Basiscursus ECG voor anesthesisten i.o.

Joris de Groot

Jonas de Jong

CARDIO NETWORKS.ORG

non-profit / open access / physician moderated / up-to-date

ECG PEDIA.ORG

part of cardionetworks.org

Cursusoverzicht

9.30 -10.00	**Ontvangst en koffie**
10.00- 10.50	**ECG interpretatie in 7+2 stappen**
10.50- 11.00	**Koffie**
11.00- 11.30	**Ritme en Geleidingsstoornissen**
11.30- 12.00	**Ischemie**
12.00- 12.30	**Lunch**
12.30- 13.00	**ECG afwijkingen op de preoperatieve poli**
13.00- 14.45	**Workshop**

De cursus is interactief. Onderbreek gerust!

Cardionetworks

Auteurs:

- Jonas de Jong
- Ivo van der Bilt
- Martijn Meuwissen
- Dr. Renée van den Brink
- Dr. Joris de Groot

Illustraties:

- Rob Kreuger
- Bart Duineveld

Met dank aan:

- Prof. Arthur Wilde
- Dr. Rudolph Koster

Boeken:

- Wellens: *The ECG in Emergency Decision Making*
- Garcia / Miller: *Arrhythmia Recognition*
- *Braunwald Heart Disease*

Basics van het ECG

Grondbeginselen

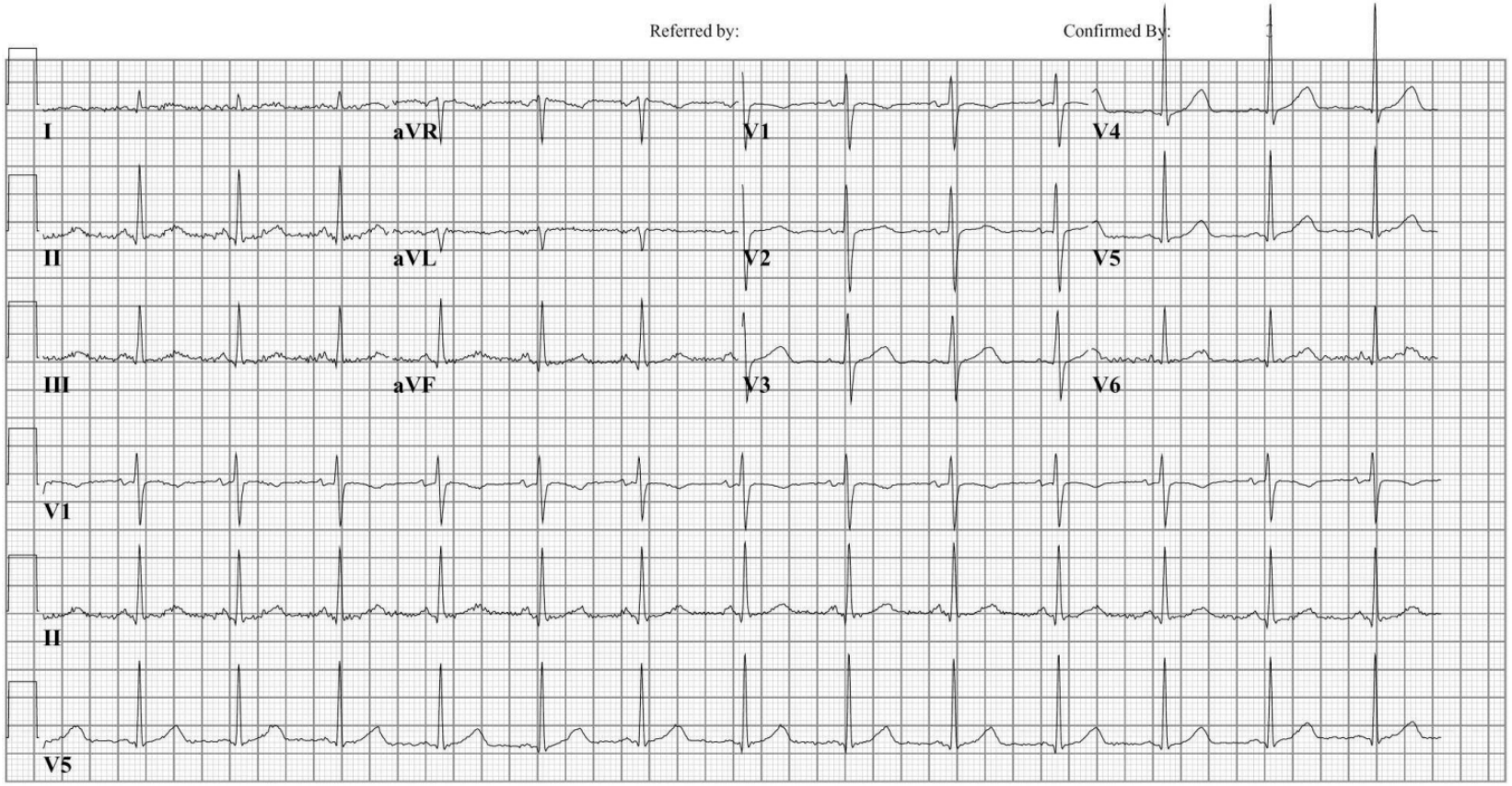
Vent. rate	81	BPM	*** Leeftijds en geslacht specifieke ECG analyse ***
PR interval	120	ms	Normaal sinusritme
QRS duration	80	ms	Normaal ECG
QT/QTc	376/436	ms	Geen oud ECG aanwezig
P-R-T axes	81 80	73	

Loc:23

Technician:

Referred by:

Confirmed By:



25mm/s 10mm/mV 40Hz 005E 12SL 233 CID: 10

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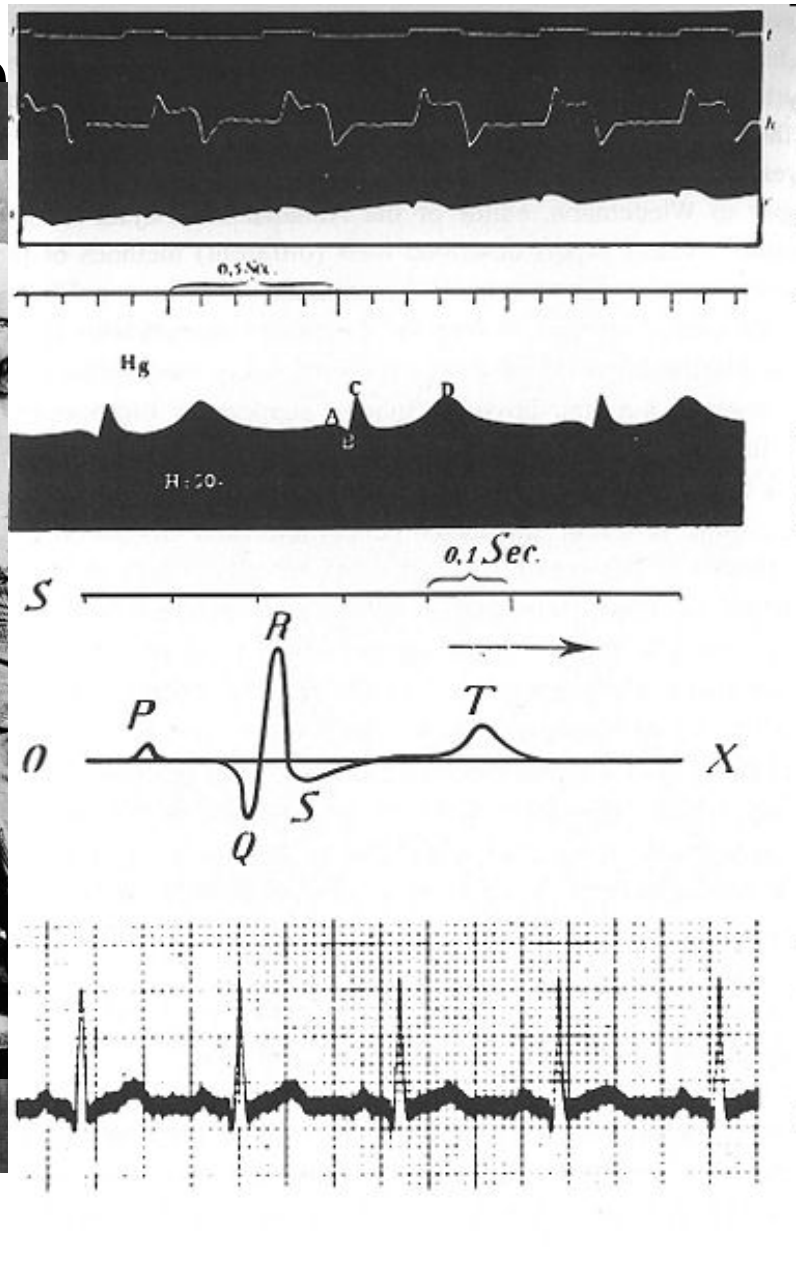
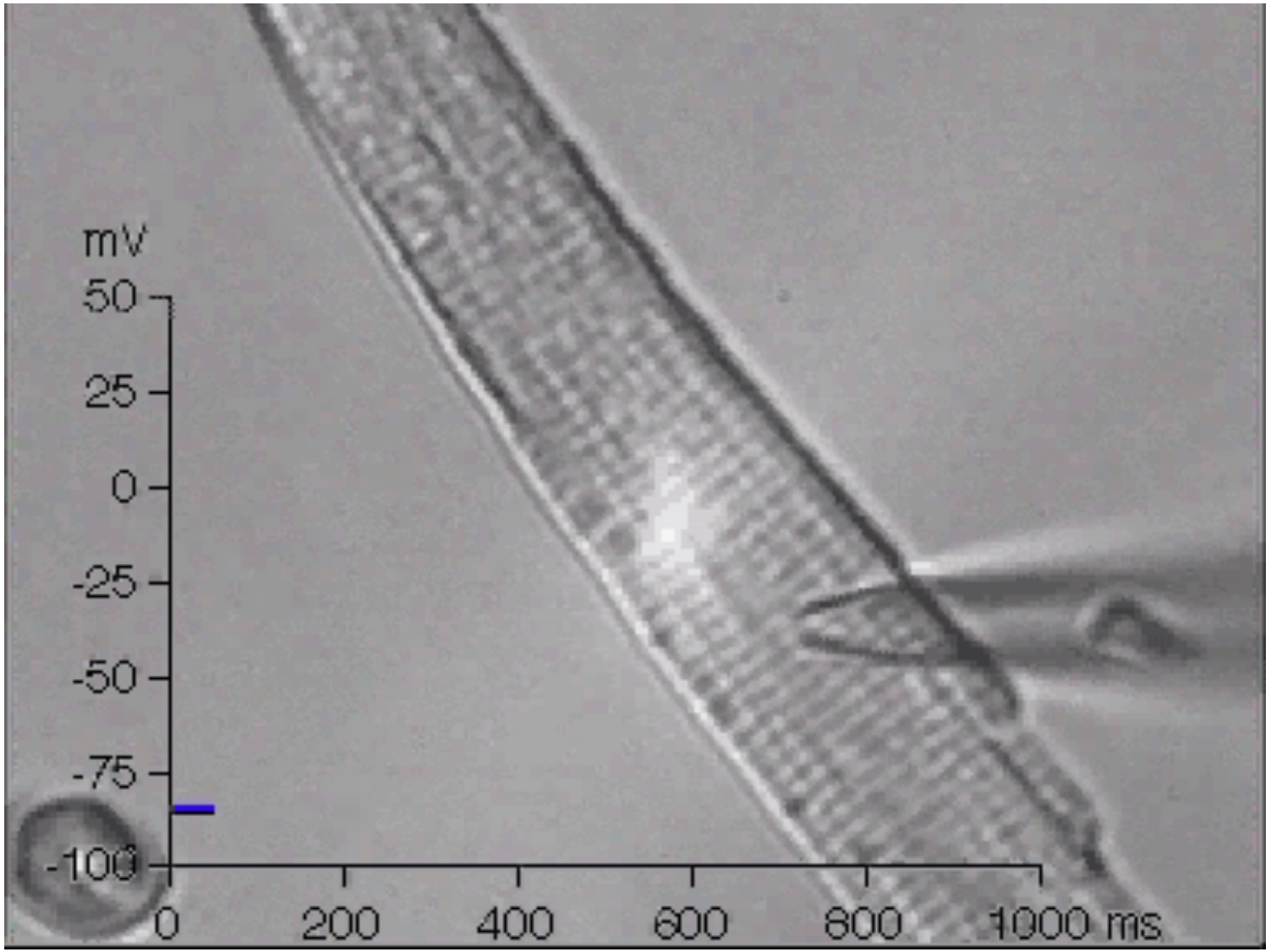
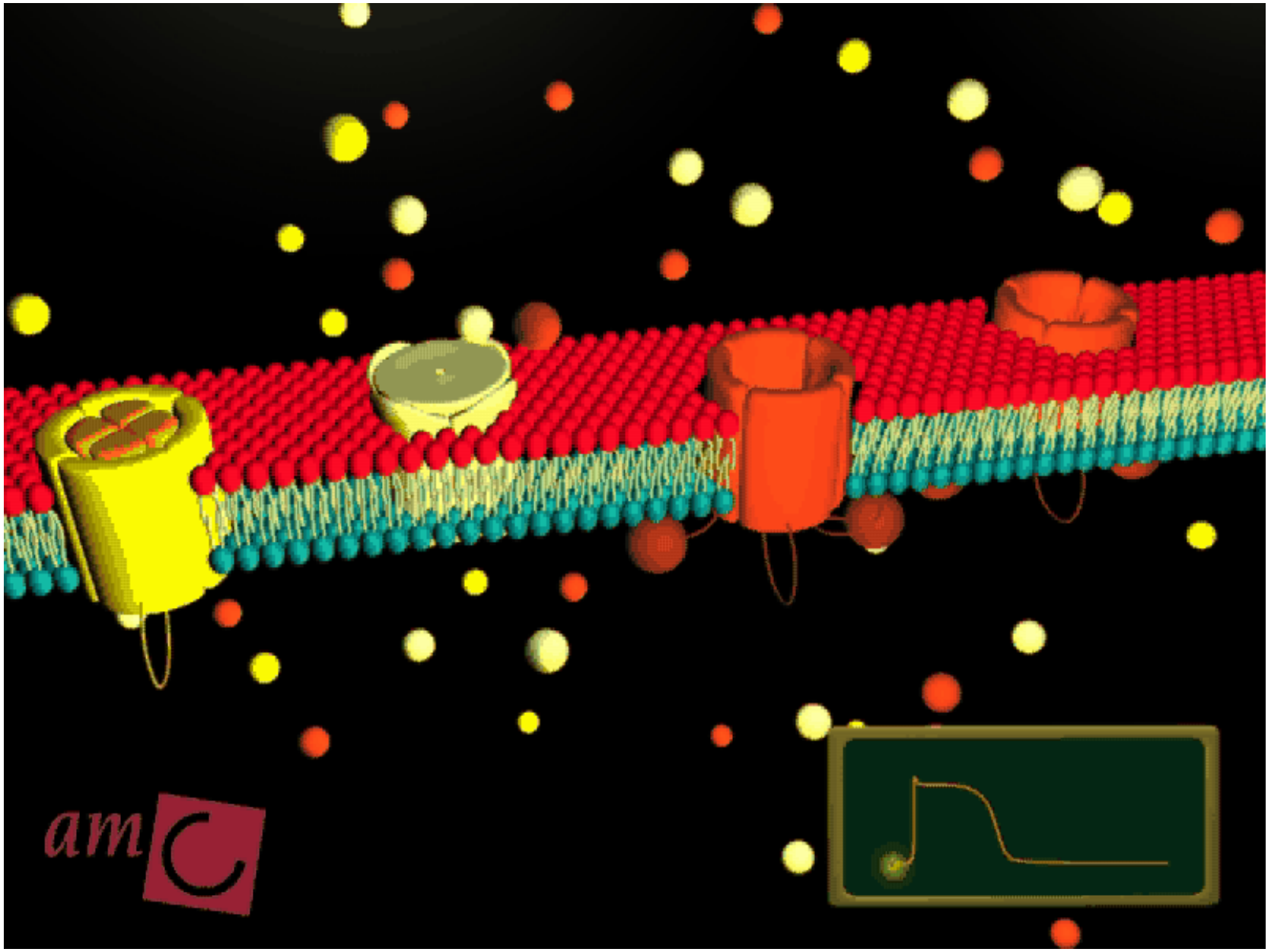
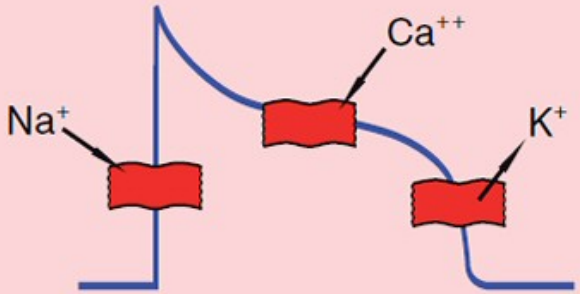
Gesch



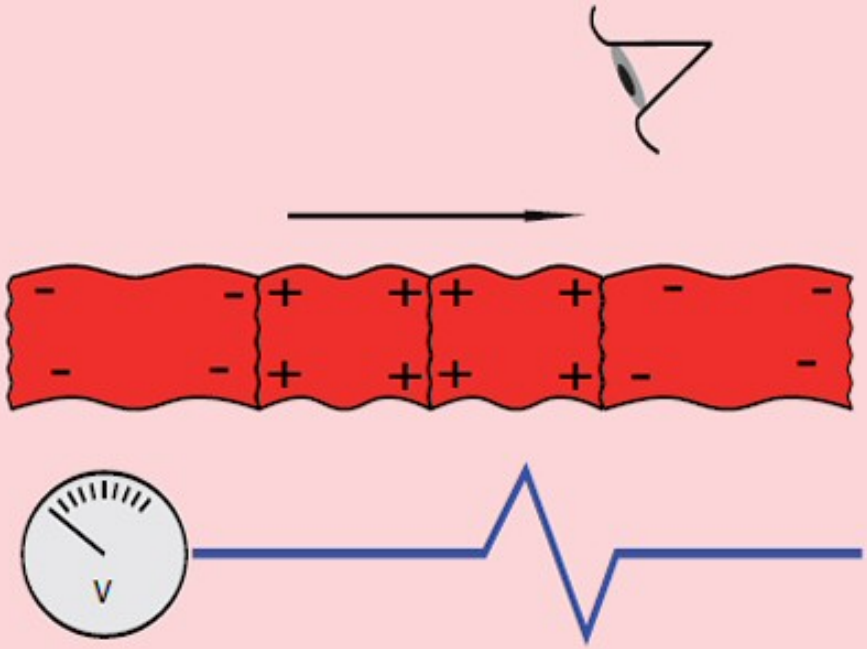


courtesy of Antoni van Ginneken

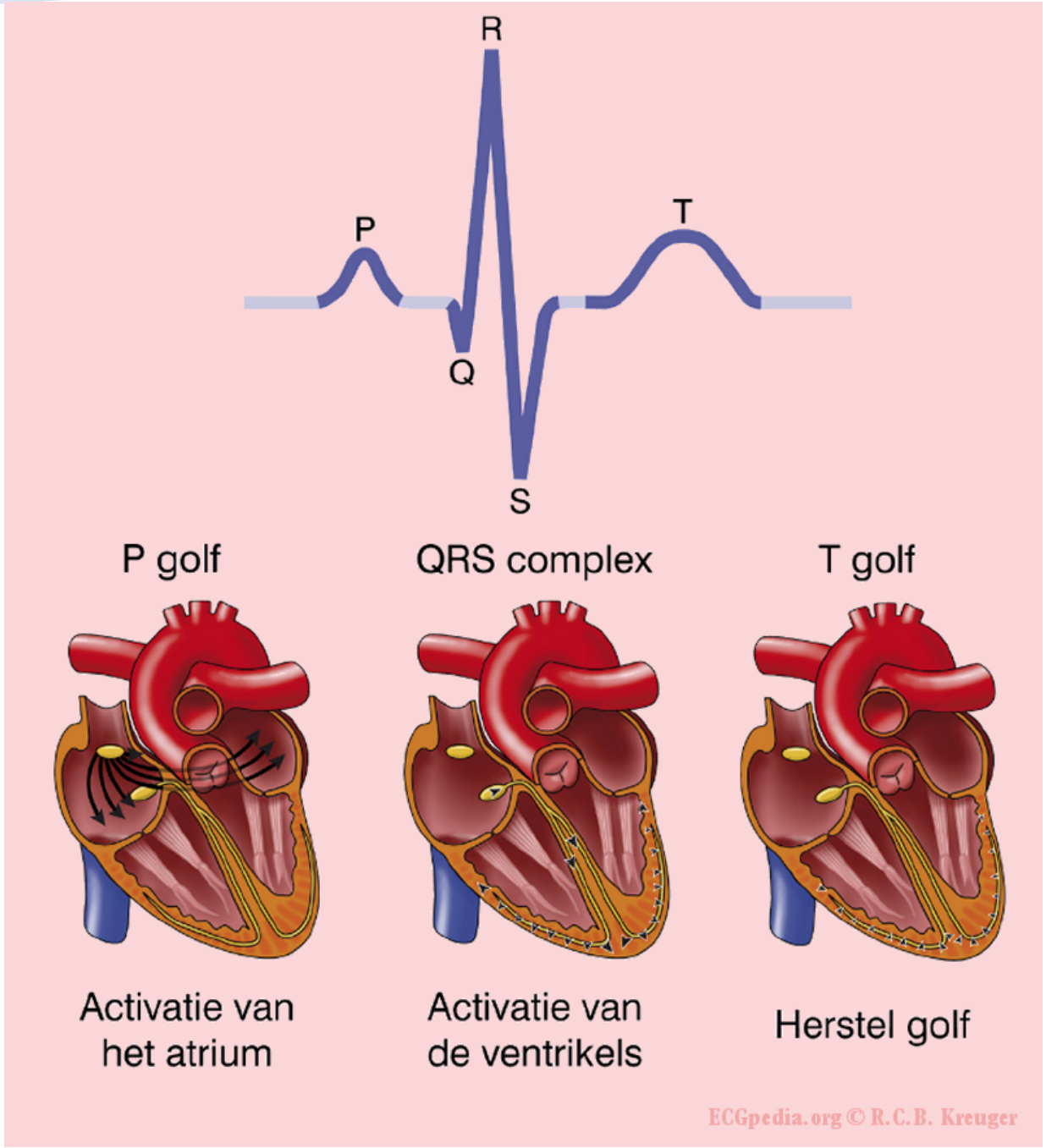

amc

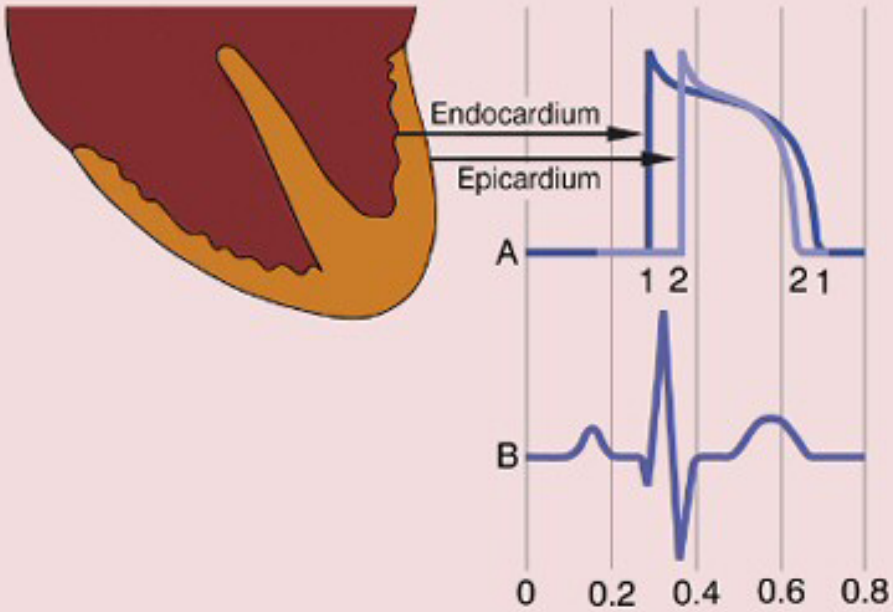


De lading verandering zorgt voor ion stromen over de hartcelwand.
Eerst Na^+ stromen naar binnen, dan Ca^{++} en daarna K^+ naar buiten



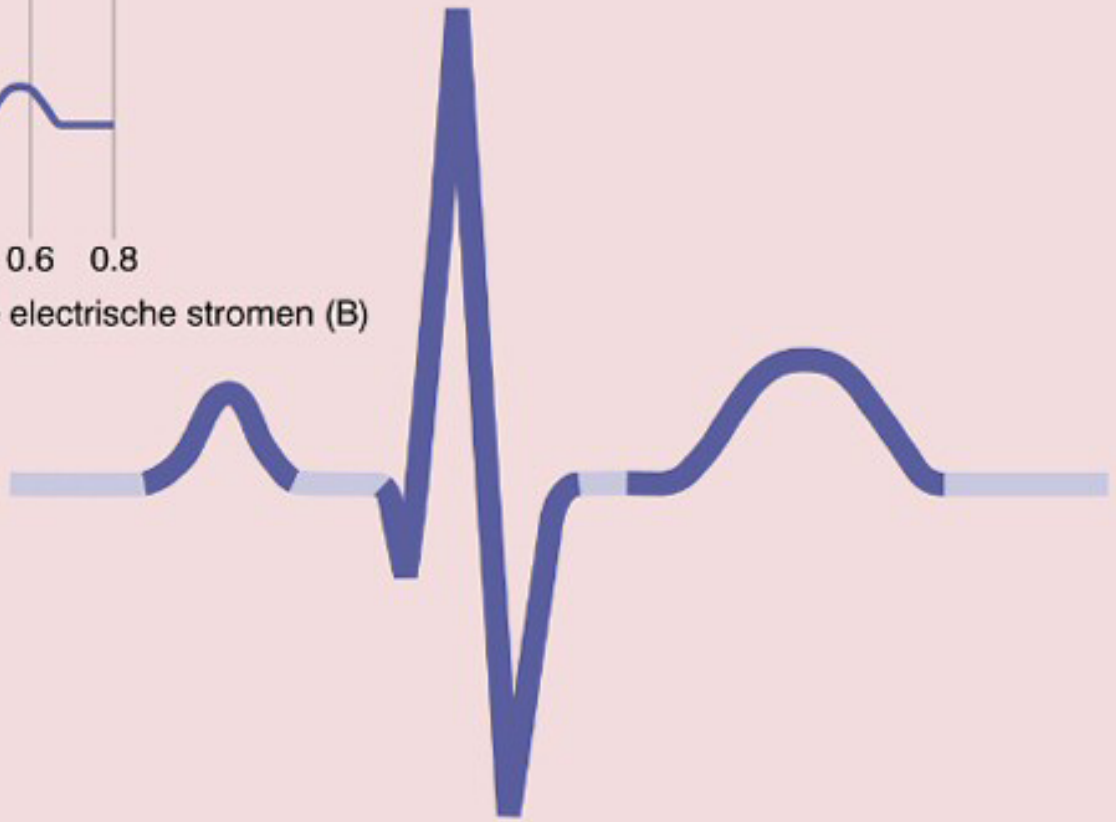
Signaal naar je toe is positieve uitslag

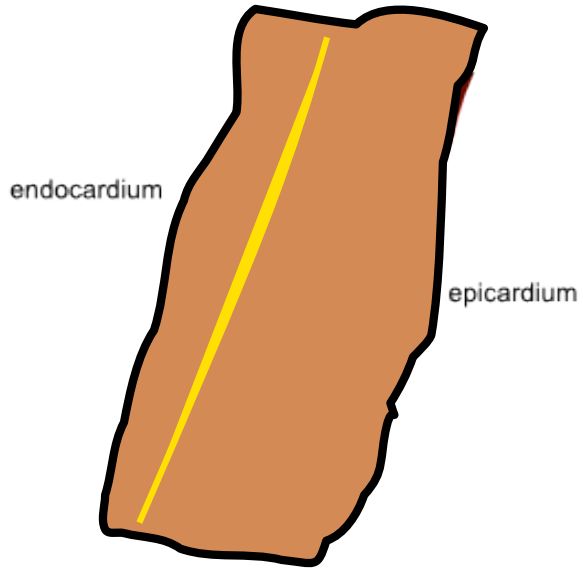

R
P
T
Q
S
P golf
QRS complex
T golf
Activatie van het atrium
Activatie van de ventrikels
Herstel golf
ECGpedia.org © R.C.B. Kreuger

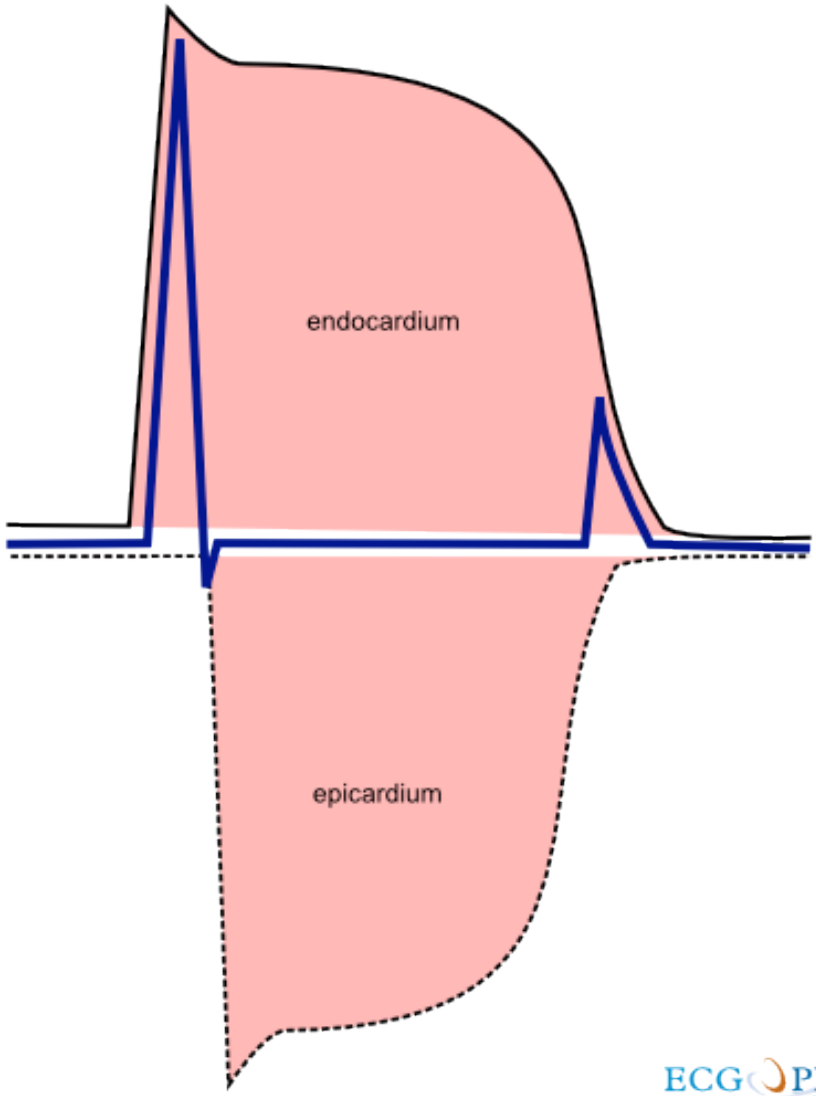


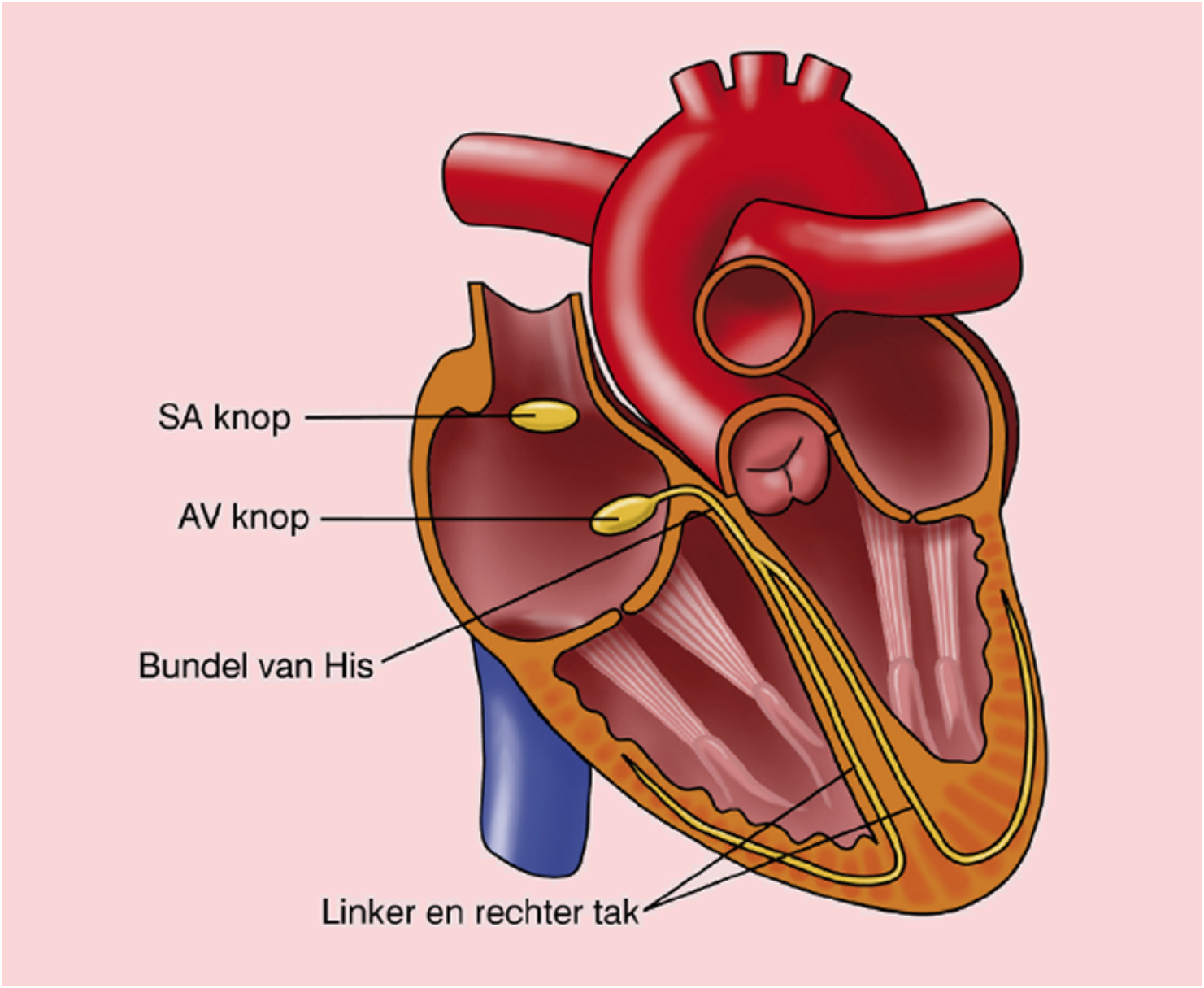
Het ECG registreert de optelsom van deze electrische stromen (B)

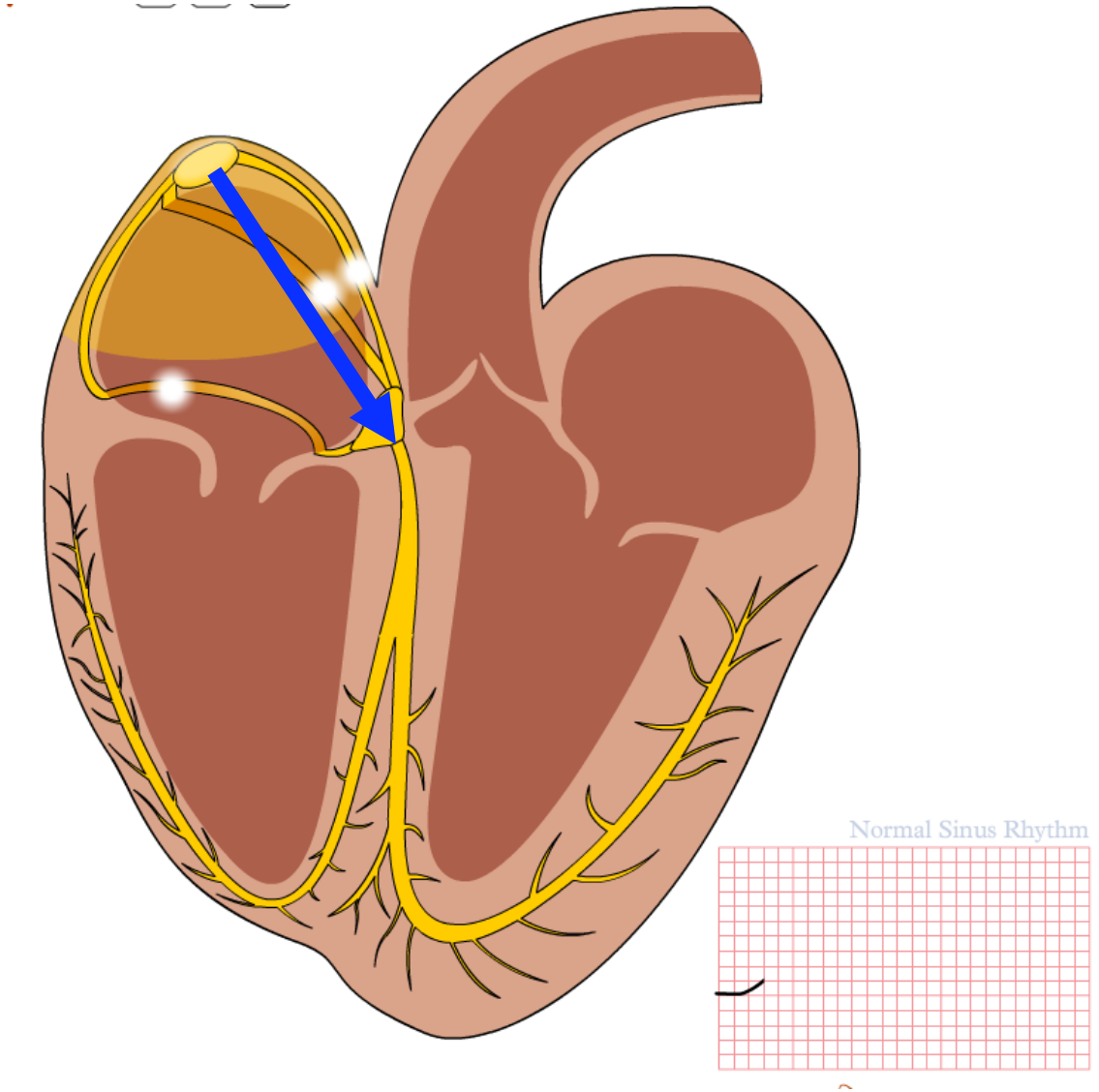
Het resultaat:

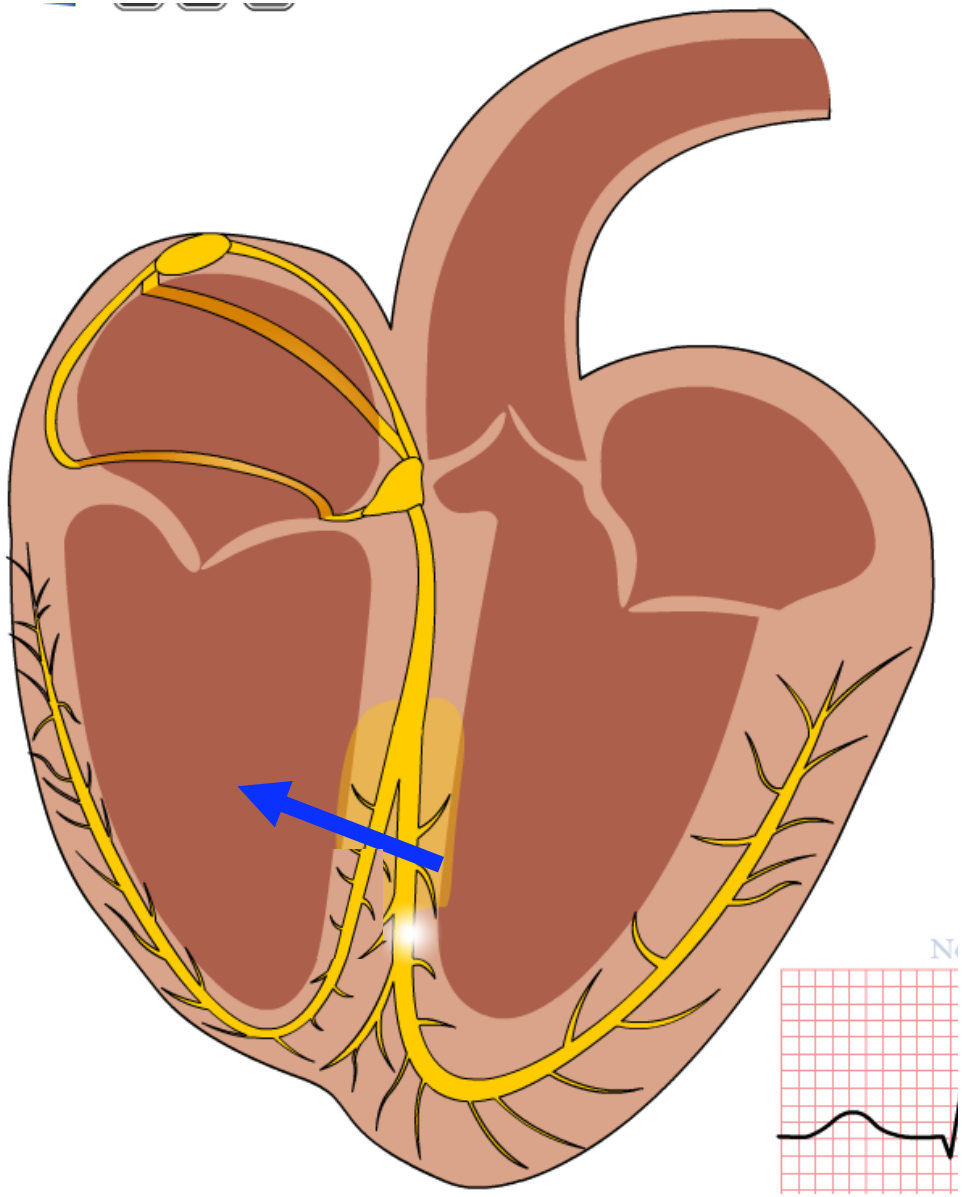


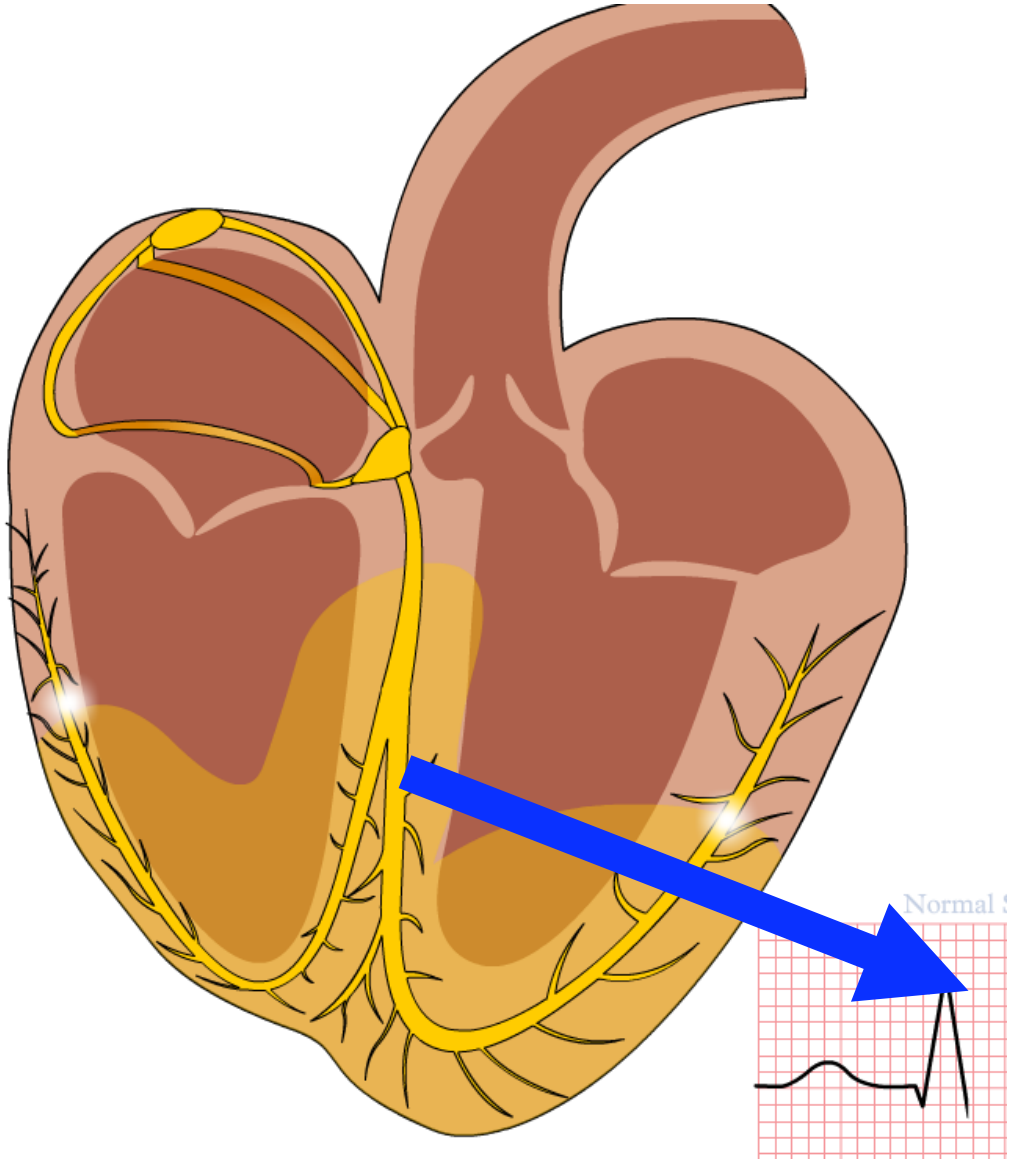


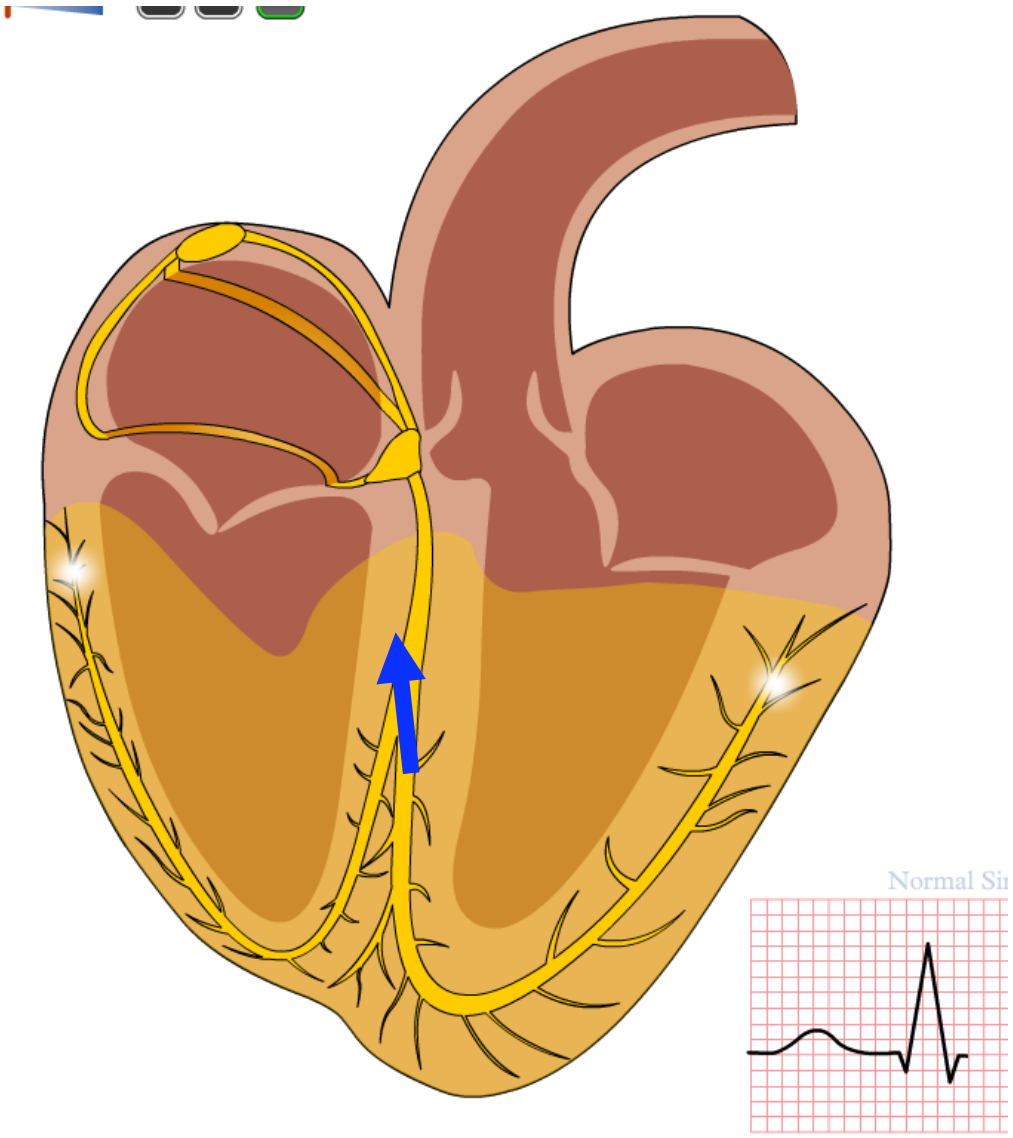


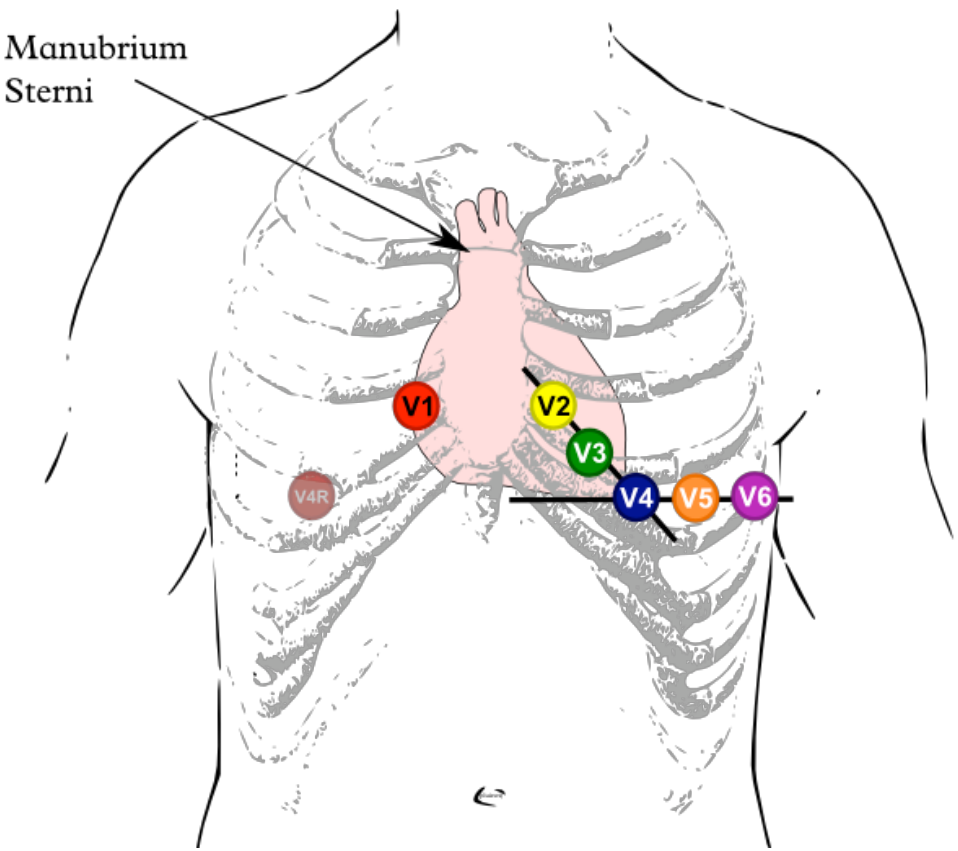

SA knop
AV knop
Bundel van His
Linker en rechter tak

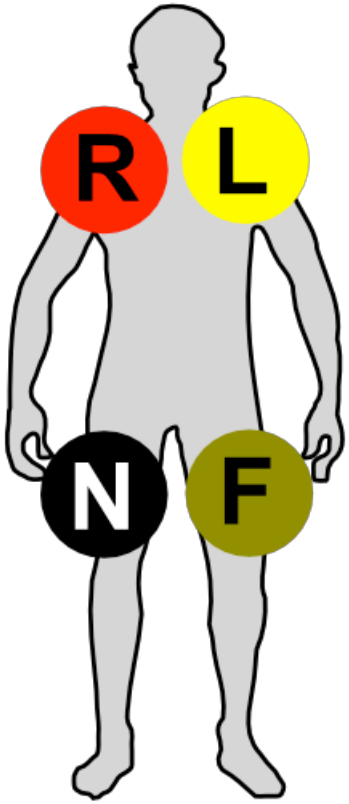

Normal Sinus Rhythm

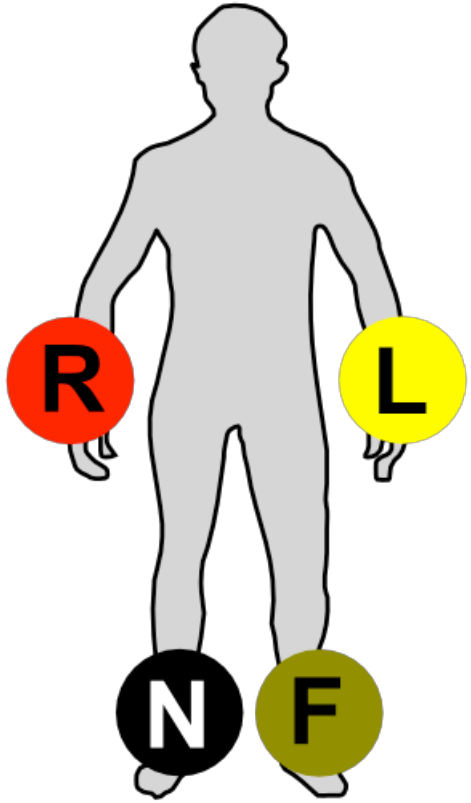


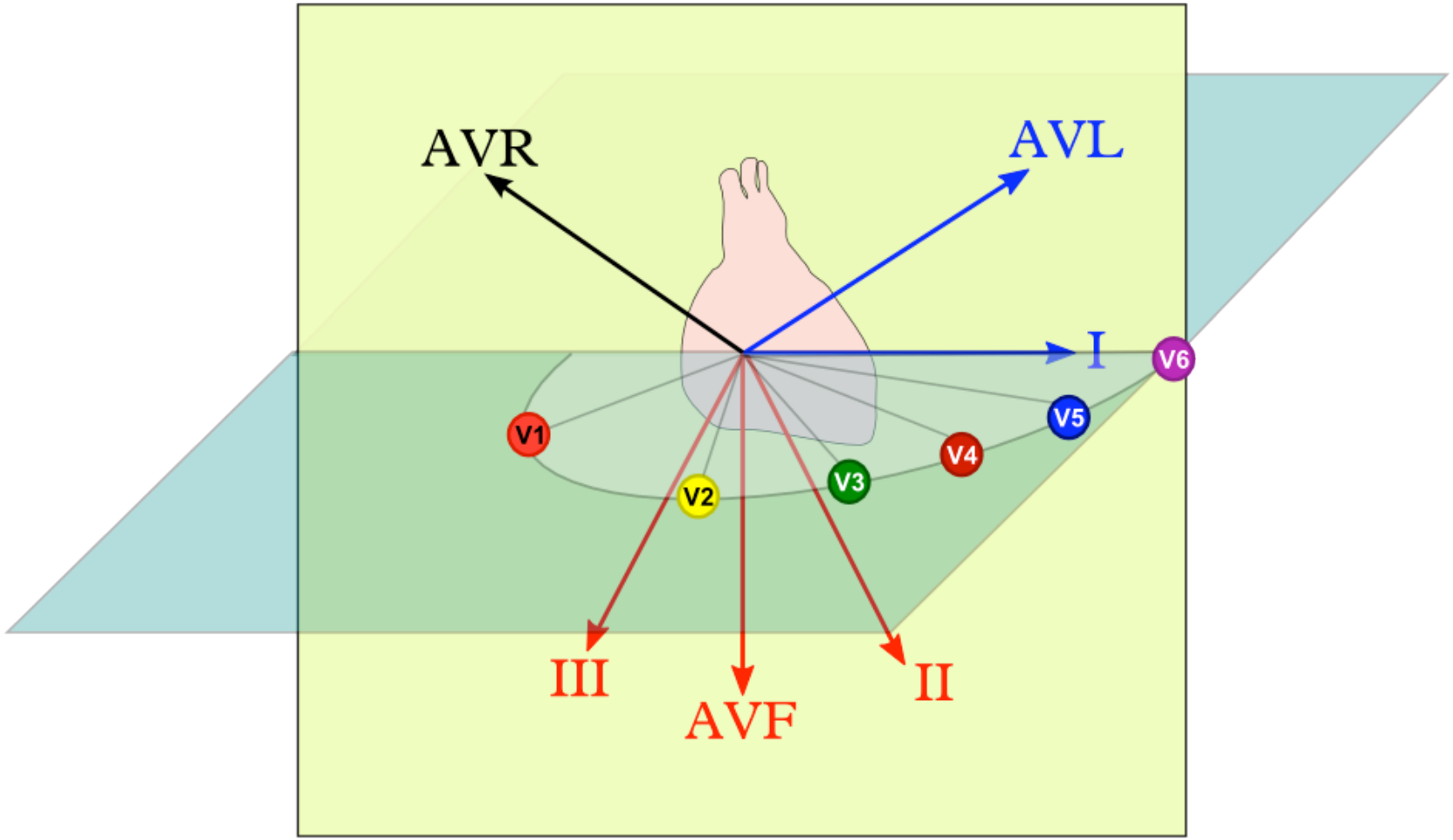

Normal

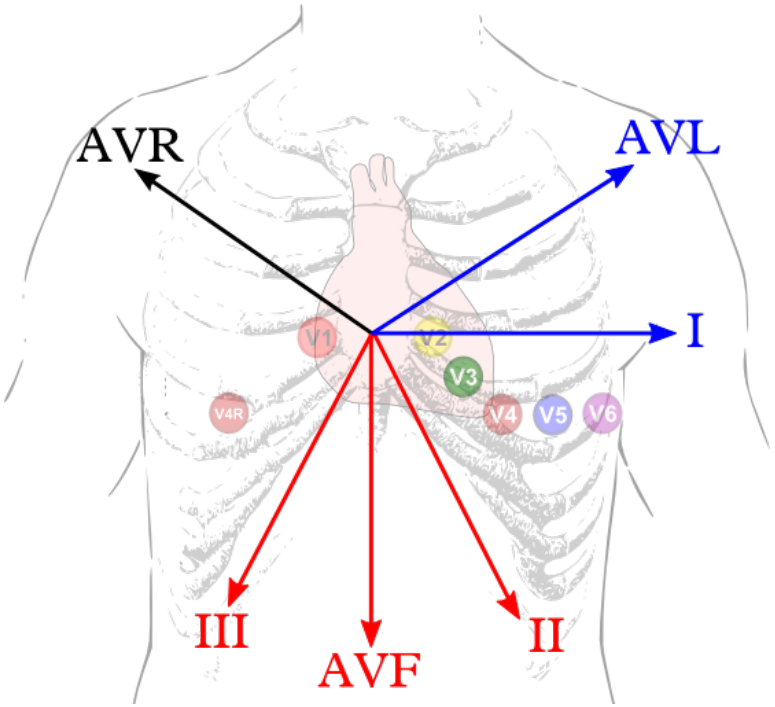

Normal Si

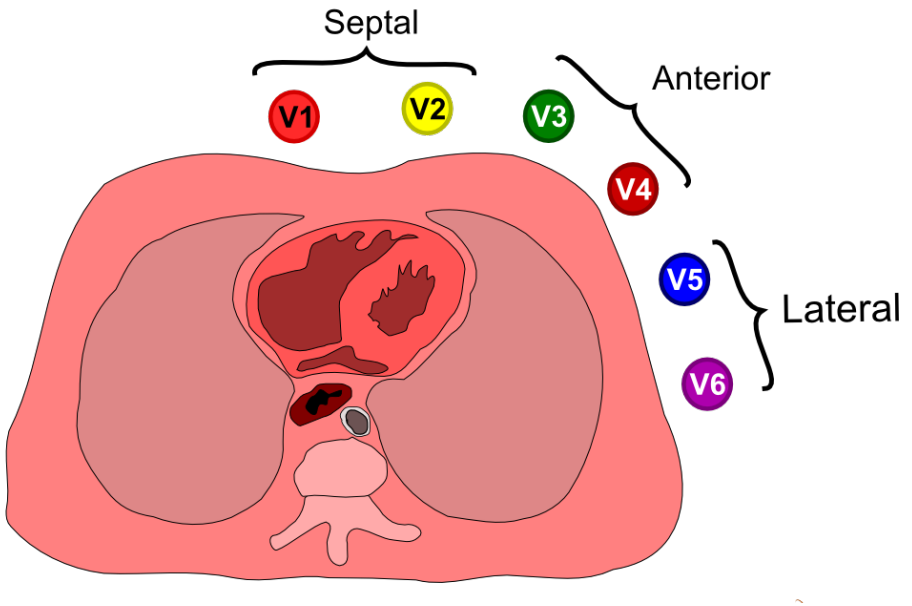

Manubrium
Sterni
V1
V2
V3
V4
V5
V6
V4R


R
L
N
F


R
L
N
F




AVR
AVL
I
III
AVF
II
V1
V2
V3
V4R
V4
V5
V6

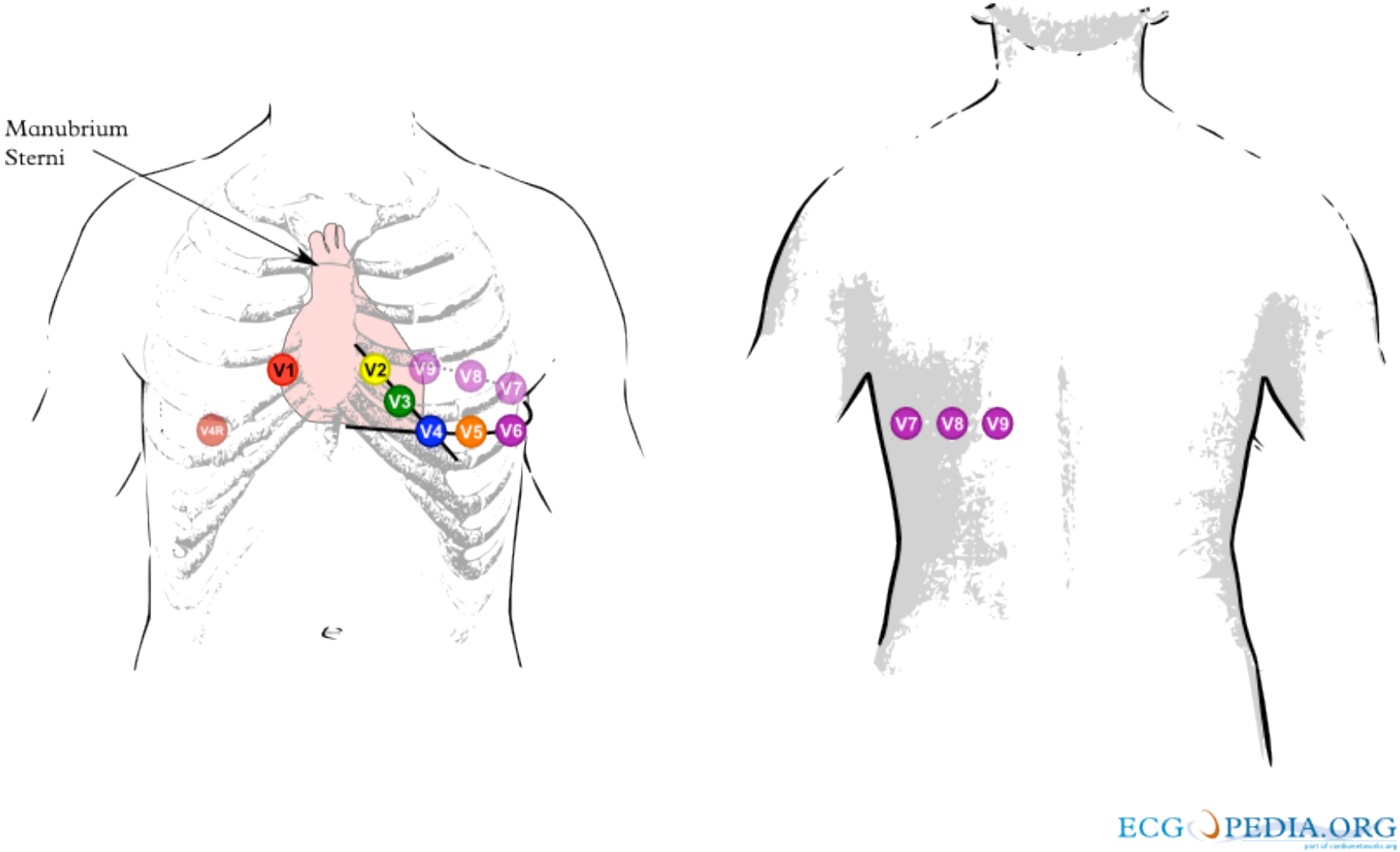

Septal
Anterior
Lateral
V1
V2
V3
V4
V5
V6

Bij elkaar horende afleidingen

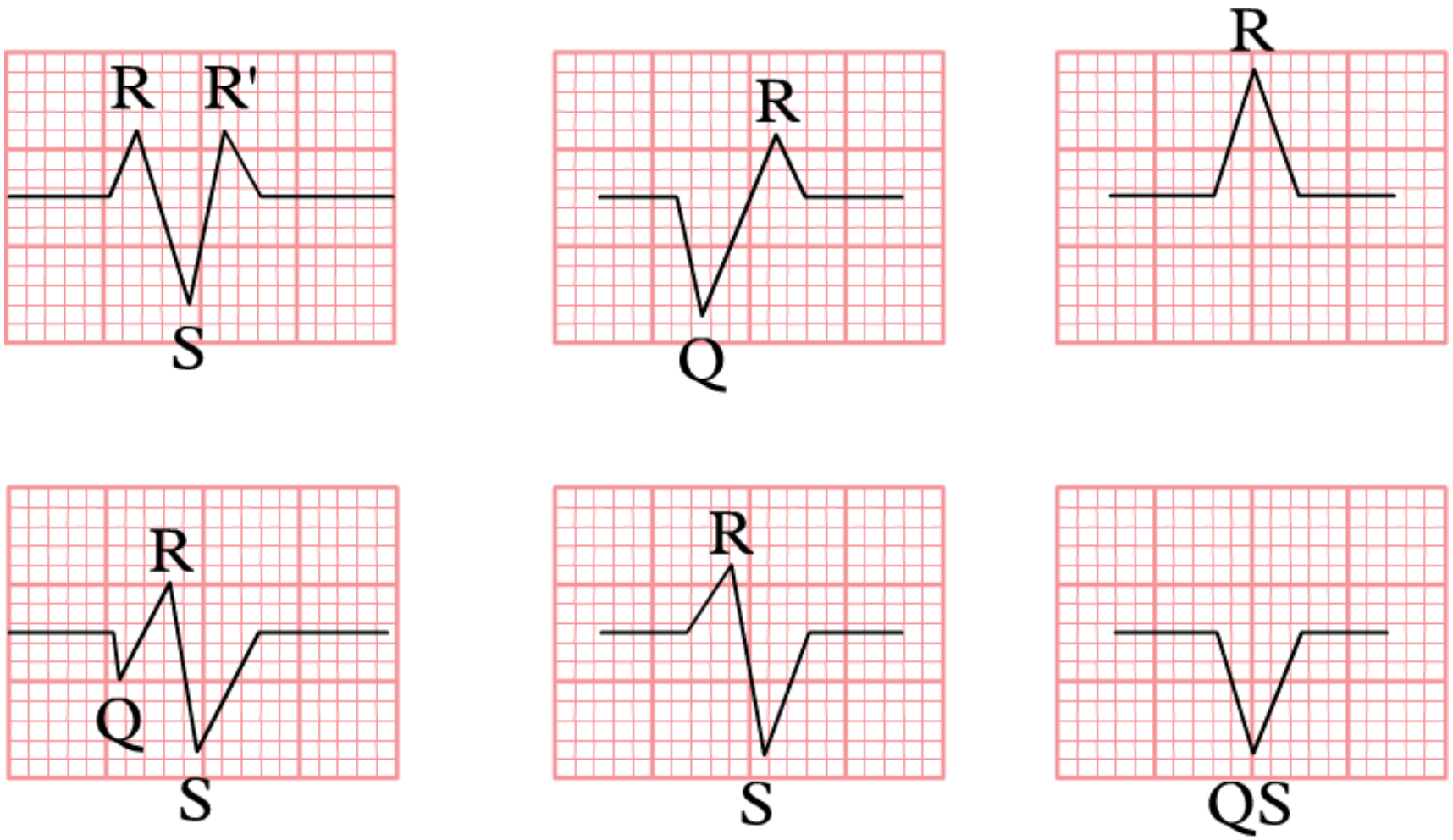
I Lateraal	V1 Septaal
II Inferior	V2 Septaal
III Inferior	V3 Anterior
aVR Hoofdstam	V4 Anterior
aVL Lateraal	V5 Lateraal
aVF Inferior	V6 Lateraal

Extra Leads

V4R, V7-V9



Nomenclatuur



QRS shapes - ECGPEDIA.ORG

SYSTEMATISCHE BEOORDELING

Systematische beoordeling

- Kijk nooit eerst naar de pathologie!
- ALTIJD systematisch beoordelen!
- U mist belangrijke punten als u dat niet doet!

Systematische beoordeling

1. Ritme
2. Frequentie
3. Geleidingstijden
4. Hart-as
5. P top morfologie
6. QRS morfologie
7. ST morfologie

8. Vergelijking met oud ECG
9. Conclusie

1 Ritme

Eigenschappen van normaal sinusritme

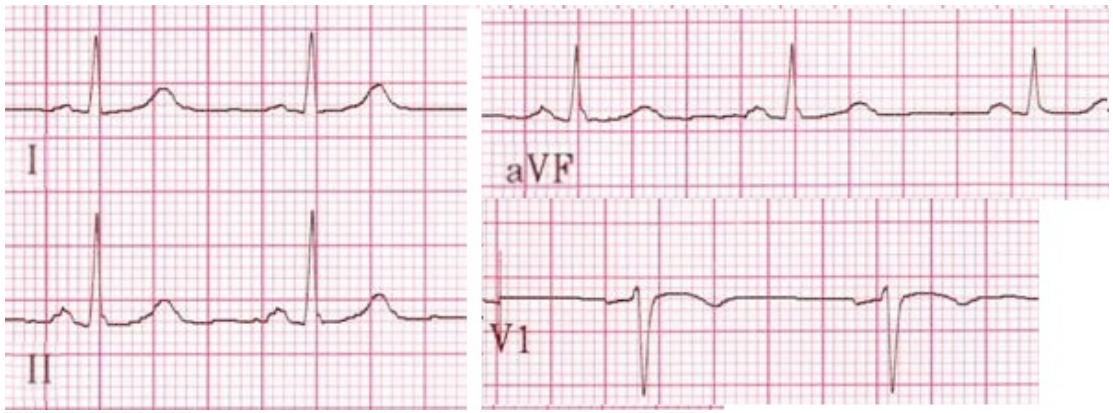
•Op een P-top volgt meestal een QRS complex

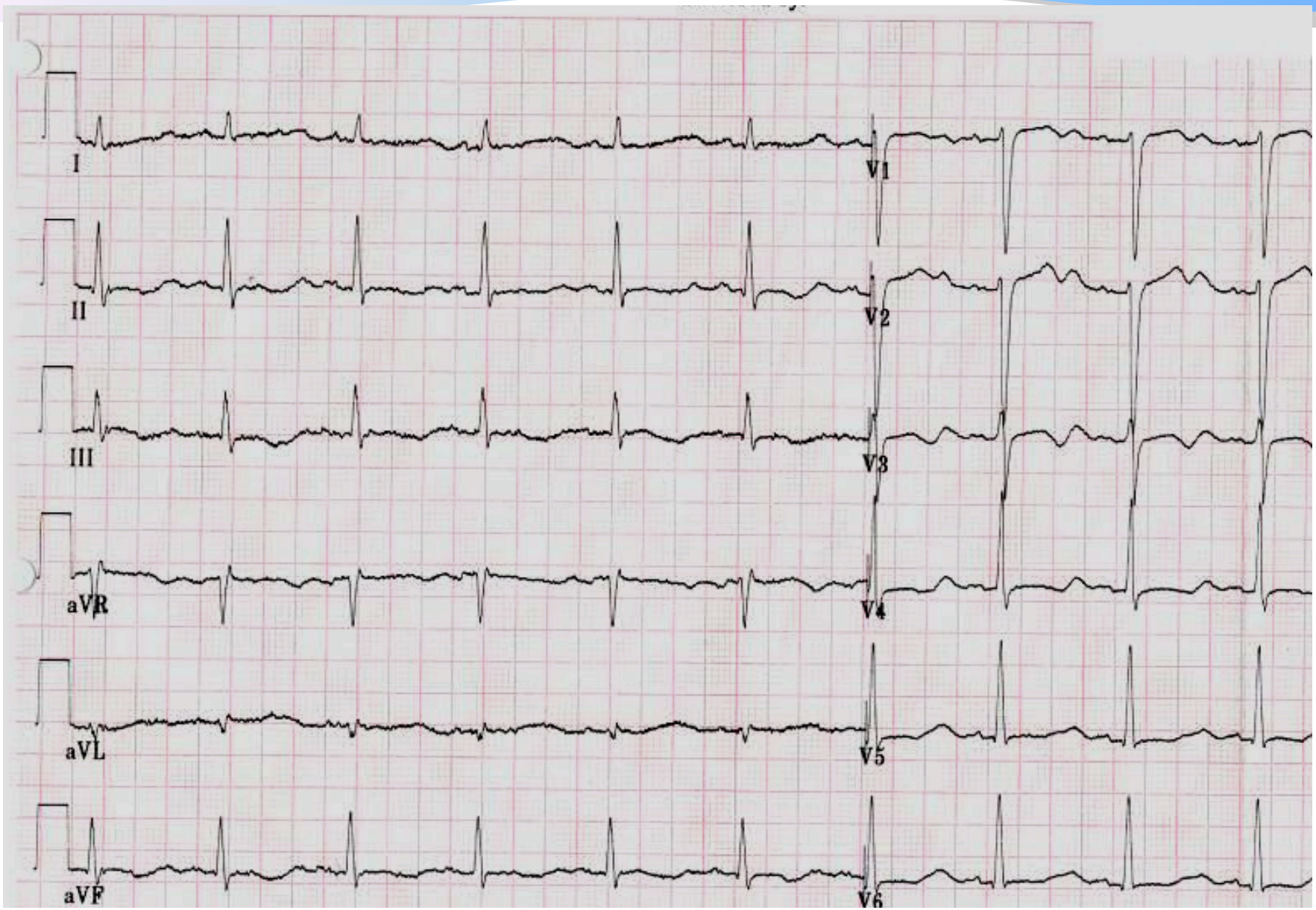
•Het ritme is regelmatig, maar varieert licht met de ademhaling

•De **frequentie** ligt tussen de 60 en 100 / minuut.

•De p top is **positief in II** en **AVF**, en bifasisch in V1

•De **PQ tijd** is tussen de 0,12 en 0,2 seconden

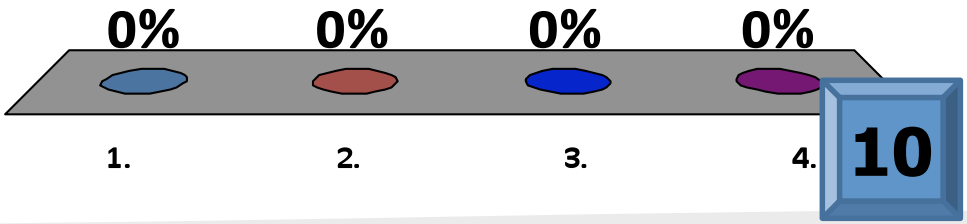


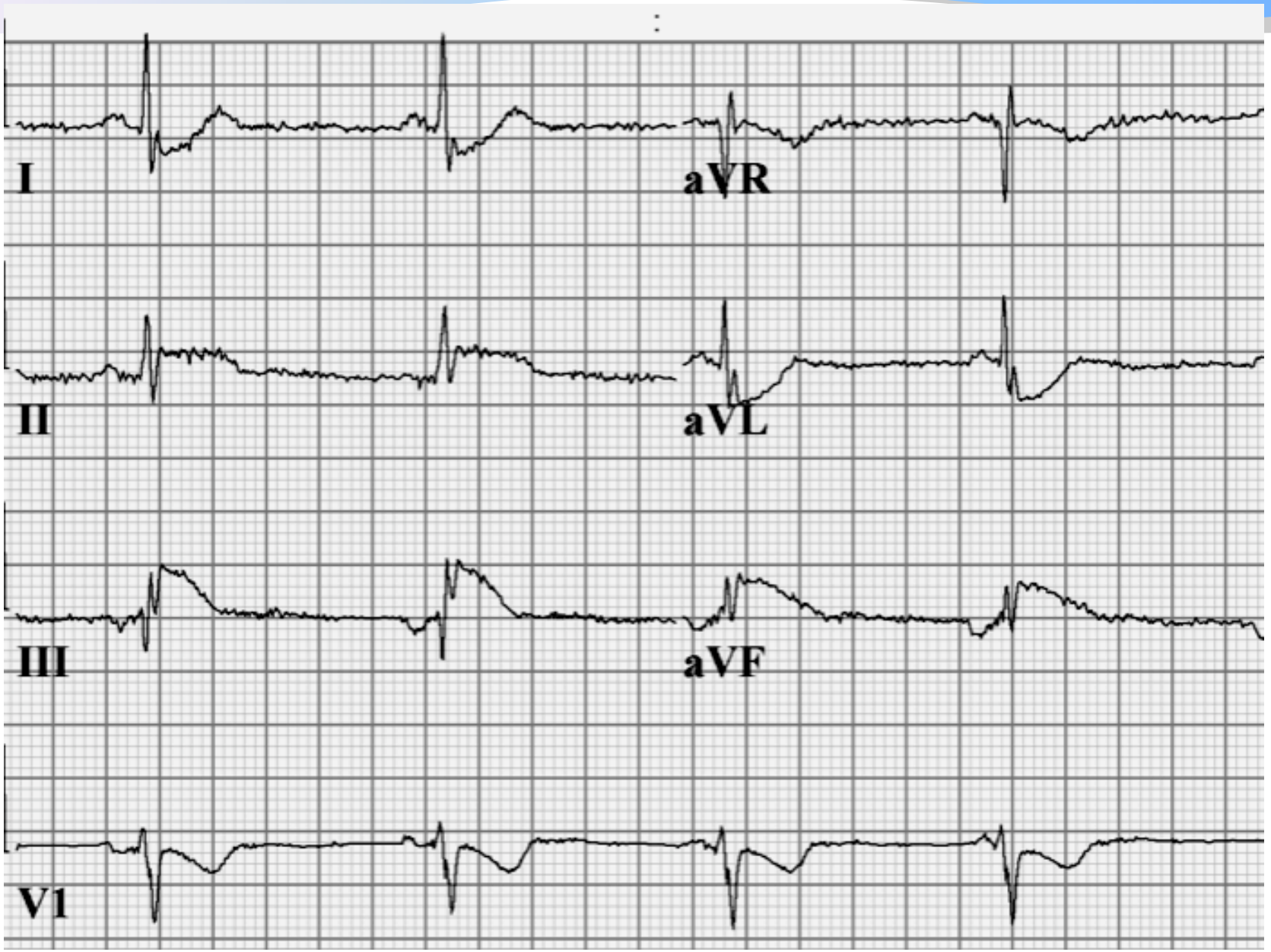


Sinusritme?

Was het sinusritme?

1. Ja, sinusritme
2. Nee, boezemfibrilleren
3. Nee, boezemflutter
4. Nee, anders

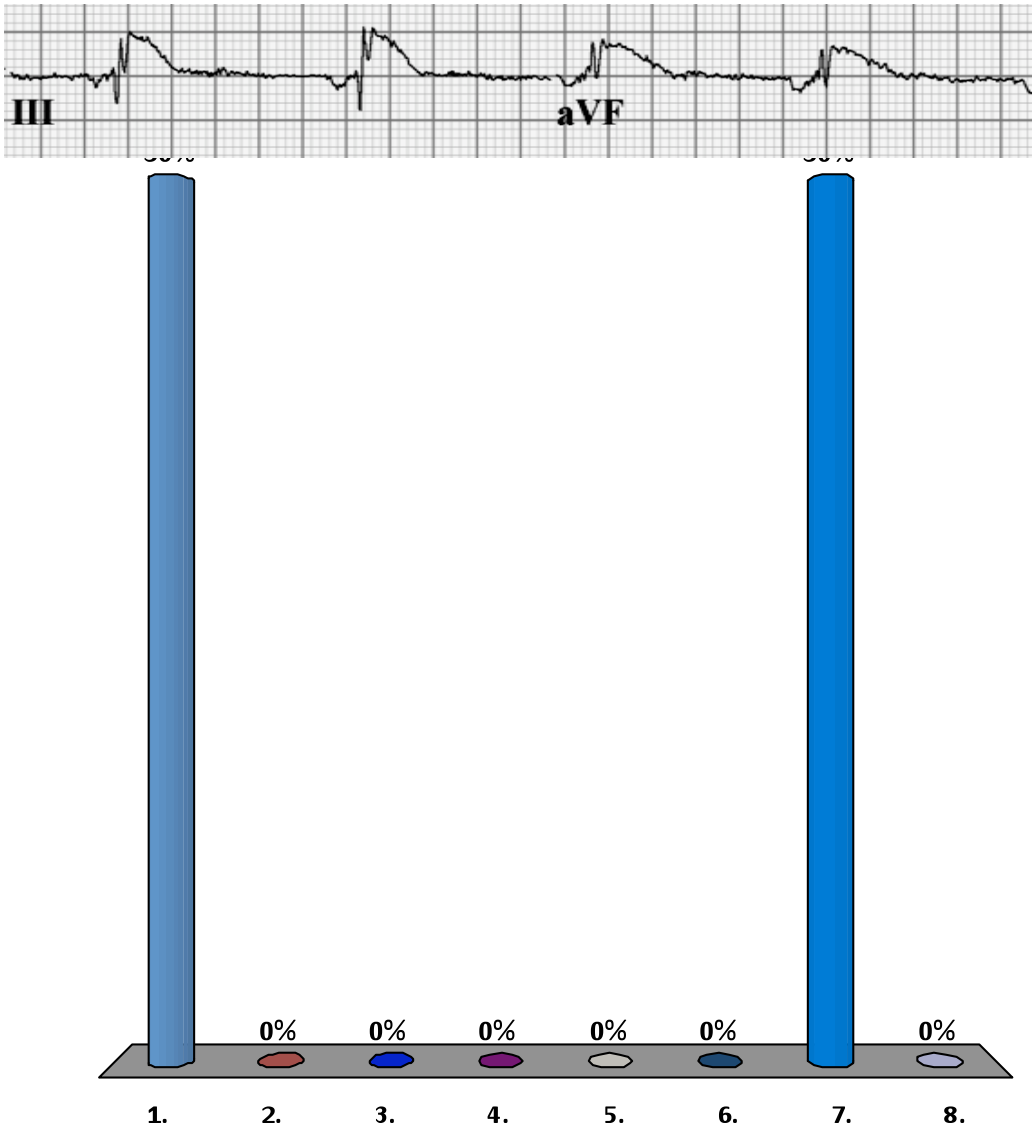




Sinusritme?

Wat is het ritme?

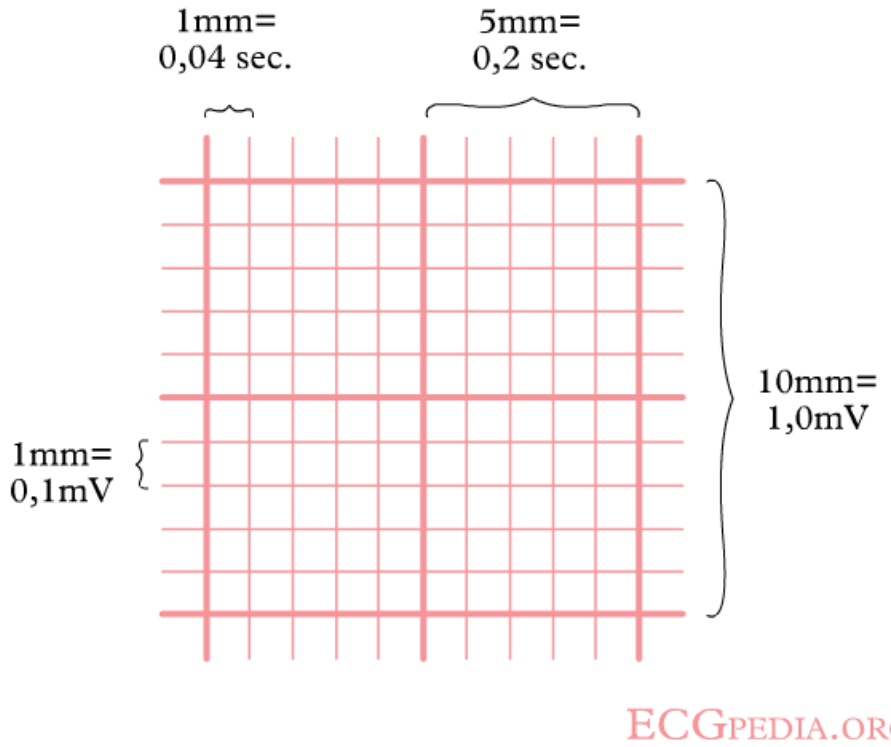
1. Sinusritme
2. Boezemfibrilleren
3. Boezemflutter
4. ✓ Boezemritme
5. SR met 1egr AV blok
6. SR met 2e gr AV versnelling
7. WPW
8. Nee, anders



2 Frequentie

3 methoden:

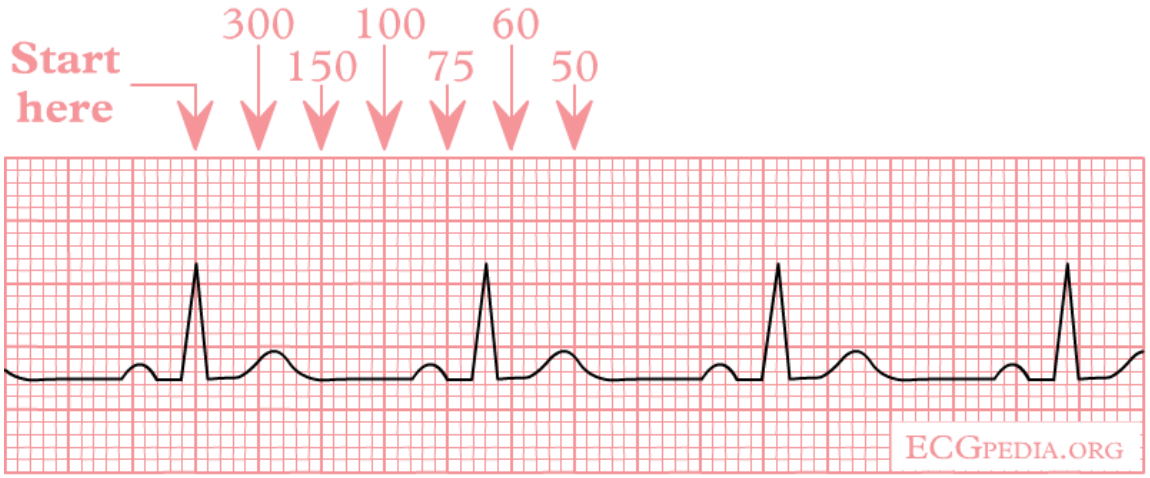
1. Aftelmethode
2. Berekenen: 1500 / aantal kleine hokjes tussen 2 hartslagen
3. Marker methode

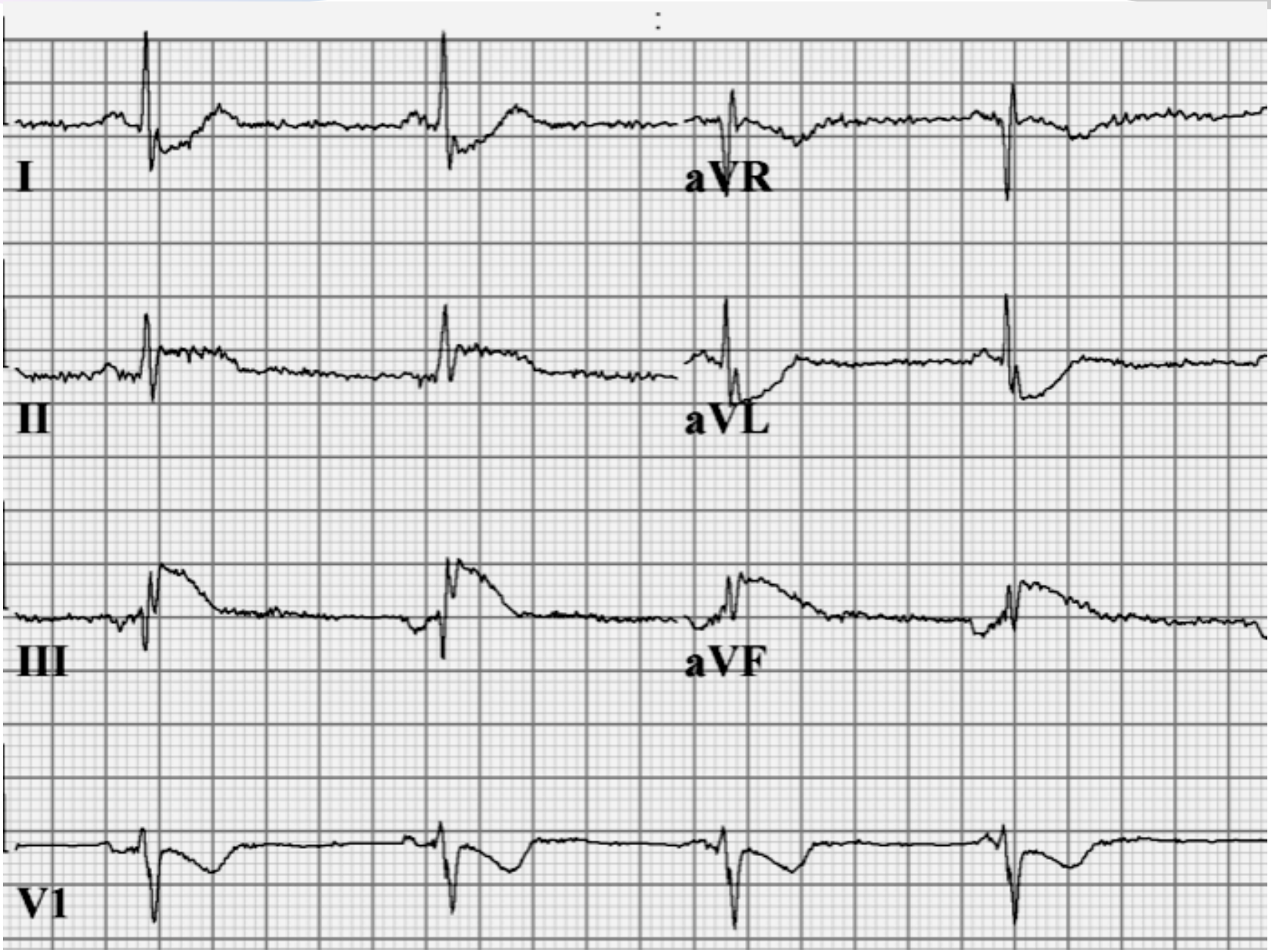


De hartfrequentie wordt beïnvloed door:

Het autonome zenuwstelsel

De vulling van het hart

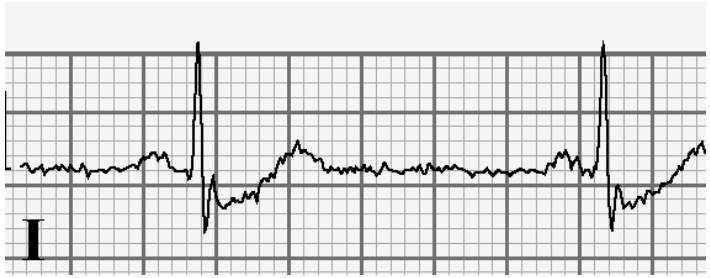


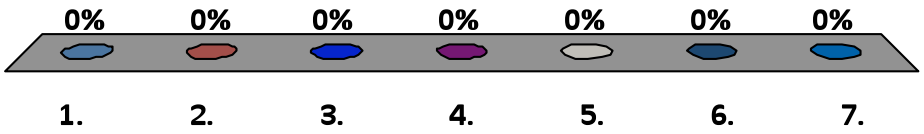


Frequentie?

Wat is de frequentie?

1. 105
2. 95
3. 85
4. 75
5. 65
6. 55
7. 45





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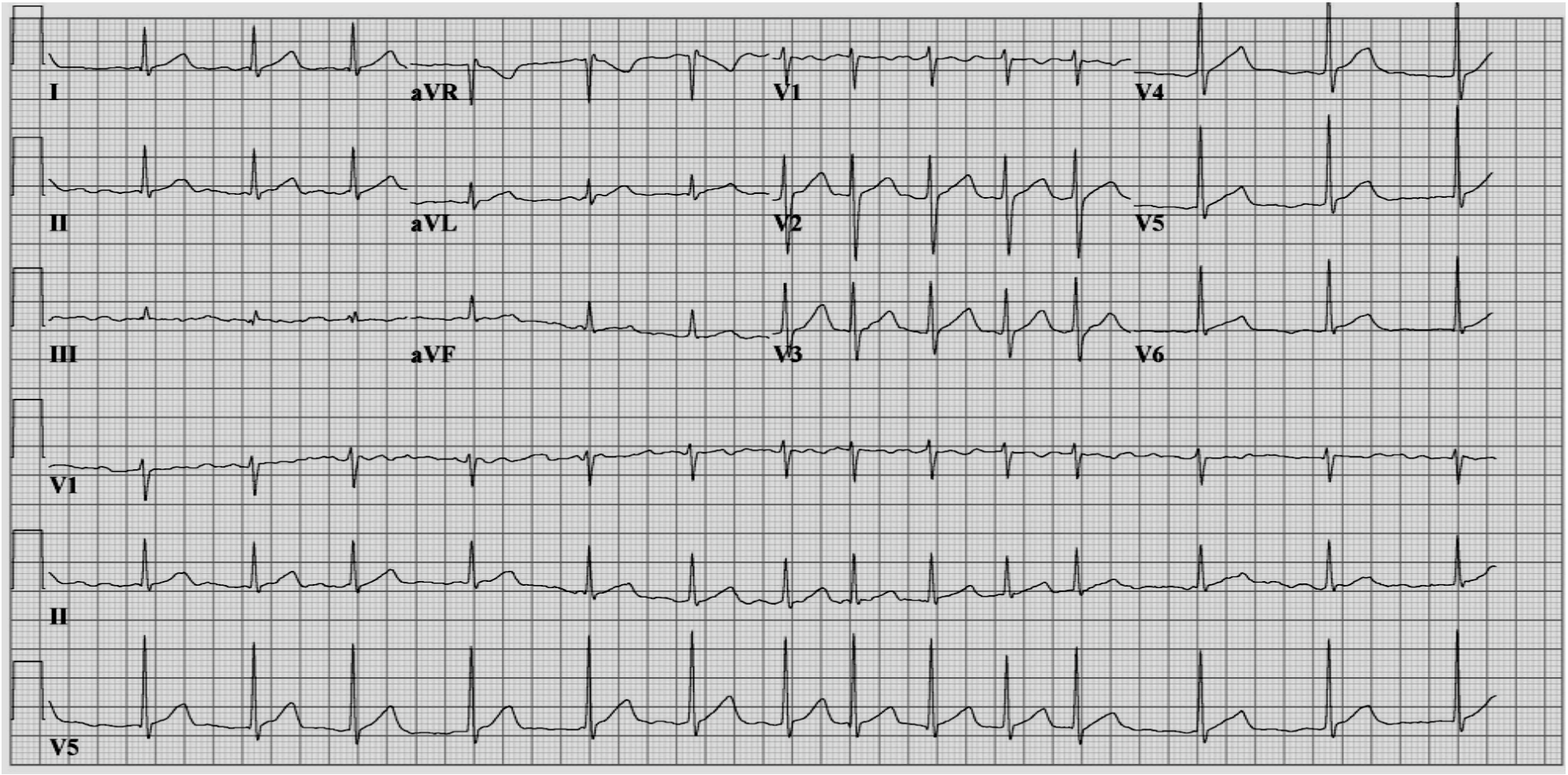
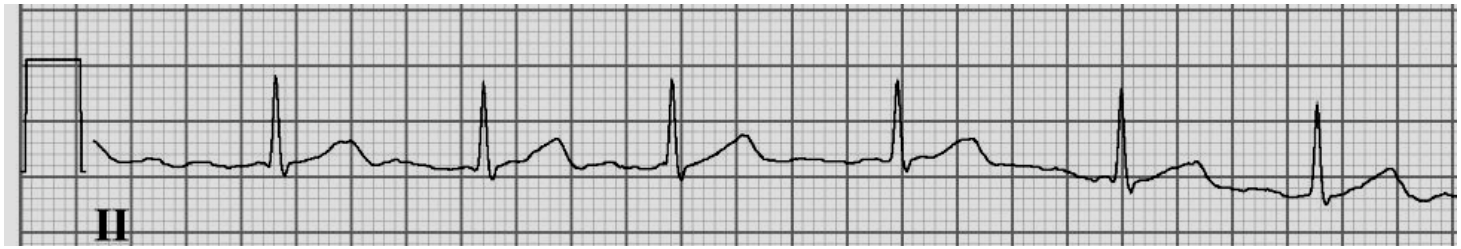


Frequentie?

Wat is de frequentie?

1. 105
2. 95
3. 85
4. ✓ 75
5. 65
6. 55
7. 45



3 Geleidingstijden

PQ tijd tussen 0.12 en 0.20 seconde

- te kort → WPW
- te lang → AV blok

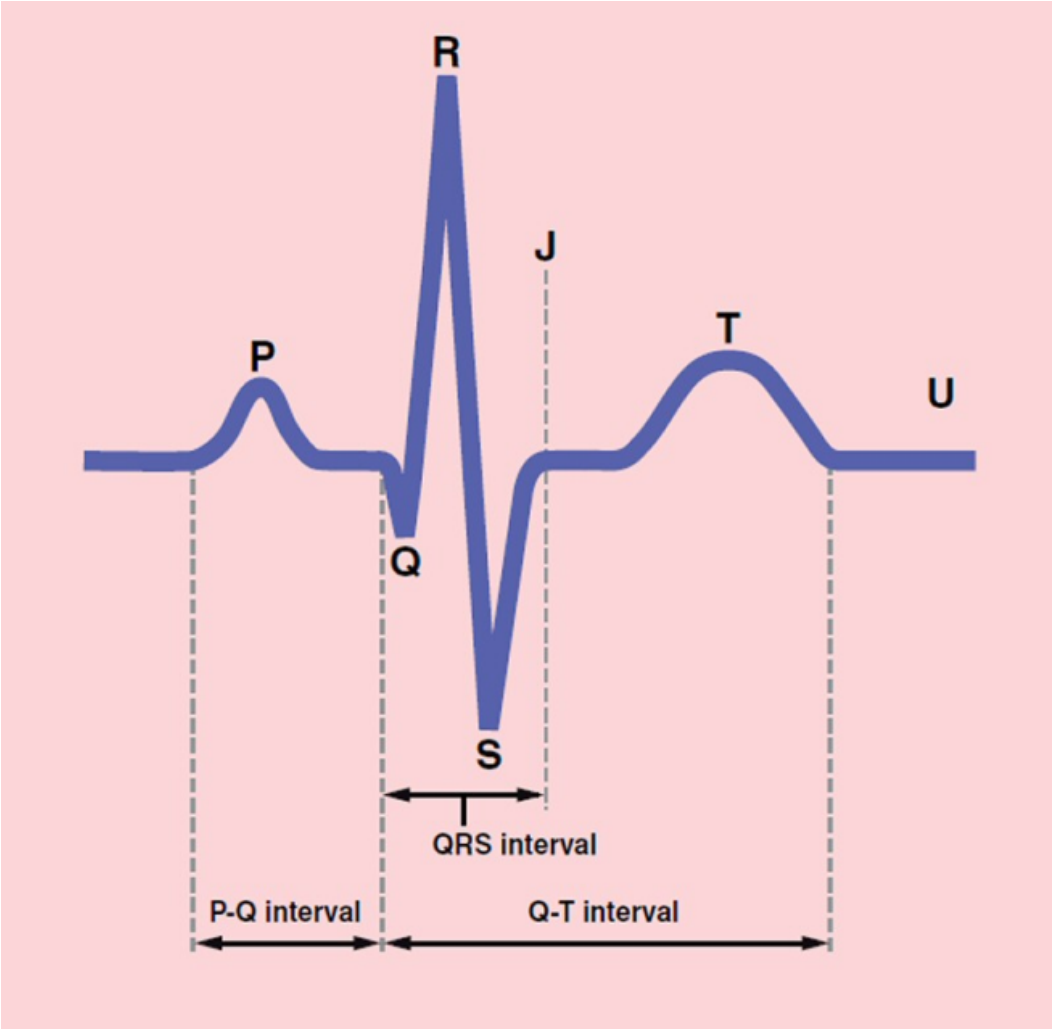
QRS duur <= 0.10-0.12 seconde

Te lang → LBTB / RBTB

QTc tijd = repolarisatie

Mannen < 450ms

Vrouwen < 460ms



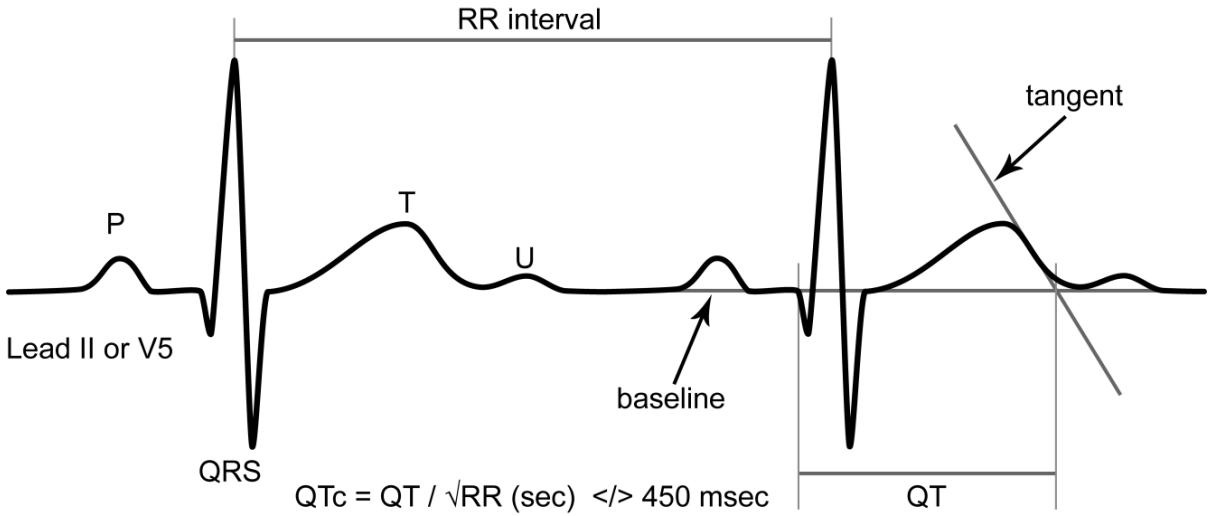
Check de QT tijd die de computer uitrekent!

Verlengde QTc tijd geeft verhoogd risico op plotse dood. Met name > 480-500 ms.

Dan geen QTc verlengende medicatie:

- Sotalol
- Amiodarone
- Erythromycine
- Clarithromycine
- Haldol

Zie www.torsades.org



$$QTc = \frac{QT}{\sqrt{RR\,interval\,(sec)}}$$

Eyeballing: als T top eindigt voorbij het punt halverwege RR is de QT meestal verlengd

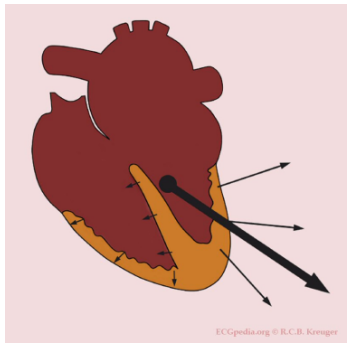
4 Hartas

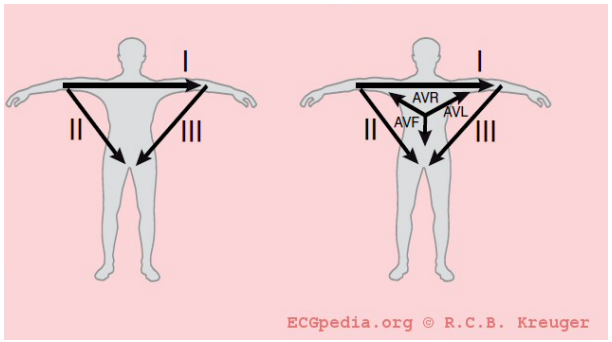
Geeft de gemiddelde electrische activiteit aan

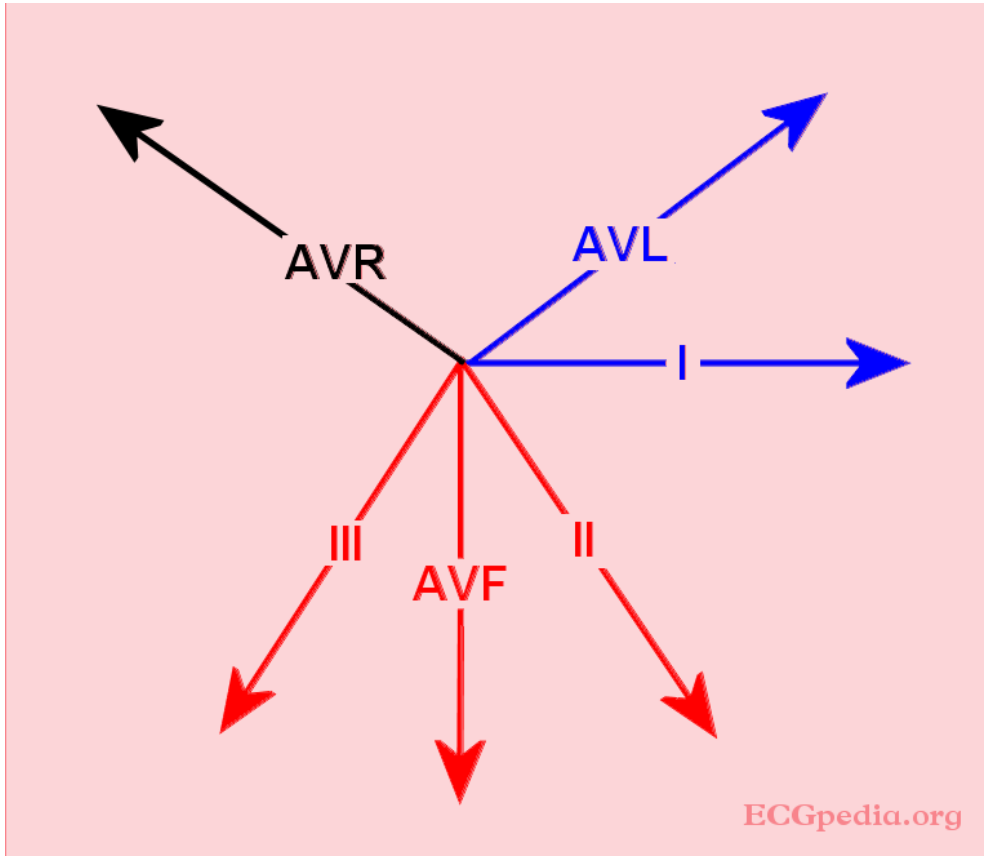
Normaal is tussen -30 en +90 graden.

Positief in I en AVF? → hartas = normaal

Kijk op het ECG! De computer heeft het meestal goed.

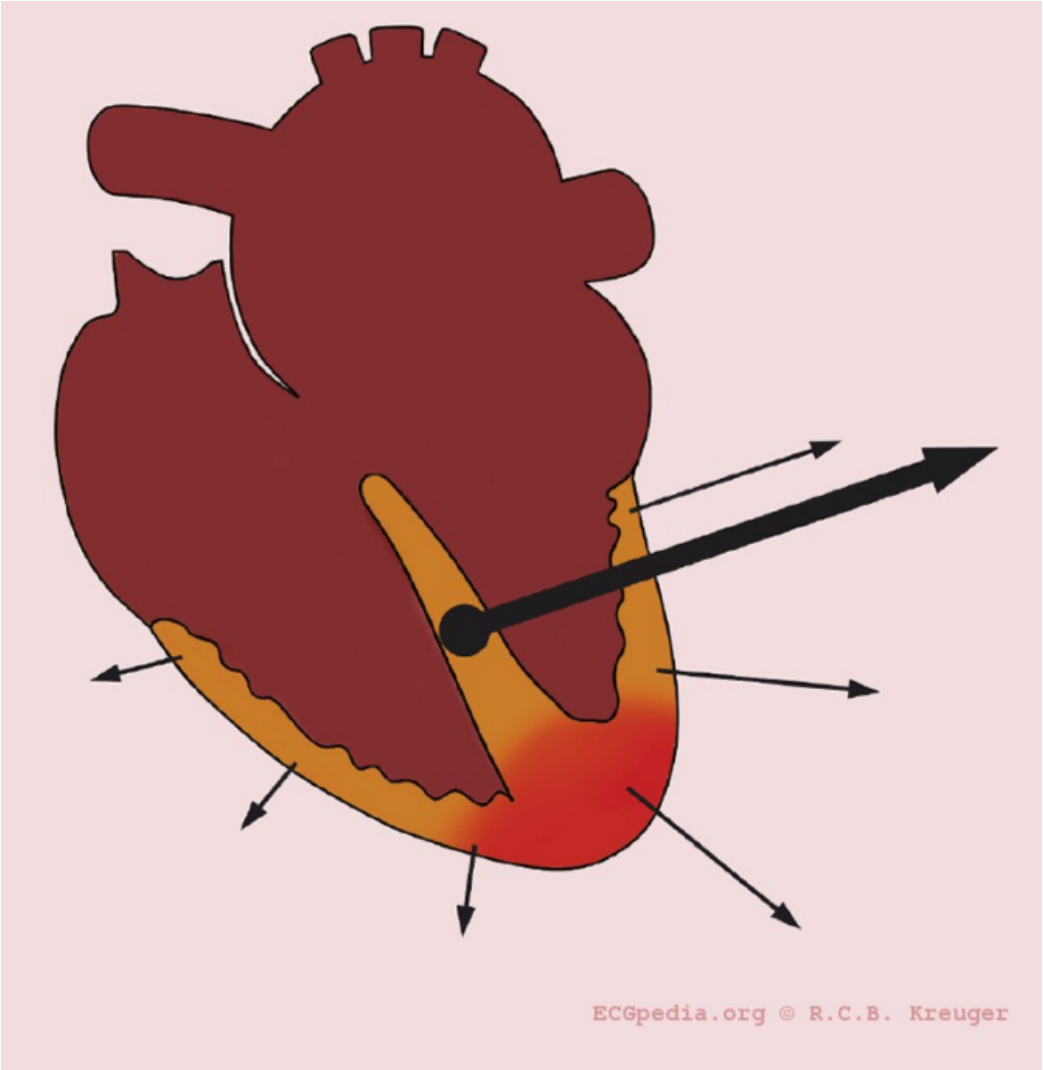






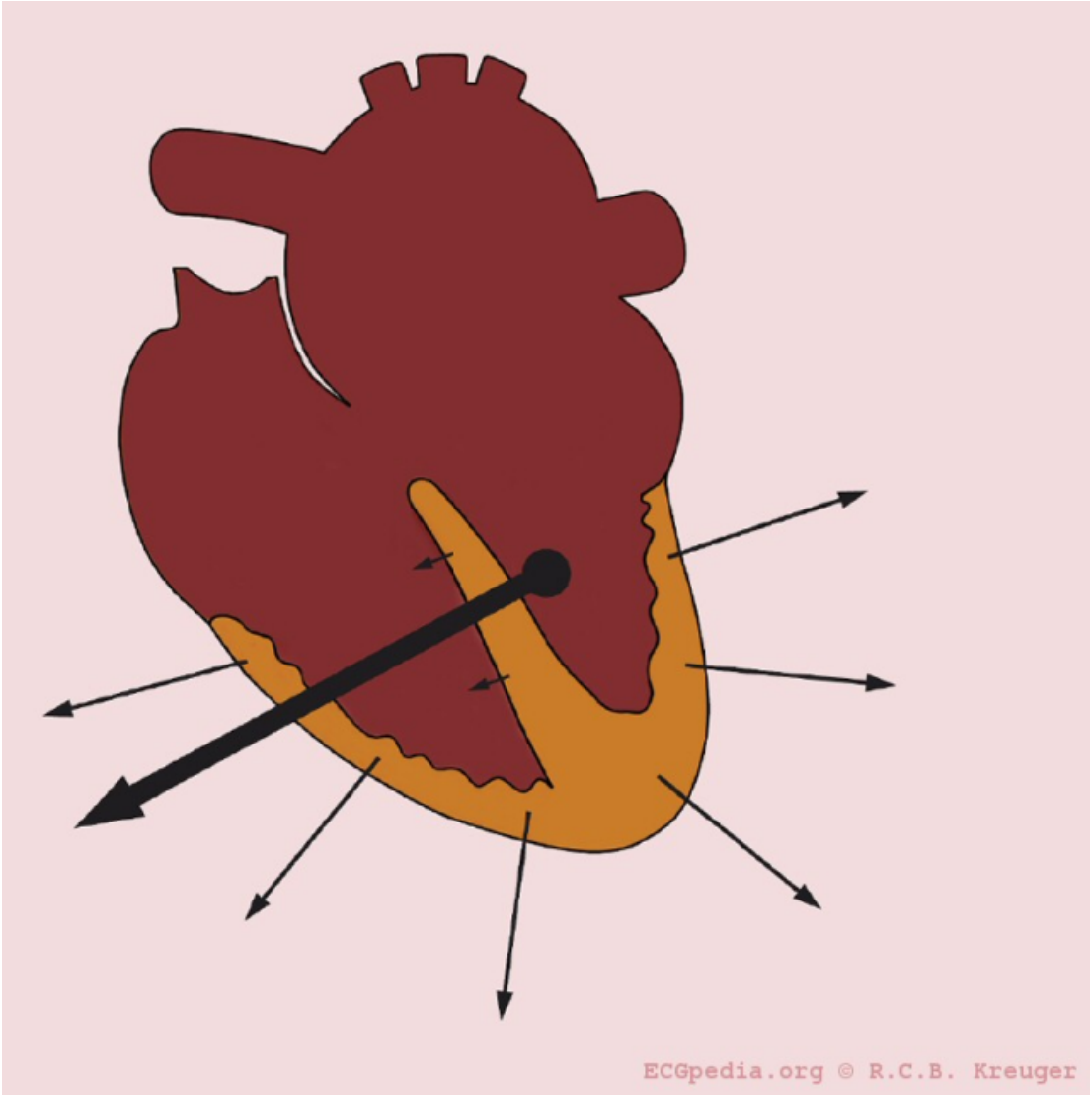
Linker hartas

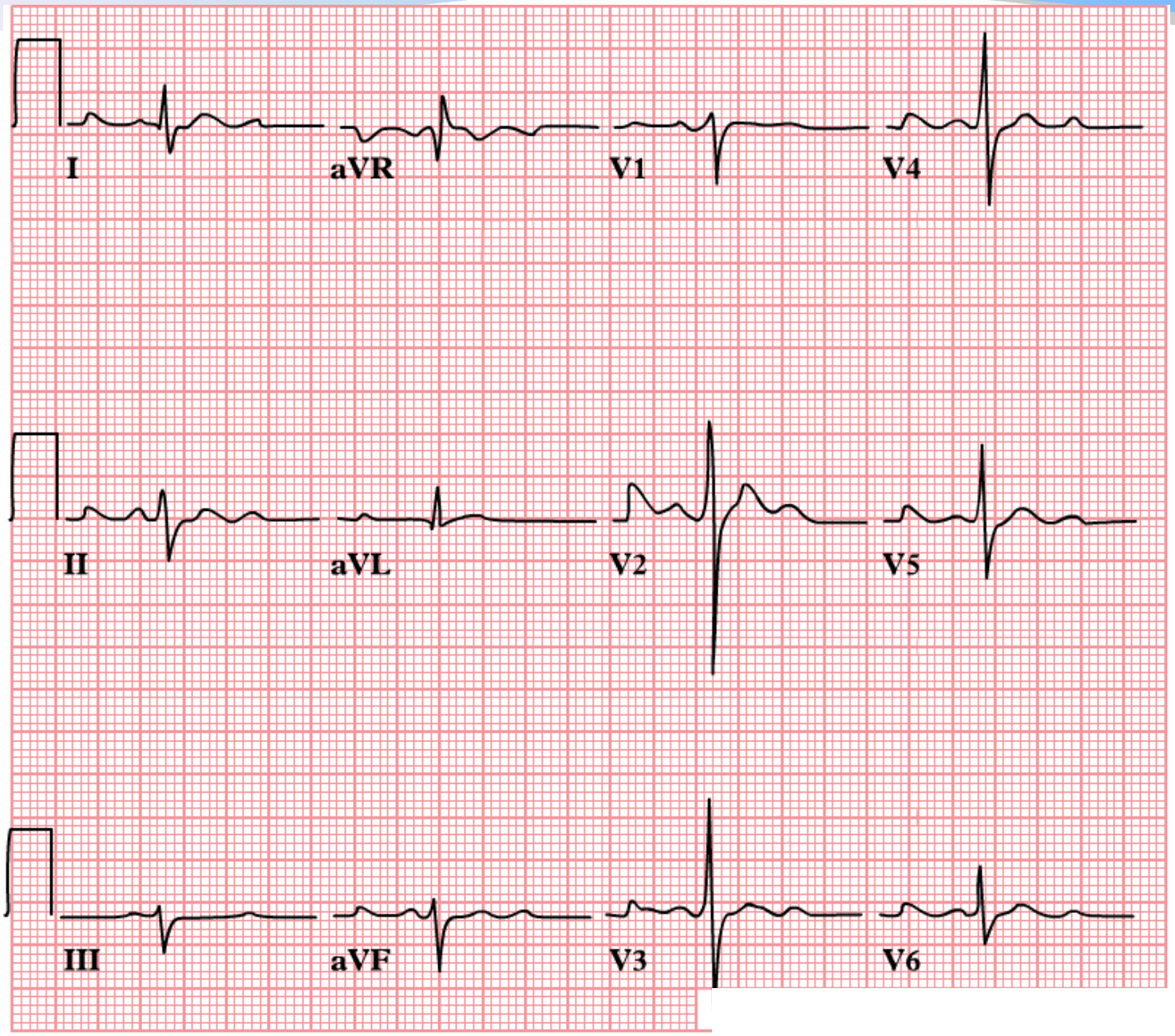
- Linker anterior hemiblok
- Onderwandinfarct
- Linker ventrikelhypertrofie
- Pacemakerritme



Rechter hartas

- Rechter ventrikelhypertrofie
- Rechter ventrikelbelasting (longembolie / COPD)
- Atriumseptumdefect, ventrikelseptumdefect
- Cave draad verwisseling!

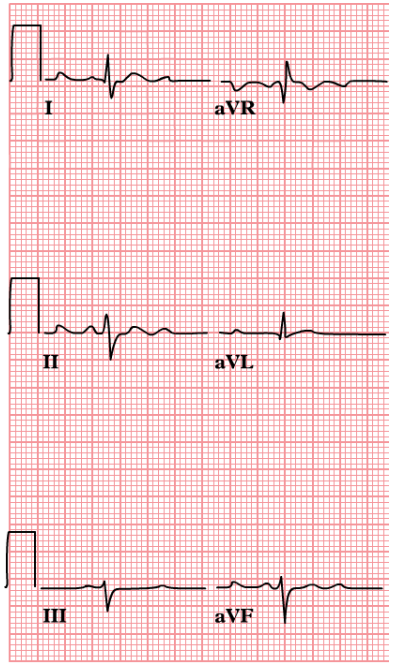


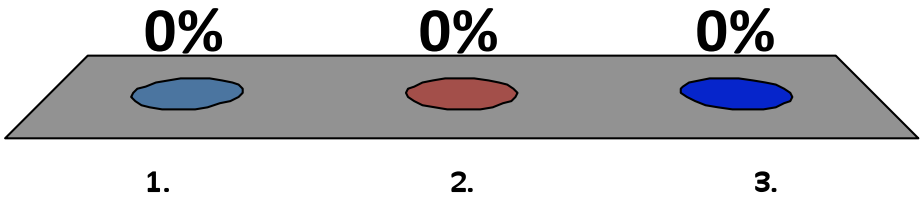


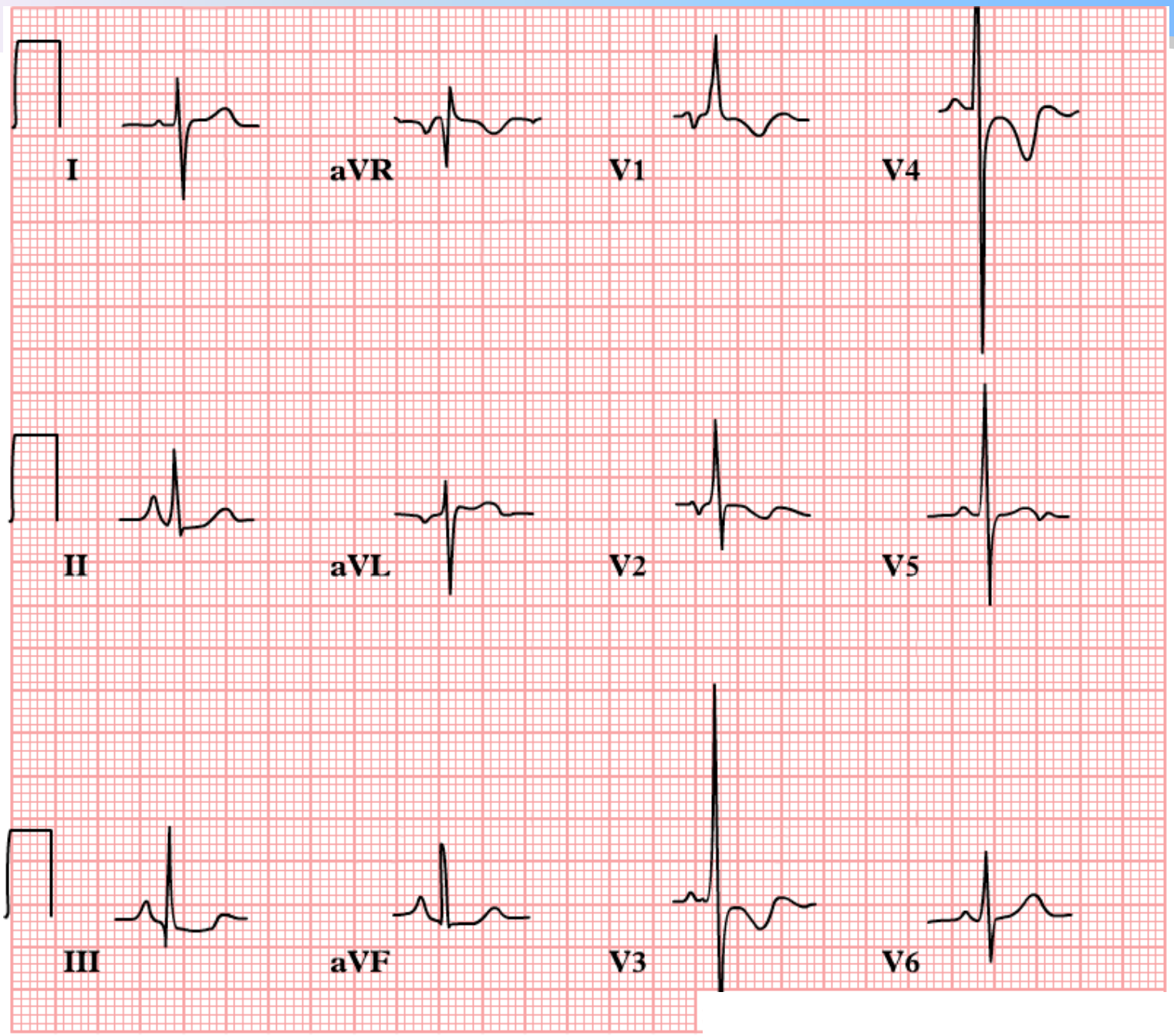
Hartas?

Hartas?

1. Links
2. Intermediair
3. Rechts



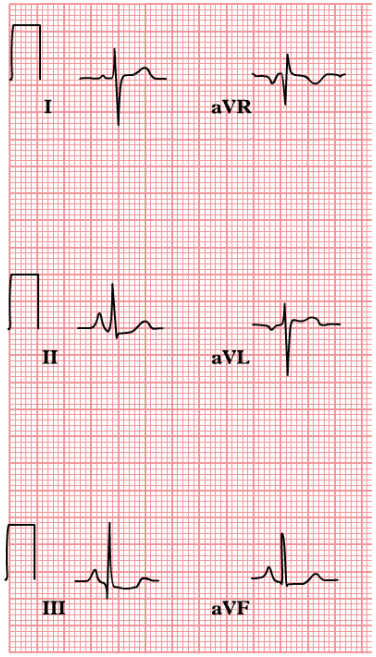


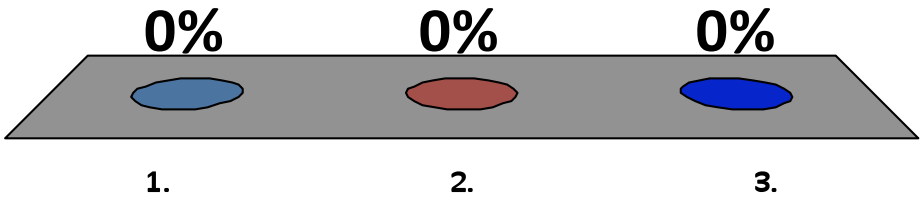


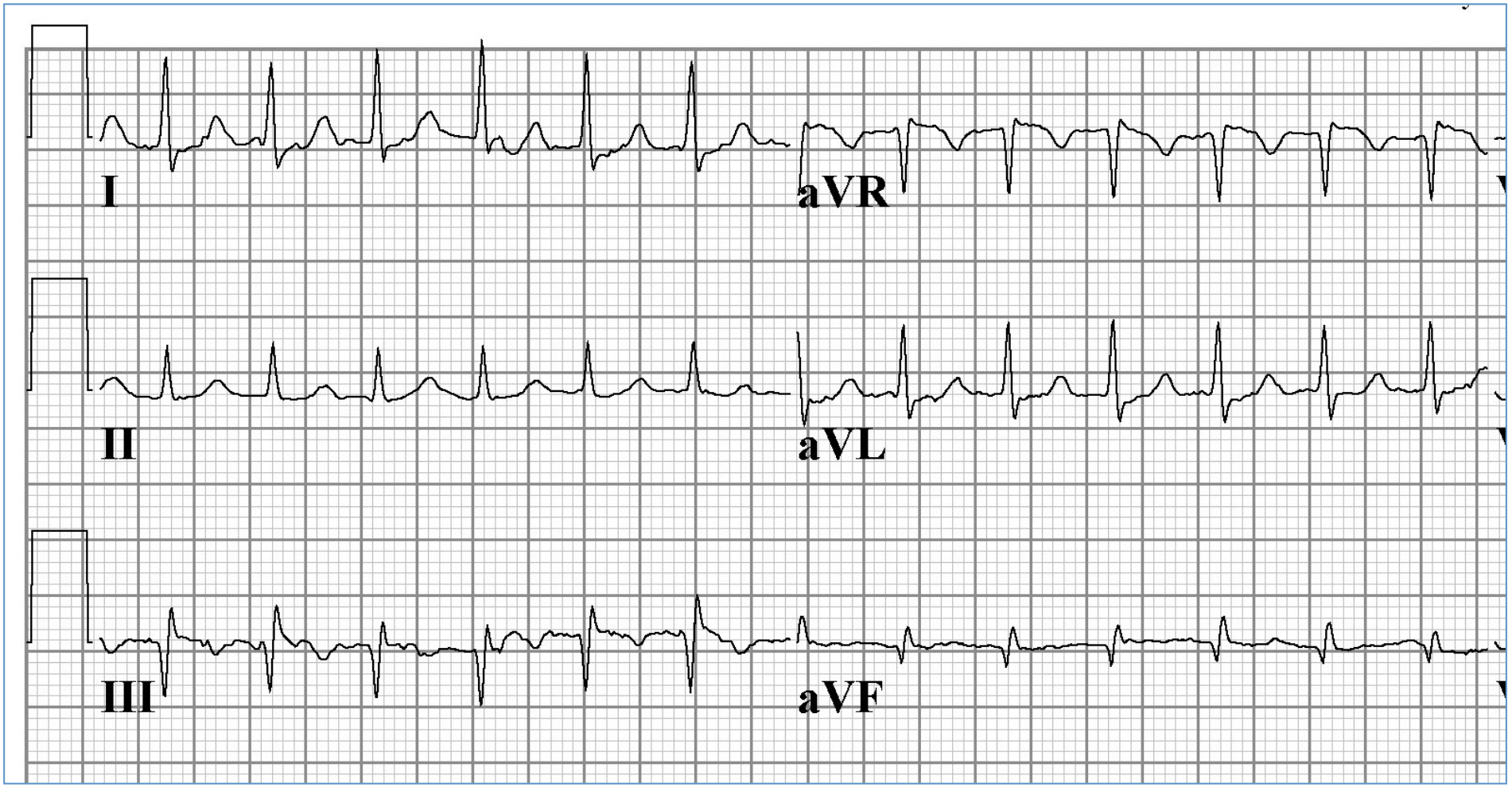
Hartas?

Hartas?

1. Links
2. Intermediair
3. Rechts

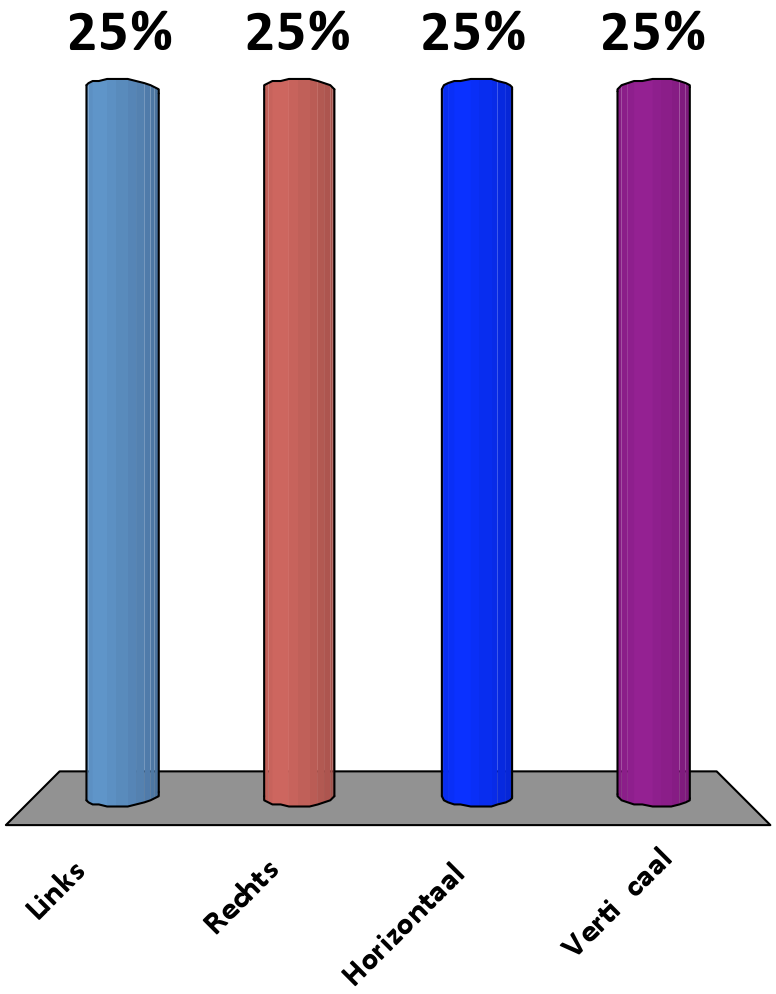





I
aVR
II
aVL
III
aVF

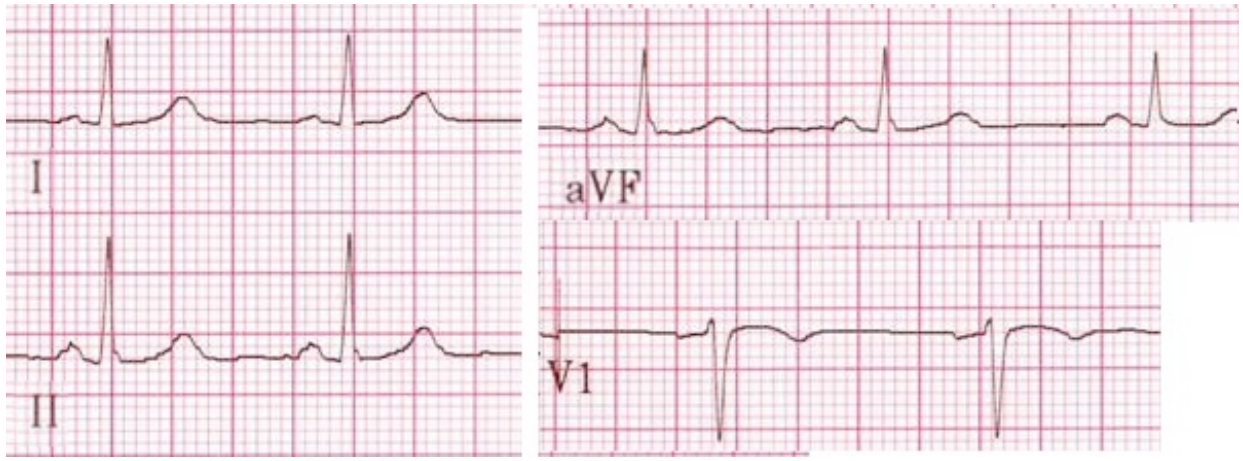
Hartas?

1. Links
2. Rechts
3. ✓ Horizontaal
4. Verticaal



5 P top morfologie

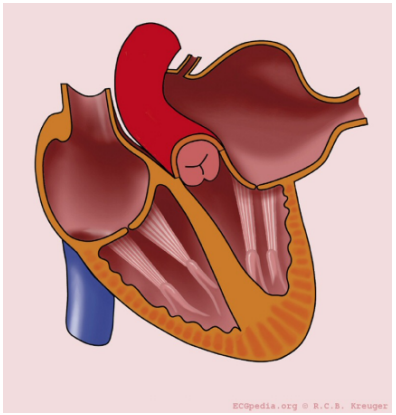
- De maximale hoogte van de p top is 2,5 mm in II en / of III
- De p top is positief in II en AVF, en bifasisch in V1
- De breedte van de p top is normaal korter dan 0.12 seconde

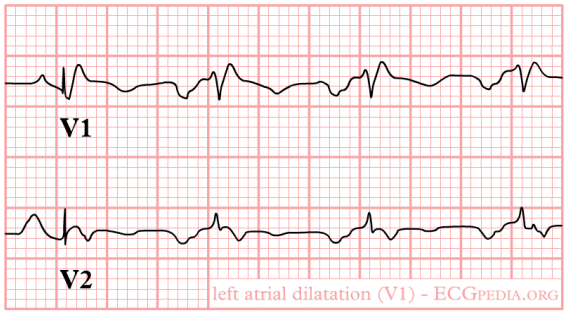


Linkeratriumdilatatie

Terminaal deel in V1 > 1mm2

en/of P >0,12 sec in I en/of II

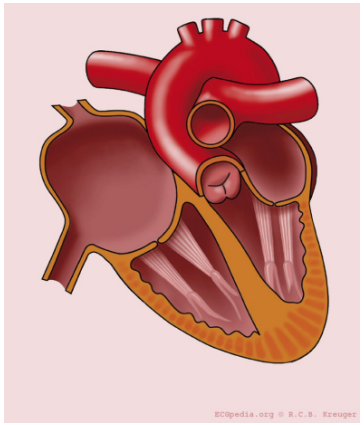


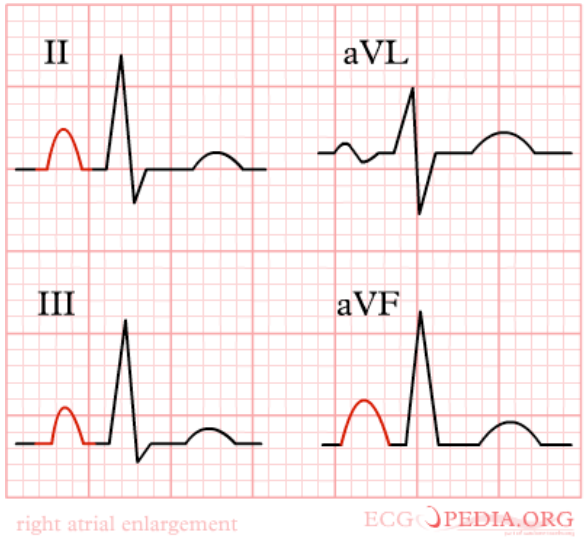


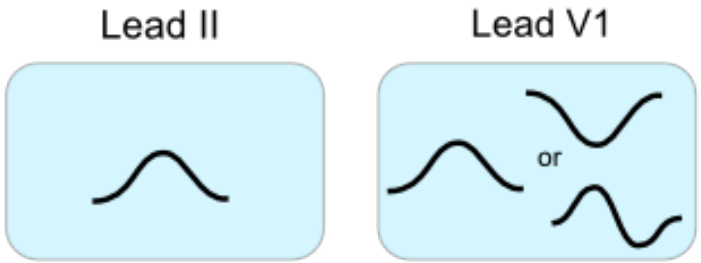
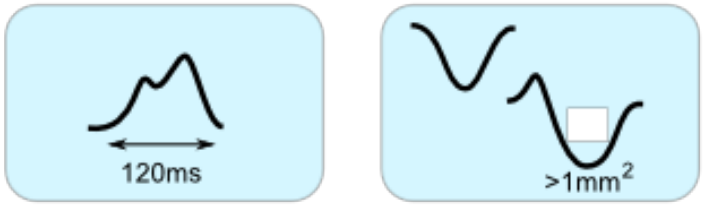
Rechteratriumdilatatie

P >2,5 mm in II en/of III en/of aVF

en/of P >1,5 mm in V1

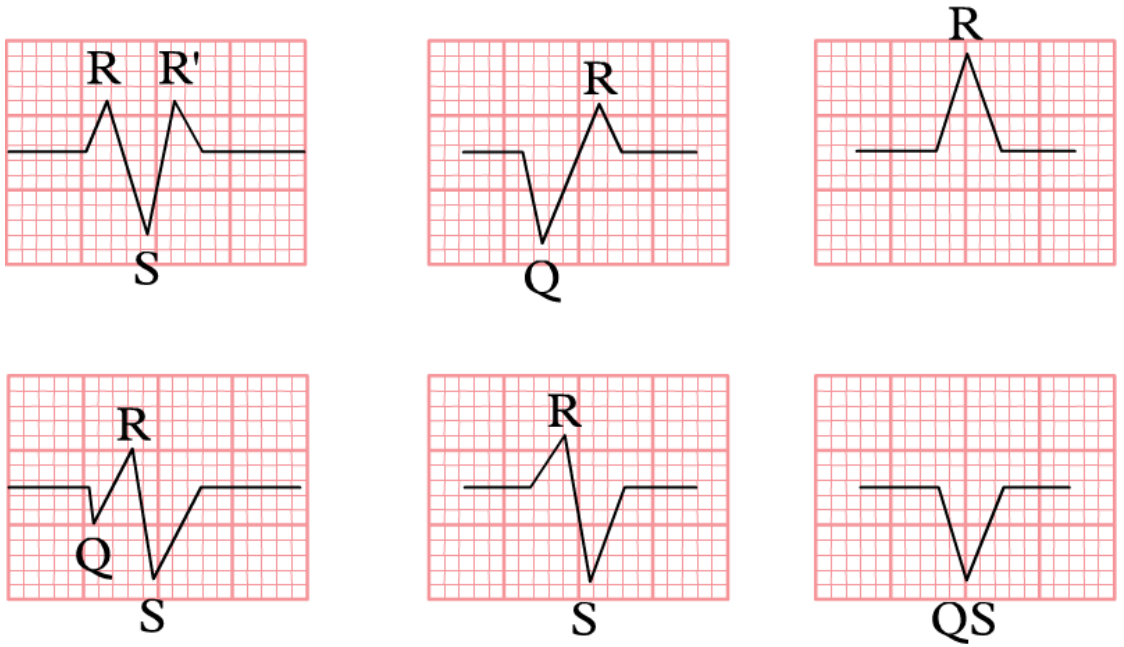




Condition	P Wave Morphology
Normal Sinus Rhythm	
Right atrial enlargement (= **P P**ulmonale)	
Left Atrial Enlargement (= **P M**itrale)	

6 QRS morfologie

- pathologische Q golven?
- LVH / RVH?
- microvoltages?
- geleidingsproblemen?
- R top progressie normaal?



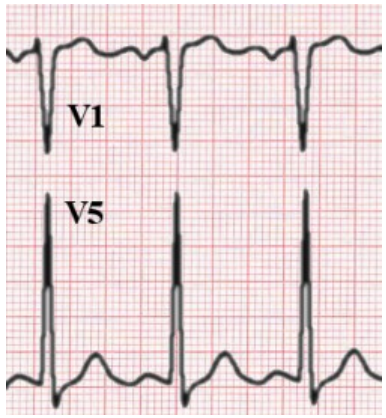
QRS shapes - ECGpedia.org

7+2 STAPPENPLAN
Stap 6: QRS morfologie

- Pathologische Q top?
  - Breedte ≥ 0.04 sec
  - Diepte > ⅓ van de R
- Differentiaal diagnose?
  - Oud infarct
  - Cardiomyopathie (HCM, DCM)
  - COPD
  - Intraventriculaire geleidingsstoornissen

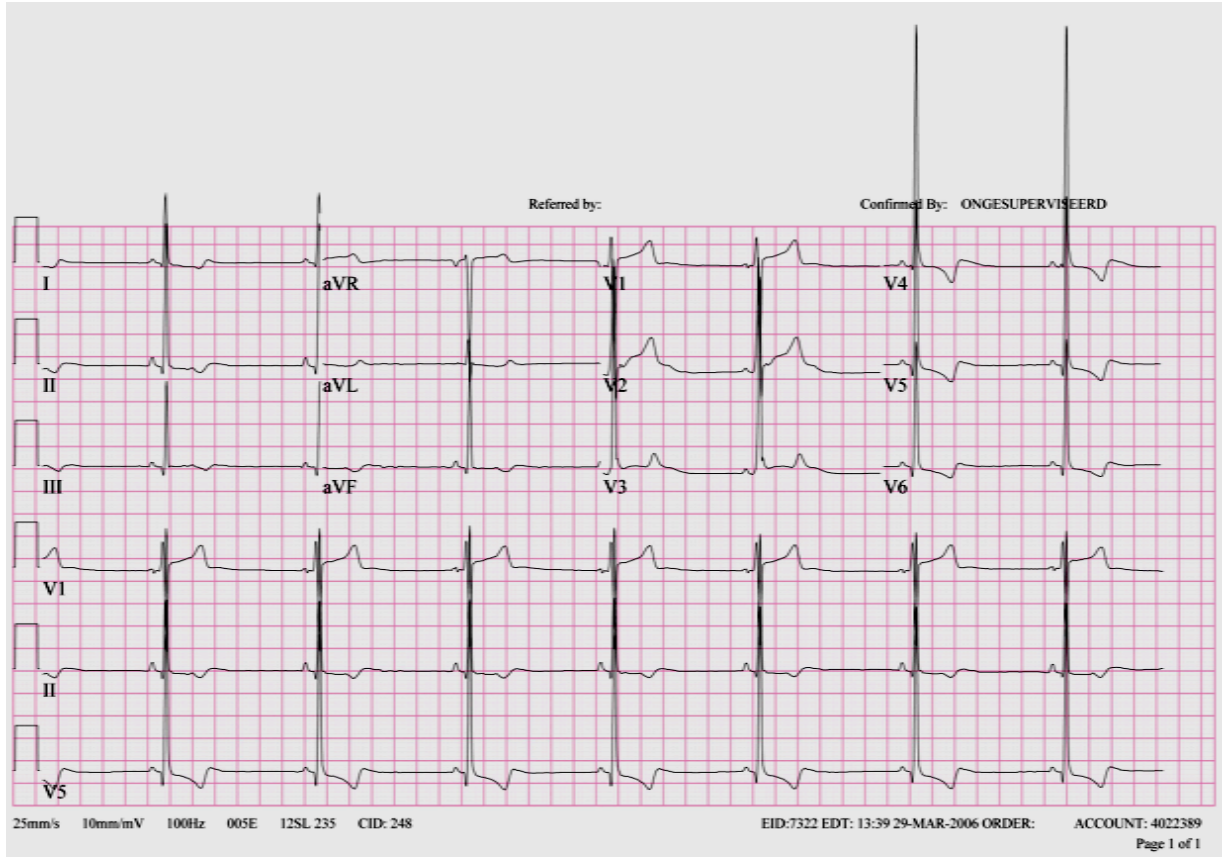
6 QRS morfologie

- pathologische Q golven?
- **LVH / RVH?**
- microvoltages?
- geleidingsproblemen?
- R top progressie normaal?



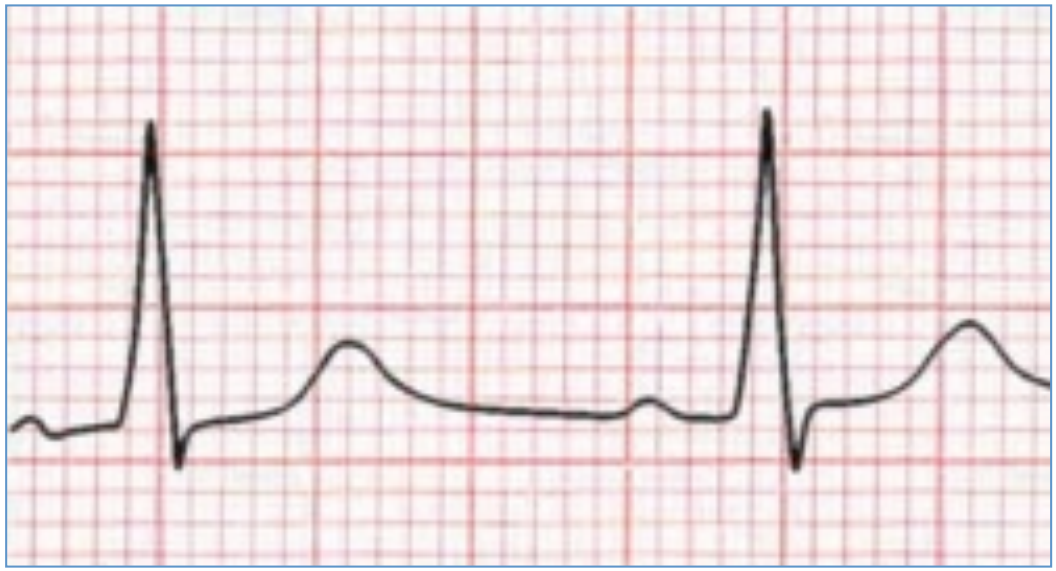
LVH:

- R in V5 of V6 + S in V1 > 35mm (Sokolow-Lyon criteria)
- Vaak strain patroon V5-V6



6 QRS morfologie

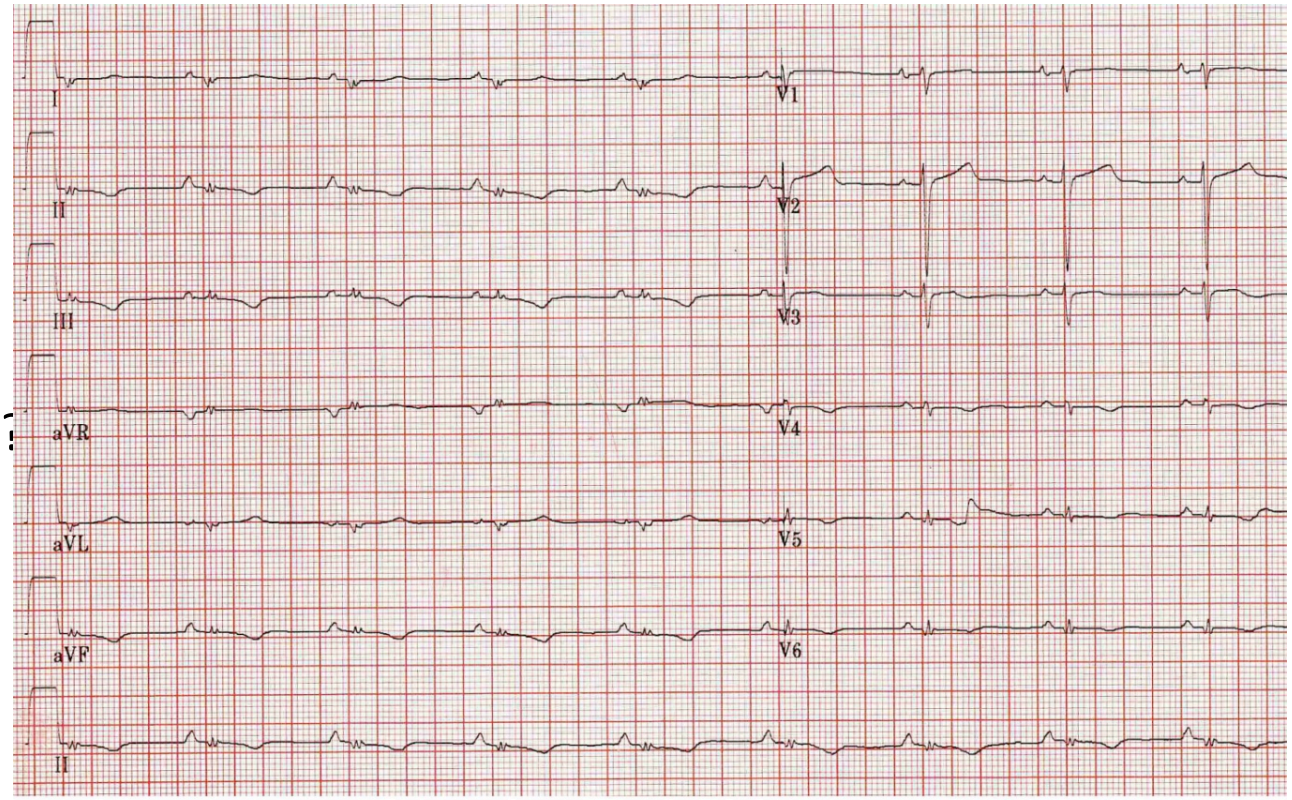
- pathologische Q golven?
- **LVH / RVH?**
- microvoltages?
- geleidingsproblemen?
- R top progressie normaal?



RVH:
R>S in V1

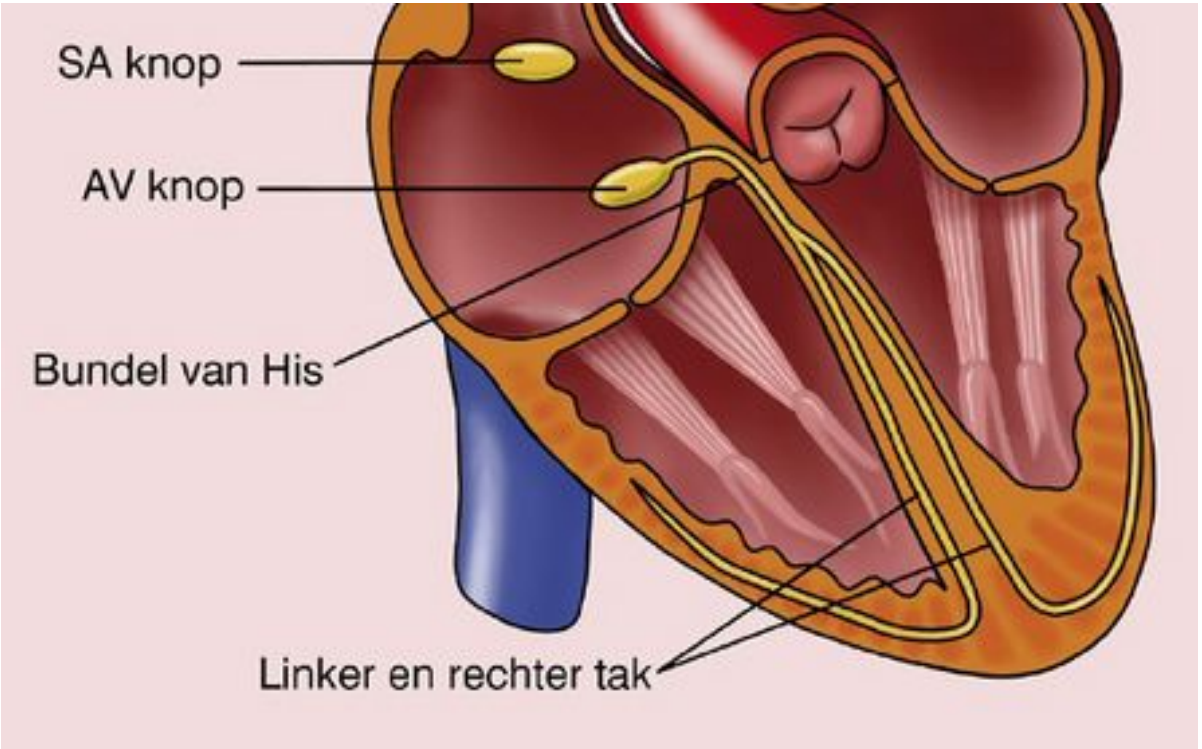
6 QRS morfologie

- pathologische Q golven?
- LVH / RVH?
- **microvoltages?**
- geleidingsproblemen?
- R top progressie normaal?



6 QRS morfologie

- pathologische Q golven?
- LVH / RVH?
- microvoltages?
- **geleidingsproblemen?**
  - **QRS > 0.12 seconde**
- R top progressie normaal?



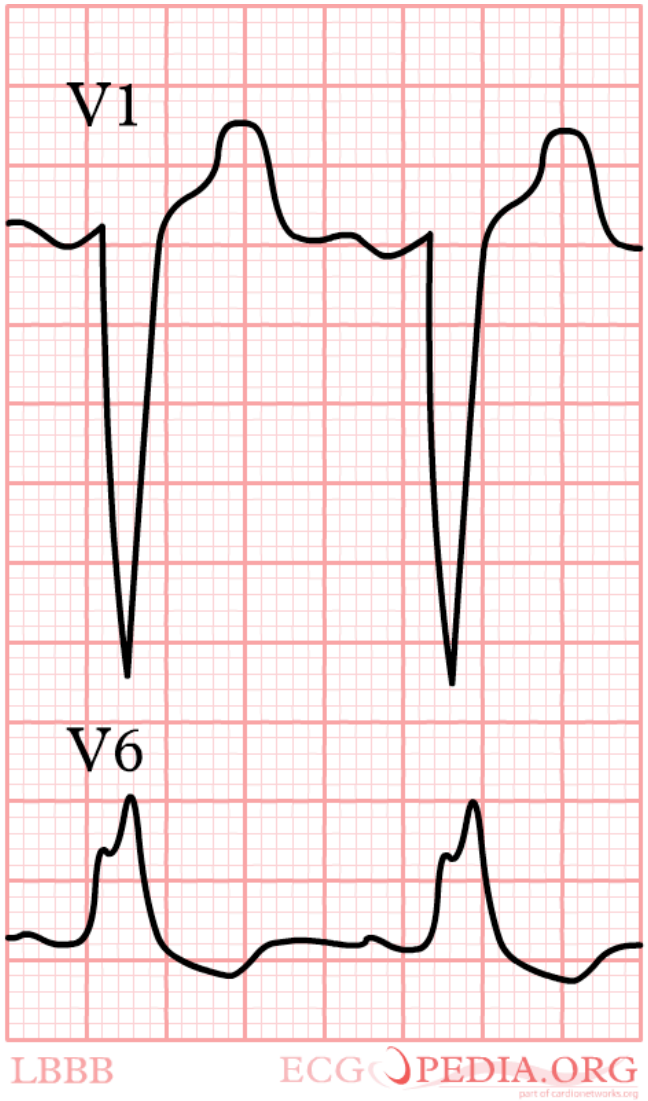
LBTB

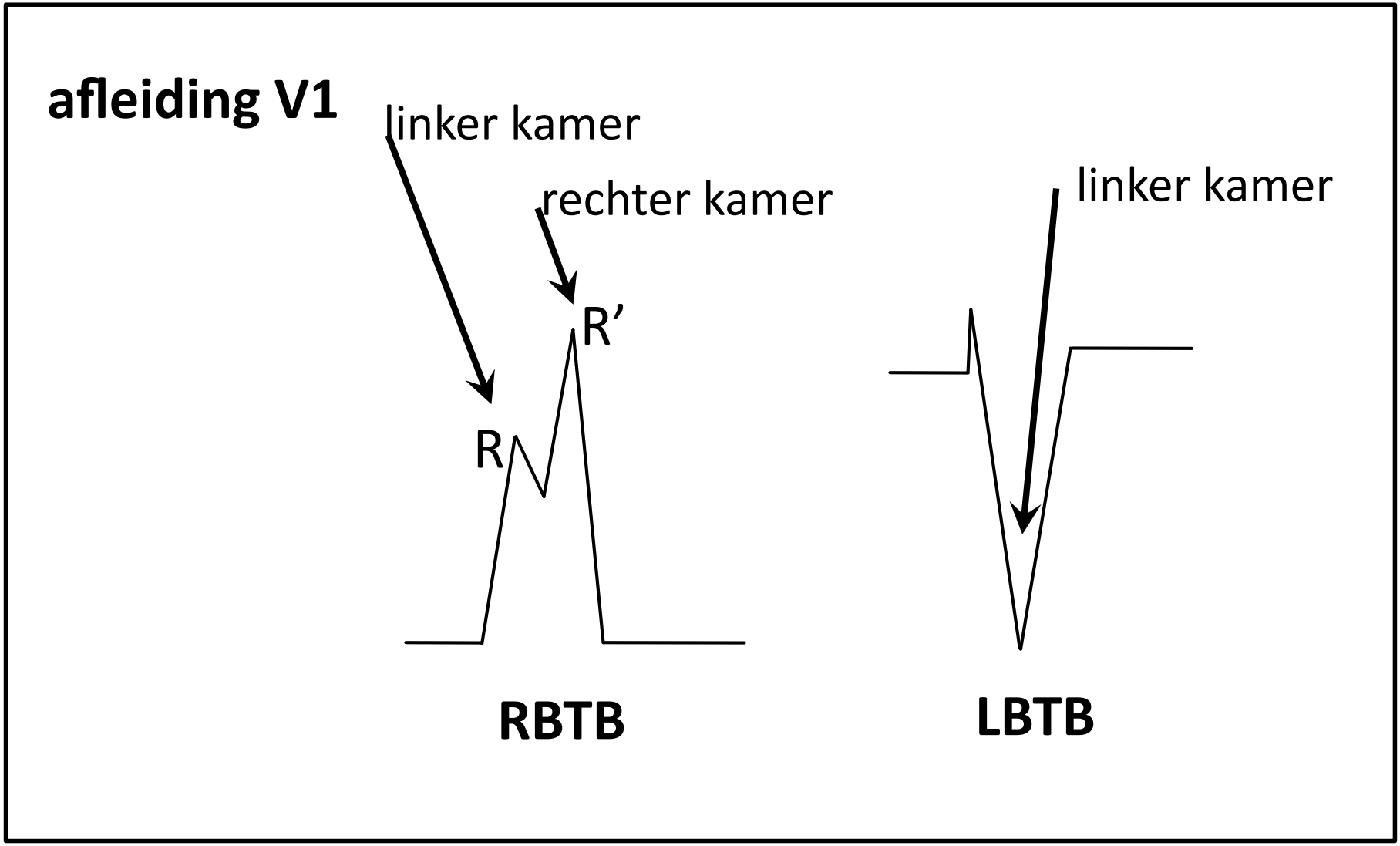
QRS > 0.12 seconde

(r)S in V1

Brede R en geen q in I, V6

(Infarctdiagnostiek lastig want ST segment afwijkend)




afleiding V1
linker kamer
rechter kamer
R'
R
RBTB
linker kamer
LBTB

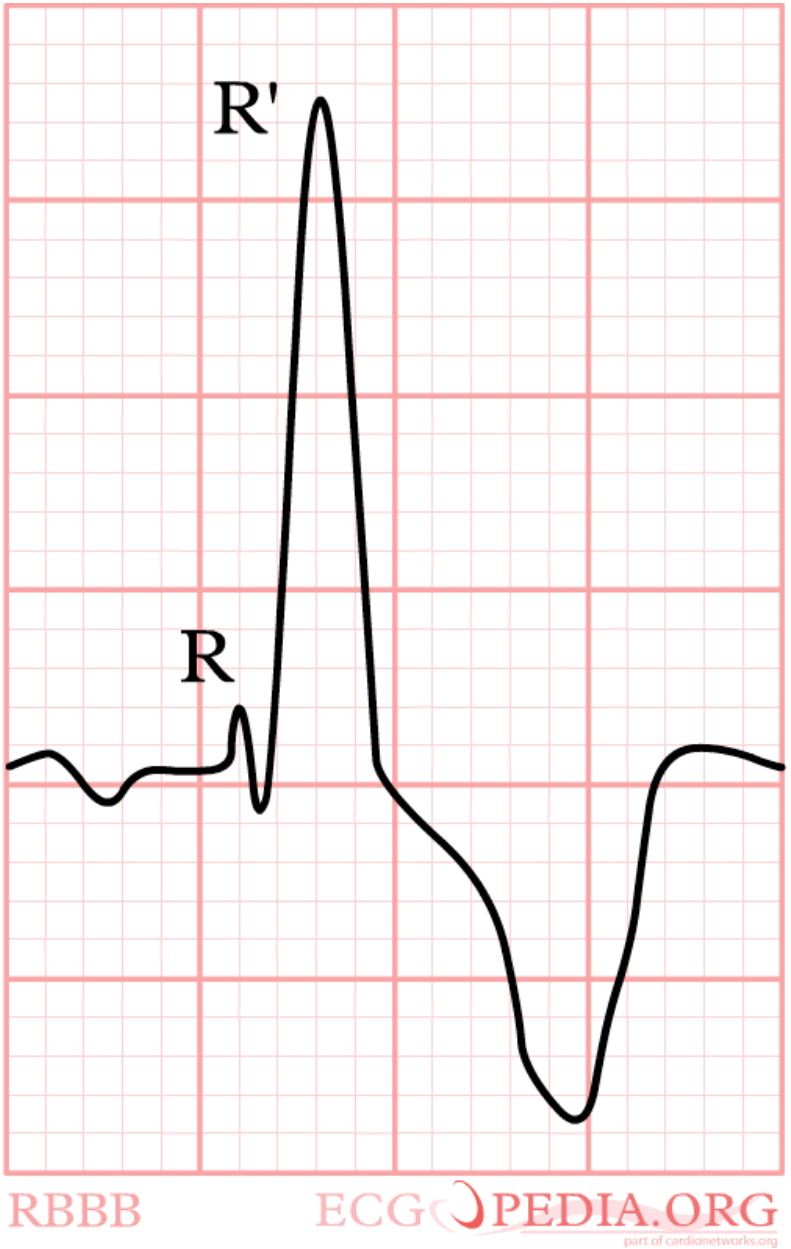
RBTB

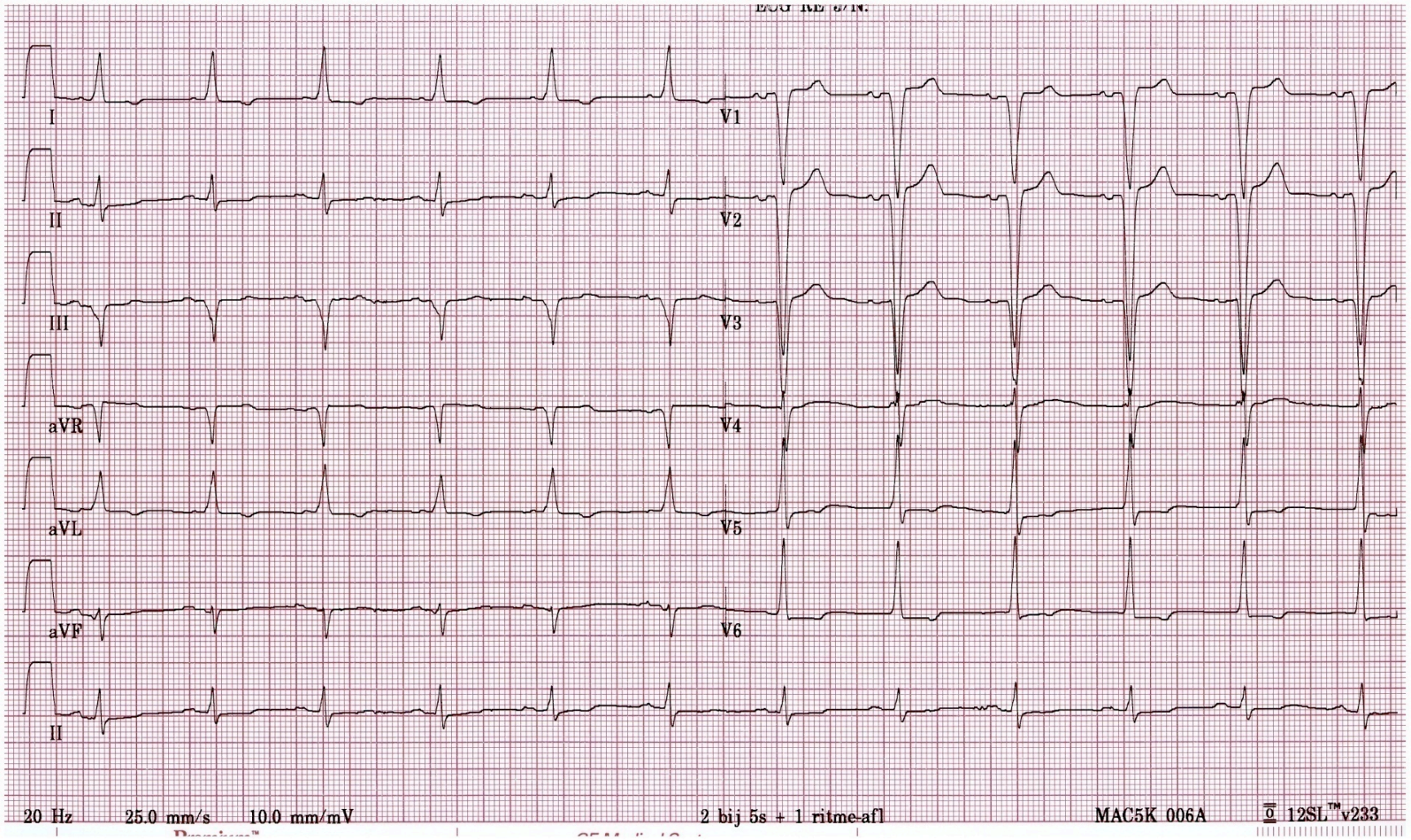
QRS > 0.12 seconde

rsR’ in V1

R’ > R

(Infarctdiagnostiek goed mogelijk)





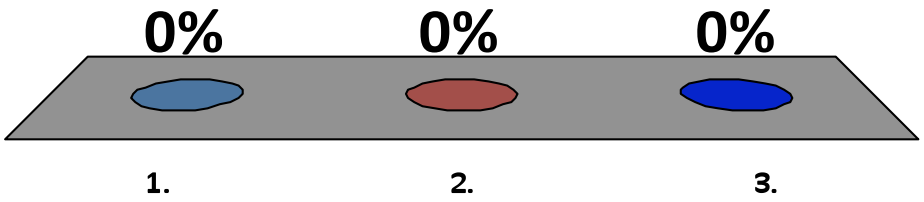
Courtesy of W.G. de Voogt, MD, PhD, Amsterdam, The Netherlands

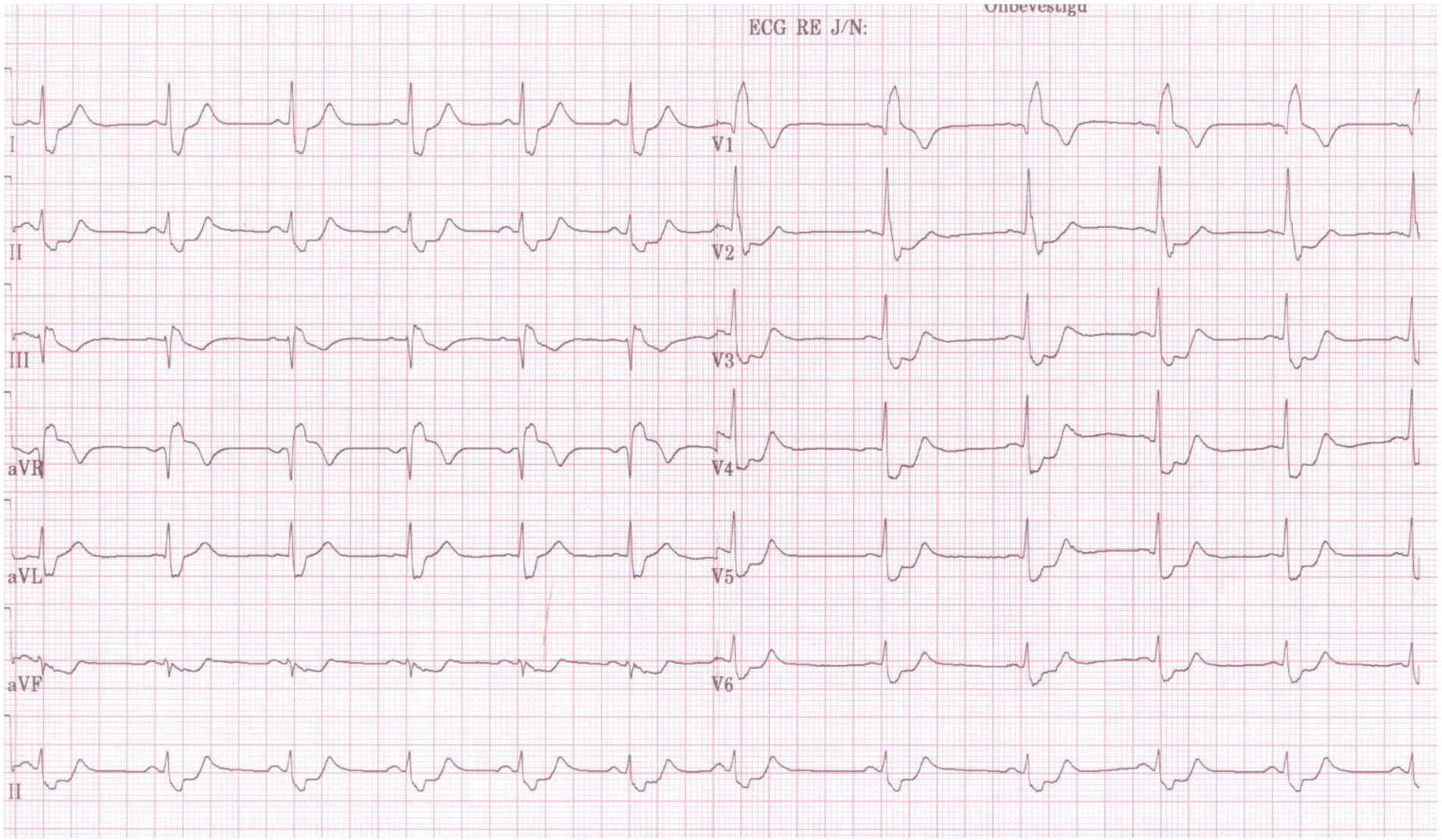
ECGPEDIA.ORG
part of cardionetworks.org

RBTB of LBTB?

LBTB of RBTB?

1. LBTB
2. RBTB
3. Intraventriculaire geleidingsvertragin

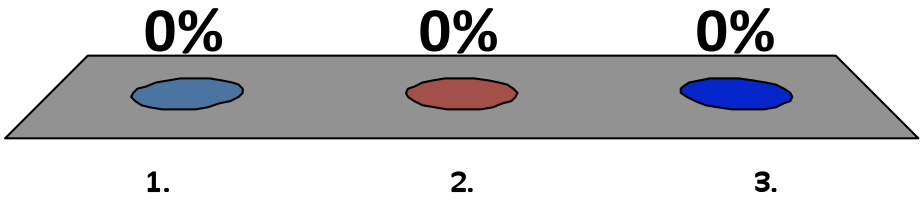


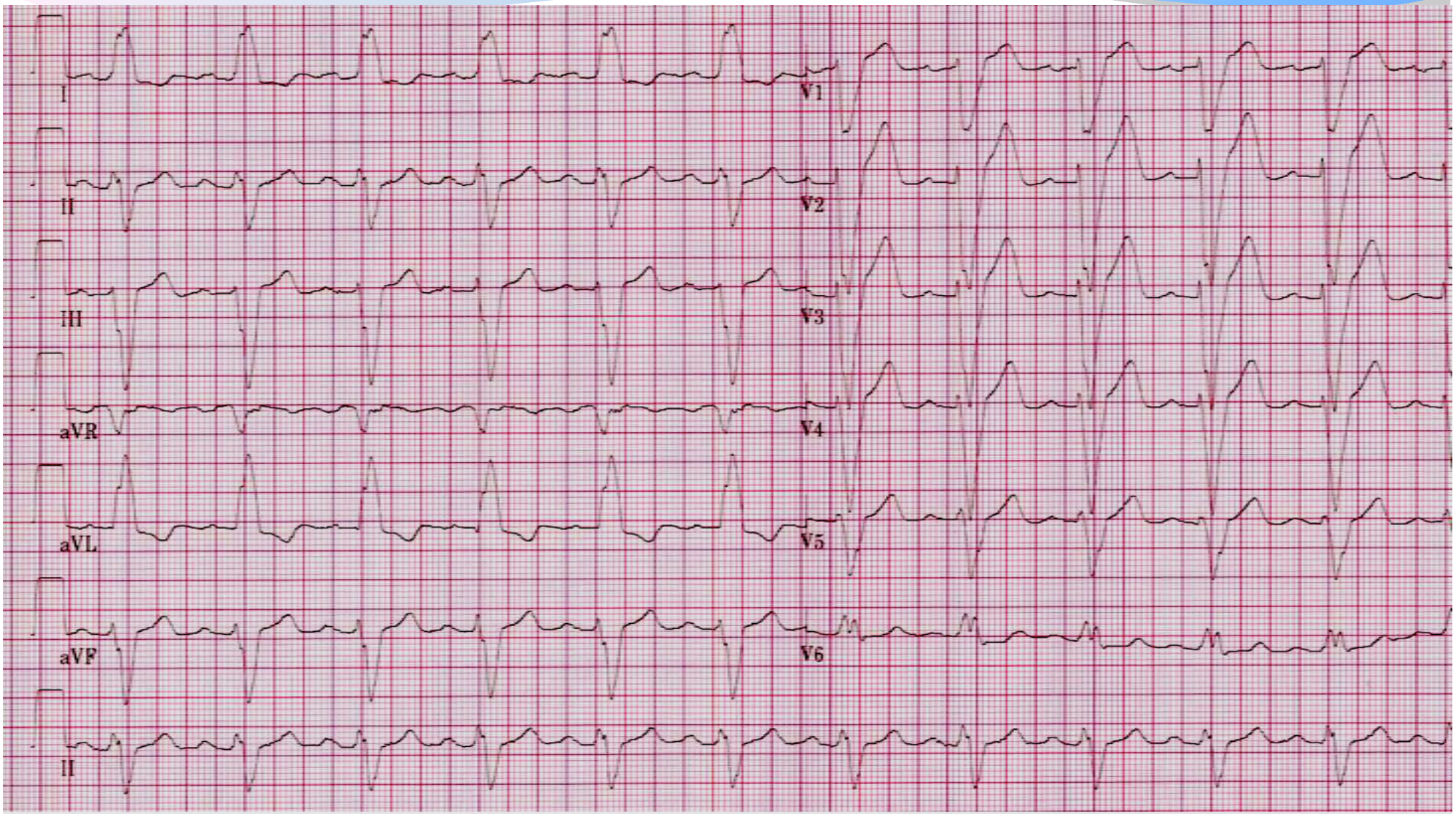


Courtesy of W.G. de Voogt, MD, PhD, Amsterdam, The Netherlands

LBTB of RBTB?

1. LBTB
2. ✓ RBTB
3. Intraventriculaire geleidingsvertraging

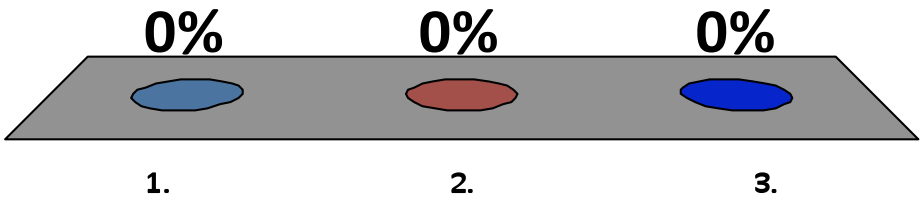



I
II
III
aVR
aVL
aVF
II
V1
V2
V3
V4
V5
V6
Courtesy of R.W. Koster, MD, PhD
AMC, The Netherlands
ECGPEDIA.ORG

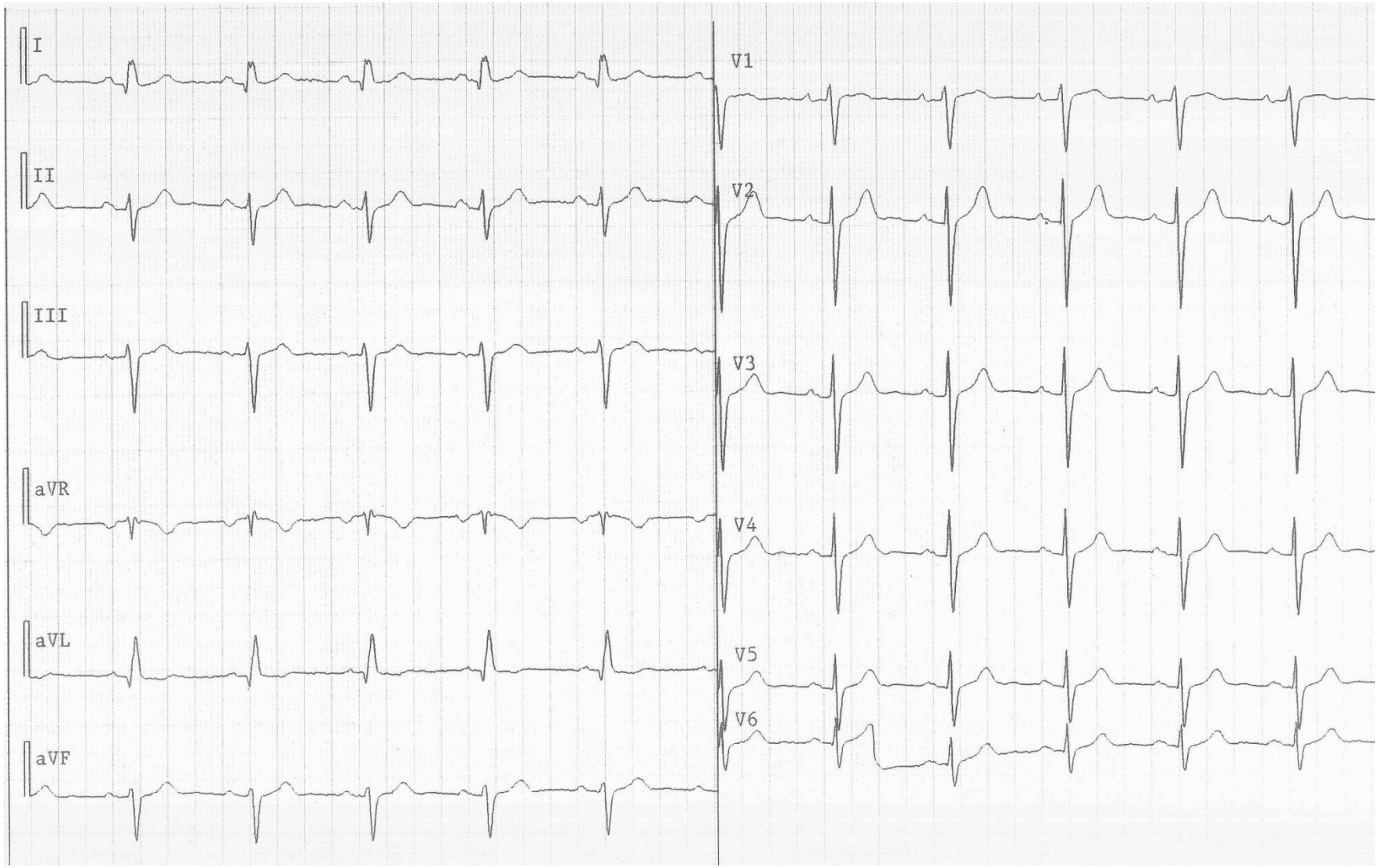
RBTB of LBTB?

LBTB of RBTB?

1. LBTB
2. RBTB
3. Intraventriculaire geleidingsvertraging



LAHB



Courtesy of R.W. Koster, MD, PhD
AMC, The Netherlands

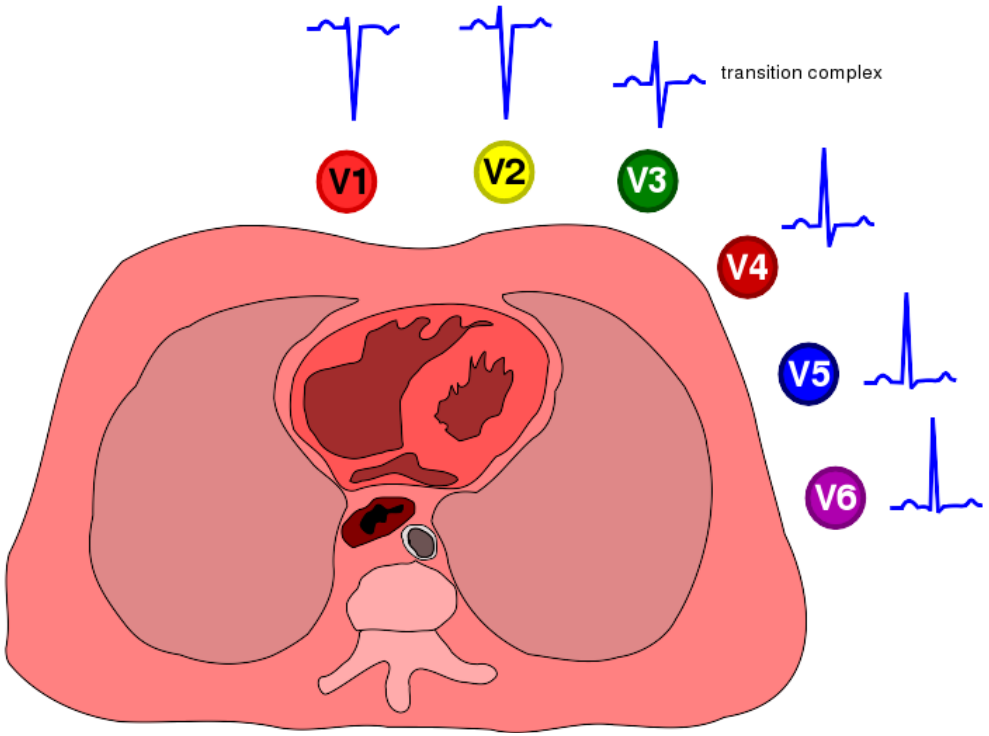
ECG PEDIA.ORG

Criteria LAHB

- asdeviatie naar links (<-30°)
- geen of vrijwel geen S in I
- normale kleine q in I
- S >R in II, III
- QRS niet of slechts in geringe mate verbreed (100ms)

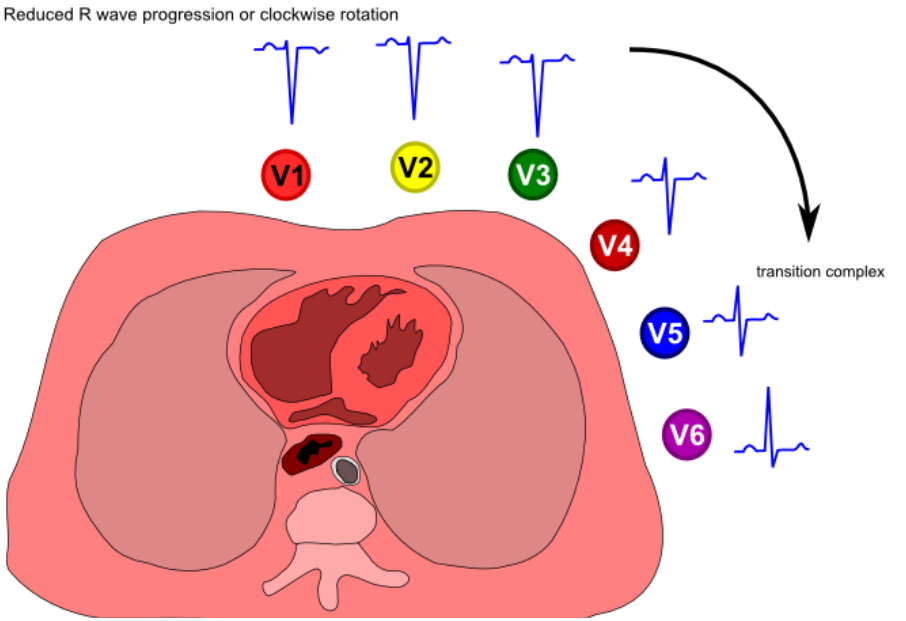
7+2 STAPPENPLAN
Stap 6: QRS morfologie

- R-top progressie?
  - Overgangs complex in V3, V4
    - Normaal zit het overgangs complex (waar de R-top groter wordt dan de S) bij V3 tot V4

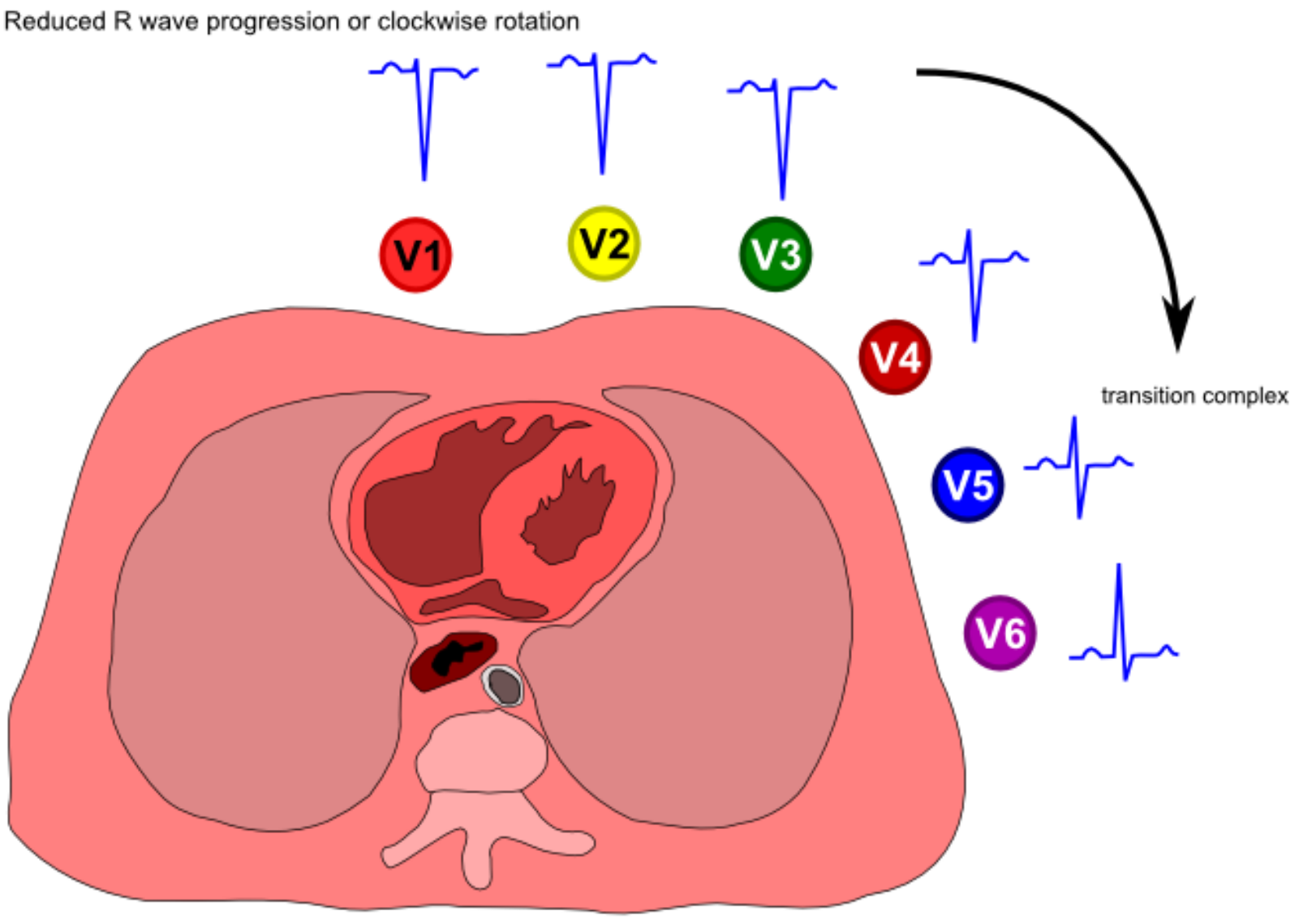


7+2 STAPPENPLAN
Stap 6: QRS morfologie

- R-top progressie?
  - Differentiaal diagnose onvoldoende r-top progressie?
    - RV hypertrofie
    - COPD, asthma
    - Voorwand infarct of anteroseptaal infarct
    - Geleidingsstoornissen (LBBB, Left anticus hemiblok, intraventriculaire geleidings vertraging)
    - Cardiomyopathie
    - Thorax afwijking
    - Normale variant
    - Precordiale afleidingen verkeerd geplaatst



ANAMNESE EN LO/ ZIJN EXTREEM BELANGRIJK VOOR JUISTE INTERPRETATIE VAN HET ECG


Reduced R wave progression or clockwise rotation
V1
V2
V3
V4
V5
V6
transition complex

7 ST morfologie

ST elevatie

Ischemie

Pericarditis

Aneurysma cordis

Normale variant

ST depressie

Reciproke bij ischemie

LVH

Digitalis

Hypokaliemie

Neurologisch

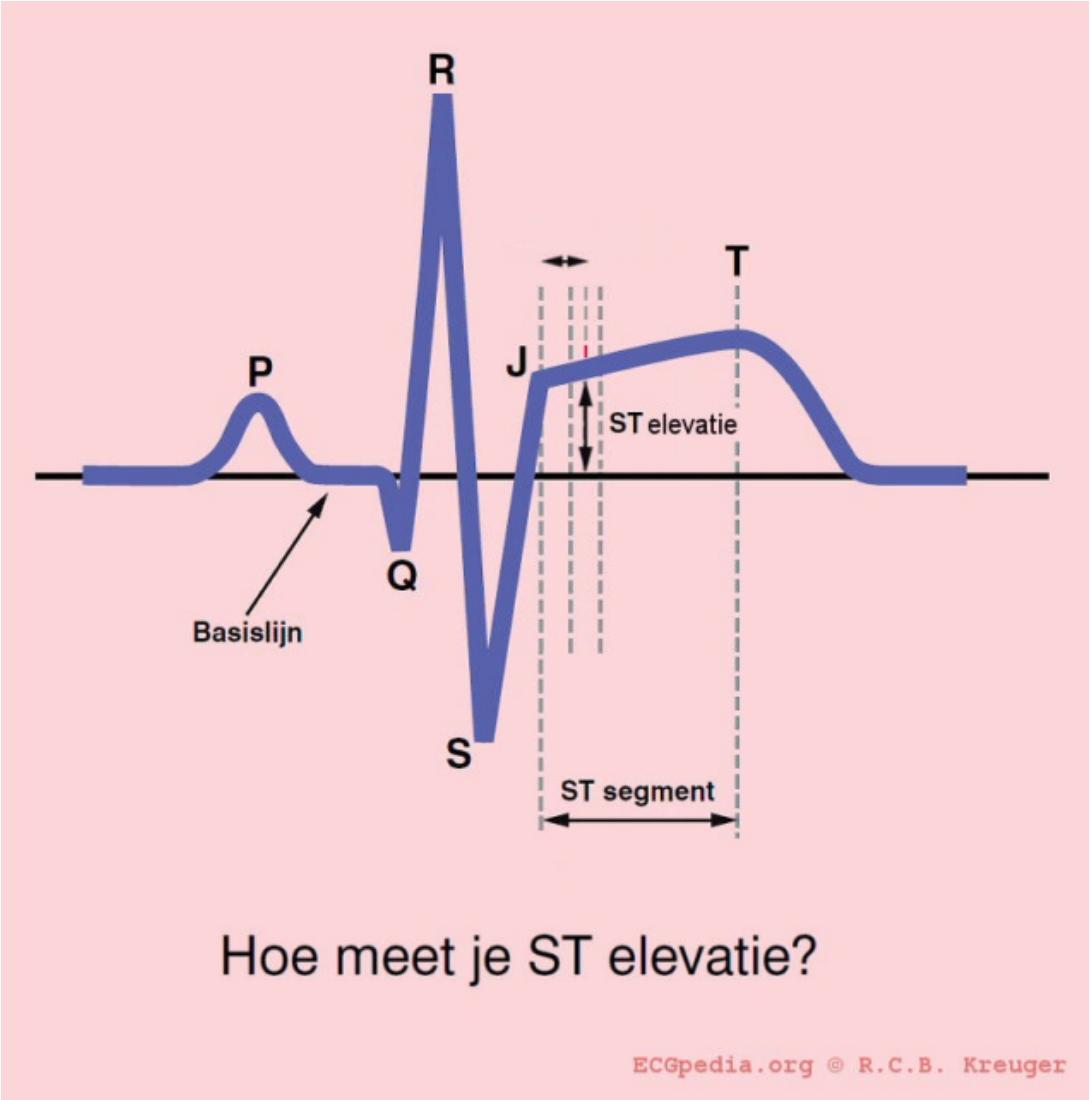
T top verandering

Ischemie

Pericarditis

Myocarditis

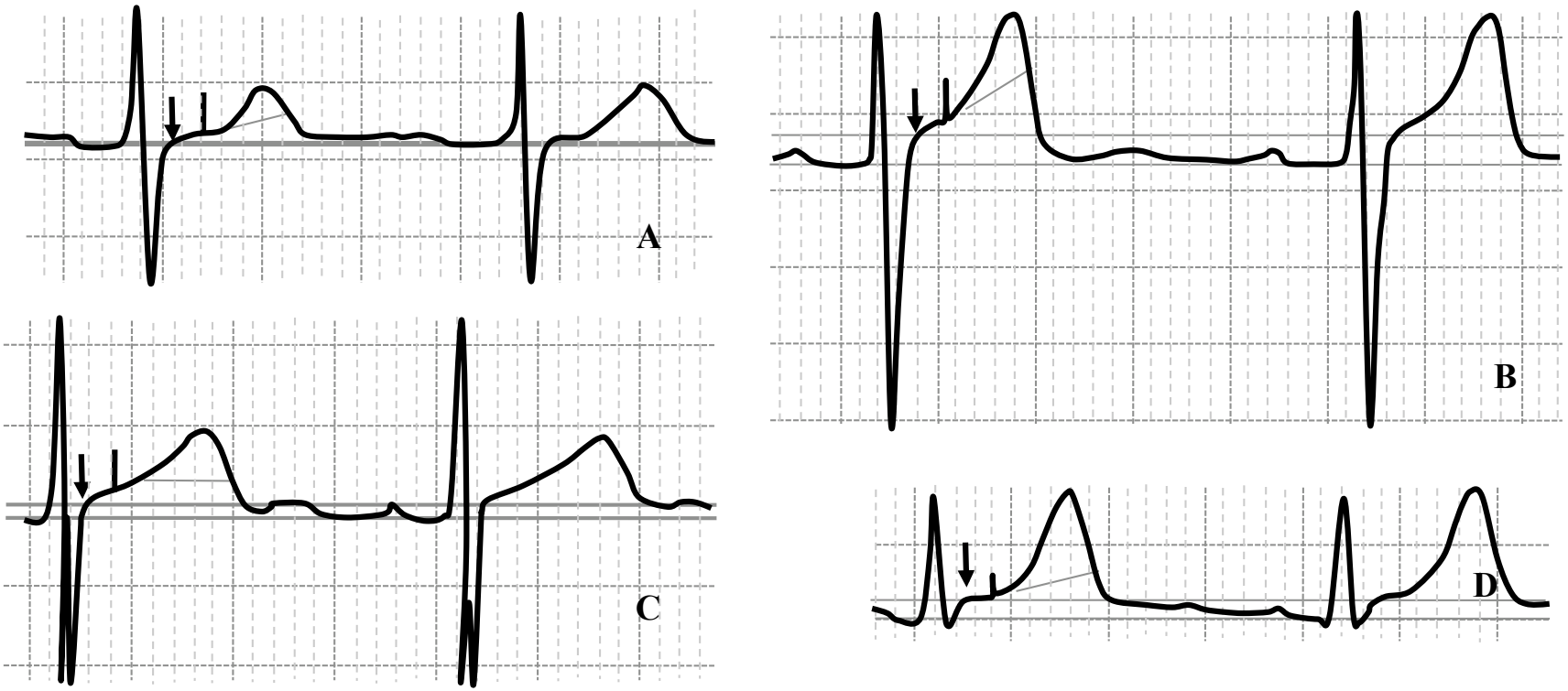
LVH / RVH



Normaal ST segment

≤ 1 mm ST shift onder/ boven iso-elektrische lijn

(PR segment 60-80 msec na punt J)

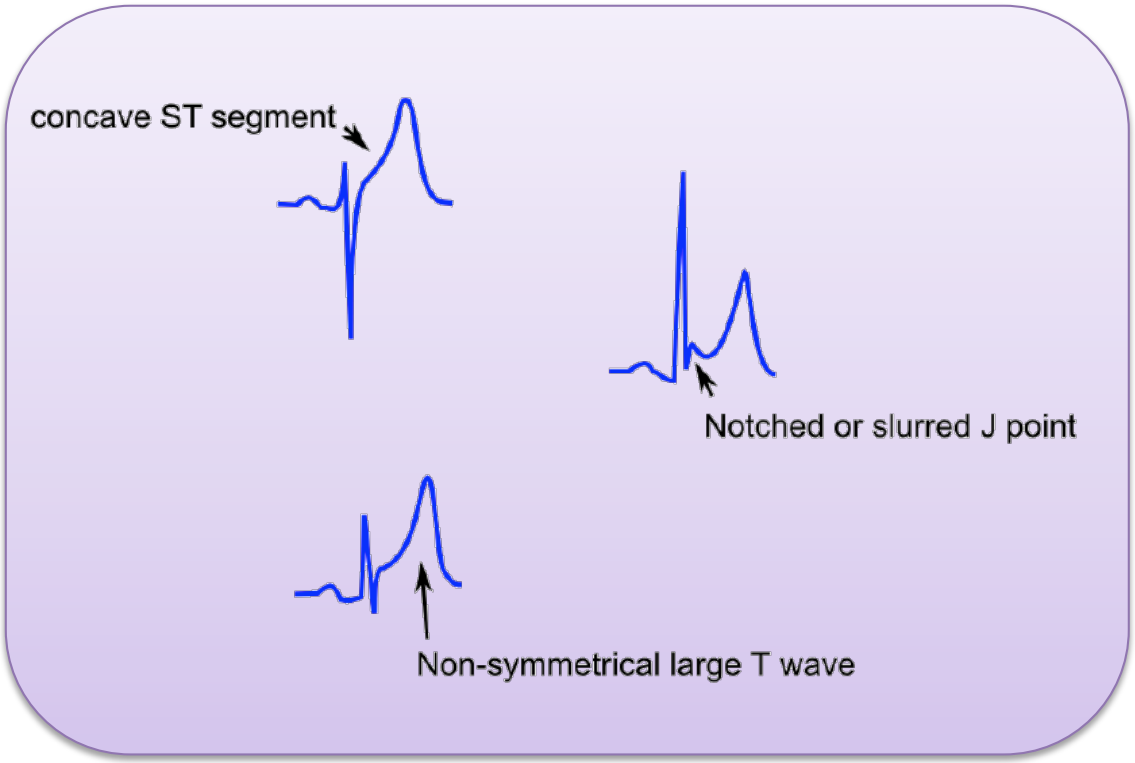


Prevalence of Male and Female Patterns of Early Ventricular Repolarization in the Normal ECG of Males and Females From Childhood to Old Age

J ACC 2002;40:1870–6

Vroege Repolarisatie

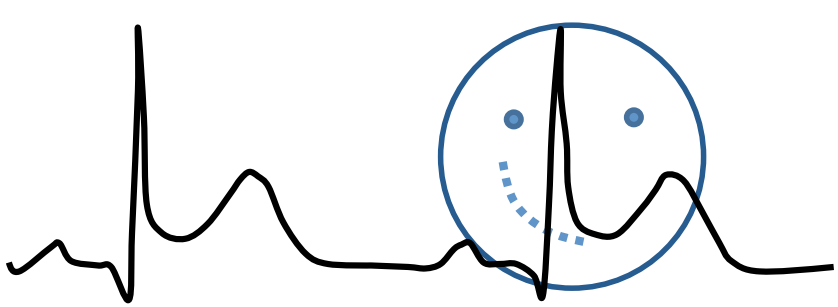
- Zeer frequente bevinding
- “Smiley”configuratie
- Overigens gezonde asymptomatische jonge volwassene
- Vaak in voorwands afl.
- Notching J punt
- Geen Q
- Geen reciproke ST depressie
- 90% van gezonde dienstplichtige mannen heeft ST-elevatie in precordiale afleidingen.
  - 1: normaal
  - 2: ‘early repolarization’
  - 3: normaal variant
- Bij onbegrepen SCD wel vaker vroege repolarisatie (31% vs 5%)



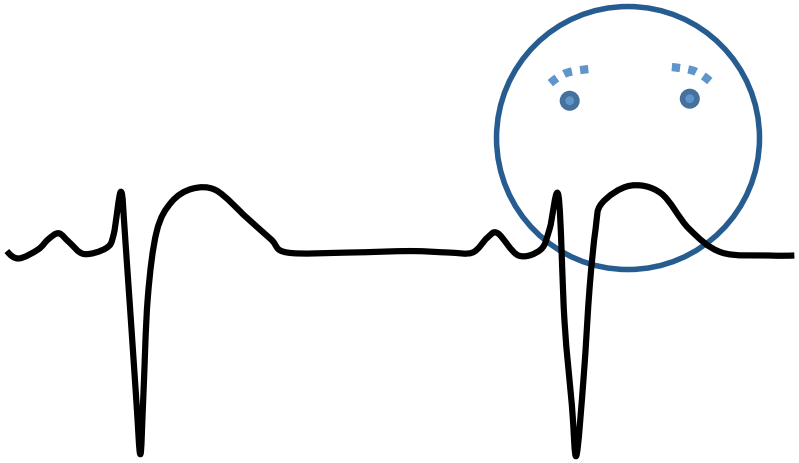
Haïssaguerre NEJM 2009

Vorm ST Segment

concaaf of convex?

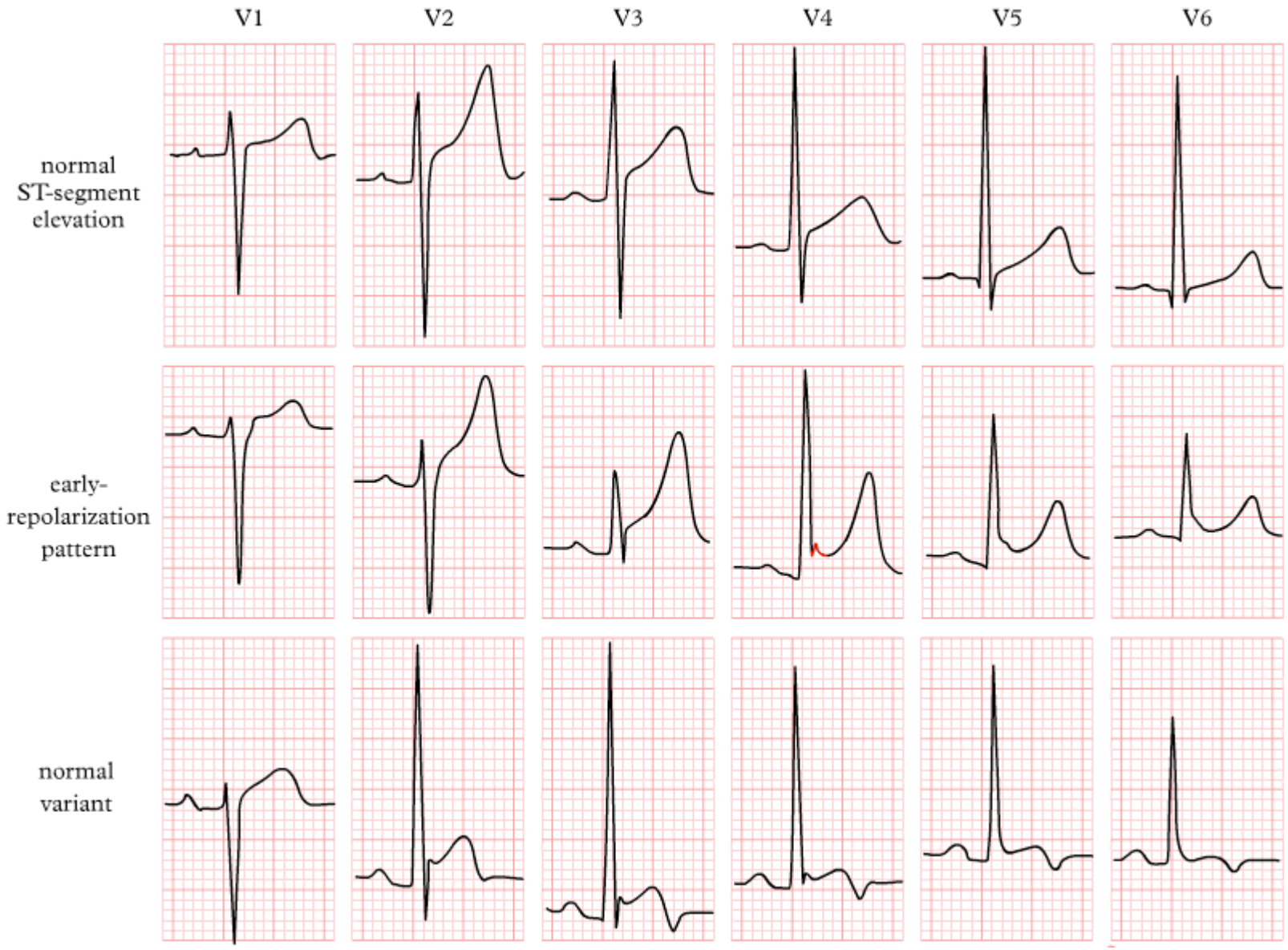


Concaaf



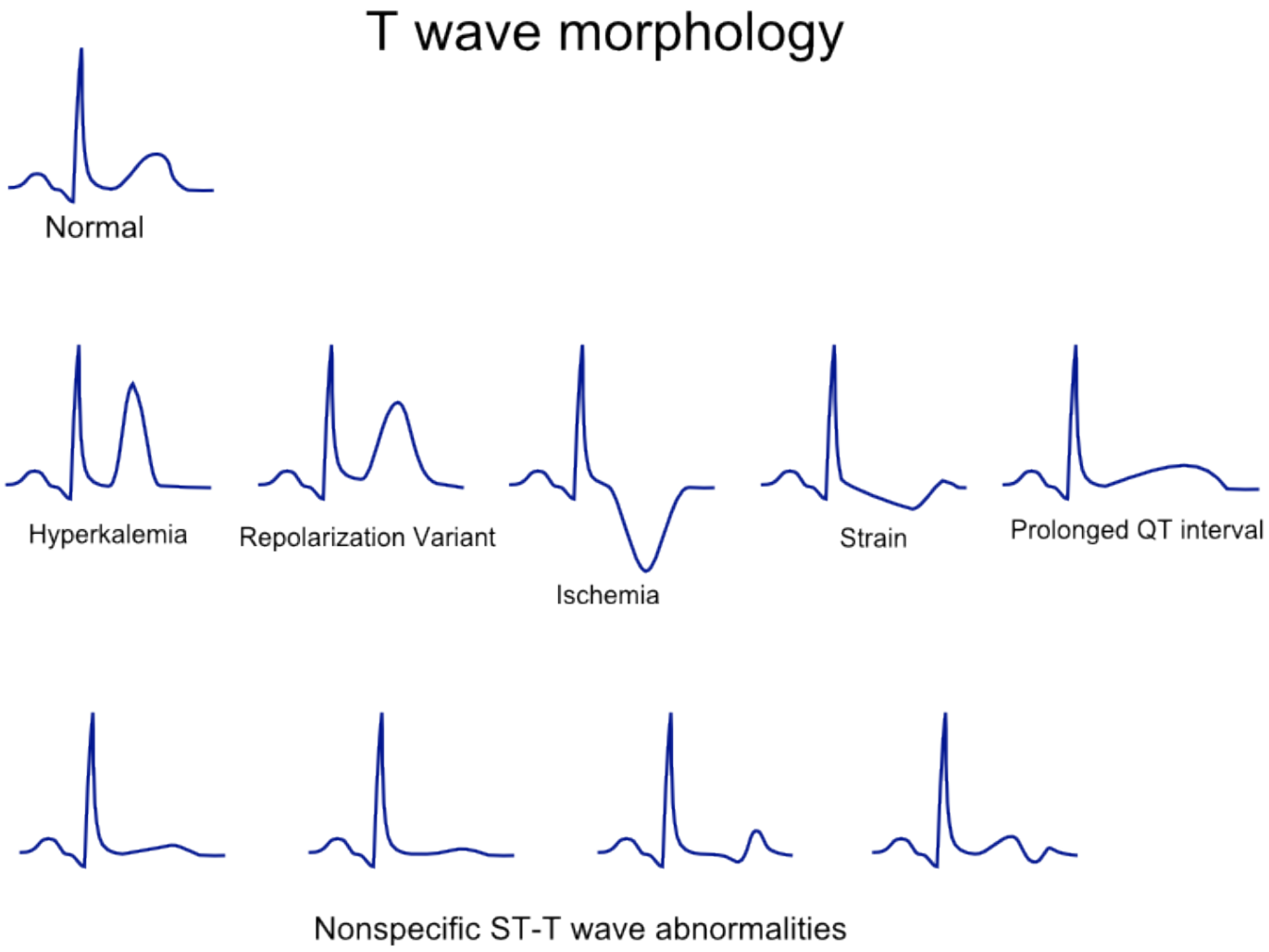
Convex

Normale Varianten



Vlak = < 0.5mm in I, II, V3-V6

Negatief = > 0.5mm in I, II, V3-V6



7+1 Vergelijken met oud ECG

- Nieuwe LBTB?
- Asdraai?
- Nieuwe pathologische Q?
- Afname R top hoogte?

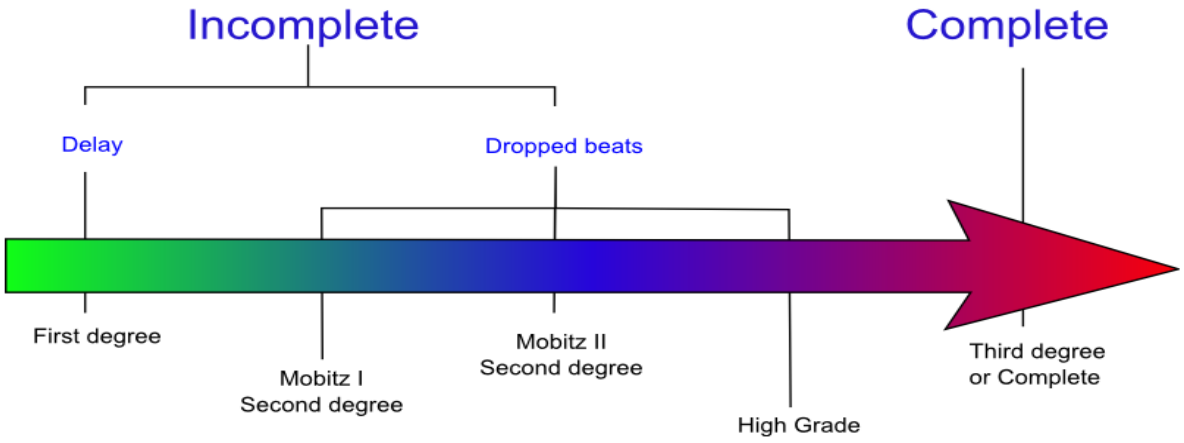
7+2 Conclusie

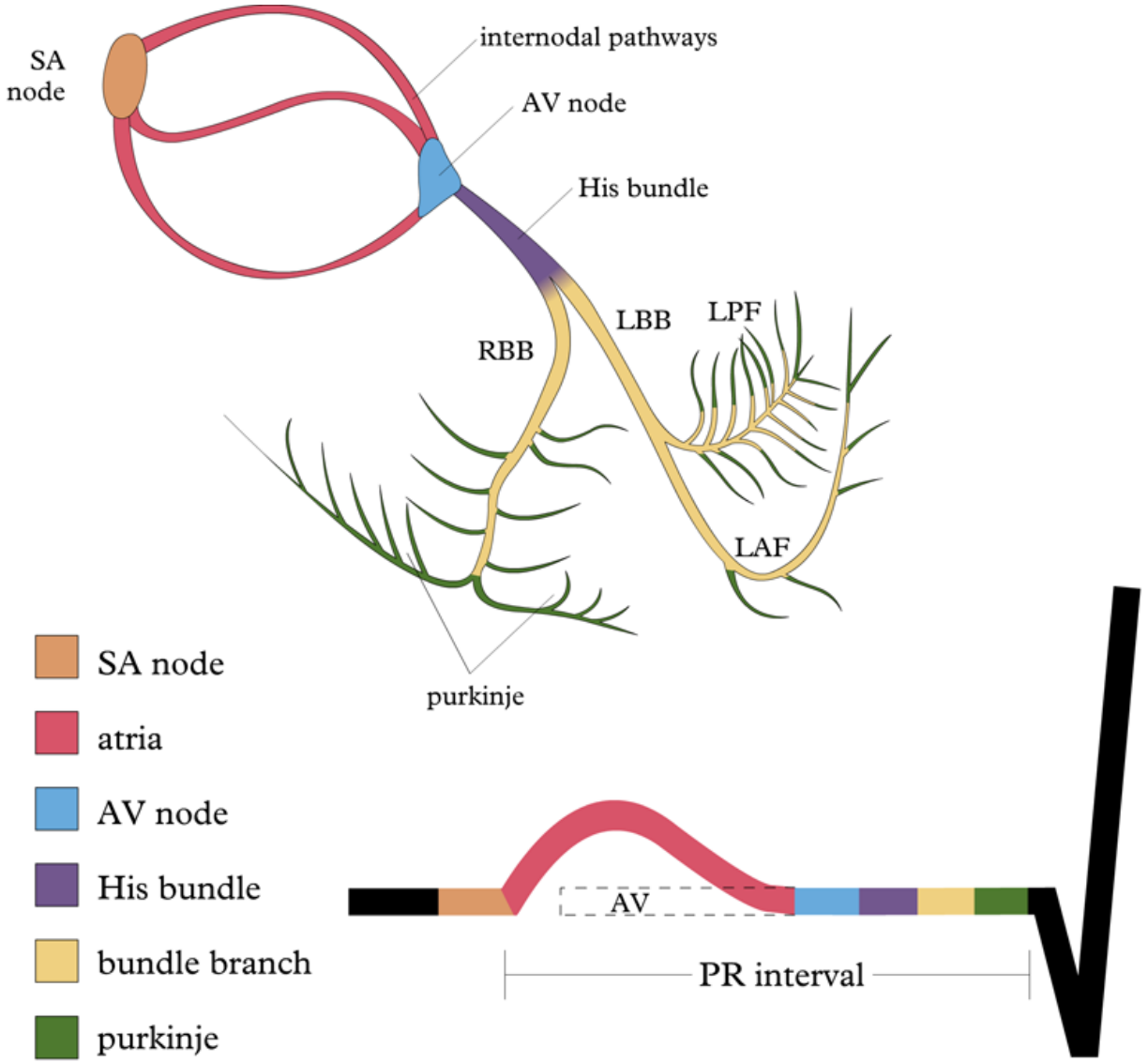
Voorbeelden:

- "Sinustachycardie met ST elevatie over de voorwand, passend bij een acuut voorwandinfarct"
- "Supraventriculaire tachycardie van 200/min op basis van een AV nodale re-entry"
- "Oud onderwandinfarct met nu een acuut lateraal myocard-infarct met QRS verbreding ten opzichte van het ECG van 14 augustus vorig jaar"
- "Normaal ECG"

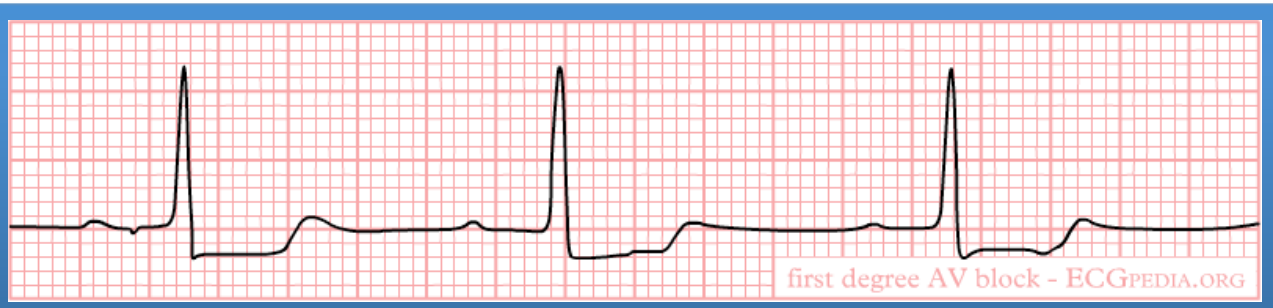
Geleidingsstoornissen

- 1e graads: verlengde PQ tijd > 200ms
- 2e graads
  - Type I (Wenkebach): PQ tijd neemt toe van complex tot complex tot er een complex uitvalt.
  - Type II (Mobitz): PQ tijd is normaal, maar niet alle p-toppen worden gevolgd (plotselinge uitval)
- Hooggradig AV blok
- 3e graads: totaal blok

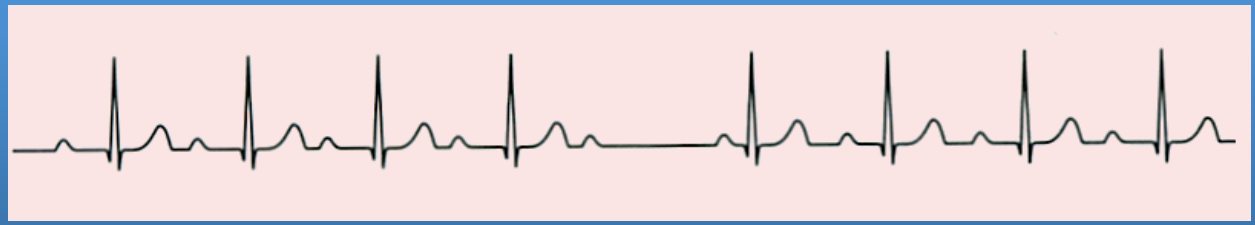




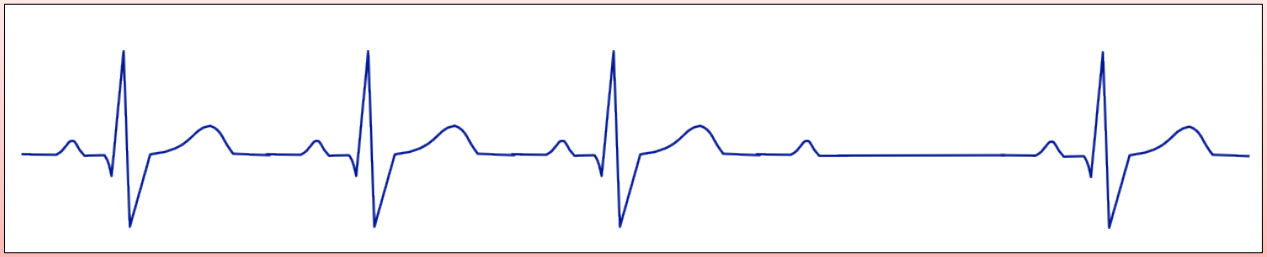
1e graads AV blok



2e graads AV blok I
Wenkebach



2e graads AV blok II
Mobitz



3e graads AV blok
Totaal AV blok