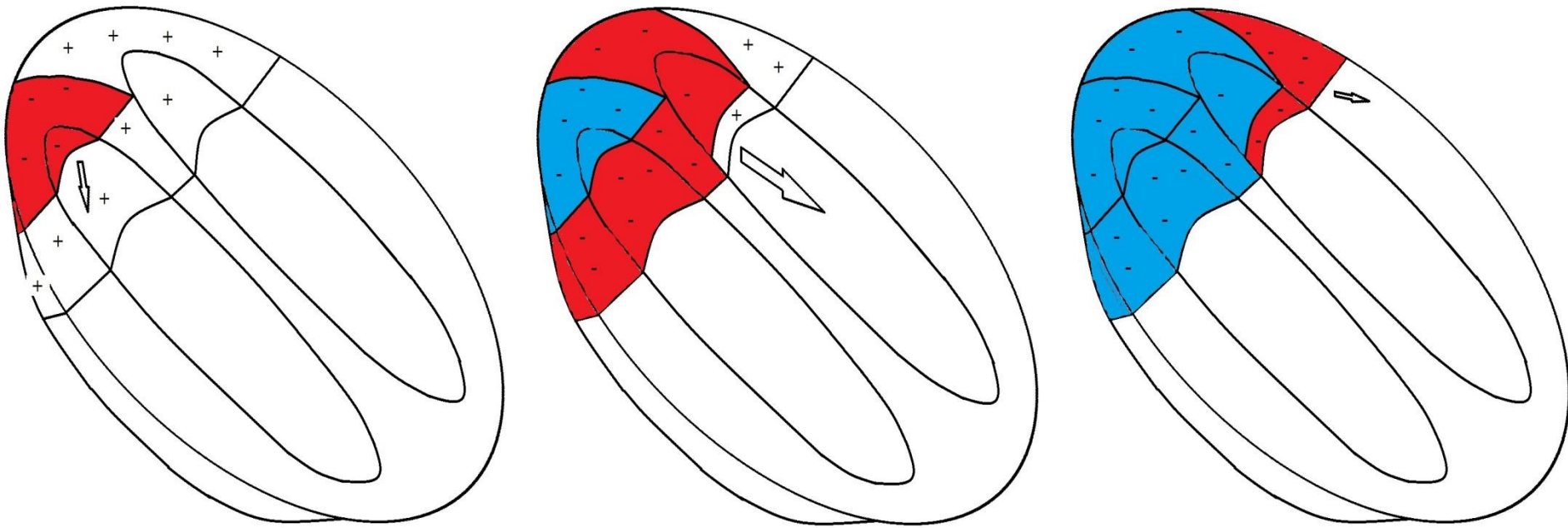


3.
Ventricular
impulses



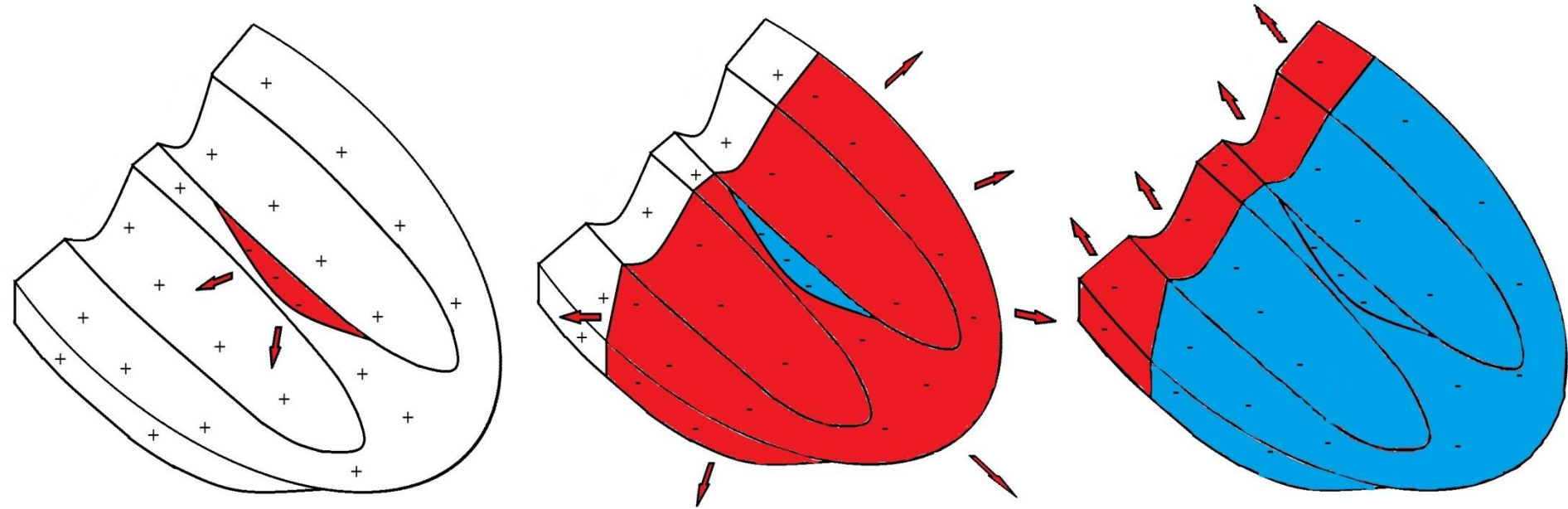
4.
Recovery

Funcțiile inimii - conductibilitate



- Depolarizarea atriilor – 0,1s;
- Nodul AV „permite” trecerea a 180-220 imp/min.

Funcțiile inimii - conductibilitate



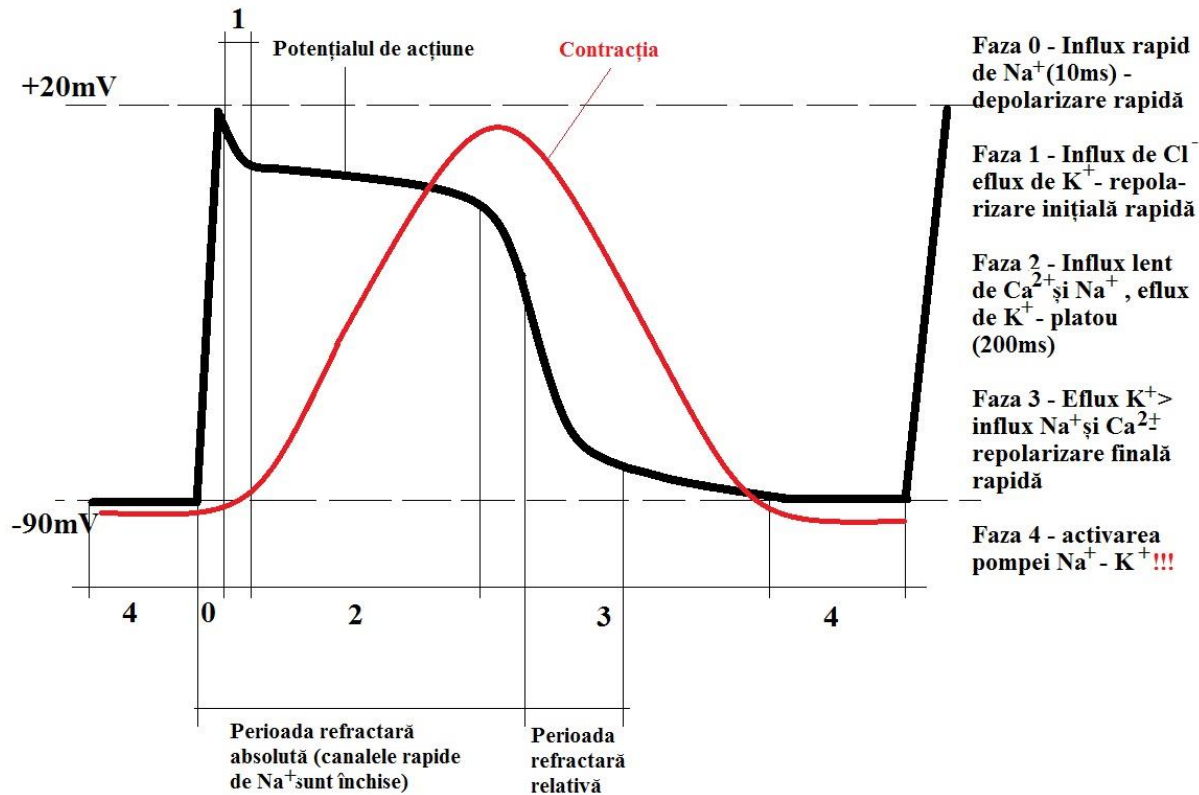
- Depolarizarea septului - 0,02s;
- Depolarizarea ventriculelor - 0,04-0,05s;
- Depolarizarea segmentelor bazale ale ventriculelor 0,06-0,08s;
- Unda de depolarizare cuprinde ventriculele în întregime în 0,08-0,1s.

Funcțiile inimii - excitabilitate

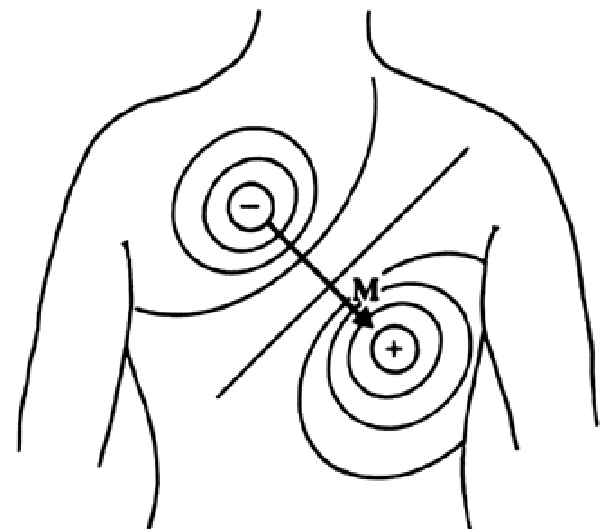
- Capacitatea mușchiului cardiac de a se excita sub influența impulsurilor.
- Fazele 0, 1, 2 ale PA – perioada refractară absolută;
- Faza 3 – perioada refractară relativă.

Funcțiile inimii - contractilitate

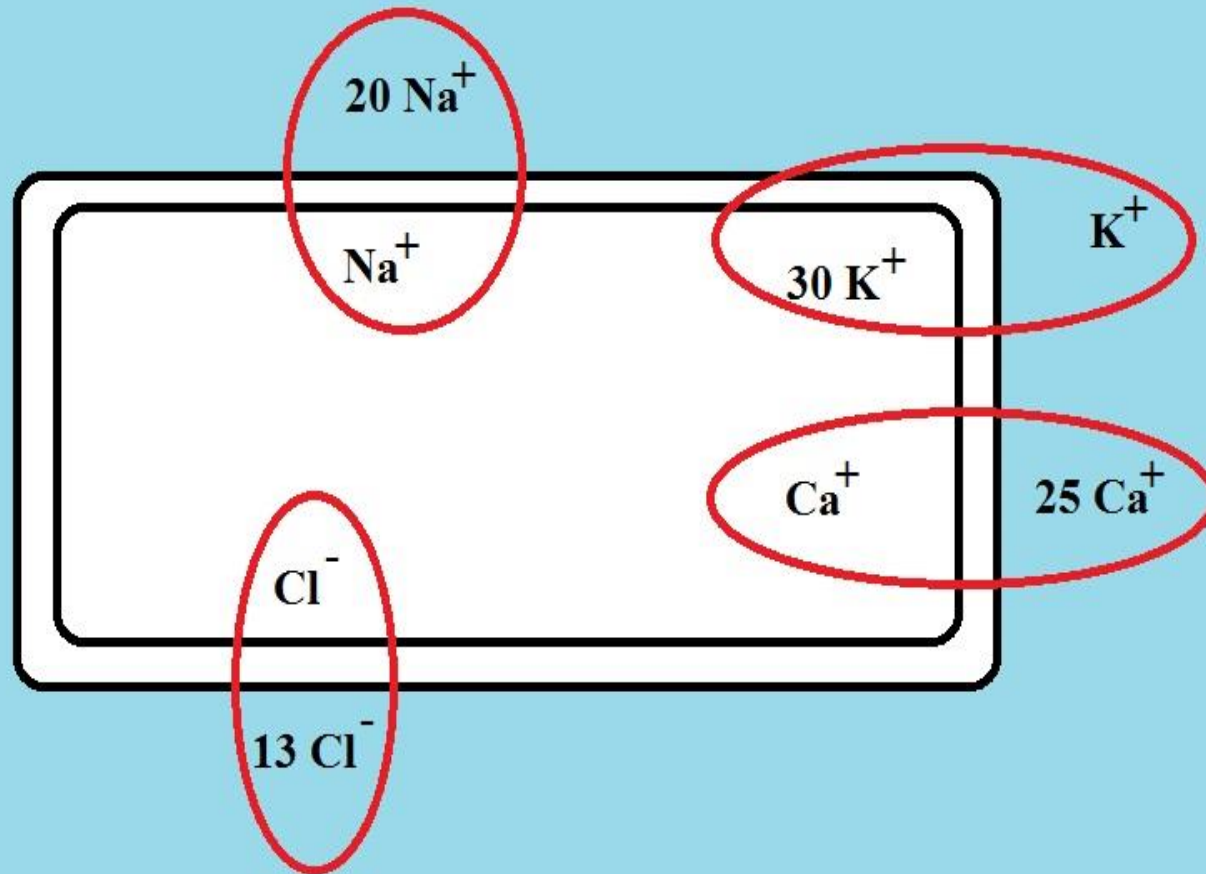
- Capacitatea mușchiului cardiac de a se contracta sub influența impusurilor.



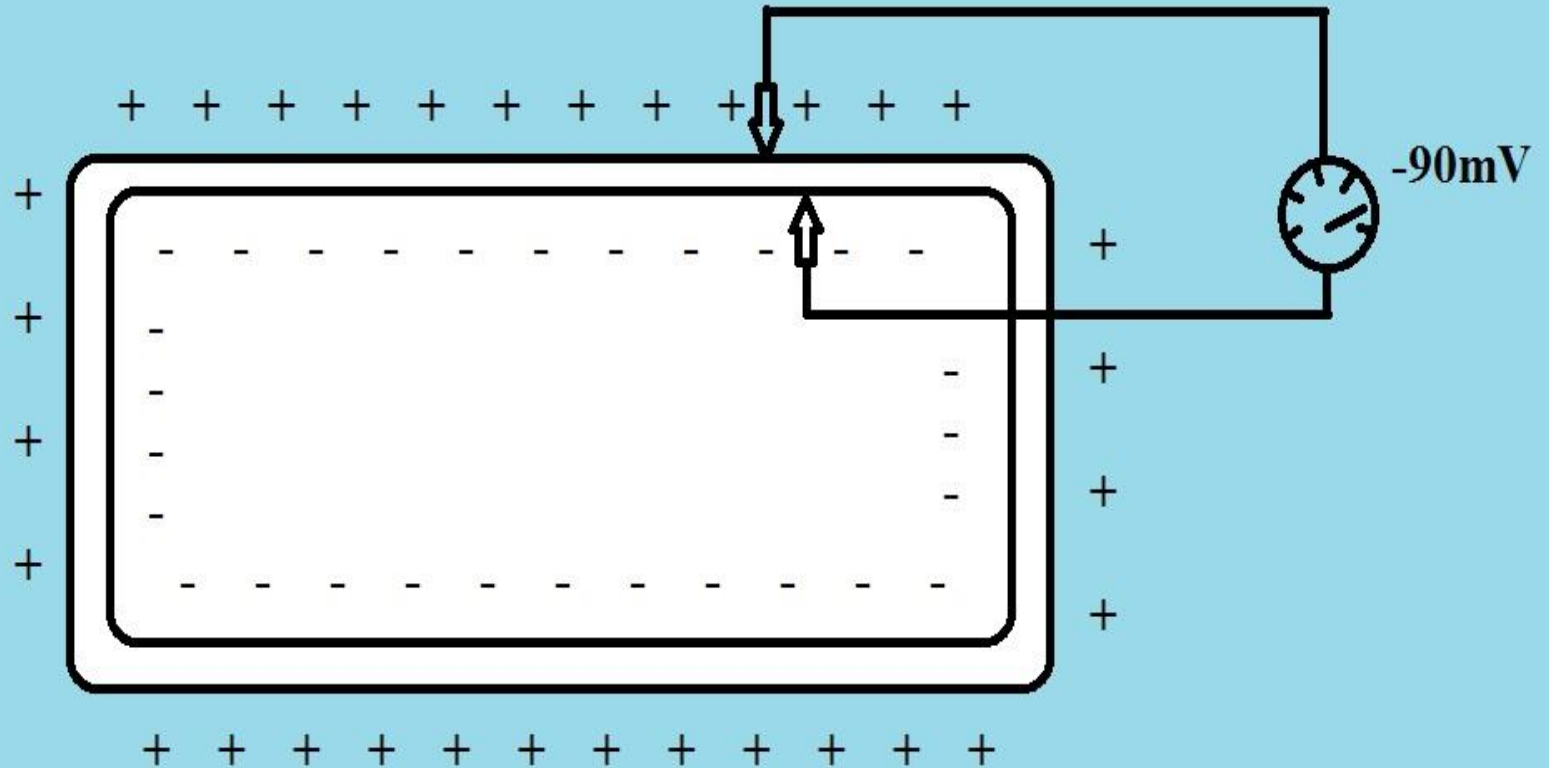
- Dipol cardiac;
- Vector rezultat mediu al TEM a inimii;
- Vector sumar;



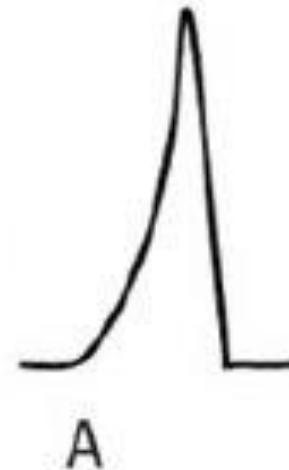
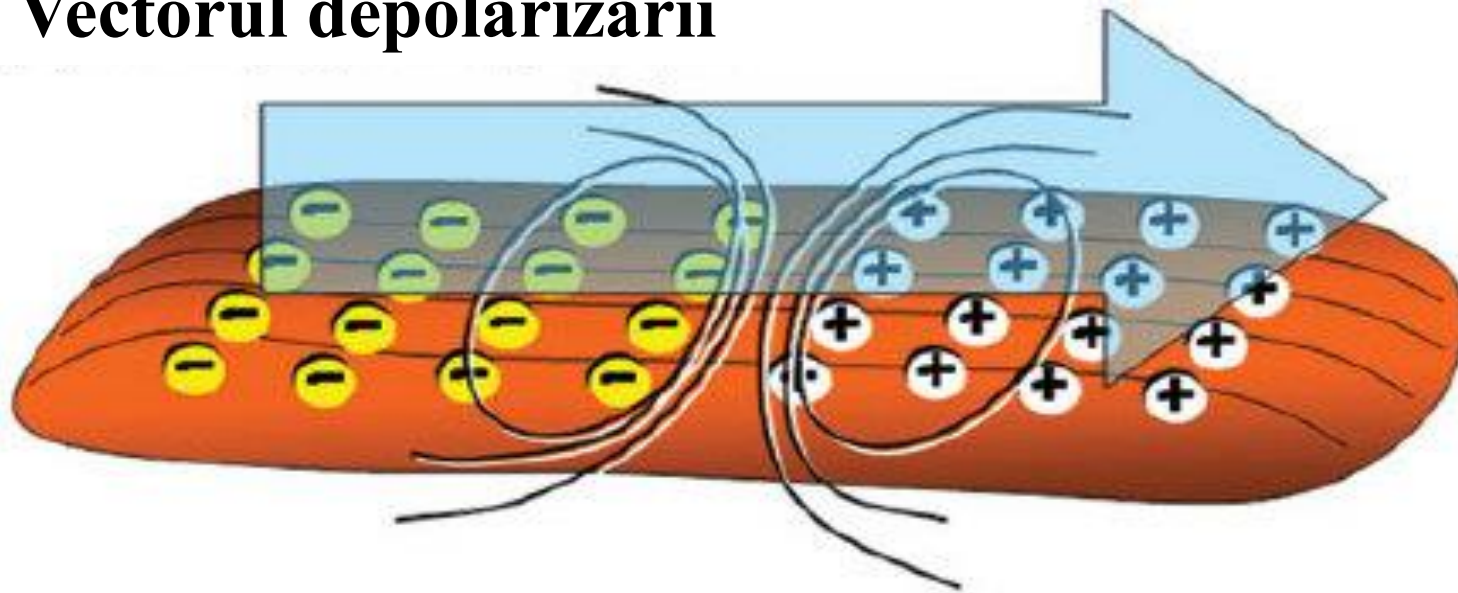
Potențialul de membrană



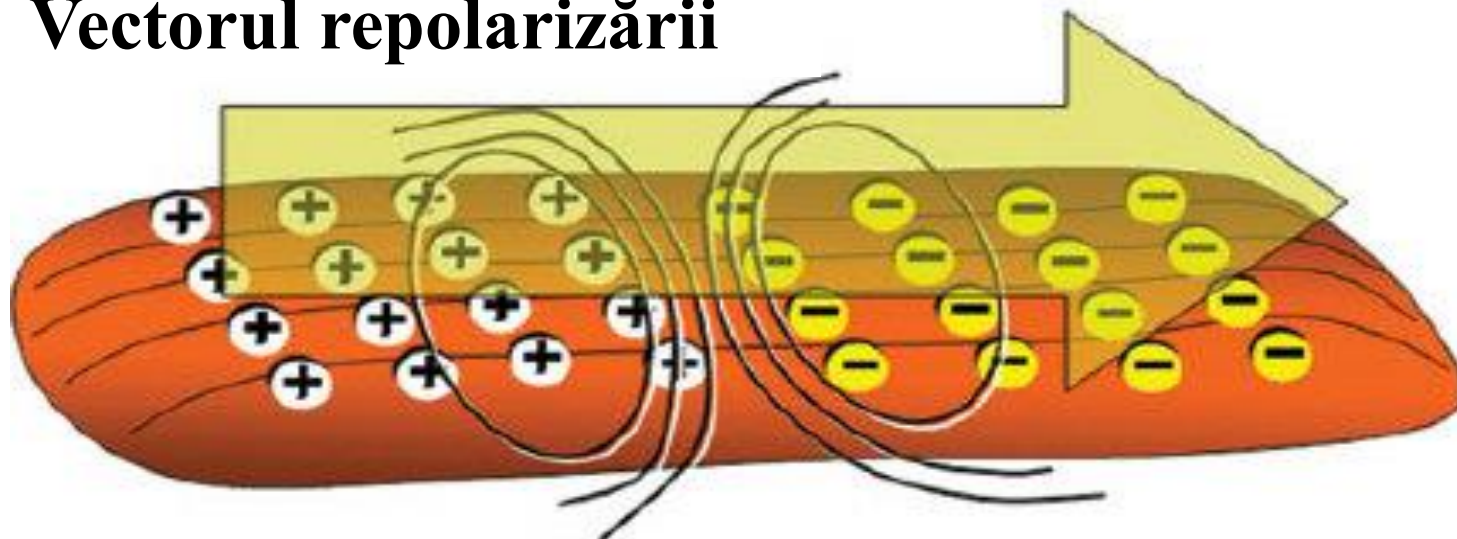
Potențialul de membrană



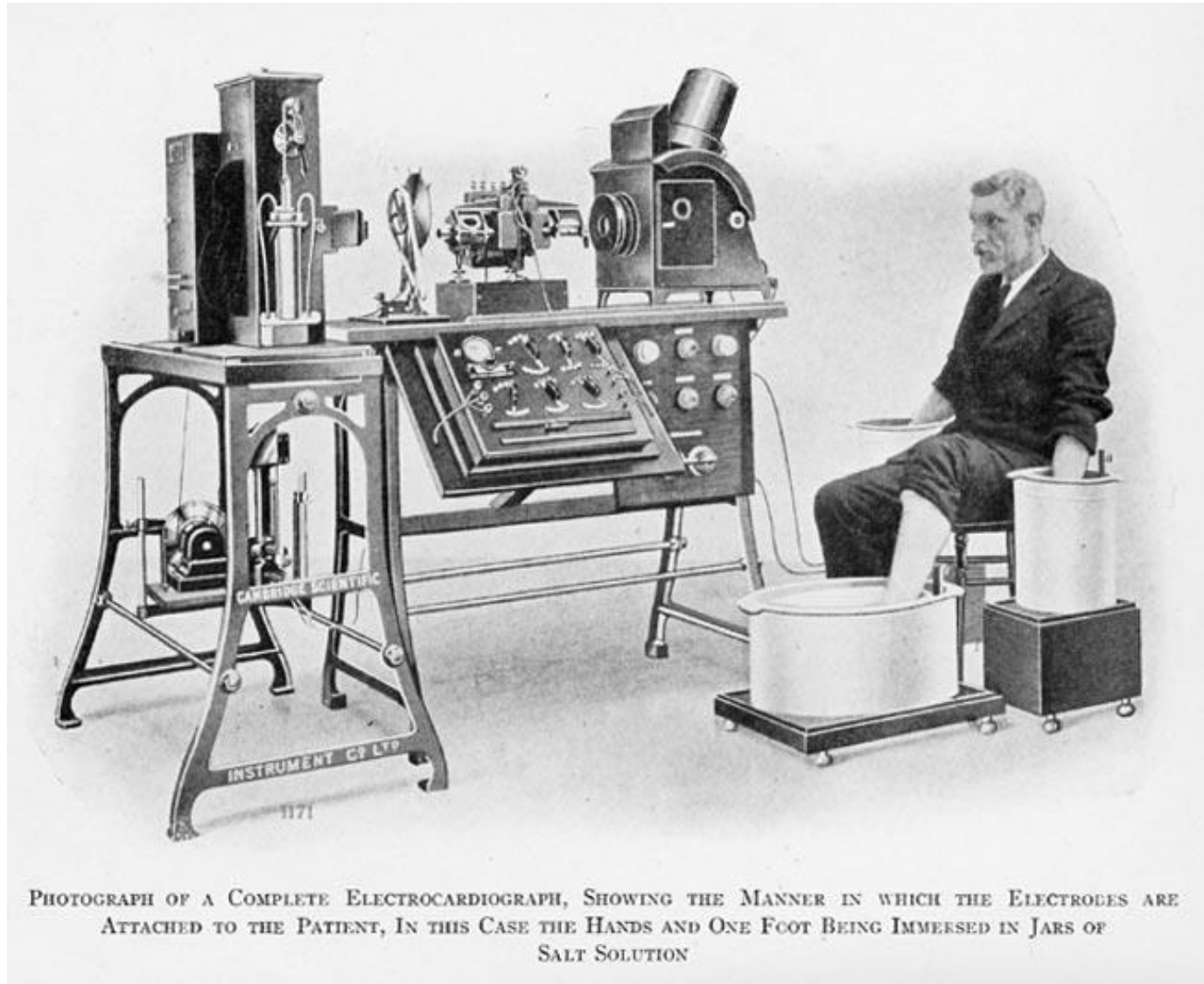
Vectorul depolarizării



Vectorul repolarizării



Înregistrarea electrocardiogramei







Derivațiile bipolare (standard) ale membrelor

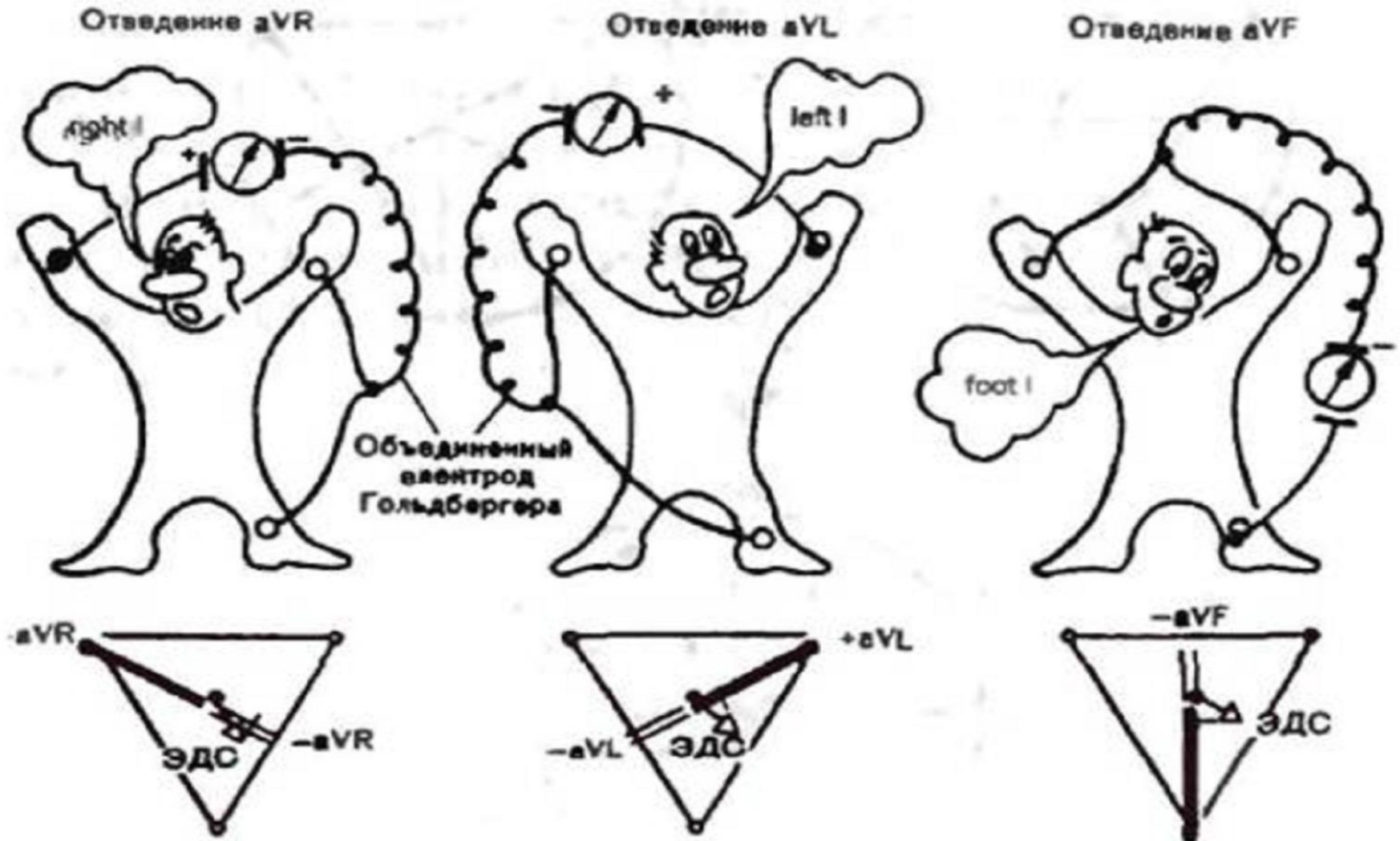
I, II și III au fost introduse în practică de către Einthoven.

Ele formează un triunghi echilateral, cu inima localizată în centru.

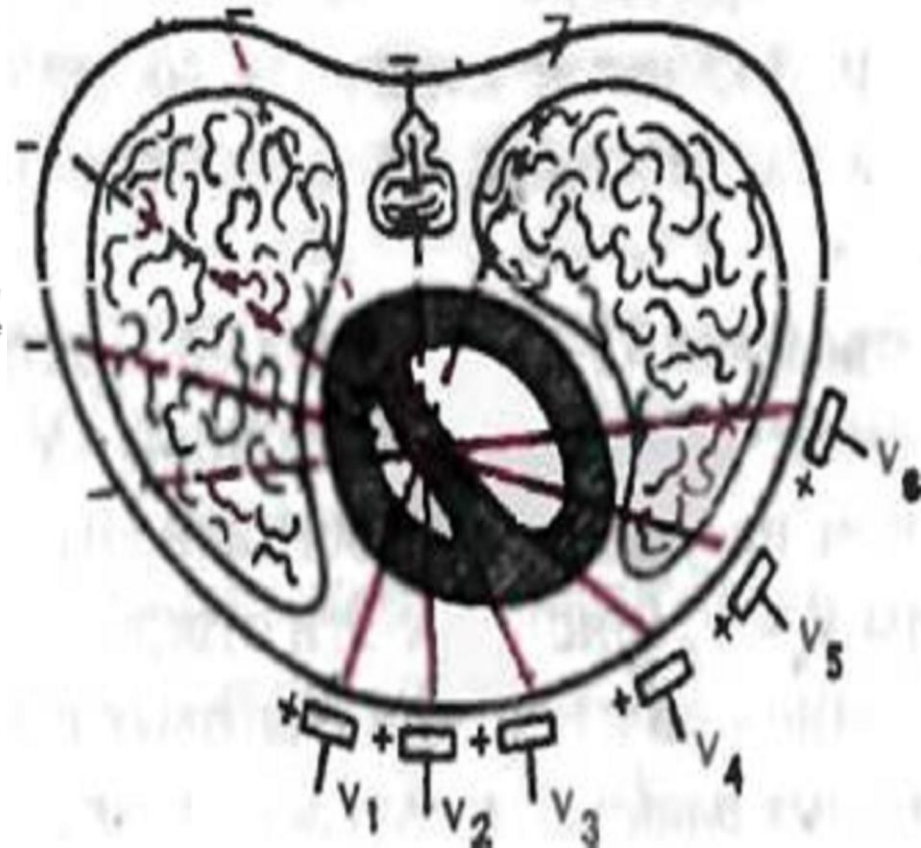
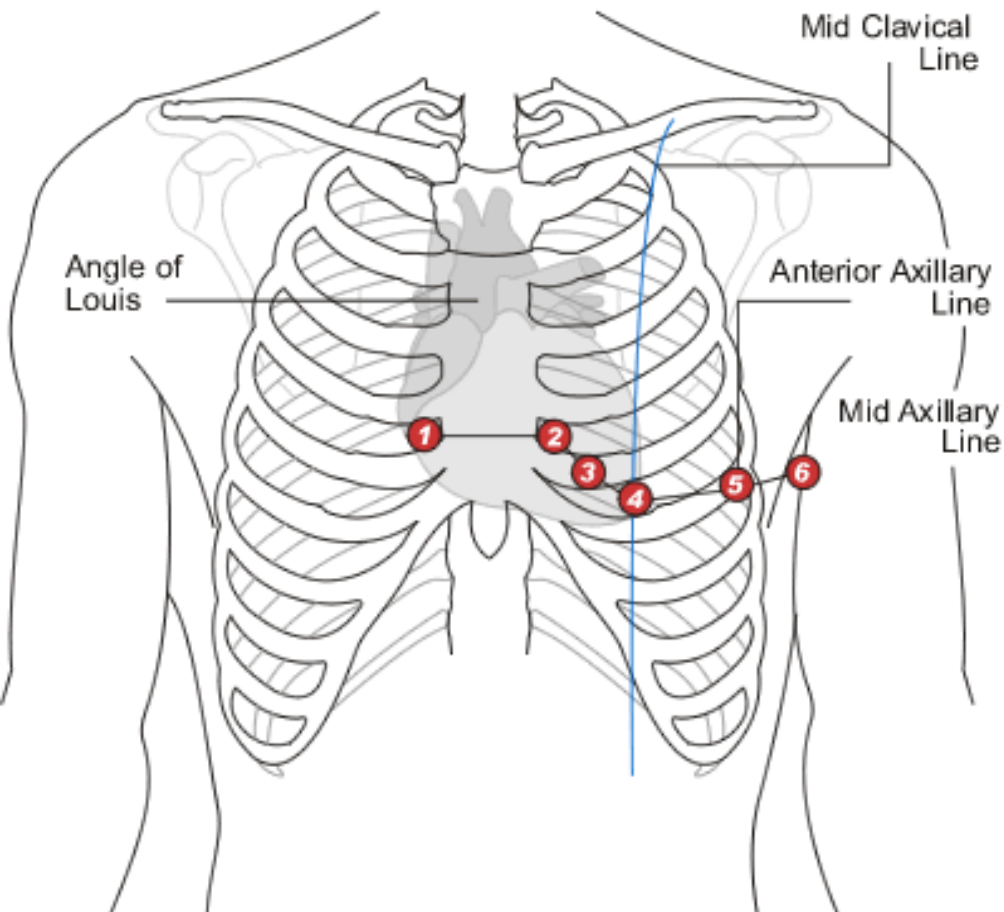


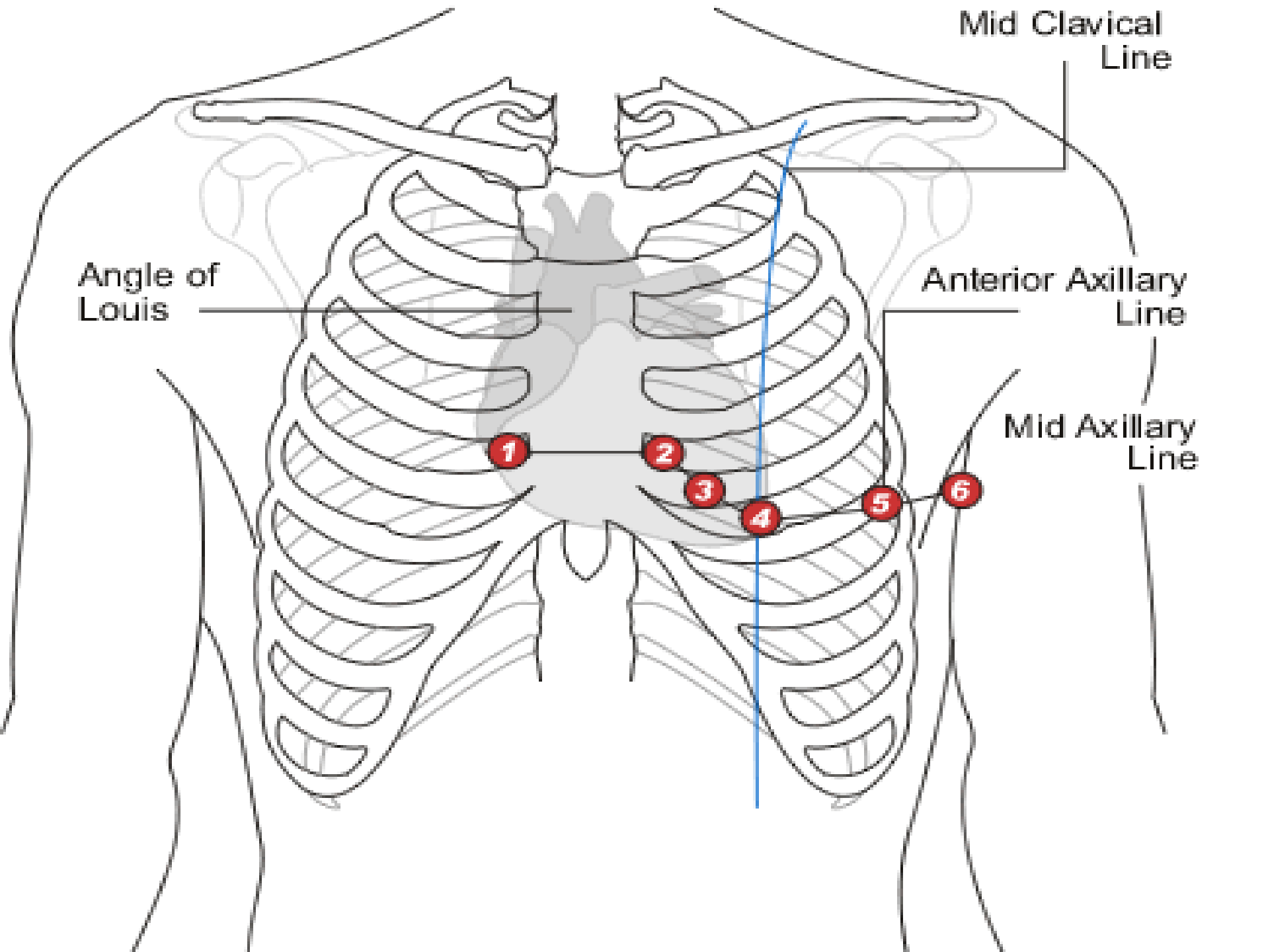
Derivațiile unipolare ale membrelor - AVR, AVL, AVF

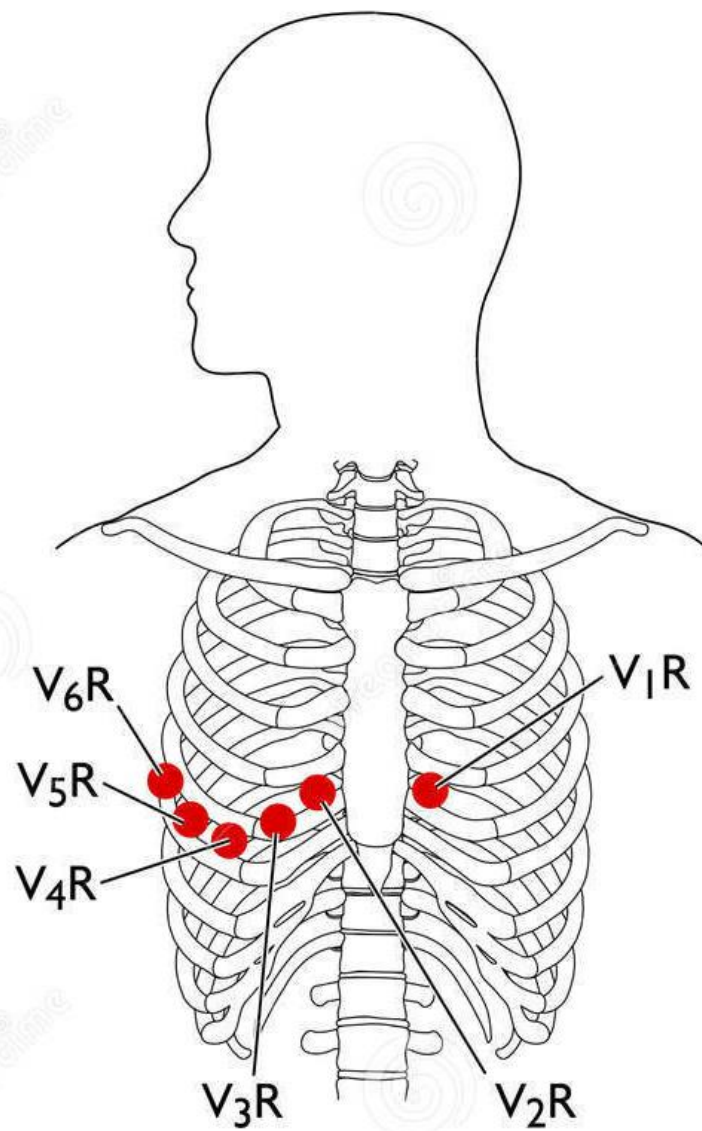
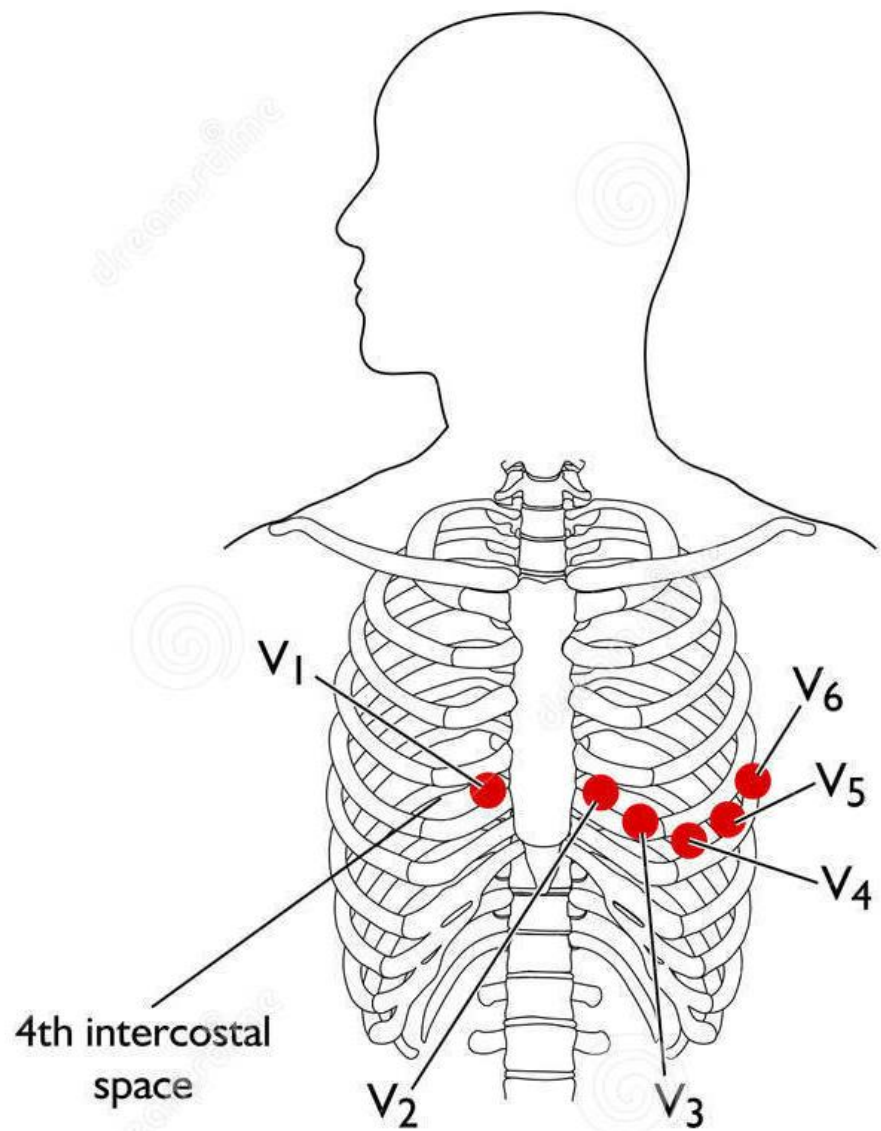
Au fost introduse de Goldberger în 1942.

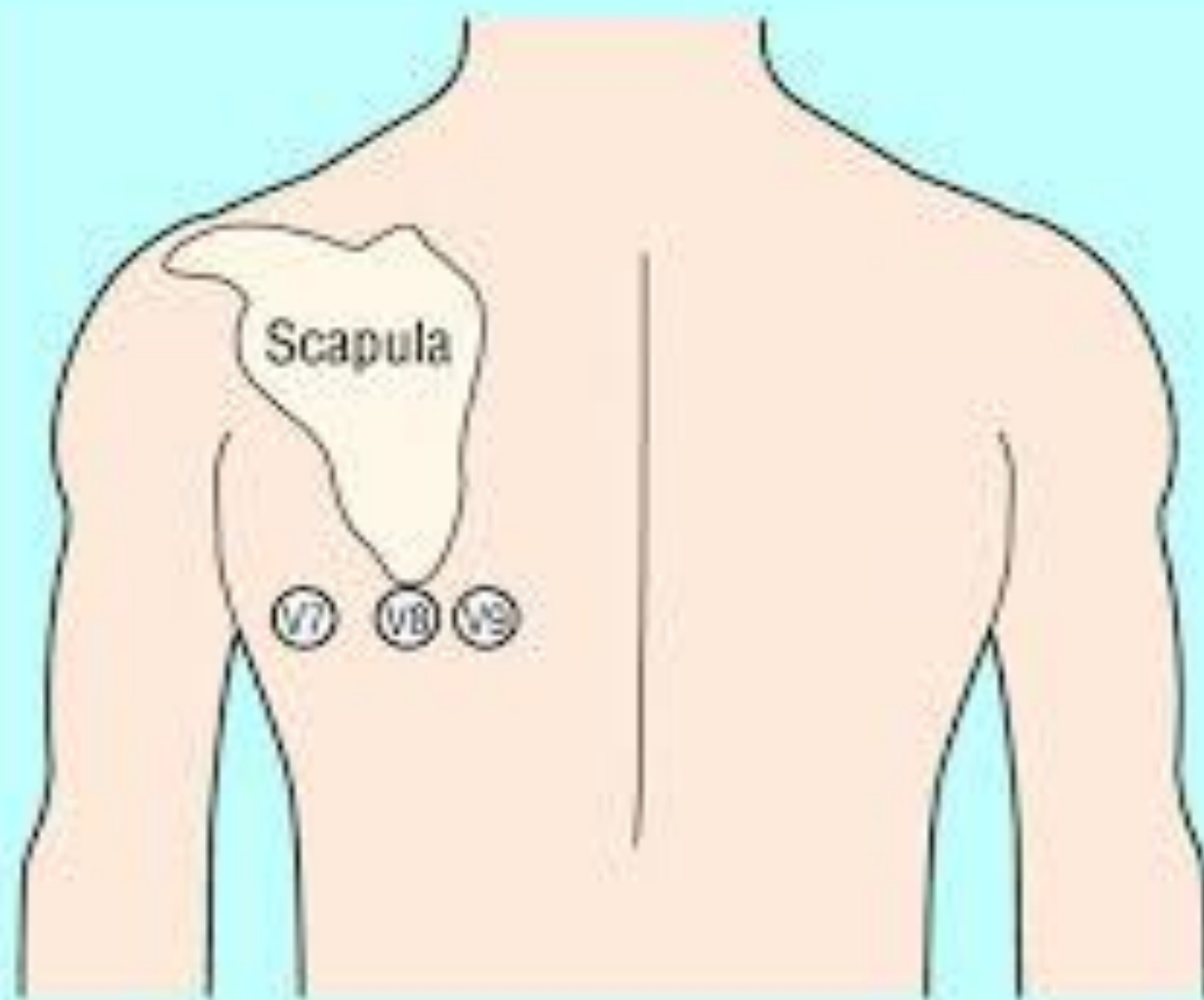


Derivațiile precordiale - V1-V6 sunt derivații unipolare, electrodul explorator (pozitiv) este plasat pe torace, în apropierea cordului. Au fost introduse de Wilson în 1934.





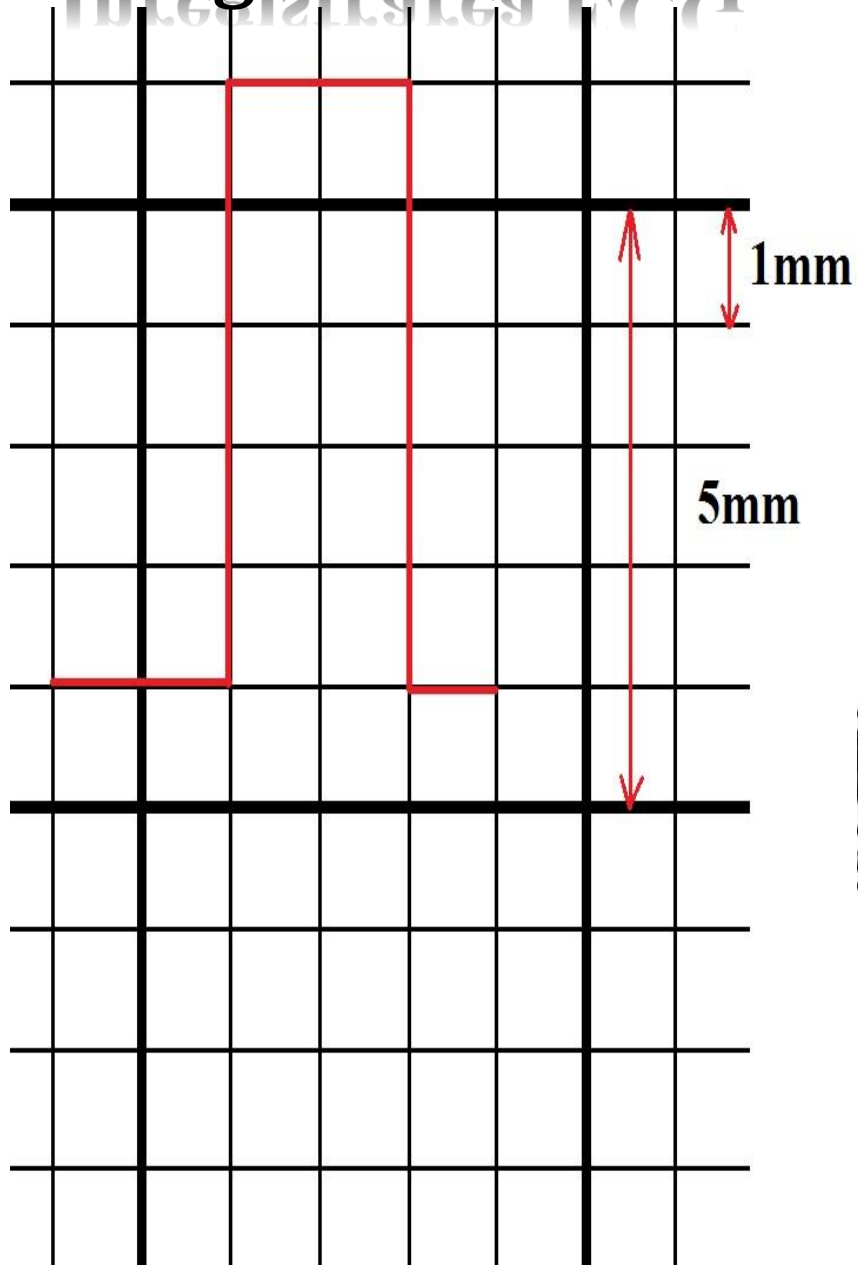




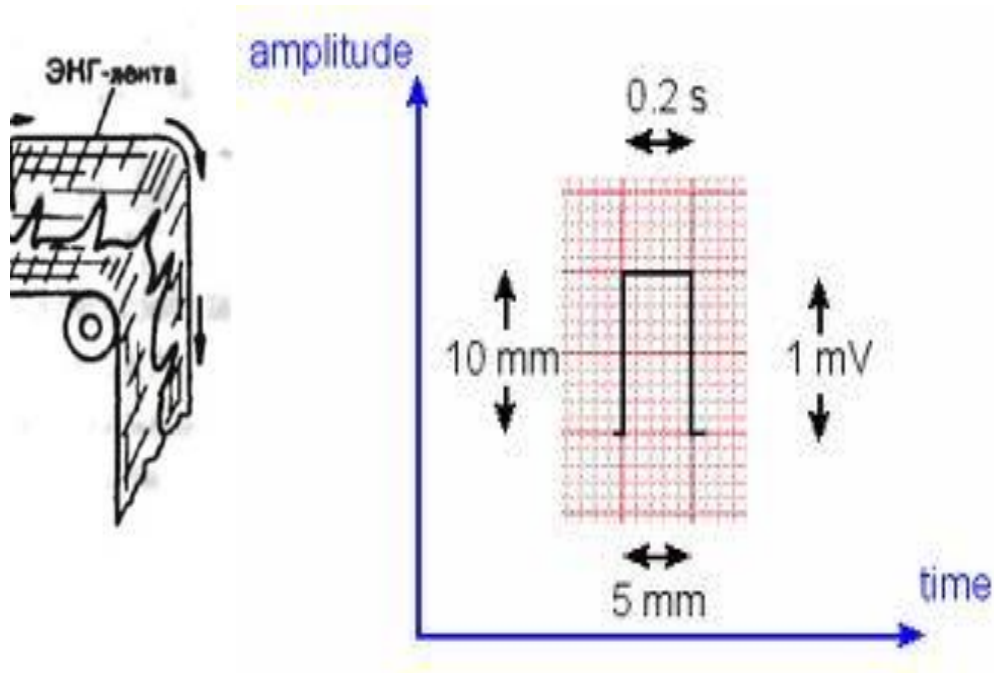
Algoritmul EKG

1. **Datele pașaportale**
2. **Voltaj**
3. **Ritm**
4. **FCC**
5. **AEC**
6. **Analiza fiecărui interval, undă, complex**

Înregistrarea ECG

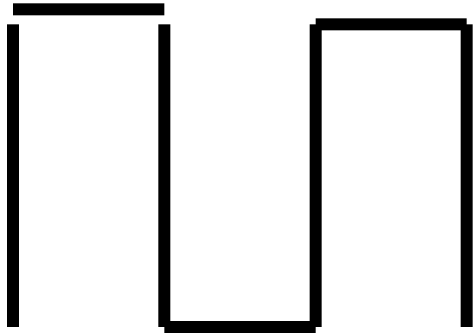


2 viteze - 25,
50mm/sec;
 $1\text{mV} = 10\text{mm}$;
 $1\text{mm} = 0,02\text{sec}$
la 50mm/sec;
 $1\text{mm} = 0,04\text{sec}$ la
25mm/sec

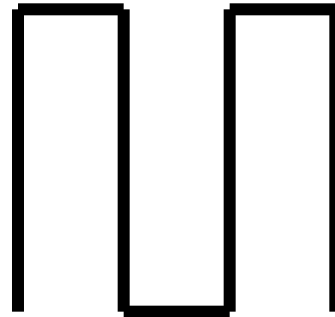


Voltaj

50 mm/sec

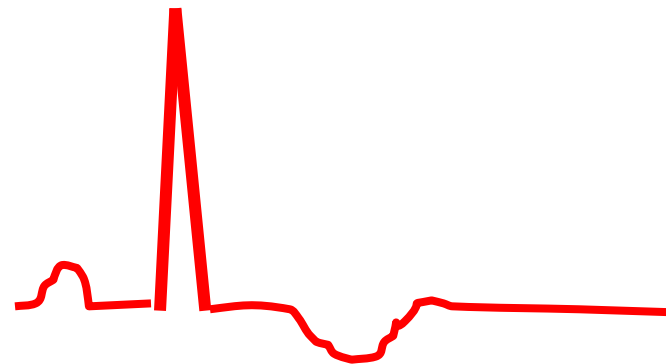
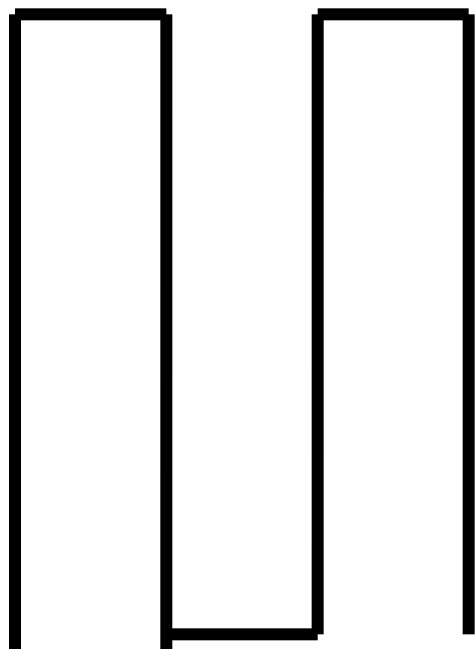


25 mm/sec



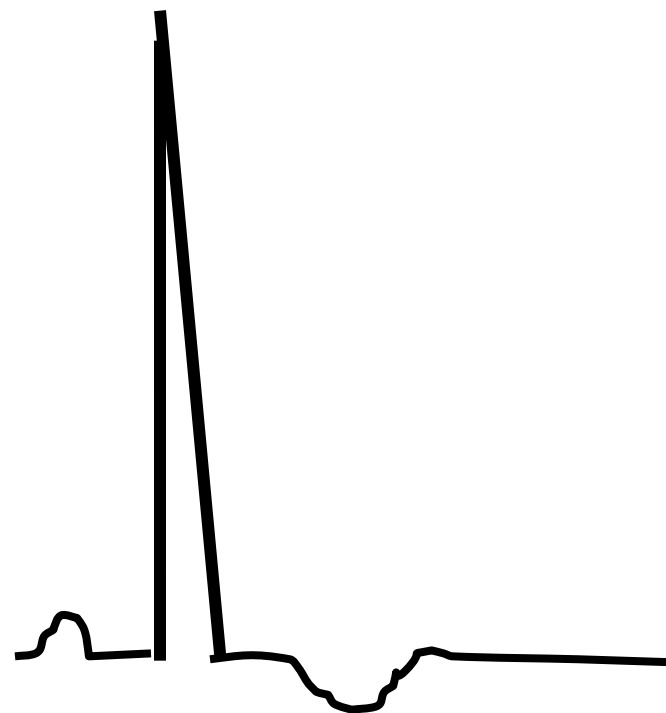
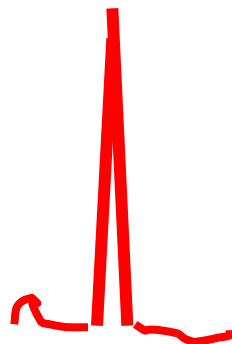
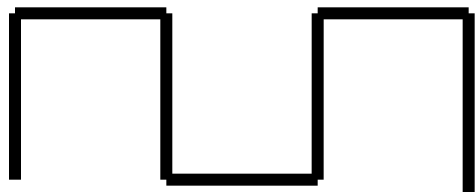
Voltaj

2/1



Voltaj

$1/2$

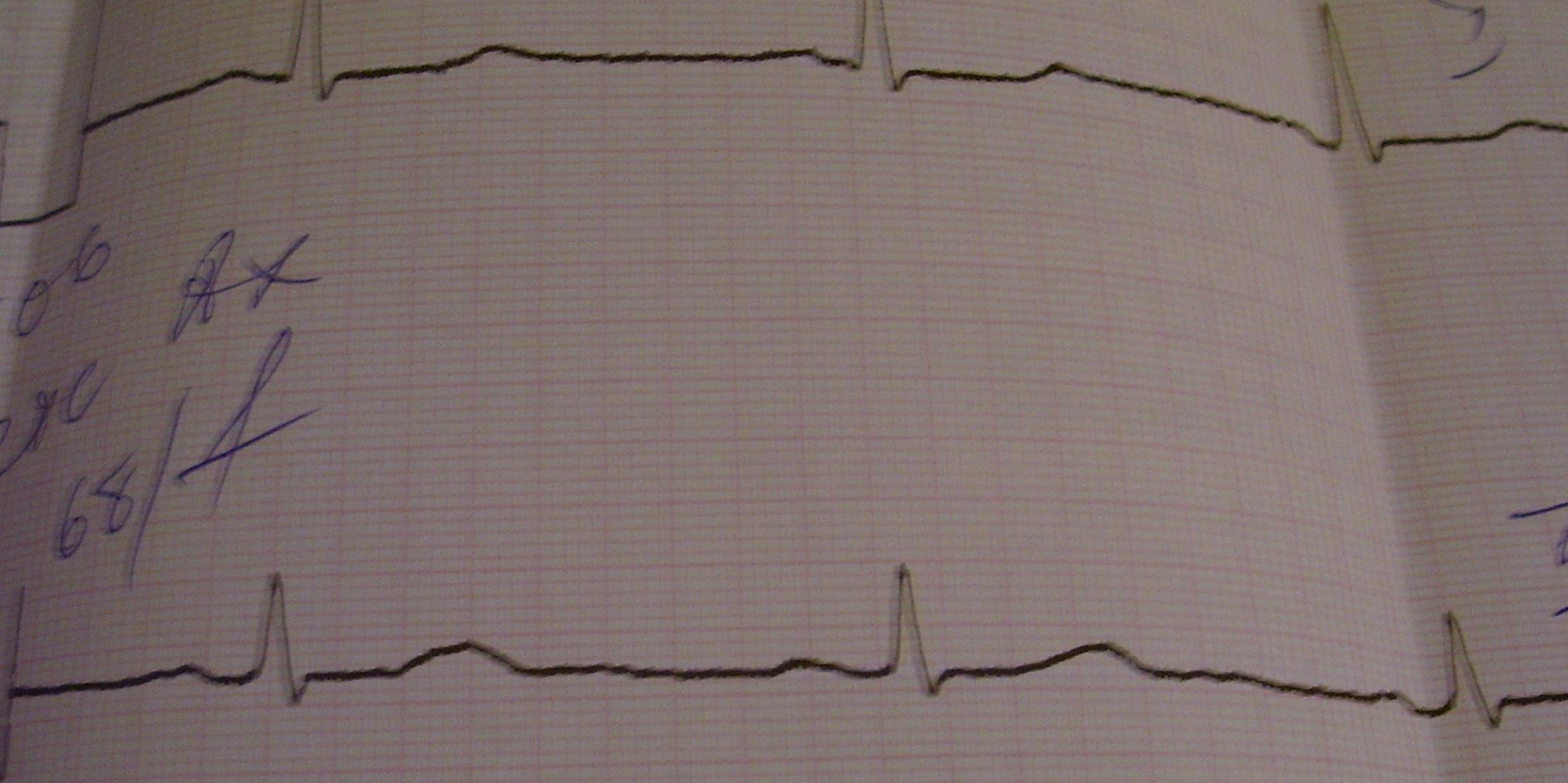


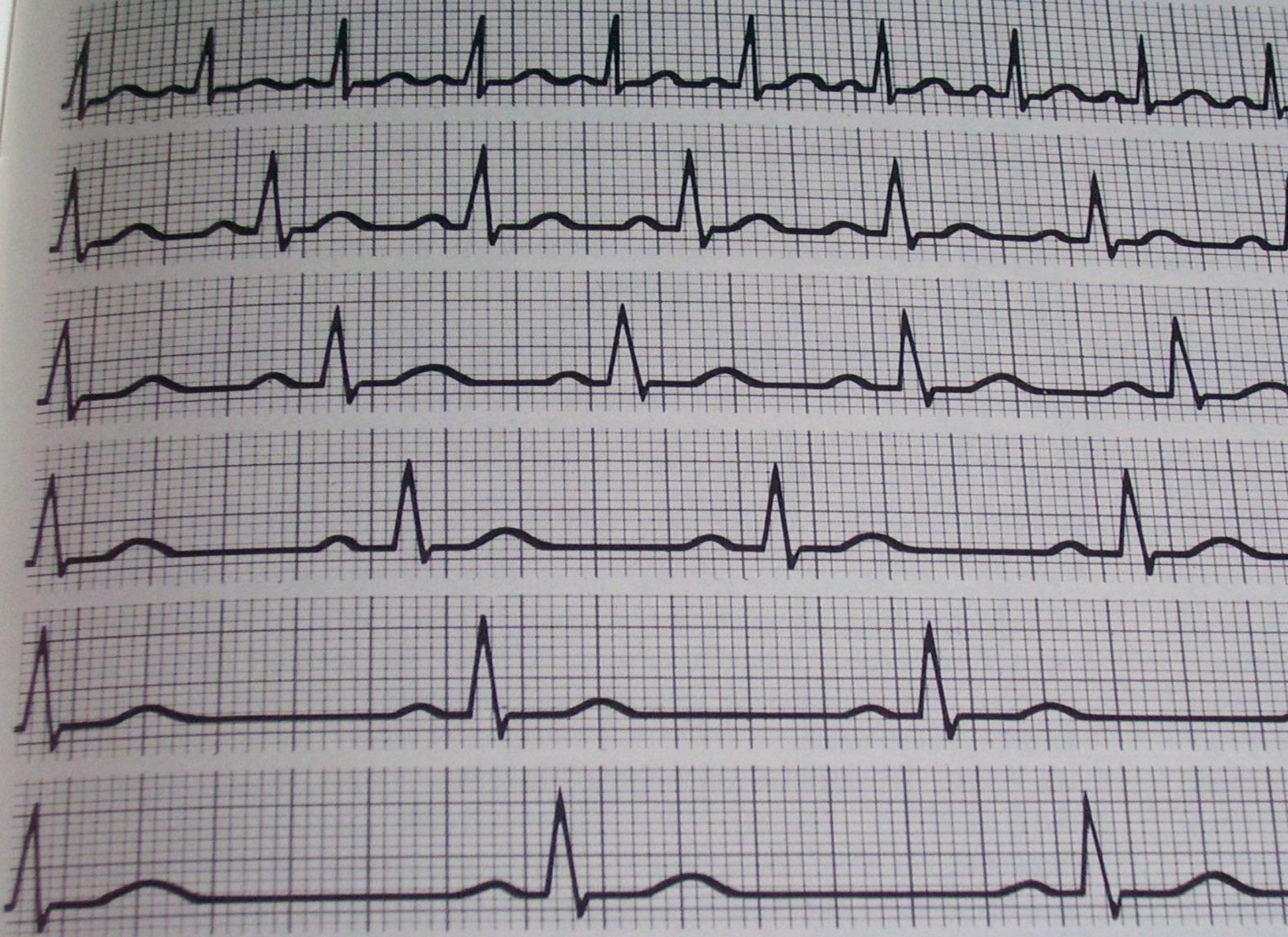
Ritm

sinusal

- 1. Distanța RR egală**
- 2. Unda P pozitivă**
- 3. Înaintea fiecărui complex QRS**

ob Rx
70
68/1

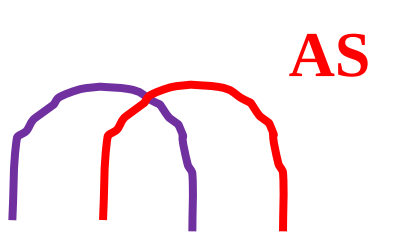




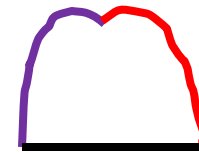
Unda P

normală

AD



1,5 – 2,5 mm



0,1 mm/sec

Derivațiile I, II, III, AVL, AVF, V₂-V₆

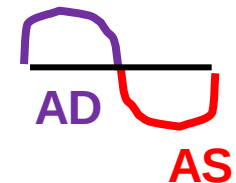
unda P pozitivă

Derivația AVR

unda P negativă

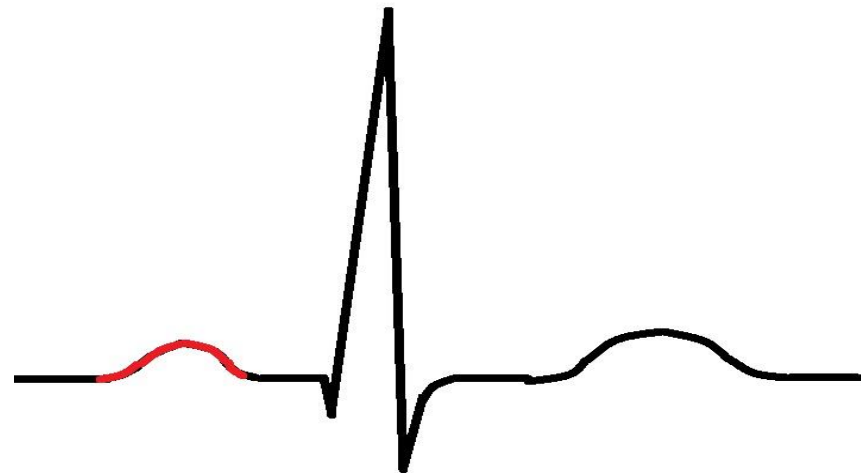
Derivațiile V₁

unda P ±

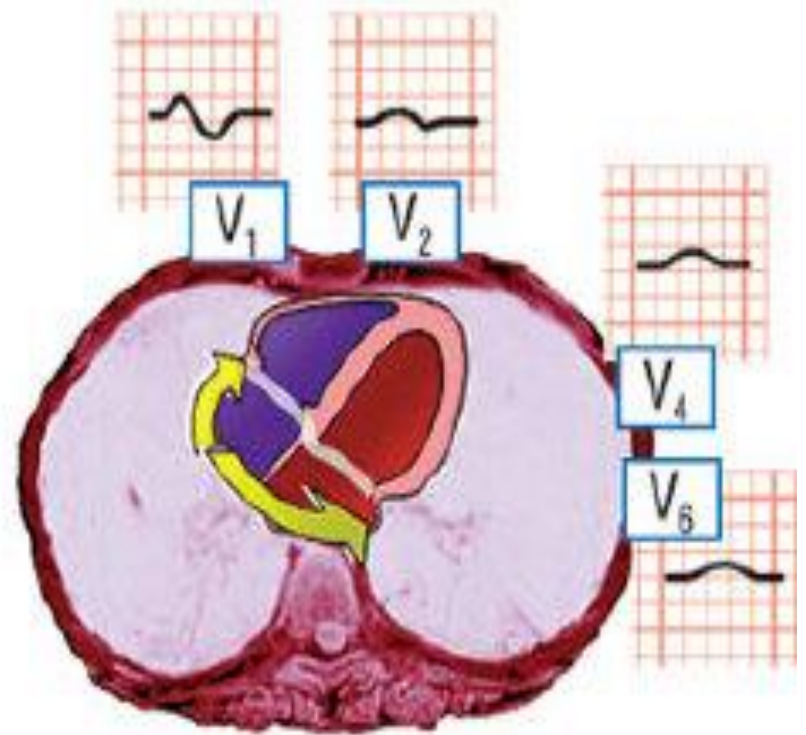
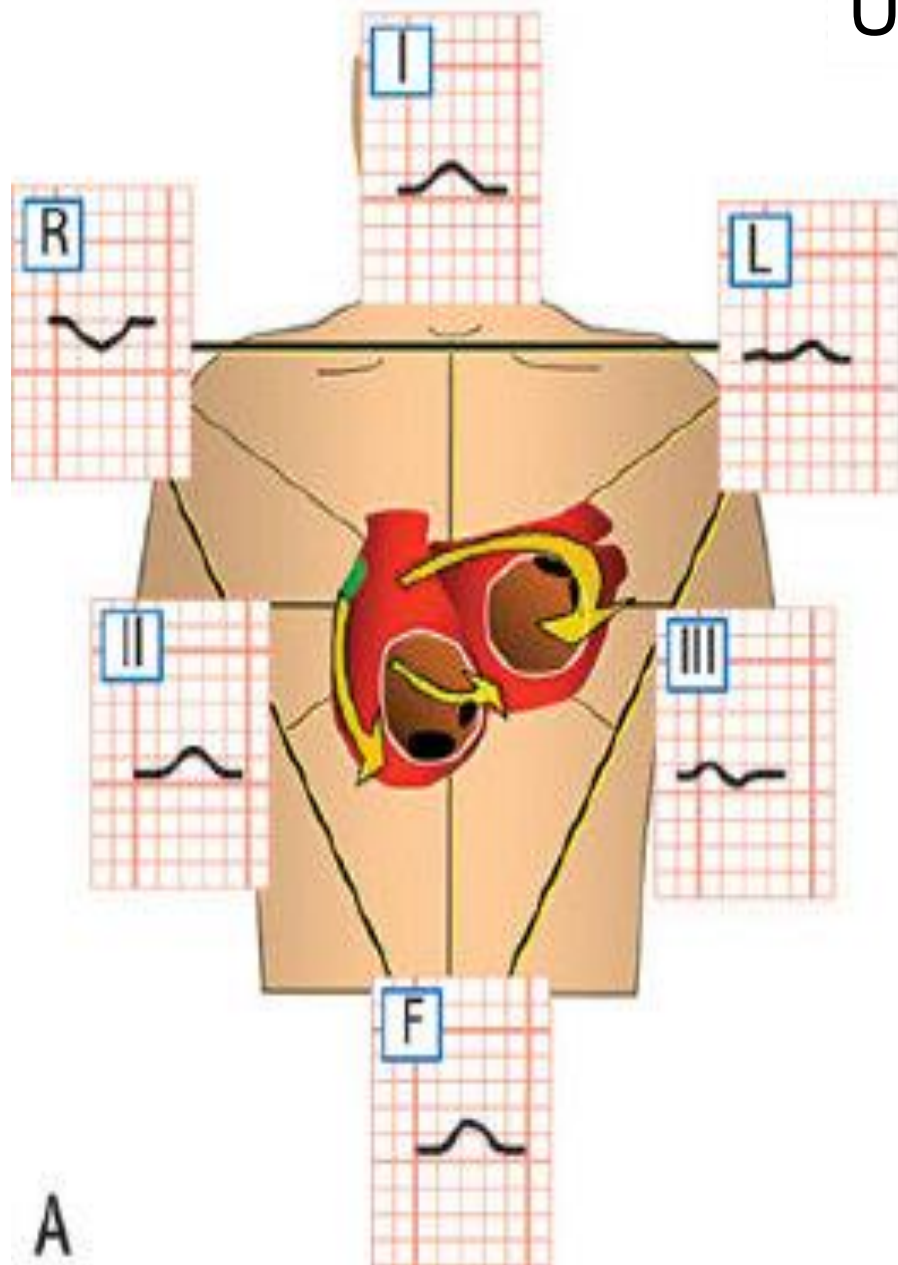


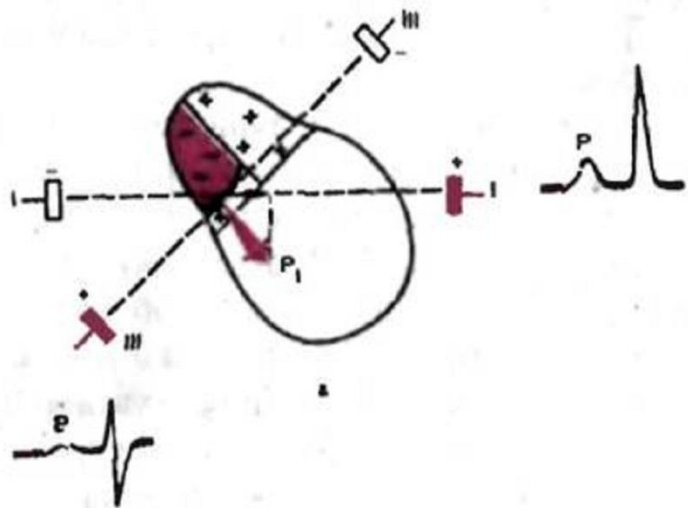
Caracteristica undei P

- În derivațiile I, II, aVF, V_2 - V_6 unda P este întotdeauna pozitivă;
- În aVR întotdeauna negativă;
- În III, aVL, V_1 unda P poate fi pozitivă, bifazică (+ -),
- în III, aVL uneori negativă;
- Durata undei P $\leq 0,1$ sec,
- amplitudinea 1,5-2,5mm.



Unda P normală





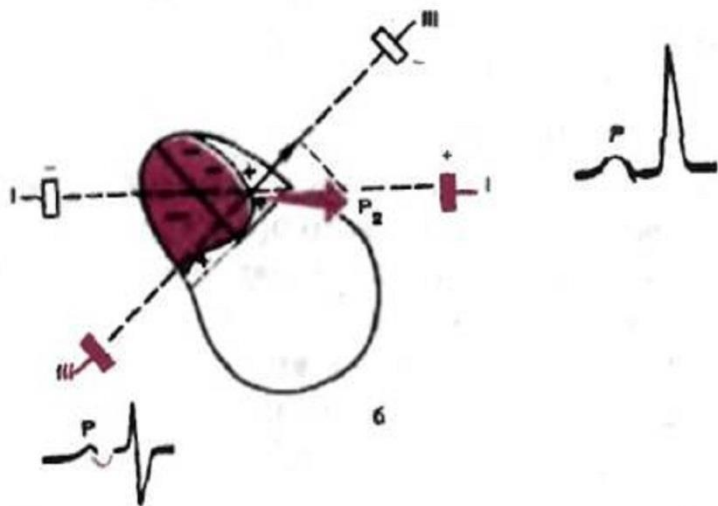
- Depolarizarea atriilor

Vectorul P_1 orientat în jos și puțin la stânga;

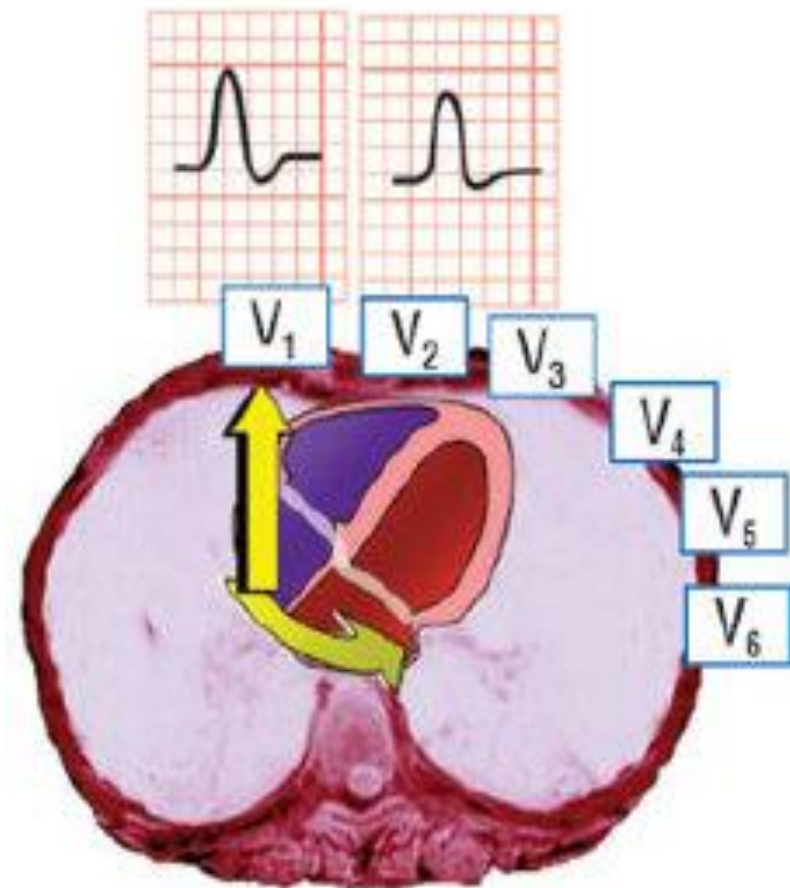
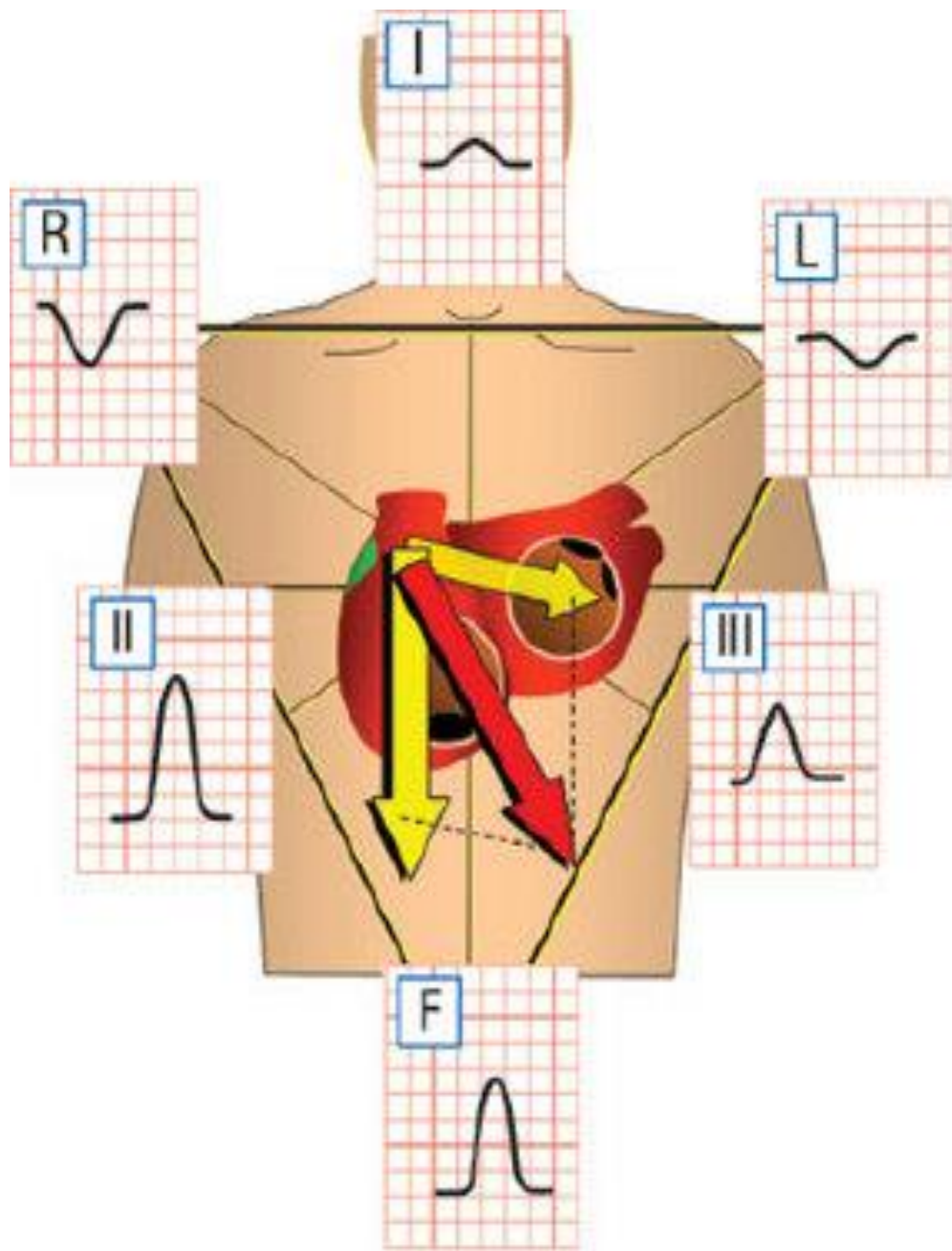
Vectorul P_2 orientat la stânga.

Vectorul sumar al depolarizării atriilor paralel axei derivației D II.

Repolarizarea atriilor nu poate fi văzută pe EKG.

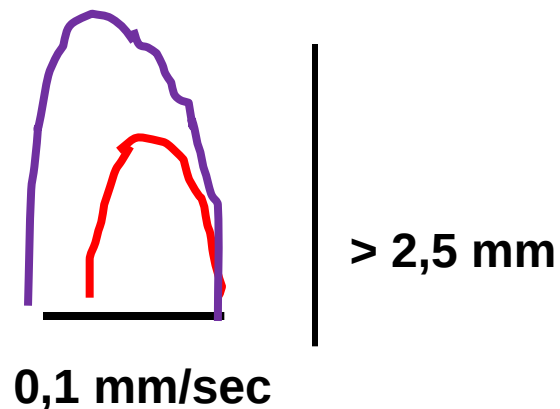
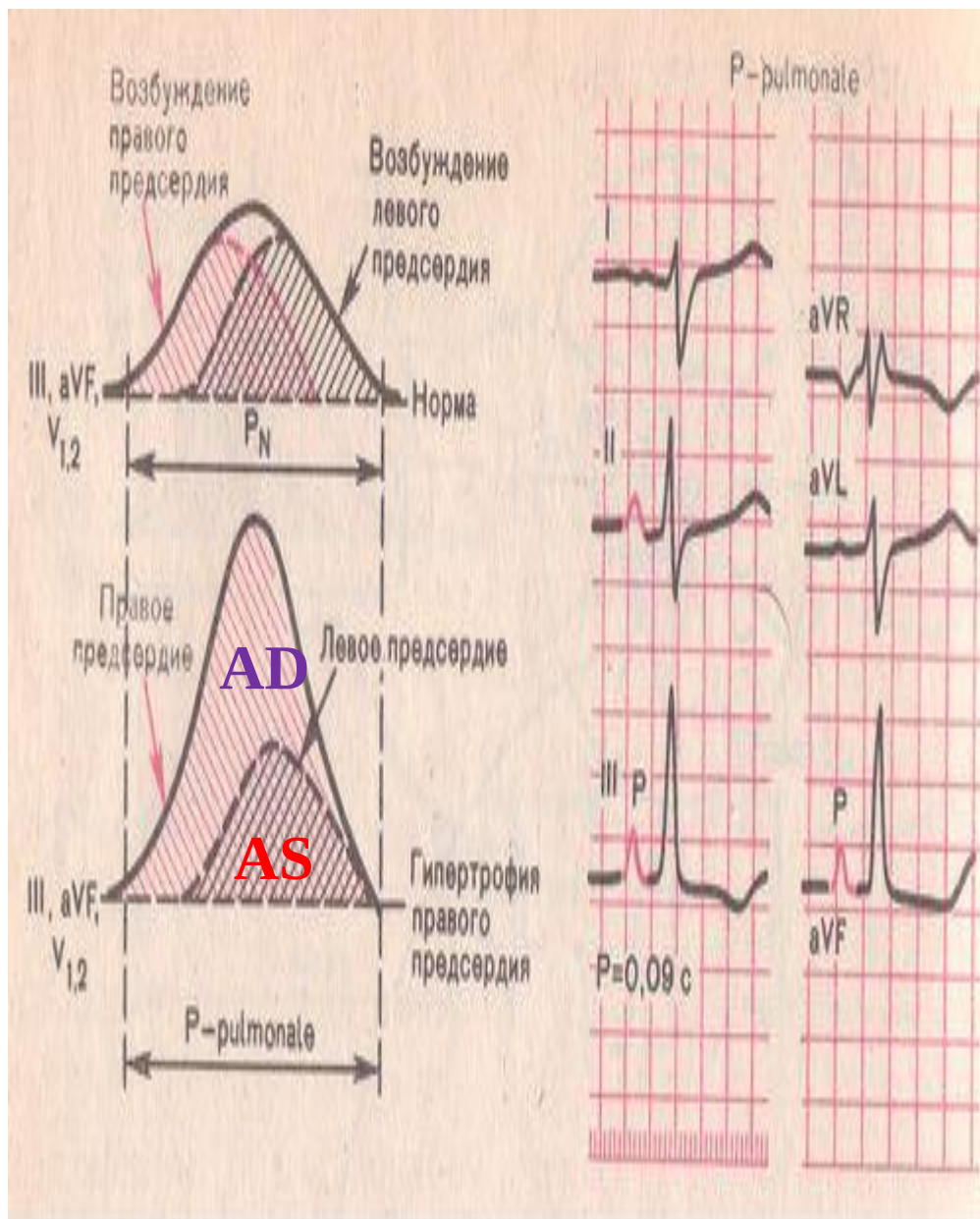


Hipertrofia AD P pulmonare



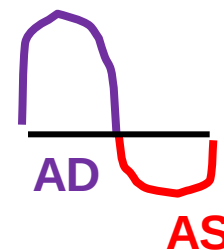
Unda P

Hipertrofia AD

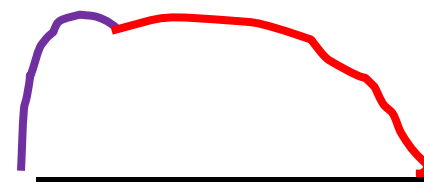
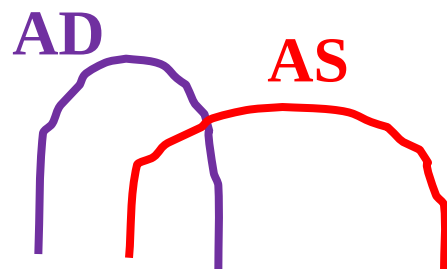


Derivațiile V1

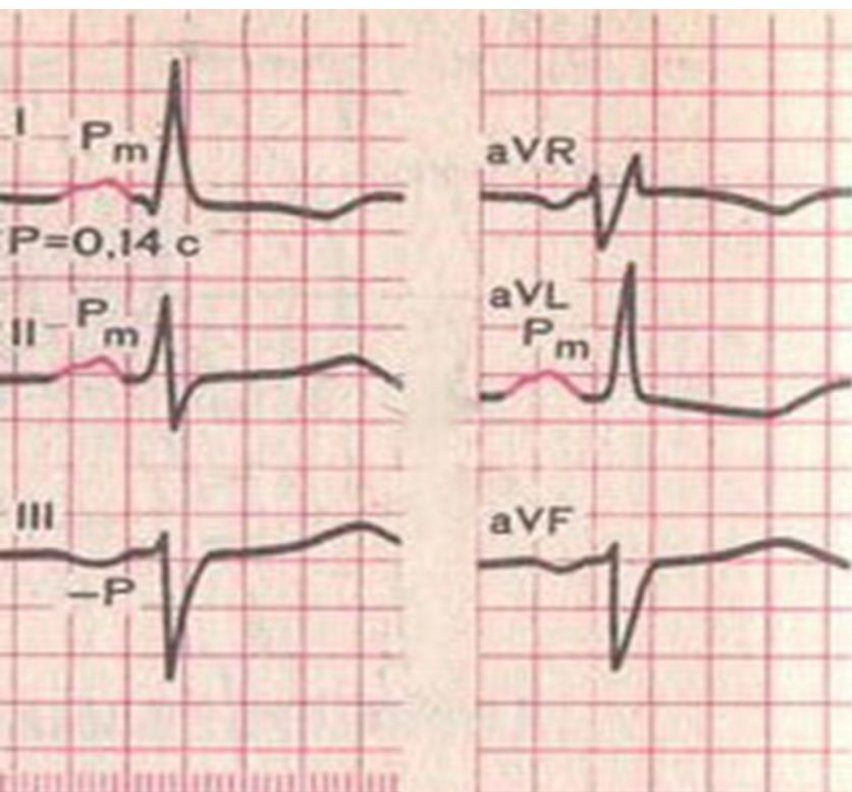
unda P $\pm$



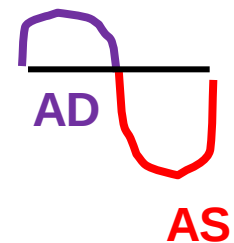
Unda P hipertrofia AS



> 0,1 mm/sec



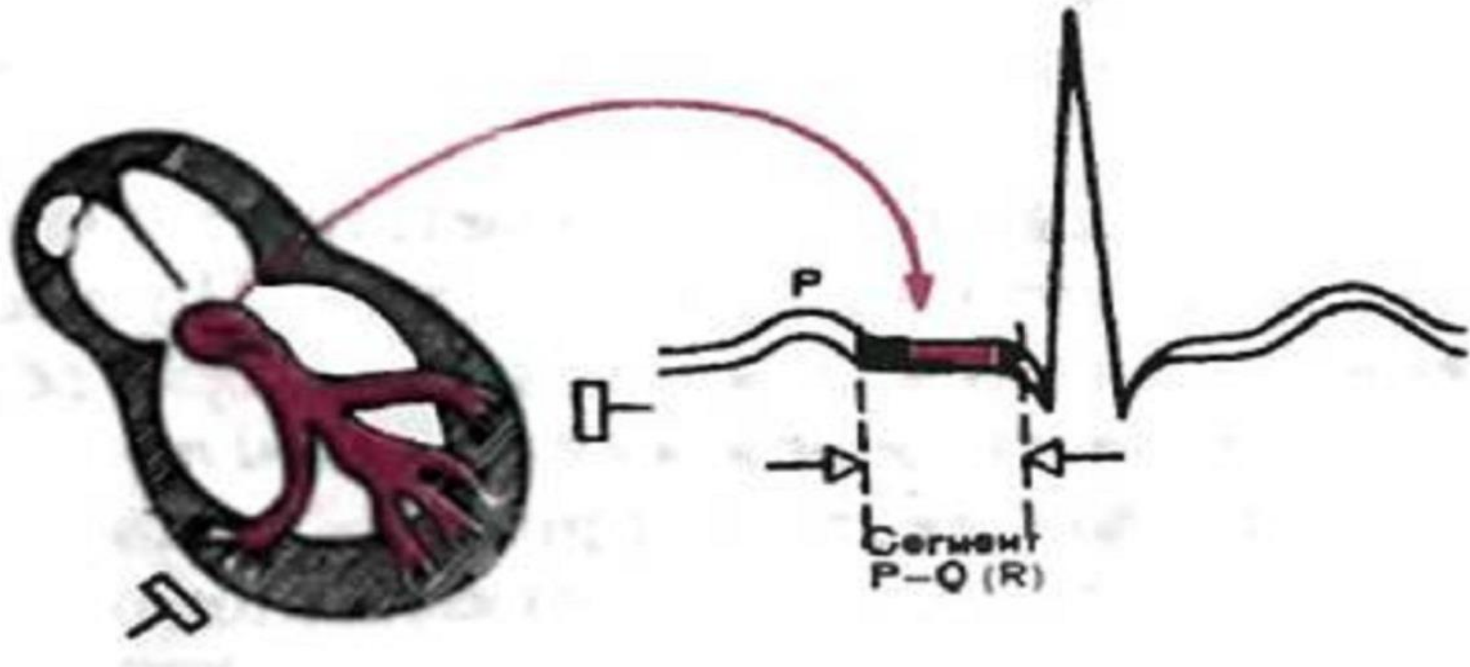
Derivațiile V₁, V₂
unda P ±



Depolarizarea nodului AV

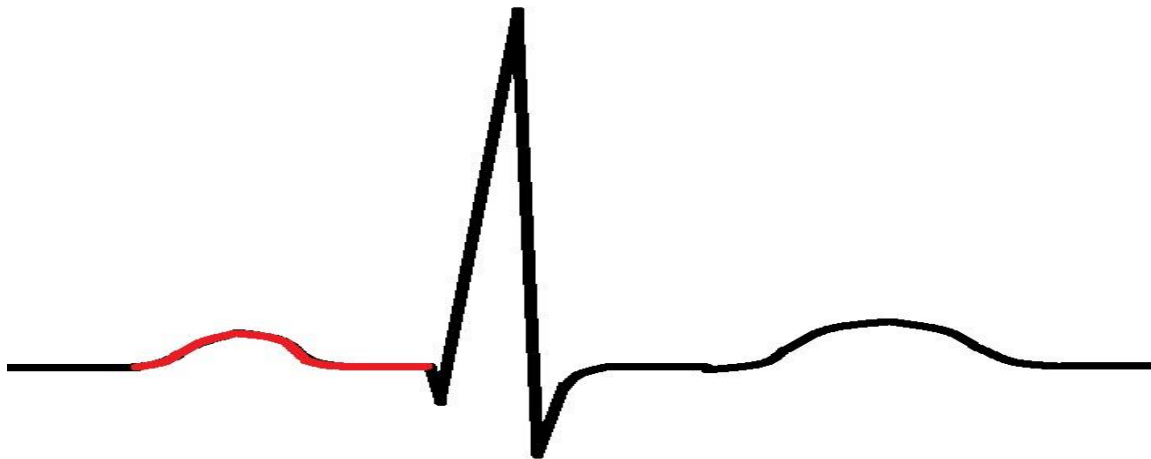
se produce lent;

Diferența de potențial apărută este mică pe EKG înregistrându-se un segment izoelectric P-Q (R)

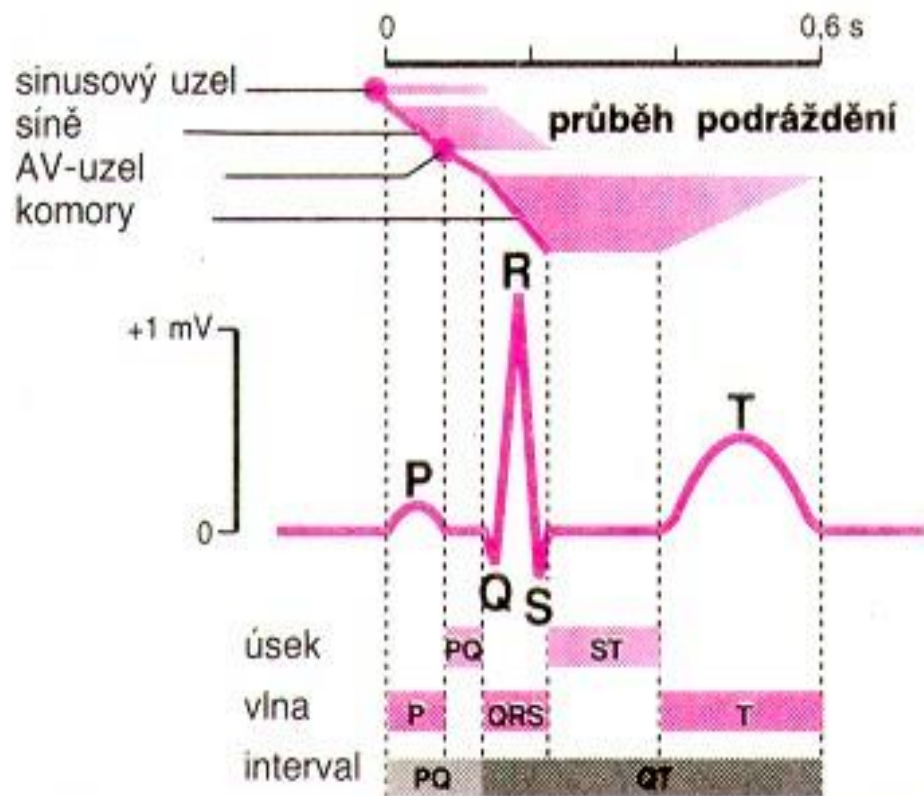


Caracteristica intervalului P-Q(R)

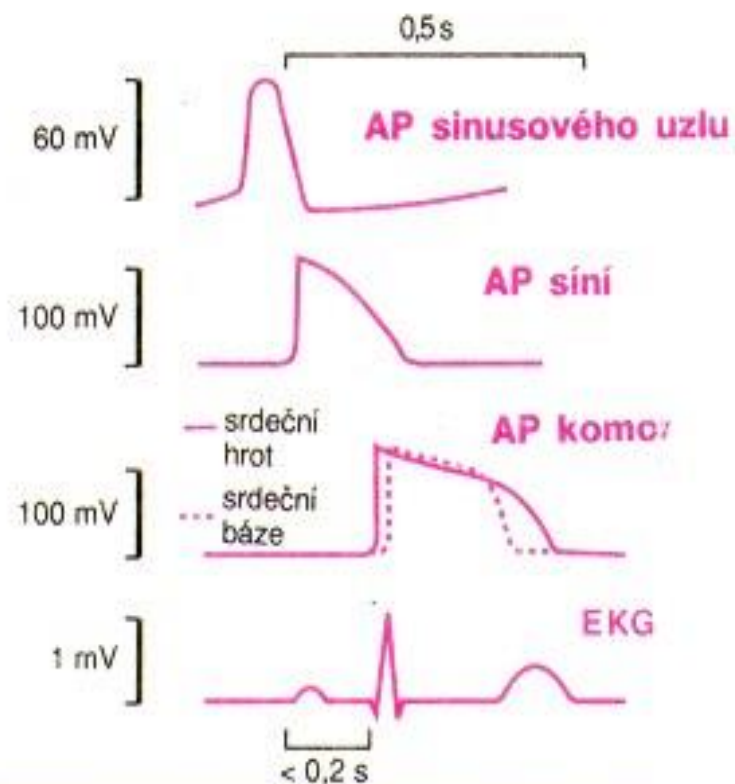
- Se măsoară de la începutul undei P până la începutul complexului ventricular QRS (unda Q sau R);
- Reprezintă răspândirea undei depolarizării în atri, nodul AV, fasc. Hiss și ramurile sale;
- Durata 0,12-0,2sec, depinde de FCC.



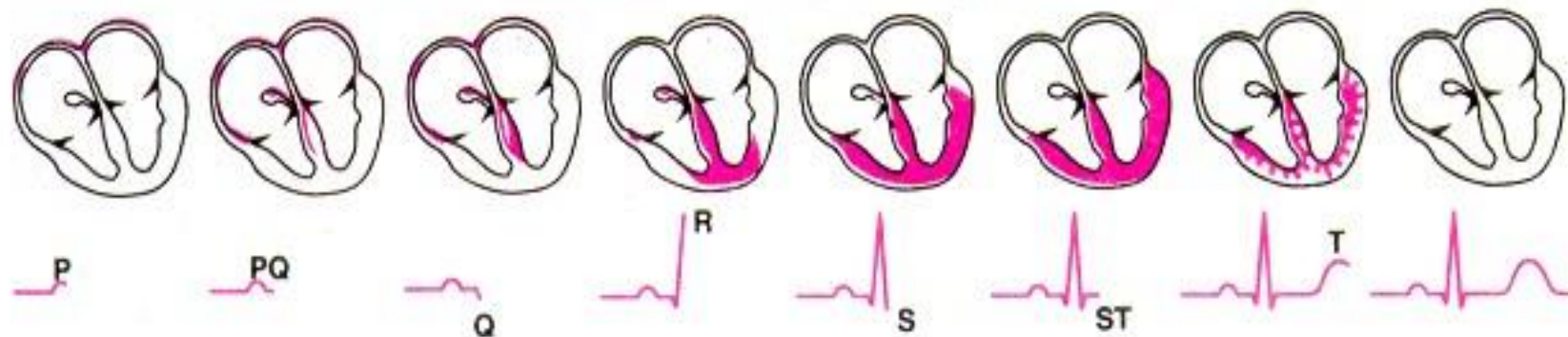
Normální tvar EKG ze svodu II



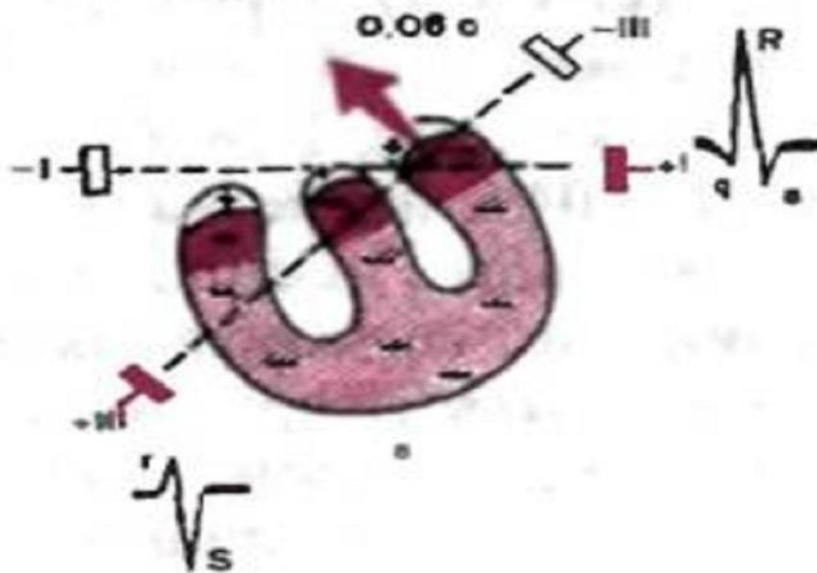
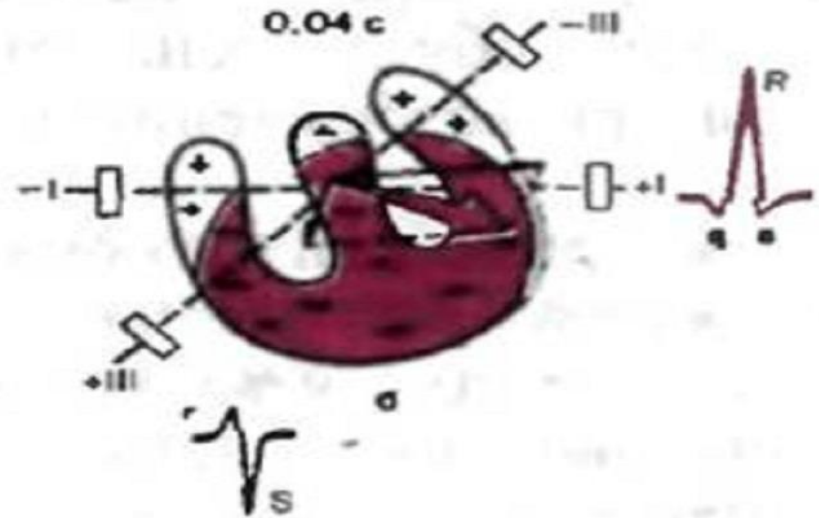
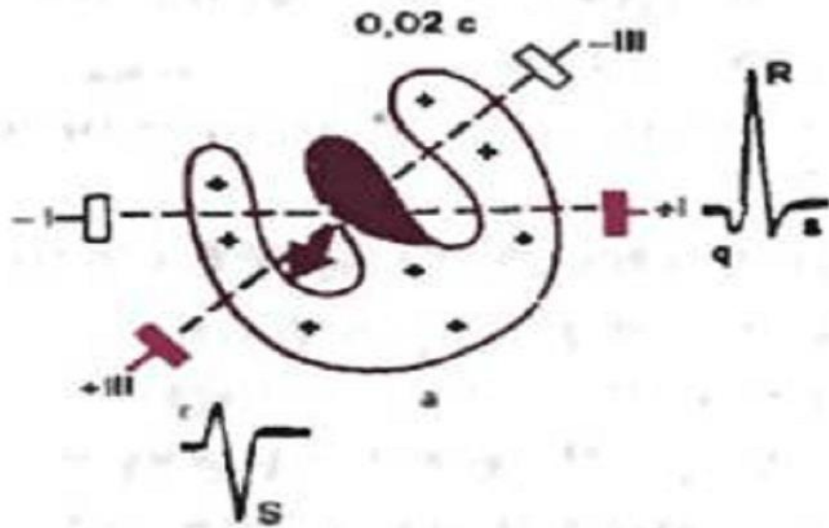
Vztah mezi AP a EKG



Šíření podráždění a repolarizace s odpovídajícím obrazem EKG



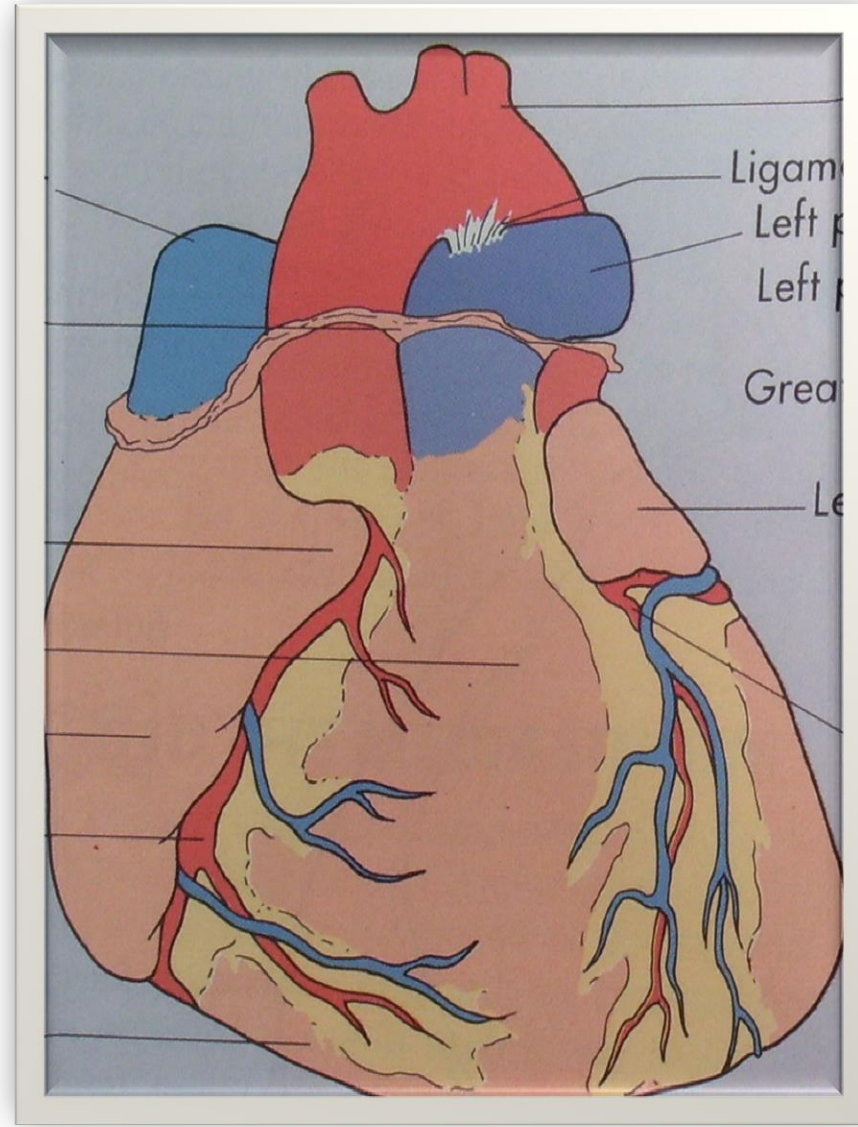
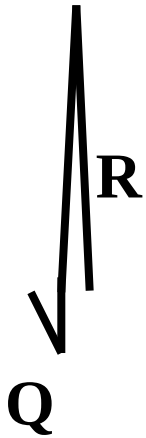
Complexul QRS

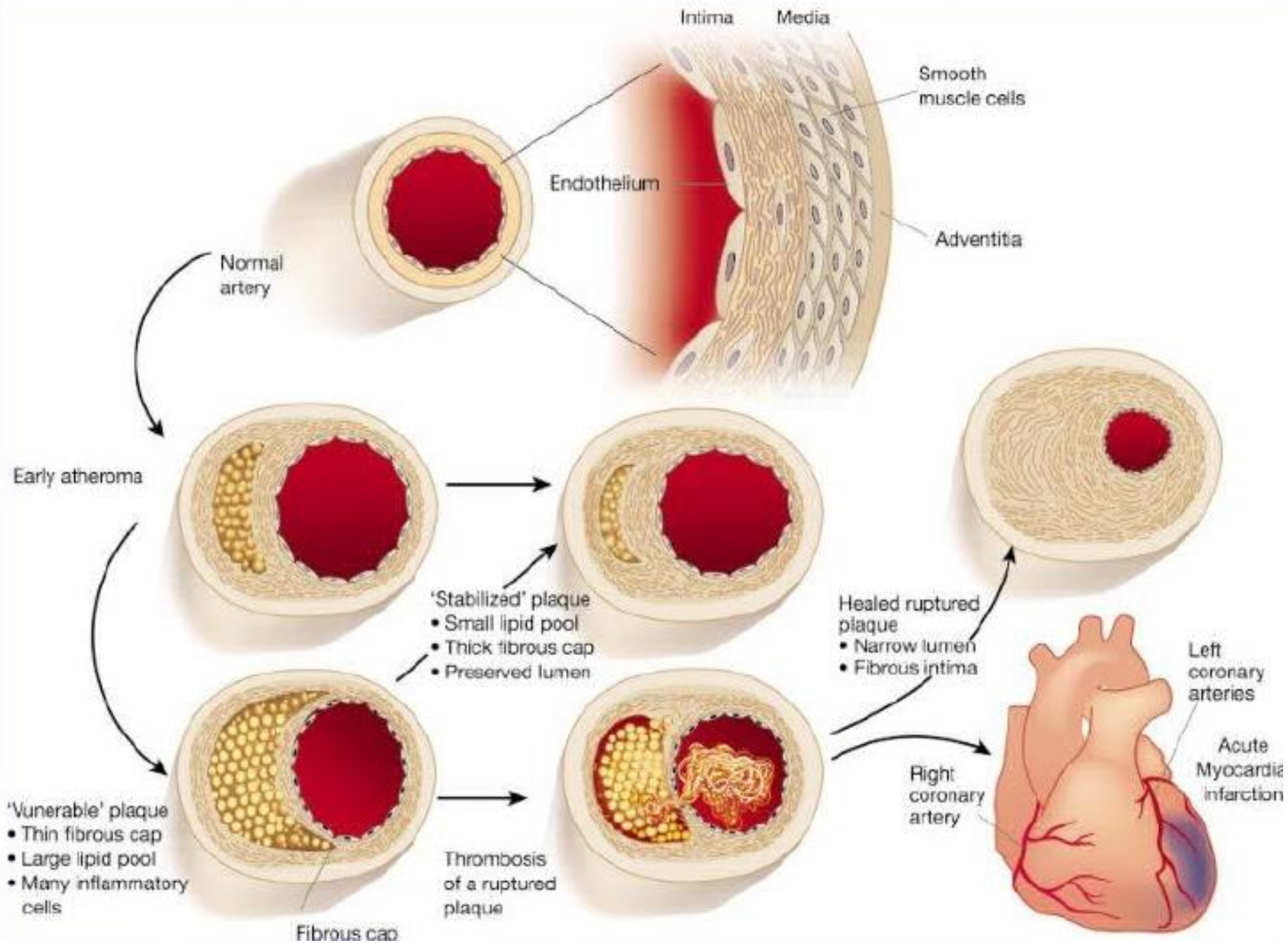


Complexul ventricular QRST

- Complexul QRST reprezintă procesul de depolarizare și repolarizare a miocardului ventricular;
- Undă R orice undă pozitivă din complex, dacă sunt câteva se notează R', R'', R''';
- Unda negativă ce precede unda R – unda Q(q);
- Unda negativă ce succede unda R – unda S(s);
- Dacă pe EKG se înregistrează o deflexiune negativă – complex QS;
- Dacă amplitudinea undelor complexului $>5\text{mm}$ undele se notează Q, R, S, dacă $<5\text{mm}$ – q, r, s;
- Durata maximă 0,1sec (mai frecvent 0,07-0,09).

Unda Q în normă





Unda Q patologică

Q
R



Normal coronary artery



Atherosclerosis

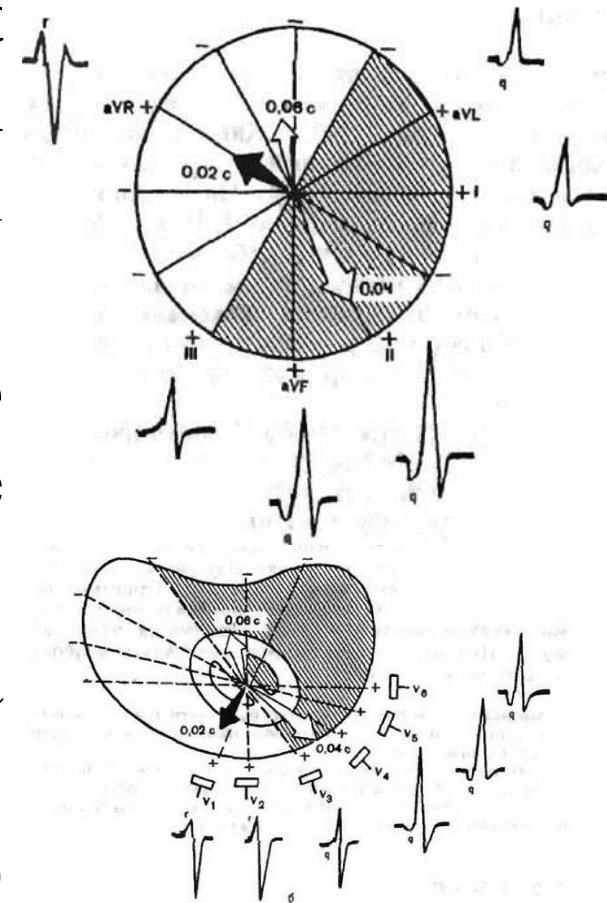


Atherosclerosis
with blood clot

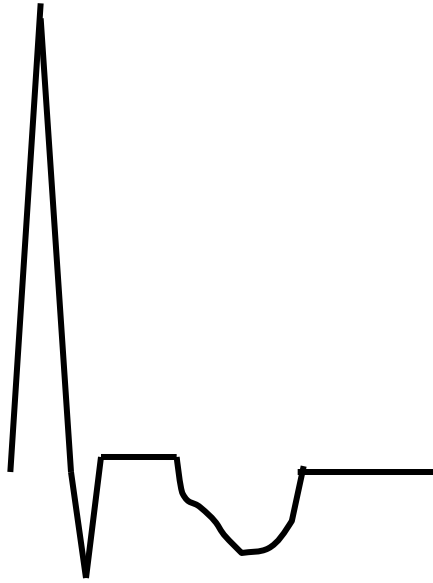


Caracteristica undei Q

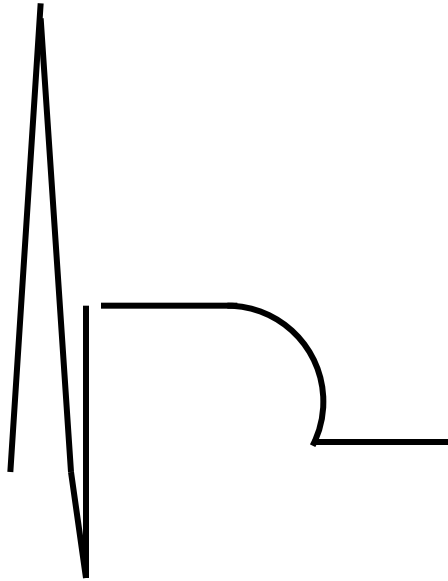
- Se formează la proiectarea vectorului depolarizării septului (0,02sec) orientat de la stânga la dreapta și puțin în sus în plan frontal și de la stânga la dreapta și înainte în plan orizontal;
- Unda Q poate fi înregistrată în toate derivațiile membrelor și în derivațiile toracice V_4 - V_6 ;
- $Q = \frac{1}{4}R$ în toate derivațiile cu excepția aVR, durata – 0,03sec;
- În aVR poate fi înregistrată unda Q adâncă, largă, sau complex QS.



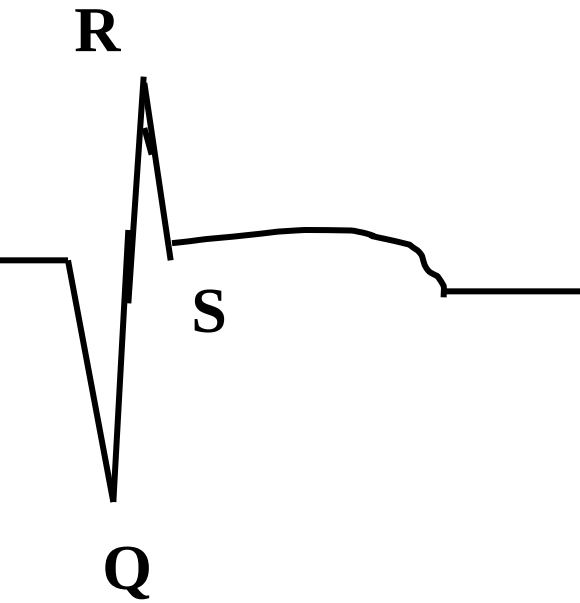
Unda T negativă - ischemie



Subdenivelare sau supradinivelare ST – alterare

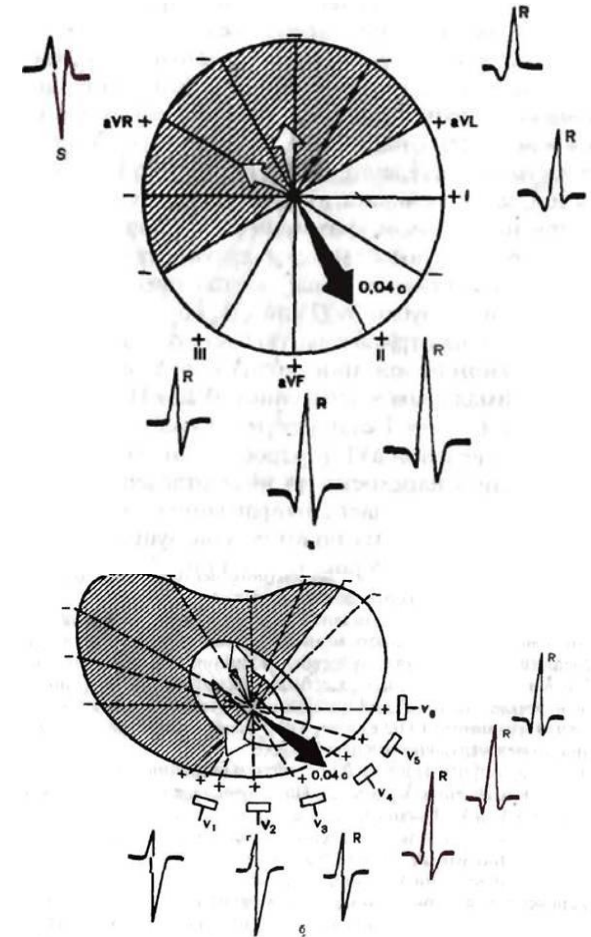


Unda Q patologică – necroză



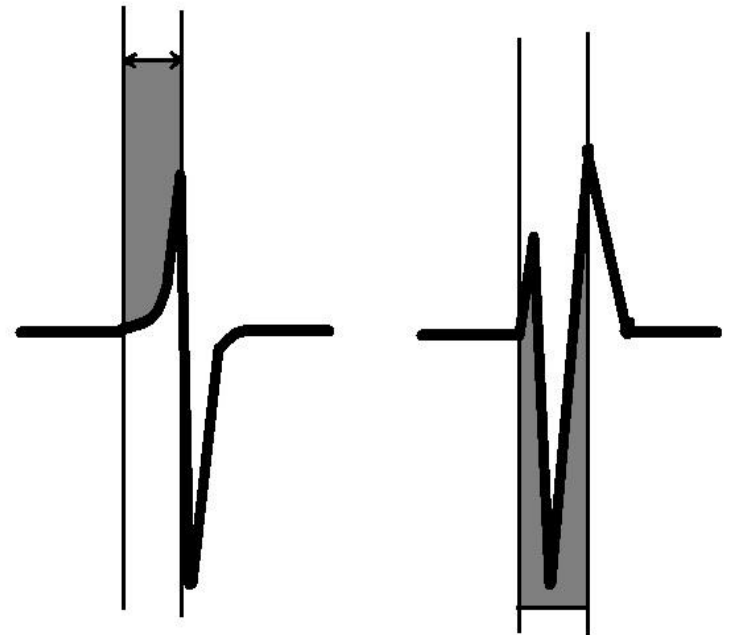
Caracteristica undei R

- Proiectarea vectorului depolarizării ventriculelor 0,04sec;
- Unda R se înregistrează în toate derivațiile membrelor. În aVR uneori poate fi slab exprimată sau poate lipsi;
- În derivațiile toracice amplitudinea undei R treptat crește de la V1 la V4 apoi puțin scade în V5 și V6. În V1 unda r poate lipsi.
- În V1, V2 unda R reprezintă depolarizarea septului și VD, în V4, V5, V6 depolarizarea VS și parțial a VD.

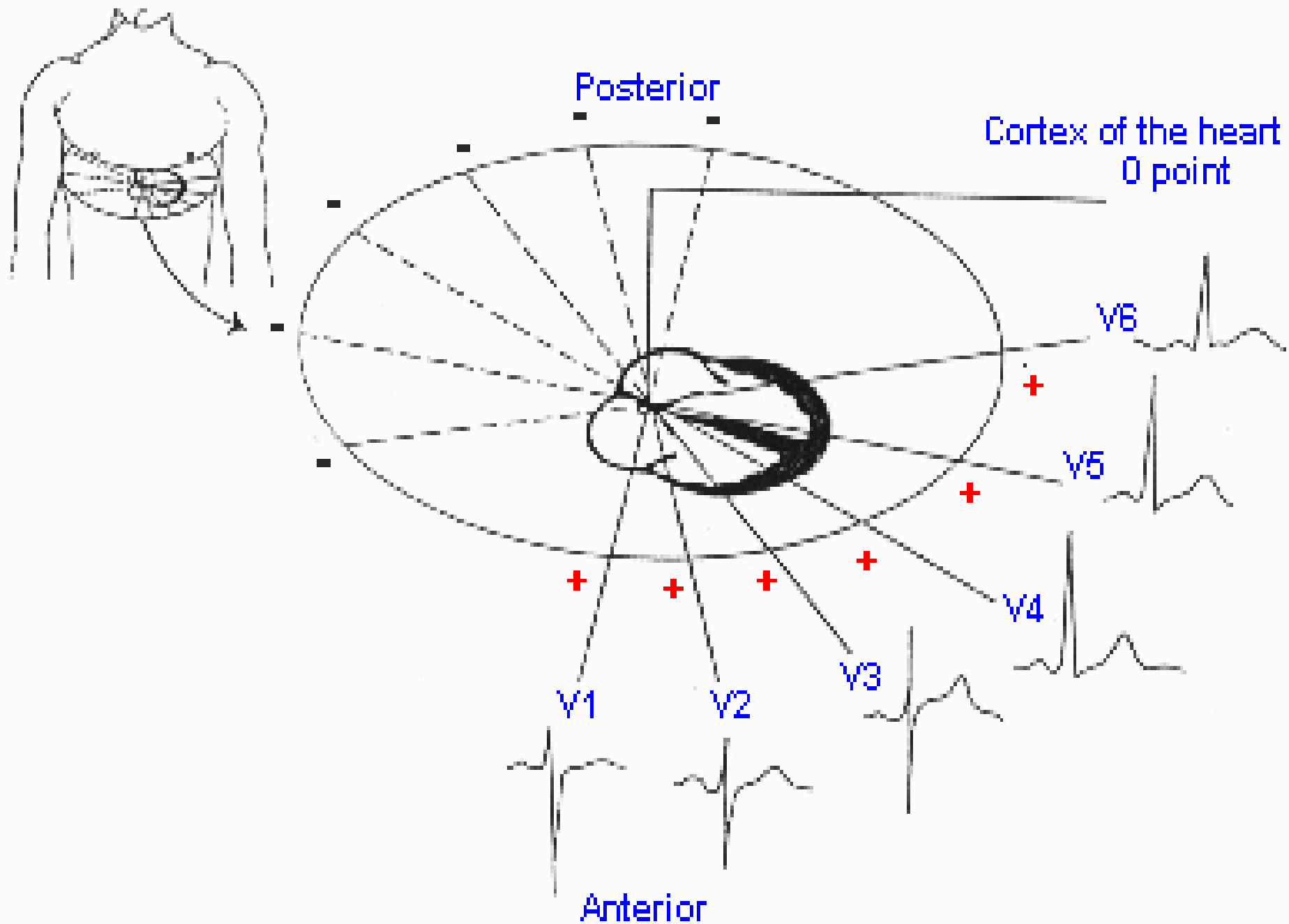


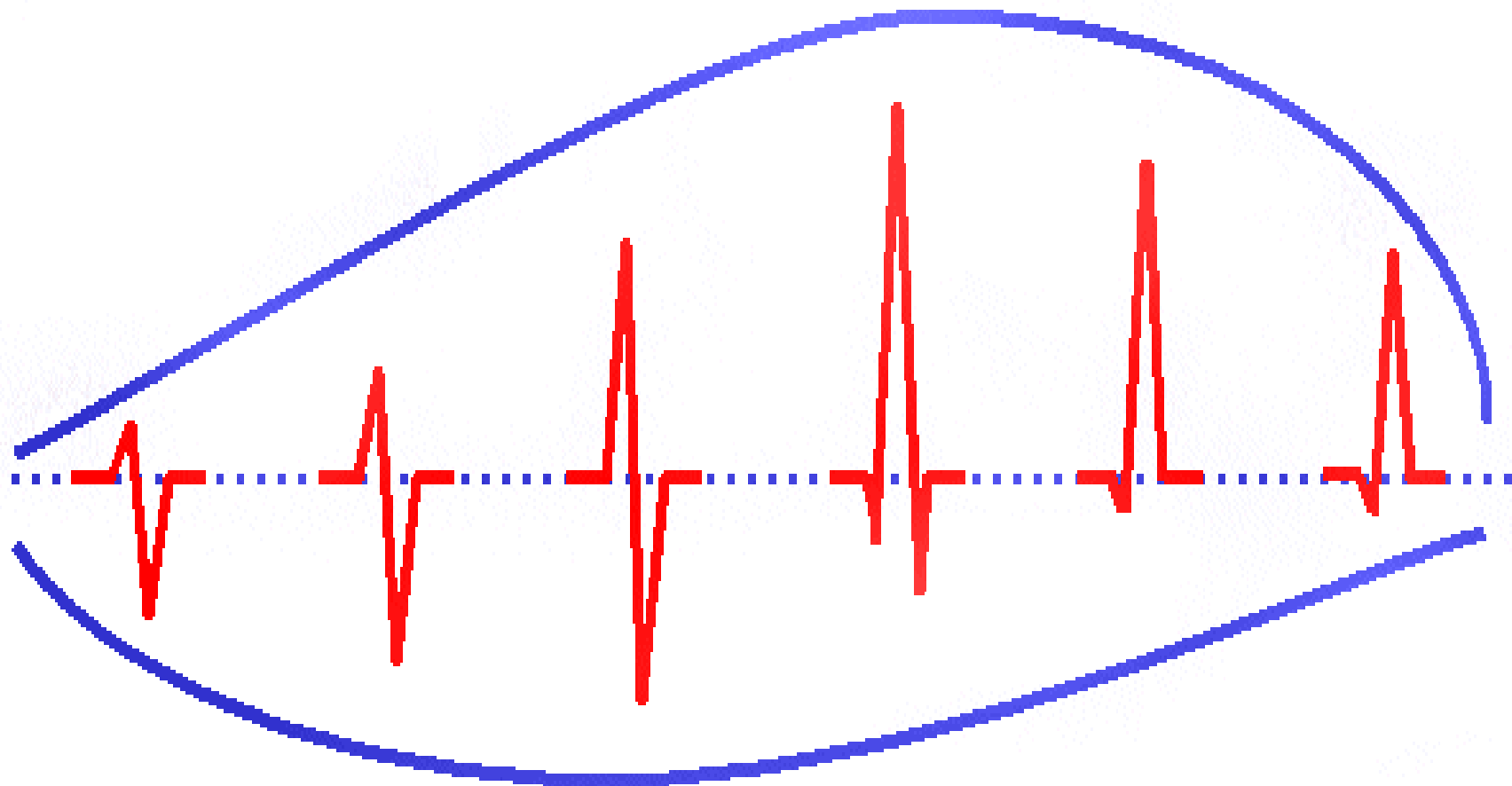
Caracteristica undei R

- Deflexiunea intrinsecă – durata răspândirii undei depolarizării de la endocard la epicard;
- Se măsoară de la începutul complexului ventricular până la vârful undei R;
- N V1-0,03sec, V6-0,05sec.



Horizontal Plane





V1

V2

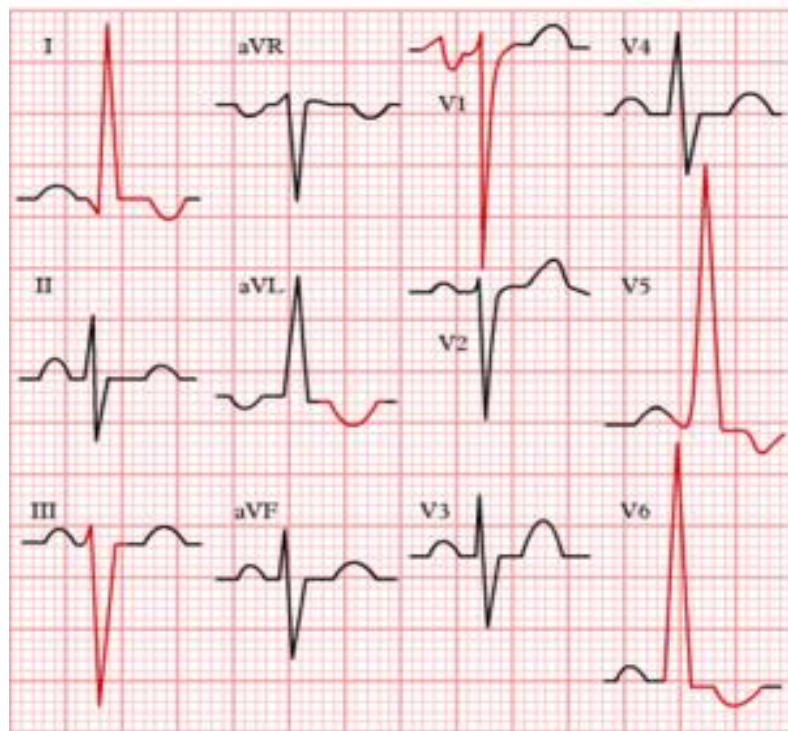
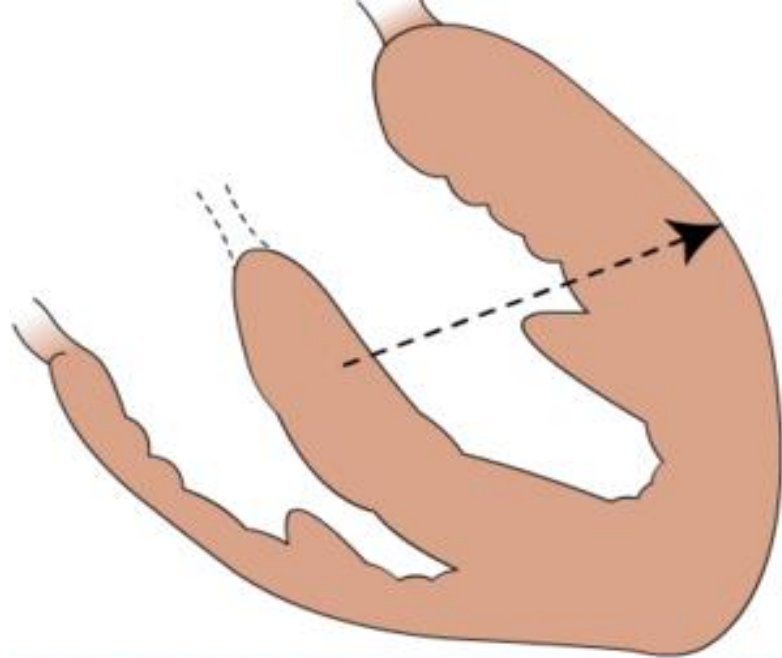
V3

V4

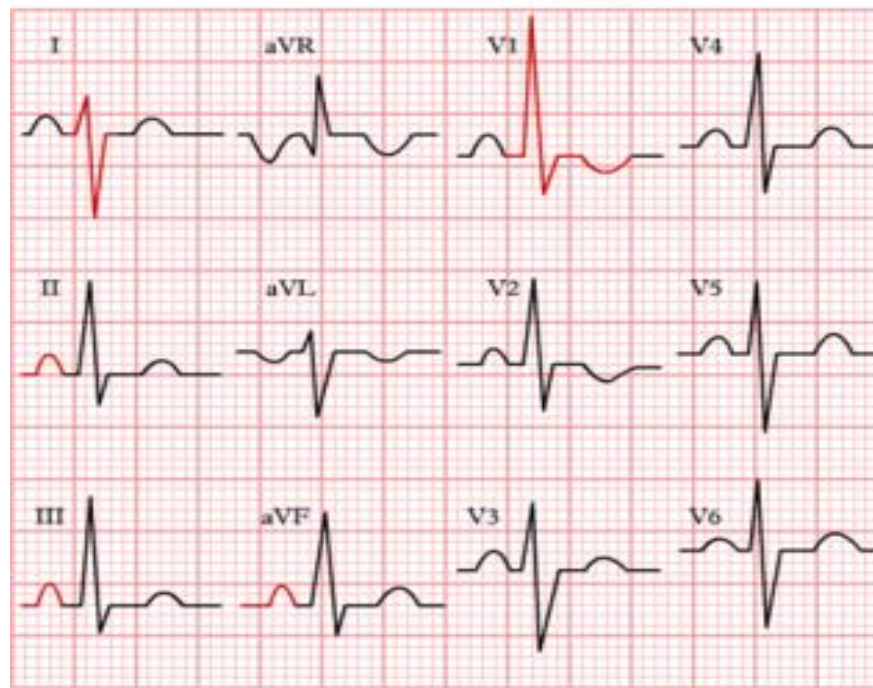
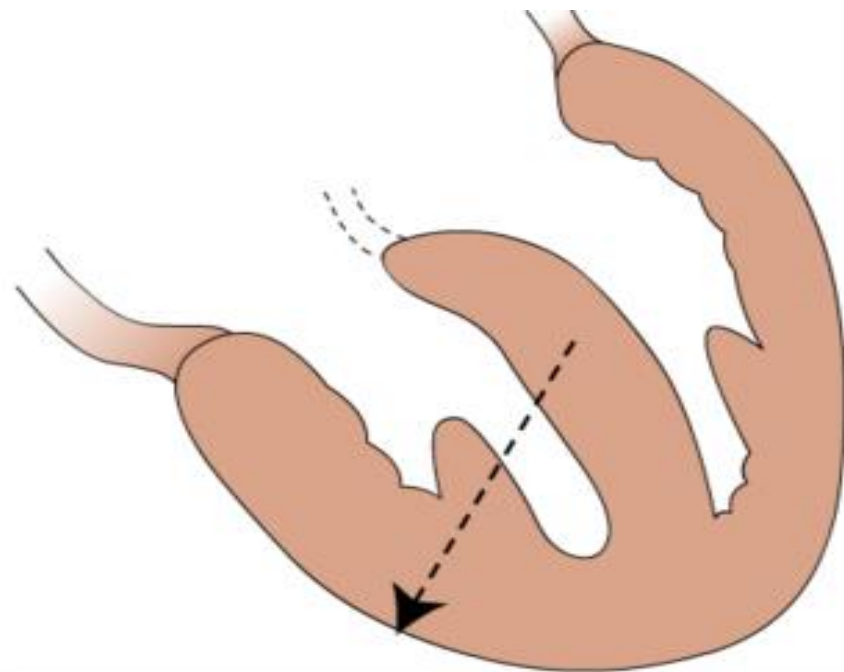
V5

V6



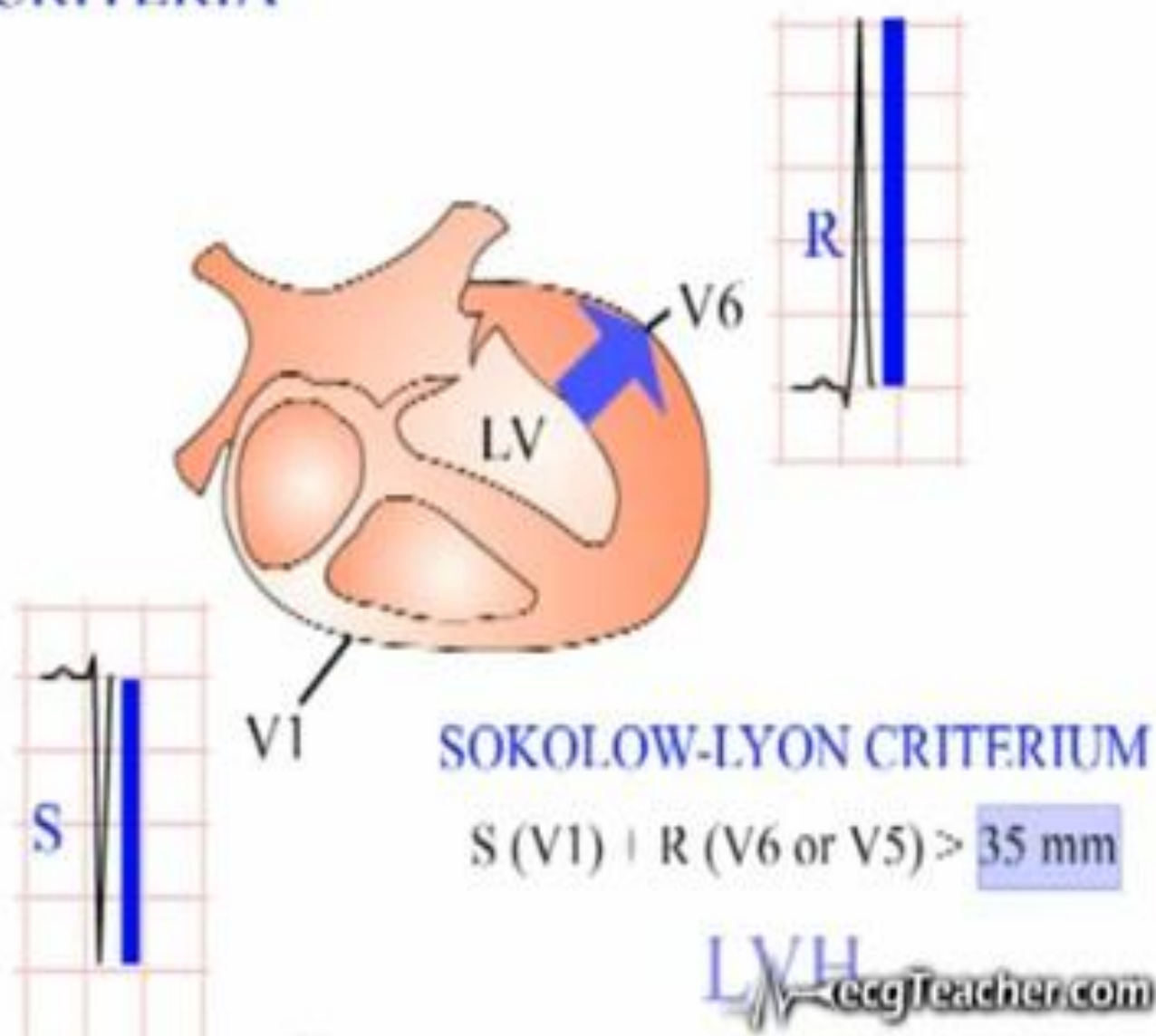


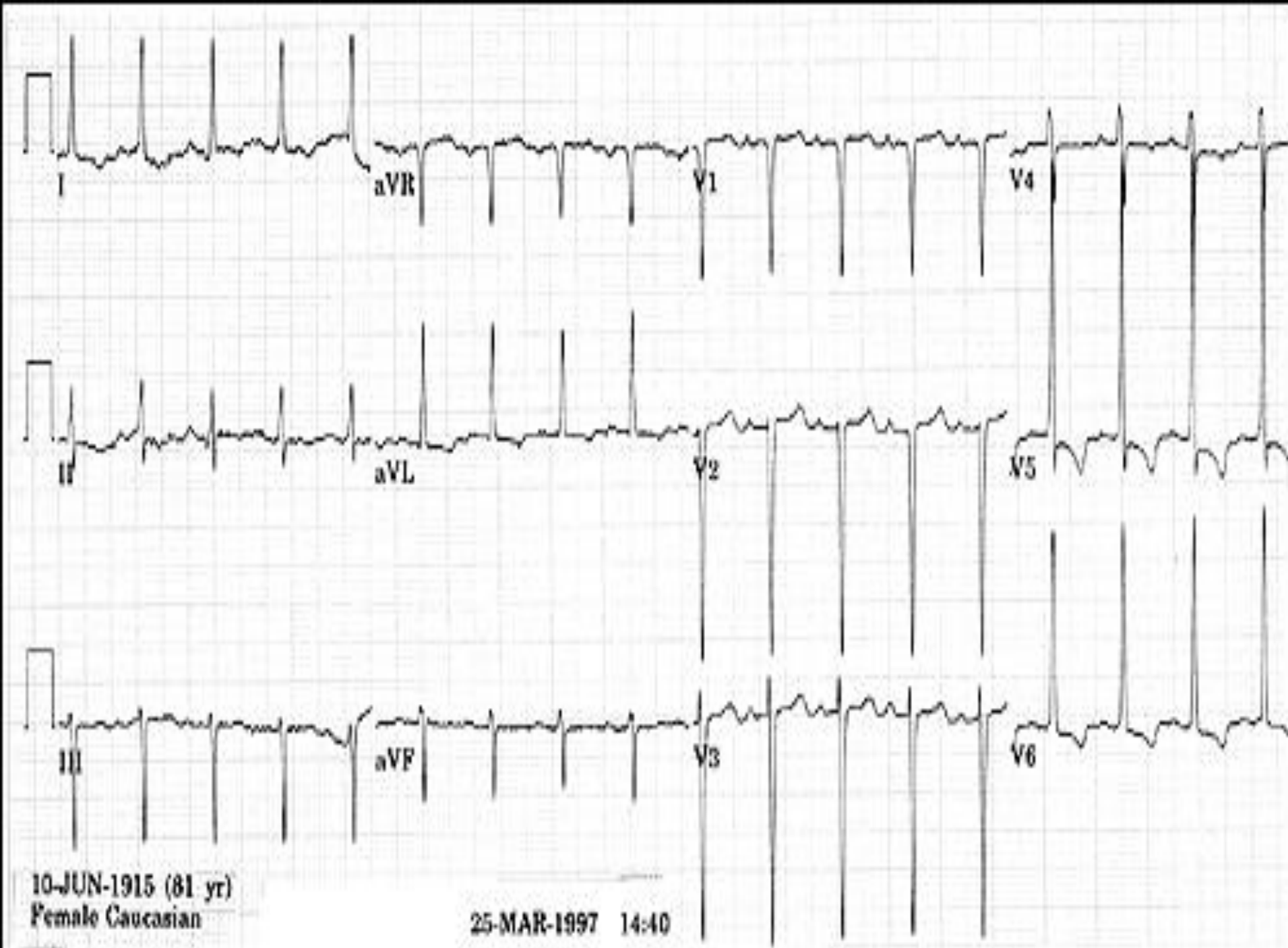
left ventricle hypertrophy



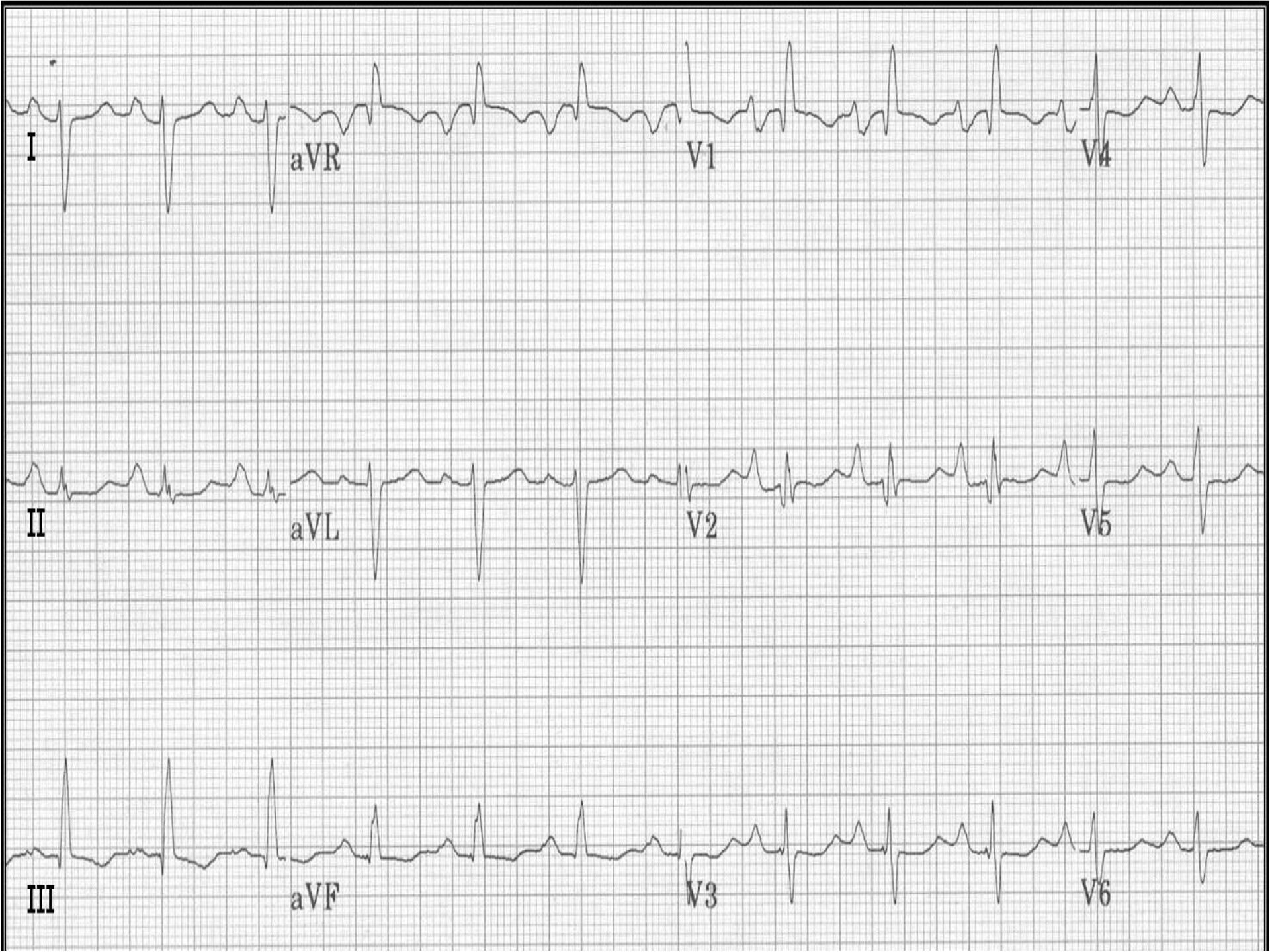
right ventricle hypertrophy

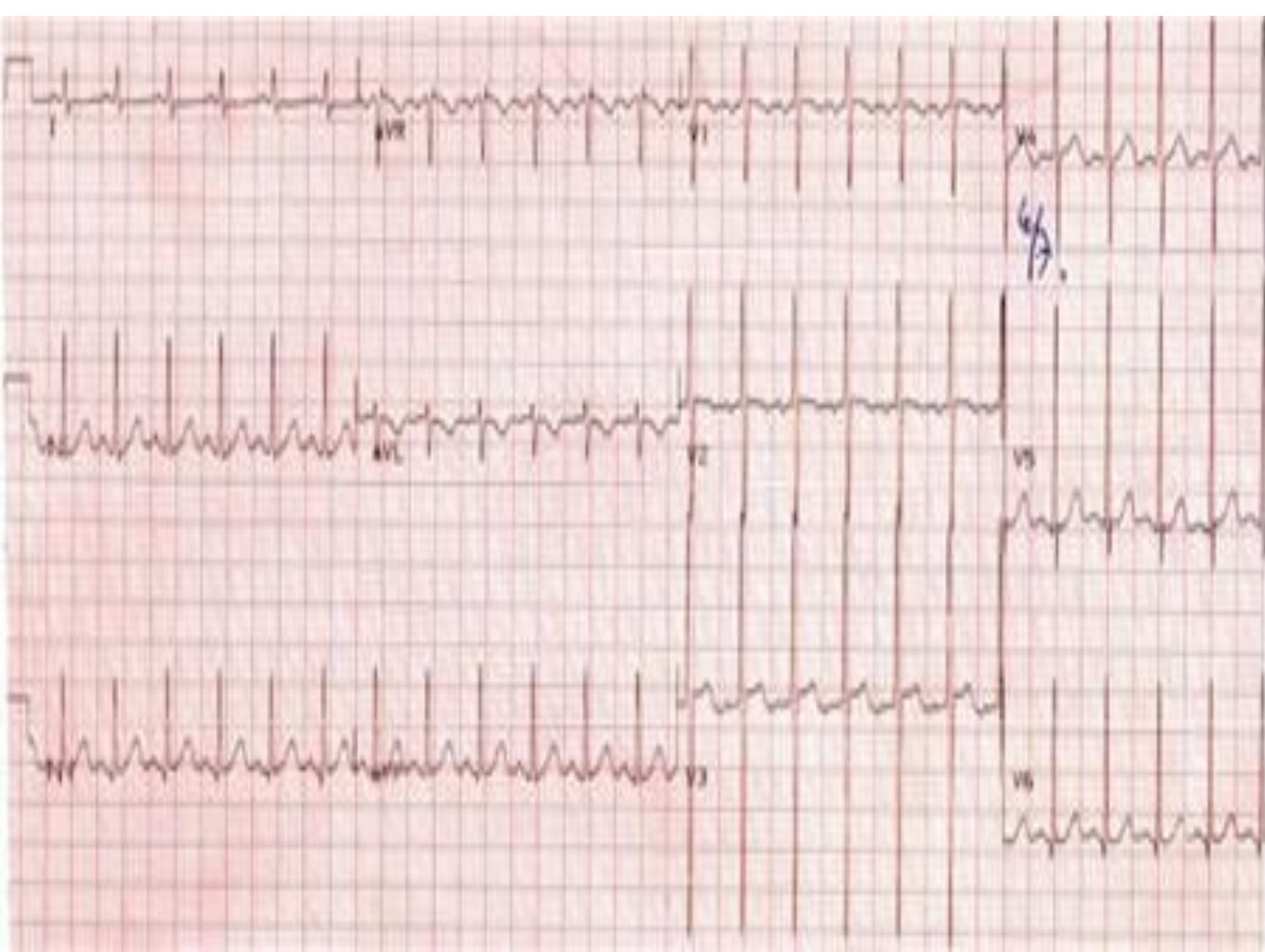
'VOLTAGE CRITERIA'





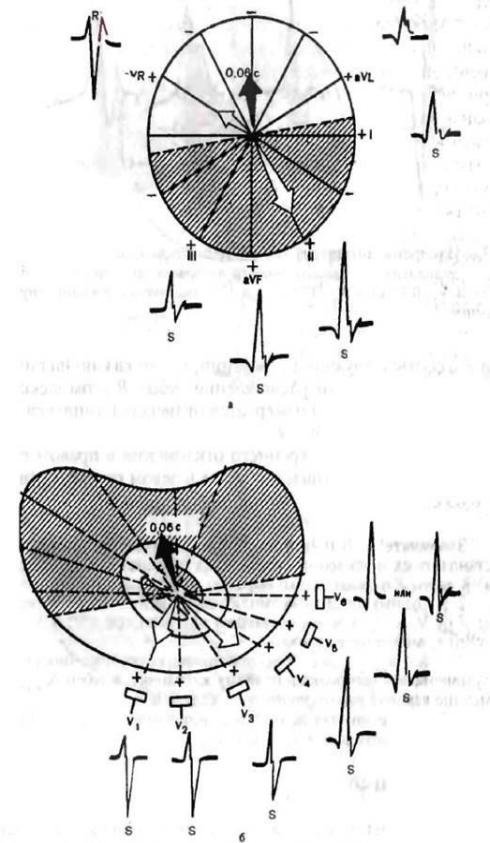




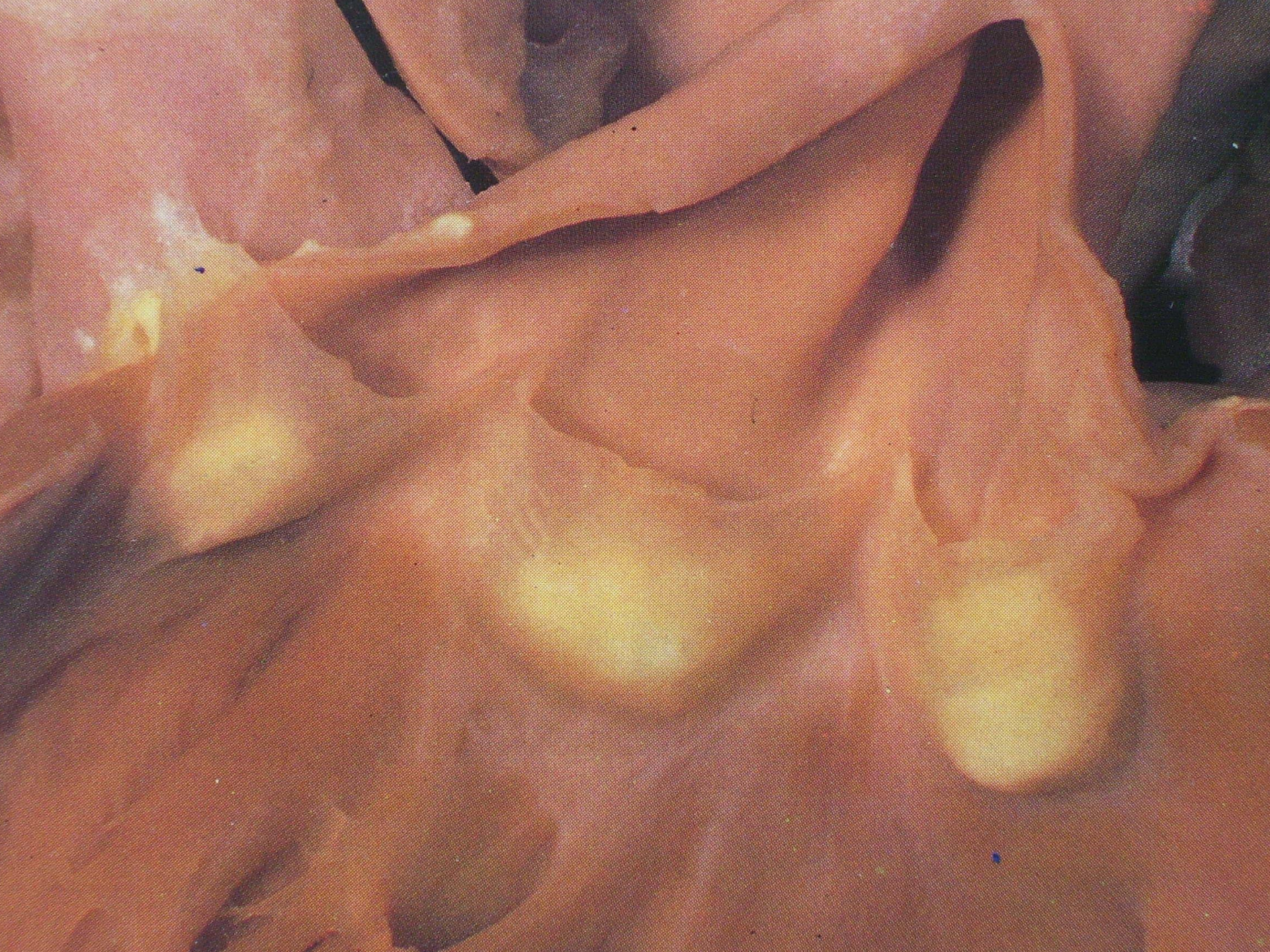


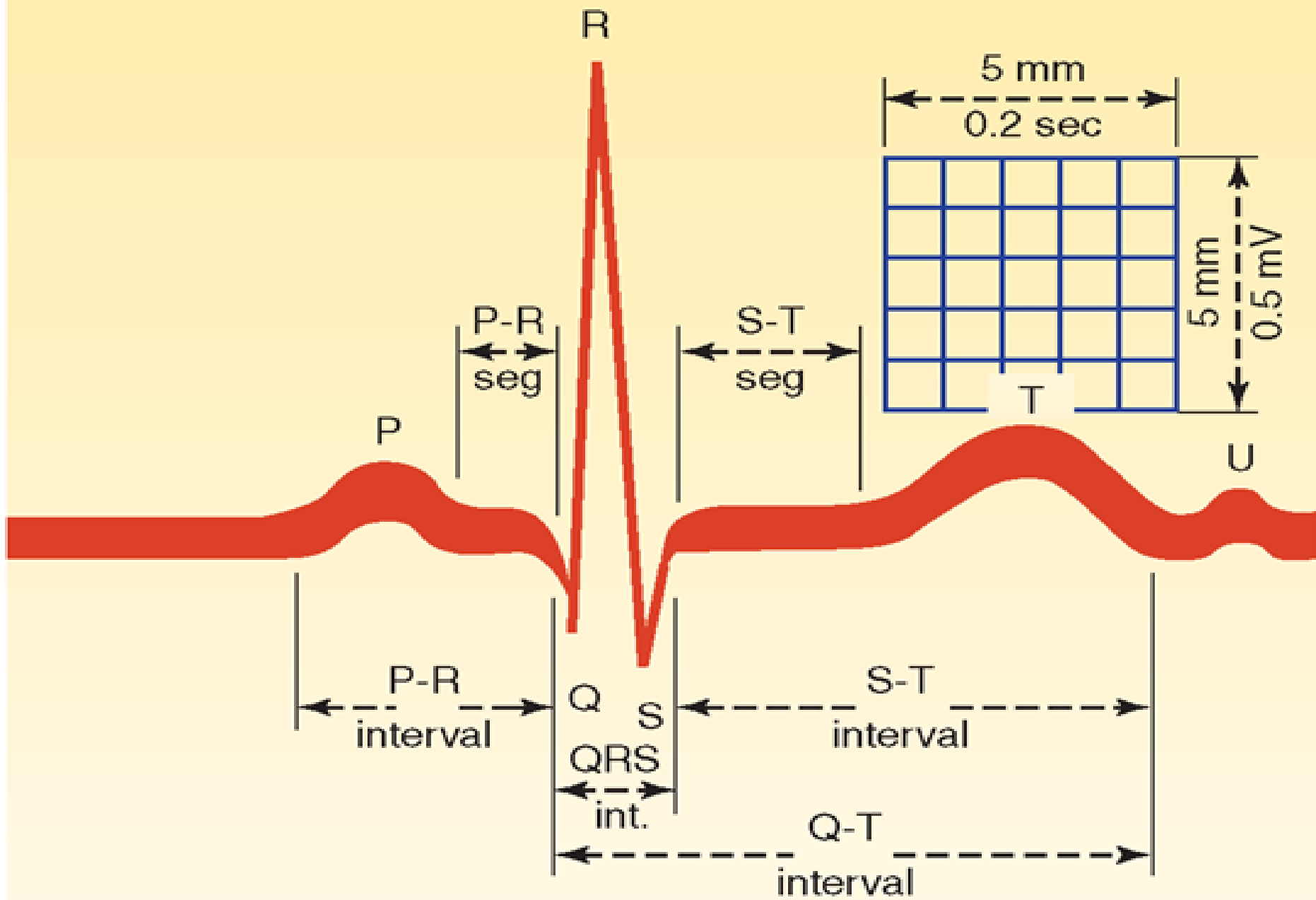
Caracteristica undei S

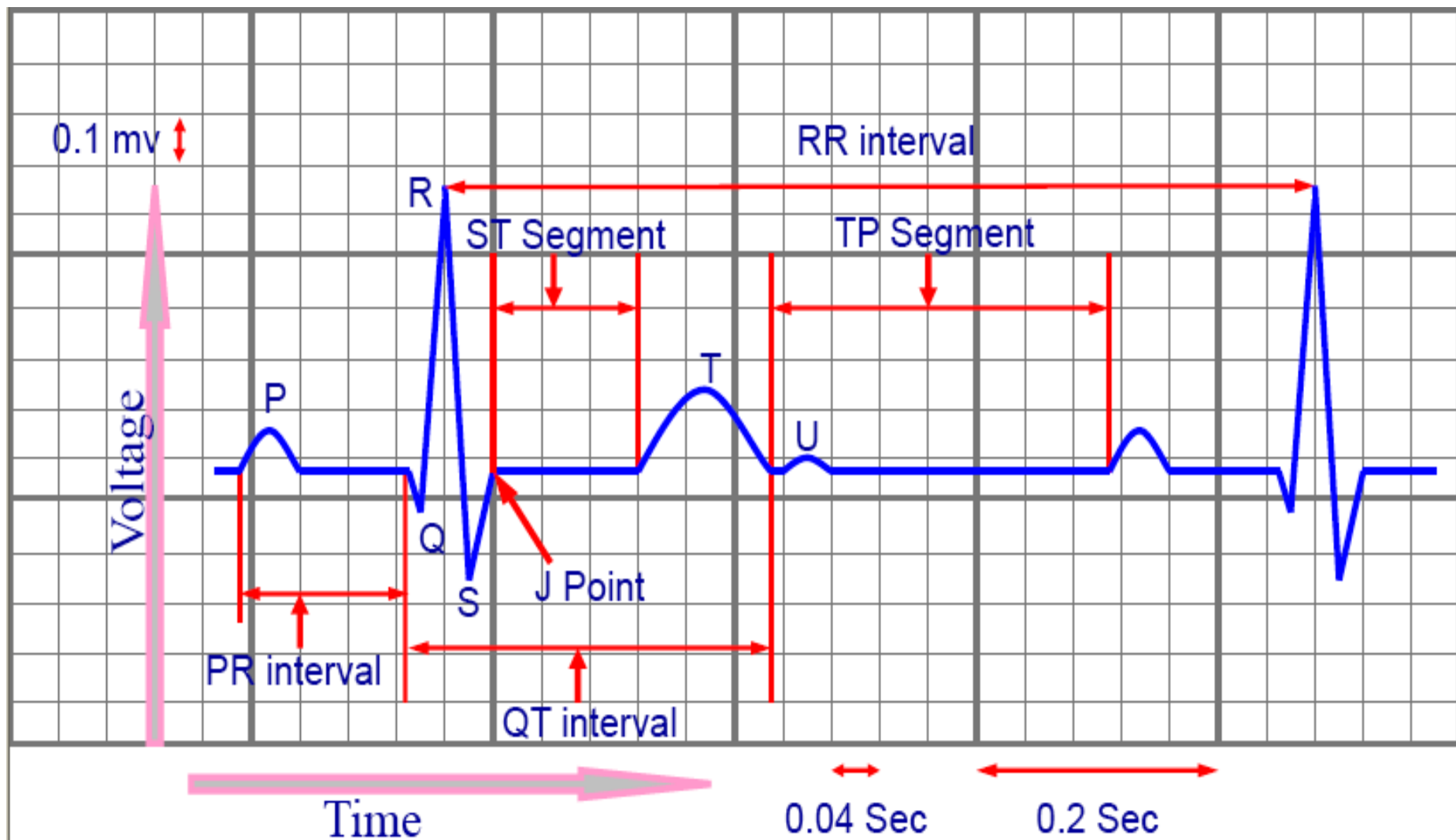
- Proiectarea vectorului 0,06sec;
- Orientat în sus, la dreapta și în urmă;
- Amplitudinea variază în limite mari dar nu mai mult de 20mm;
- La o poziție normală amplitudinea undei e mică, cu excepția aVR;
- În derivațiile toracice amplitudinea undei S scade treptat din V1 până în V4, în V5, V6 are o amplitudine mică sau lipsește;
- R=S în derivațiile toracice („zona de tranziție”) de regulă se înregistrează în V3, mai rar între V2 și V3 sau V3 și V4.







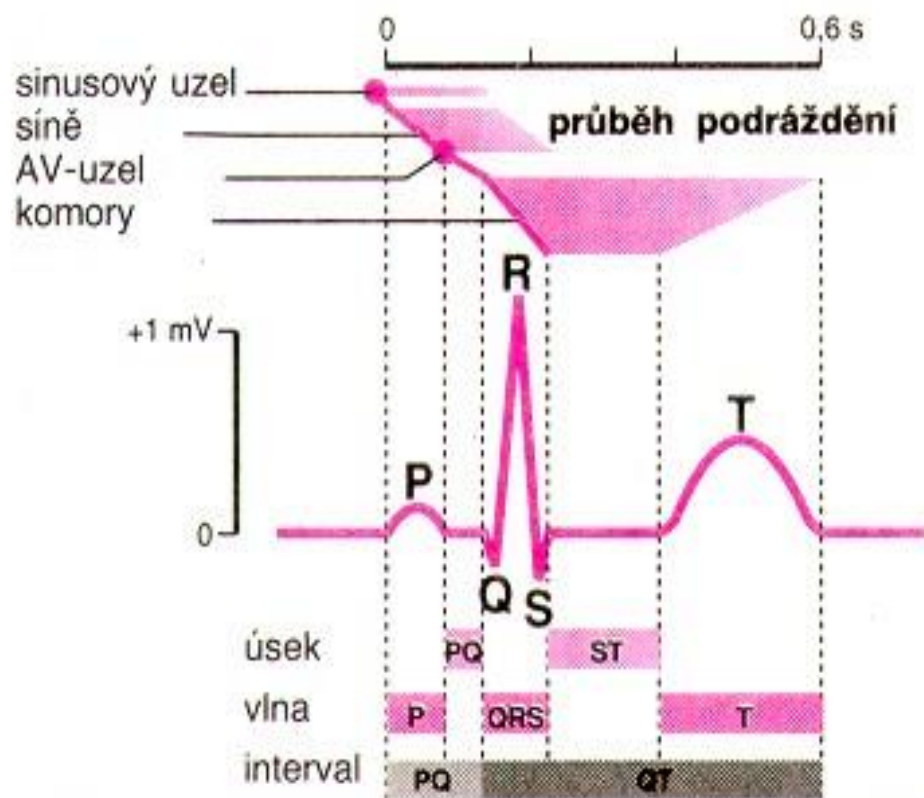




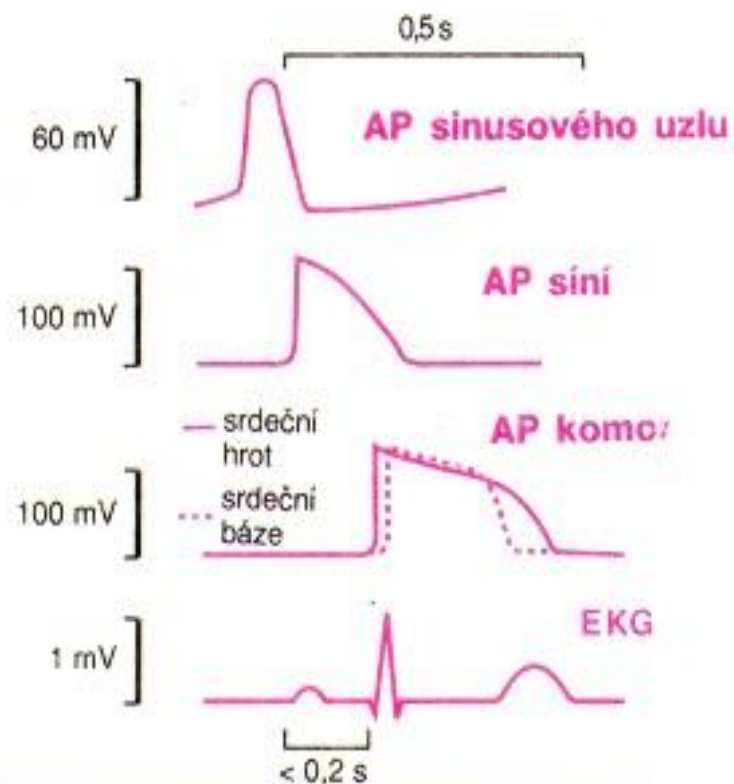
- PR interval 0.12 – 0.20 sec
- QRS duration 0.08 – 0.10 sec

- QT interval 0.4 – 0.43 sec
- RR interval 0.6 – 1.0 sec

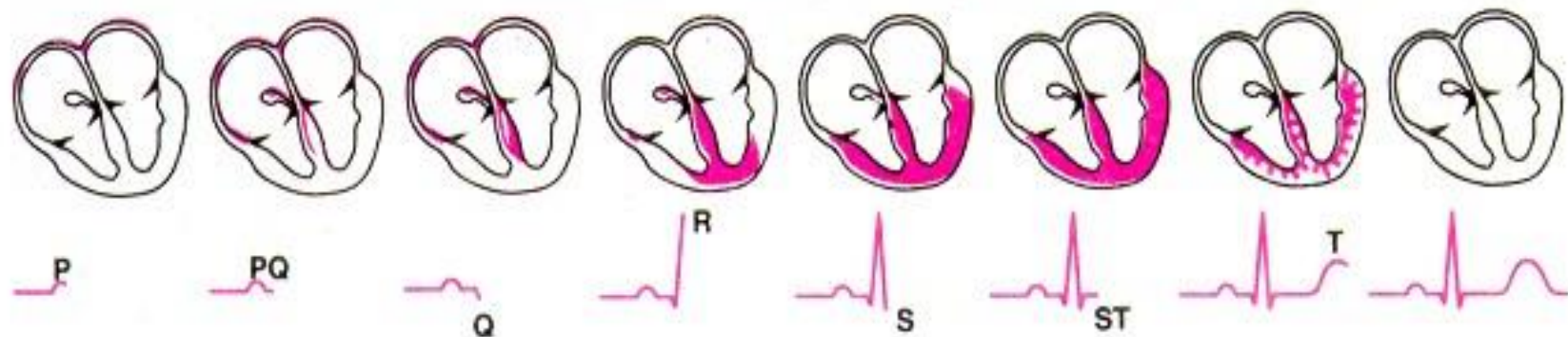
Normální tvar EKG ze svodu II

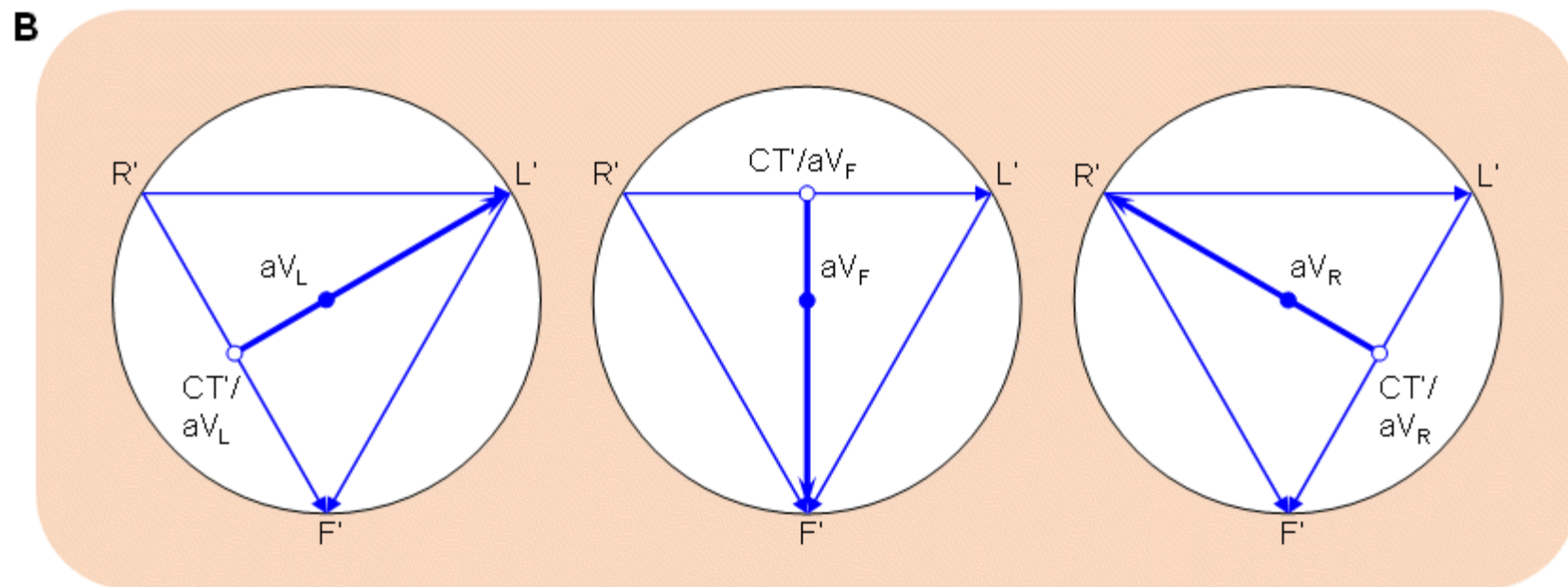
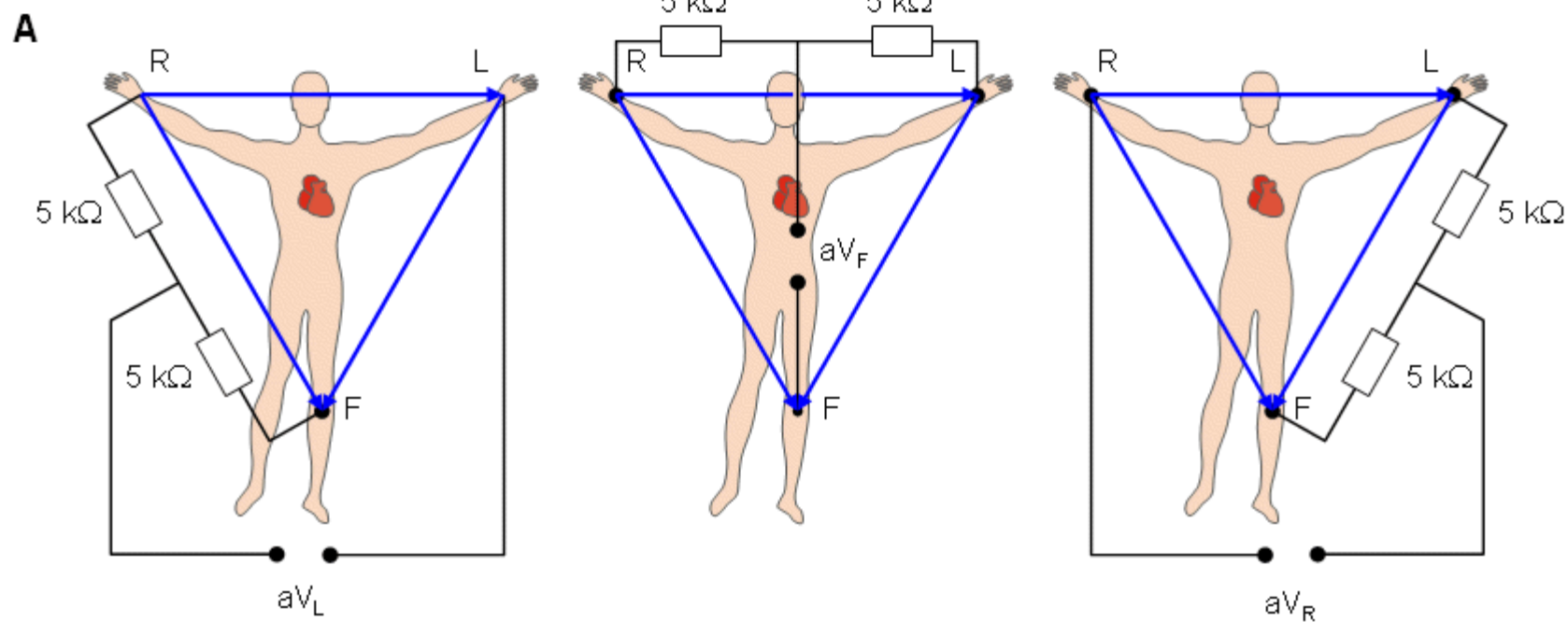


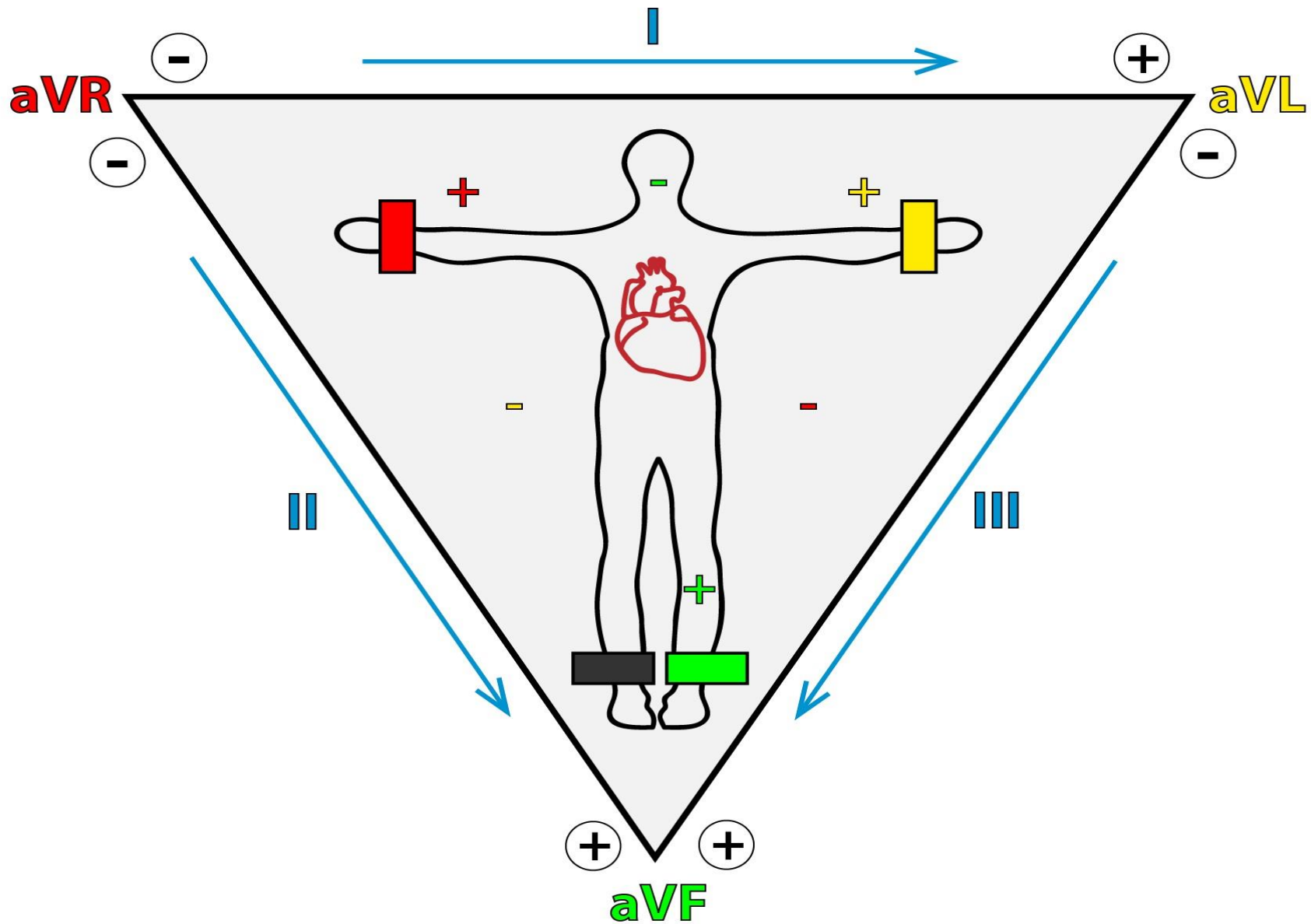
Vztah mezi AP a EKG

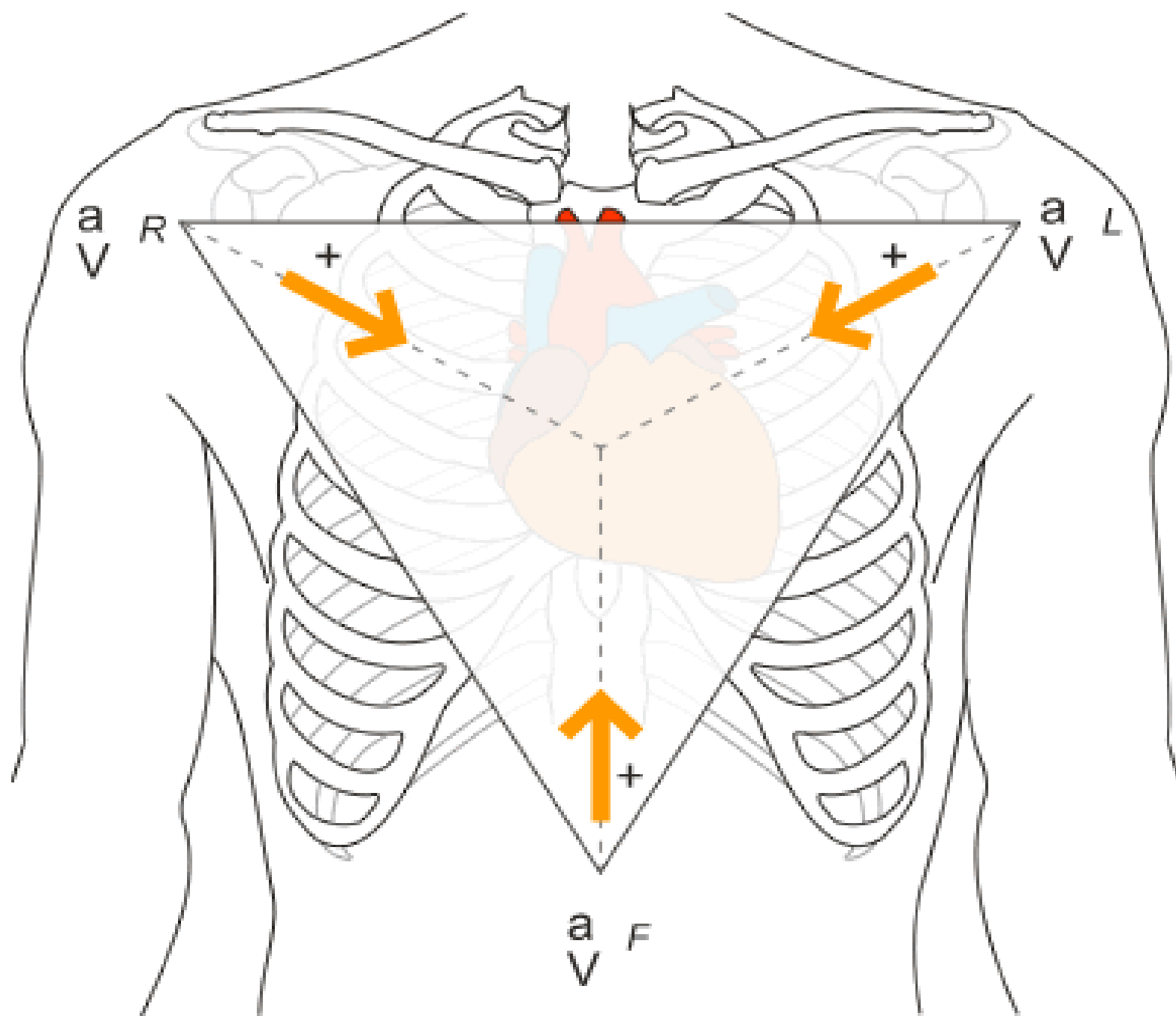


Šíření podráždění a repolarizace s odpovídajícím obrazem EKG

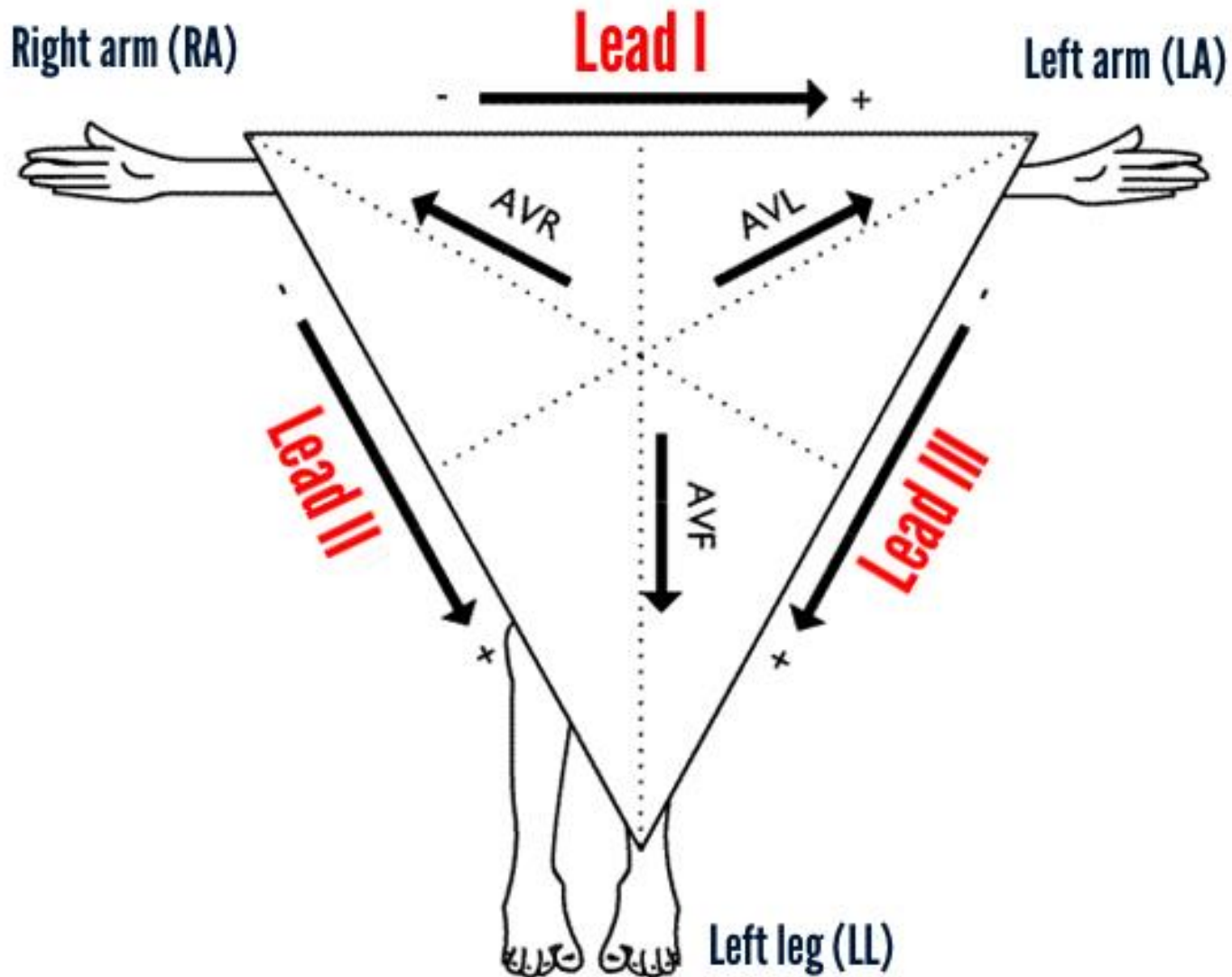




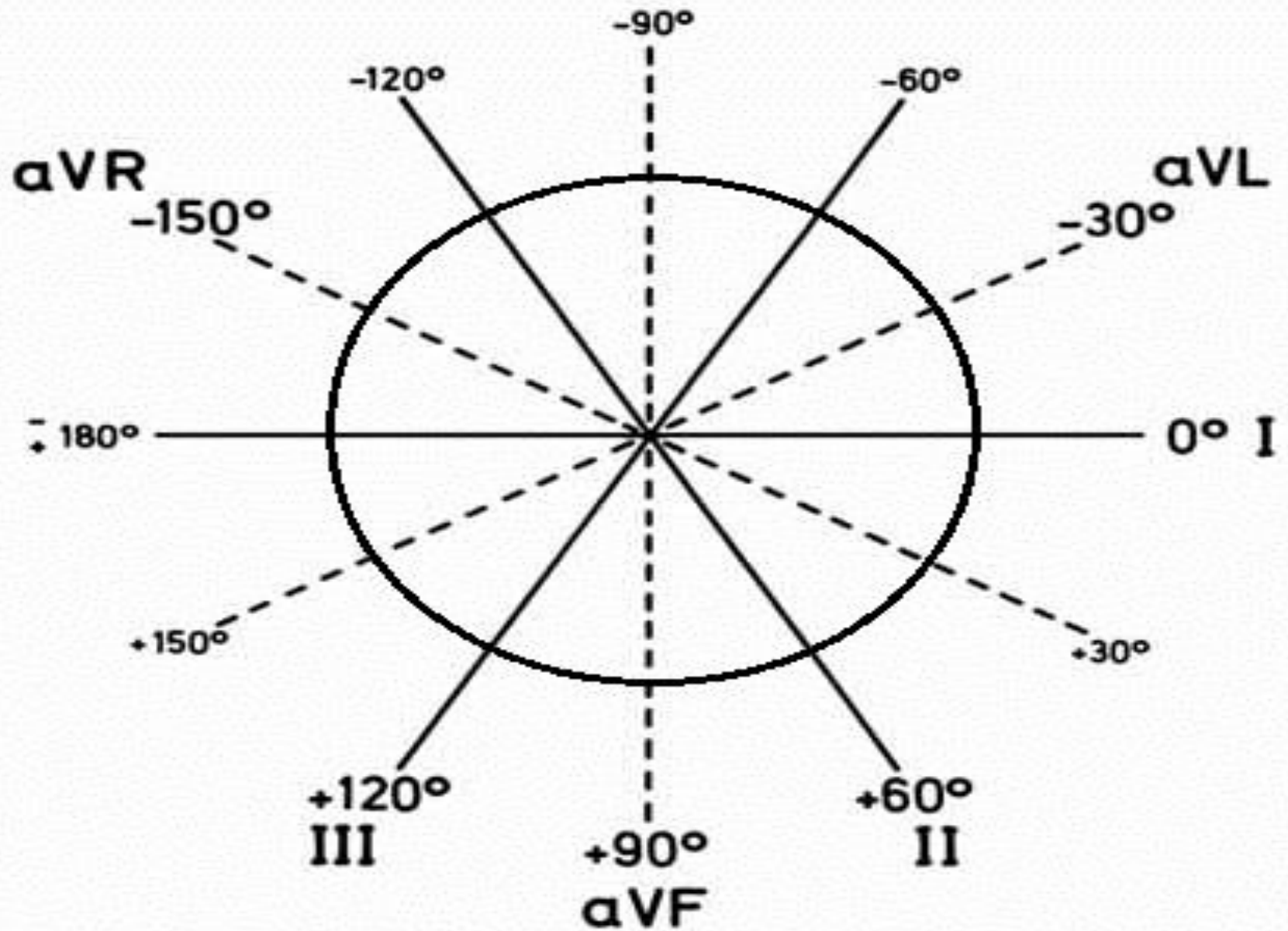


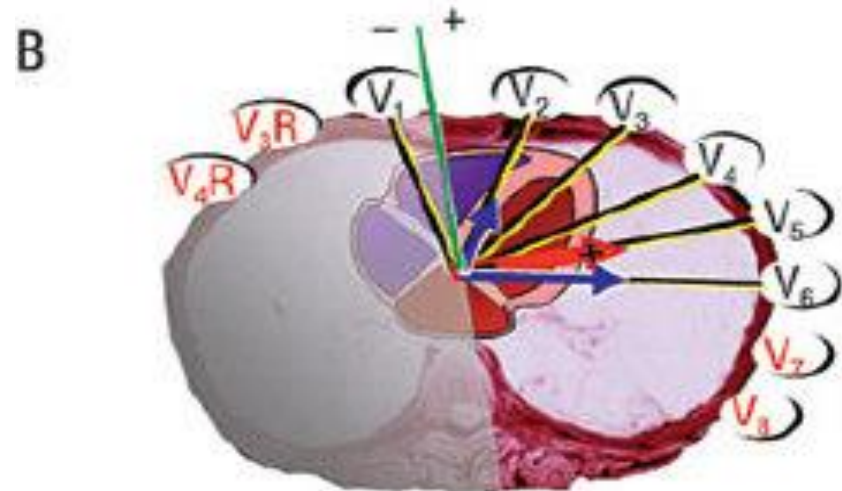
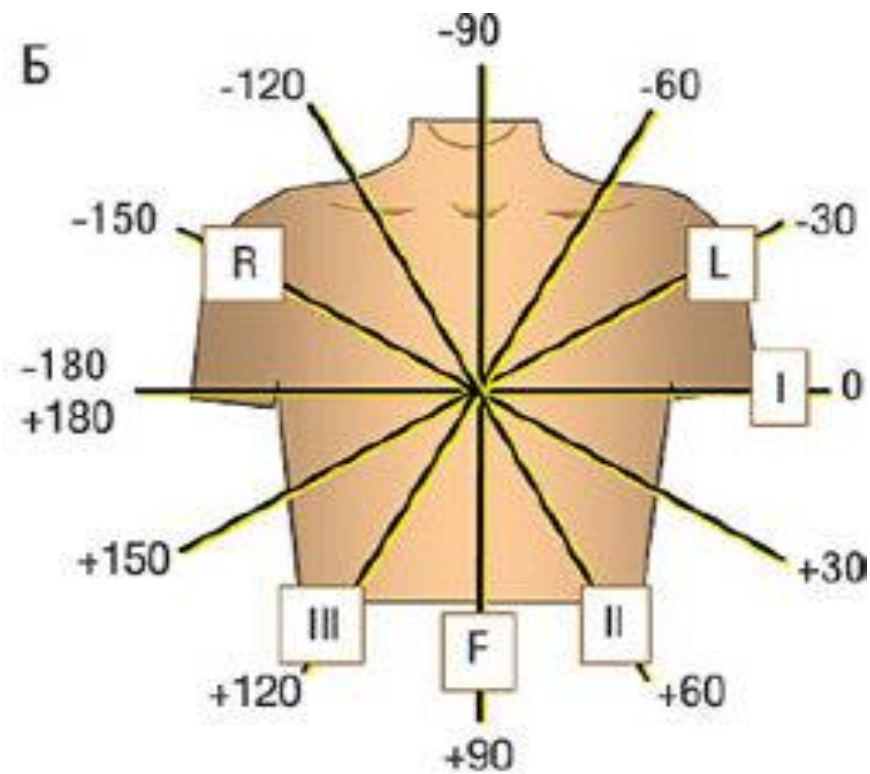
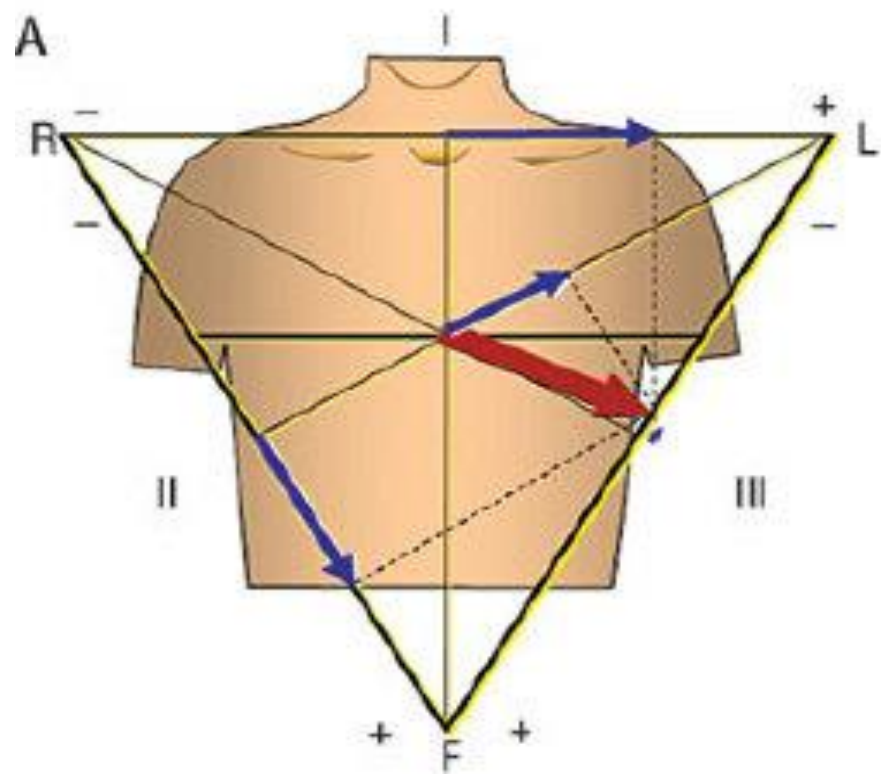


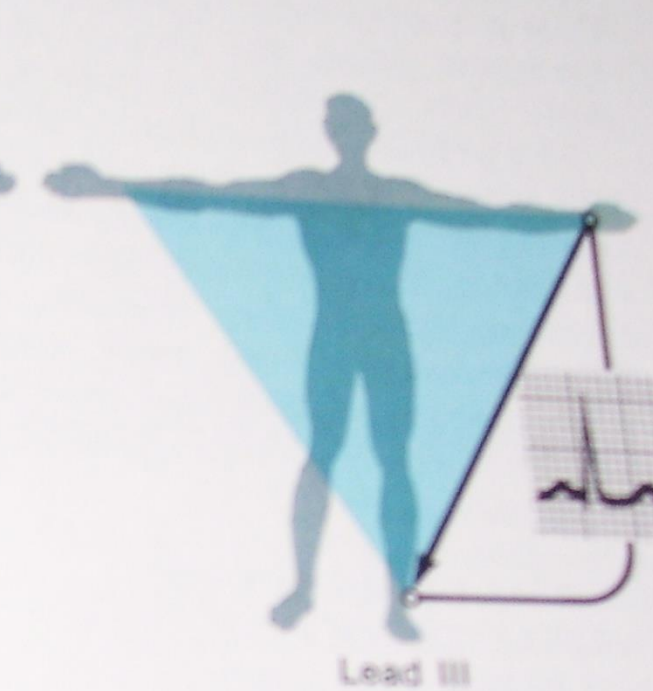
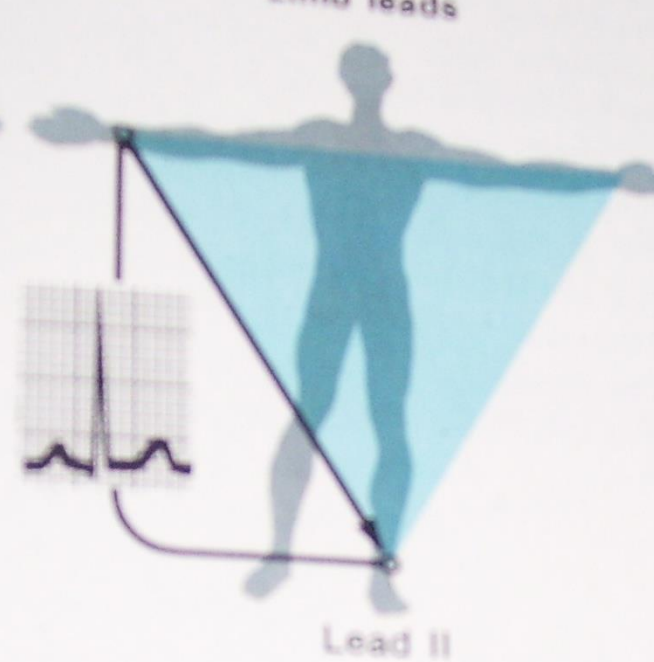
Triunghiul Einthoven



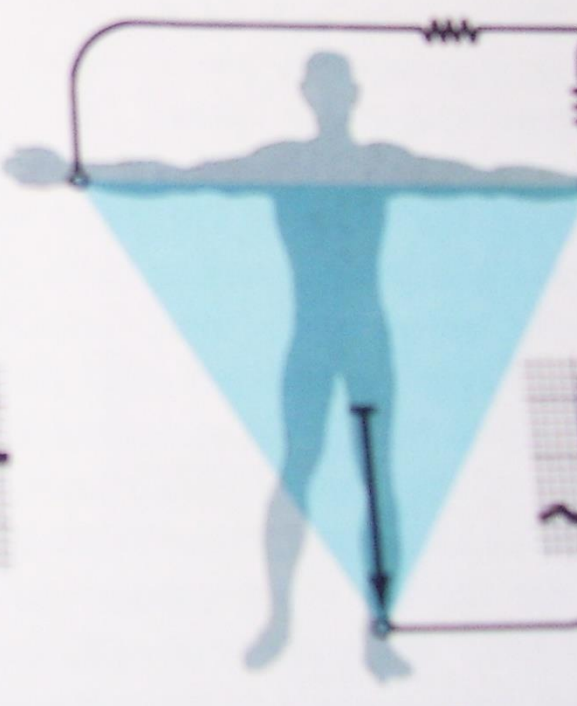
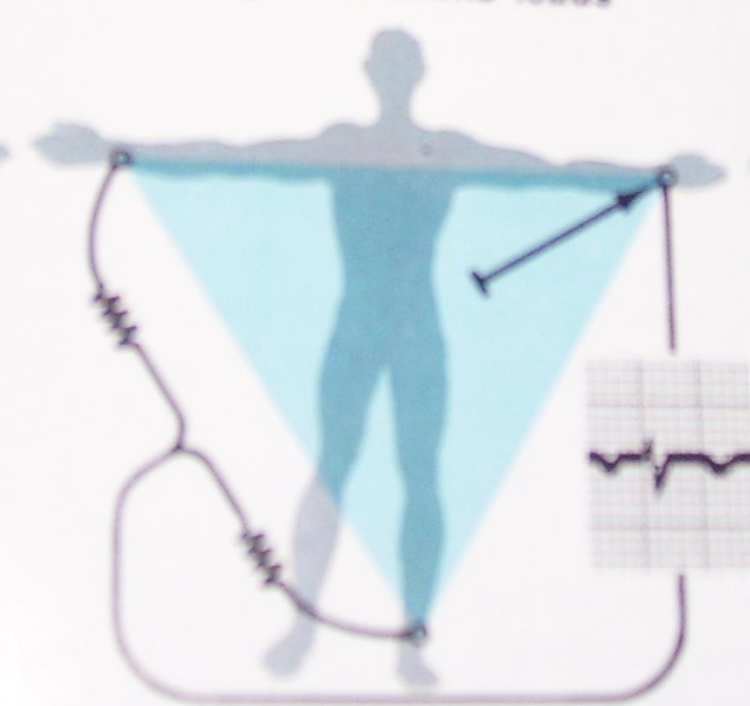
Sistemul hexaxial Bayley

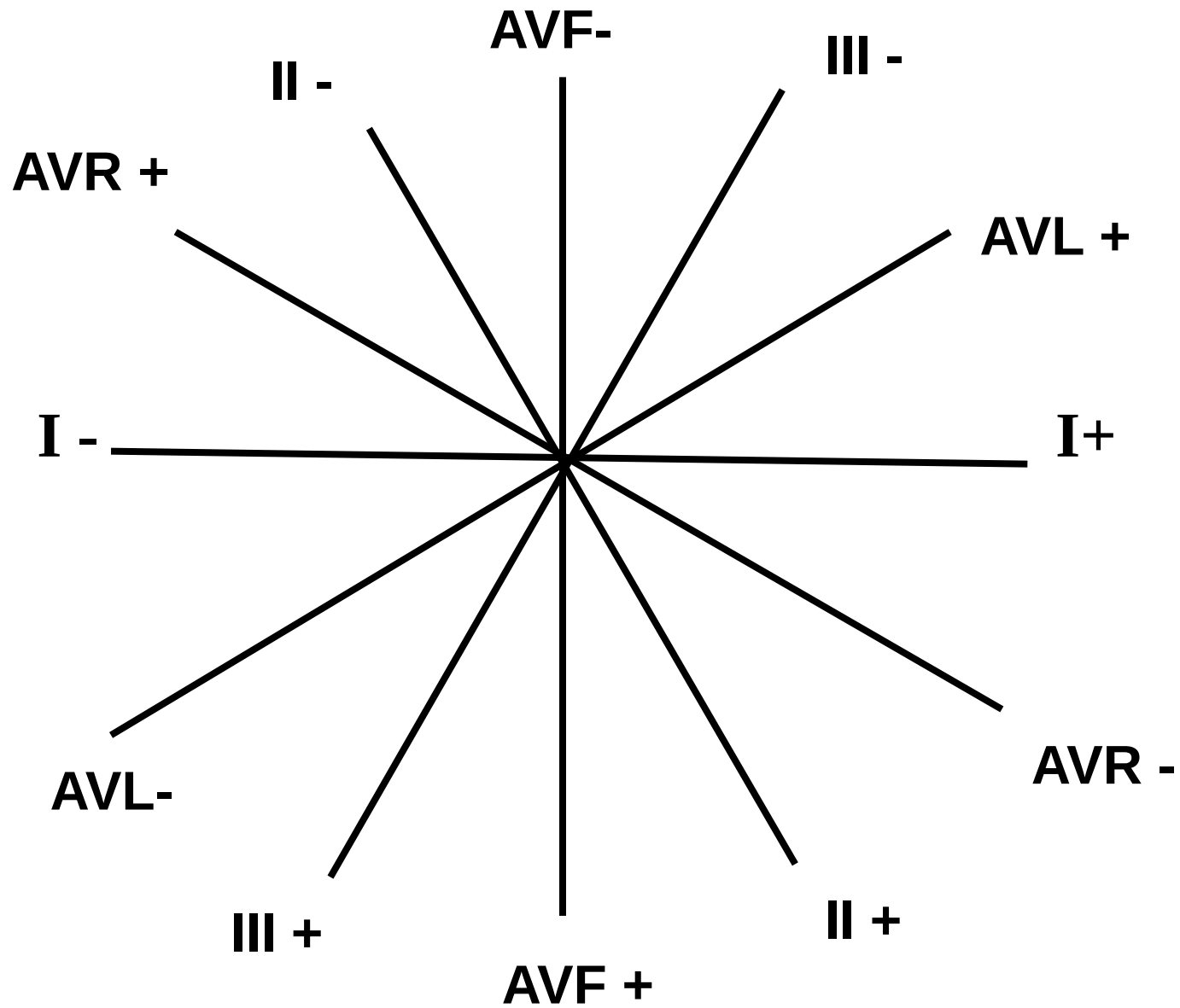


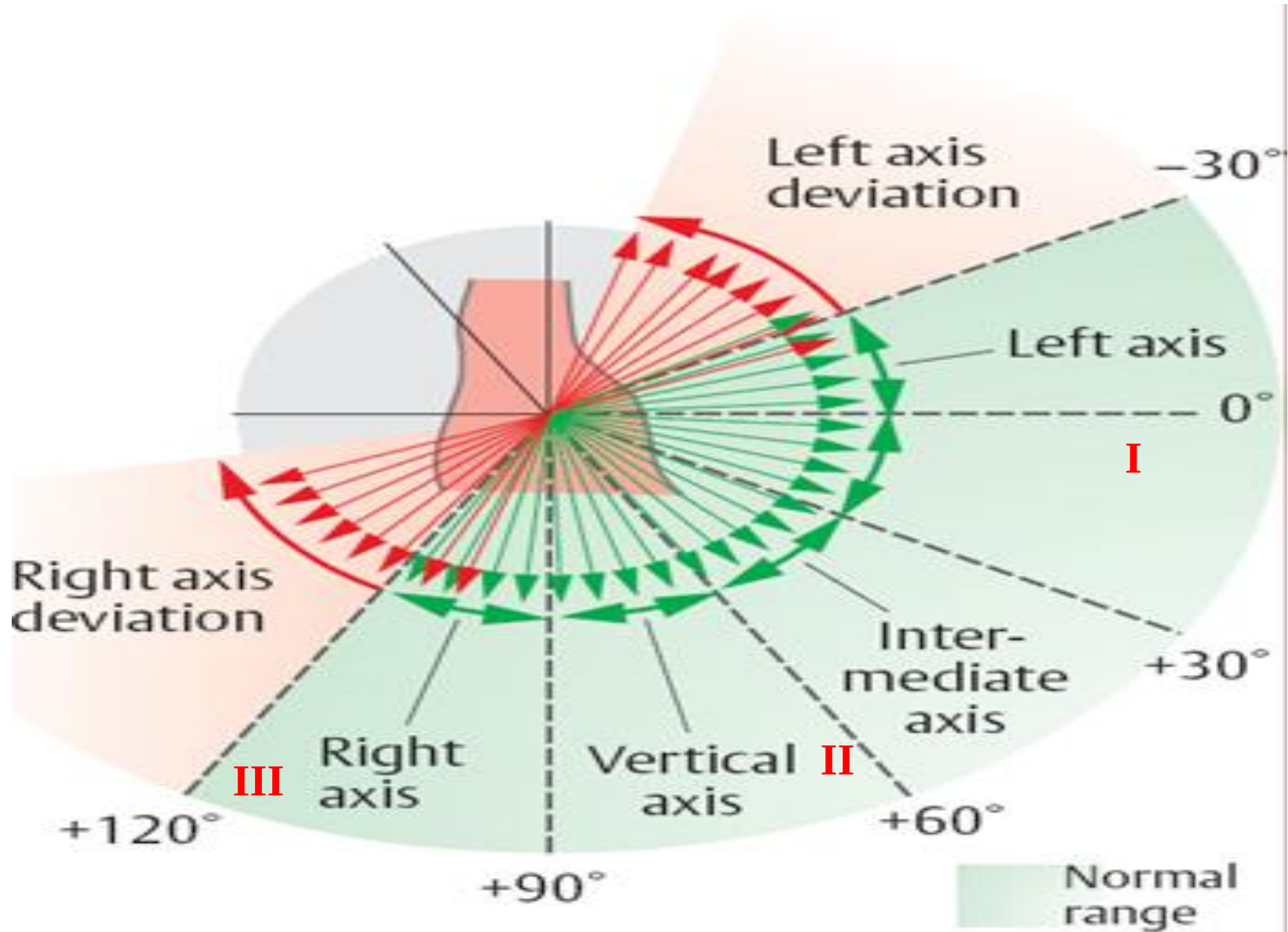




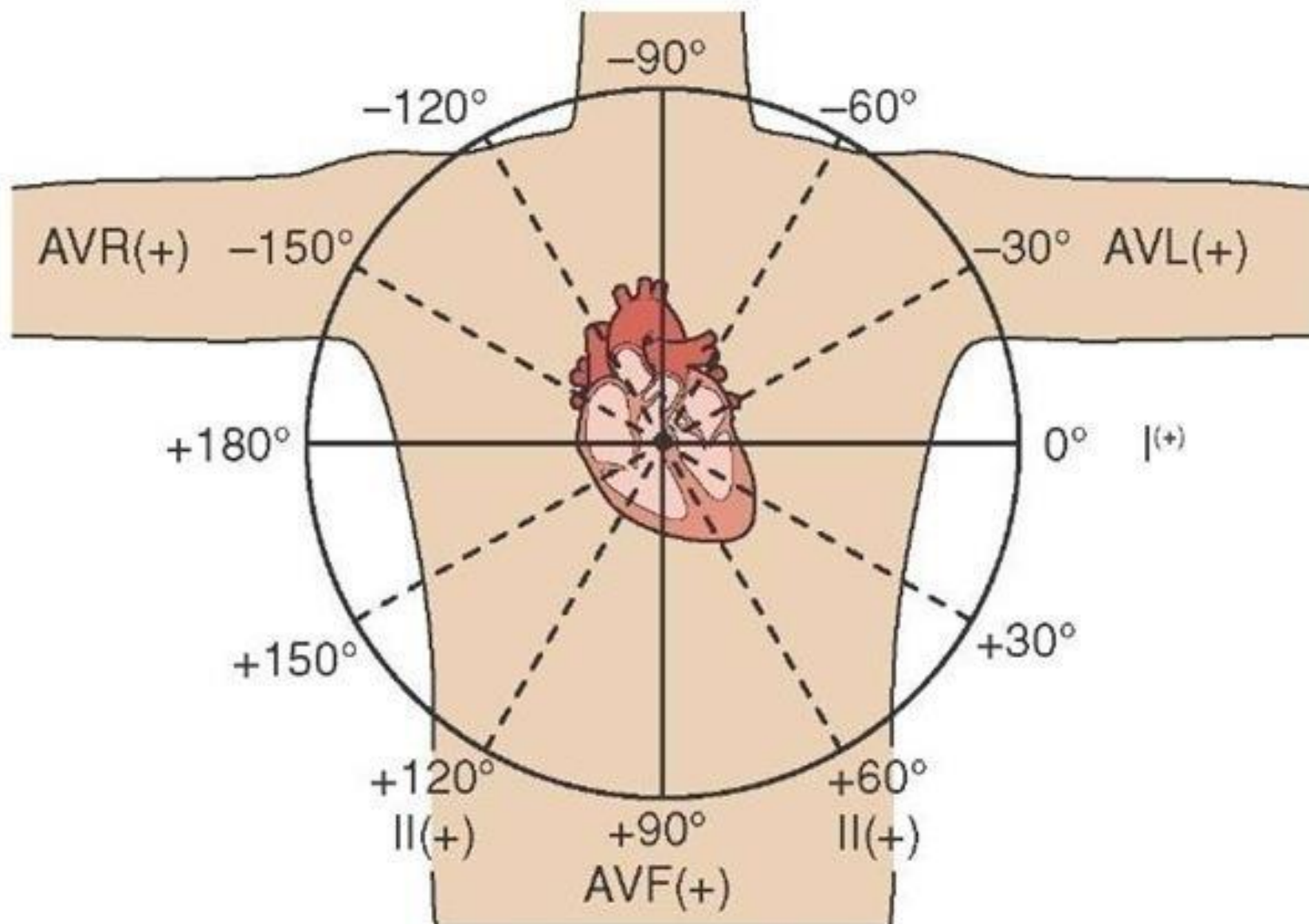
Augmented limb leads

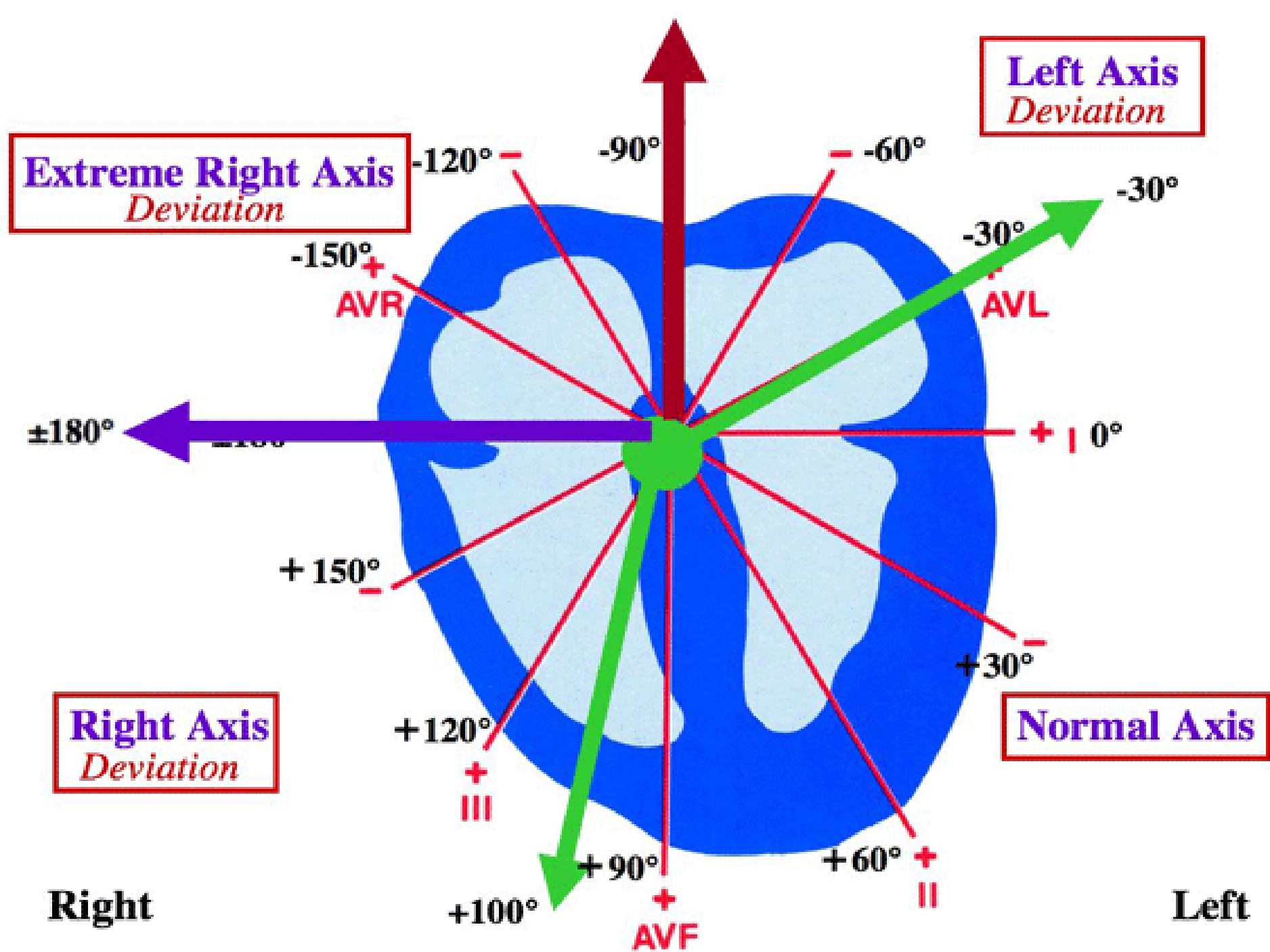






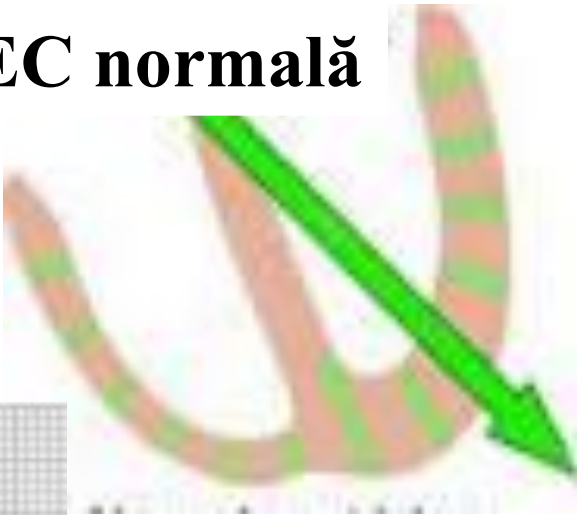
Hexaxial Reference System



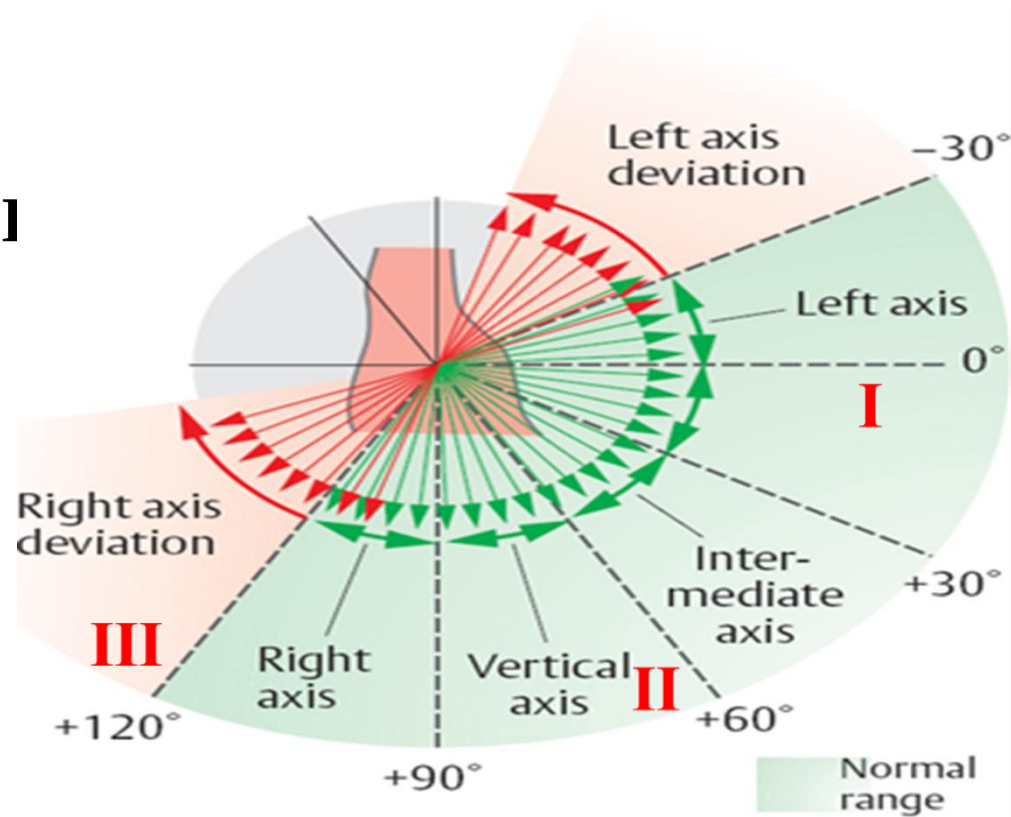


AEC normală

+ 30 – + 70

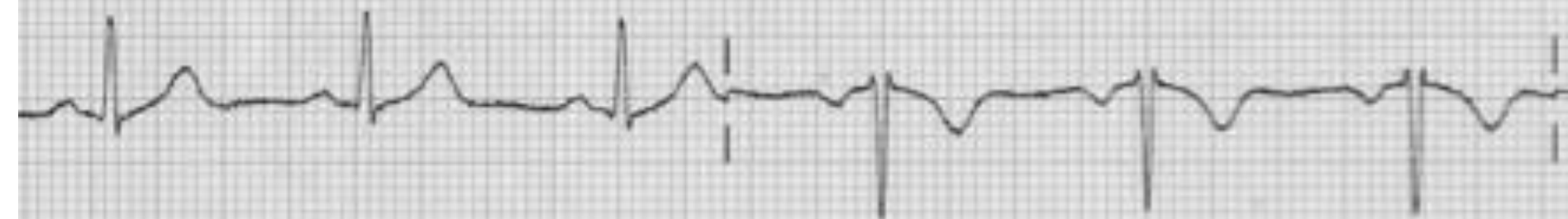


$$R_{II} > R_I > R_{III}$$



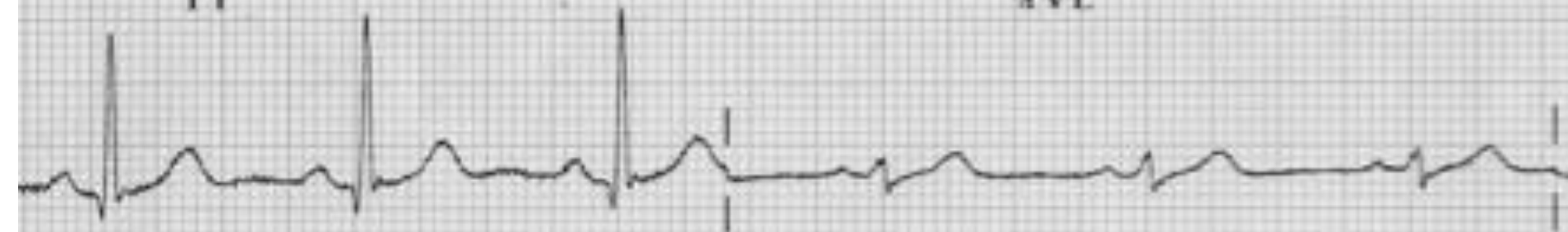
I

aVR



II

aVL



III

aVF



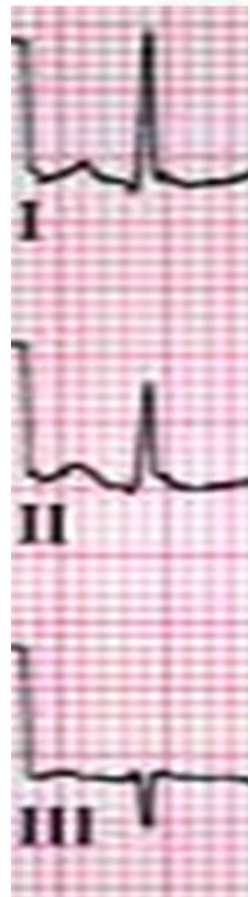
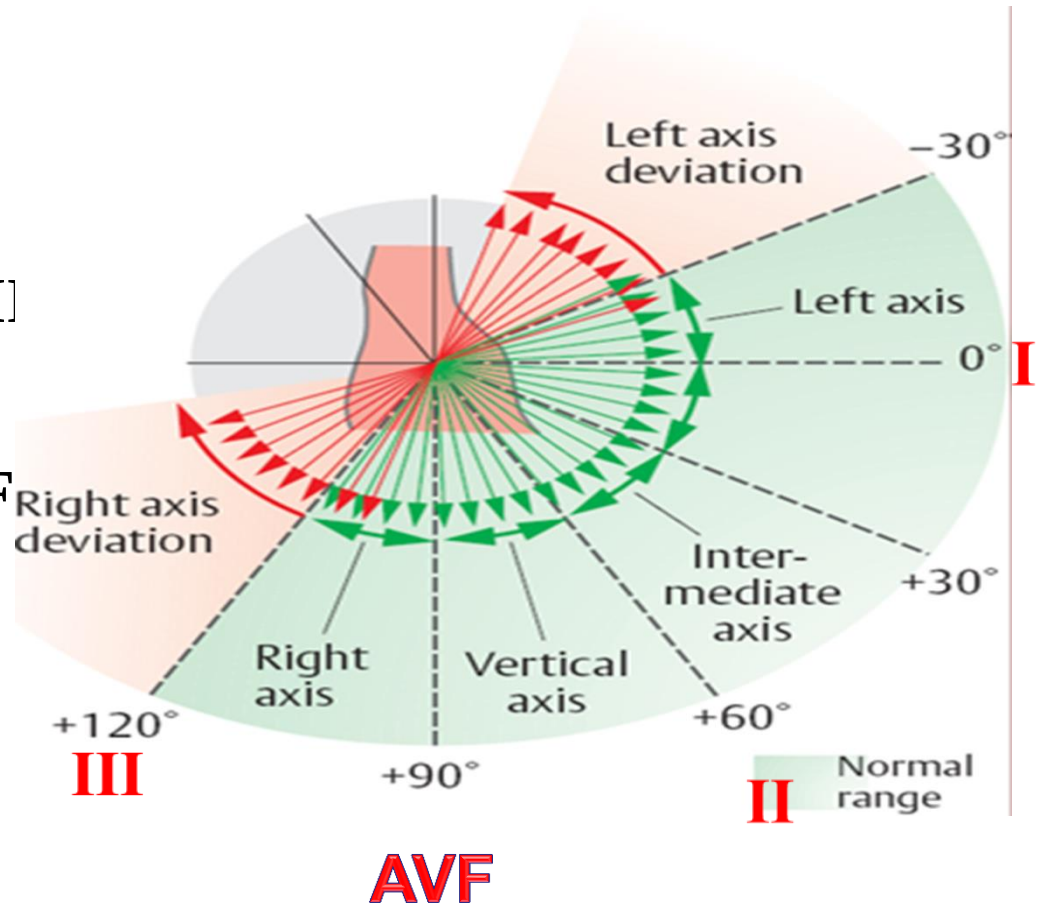
AEC
orizontală

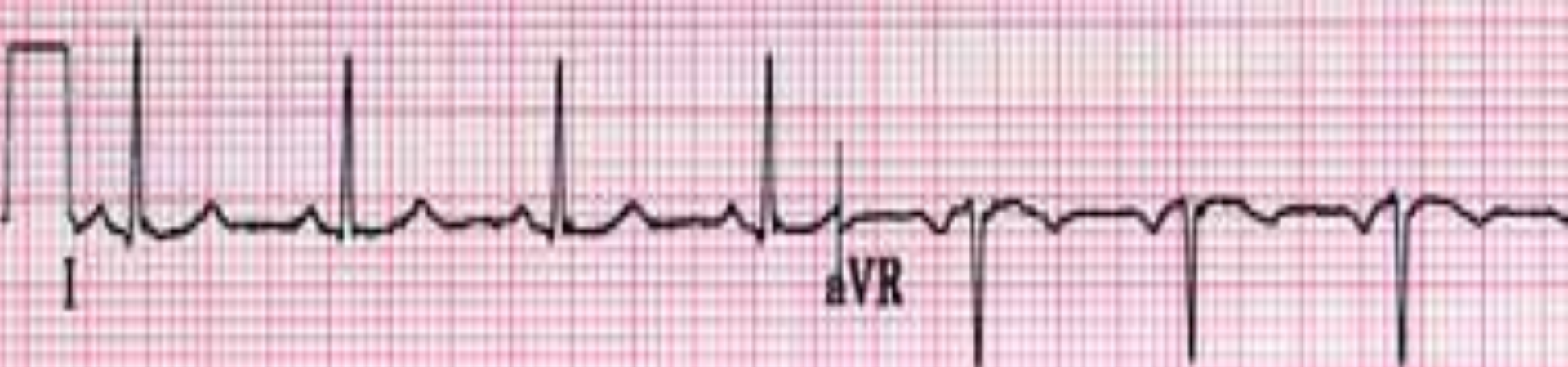


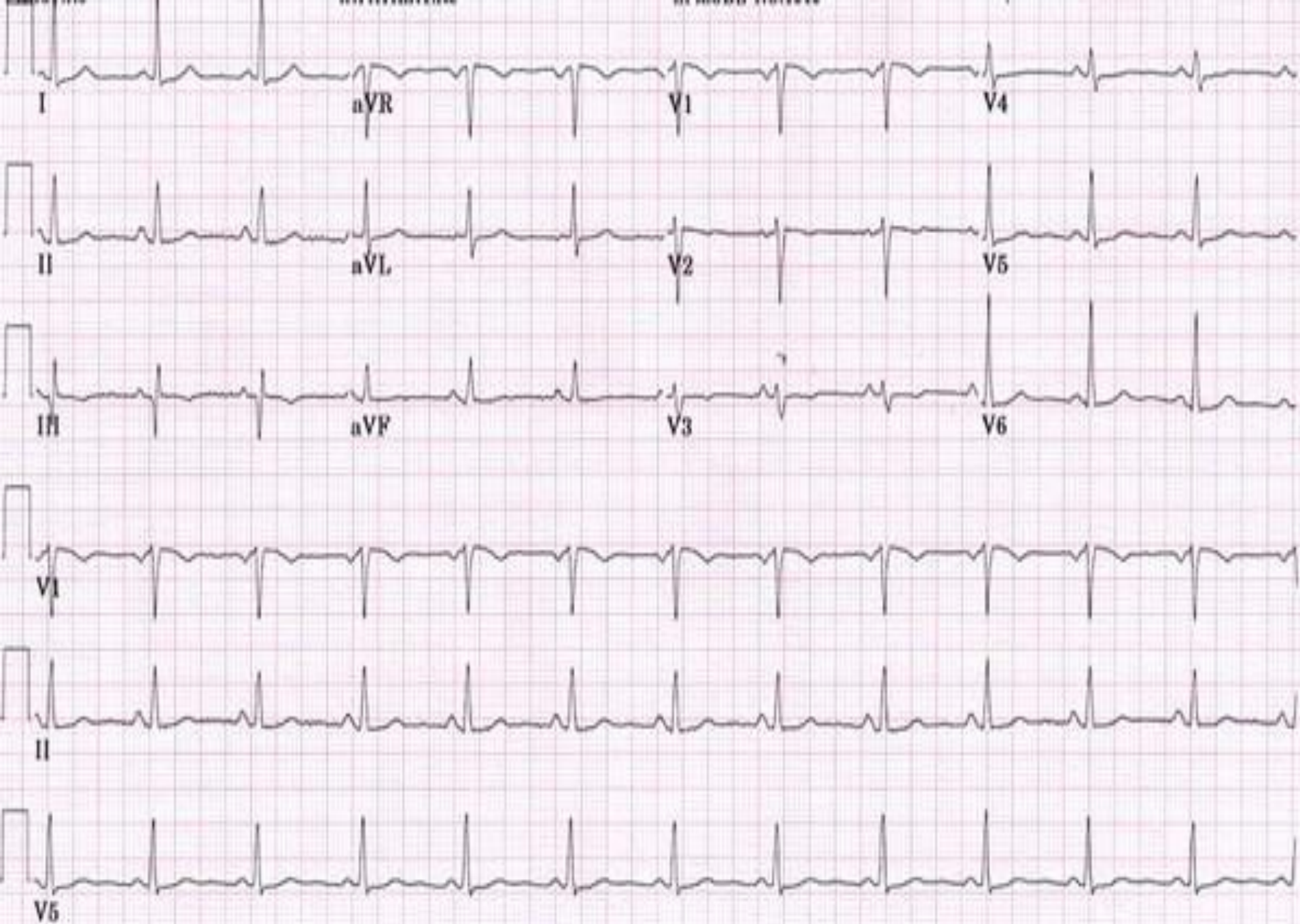
+ 0 – + 30

$$R_I > R_{II} > R_{III}$$

$$R_{AVF} > S_{AVF}$$

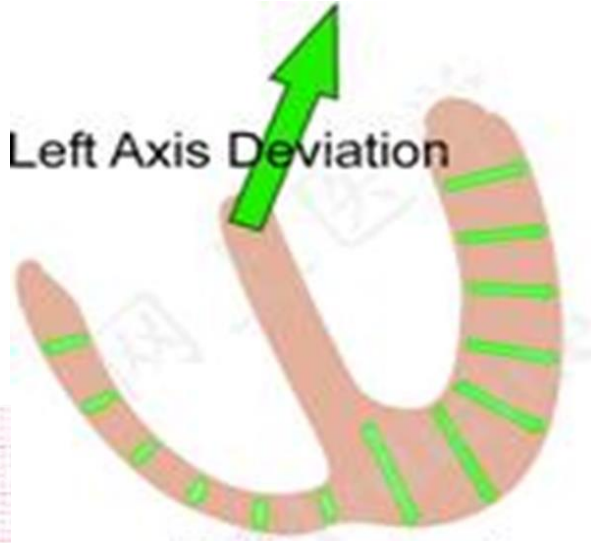






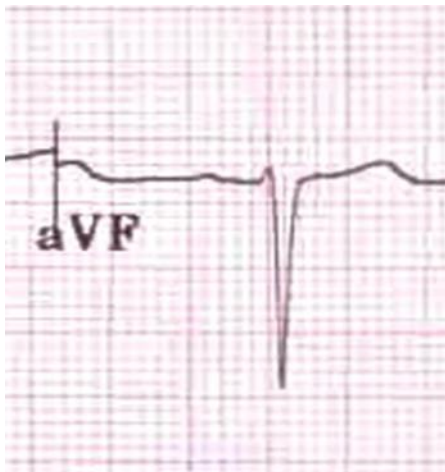
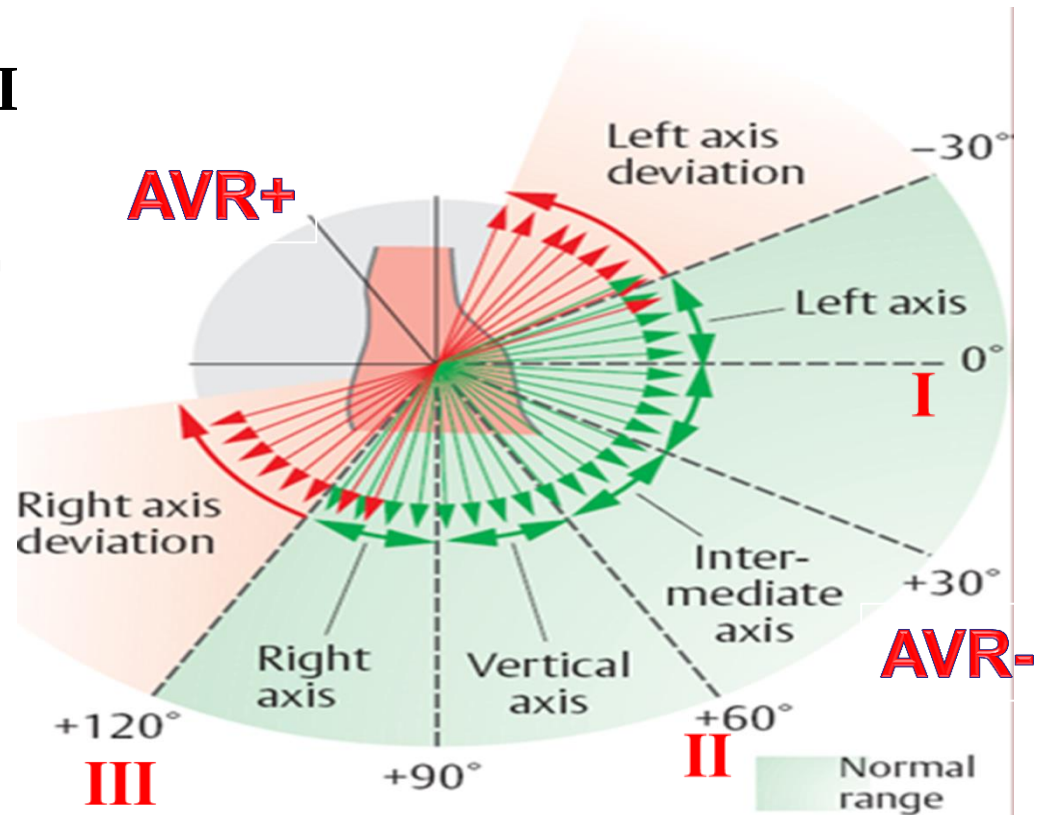
AEC deviație stângă

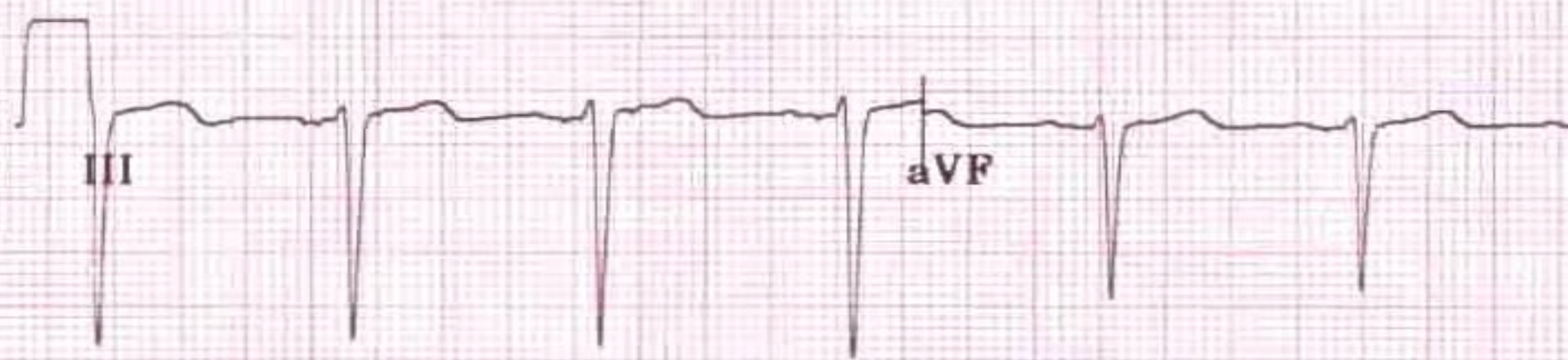
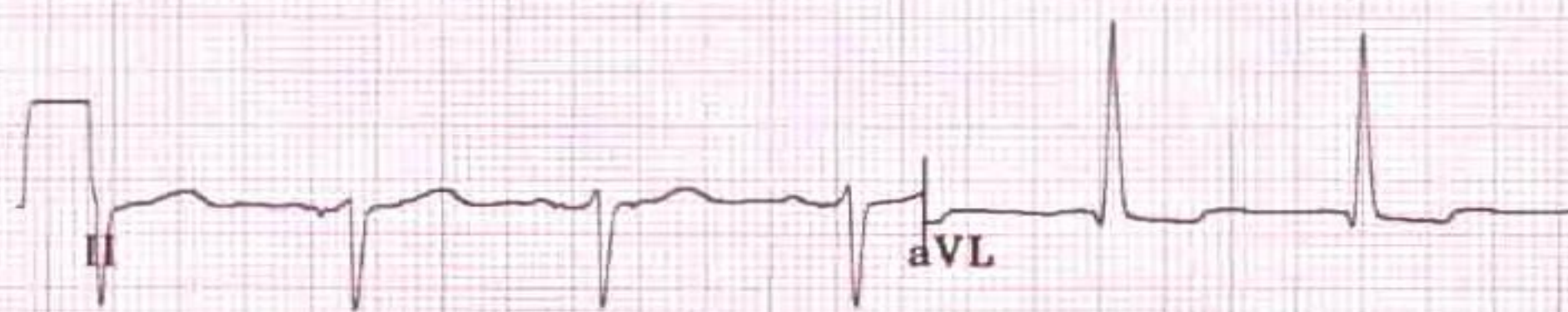
+ 0 – - 30

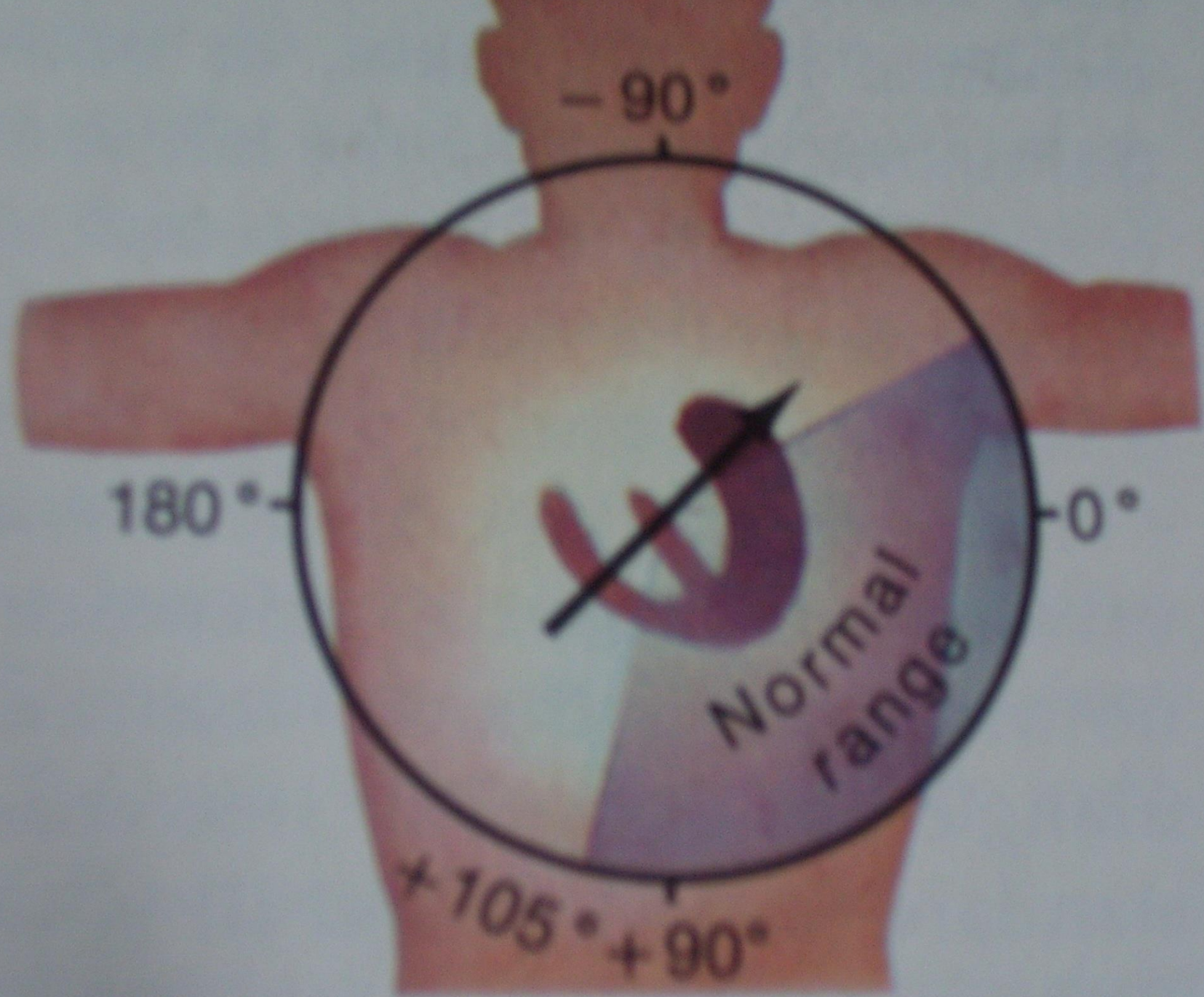


$$R_I > R_{II} > R_{III}$$

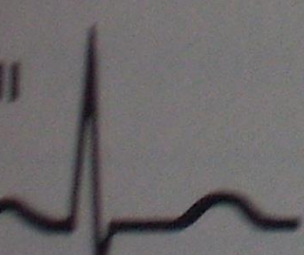
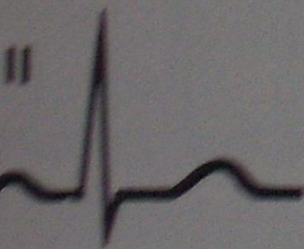
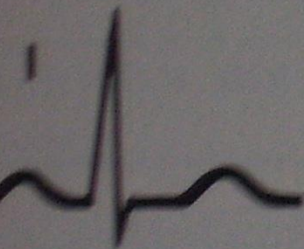
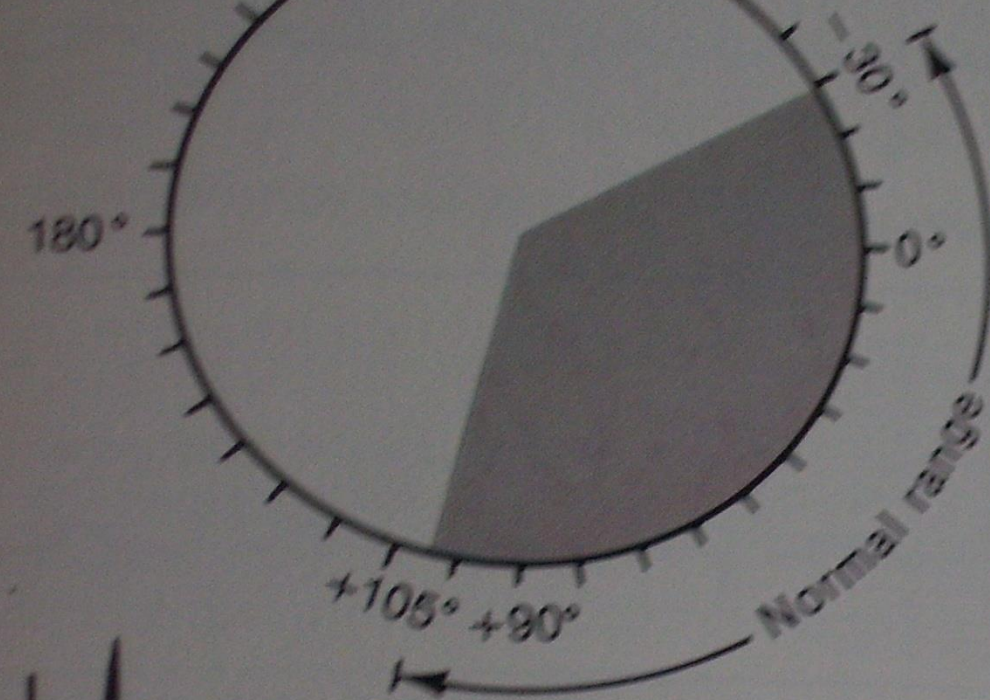
$$S_{AVF} > R_{AVF}$$



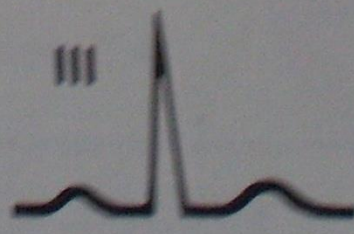
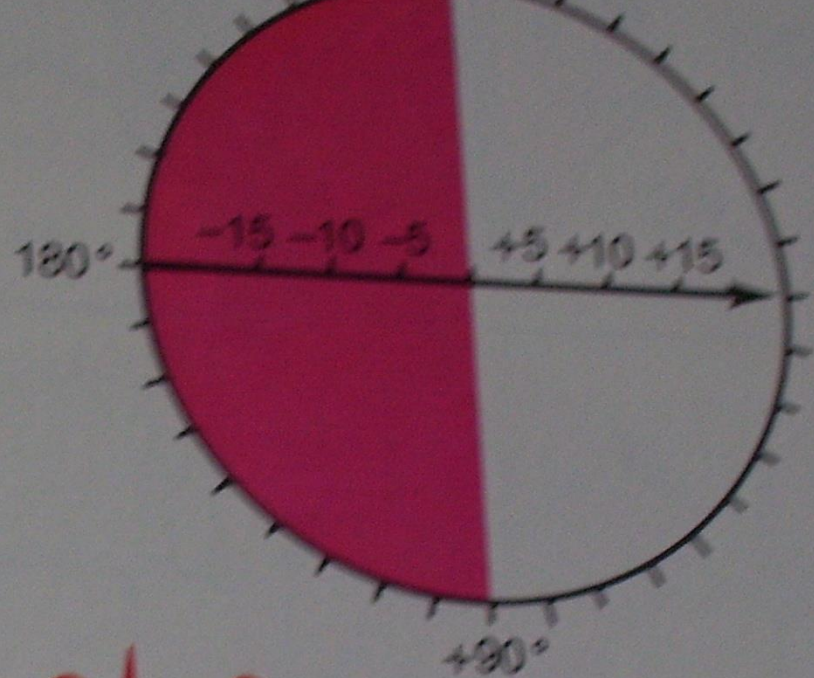
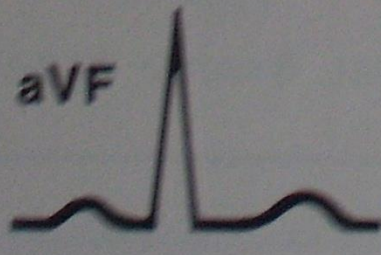




Left axis deviation: $> 90^\circ$

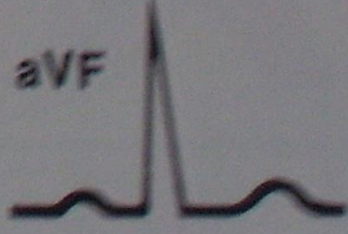


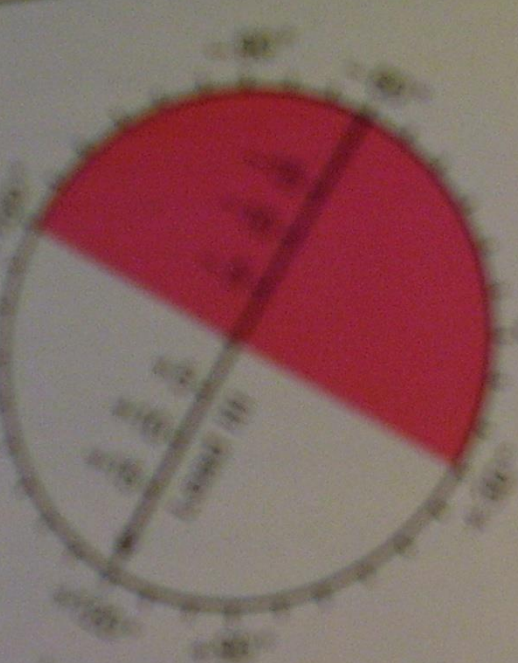
1. If QRS is not negative in leads I, II, III or aVF, axis is within normal range



2. Examine lead I
If QRS is negative in lead I, axis is to right of 90° (shaded area)

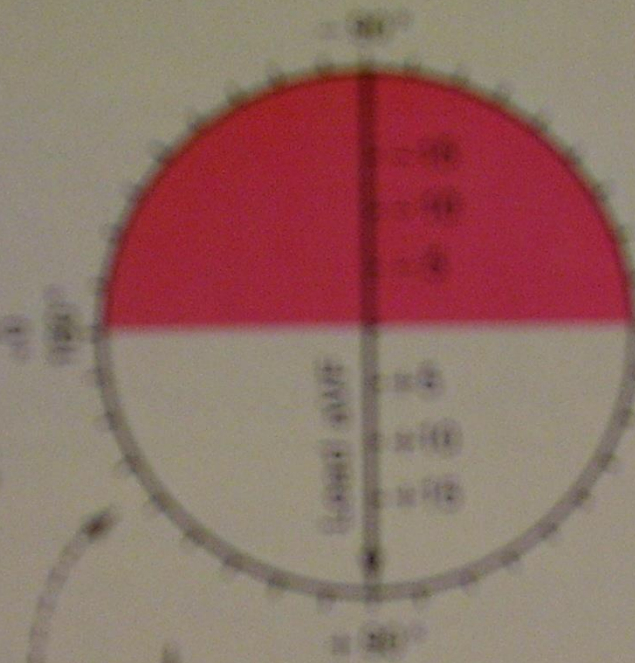
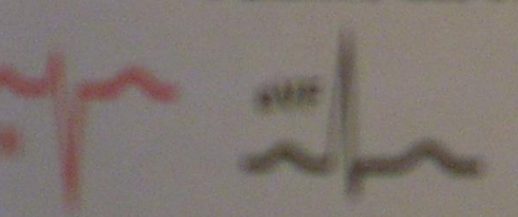
2a. If QRS is also positive in lead aVF, right axis deviation





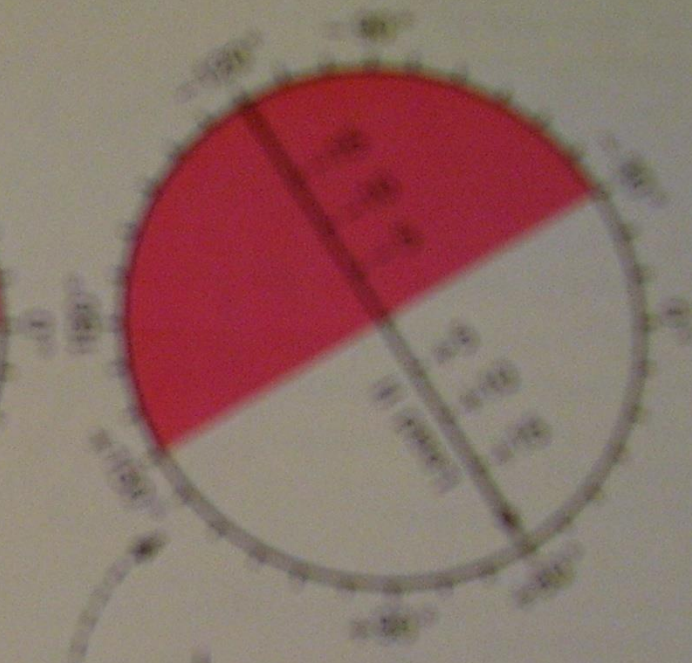
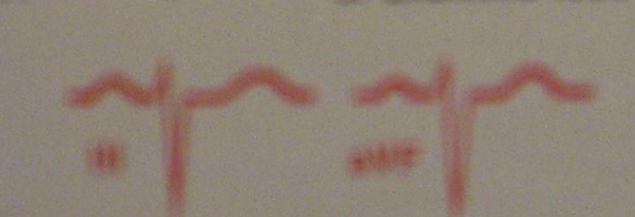
1. Examine lead II
 If QRS is negative in lead II, axis is in abnormal zone, left axis deviation

2. Examine lead aVF

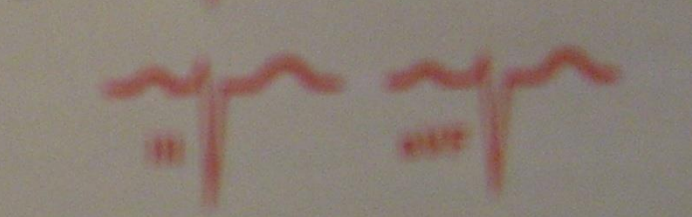


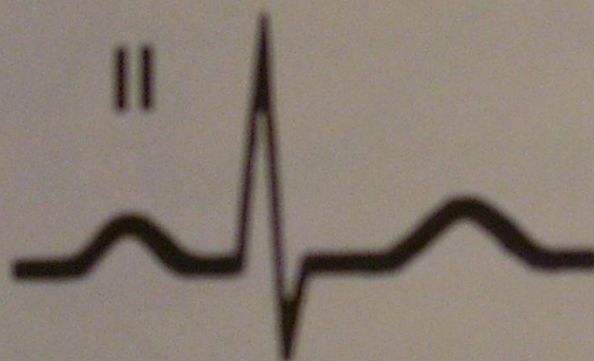
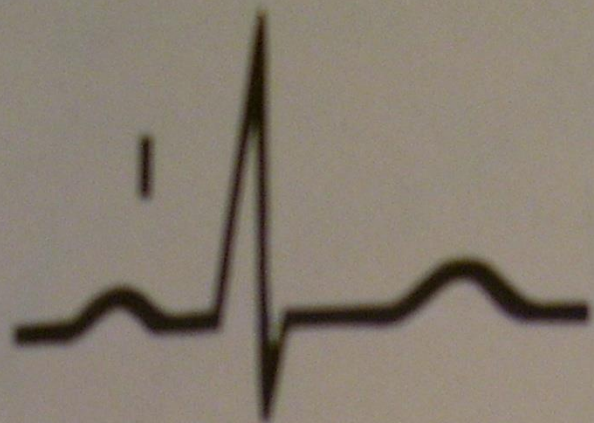
1. Examine lead II
 If QRS is negative in lead II and aVF, axis is in abnormal zone, left axis deviation

2. Examine lead I



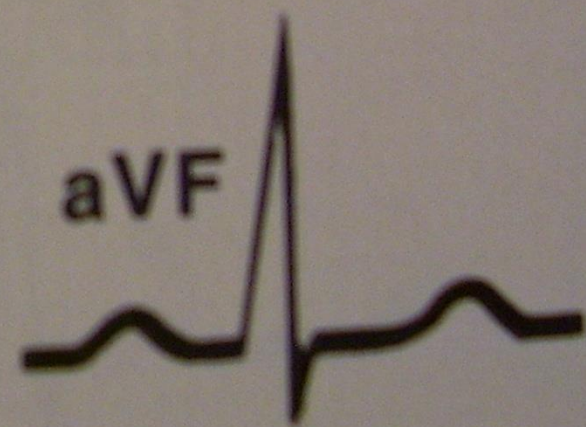
1. Examine lead II
 If QRS is negative in lead II, aVF and I, axis is in abnormal zone, left axis deviation

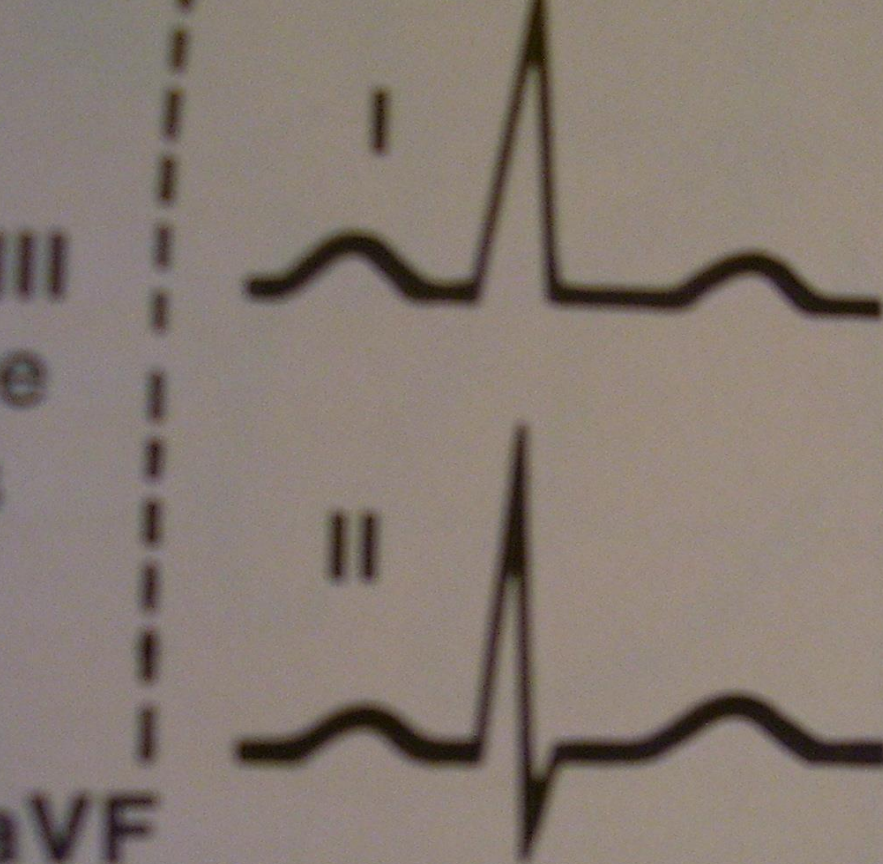




3. Examine lead III
If QRS is negative
in lead III, axis is
in shaded area,
left of $+30^{\circ}$

4. Examine lead aVF



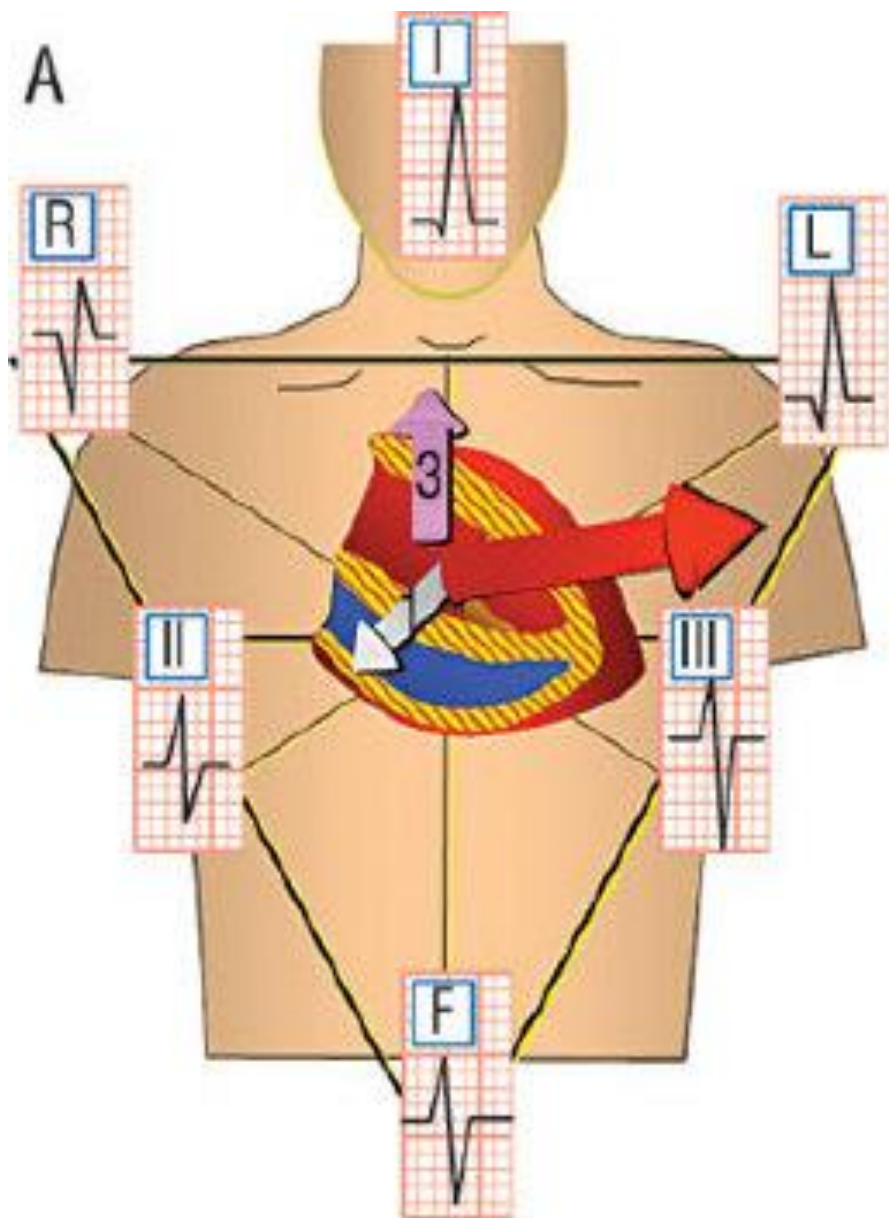


If QRS is negative
in leads III and
aVF, axis is in
shaded area, left
of 0°

5. Examine lead II

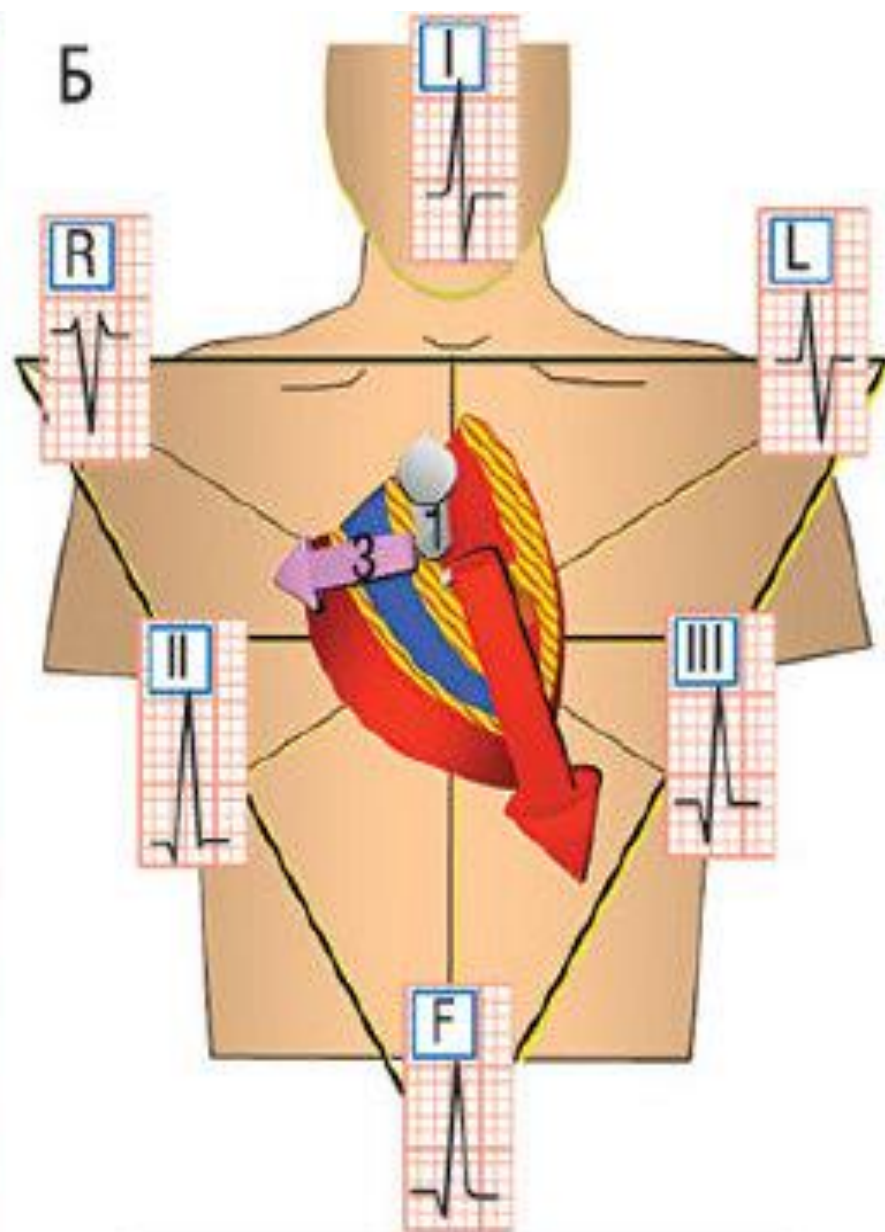


A



Горизонтальная позиция

Б



Вертикальная позиция

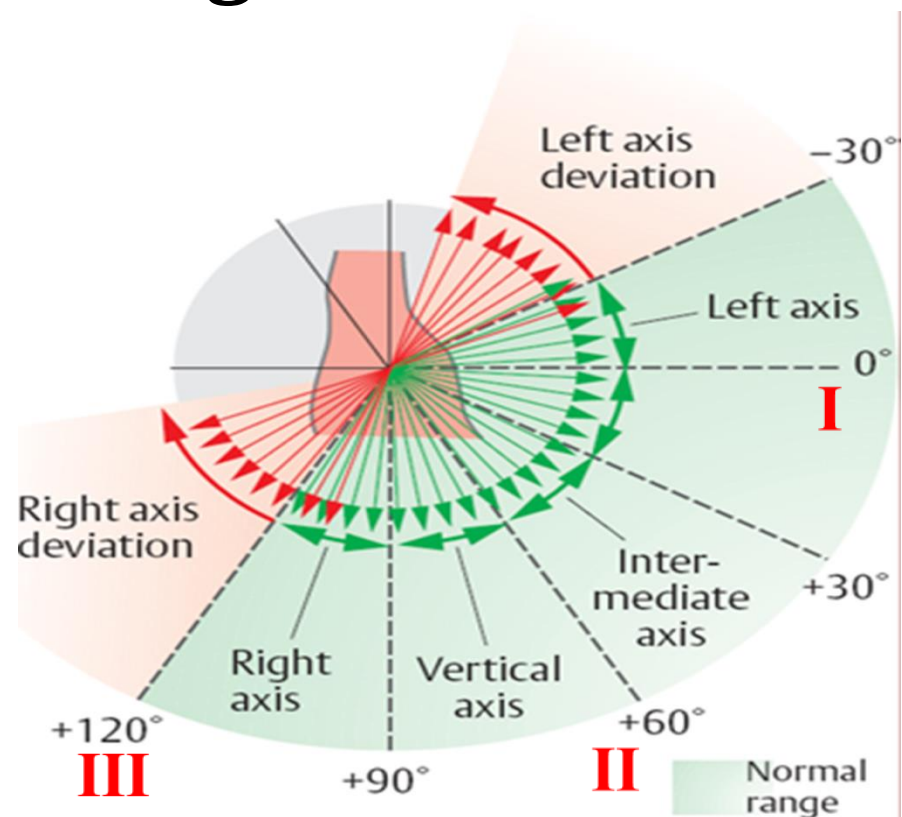
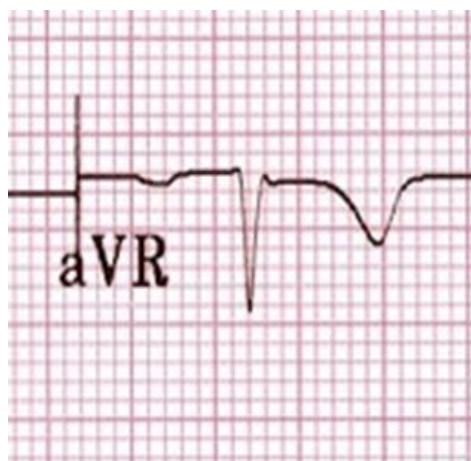
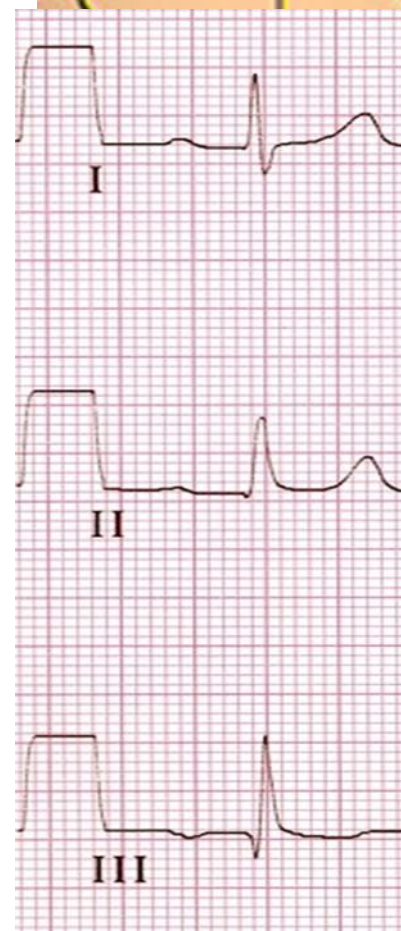


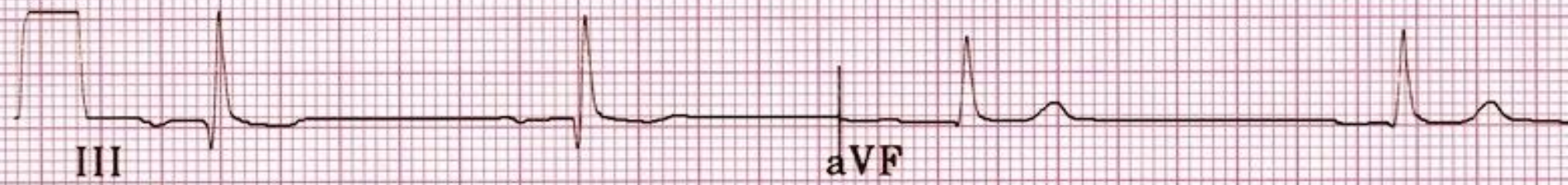
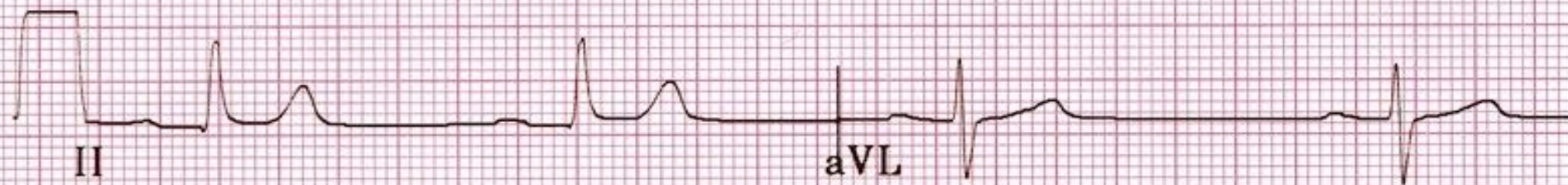
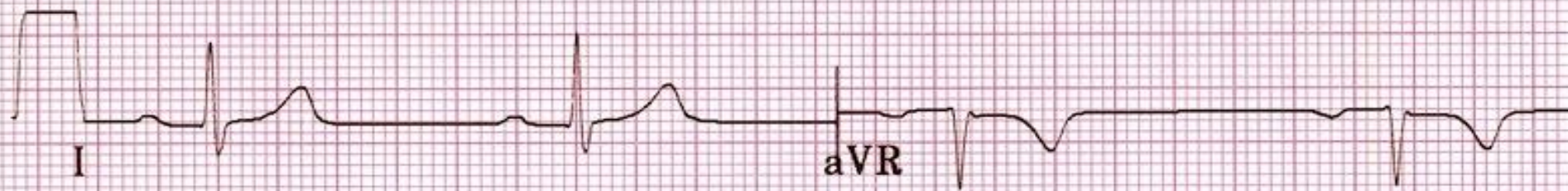
AEC verticală

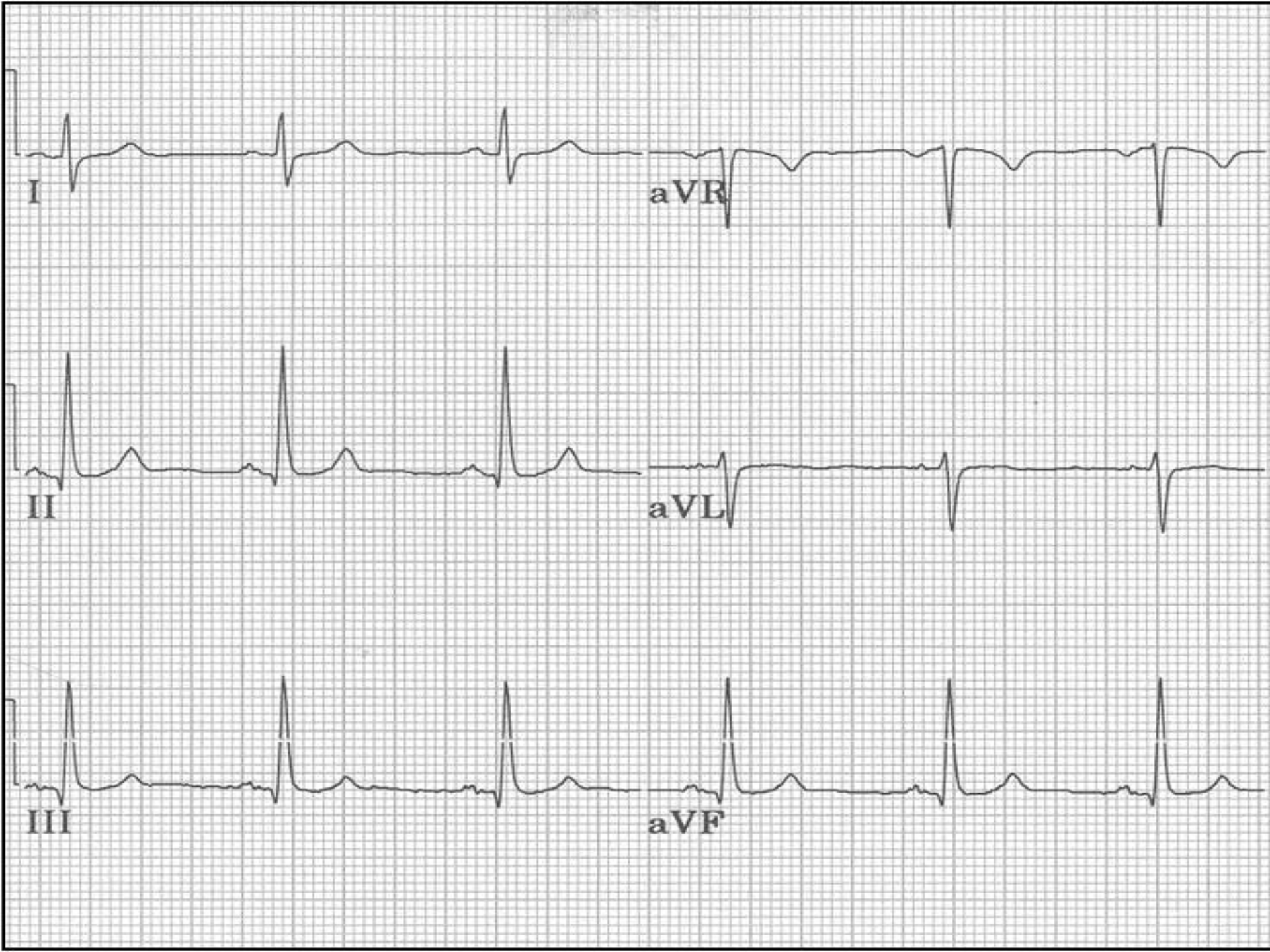
+ 70 – + 110

$R_{III} > R_{II} > R_I$

AVR P neg, rS

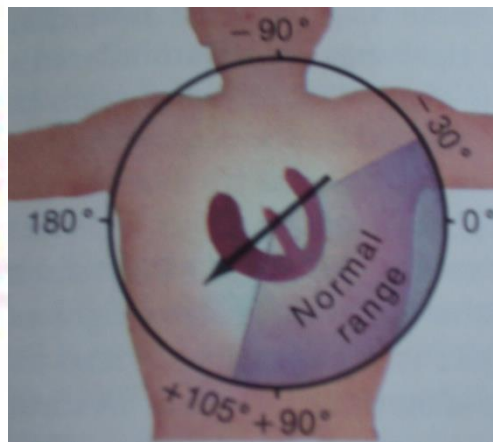








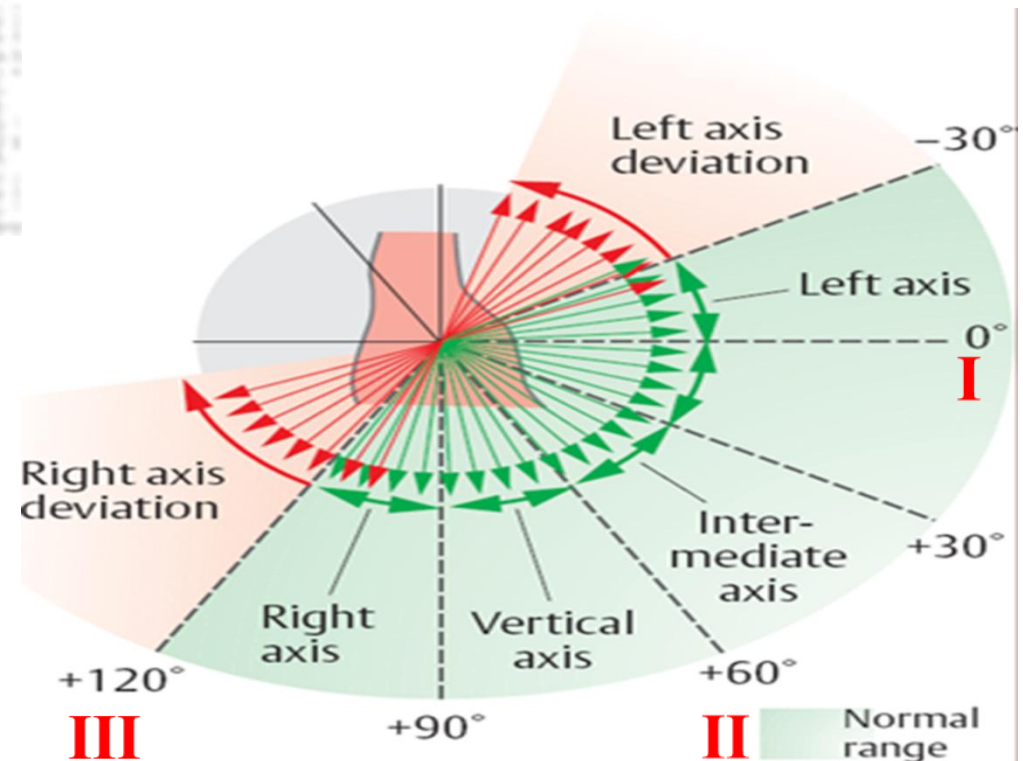
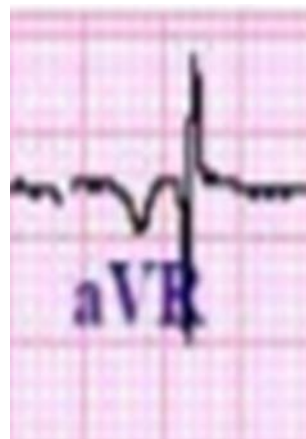
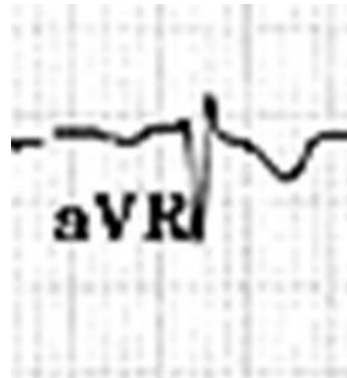
Right Axis Deviation

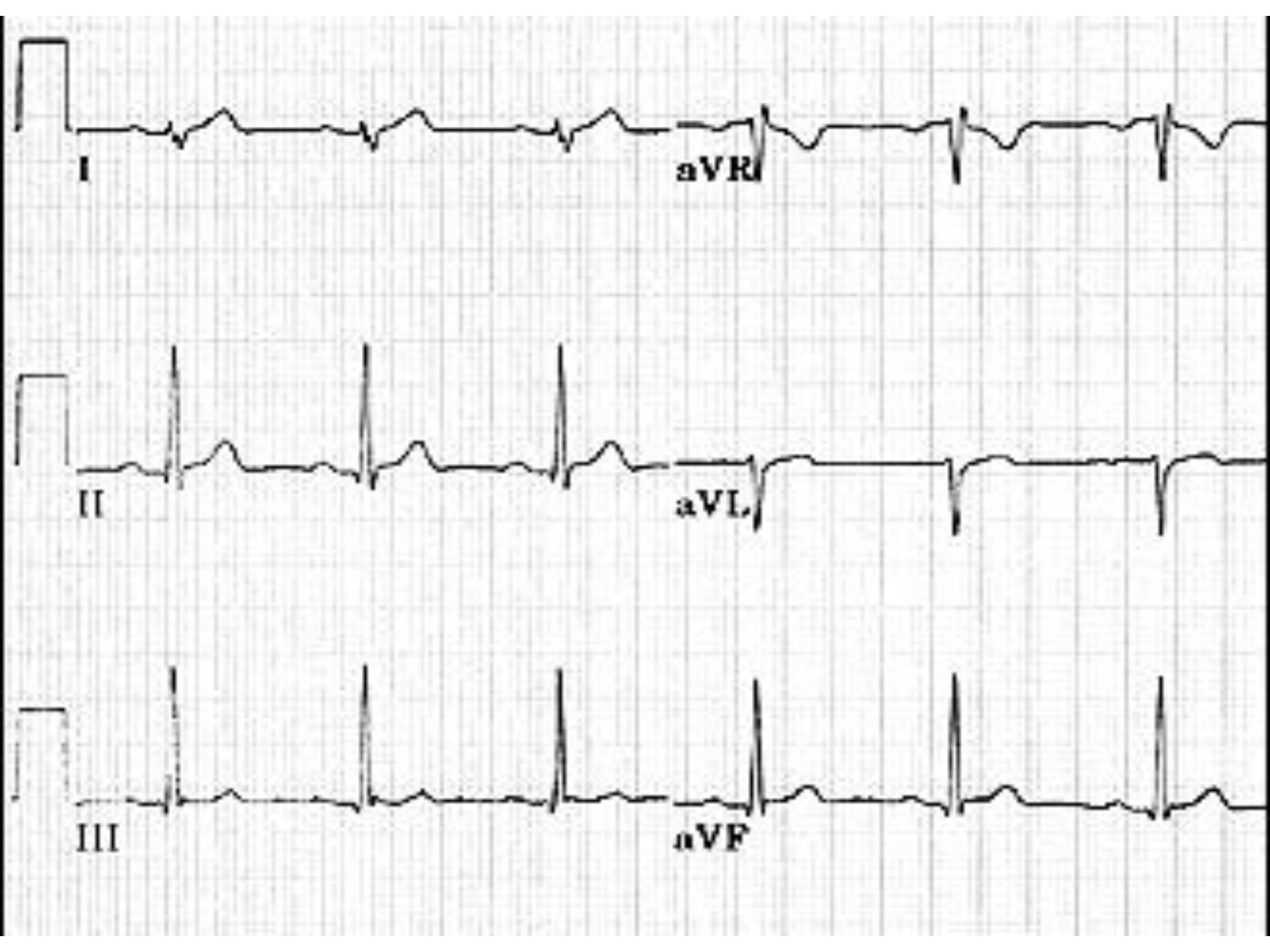


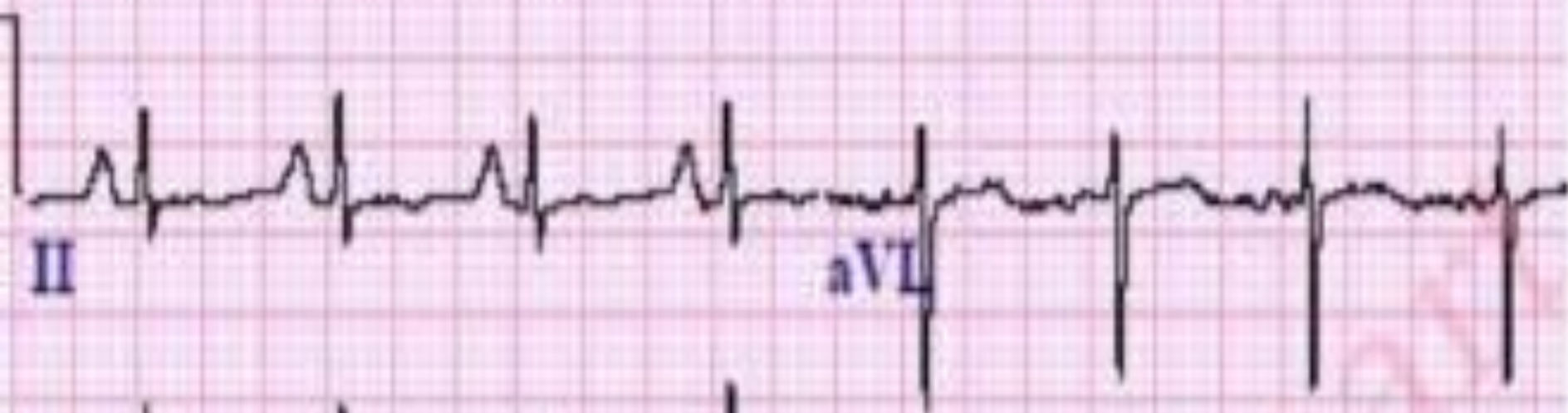
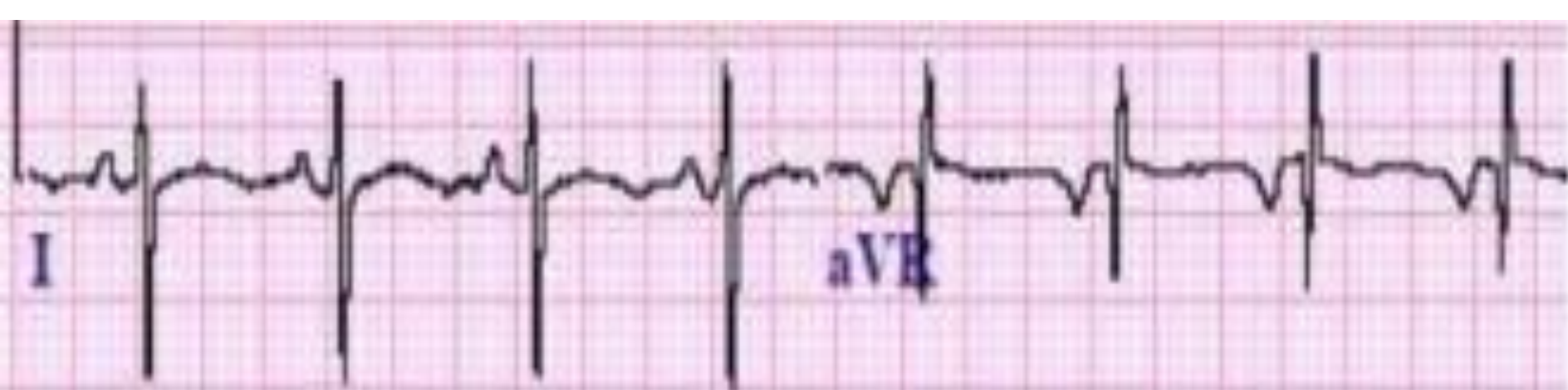
+ 70 – + 110

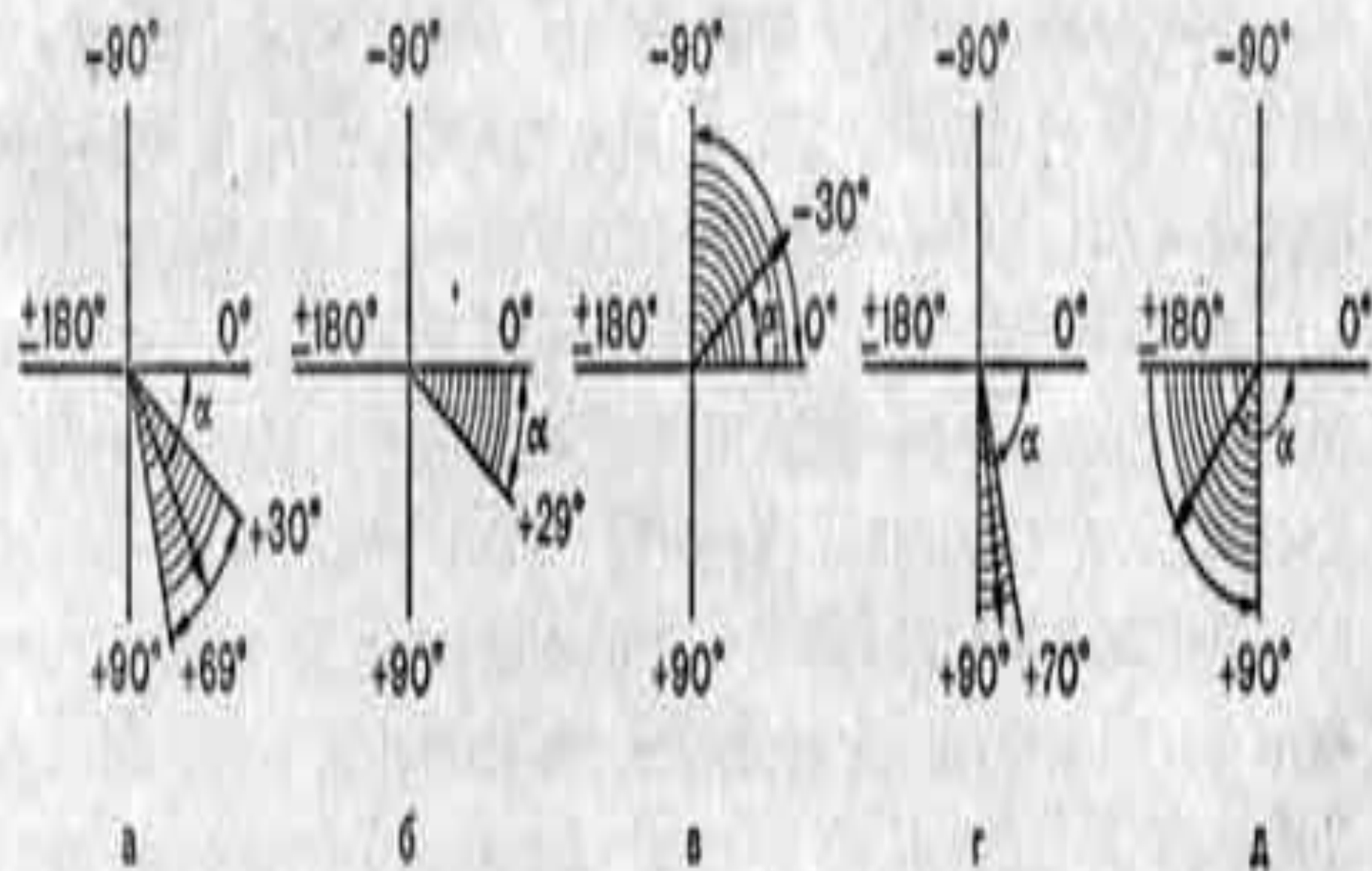
$$R_{III} > R_{II} > R_I$$

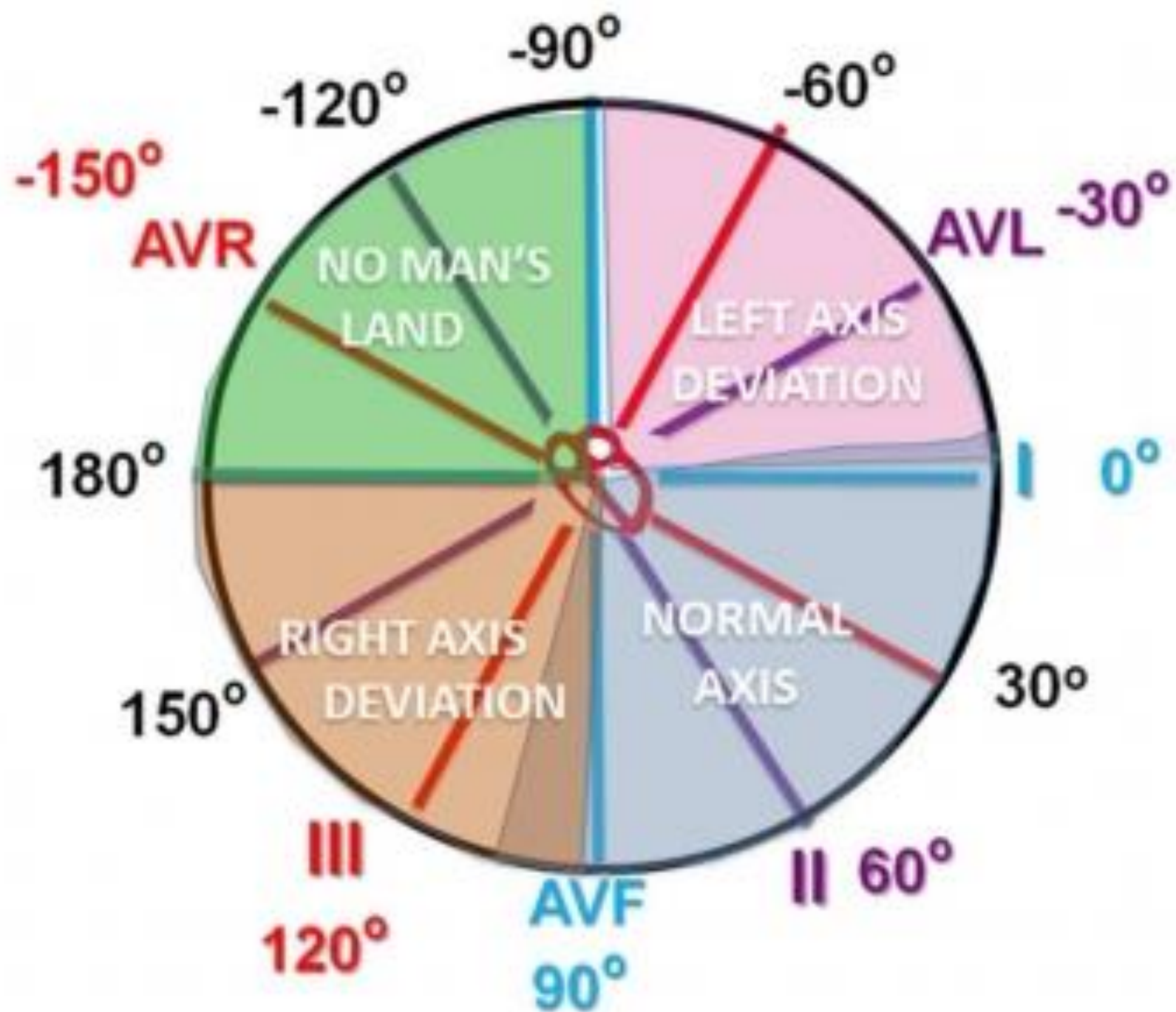
AVR P neg, rSR¹



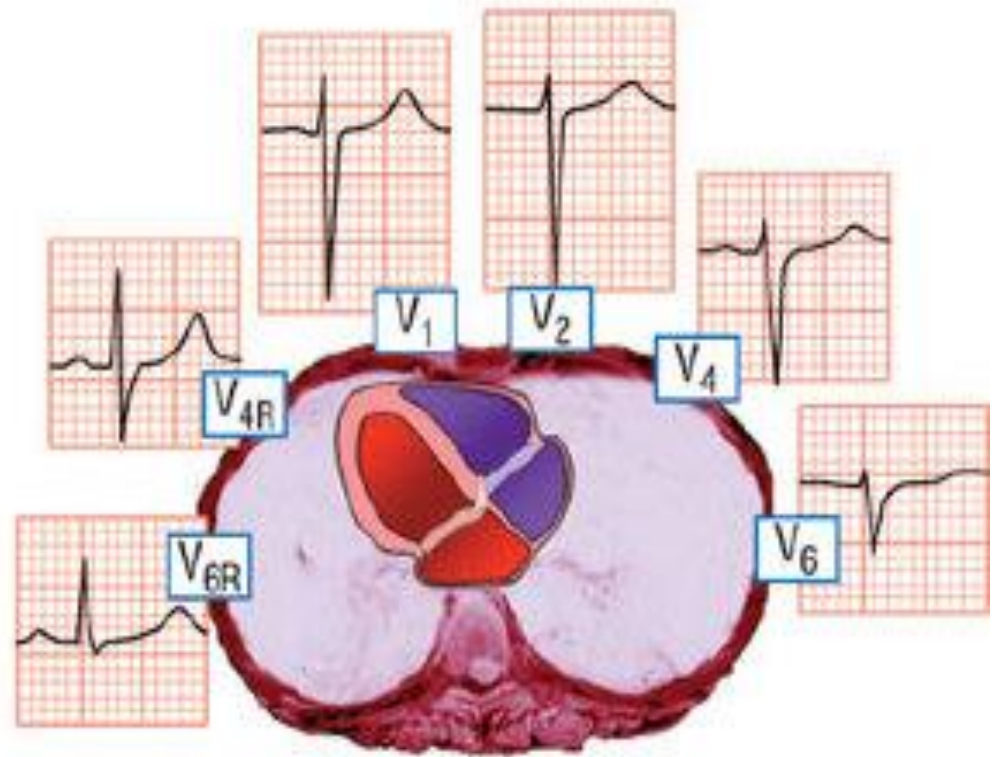
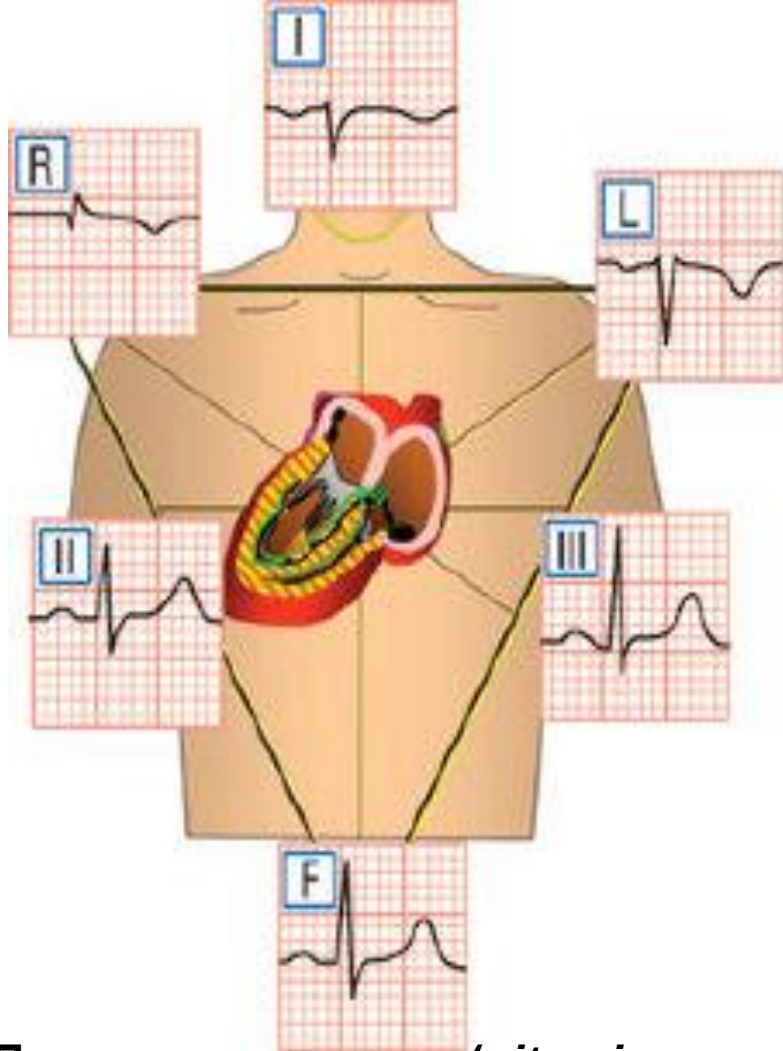




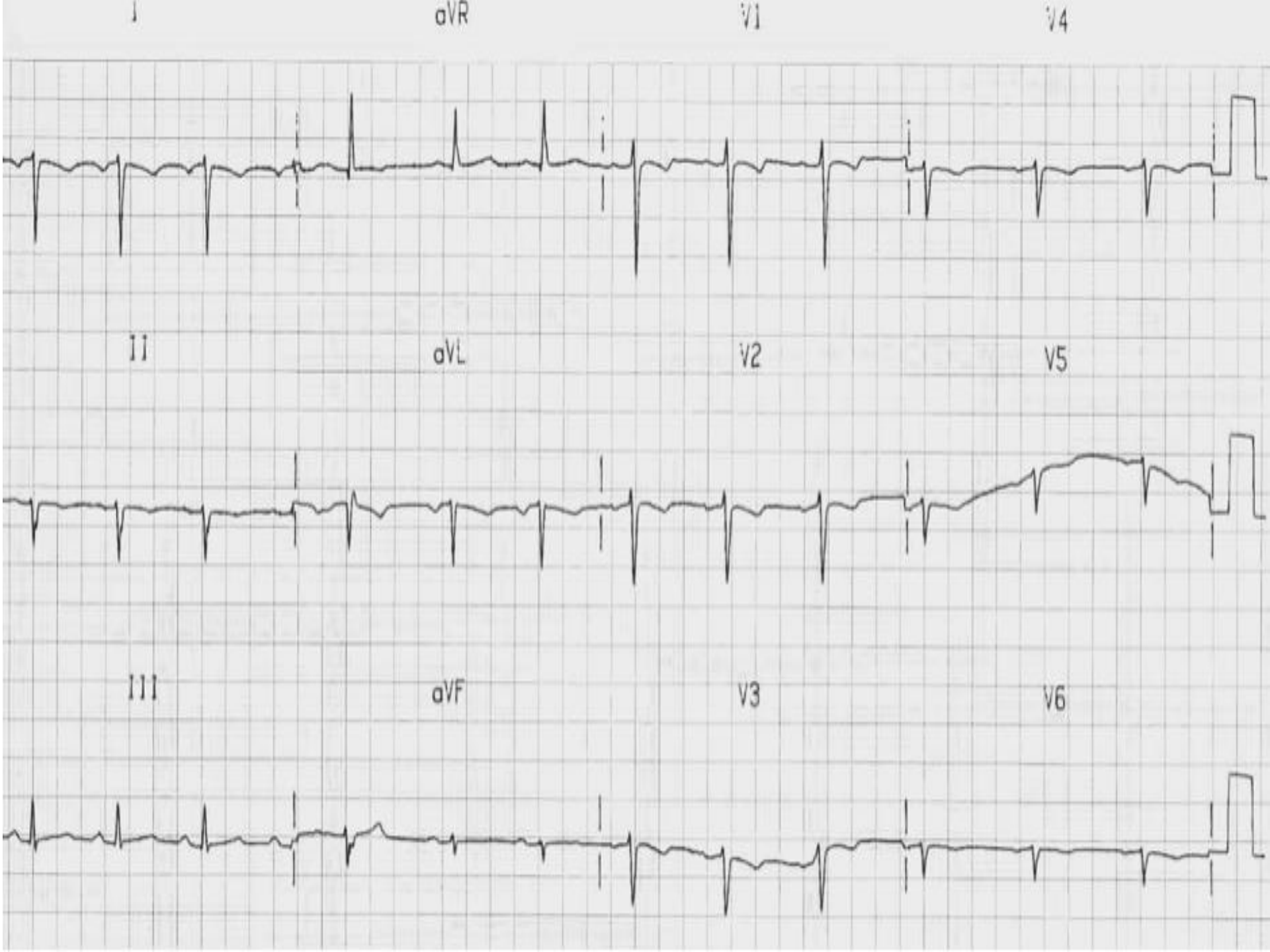




ДЕКСТРОКАРДИЯ



При декстрокардии (*situs inversus*) все параметры электрической позиции сердца зеркально отражаются справа от срединной линии. Зубец *P* будет отрицательным в отведении I, а ось *QRS* будет отклонена в правый нижний квадрант (от $+90^\circ$ до $+180^\circ$). В прекардиальных отведениях не будет происходить нормального развития комплекса от *rS* до *qR* к отведениям *V*₅-*V*₆, но это будет наблюдаться в отведениях, расположенных симметрично на правой половине грудной клетке (*V*_{3R}-*V*_{6R})



**Deschide-ți inima la învățătură, și urechile
la cuvintele științei.
Proverbe 23:12**

