ECG bij niet cardiale pathologie

Prof. Dr. Rik Willems

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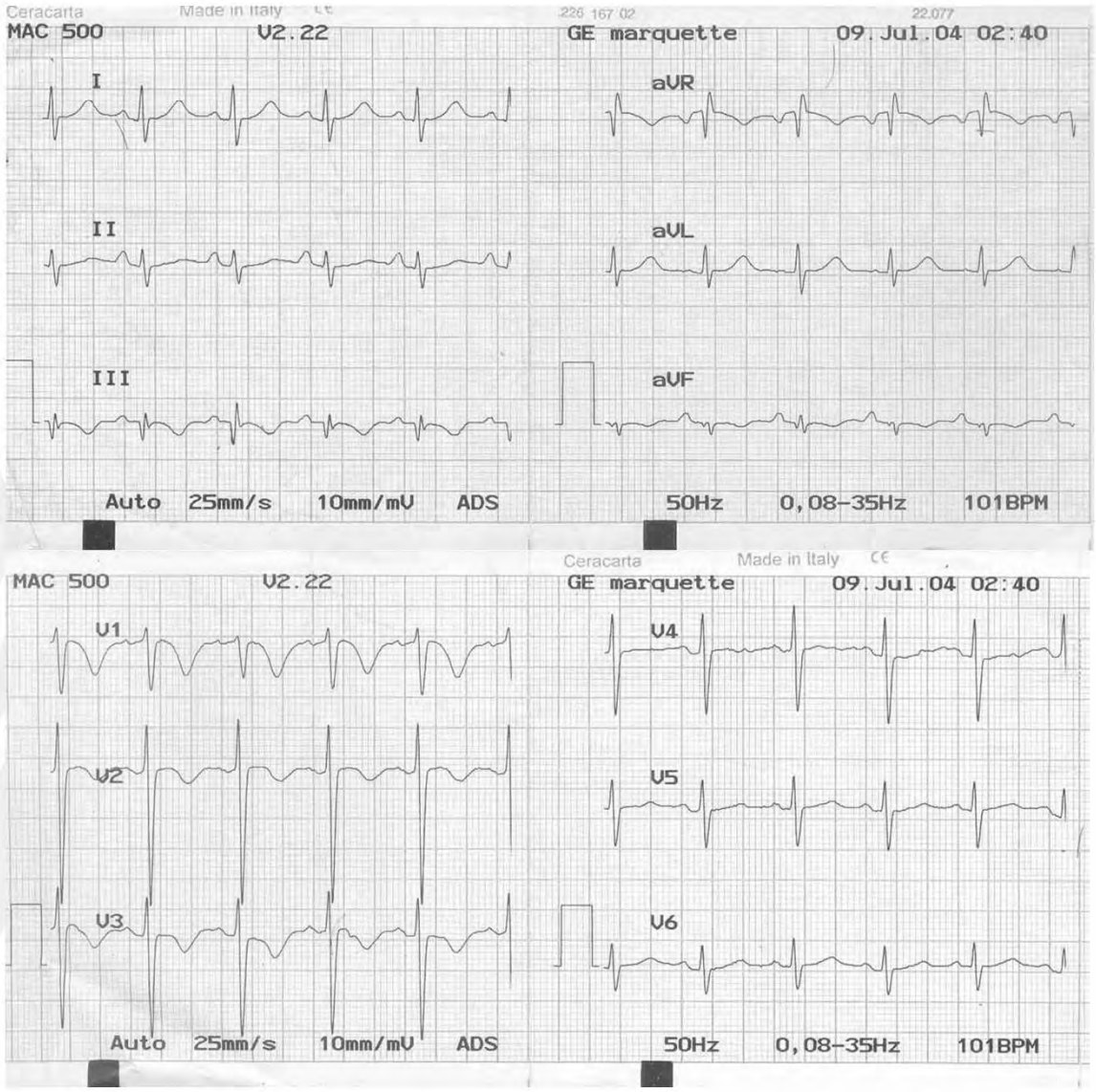
Longembolen



Mechanismen ECG verandering

- Verhoging druk in RV
- RV dilatatie met verplaatsing van de rechterzijde van het septum naar boven
- Verhoging druk RA
- RA dilatatie
- Verminderd hartdebiet
- Hypoxie

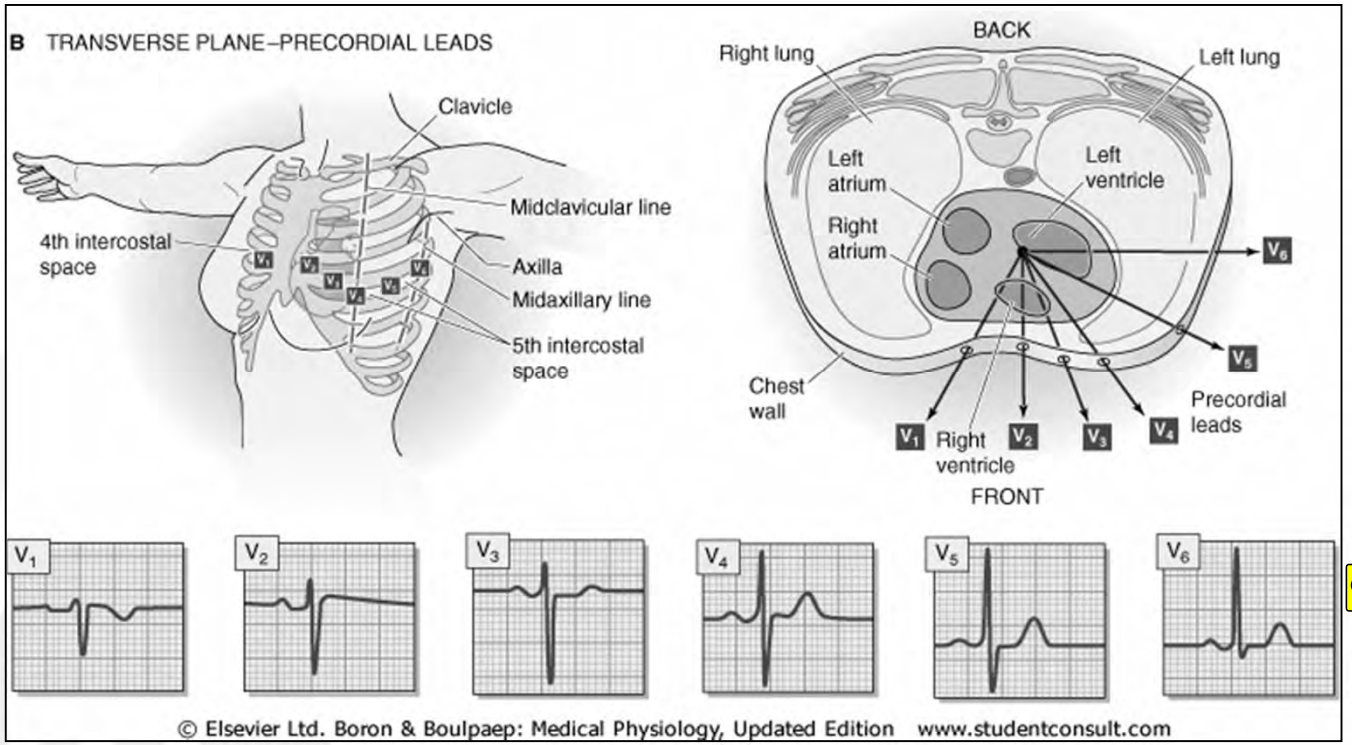
ECG verdacht voor longembolen

- Ritme:
  - Sinustachycardie tgv hypoxie en verminderd hartdebiet
  - VKflutter-VKF door verhoging druk RA
  - Vaak SVES en VES met morfologie als komende uit rechter hart

- P-golf
  - Vaak rechteras deviatie
  - Asverschuiving: P-golf naar rechts tov ECG van voor longembolen

ECG verdacht voor longembolen

- QRS-complex:
  - verplaatst naar rechts
- Geleidingsvertraging thv RB:
  - acute elongatie van RB, secundair aan RV dilatatie:
    - V1: onvolledig tot volledig RBTB
    - I en aVL: diepe S-golven
- "horaire rotatie":
  - RV naar voor en LV naar achter; nl transitiezone verschuift naar V5 (en zelden V6)
  - interventriculair septum draait naar boven en kan zelfs naar links; linker septum wordt rechtszijdig
  - pseudo-inferiorinfarct (q in III) en pseudo-anteroseptaal infarct (q in V1)


B TRANSVERSE PLANE–PRECORDIAL LEADS
Clavicle
Midclavicular line
4th intercostal space
Axilla
Midaxillary line
5th intercostal space
BACK
Right lung
Left lung
Left atrium
Left ventricle
Right atrium
Chest wall
Precordial leads
Right ventricle
FRONT
V1
V2
V3
V4
V5
V6
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ECG verdacht voor longembolen

- ST segment elevatie:
  - soms in V1 en aVR door acute RV ischemie, vroegtijdig en kort
- T-golf afwijkingen:
  - negatief van V1 tot V5, doorgaans 1 tot 2 dagen na het acute moment
  - gevolg van drukoverbelasting van het RV
- SI-QIII-TIII:
  - horaire rotatie, geleidingsvertraging RB en RV dilatatie

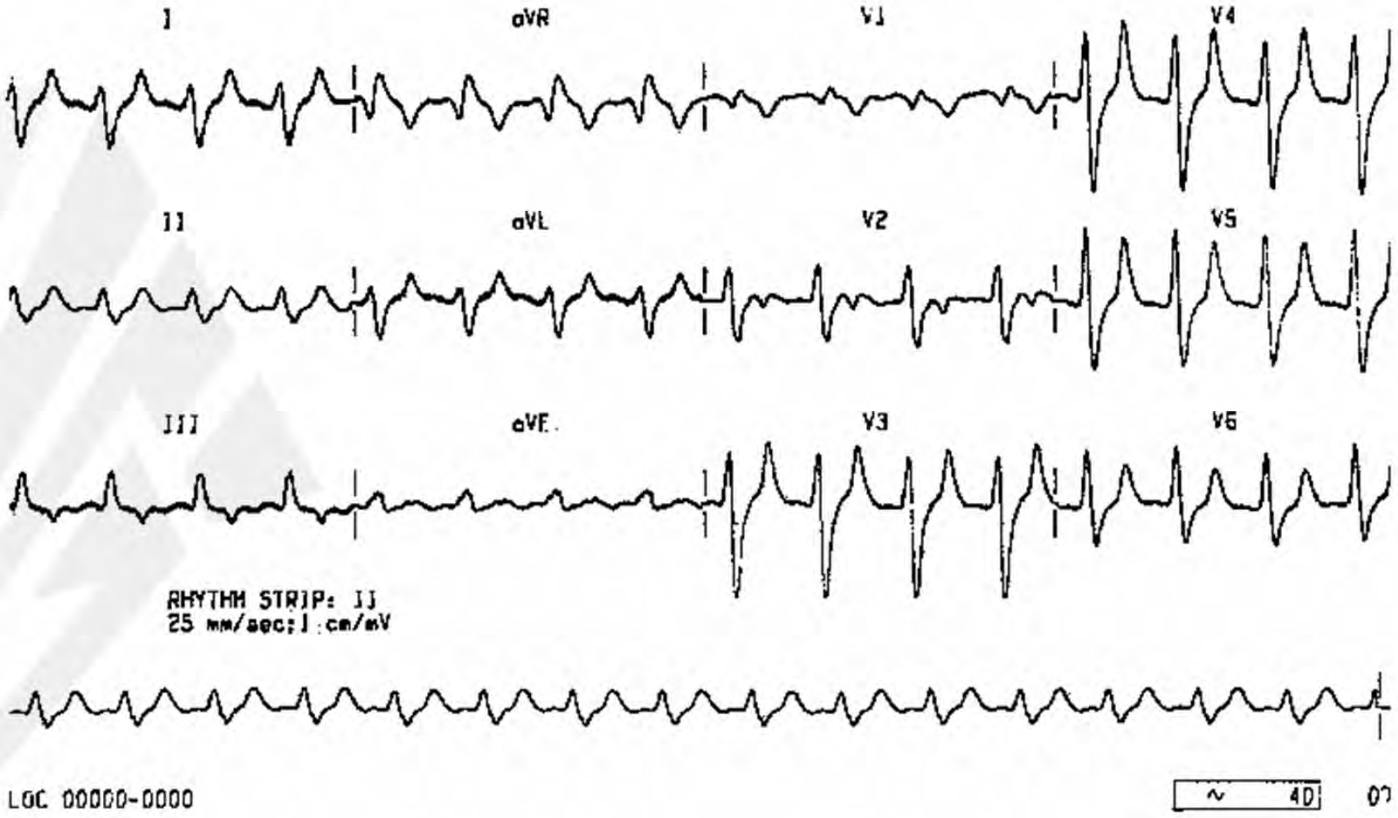
ECG verdacht voor RV overbelasting bij PE

- > 3 van volgende criteria
  - (O)RBTB
  - S in I en aVL>1.5 mm
  - Transitie in precordialen in V5
  - Q in III en aVF, maar niet in II
  - Rechter of NW as
  - Lage voltages in ledemaat afleidingen
  - Neg T in III en aVF of in V1-4

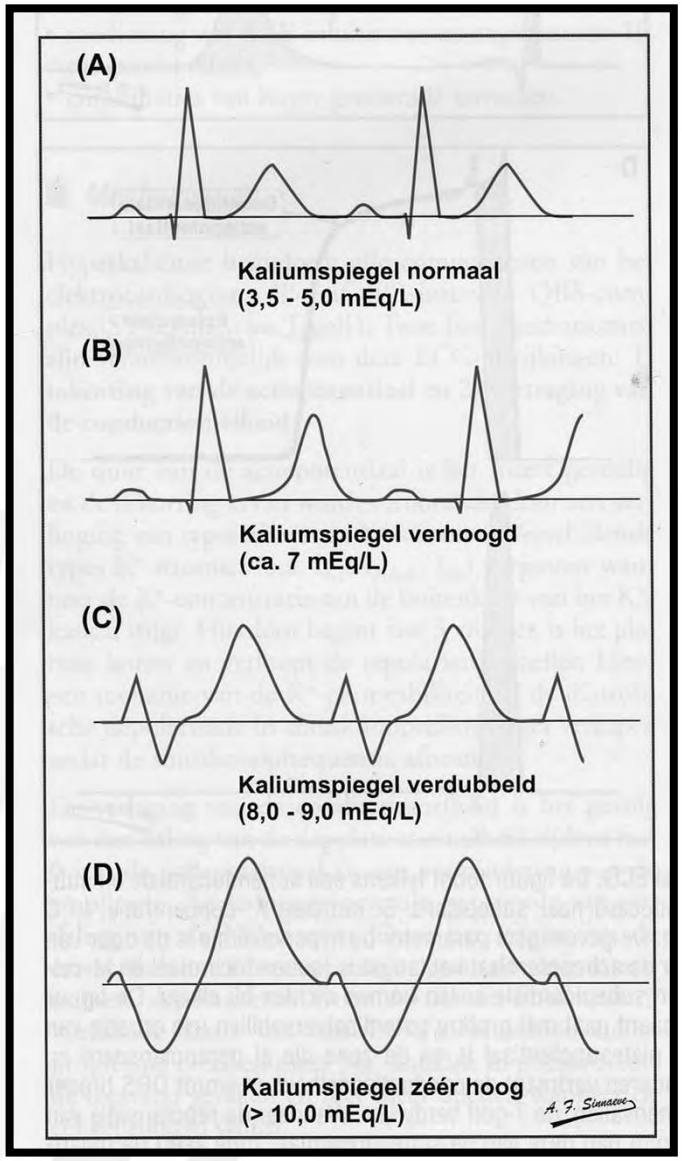
Sreeram et al. Am J Cardiol 1994

Hyperkaliemie

- Hoge piekvormige T
- QRS verbreding
- Kleine P, atriale stilstand, atriale ritmestoornissen
- Levensbedreigend!



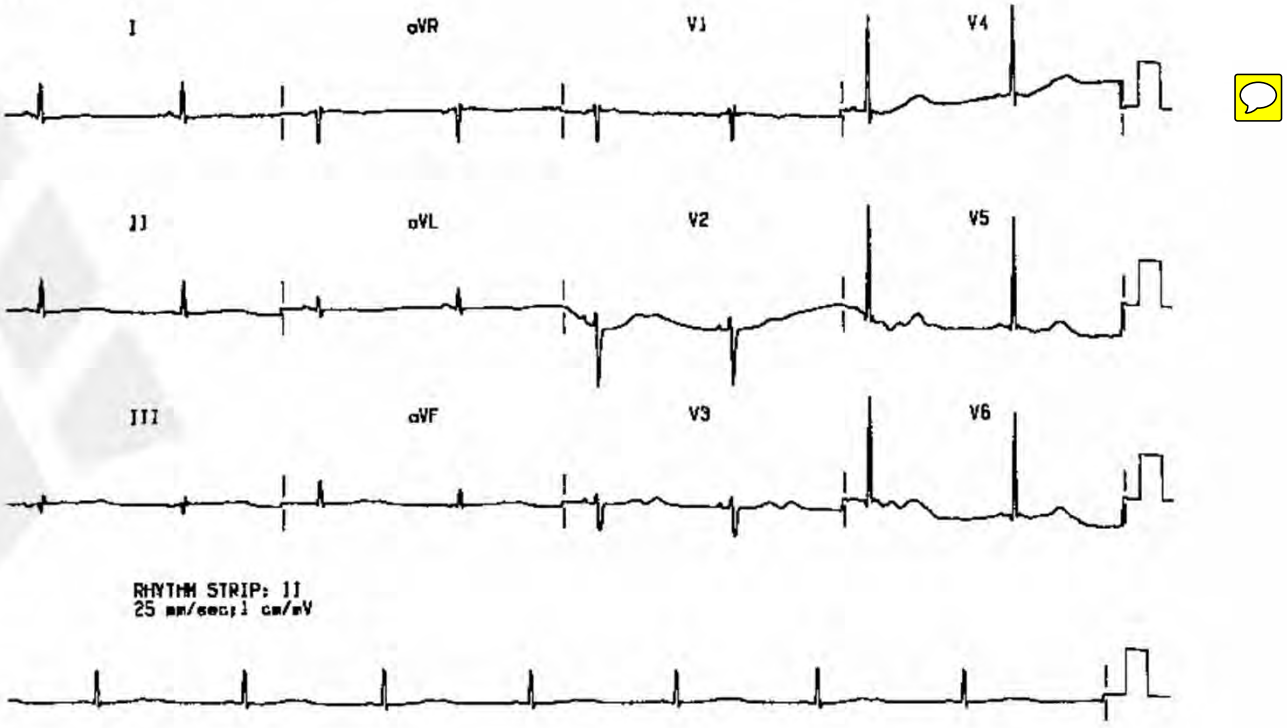
Hyperkaliemie



1. P-golf verdwijnt
2. PR verlengt
3. QRS verbreedt
4. T-golf
5. ST-segment verkort
6. QT-interval

Hypokaliemie

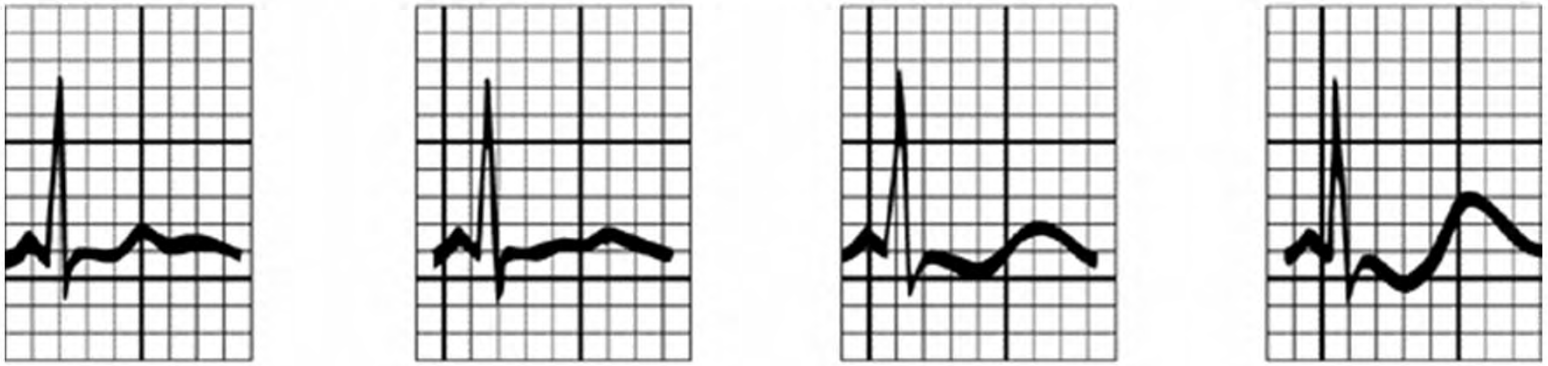
- T top isoëlektrisch of negatief
- Velengd QT
- ST daling
- U-golf



I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

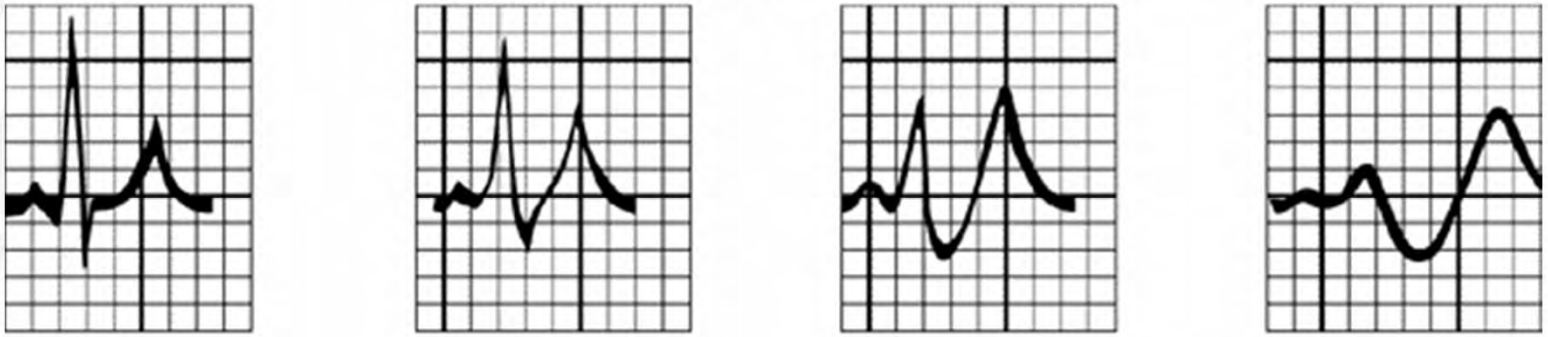
Kaliumstoornissen

Hypokalemia

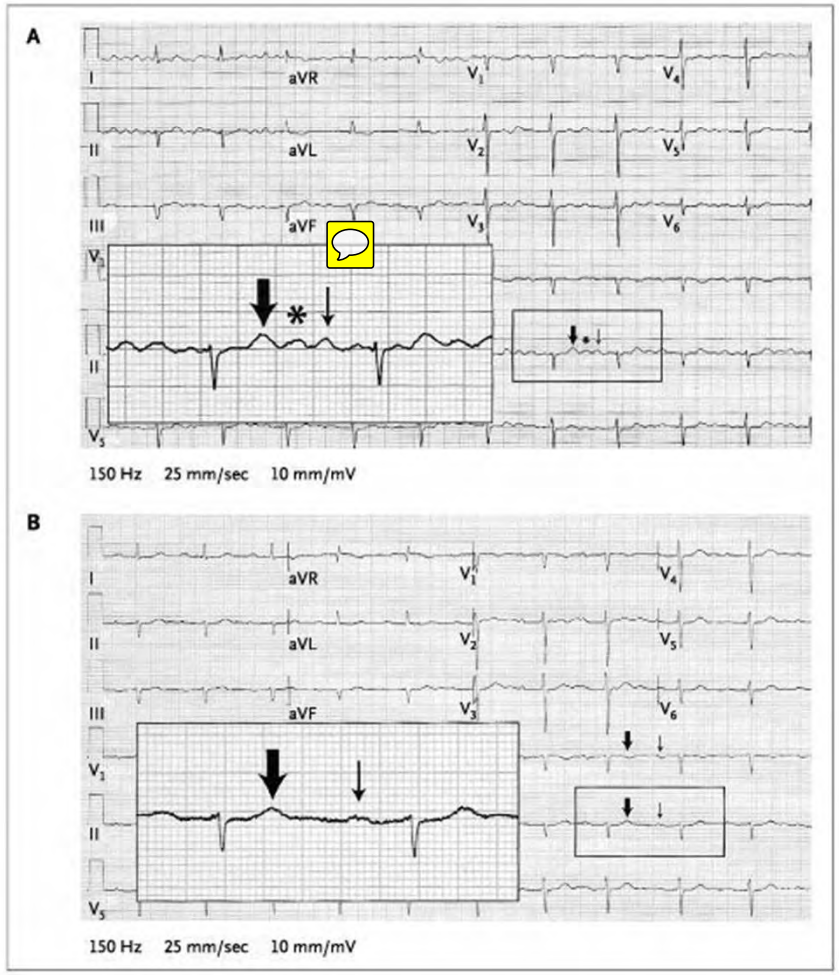


2.8 2.5 2.0 1.7

Hyperkalemia



6.5 7.0 8.0 9.0



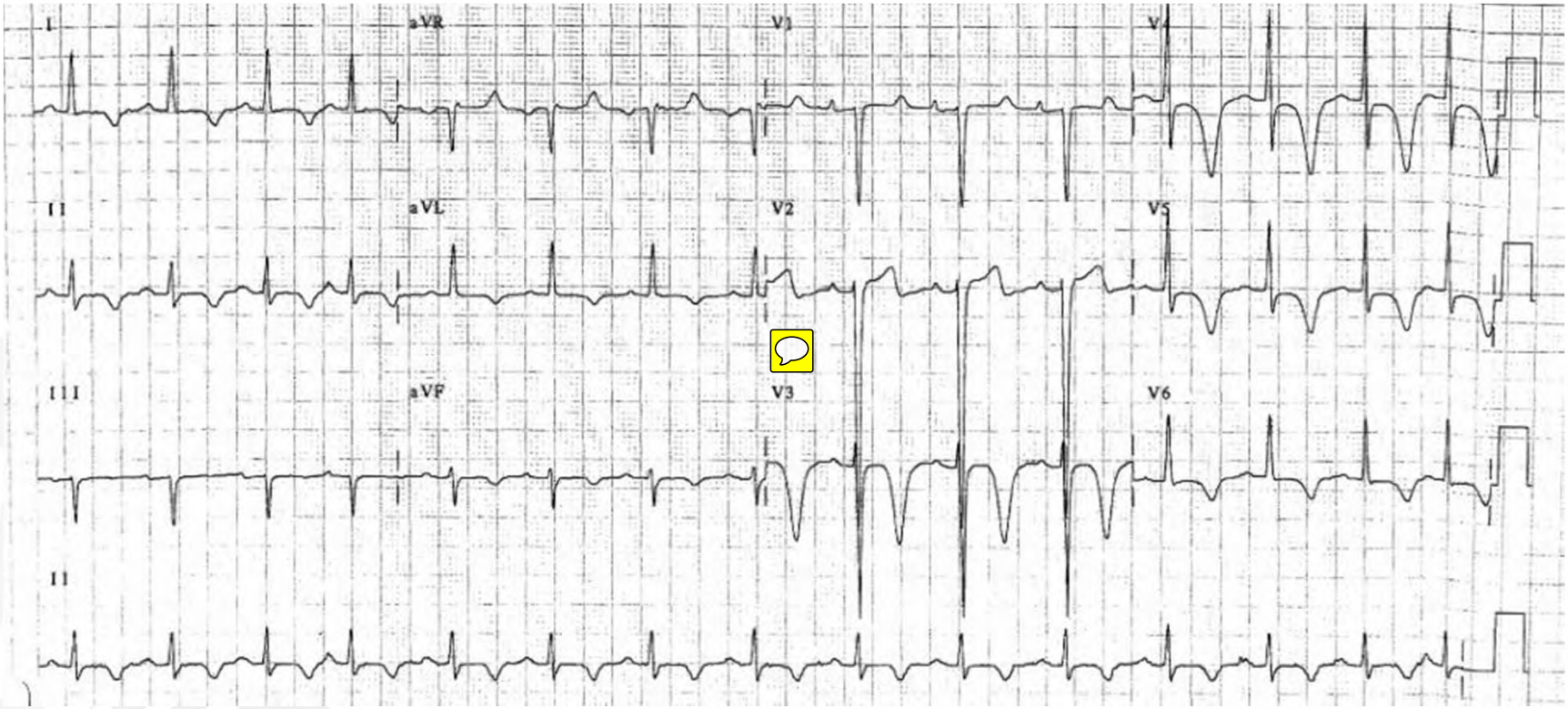
A 77-year-old man with a remote history of atrial fibrillation presented to the emergency department reporting fatigue and weakness

Marcus G and Atwood J. N Engl J Med 2003;349:e15

Hypercalciemie

- Kort ST
- Kort QT
  - DD/ kort QT syndroom
- Osborne wave
- Zo belangrijke hypercaliemie
  - QRS verbreding
  - PR verlenging
  - Geleidingsstoornissen

Hypercalciemia

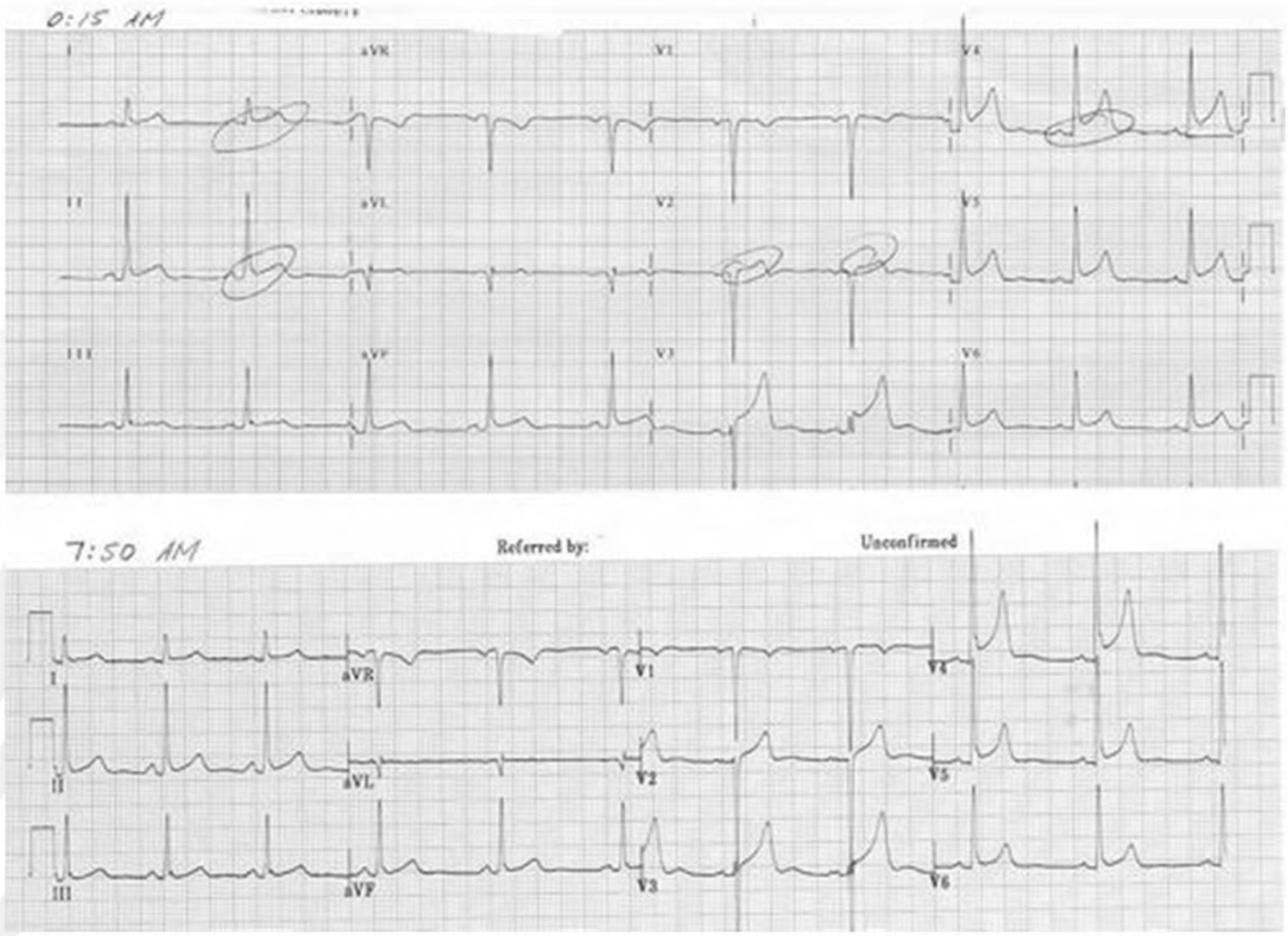


Met dank aan Prof.Dr.Mullens ZOL Genk

Hypocalciemie

- Lang ST
- Lang QT

Hypocalciemia



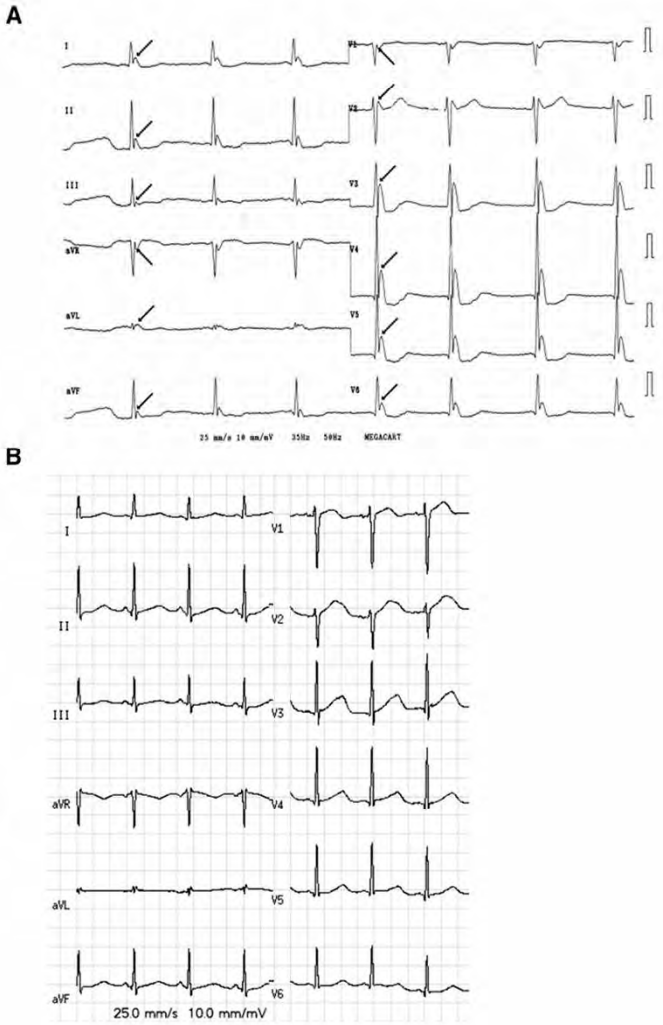
Met dank aan Prof.Dr.Mullens ZOL Genk

Hypothermie

- Osborn wave
- Tremor artefact
- Sinusbradycardie
- QRS verbreding
- PR verlenging

A 39-year-old man was brought to the emergency department with altered mental status and a core temperature of 27.6{degrees}C. The patient appeared to have had exposure to cold temperatures

Saadlla H. N Engl J Med 2004;351:e4

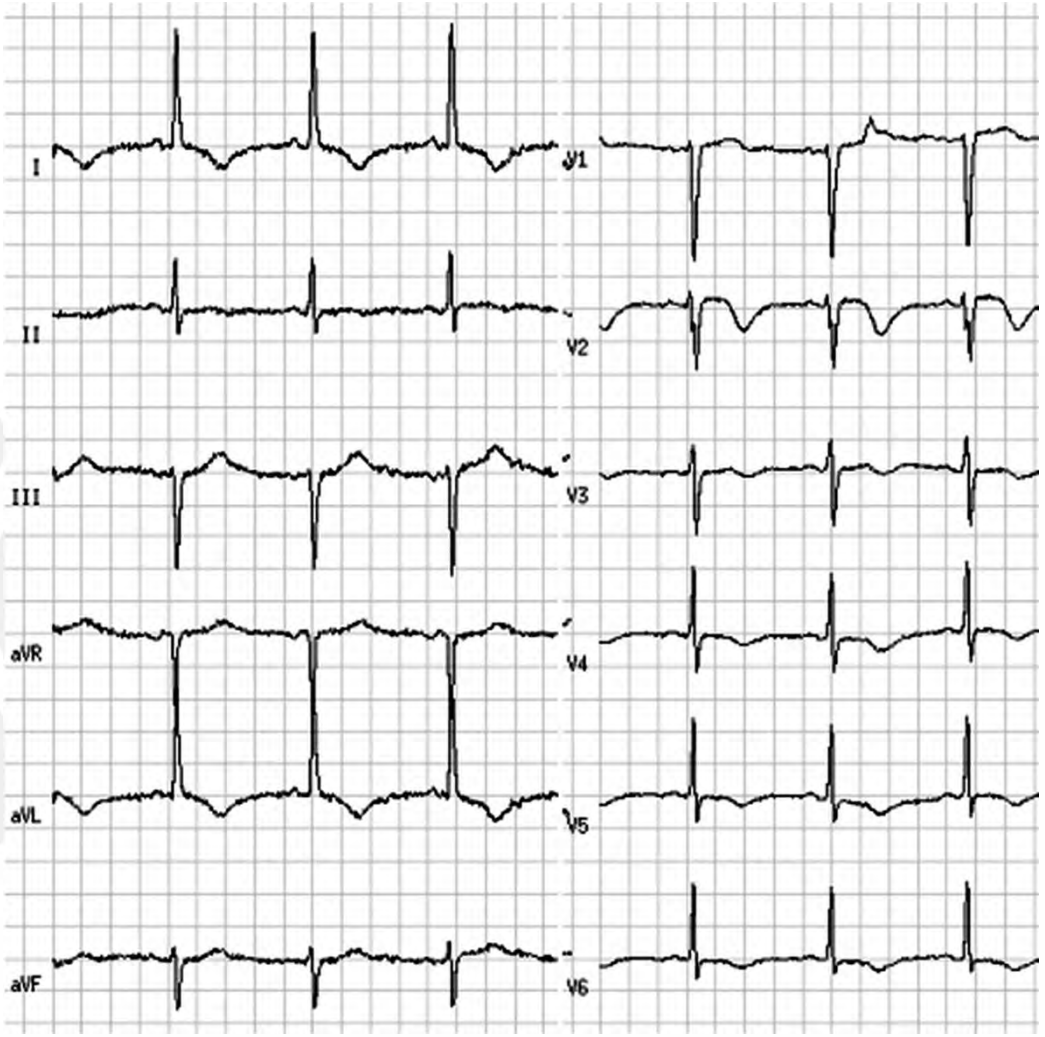


Van Mieghem C. et.al. Chest 2004

Cerebrale pathologie

- ST depressie
- Negatieve Ts
- Prominente Us
- QTc verlenging
  - tot 8 wkn aanhoudend
- Brady- en tachycardie

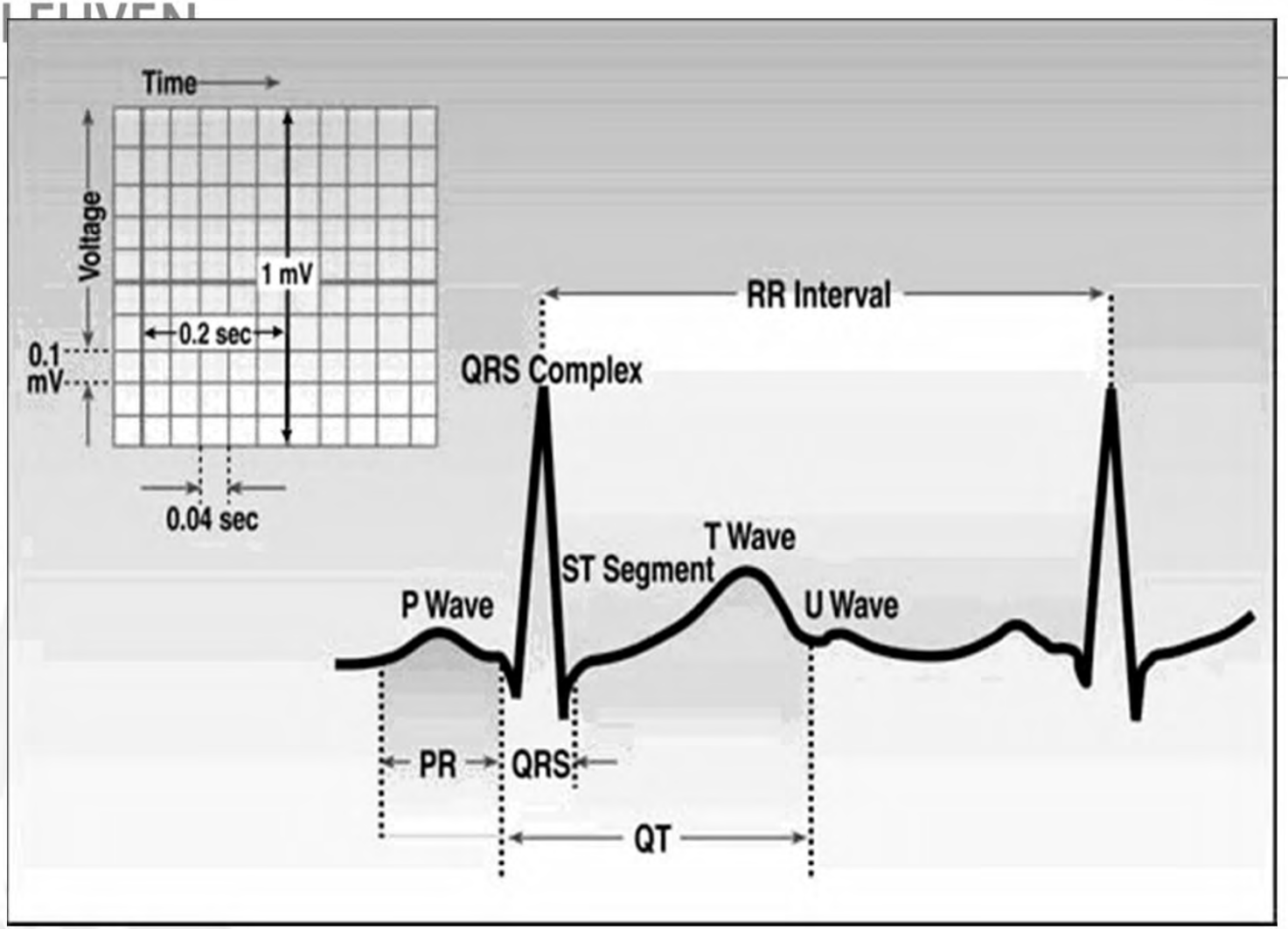
acute subarachnoid hemorrhage



Van Mieghem C. et.al. Chest 2004

Acquired long QT

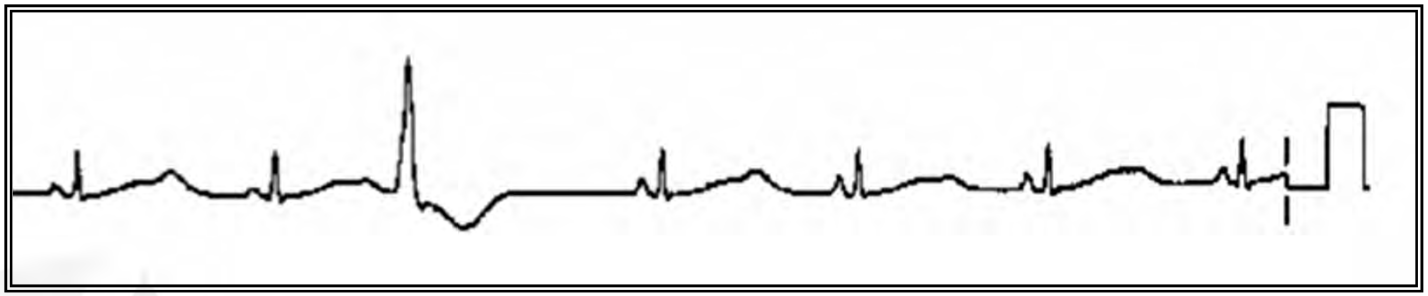
- Lijst met medicatie
  - www.uzleuven.be/CEH
- Normaal QTc
  - Man < 450ms
  - Vrouw < 470ms
  - CAVE zo > 500 ms



Long QT syndrome - QT > 0.5s

Proarrhythmia

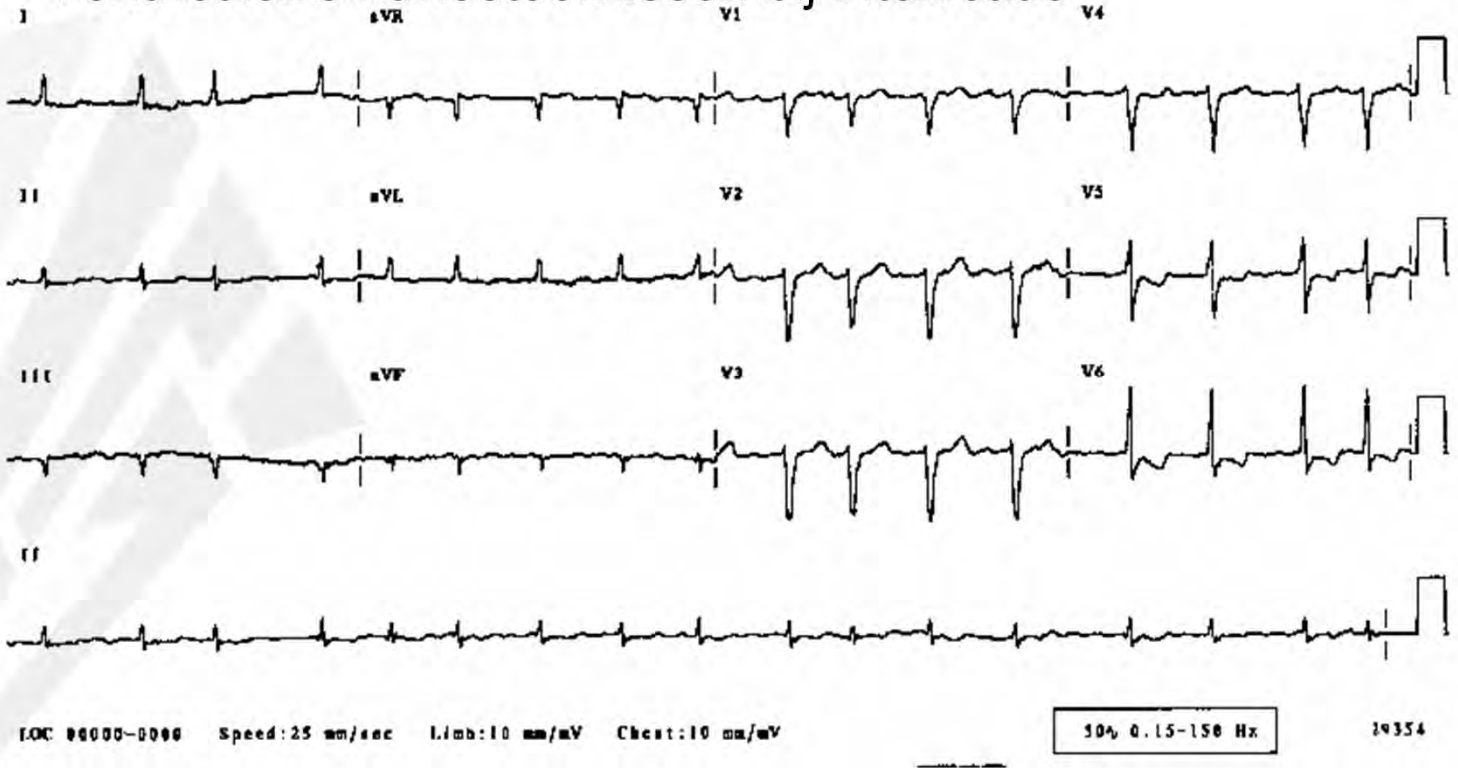
QT-prolongation



Torsade de pointes

Digitaliseffect

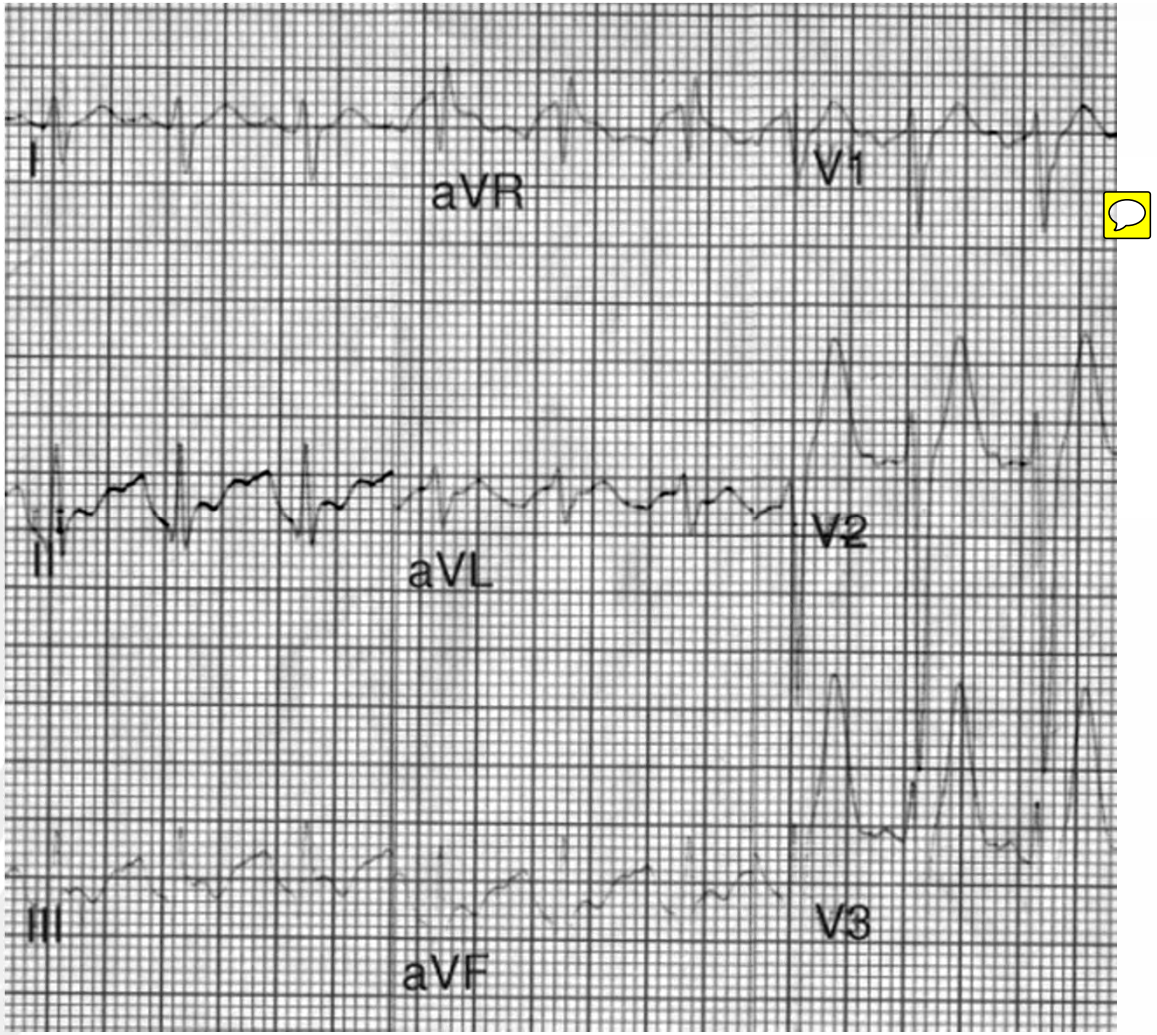
- Komvormige ST daling
- Verkort QT
- Gewijzigde T
- PR verlenging
- Ventriculaire ritmestoornissen bij intoxicatie



TCA

- Anticholinergisch
- Na+ en K+ kanaal blokker

- sinustachycardie
- QRS verbreding, PR verlenging, geleidingsstoornissen
- QT verlenging



ECG showing sinus tachycardia with widened QRS complex (110 ms) and marked deviation of the terminal portion of the QRS complex in lead I (deep S wave) and aVR (large R wave)

Van Mieghem C. et.al. Chest 2004

DD/ ST segment elevatie

- STEMI
- Vroege repolarizatie
- Pericarditis
- LBTB
- Hyperkaliëmie
- Brugada-syndroom
- Elektrische schade
  - Cardioversie
  - elektrocutie

DD/ ST segment depressie

- Subendocardiale ischemie
  - Coronair stenose
  - Coronair spasme: Prinz-Metal, cocaine
  - Niet coronair: anemie, CO, cyanide
- Reciproke verandering bij infarct
- Apical ballooning
- Longembolen
- Linker kamer hypertrofie
- Athlete's heart
- Digitalis
- Hypokaliemie
- Preexcitatie - WPW
- Neurologische aandoeningen
- Normale J-punts depressie bij tachycardie
  - tot 80 ms na J-punt
- T-wave memory

DD/ Acute coronaire syndromen

- ST elevatie myocardinfarct (STEMI)
- Niet ST elevatie myocardinfarct (NSTEMI)

Table 3 ECG manifestations of acute myocardial ischaemia (in absence of LVH and LBBB)

ST elevation
New ST elevation at the J-point in two contiguous leads with the cut-off points: $\geq$0.2 mV in men or $\geq$0.15 mV in women in leads V_2–V_3 and/or $\geq$0.1 mV in other leads
ST depression and T-wave changes
New horizontal or down-sloping ST depression $\geq$0.05 mV in two contiguous leads; and/or T inversion $\geq$0.1 mV in two contiguous leads with prominent R-wave or R/S ratio $>$1

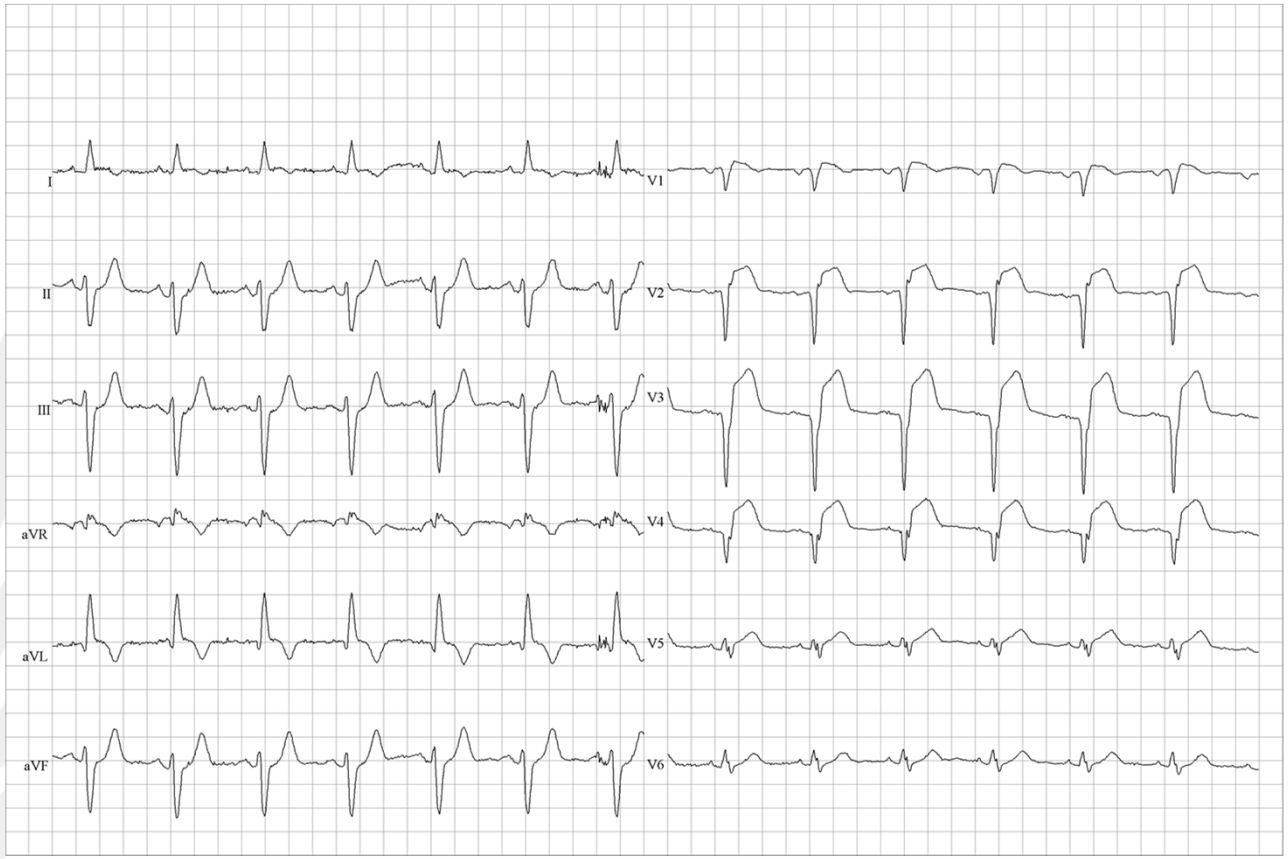
Thysegen et al Circulation 2007

STEMI

- Klachten
- Gestegen cardiale enzymes
- ST elevatie op 12 afleidingen ECG
  - > 2 mm bij mannen, > 1.5 mm bij vrouwen in rechter precordialen
  - > 1 mm in andere afleidingen

Thysegen et al Circulation 2007

STEMI



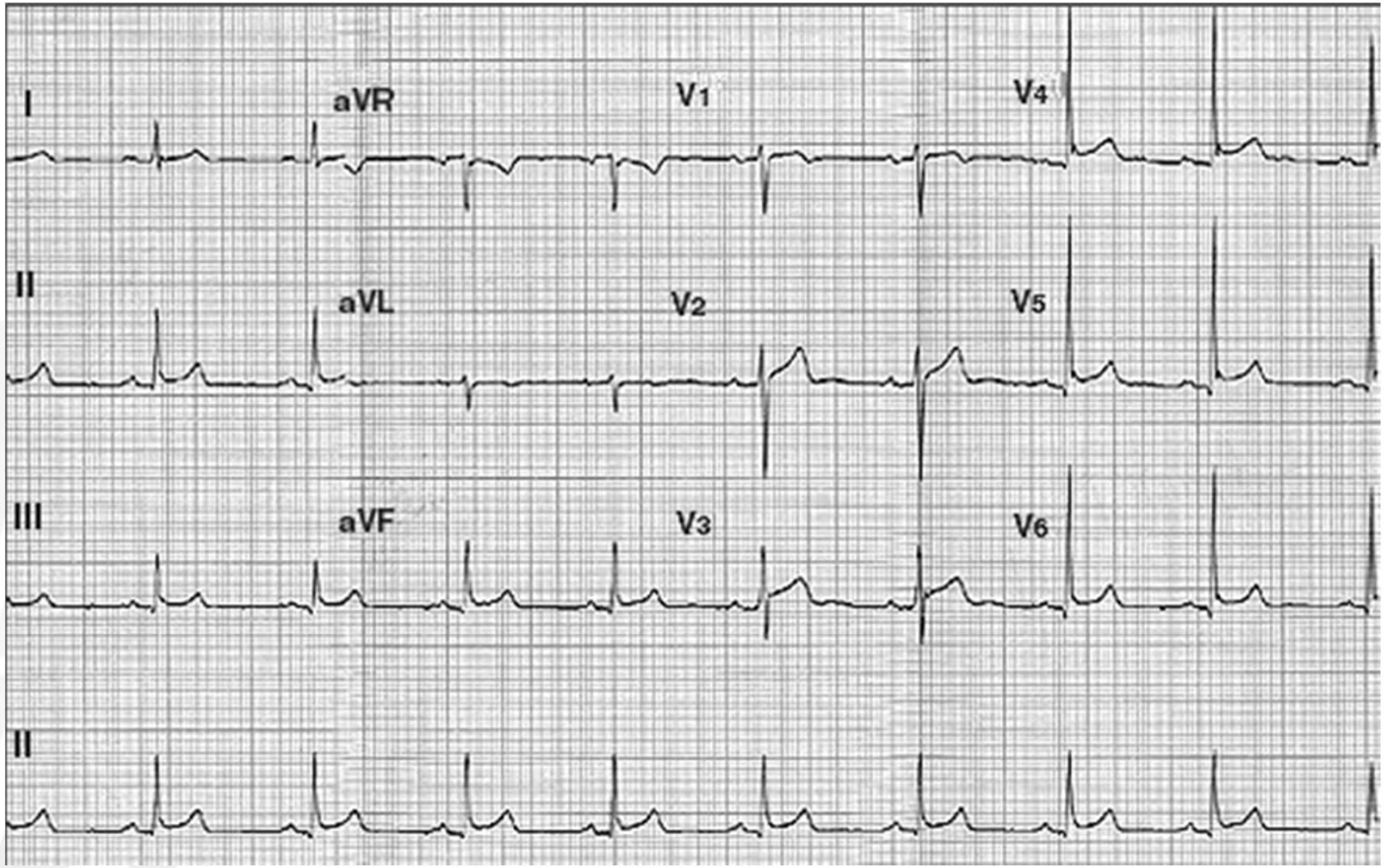
DD/ STEMI

- Levensbedreigend
  - Aortadissectie
  - Longembool
  - Spanningspneumothorax
  - Maagperforatie
  - Slokdarmruptuur met mediastinis

DD/ ST segment elevatie

- STEMI
- Vroege repolarizatie
- Pericarditis
- LBTB
- Hyperkaliëmie
- Brugada-syndroom
- Na cardioversie

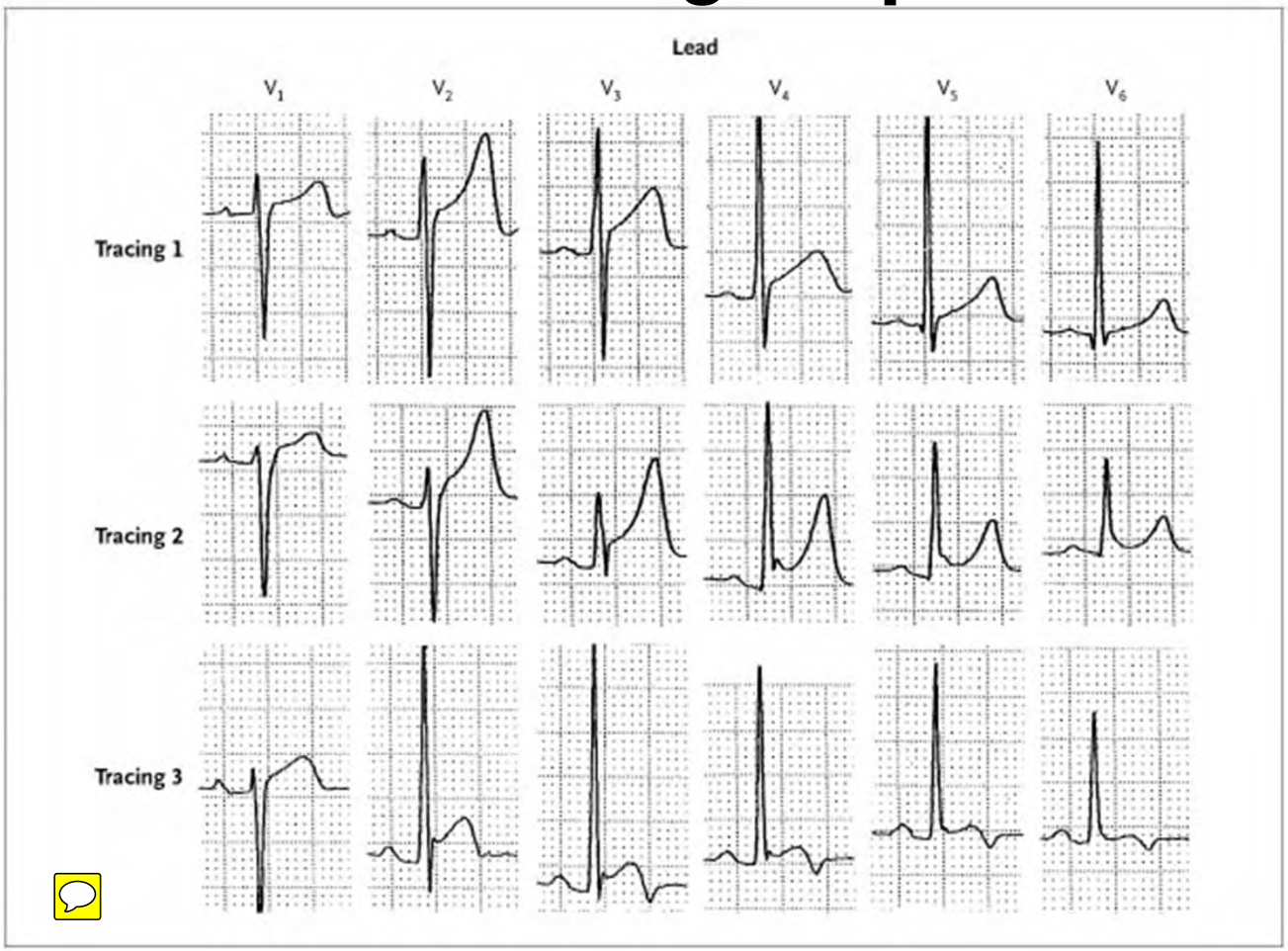
Vroege repolarizatie



Vormen van vroege repolarizatie

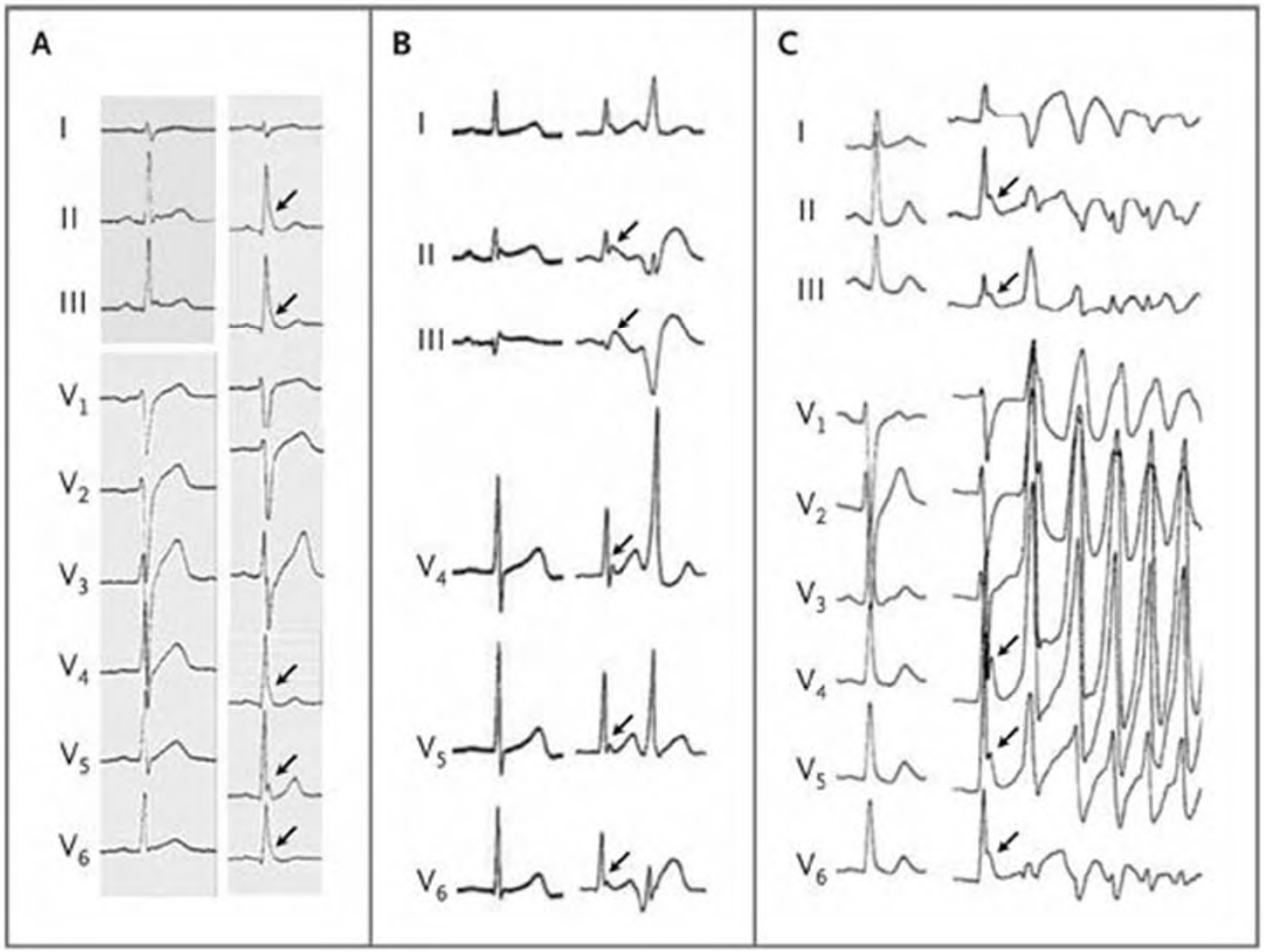
- Normaal “Mannelijke variant”
  - tot 90% van gezonde jongere mannen
  - ST elevatie 1-3 mm
  - voormalelijk in V2
  - concaaf
- Typische vroege repolarizatie
  - voornamelijk in V4
  - haking in J-punt
  - grote spitse Ts
  - soms ST depressie in aVR
- Variant van vroege repolarizatie bij zwarten
  - V3 tot V5
  - negatieve Ts
  - hoge voltages en korter QT

Vormen van vroege repolarizatie



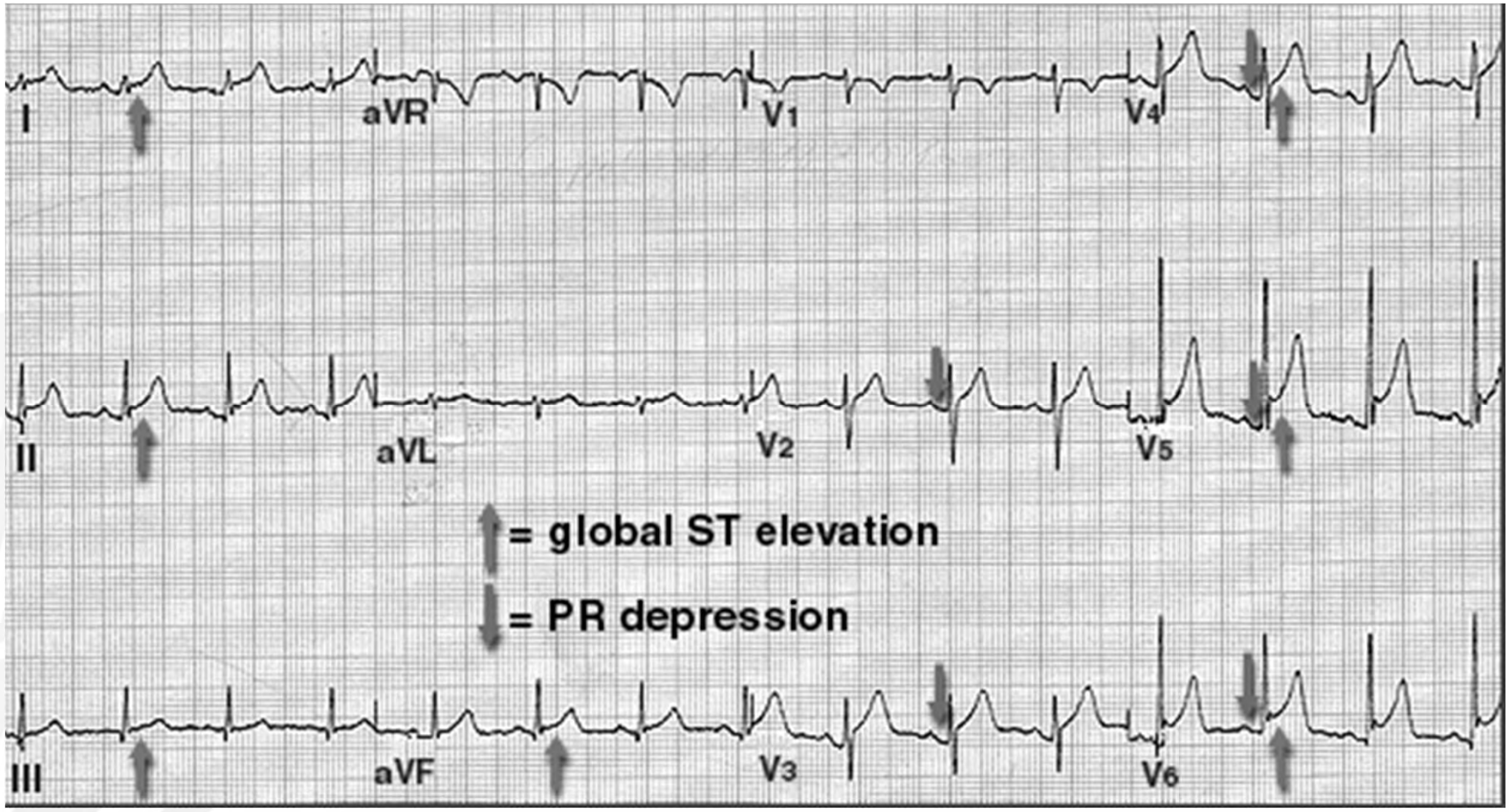
Wang K et al. N Engl J Med 2003

Schrik van vroege repolarizatie ?



Haissaguerre M et al. N Engl J Med 2008

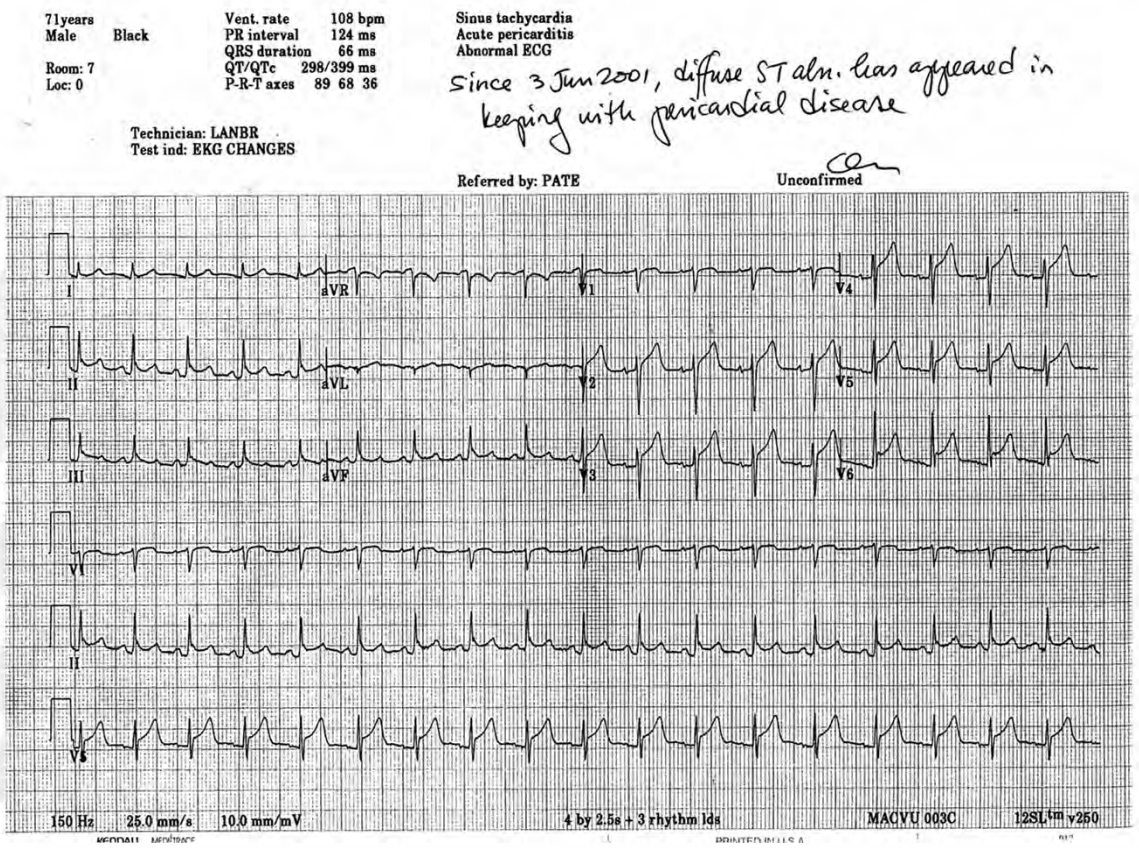
Acute pericarditis



Anatomische correlatie

I Lateral	aVR None	V_1 Septal	V_4 Anterior
II Inferior	aVL Lateral	V_2 Septal	V_5 Lateral
III Inferior	aVF Inferior	V_3 Anterior	V_6 Lateral

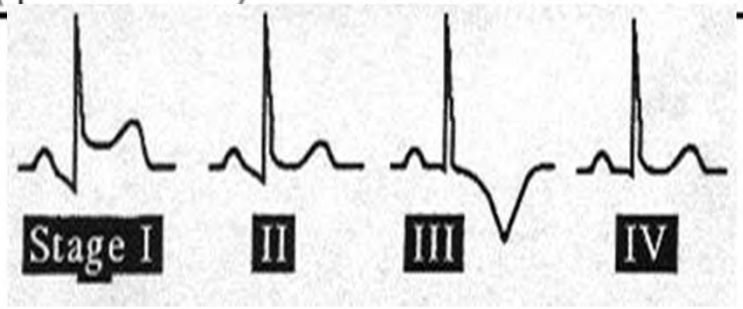
Geen anatomische correlatie bij acute pericarditis



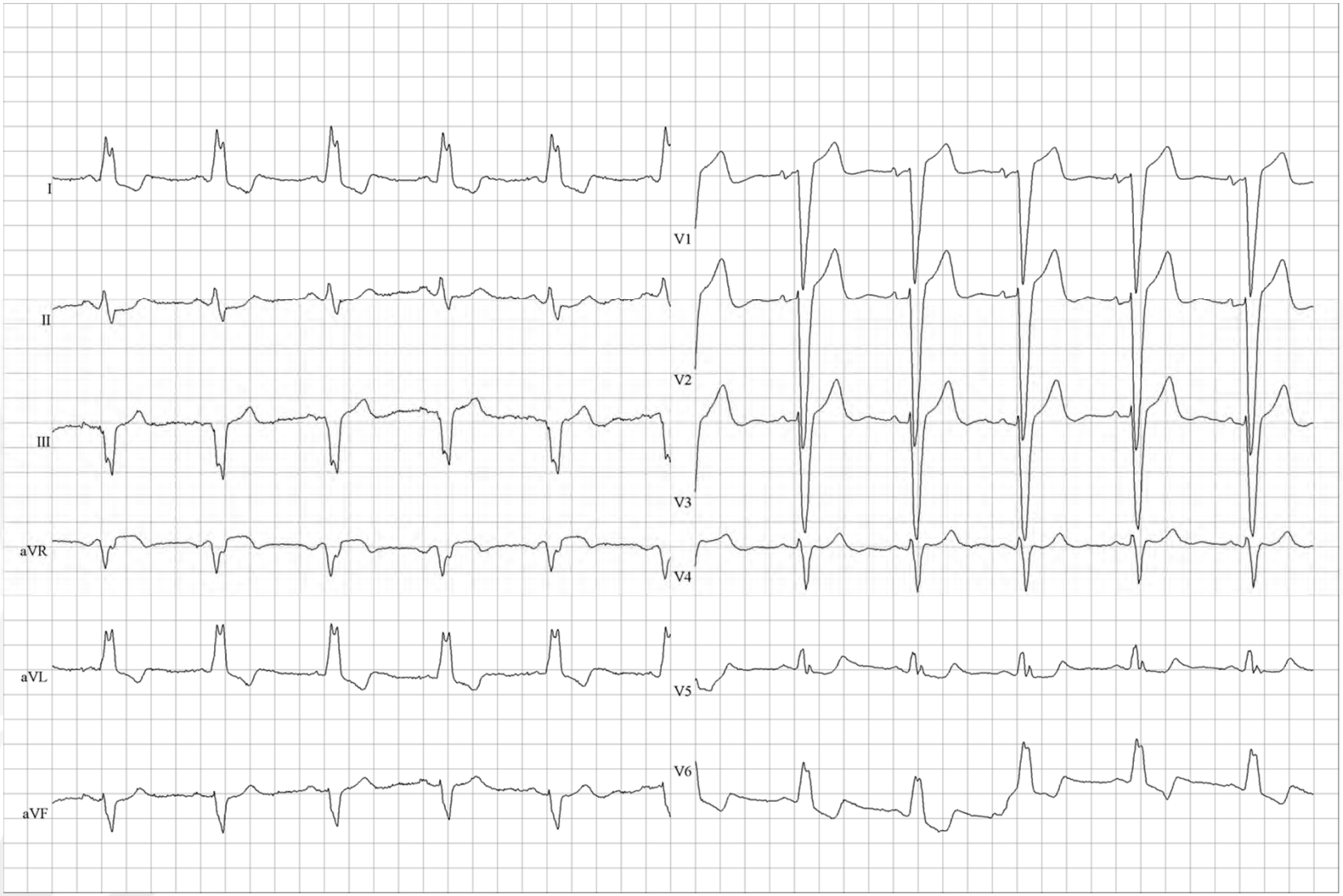
Stadia van acute pericarditis

Table IV. ECG changes in acute pericarditis: the four stages[9,11-13].

Stage	Timing	ECG changes
1	First few days (up to two weeks)	• Diffuse concave upward ST segment elevation in leads I, II, aVF and V2 - 6 without reciprocal ST segment depression • ST segment elevation is higher in lead II than lead III with ST segment depression in aVR or V1 • PR segment depression best seen in all leads except aVR and V1[9] indicative of subepicardial atrial injury • PR segment elevation seen in aVR is characteristic[14] • Low voltages in leads
2	Days to weeks	• ST segments return to baseline • T wave flattening
3	Second to third week	• T wave inversion
4	Weeks to months (up to three months)	• Gradual resolution of T wave inversion[15]

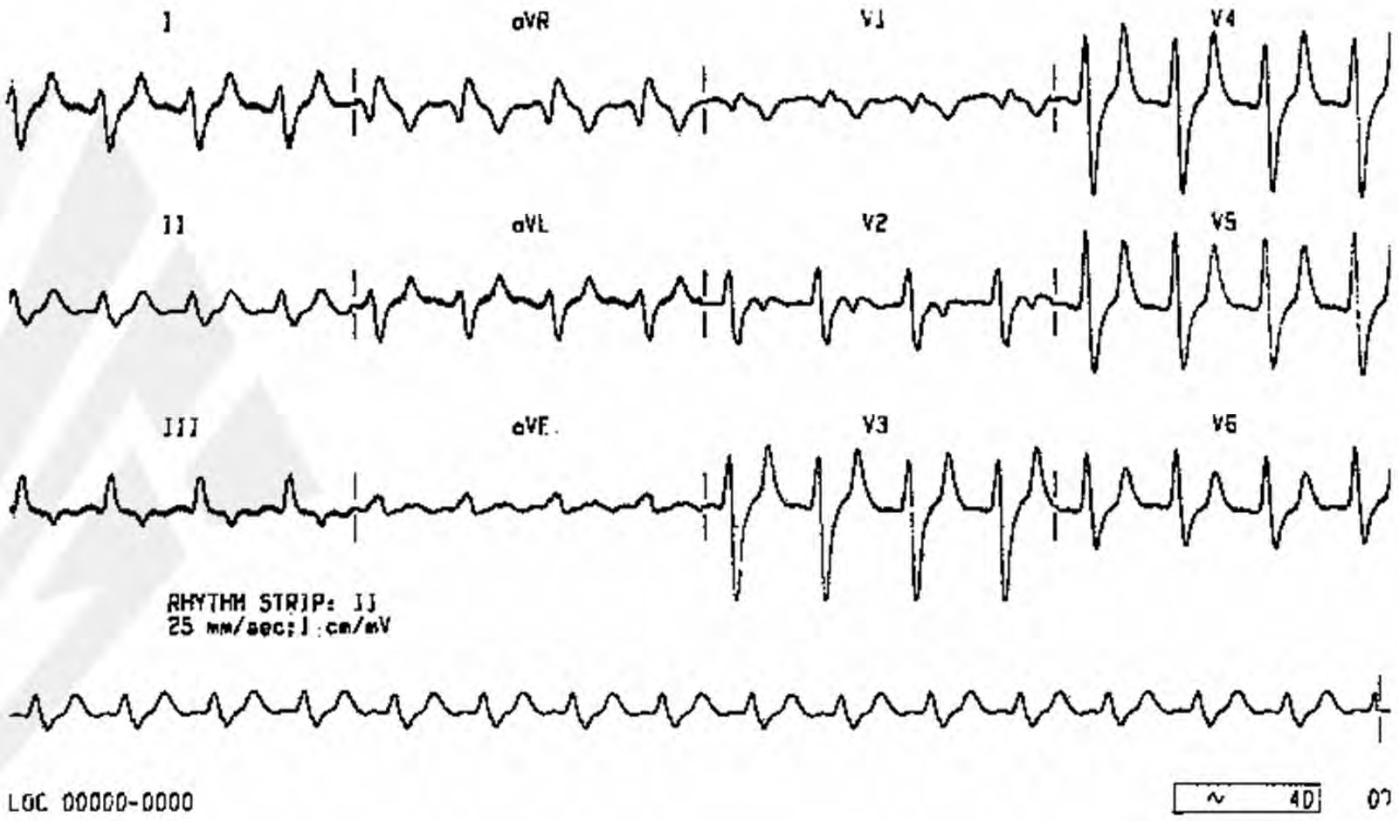


LBTB

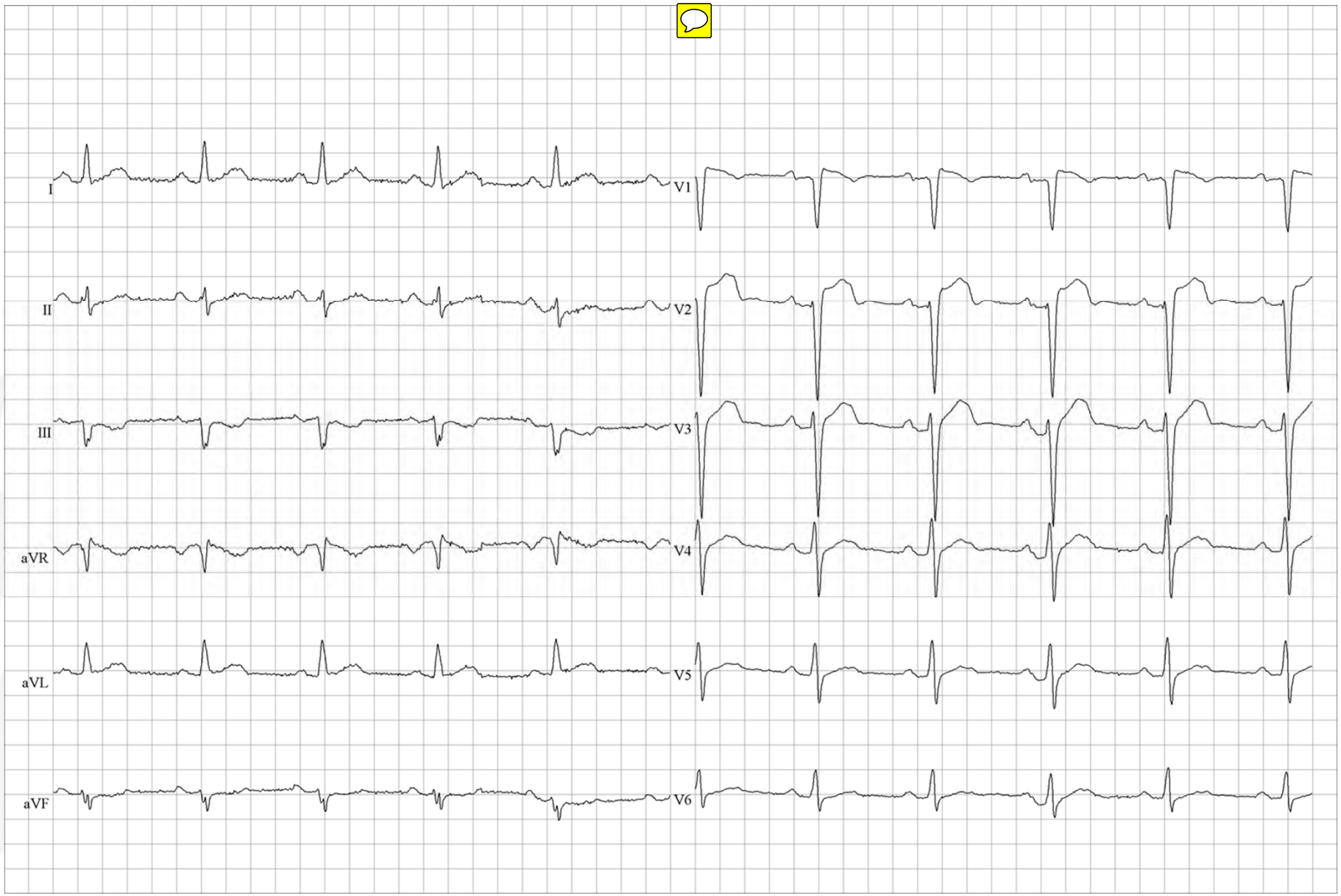


Hyperkaliemie

- Hoge piekvormige T
- QRS verbreding
- Kleine P, atriale stilstand, atriale ritmestoornissen
- Levensbedreigend!



Brugada syndroom



DD/ ST segment depressie

- Subendocardiale ischemie
- Reciproke verandering bij infarct
- Apical ballooning
- Longembolen
- Linker kamer hypertrofie
- Athlete’s heart
- Digitalis
- Hypokaliemie
- Preexcitatie - WPW
- *Neurologische aandoeningen*
- *Normale J-punts depressie bij tachycardie*
  - *tot 80 ms na J-punt*
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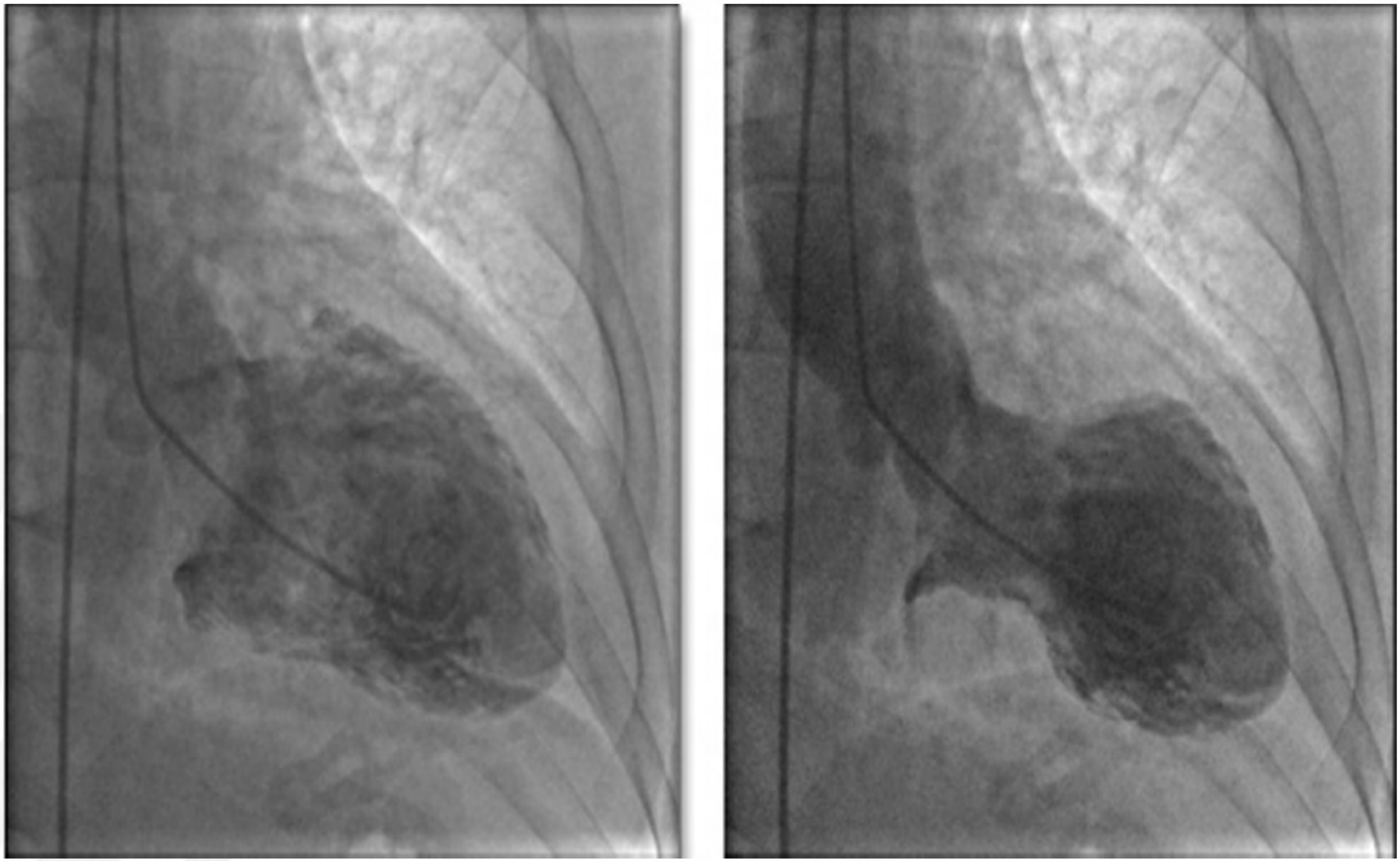
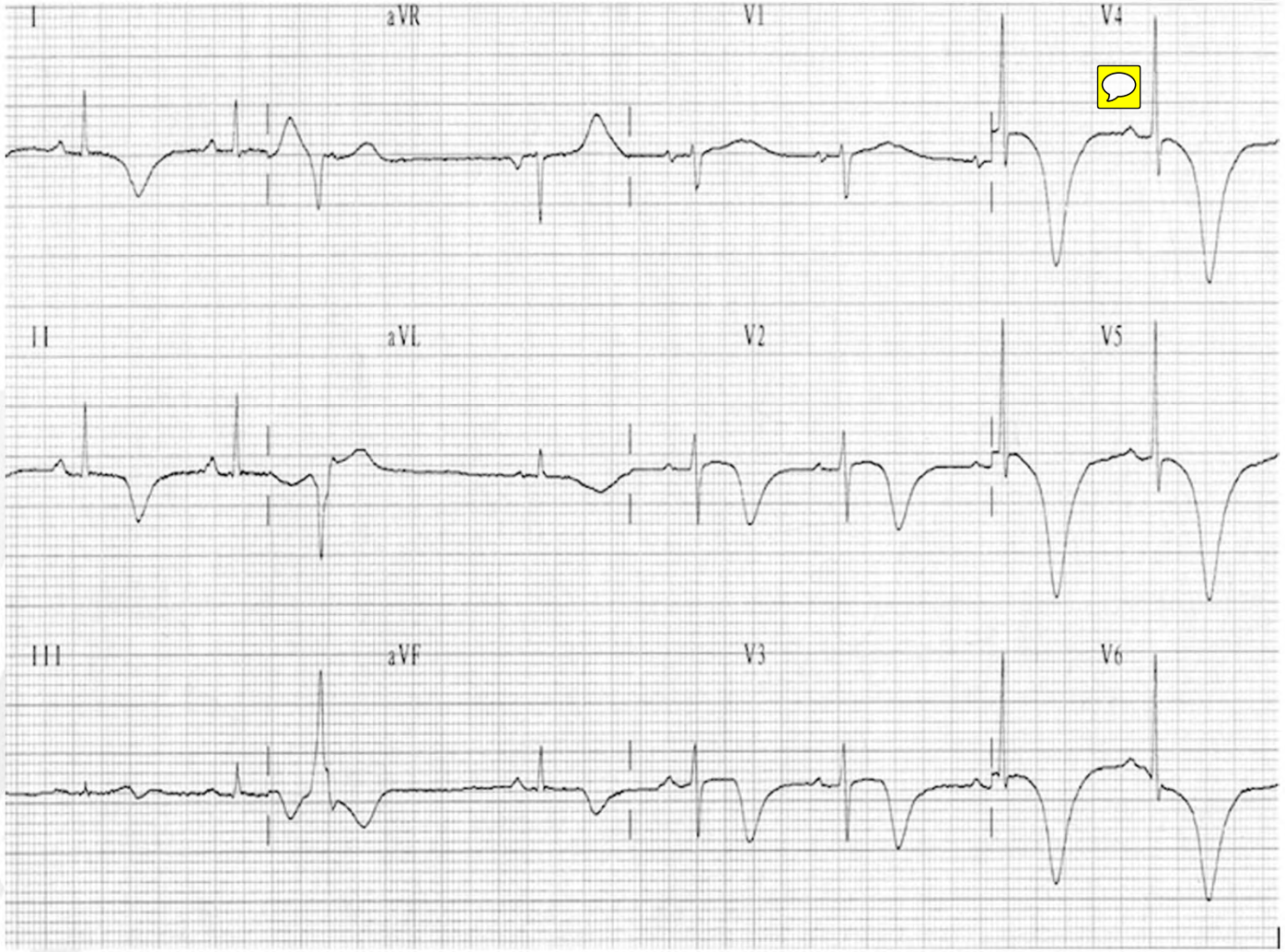


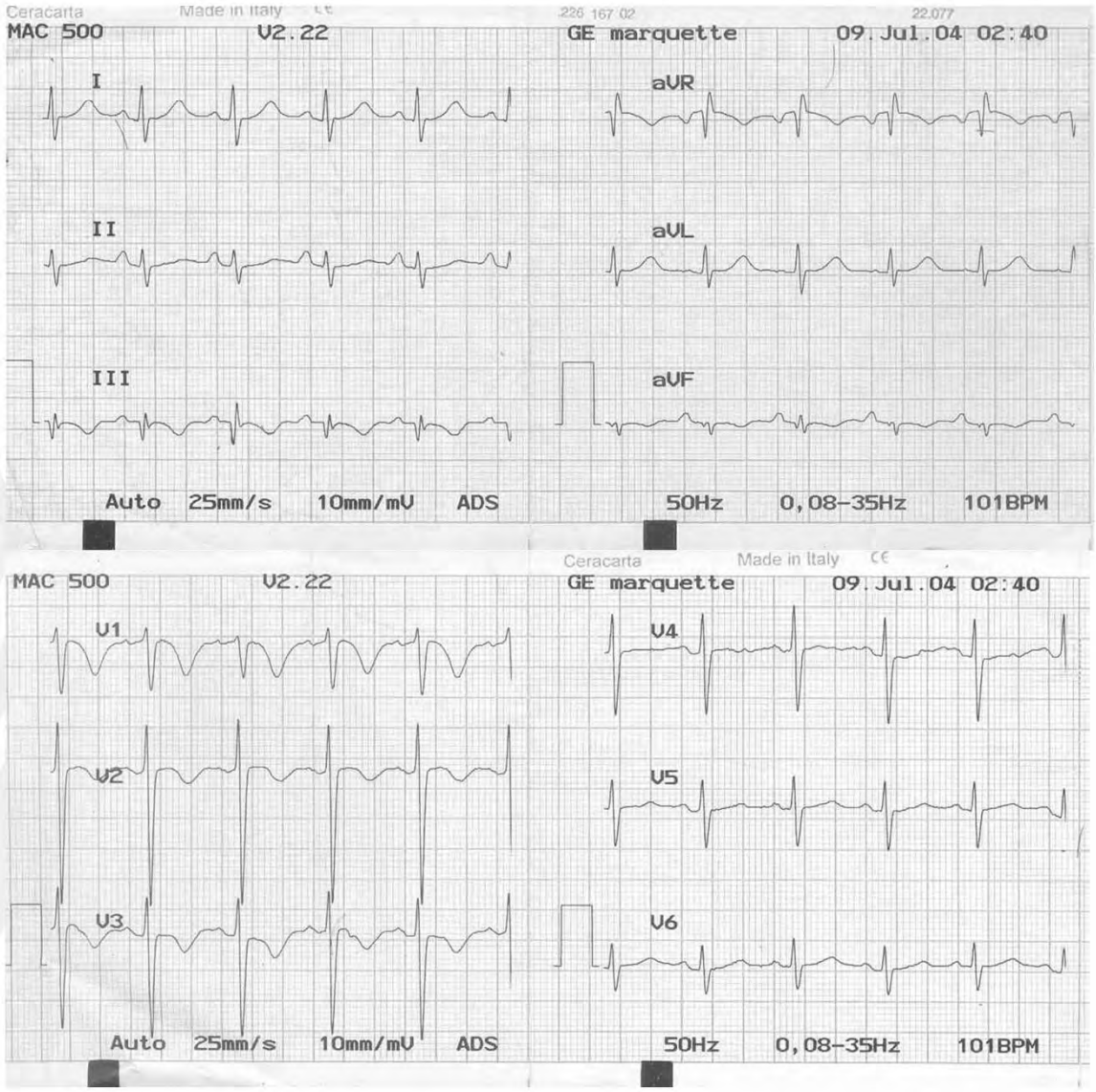
Takotsubo Cardiomyopathy

Apical ballooning



Iengo, R. et al. Eur J Echocardiogr 2007

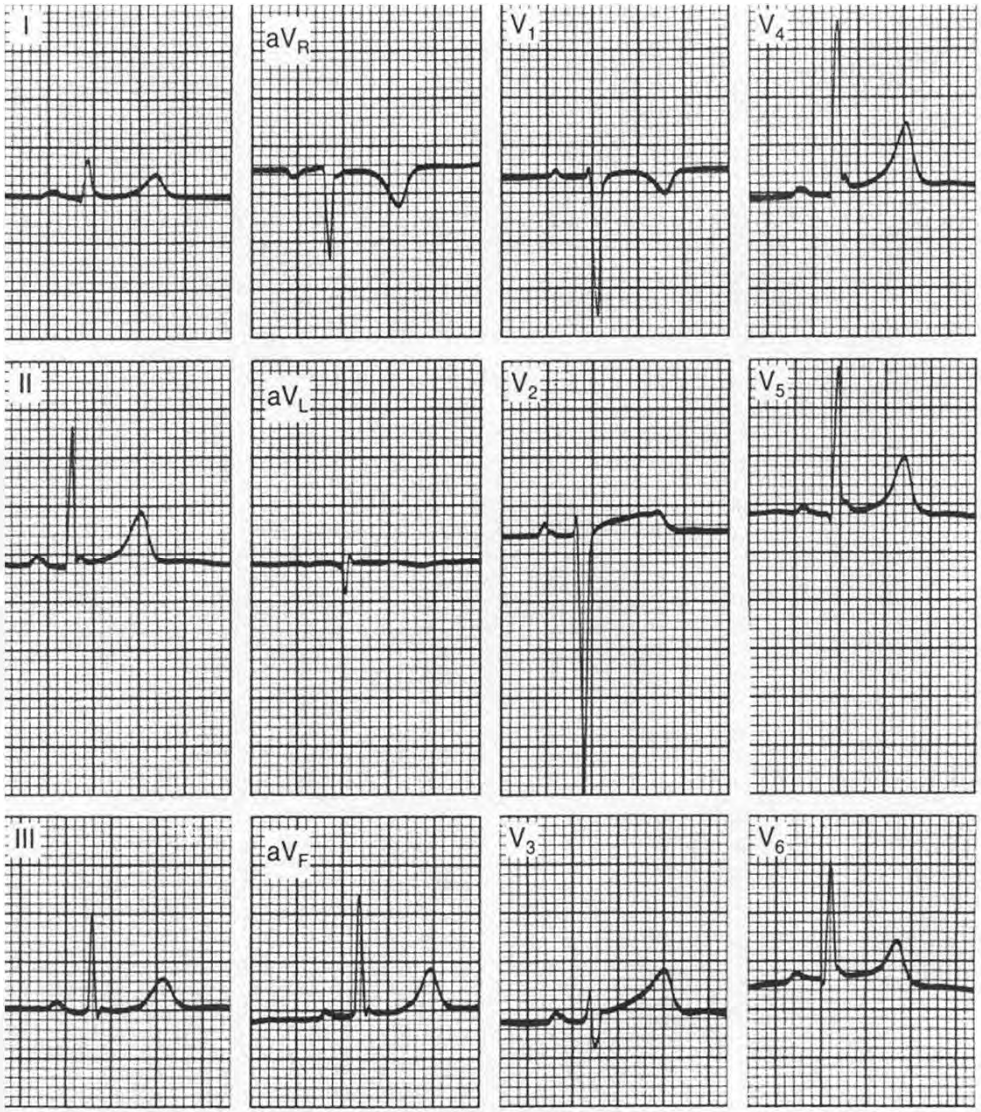
Longembolen



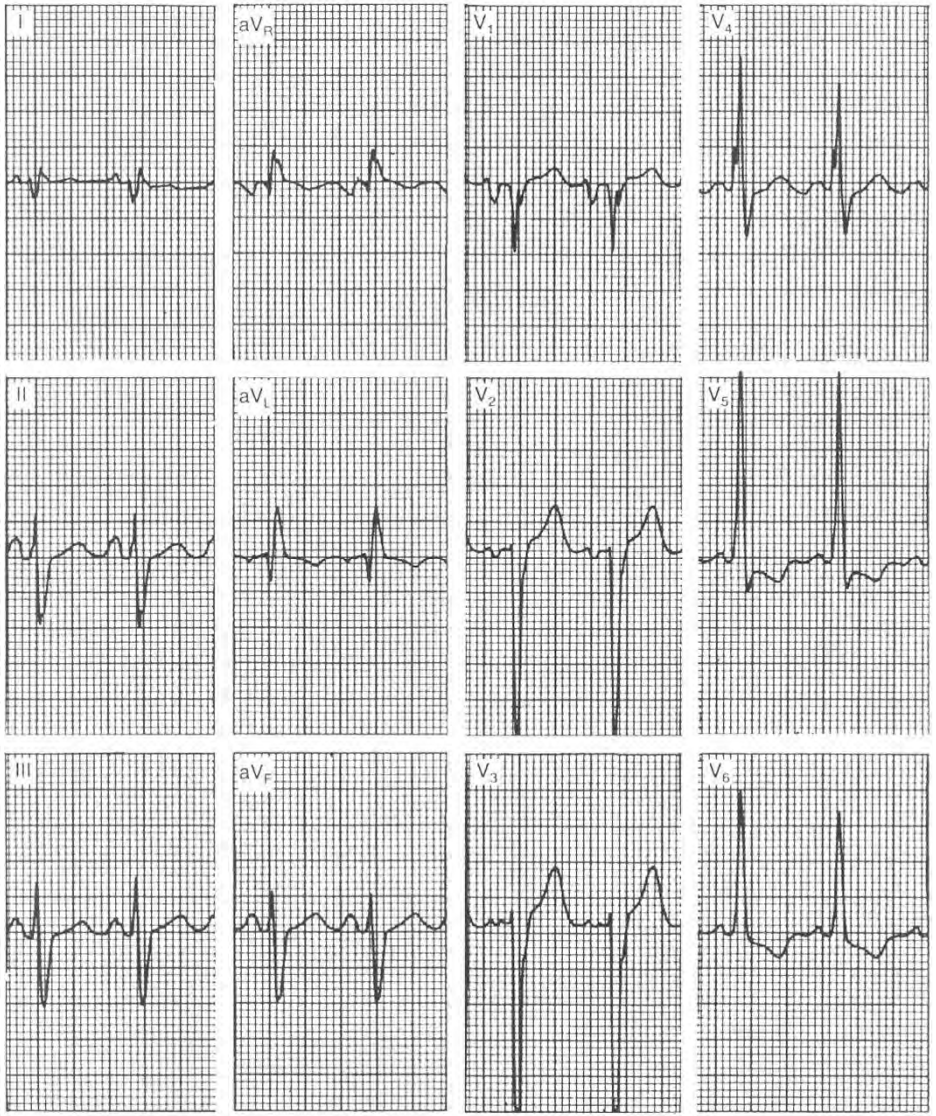
LVHT

The Athlete's Heart

LVH in an athlete

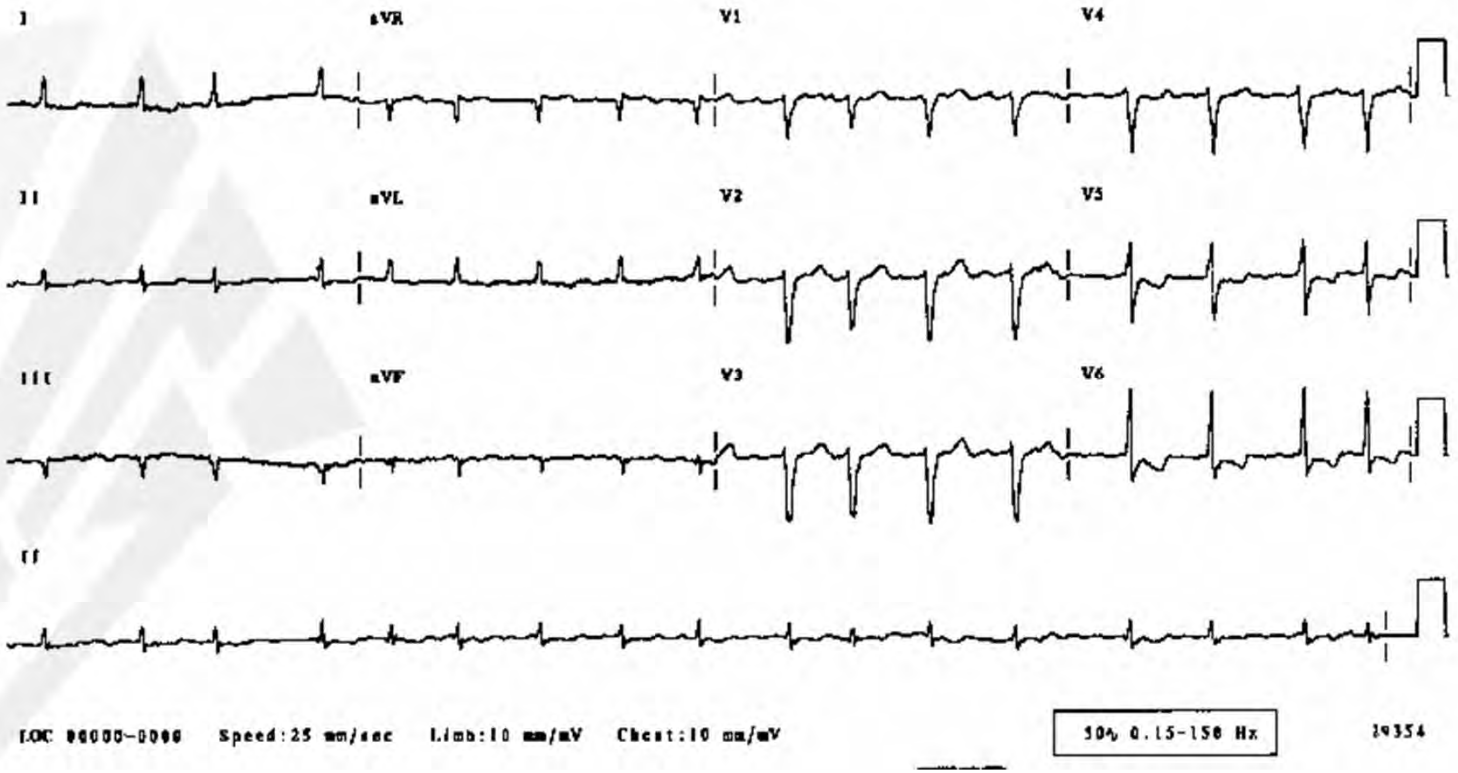


Patholigical LVH



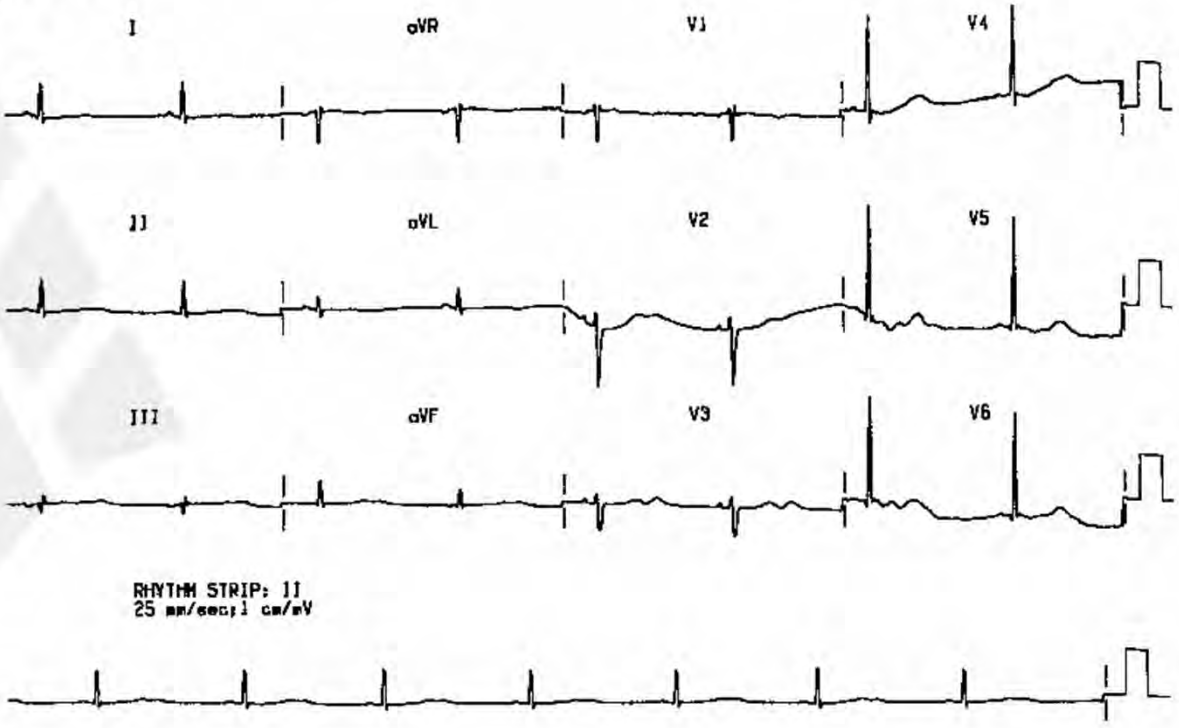
Digitaliseffect

- Komvormige ST daling
- Verkort QT
- Gewijzigde T
- PR verlenging
- Ventriculaire ritmestoornissen bij intoxicatie

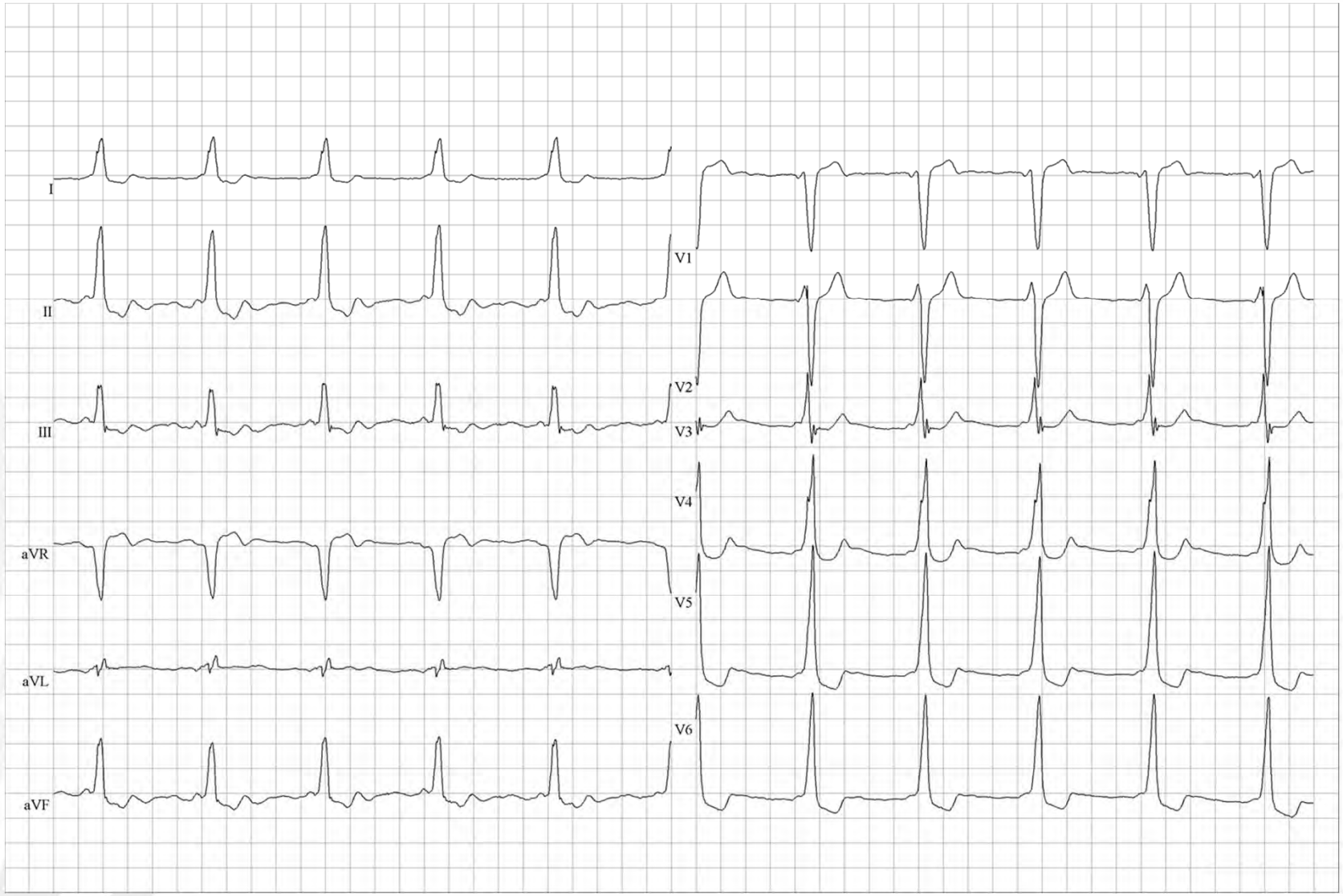


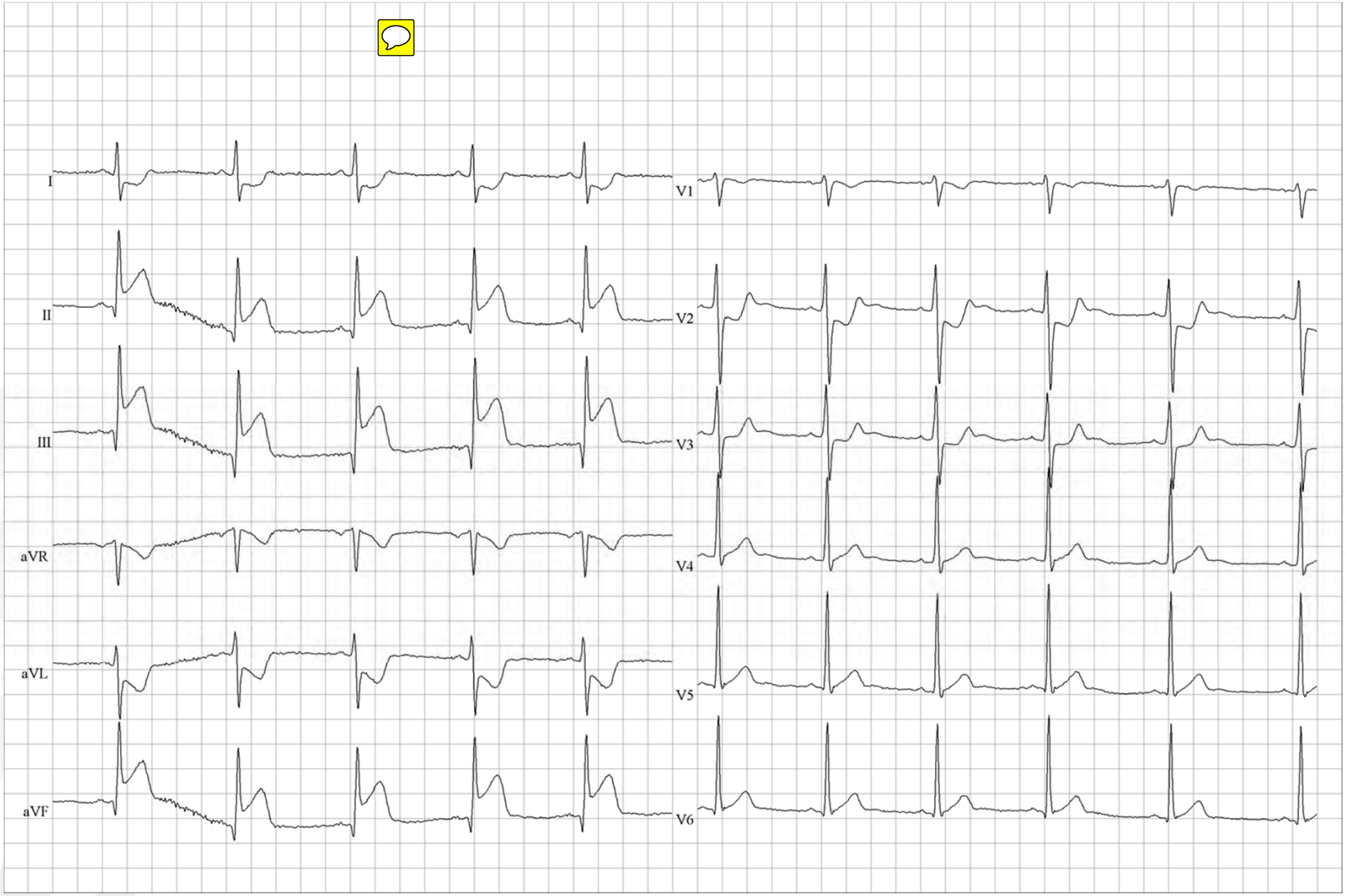
Hypokaliemie

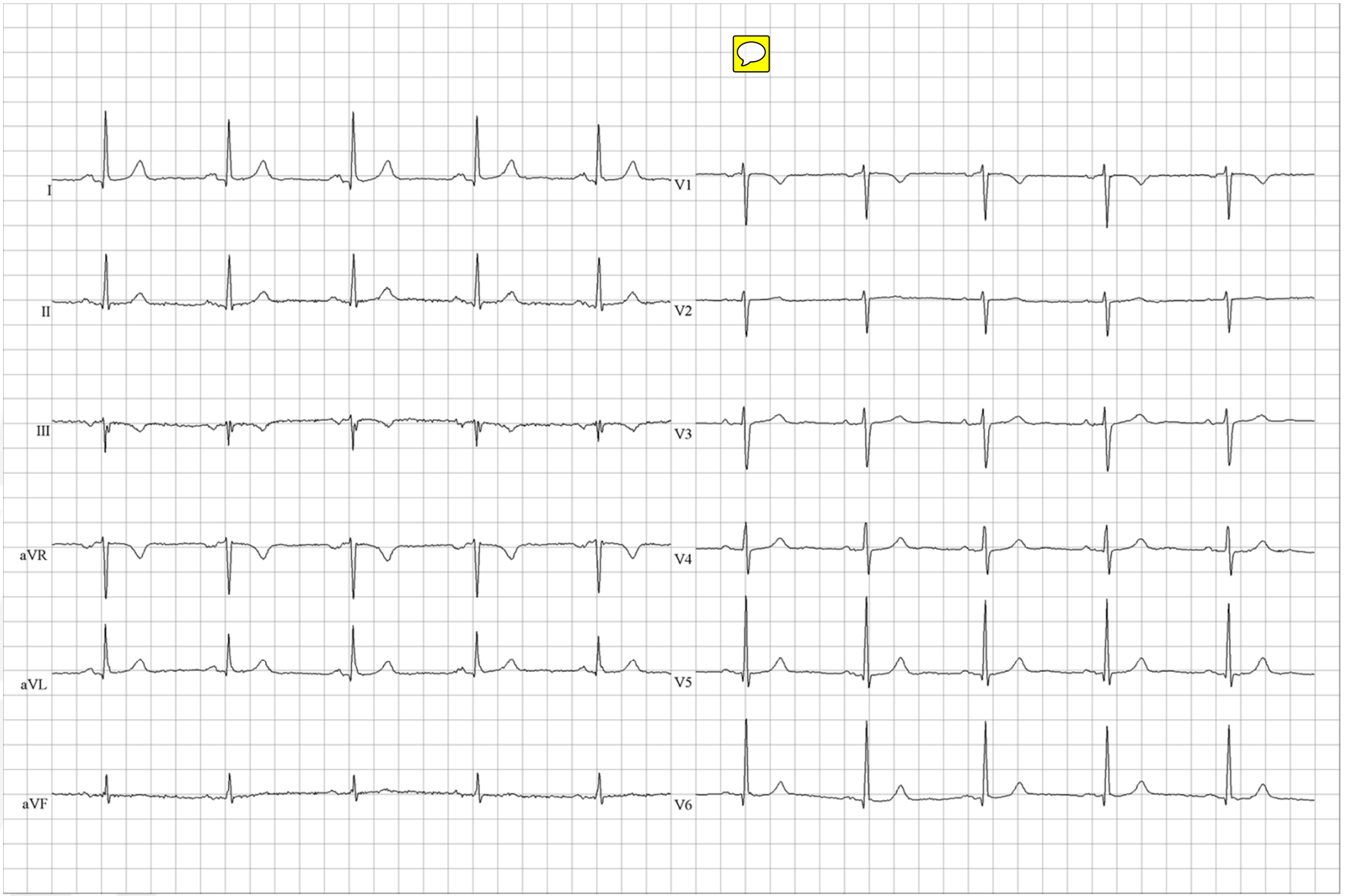
- T top isoëlektrisch of negatief
- Velengd QT
- ST daling
- U-golf

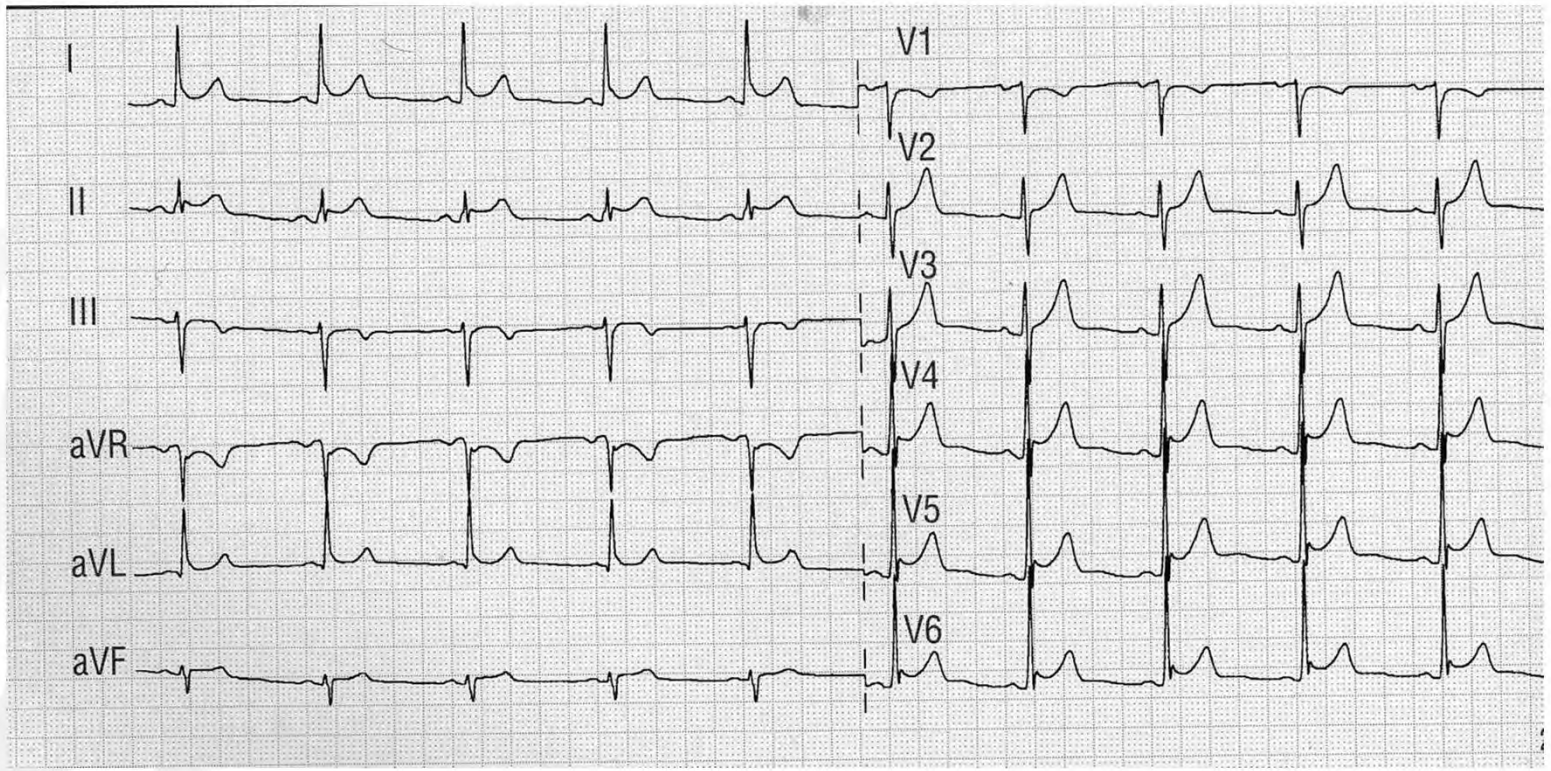


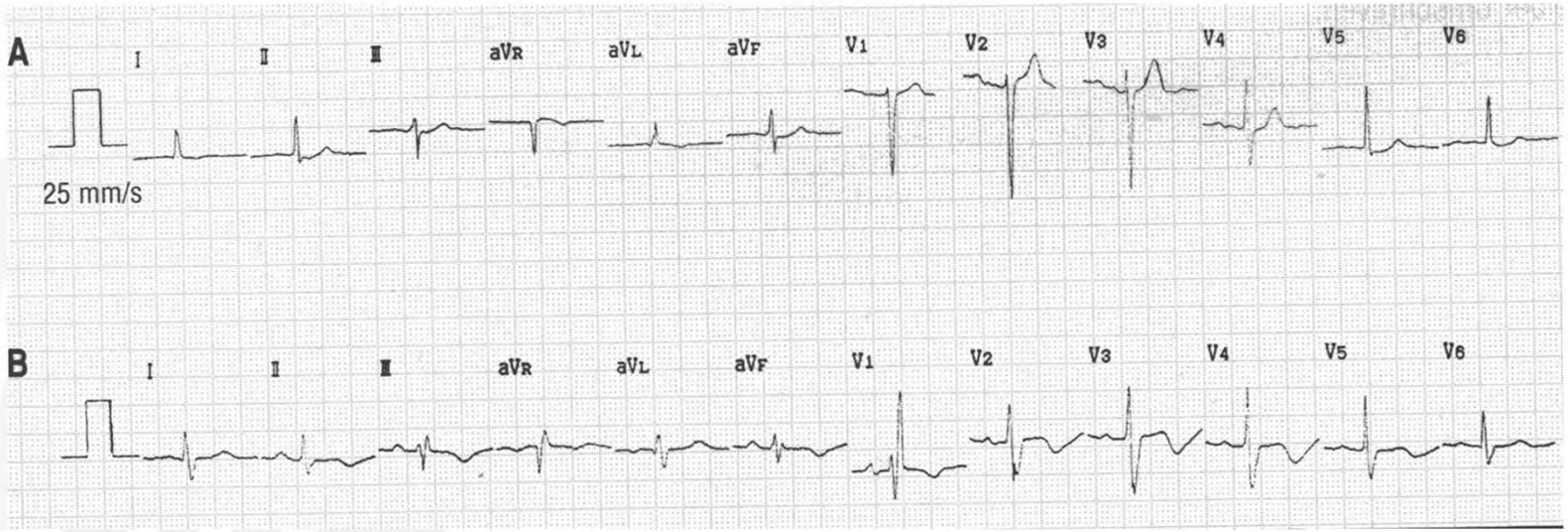
WPW

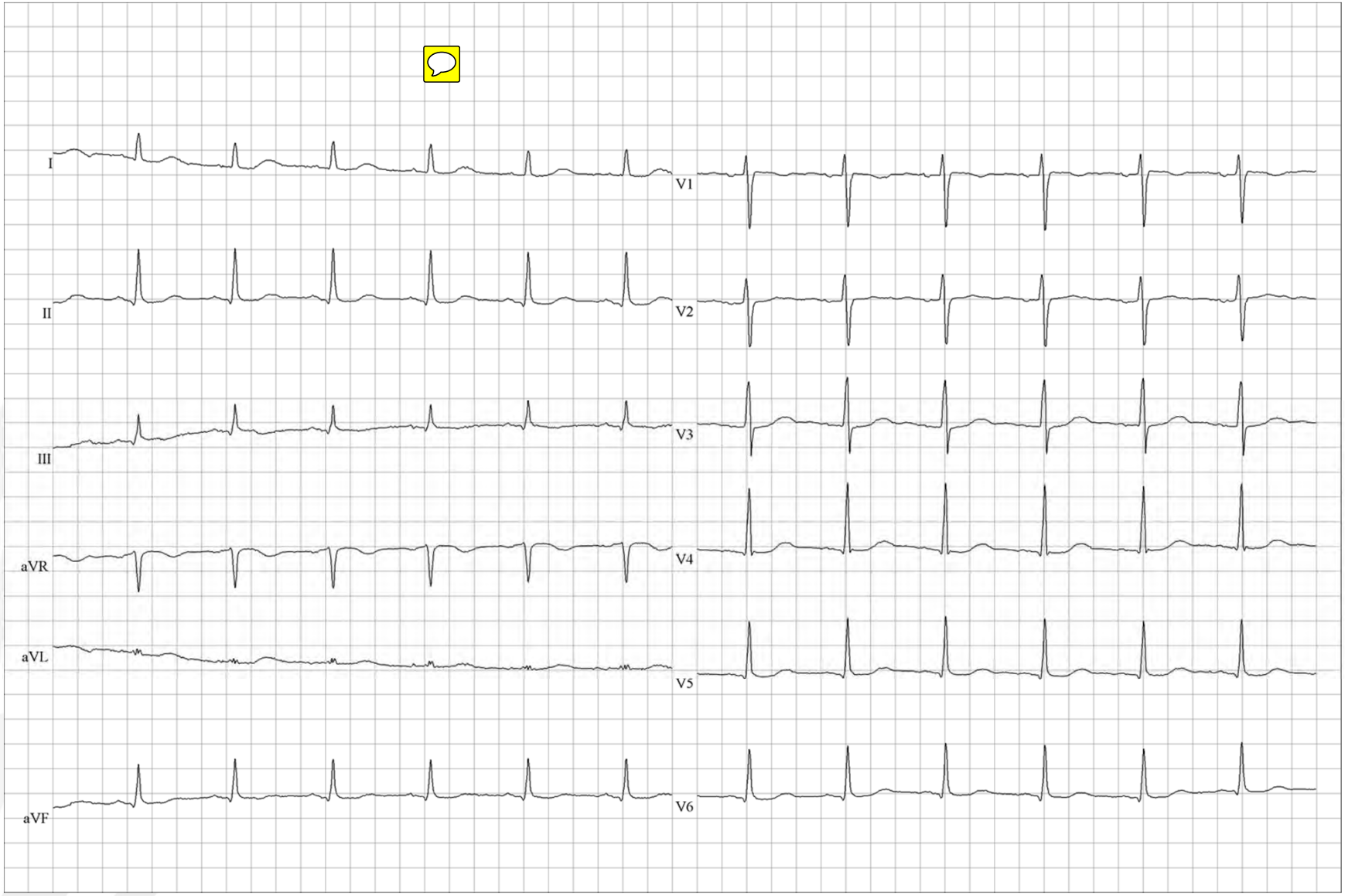


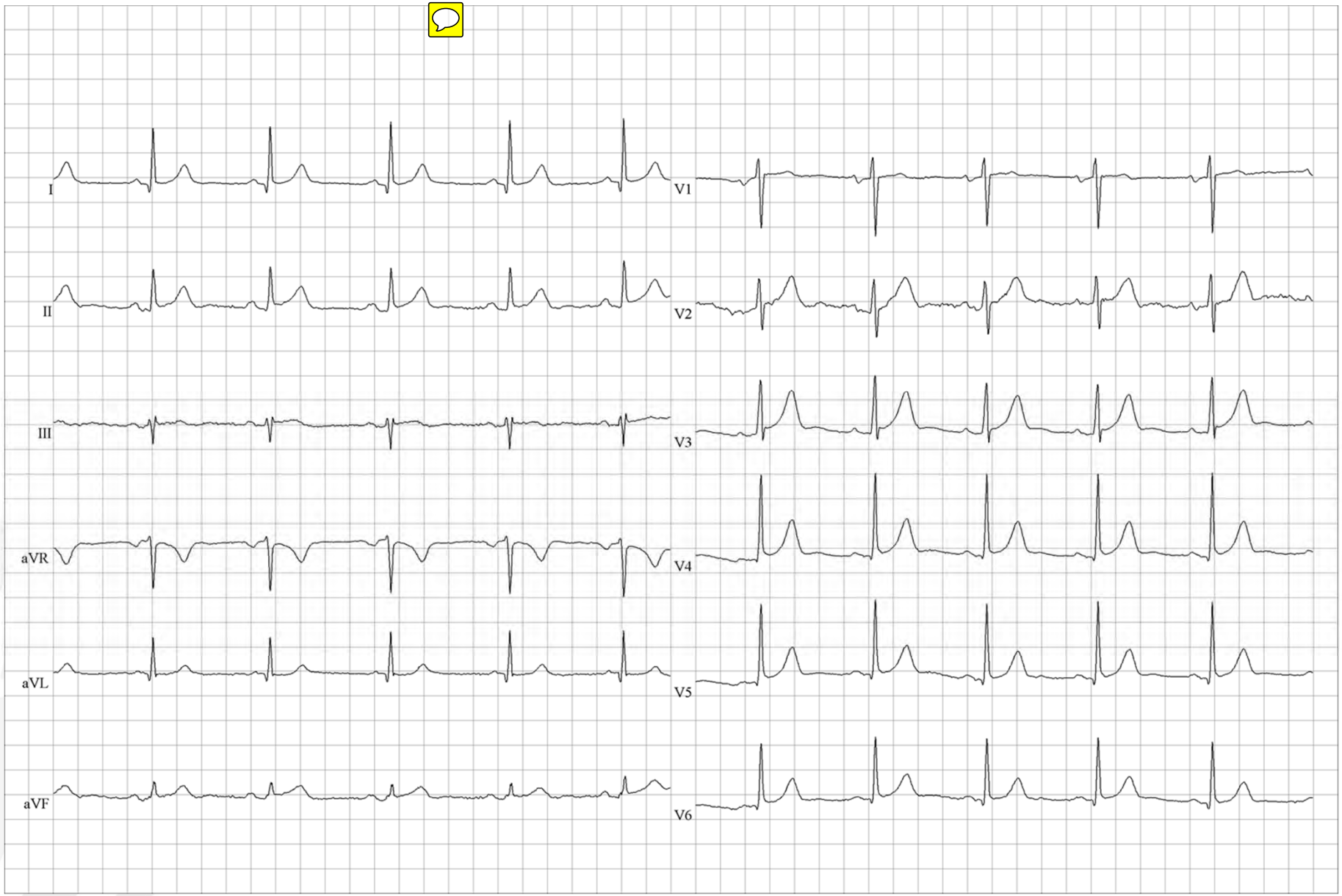

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

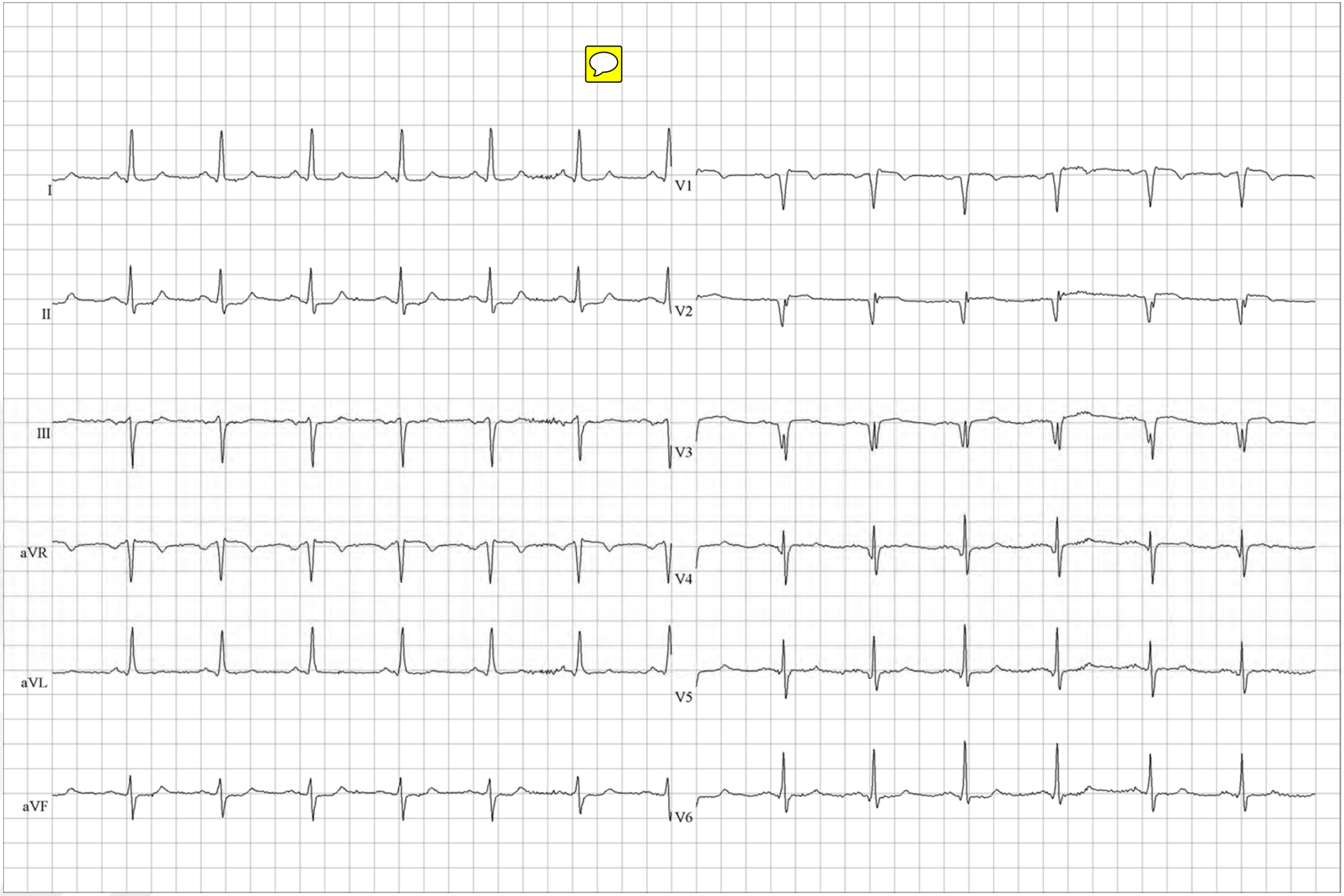

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

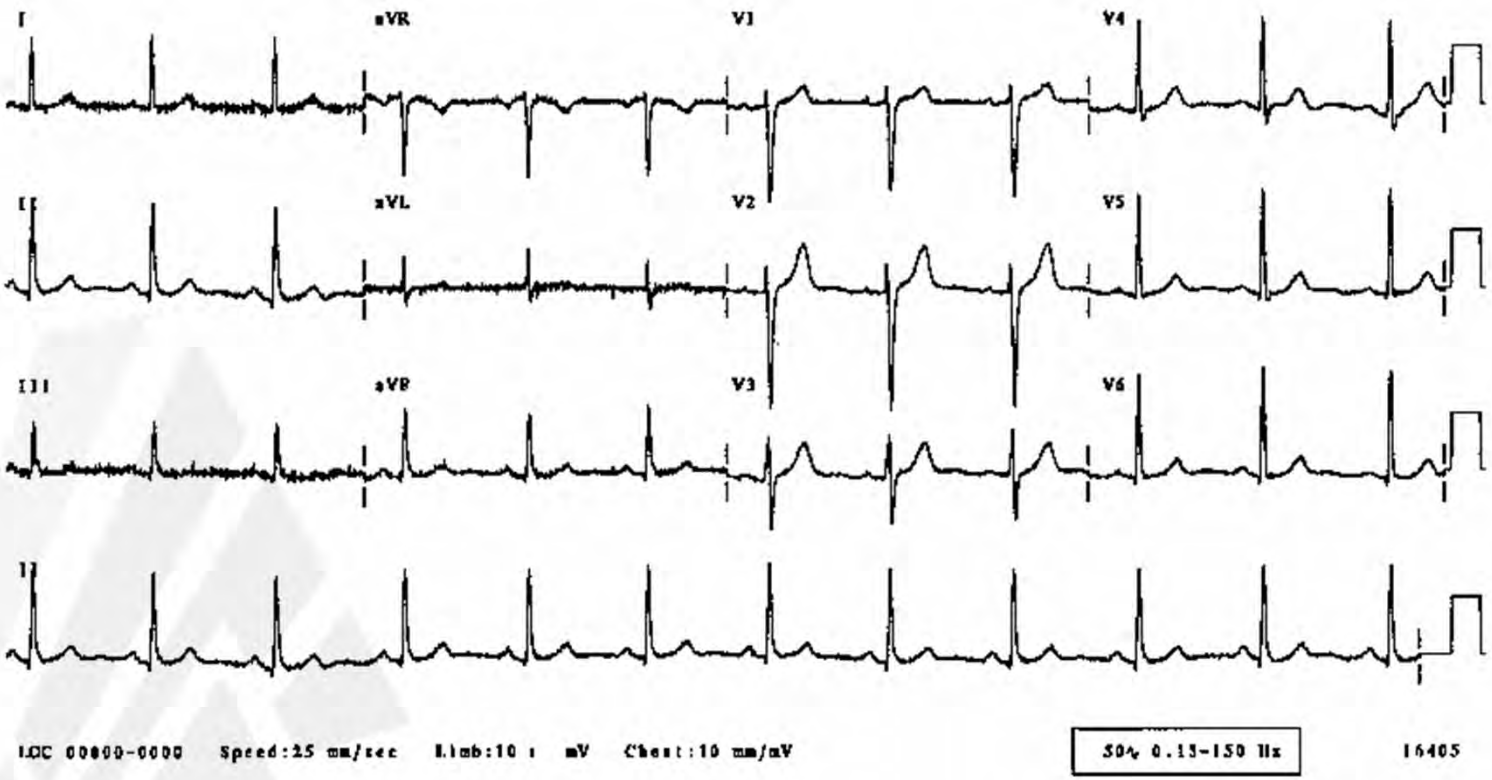

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


A
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
25 mm/s
B
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

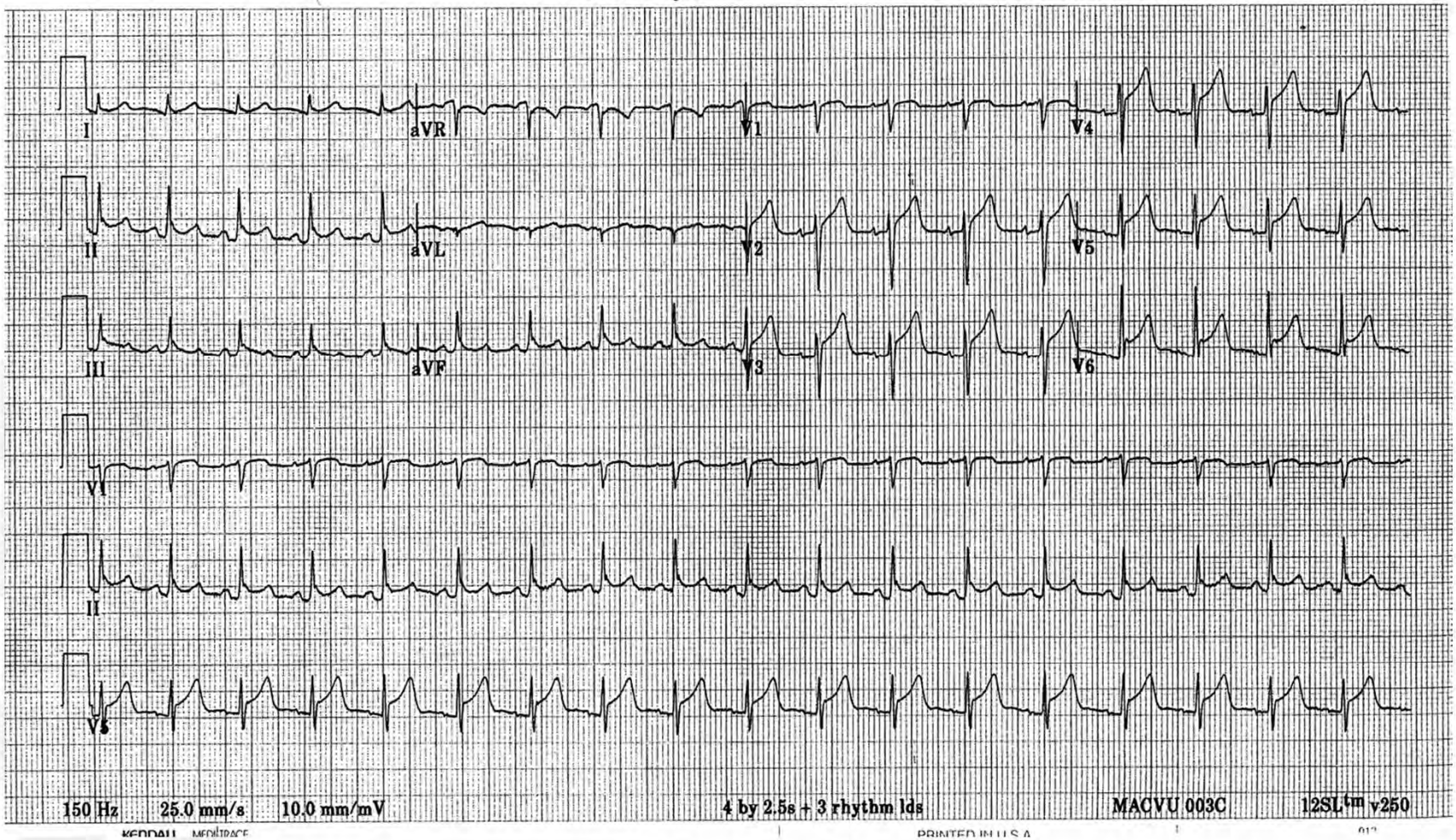

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
LOC 00000-0000
Speed:25 mm/sec
Limb:10 mV
Chest:10 mm/mV
50% 0.15-150 Hz
16405

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1

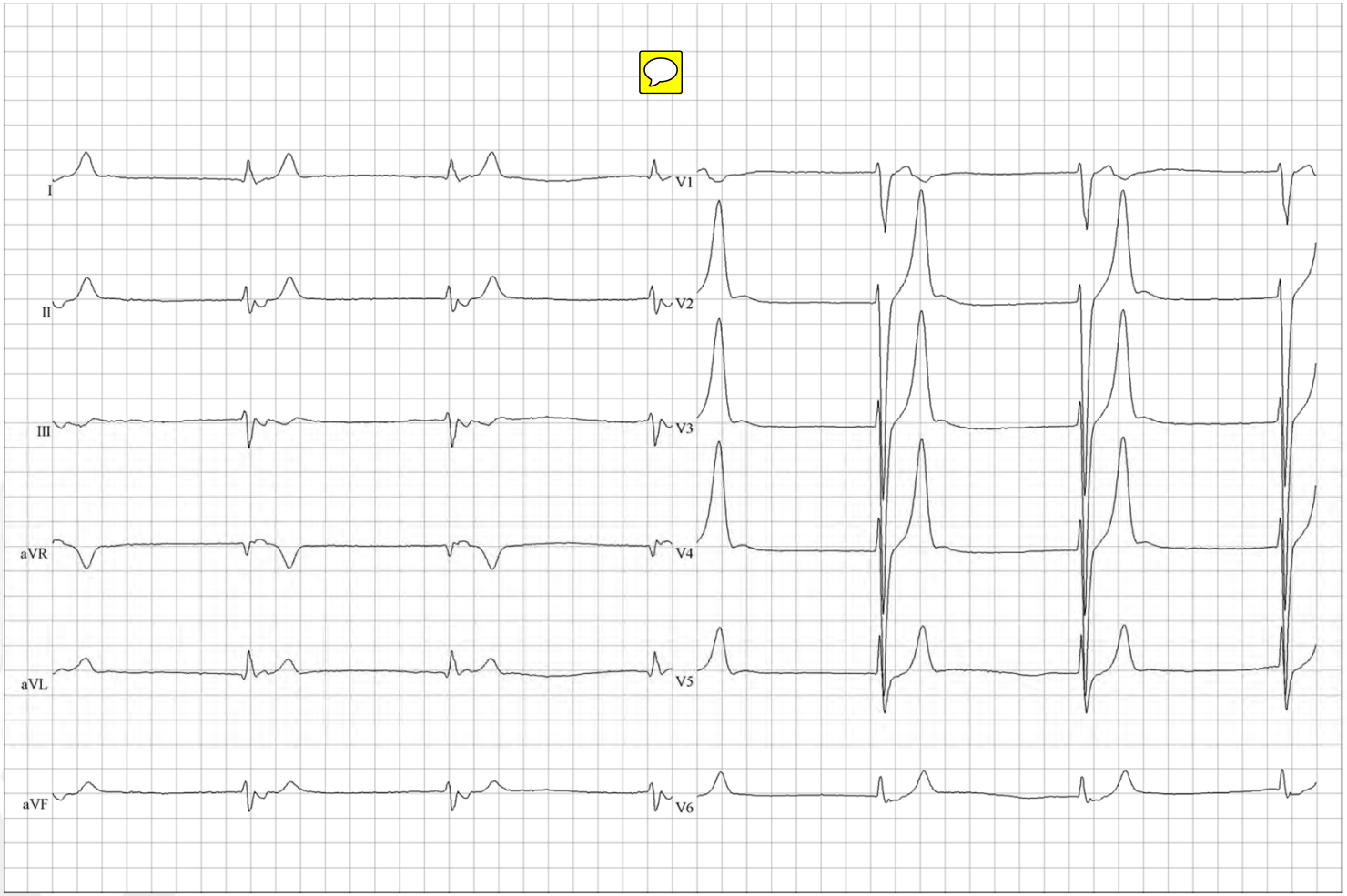
Test ind: EKG CHANGES

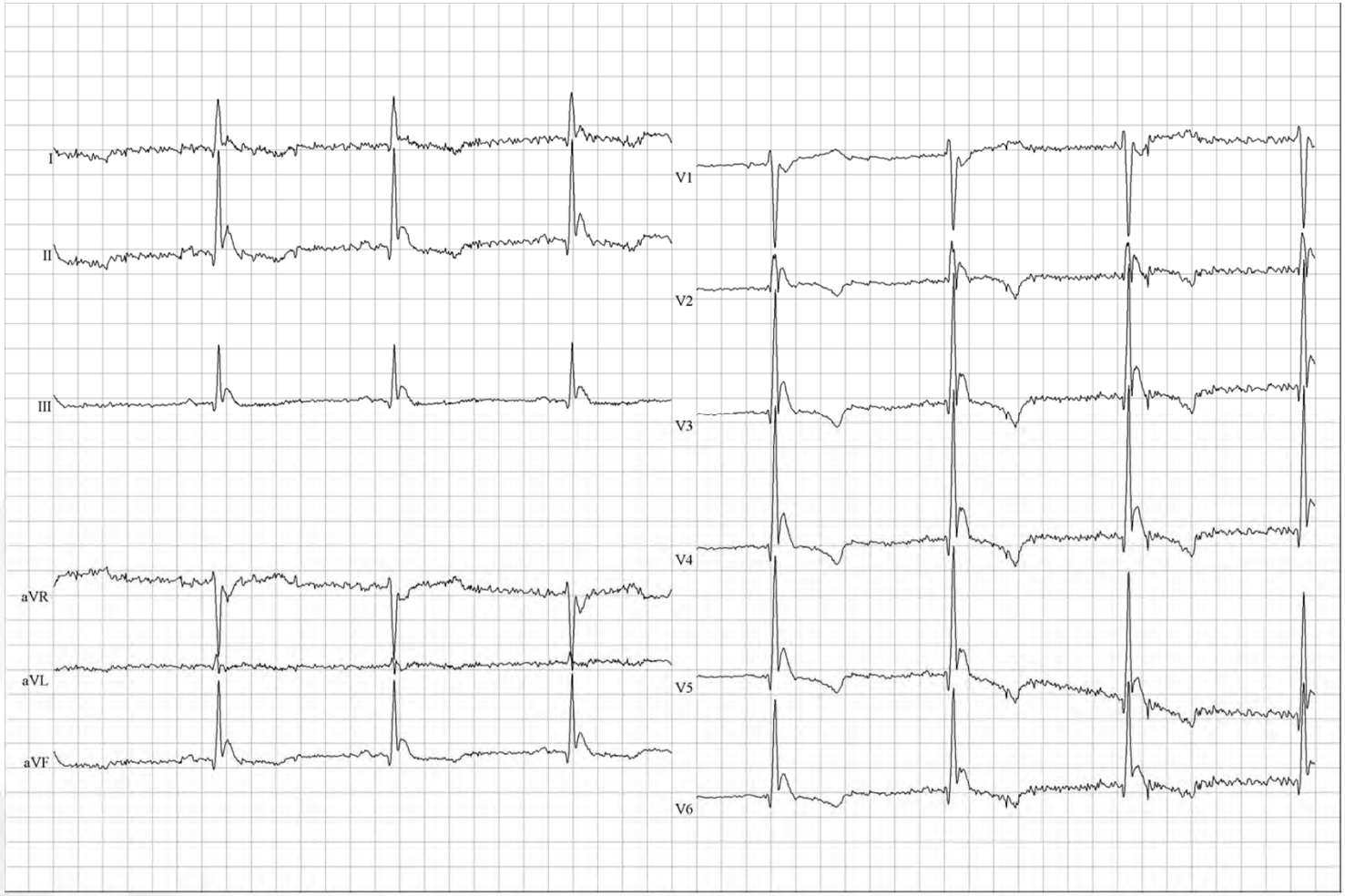
Referred by: PATE

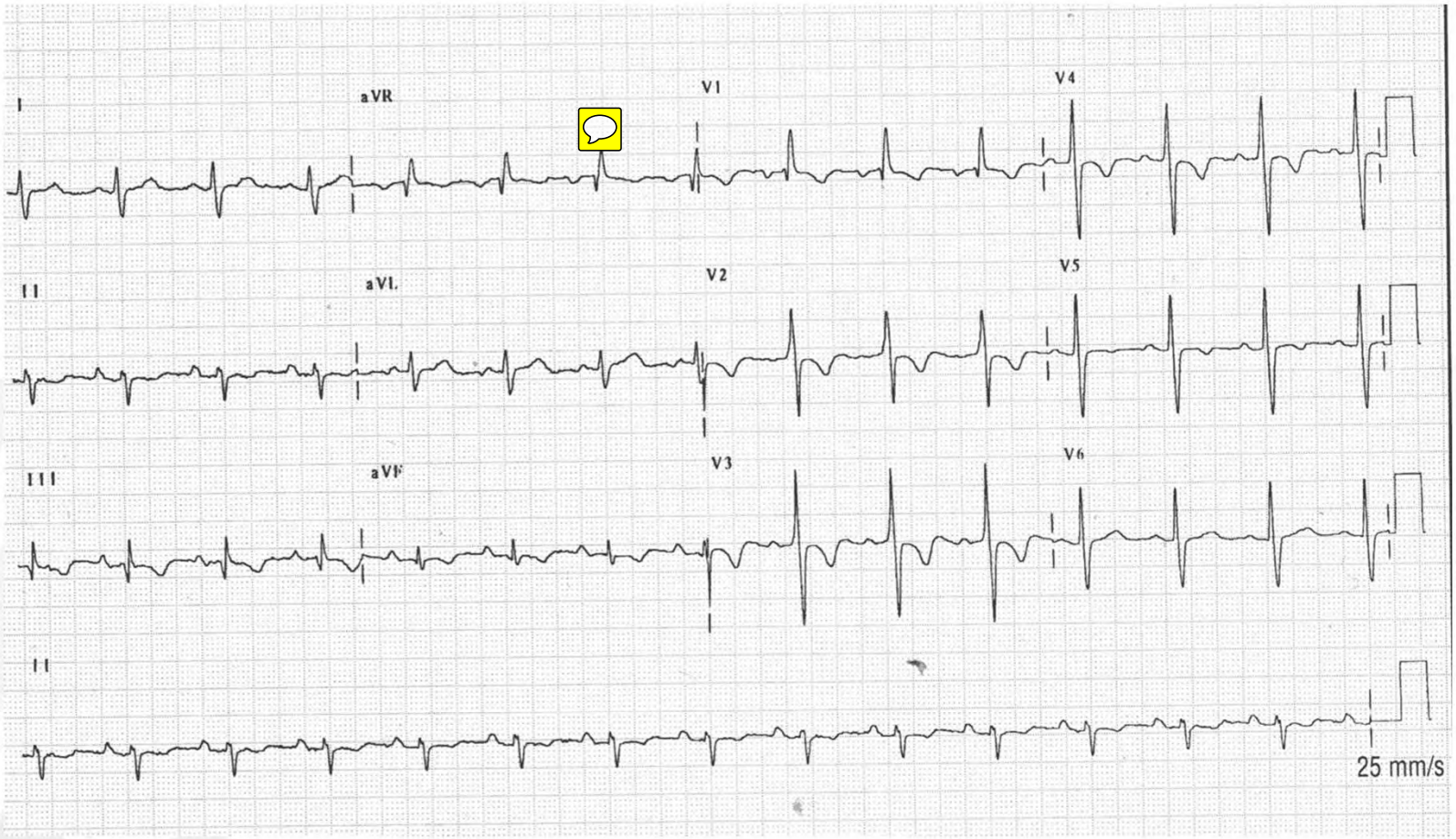
Unconfirmed

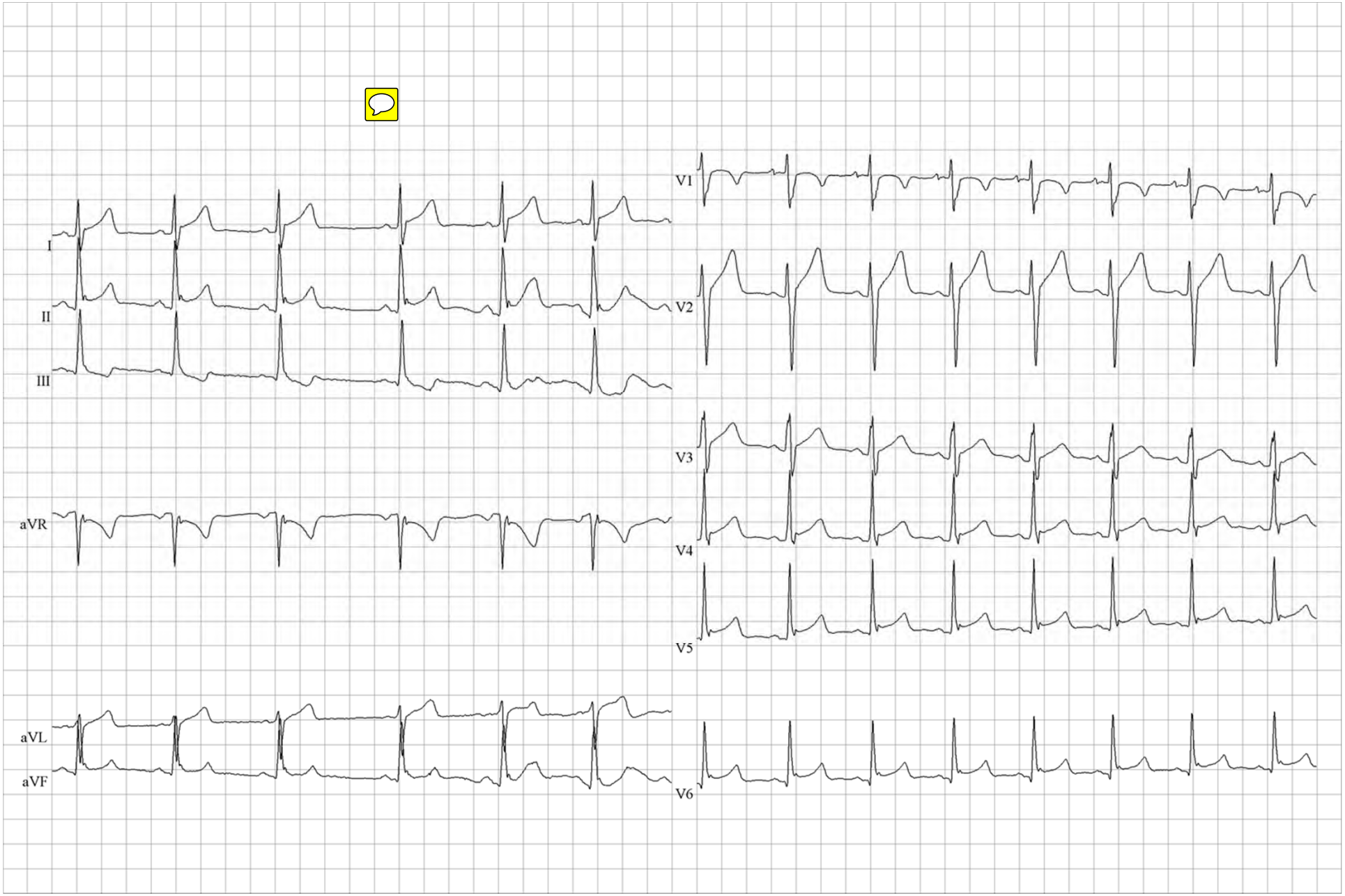


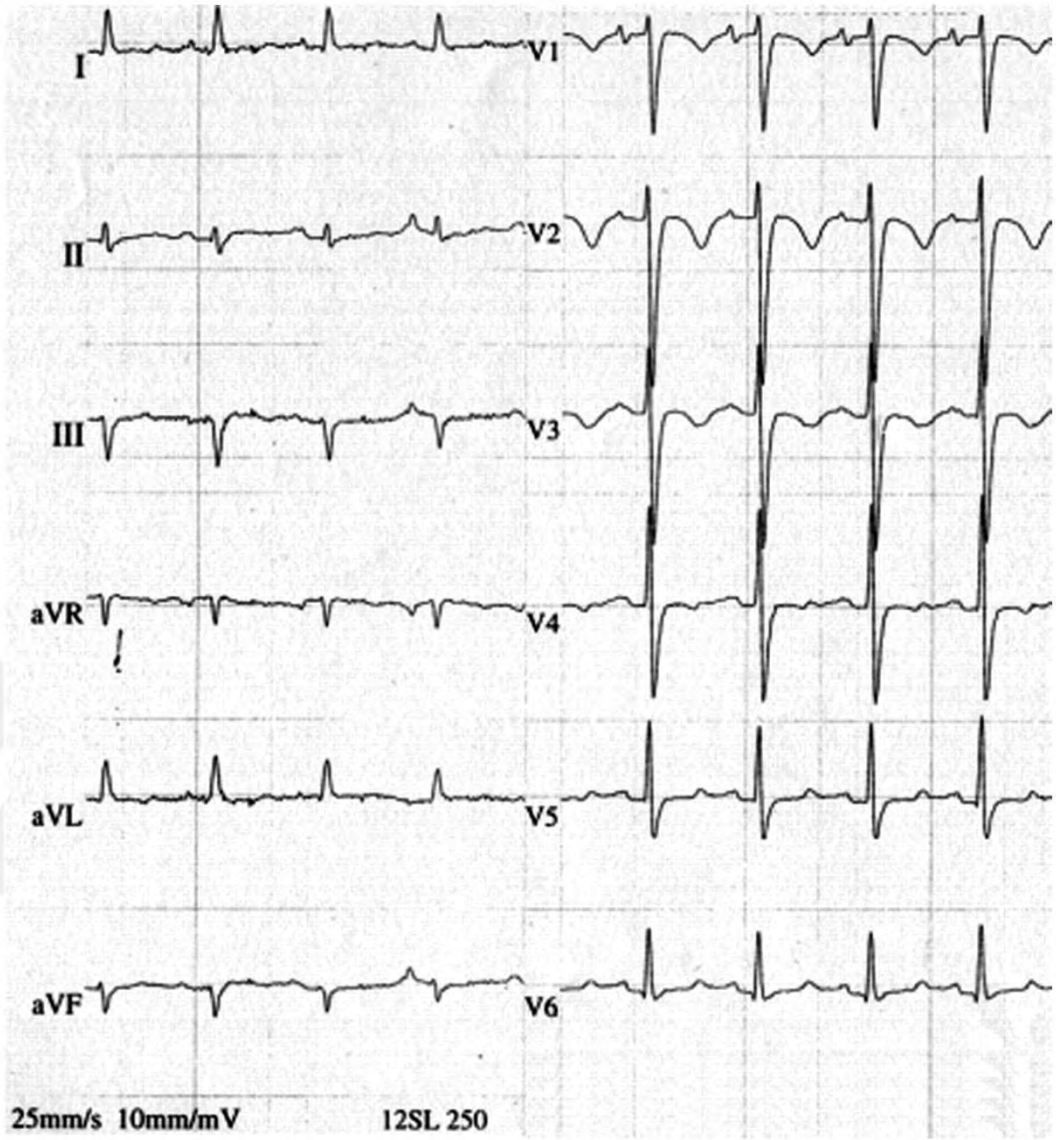
KEDDALL MEDITRACE PRINTED IN U.S.A.

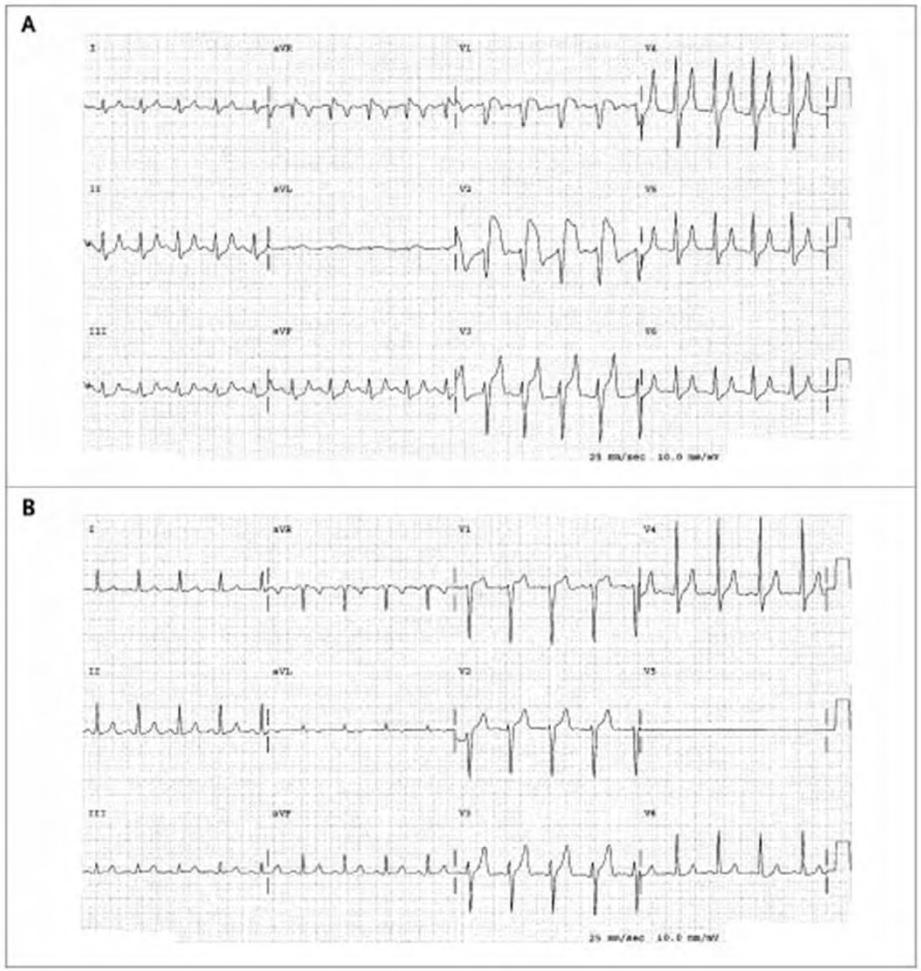

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25 mm/s

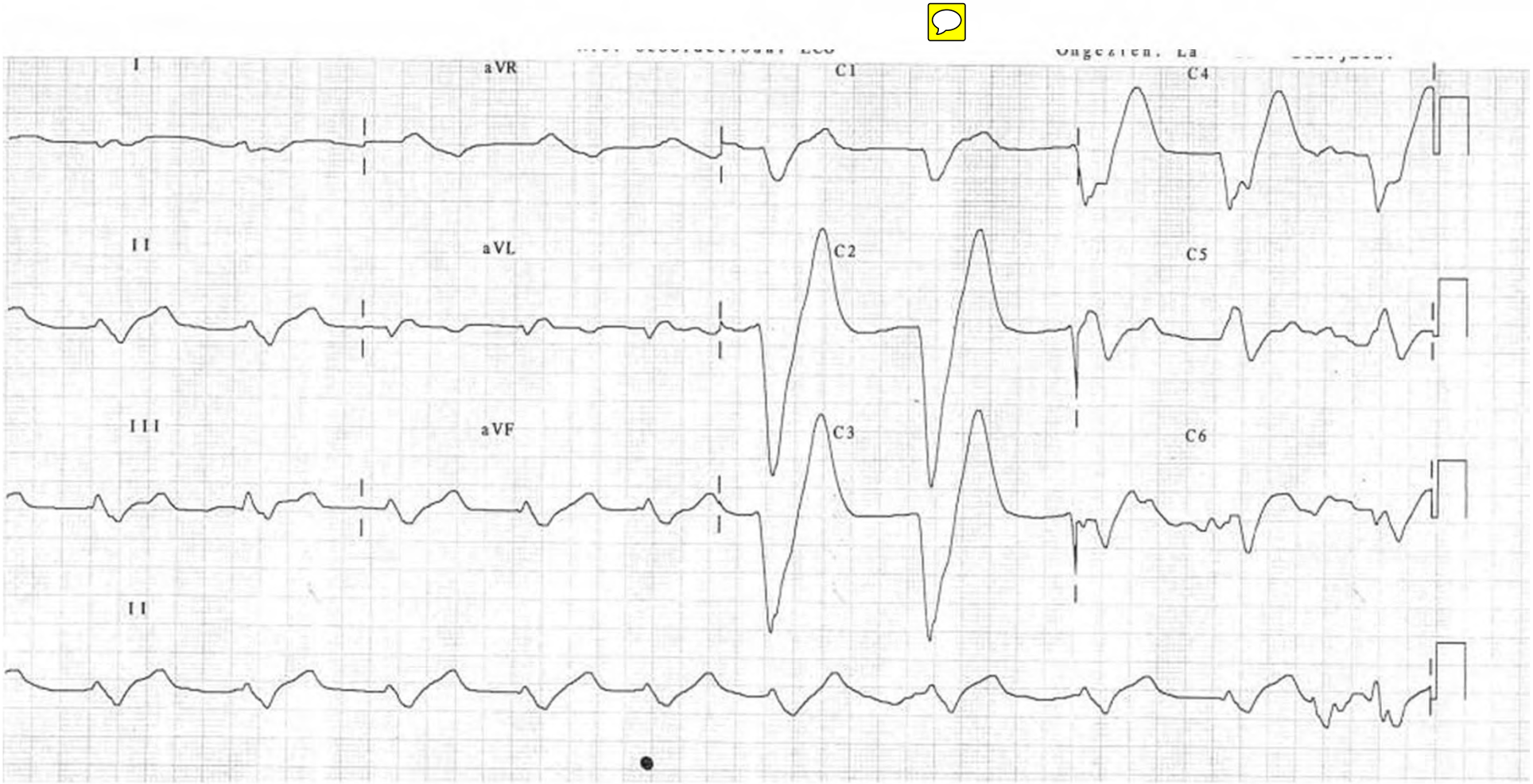

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
25mm/s 10mm/mV
12SL 250

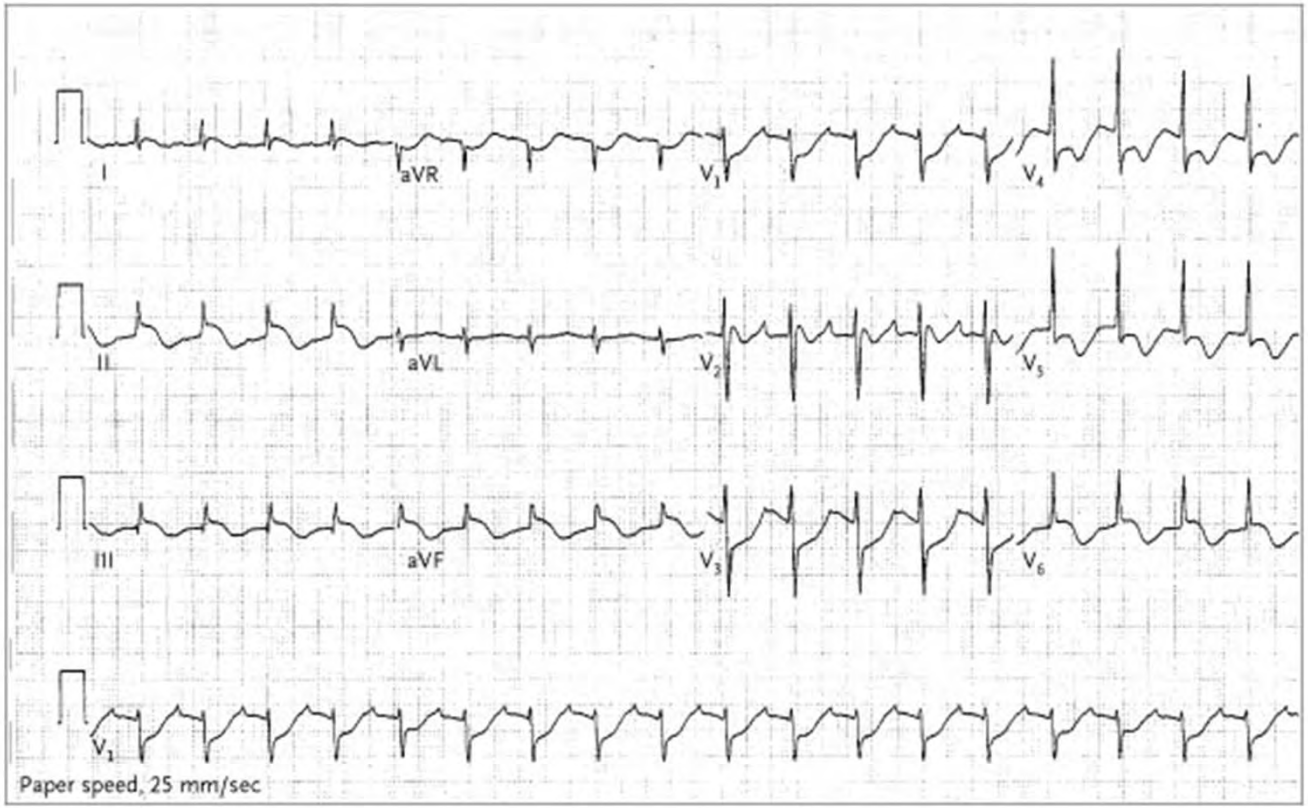


A 38-year-old man presented to the emergency department with nausea, vomiting, and epigastric pain

Wang K. N Engl J Med 2004;351:593


I
aVR
C1
C4
II
aVL
C2
C5
III
aVF
C3
C6
II
Courtesy of K.J. Rooyaards, MD
ECG PEDIA.ORG

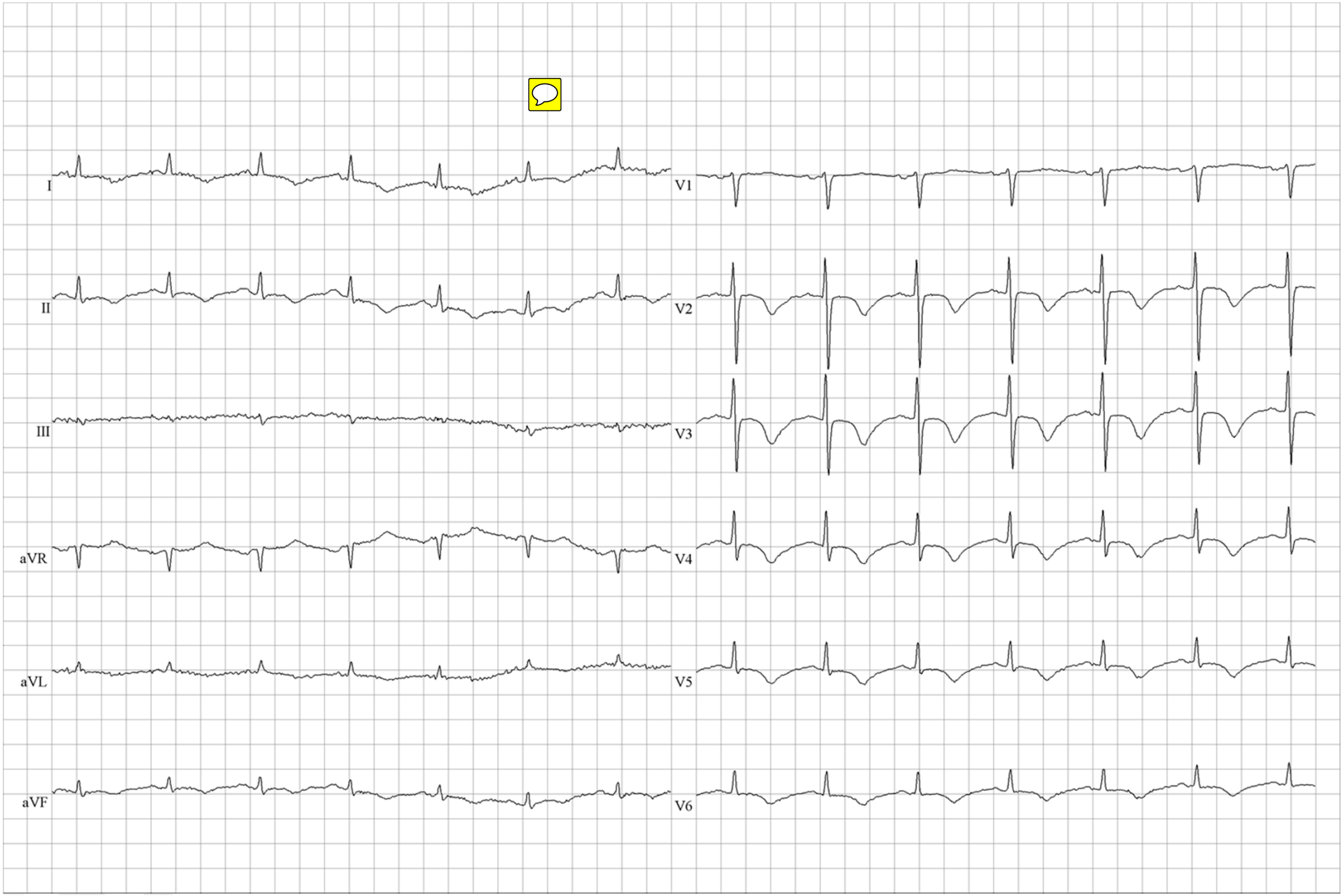
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

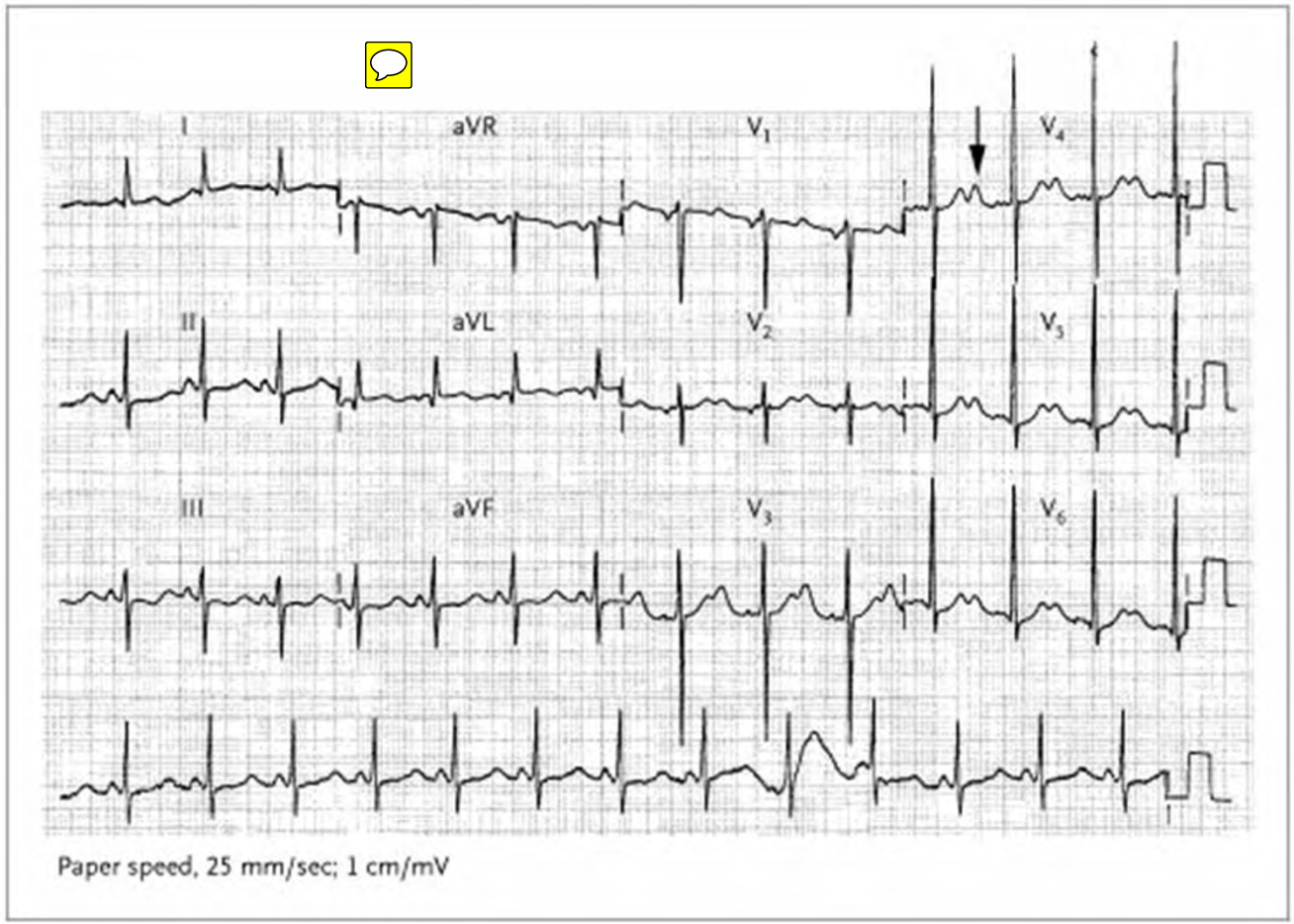


A 19-year-old man was admitted to the trauma unit after being struck in the left temple by a brick

Bailey W and Chaitman B. N Engl J Med 2003;349:561

UZ LEUVEN

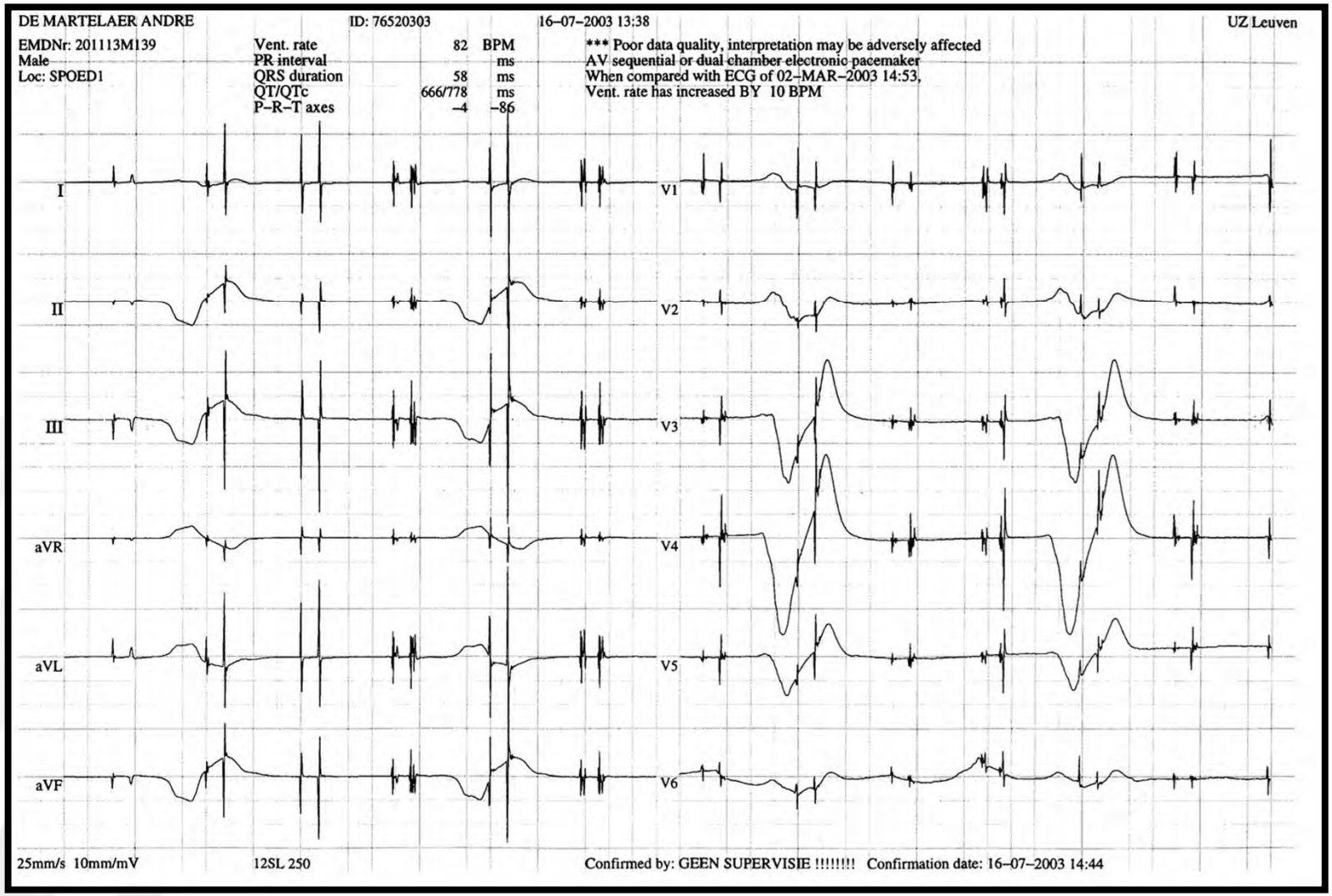


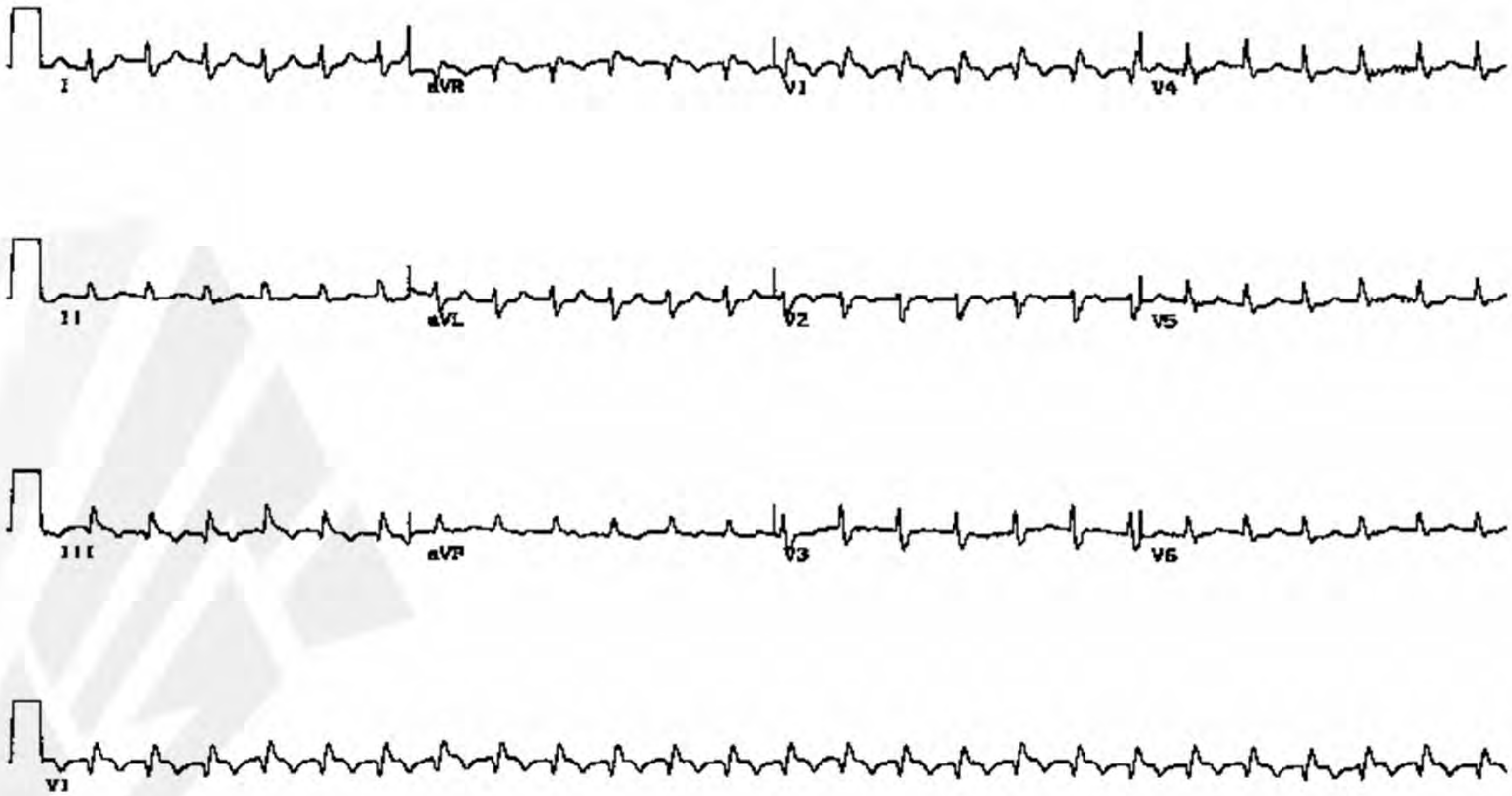


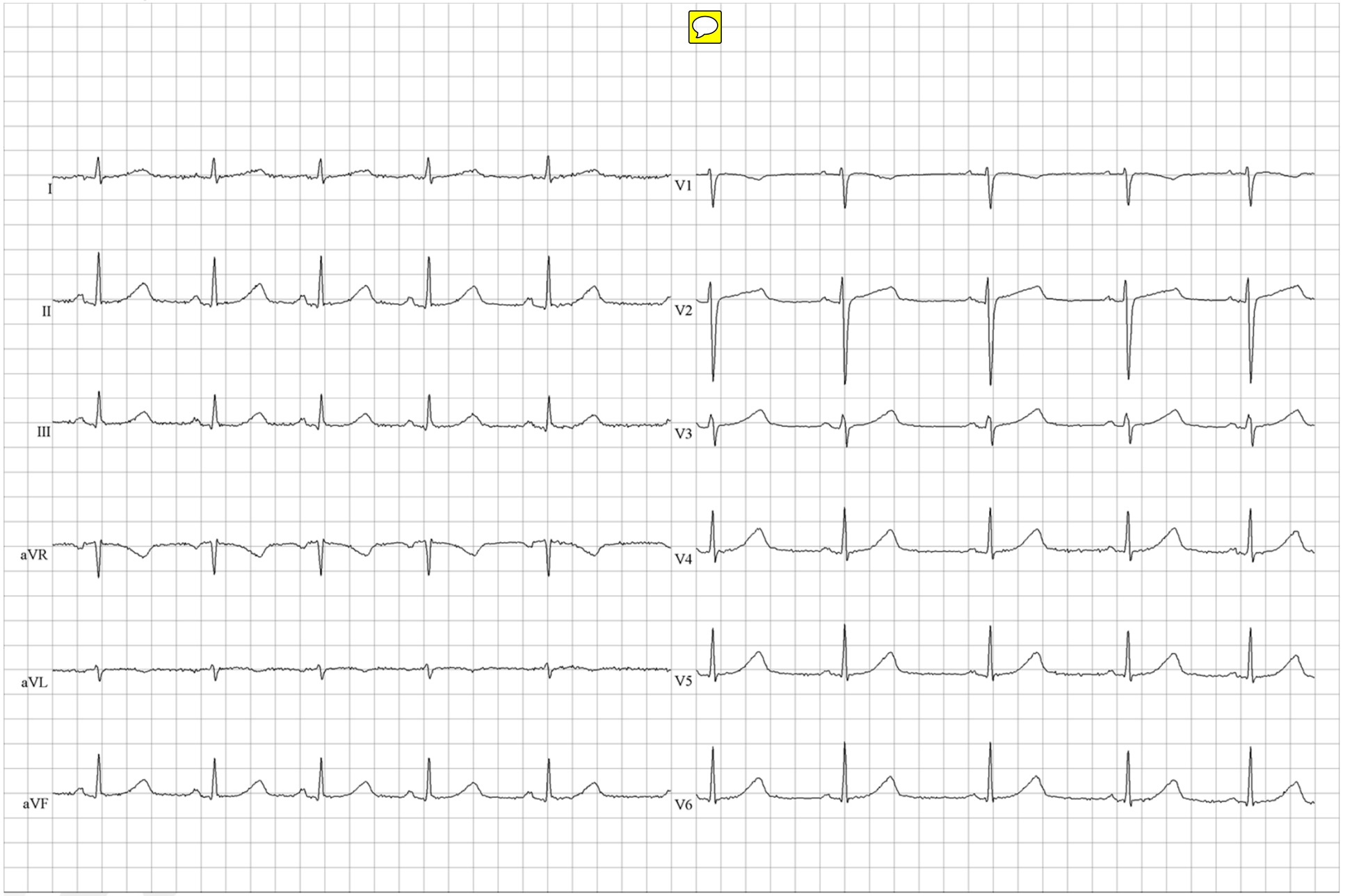
A 42-year-old man was hospitalized because he had had confusion, weakness, and lethargy for approximately a week

Nosworthy A. N Engl J Med 2003;349:2116

ECG male 83 y

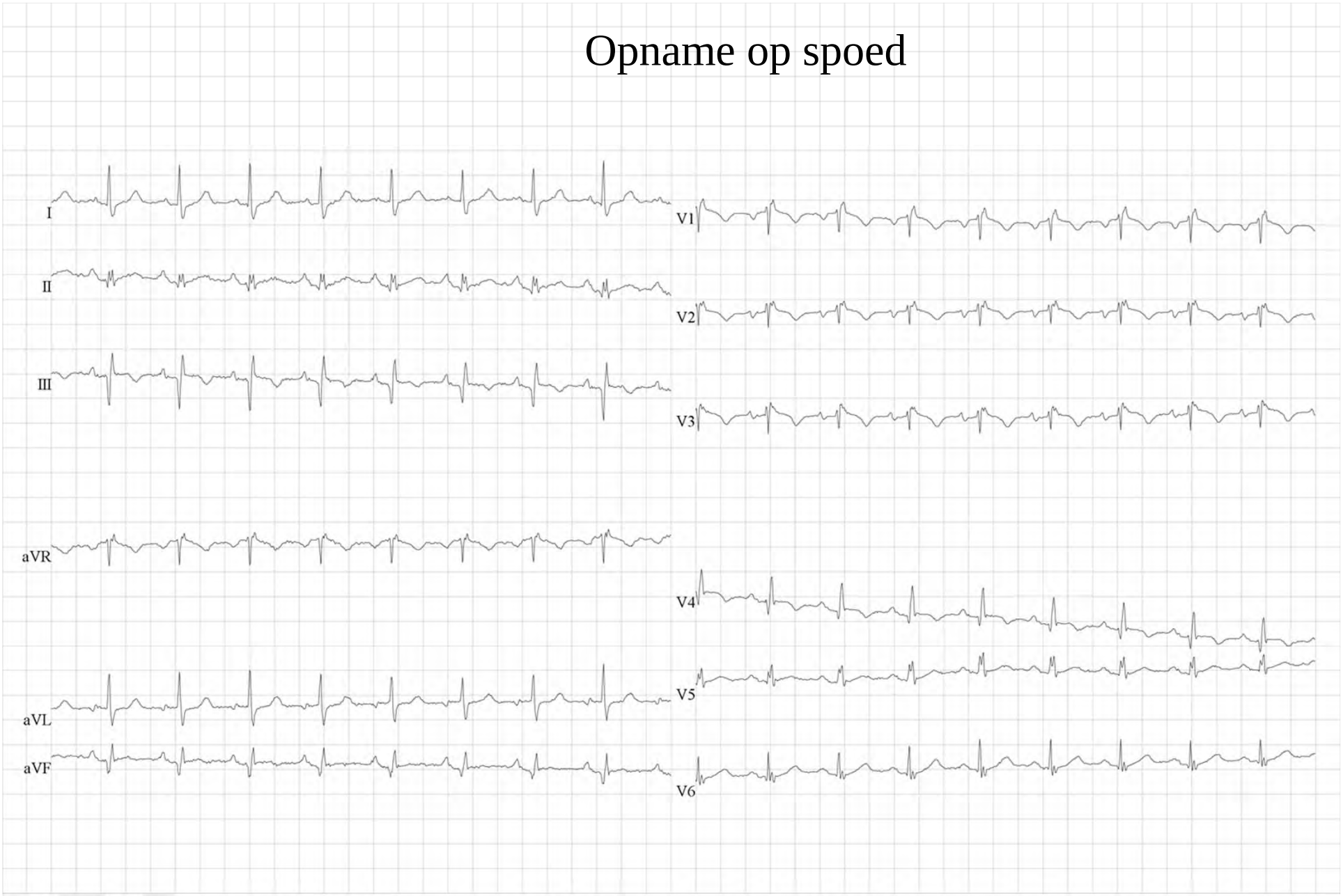
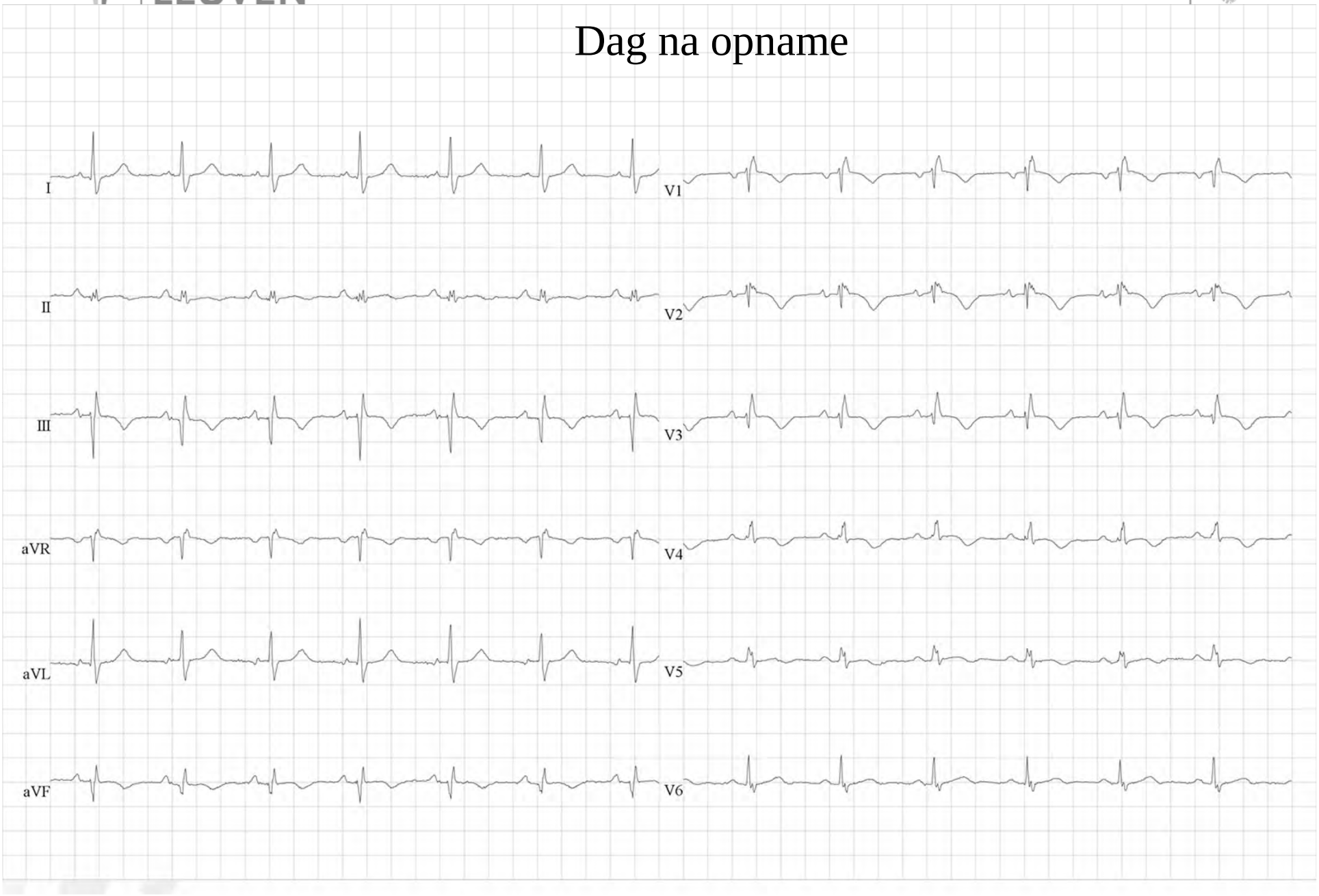

DE MARTELAER ANDRE
ID: 76520303
16–07–2003 13:38
UZ Leuven
EMDNr: 201113M139
Male
Loc: SPOED1
Vent. rate 82 BPM
PR interval ms
QRS duration 58 ms
QT/QTc 666/778 ms
P–R–T axes –4 –86
*** Poor data quality, interpretation may be adversely affected
AV sequential or dual chamber electronic pacemaker
When compared with ECG of 02–MAR–2003 14:53,
Vent. rate has increased BY 10 BPM
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
25mm/s 10mm/mV
12SL 250
Confirmed by: GEEN SUPERVISIE !!!!!!!! Confirmation date: 16–07–2003 14:44


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

Oud ecg

Opname op spoed



Dag na opname