EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT BRUGADA ECG

Giuseppe Oreto

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Right Bundle Branch Block, Persistent ST Segment Elevation and Sudden Cardiac Death: A Distinct Clinical and Electrocardiographic Syndrome

A Multicenter Report

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Aalst, Belgium and Barcelona, Spain

Objectives. The objectives of this study were to present data on eight patients with recurrent episodes of aborted sudden death unexplainable by currently known diseases whose common clinical and electrocardiographic (ECG) features define them as having a distinct syndrome different from idiopathic ventricular fibrillation.

Background. Among patients with ventricular arrhythmias who have no structural heart disease, several subgroups have been defined. The present patients constitute an additional subgroup with these findings.

Methods. The study group consisted of eight patients, six male and two female, with recurrent episodes of aborted sudden death. Clinical and laboratory data and results of electrocardiography, electrophysiology, echocardiography, angiography, histologic study and exercise testing were available in most cases.

Results. The ECG during sinus rhythm showed right bundle branch block, normal QT interval and persistent ST segment elevation in precordial leads V_1 to V_2–V_3 not explainable by electrolyte disturbances, ischemia or structural heart disease. No histologic abnormalities were found in the four patients in whom ventricular biopsies were performed. The arrhythmia leading to (aborted) sudden death was a rapid polymorphic ventricular tachycardia initiating after a short coupled ventricular extrasystole. A similar arrhythmia was initiated by two to three ventricular extrastimuli in four of the seven patients studied by programmed electrical stimulation. Four patients had a prolonged HV interval during sinus rhythm. One patient receiving amiodarone died suddenly during implantation of a demand ventricular pacemaker. The arrhythmia of two patients was controlled with a beta-adrenergic blocking agent. Four patients received an implantable defibrillator that was subsequently used by one of them, and all four are alive. The remaining patient received a demand ventricular pacemaker and his arrhythmia is controlled with amiodarone and diphenylhydantoin.

Conclusions. Common clinical and ECG features define a distinct syndrome in this group of patients. Its causes remain unknown.

(J Am Coll Cardiol 1992;20:1391–6)

ELECTROCARDIOGRAPHIC PATTERN SIMULATING ACUTE MYOCARDIAL INJURY

By Harold L. Osher, M.D.
PORTLAND, MAINE

AND

Louis Wolff, M.D.
BOSTON, MASSACHUSETTS

(From the Electrocardiographic Laboratory, Beth Israel Hospital, the Department of Medicine, Harvard Medical School, Boston, Massachusetts, and the Heart Disease Epidemiology Study, National Heart Institute, National Institutes of Health, Public Health Service, Department of Health, Education, and Welfare, Framingham, Massachusetts.)

Abnormal displacement of the S-T segment may be associated with a variety of clinical states. In myocardial injury the typical configuration consists of elevation and upward bowing of the S-T segment with symmetrical in-

blood cell counts and erythrocyte sedimentation rates remained normal. Initial electrocardiograms showed right bundle branch block (RBBB) with elevation of S-T segments and inversion of T waves in the right pre-

Am J Med Sci 1953;226:541-545.

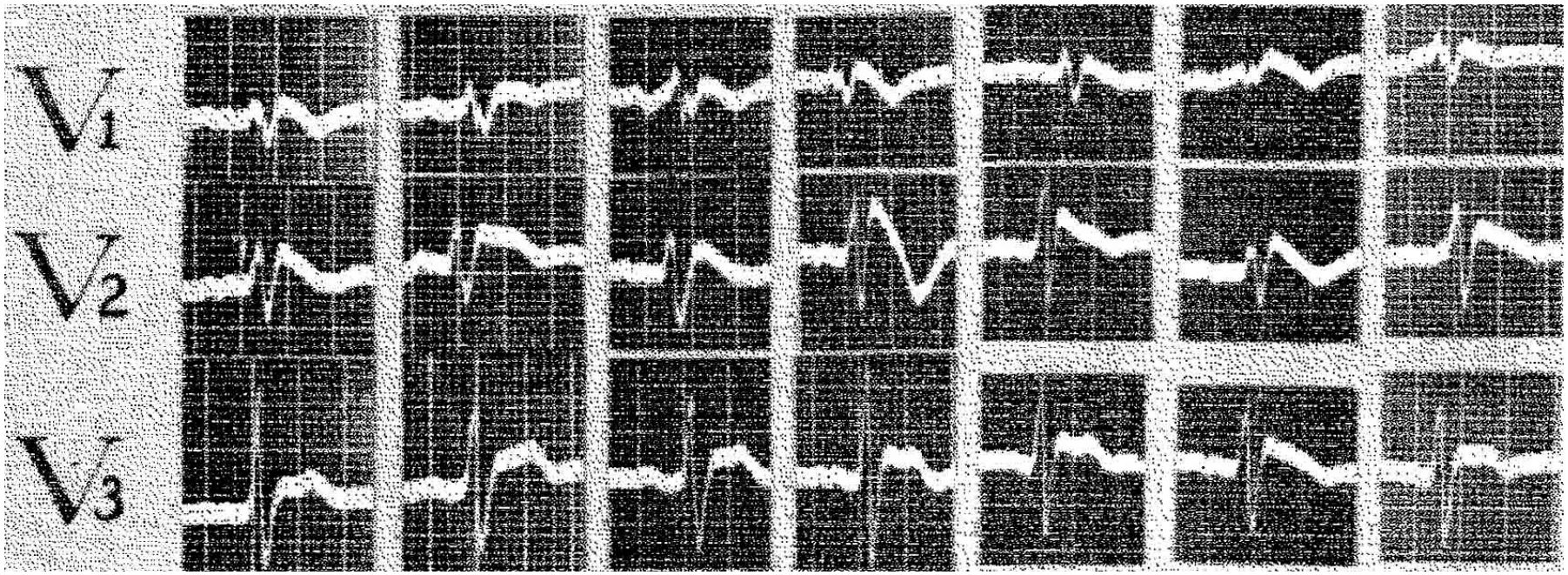


Fig. 1. – Electrocardiogram of a 39-year-old white male with mild atypical chest pain but no clinical evidence of heart disease. Note the wide QRS interval (0.12-0.13 sec) with features of RBBB, and ST segment elevation and T wave inversion in the right precordial leads, simulating the pattern pf anteroseptal injury. The serial tracings show minor variations in the ST-T configuration, but not the typical evolution seen with myocardial injury.

Osher HL, Wolff L, 1953

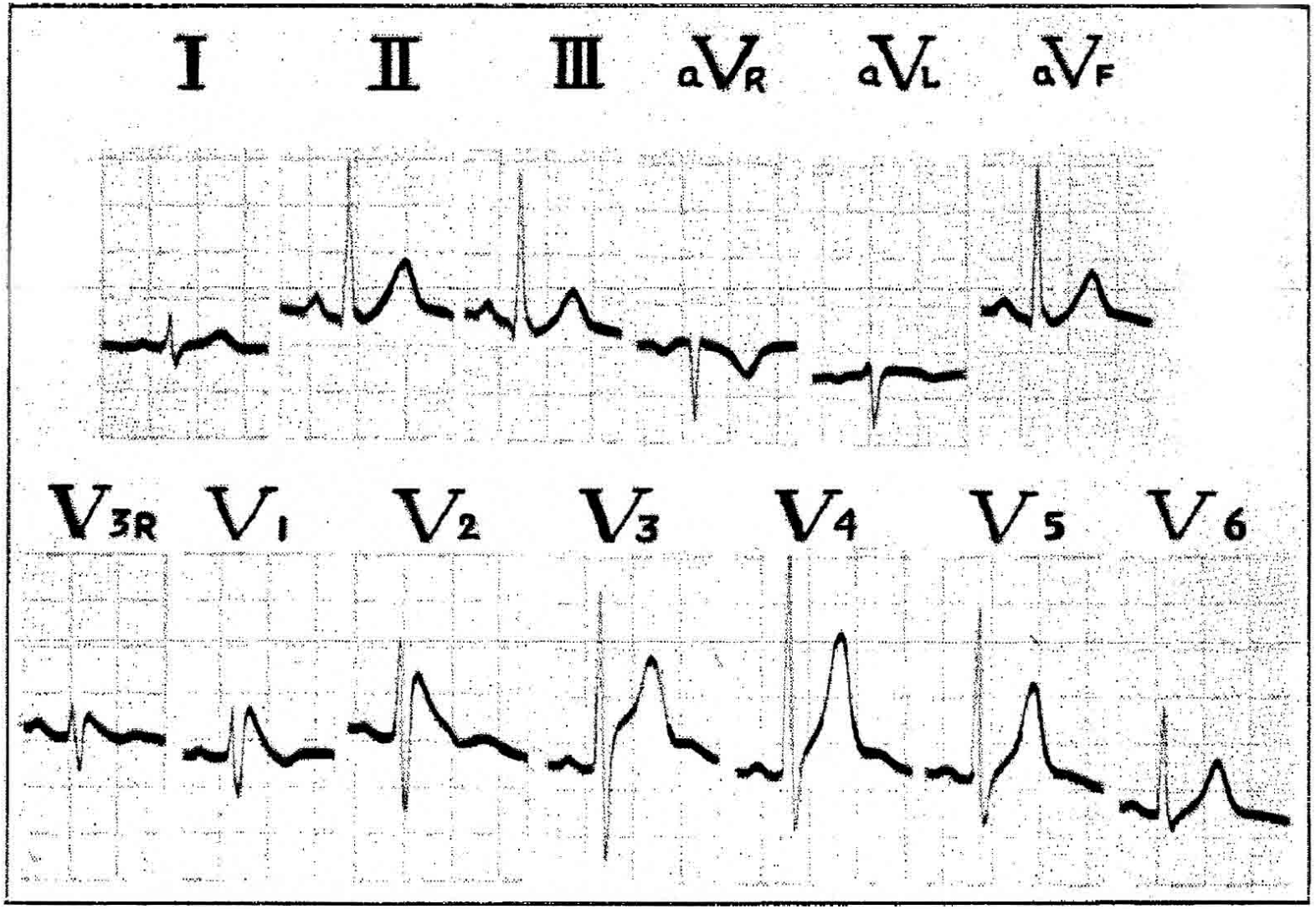


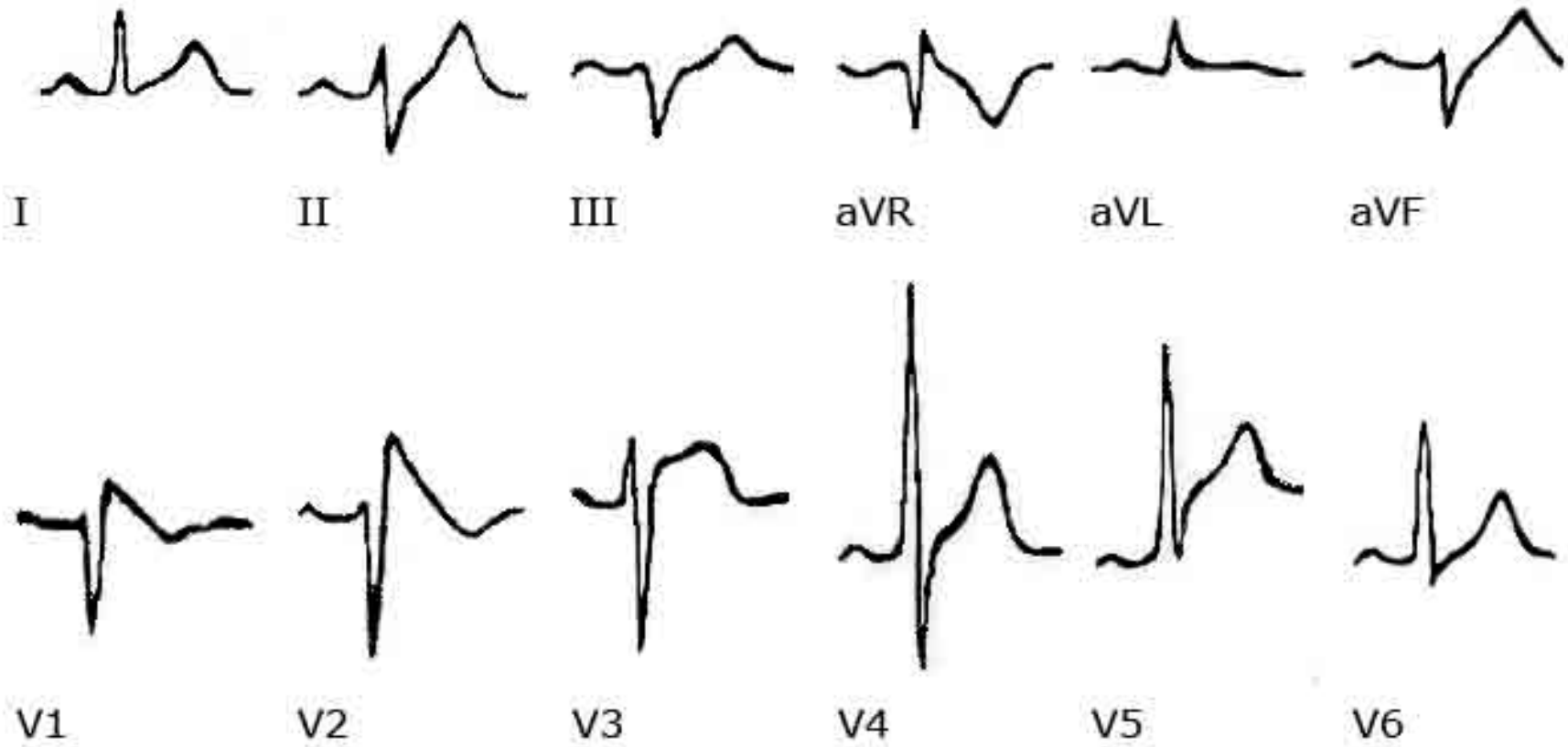
Fig. 3.—Electrocardiogram of a healthy 37-year-old white male with no clinical evidence of heart disease.

Edeiken J: Elevation of the RS-T segment, apparent or real, in the right precordial leads as a probable normal variant. Am Heart J 1954:48:331-9

Ventricular fibrillation without apparent heart disease: Description of six cases

Since 1977, six patients (five males and one female), aged 14 to 35 years, resuscitated from ventricular fibrillation, were referred to our department for detailed evaluation, after exclusion of major cardiac pathologic conditions. Four patients had a family history of heart disease. Basic ECGs showed sinus rhythm in all of them. PR interval was prolonged in one. Two patients had complete and one had incomplete right bundle branch block. One patient had inverted t waves in V_{1-3} and late potentials. Three had an upsloping ST-T segment elevation in V_{1-2}. The cardiothoracic index was less than 0.5 in five and 0.50 in one. In one of the five patients studied, the clinical episode of ventricular fibrillation was reproduced by stimulation of the right ventricular outflow tract during electrophysiologic study. Results of cross-sectional echocardiography and angiography showed predominantly structural and wall motion abnormalities of the right ventricle in five patients and slight wall motion abnormalities of the left ventricle in two. Two patients also had mitral and tricuspid valve prolapse. Coronary arteries were normal in all five patients examined. Results of endomyocardial biopsy showed no abnormalities in one patient, fibrosis in two, and fibrolipomatosis in one. Two patients died during follow-up: autopsy was performed in one and results showed right ventricular cardiomyopathy. Thus in five of these selected patients with apparent idiopathic ventricular fibrillation, some abnormalities, predominantly of the right ventricle, were documented only after detailed investigation; however, clinical history and some nonspecific ECG abnormalities were factors in the diagnostic procedure. (AM HEART J 1989;118:1203.)

Bortolo Martini, MD, Andrea Nava, MD, Gaetano Thiene, MD,
Gian Franco Buja, MD, Bruno Canciani, MD, Roldano Scognamiglio, MD,
Luciano Daliento, MD, and Sergio Dalla Volta, MD. *Padua, Italy*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V5
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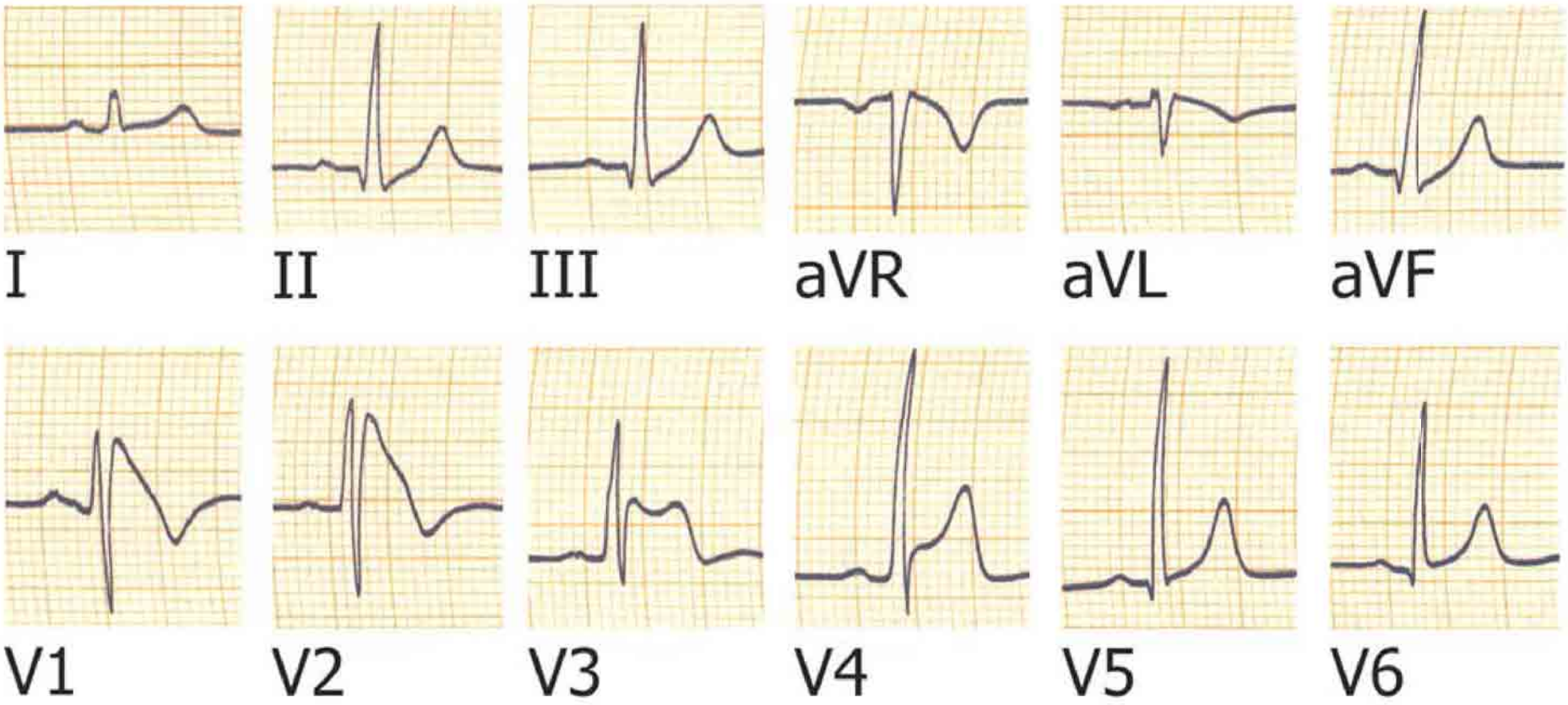

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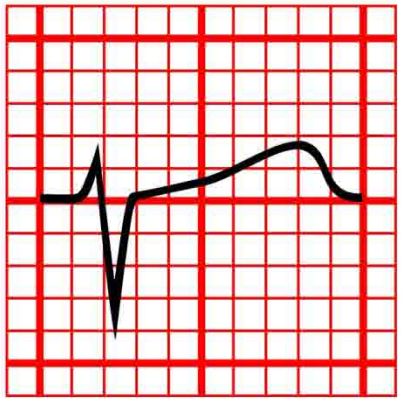

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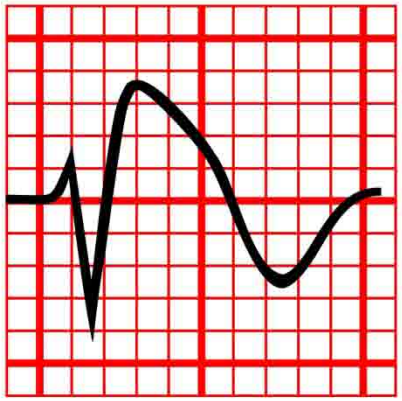
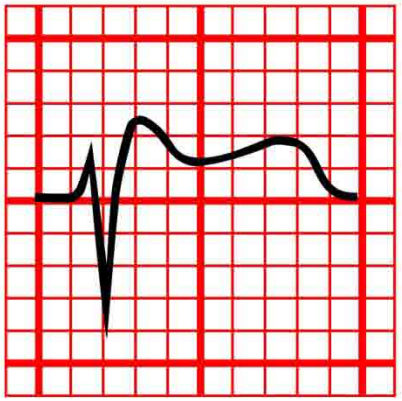
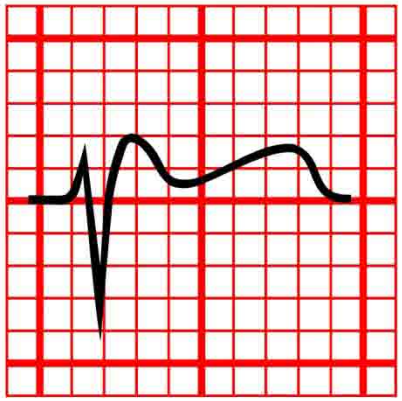


type 1



type 2



type 3

Wilde AA, et al: Eur Heart J 2002; 23:1648-1654

Antzelevitch C et al: Circulation 2005; 111:659-670

Challenges to the cardiologist when assessing an ECG with positive terminal deflection (J wave) and ST segment elevation in leads V1 to V3

Consensus Conference endorsed by the Italian Society of Cardiology

Giuseppe Oreto[1], Domenico Corrado[2], Pietro Delise[3], Francesco Fedele[4], Fiorenzo Gaita[5], Federico Gentile[6], Carla Giustetto[5], Antonio Michelucci[7], Luigi Padeletti[7], Silvia Priori[8]

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When an ECG shows (or is suspicious for) a Brugada pattern, i.e. the association of a positive terminal deflection and ST segment elevation in the right precordial leads, the cardiologist often faces several problems. Three important questions are raised by this ECG pattern: 1) is this really a Brugada ECG pattern? 2) How can be determined whether this patient is at risk for sudden death? and 3) Should this patient receive an implantable cardioverter-defibrillator (ICD)? The term "Brugada syndrome" should be restricted to patients who have diagnostic ECG changes,

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www.jecgonline.com

Current electrocardiographic criteria for diagnosis of Brugada pattern: a consensus report☆

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[b]*Hospital Clínico, Barcelona, Spain*
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[d]*Universitätsmedizin Mannheim-I. Medizinische Klinik, Mannheim, Germany*
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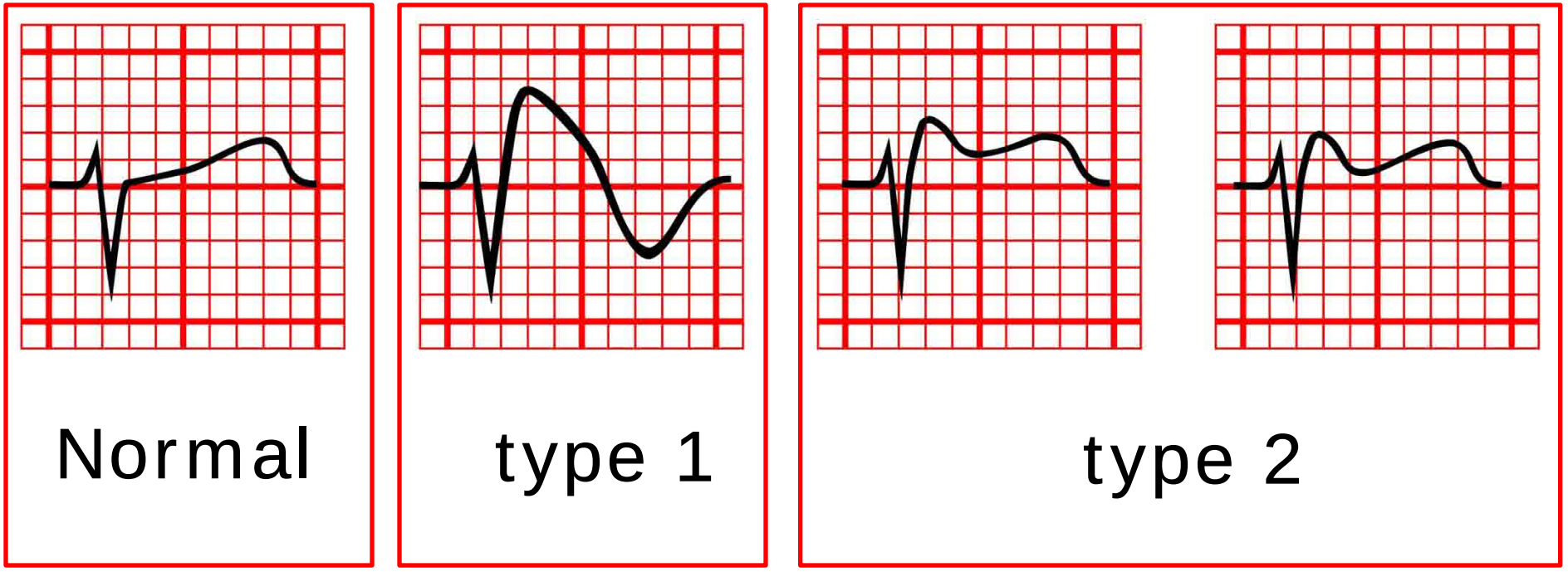
[f]*Heart Hospital, UCL, London, UK*
[g]*Facultad de Medicina del ABC-Santo André, Sao Paulo, Brasil*
[h]*Cannary Islands, Spain*
[i]*Instituto do Coraçao, Sao Paulo, Brasil*
[j]*Universita de Messina, Messina, Italy*
[k]*University of Rochester Medical Center, Rochester, NY, USA*
[l]*Cardiovascular Genetic Center UdG-IDIBGI, Girona, Spain*
[m]*Free University of Brussels (UZ Brussel) VUB, Brussels, Belgium*

Received 20 March 2012

Bayes de Luna et al: Current Electrocardiographic criteria for diagnosis of Brugada pattern: a consensus document. *J Electrocardiol, 2012;45:433-442*



Type 1
(Coved pattern)

This typical coved pattern presents in V1-V2 the following:

- At the end of QRS an ascending and quick slope with a high take-off ≥ 0.2 mv followed by concave or rectilinear downsloping ST.
- There is no clear r' wave.
- The high take-off often does not correspond with the J point
- At 40 ms of high take-off the decrease in amplitude of ST is ≤ 0.4 mV.
- ST at high take-off > ST at 40 ms > ST at 80 ms.
- ST is followed by negative and symmetric T wave.
- The duration of QRS is longer than in RBBB and there is a mismatch between V1 and V6.

Bayes de Luna et al: *J Electrocardiol, 2012;45:433-442*

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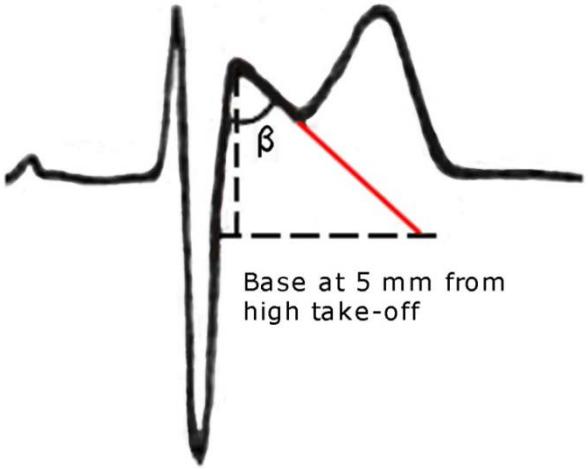
Bayes de Luna et al: *J Electrocardiol, 2012;45:433-442*

Type 2
(Saddle back pattern)



- High take-off of r' (that not necessary coincides with J point) ≥2 mm
- The descending arm of r' coincides with the beginning of ST
- Minimum ST elevation ≥ 0.05 mv
- Positive T wave in V2 (T peak>ST minimum> 0) and of variable morphology in V1.
- The duration of QRS is longer in BP type 2 than in other cases with r' in V1 and there is a mismatch between V1 and V6
- The characteristics of triangle formed by r' allow to define different criteria useful for diagnosis
  a)β angle > 58° (Chevallier 2011).
  b)duration of the base triangle of r' at 5 mm from the high take-off > 3.5 mm (Serra 2012)

Bayes de Luna et al: *J Electrocardiol, 2012;45:433-442*

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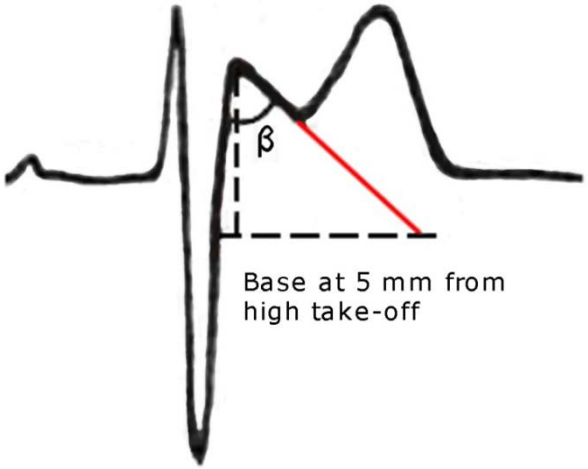
(Saddle back pattern)



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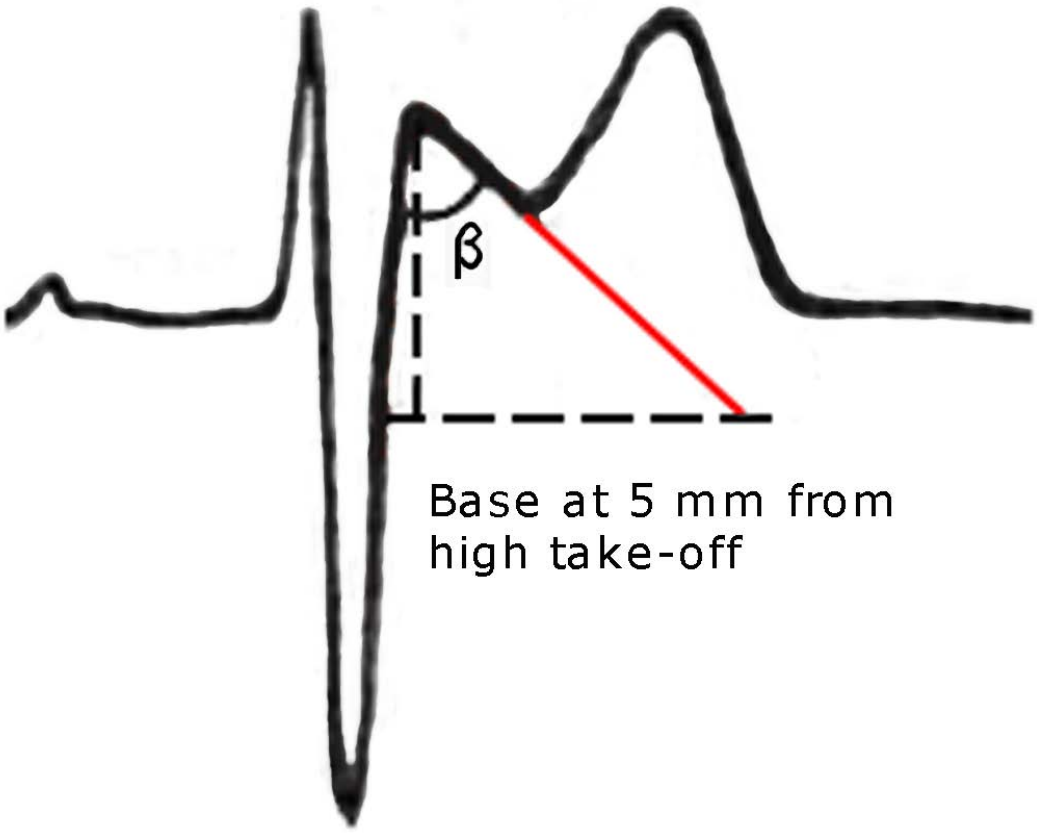
Bayes de Luna et al: *J Electrocardiol, 2012;45:433-442*

β angle > 58º (Sensitivity 79%; specificity 84%) (*Chevalier 2011*)



The base of triangle of r' at 5 mm from the high take-off > 3.5 mm (Sensitivity 81%; specificity 82%) (*Serra 2012*).

PROBLEMS WITH BRUGADA EGC PATTERN

- ✓ Is only type 1 diagnostic?
- ✓ Is type 2 “innocent”?
- ✓ The ECG manifestation is widely variable, from a totally normal tracing to the most obvious type 1 pattern
- ✓ Conditions other from Brugada pattern have similar ECGs
- ✓ There is high risk of either underdiagnosis or overdiagnosis

CONDITIONS TO BE DISTINGUISHED FROM BRUGADA ECG PATTERN

- ✓Right bundle branch block
- ✓Myocardial ischemia
- ✓Acute pericarditis
- ✓Electrolyte imbalance
- ✓Early repolarization
- ✓Drug effect
- ✓Hypothermia
- ✓Pectus excavatum
- ✓Right ventricular involvement
- ✓Use of inappropriate ECG filters

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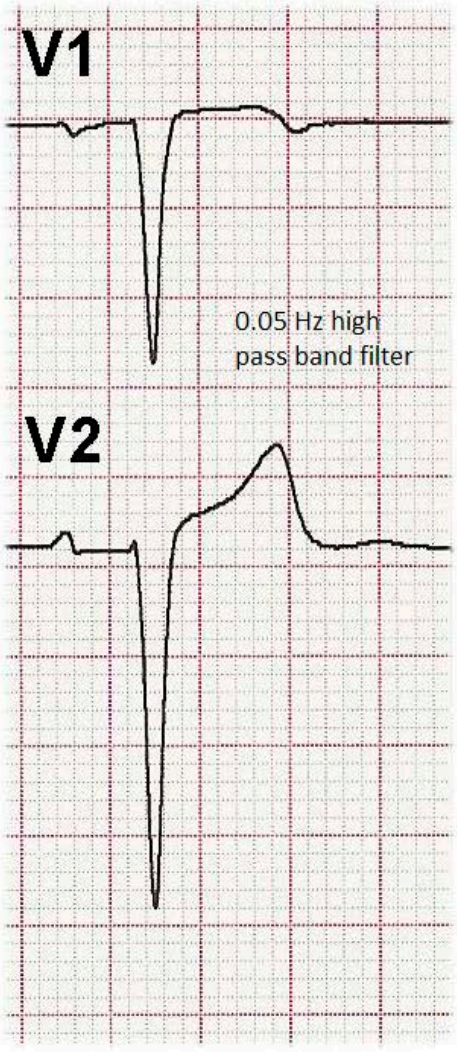
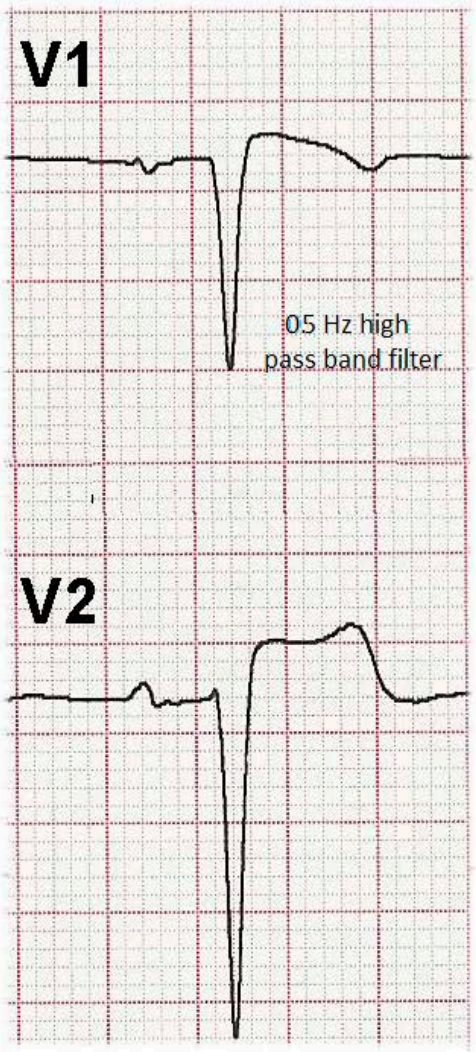
0.05 Hz high pass band filter



0.5 Hz high pass band filter



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ECG ANALYSIS IN THE PRESENCE OF A POSITIVE TERMINAL WAVE IN LEADS V1-V2

Diagnostic items:

- ✓Leads V1-V3 recorded at the 3rd and 2nd intercostal space
- ✓Positive terminal wave morphology
- ✓Positive terminal wave duration
- ✓QRS duration in leads V1-V2 compared to lead V6

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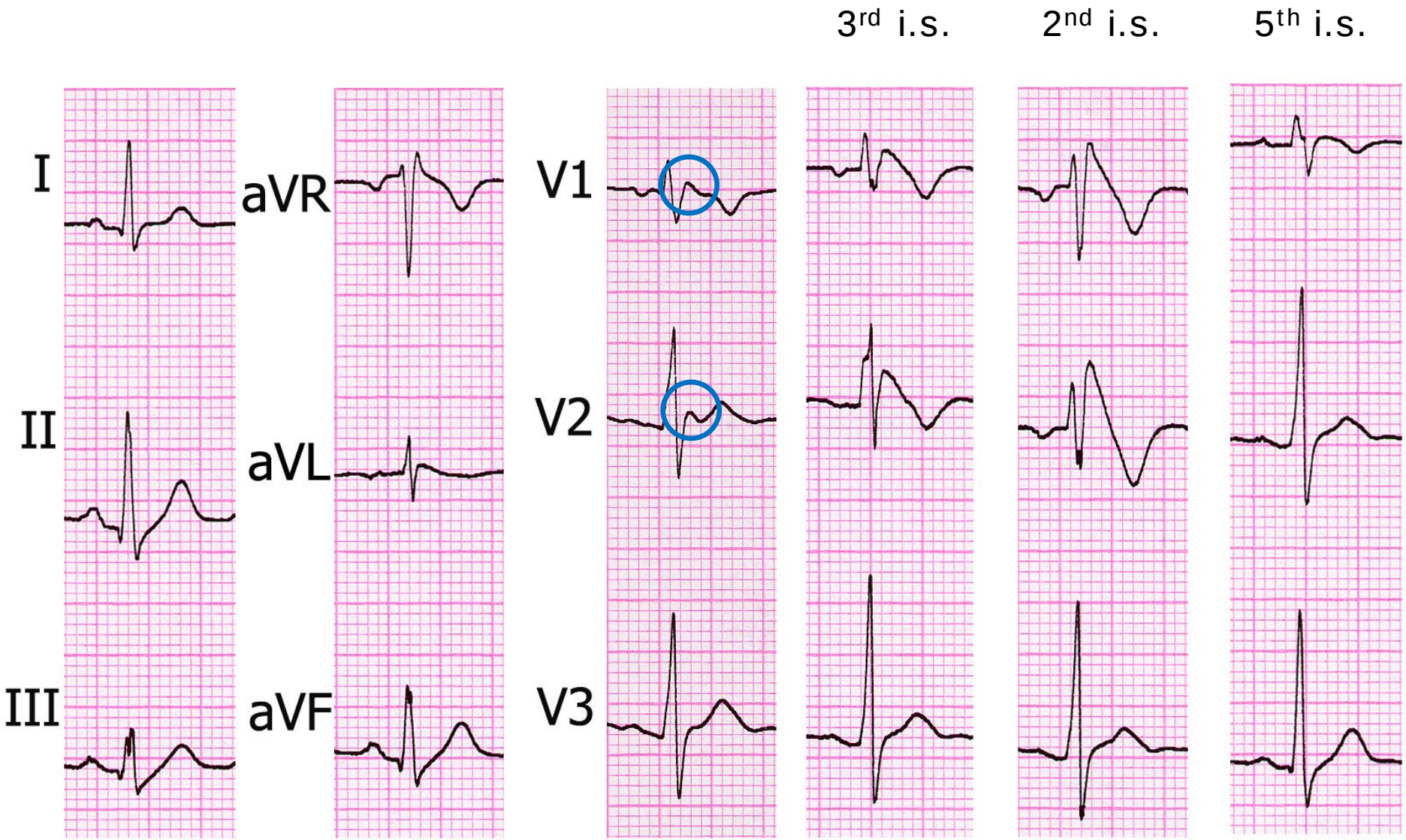
3rd i.s.
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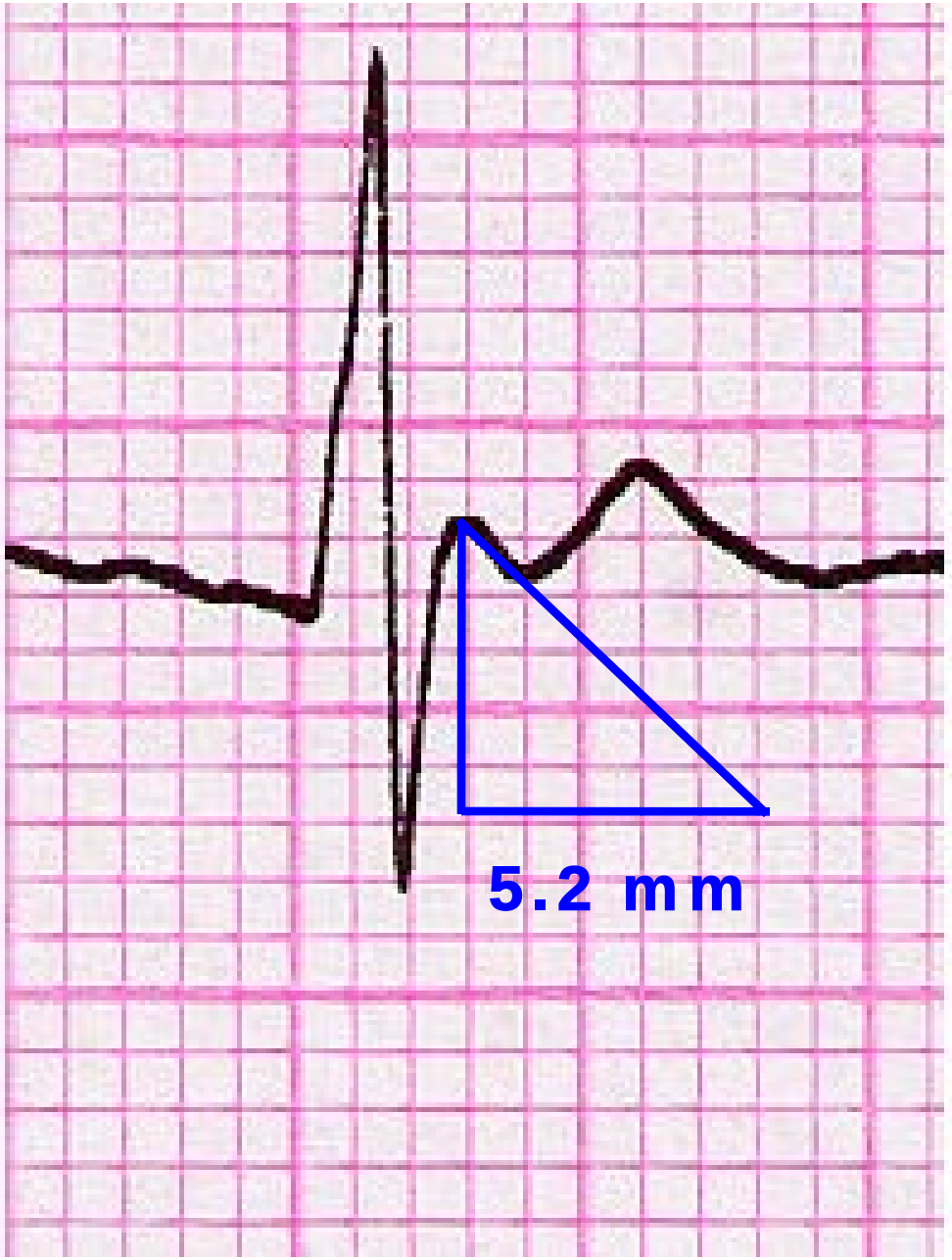
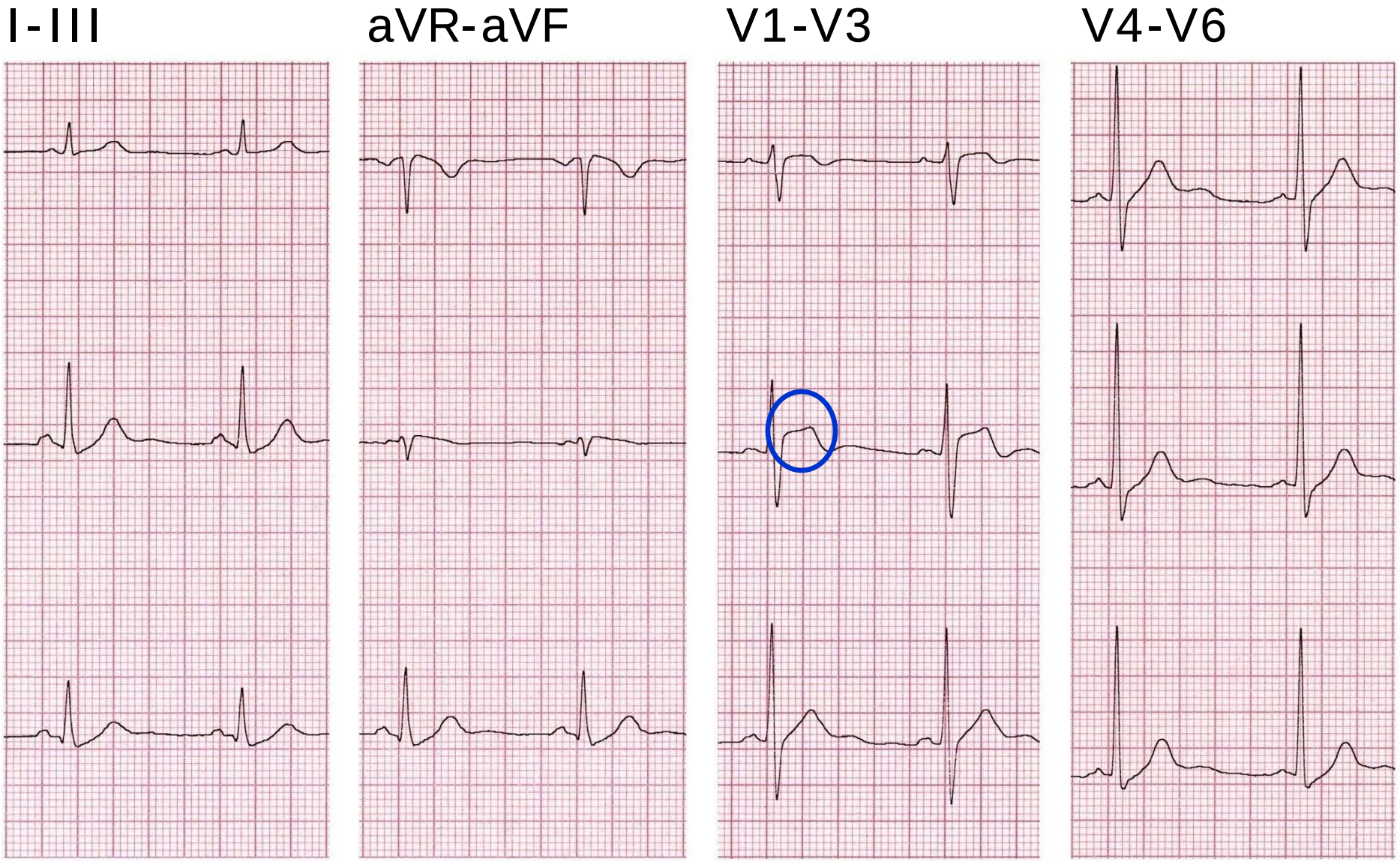
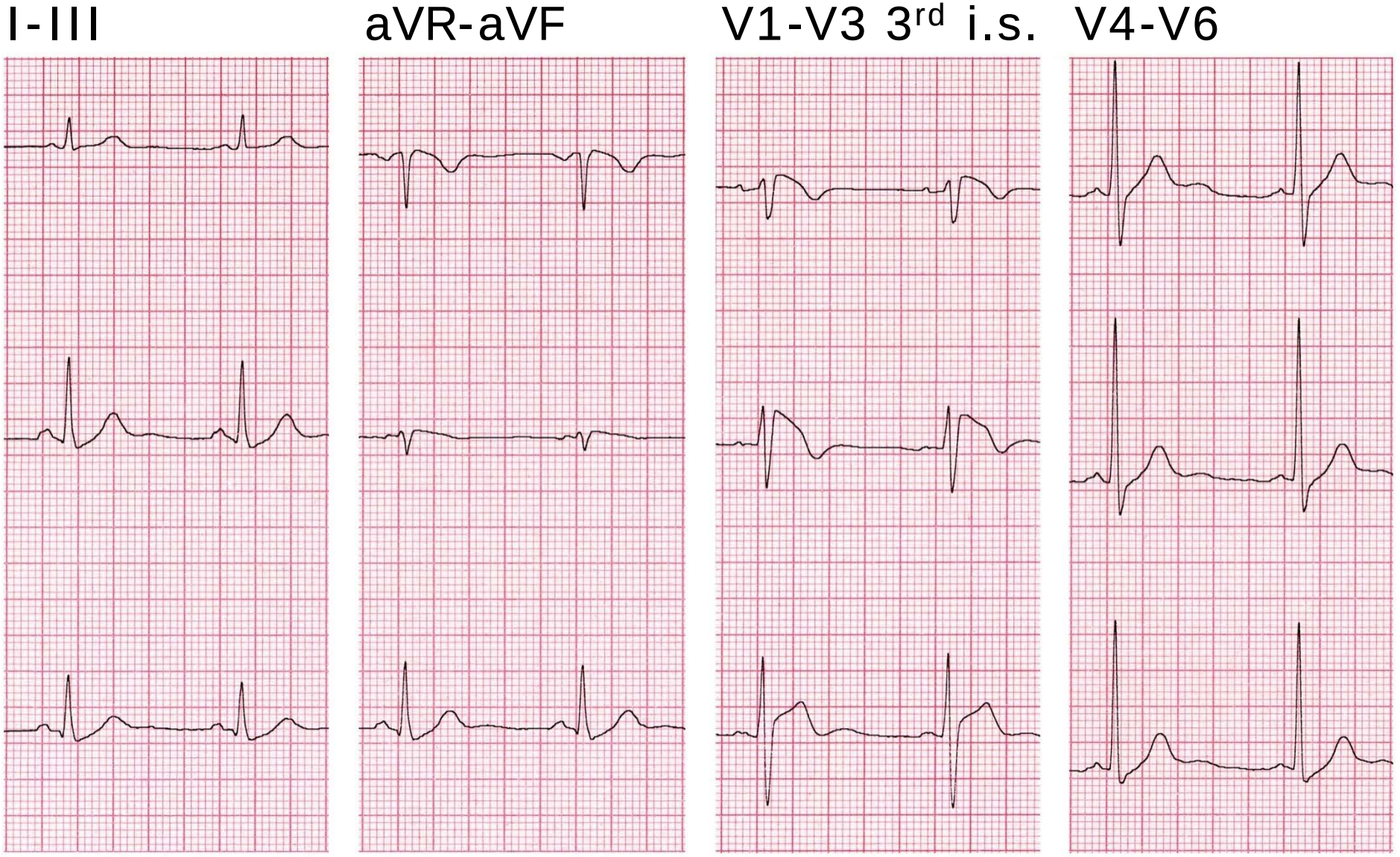
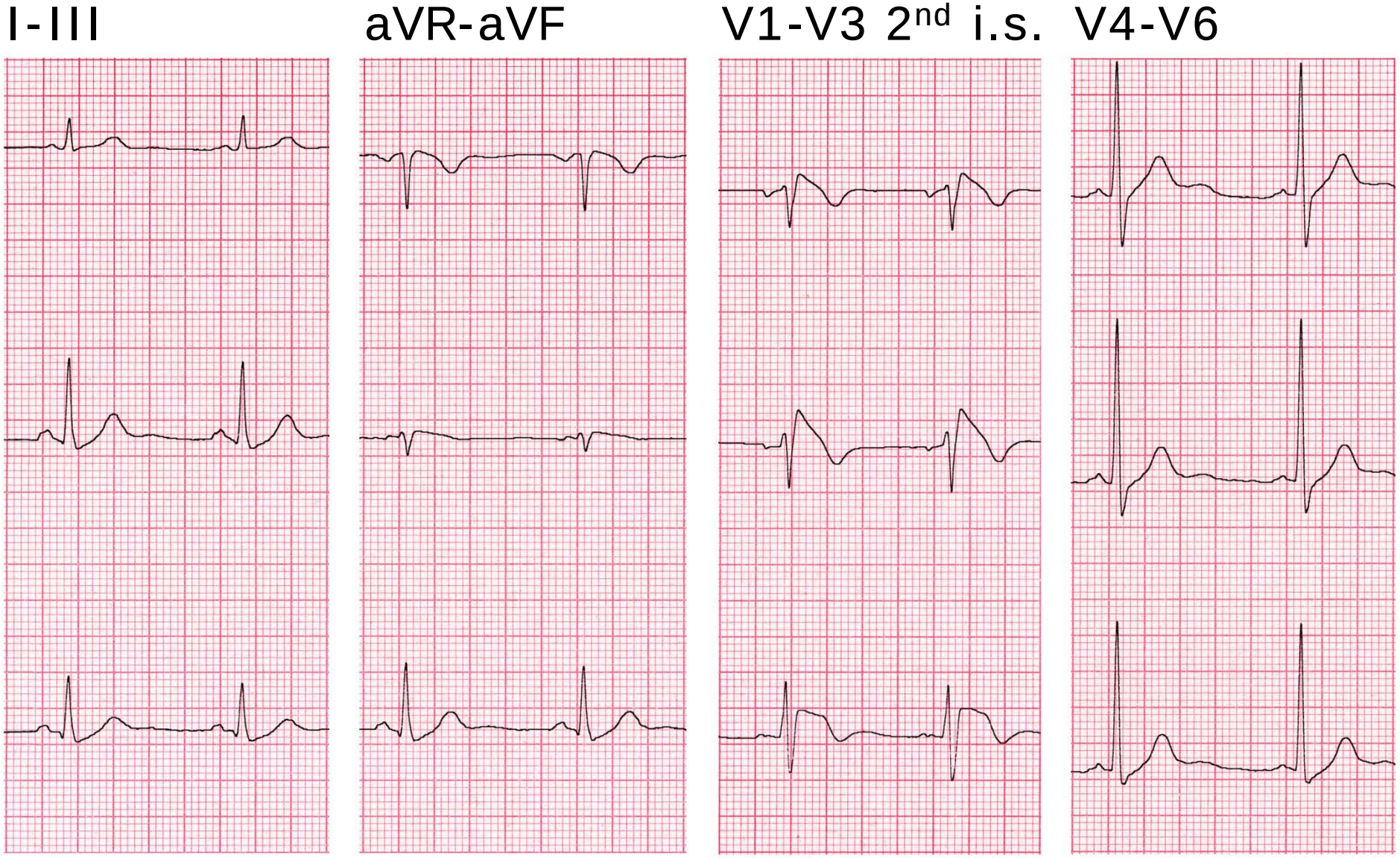
V3

V2

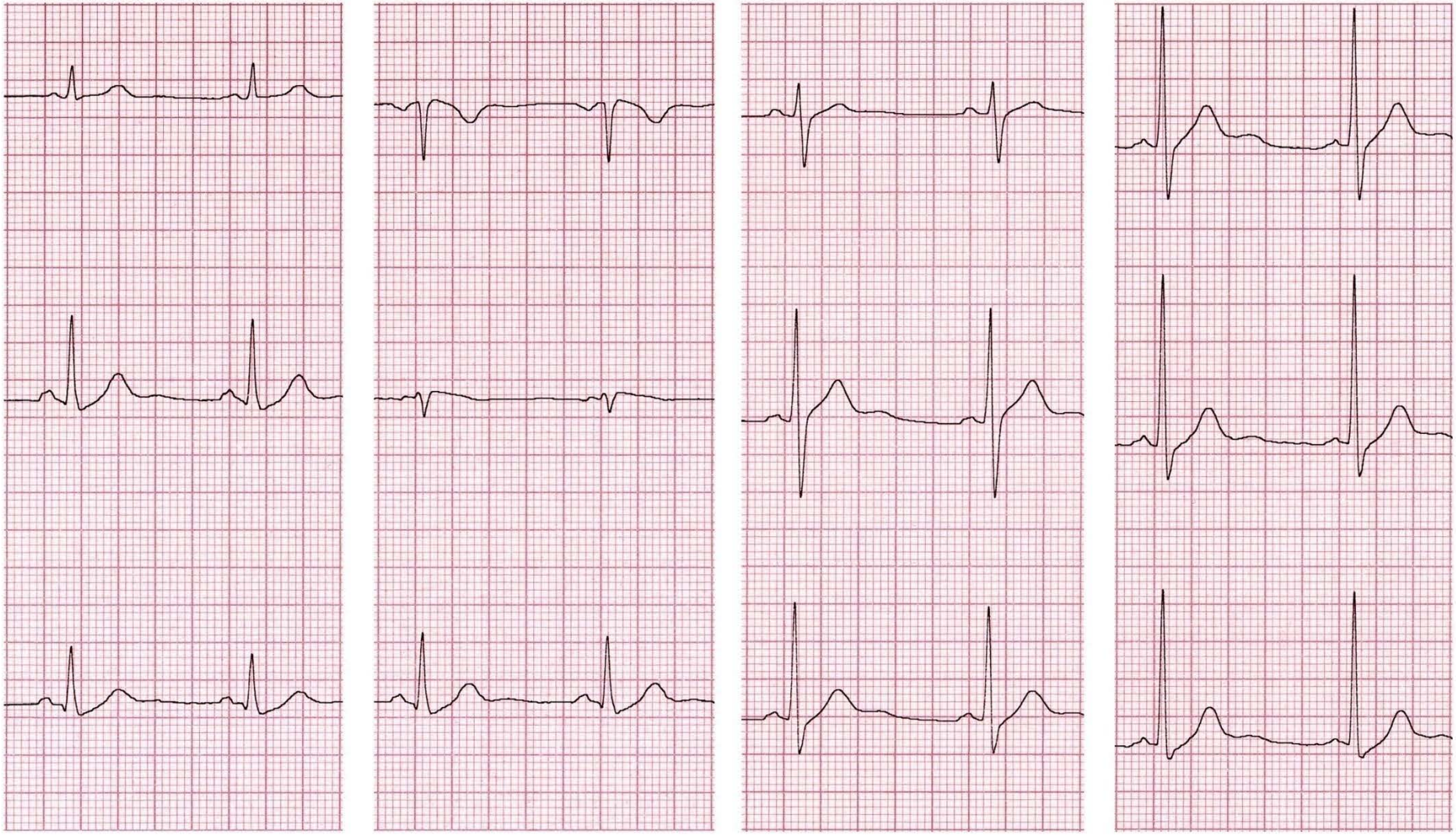


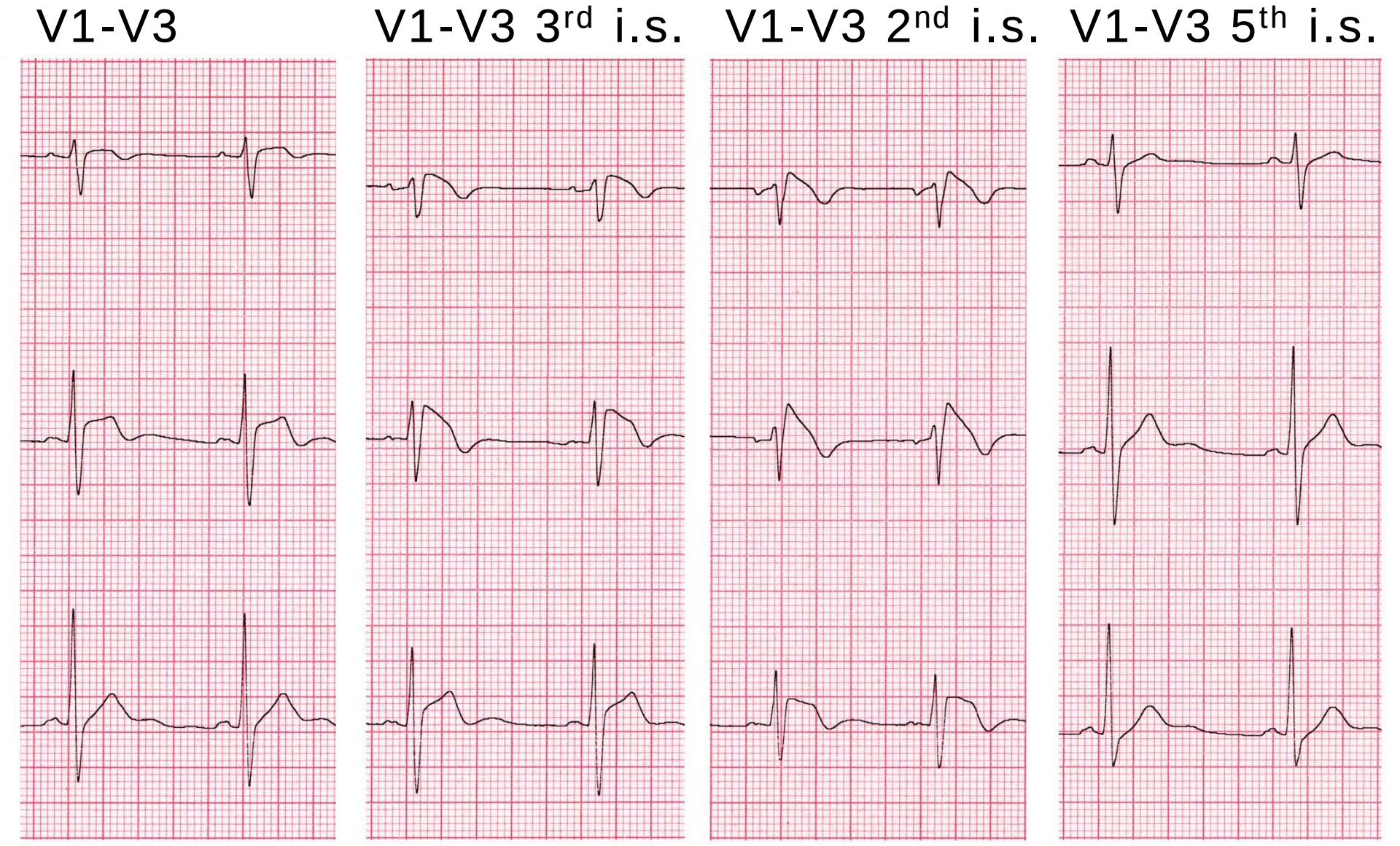

I-III
aVR-aVF
V1-V3
V4-V6

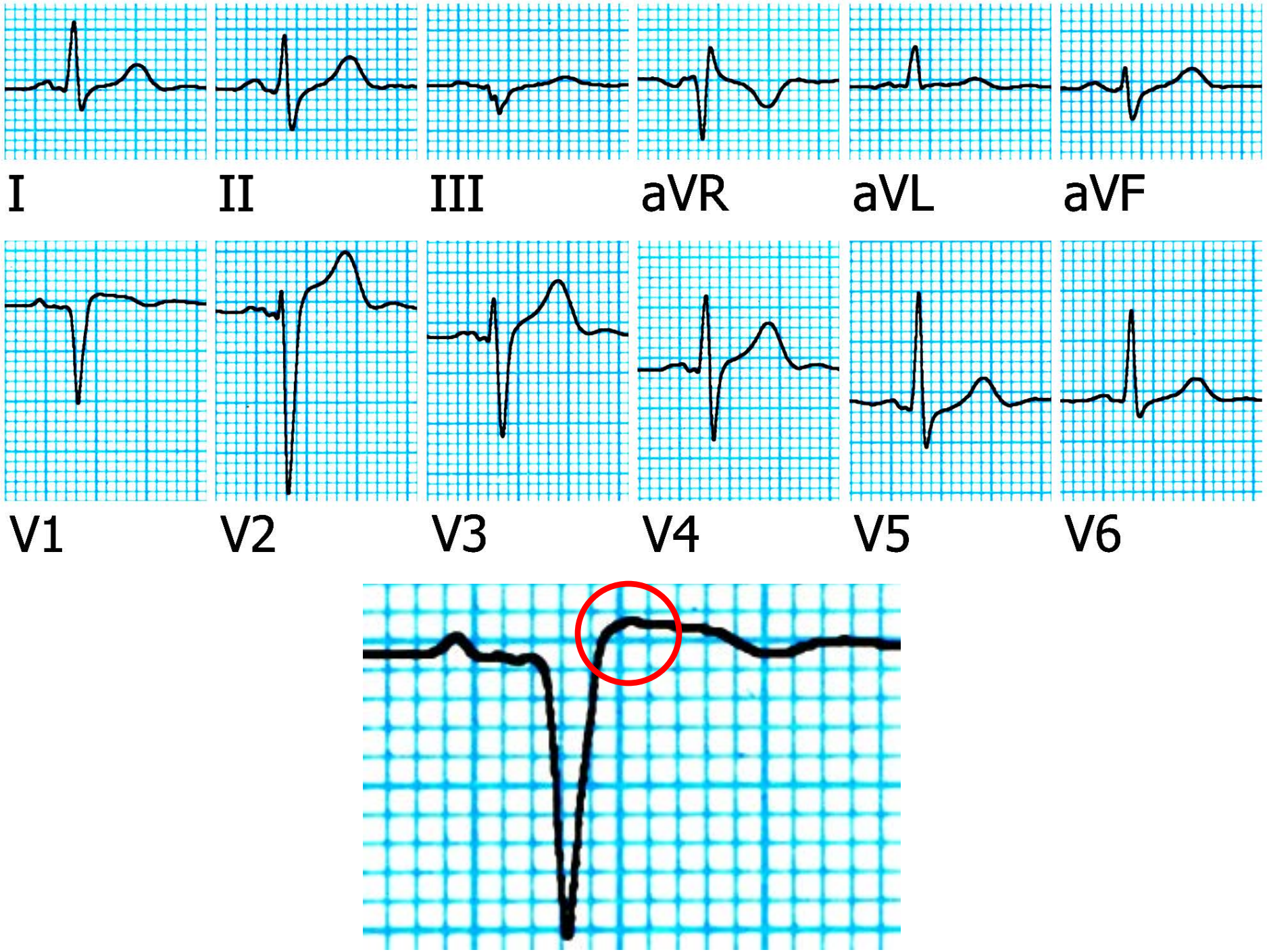

I-III
aVR-aVF
V1-V3 3rd i.s.
V4-V6


I-III
aVR-aVF
V1-V3 2nd i.s.
V4-V6

I-III aVR-aVF V1-V3 5th i.s. V4-V6




V1-V3
V1-V3 3rd i.s.
V1-V3 2nd i.s.
V1-V3 5th i.s.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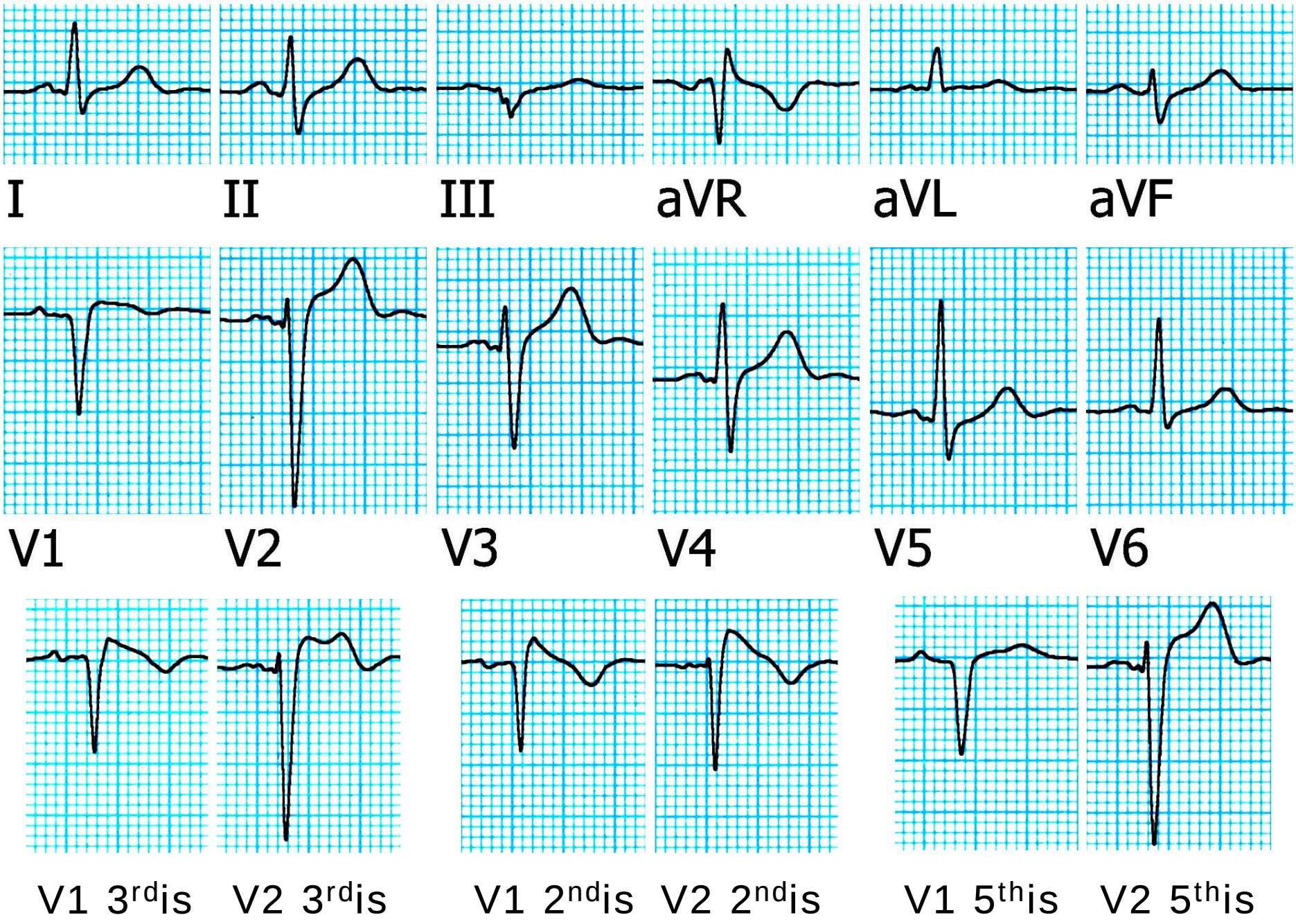
V5
V6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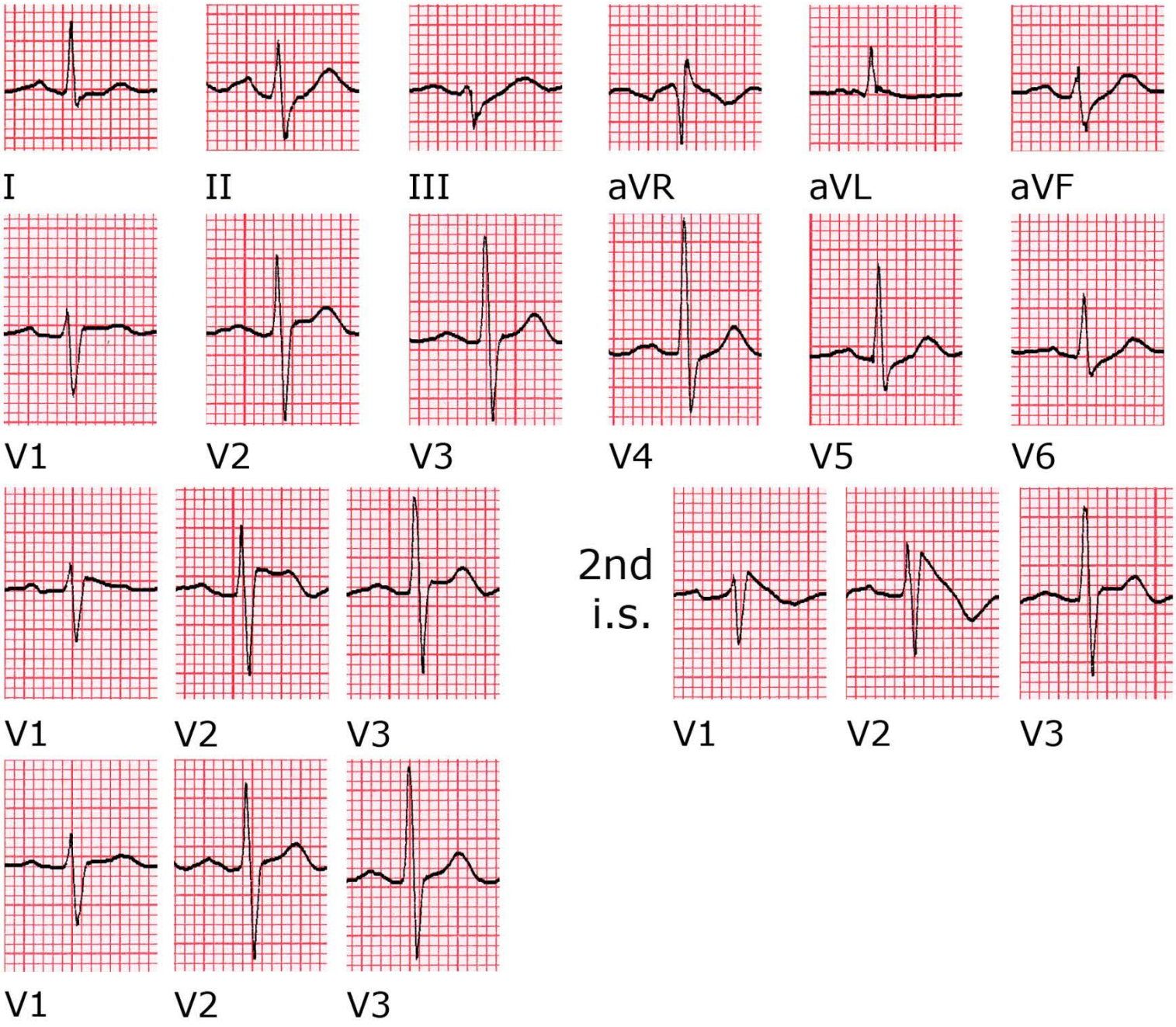
V1 5this
V2 5this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aVF
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V2
V3
V4
V5
V6
3rd i.s.
V1
V2
V3
2nd i.s.
V1
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V3
5th i.s.
V1
V2
V3

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I

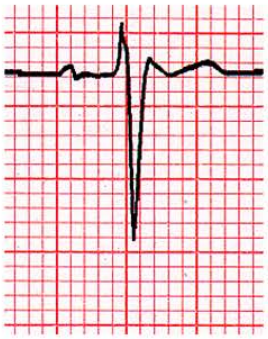
II

III

aVR

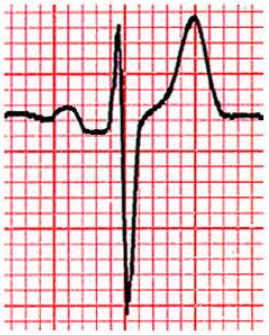
aVL

aVF

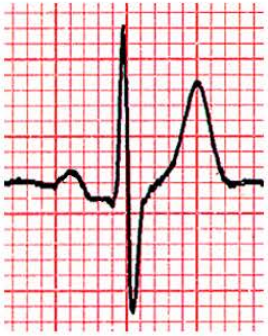


V1

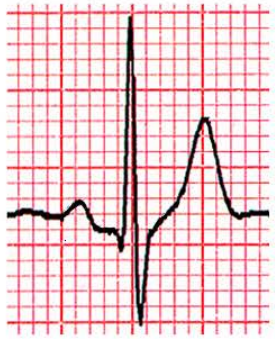
V2



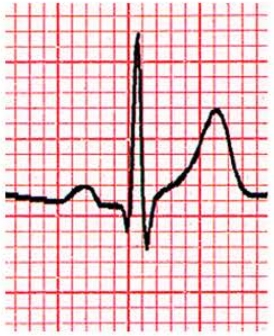
V3



V4



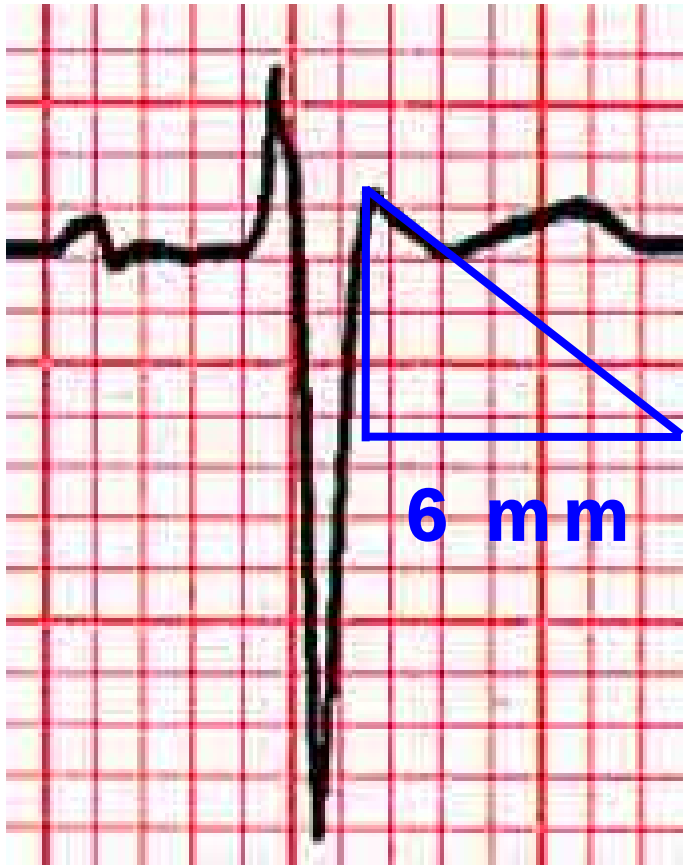
V5

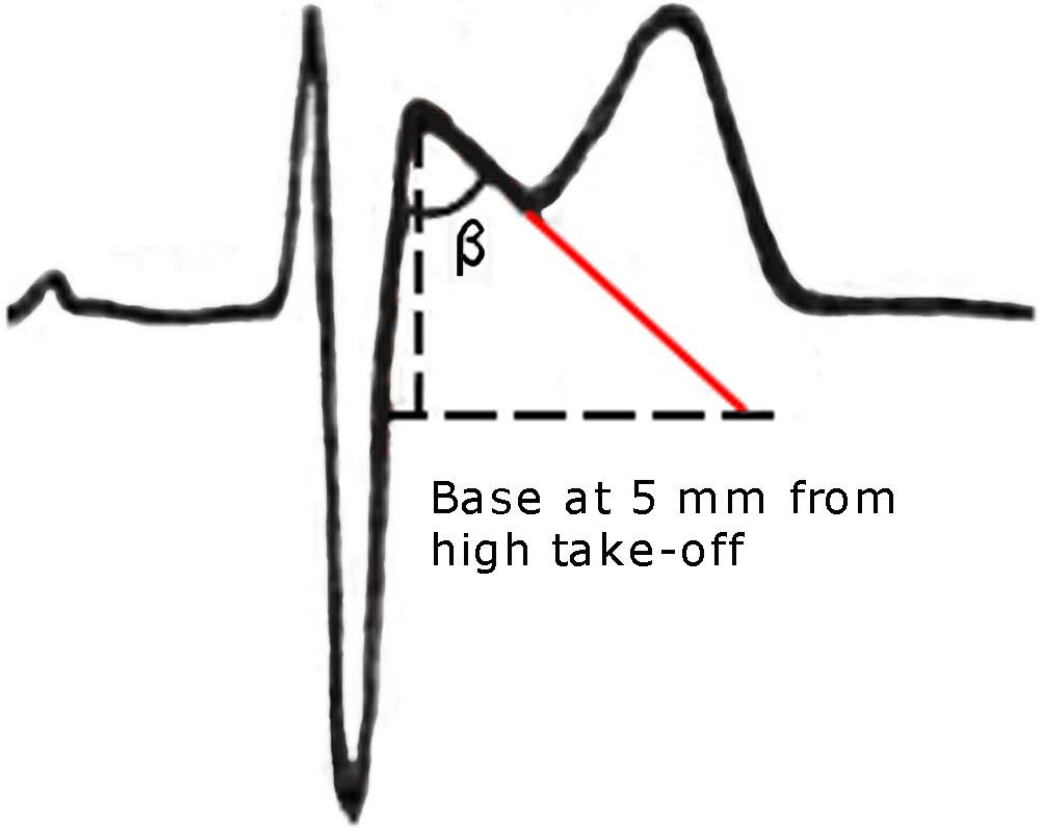


V6

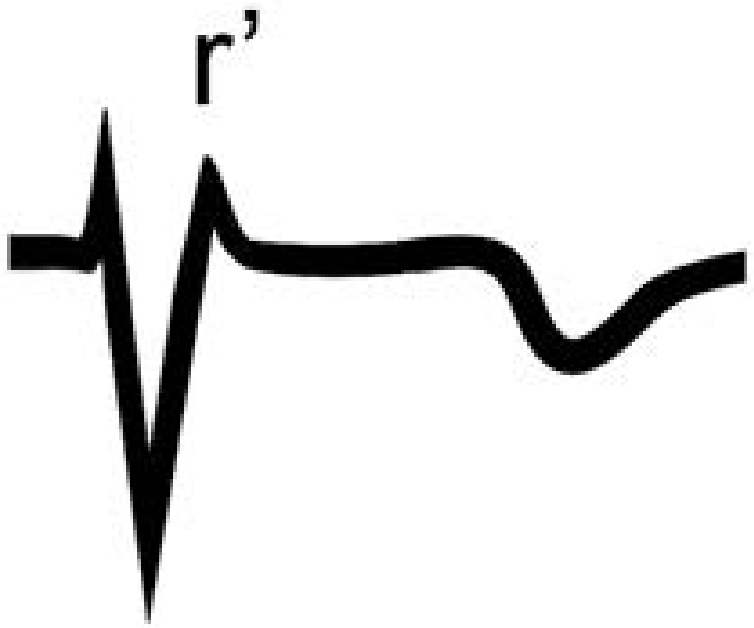
V1

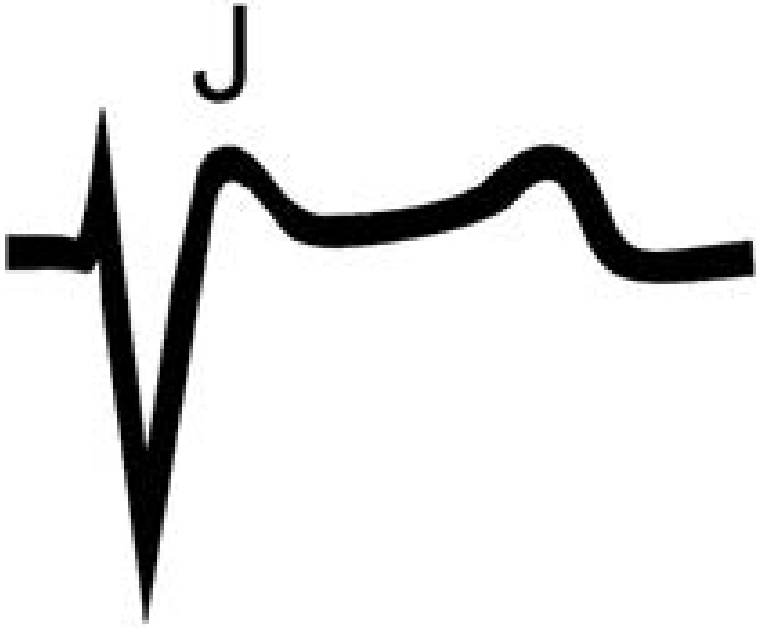
β angle > 58º (Sensitivity 79%; specificity 84%) (*Chevalier 2011*)

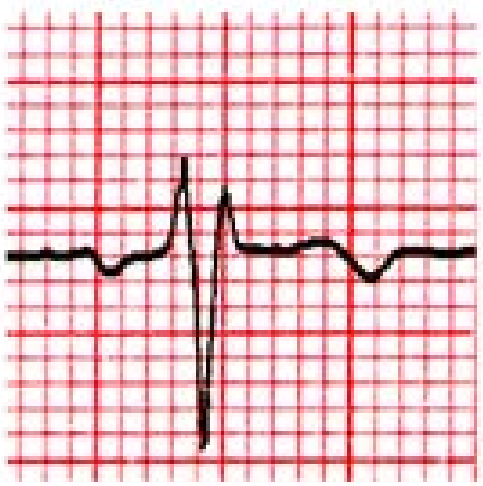


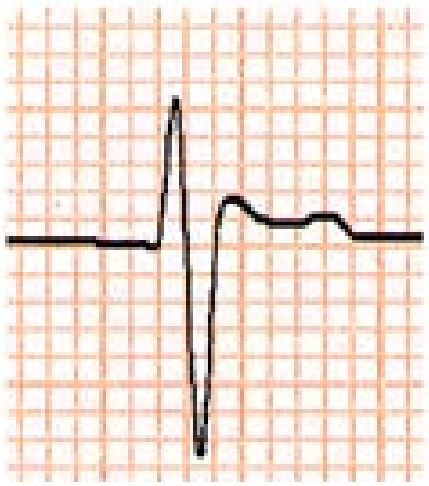


The base of triangle of r' at 5 mm from the high take-off > 3.5 mm (Sensitivity 81%; specificity 82%) (*Serra 2012*).


r'


J

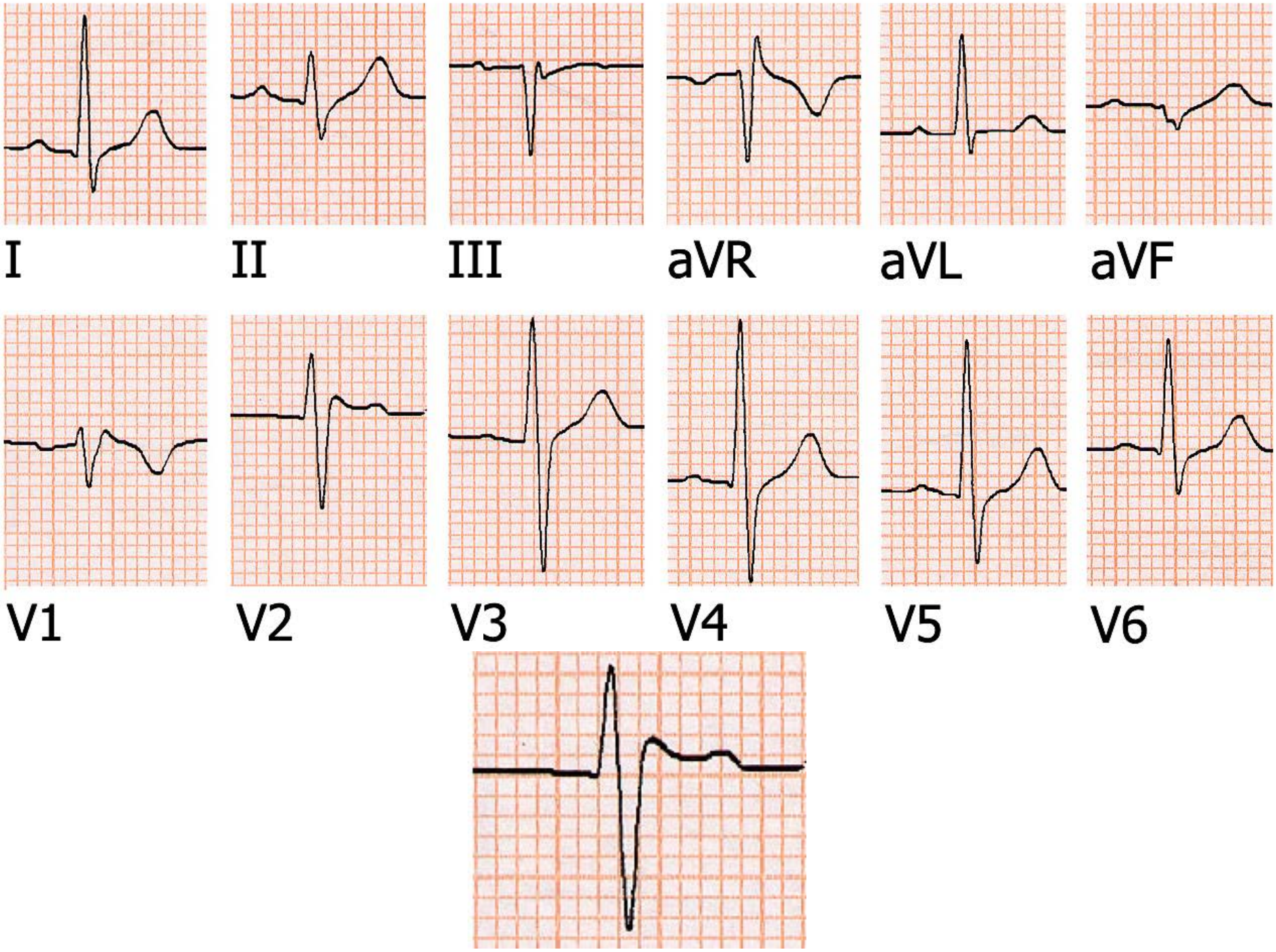




ECG ANALYSIS IN THE PRESENCE OF A POSITIVE TERMINAL WAVE IN LEADS V1-V2

Diagnostic items:

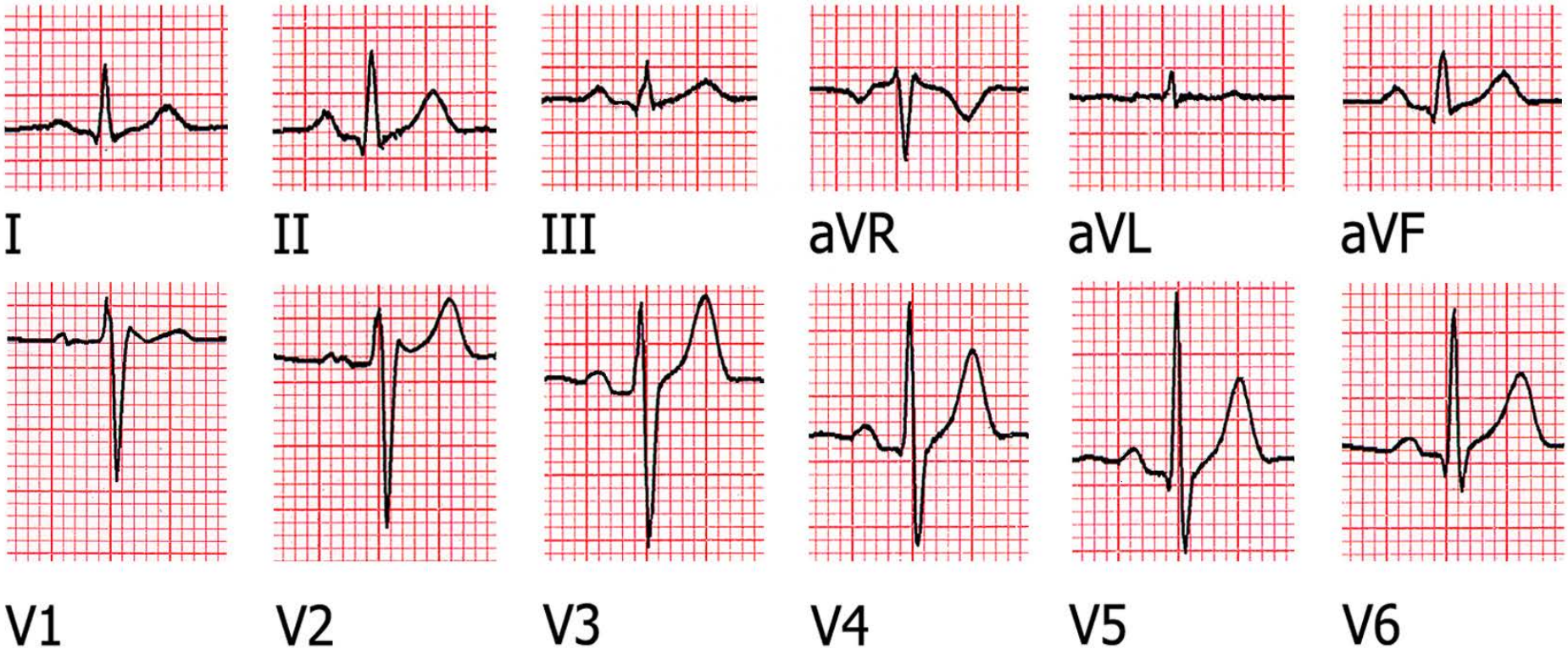
- ✓Leads V1-V3 recorded at the 3rd and 2nd intercostal space
- ✓Positive terminal wave morphology
- ✓**Positive terminal wave duration**
- ✓QRS duration in leads V1-V2 compared to lead V6


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

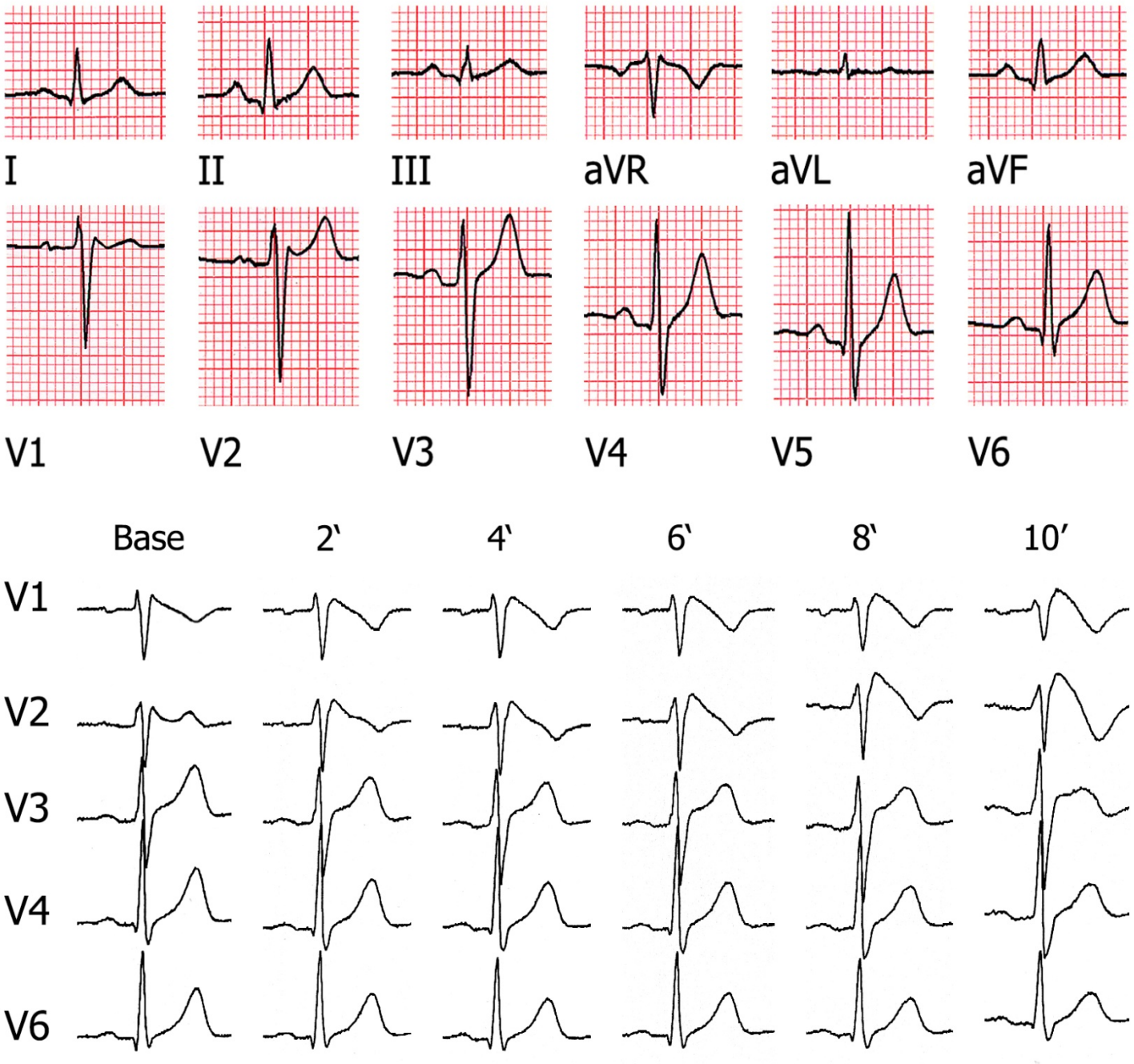
ECG ANALYSIS IN THE PRESENCE OF A POSITIVE TERMINAL WAVE IN LEADS V1-V2

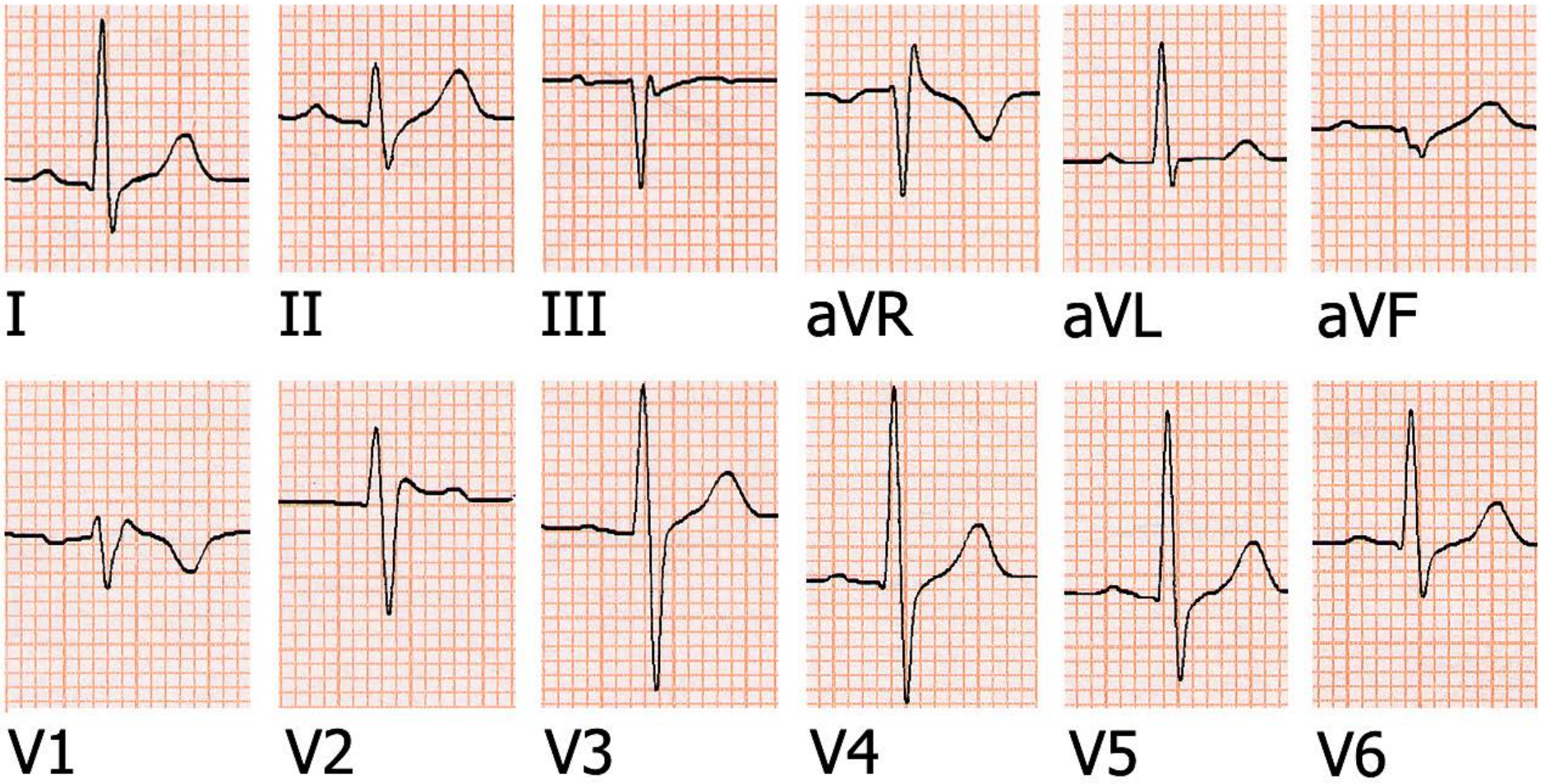
Diagnostic items:

- ✓Leads V1-V3 recorded at the 3rd and 2nd intercostal space
- ✓Positive terminal wave morphology
- ✓Positive terminal wave duration
- ✓**QRS duration in leads V1-V2 compared to lead V6**


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


V1
V2
V6

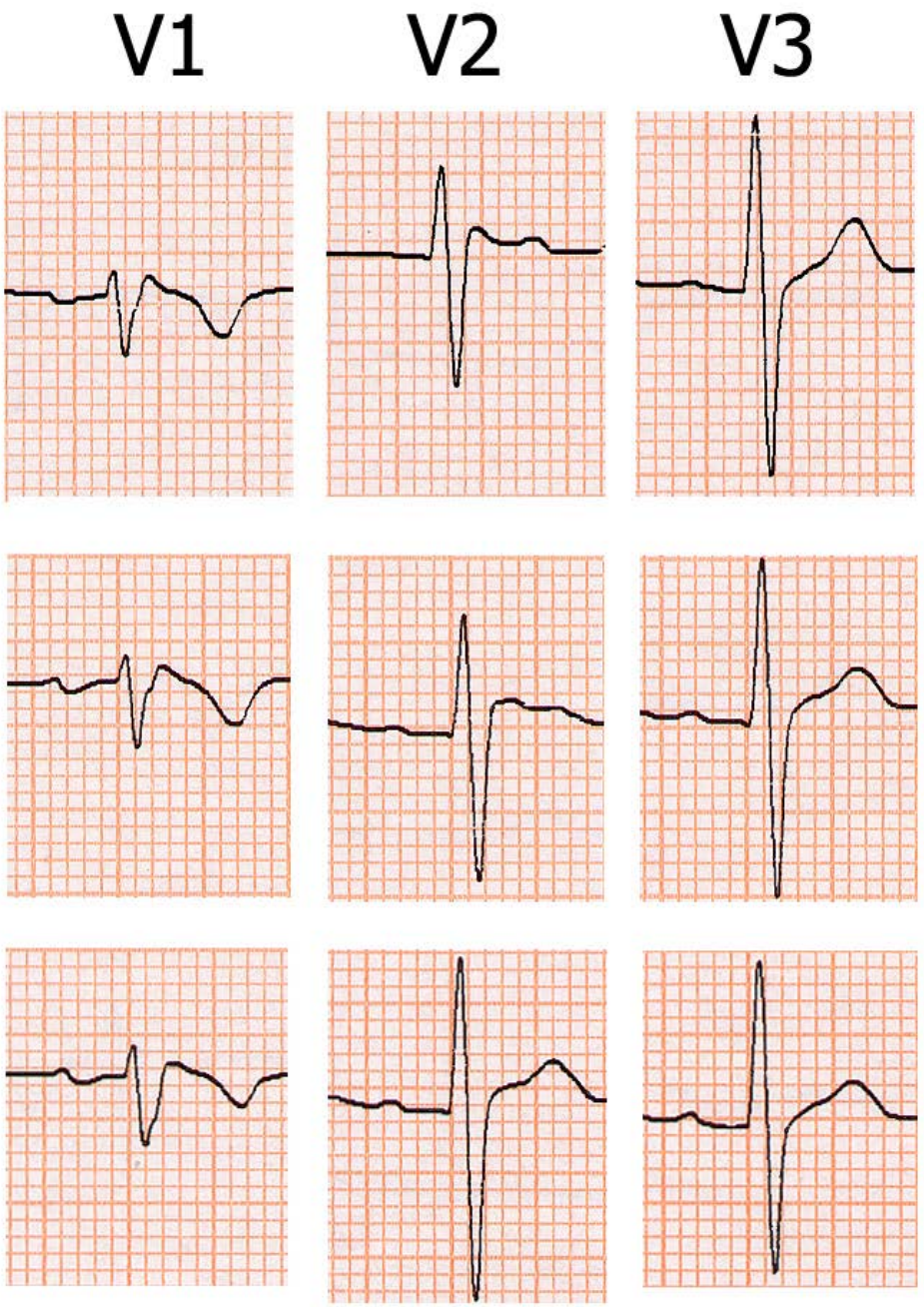

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
Base
2‘
4‘
6‘
8‘
10’
V1
V2
V3
V4
V6

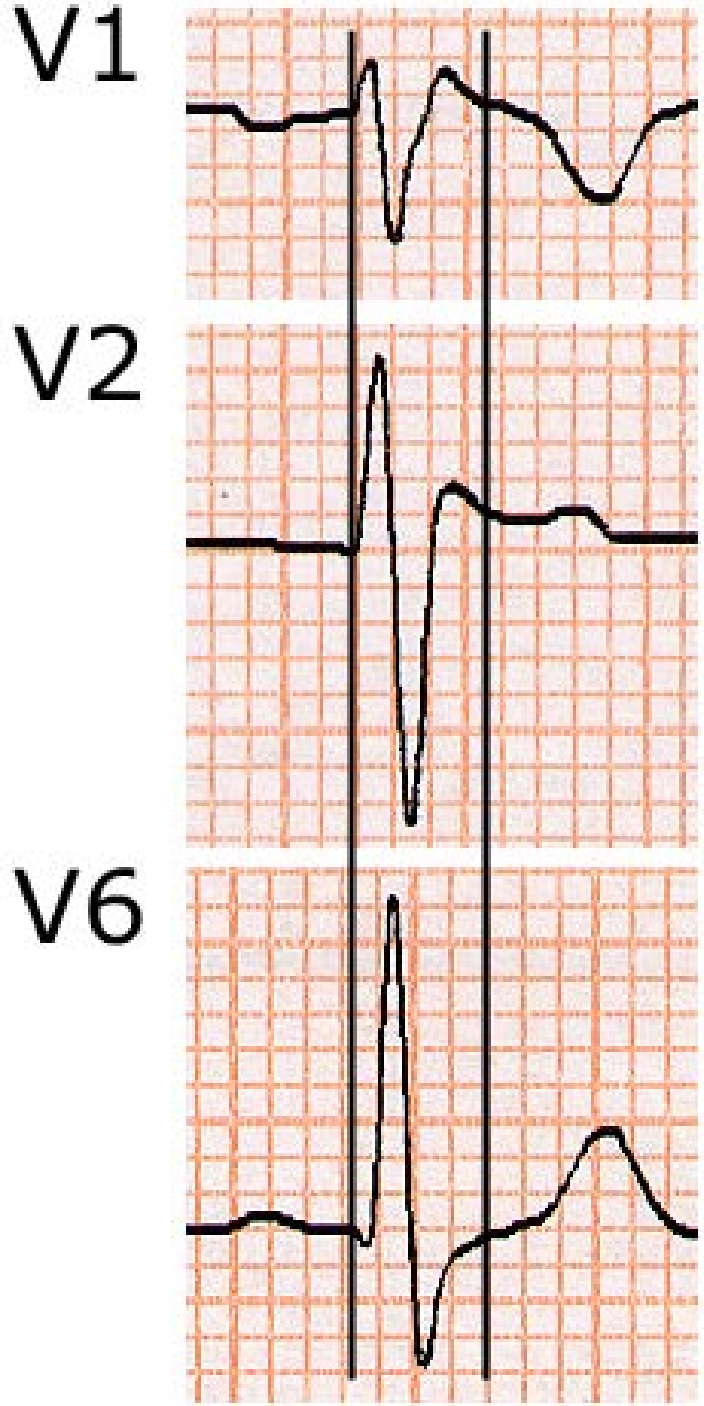

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

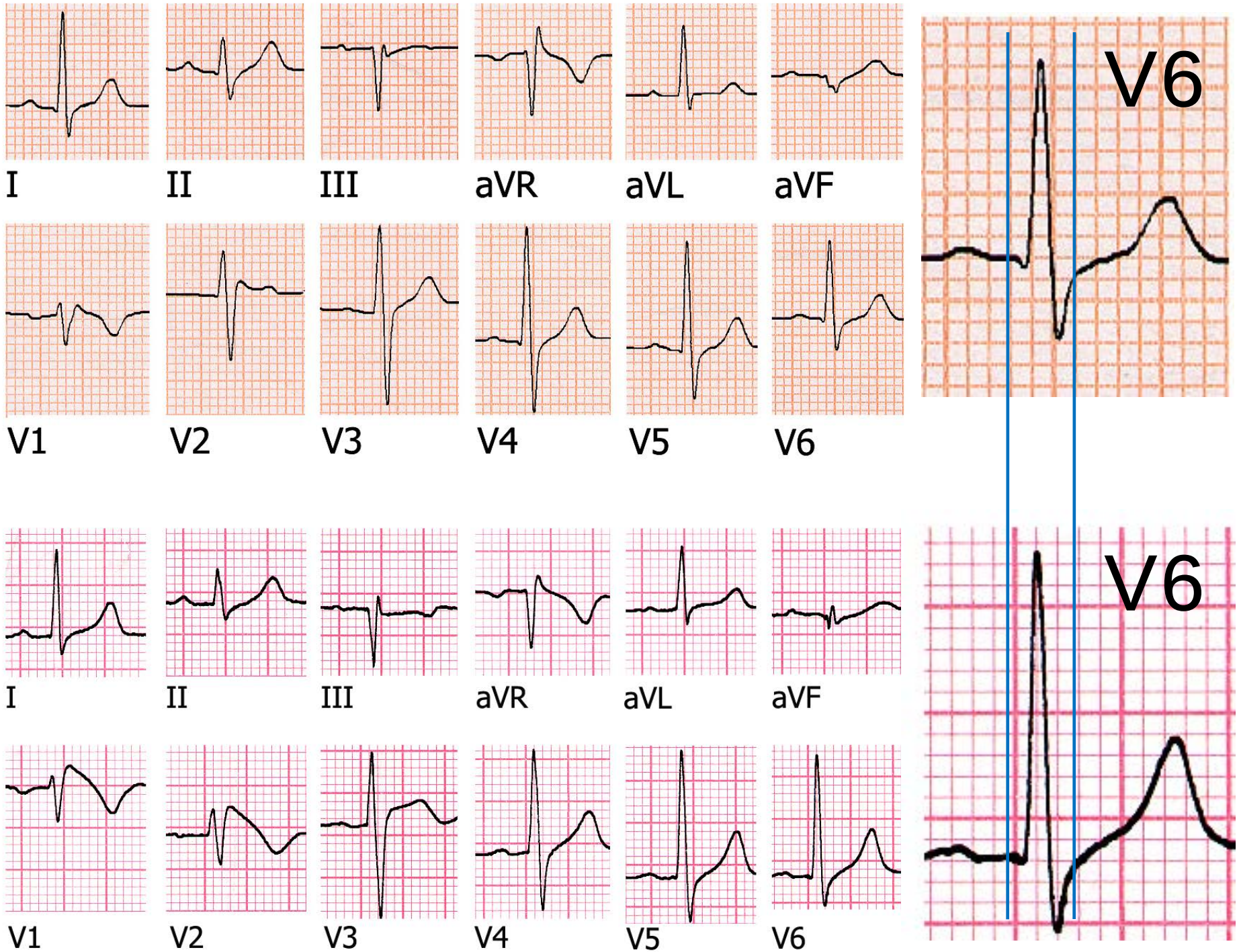
4th i.s.

3rd i.s.

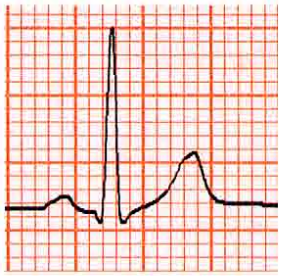
5th i.s.



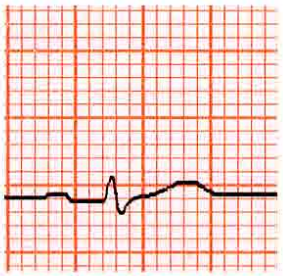

V1
V2
V6


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

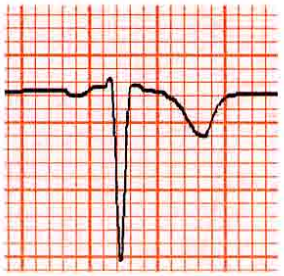
I



II

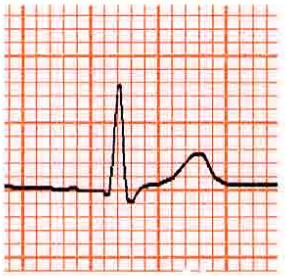


III

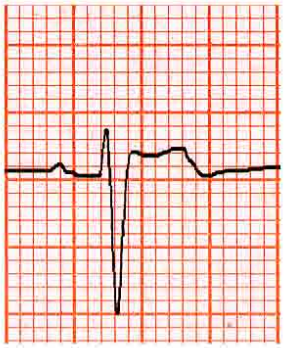


aVR

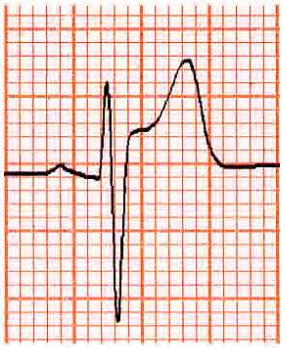
aVL



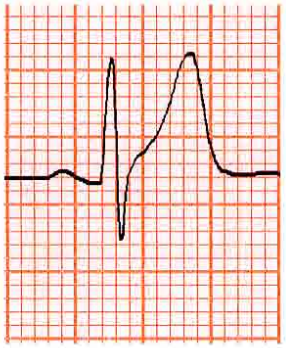
aVF



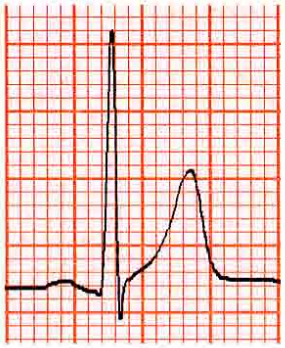
V1



V2

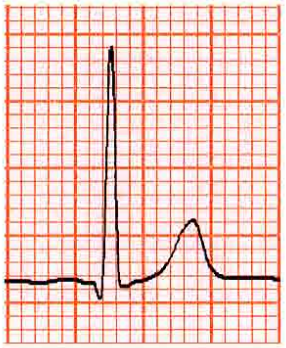


V3



V4

V5

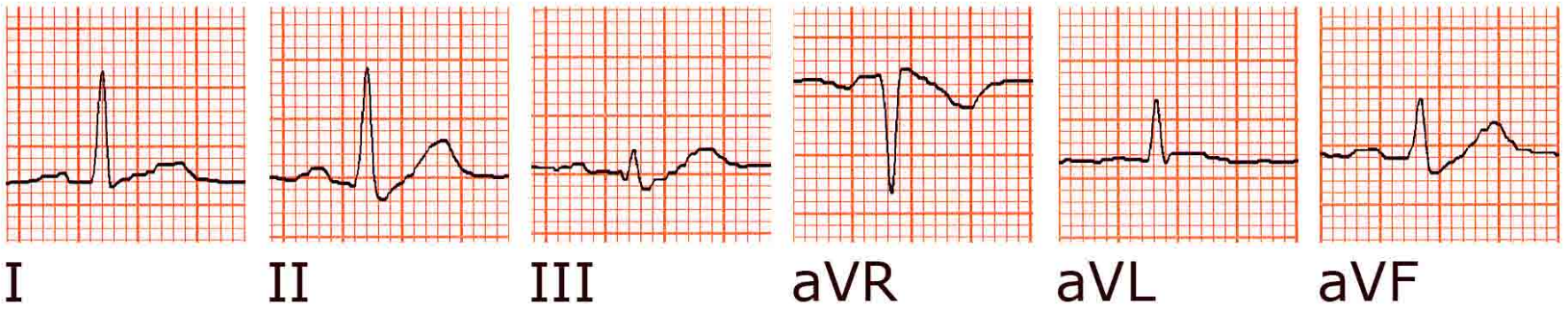


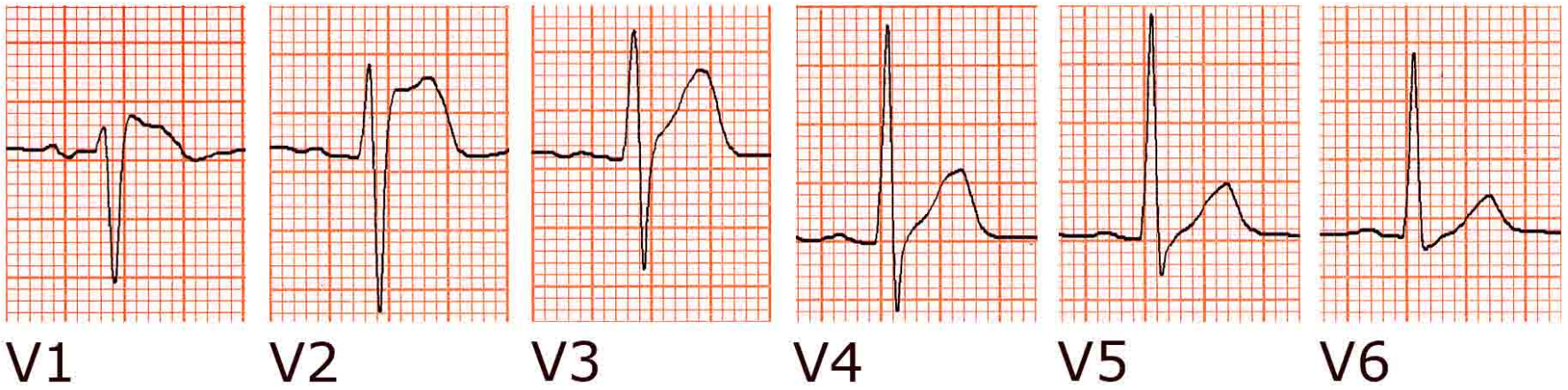
V6

V1

V2

2nd i.s.



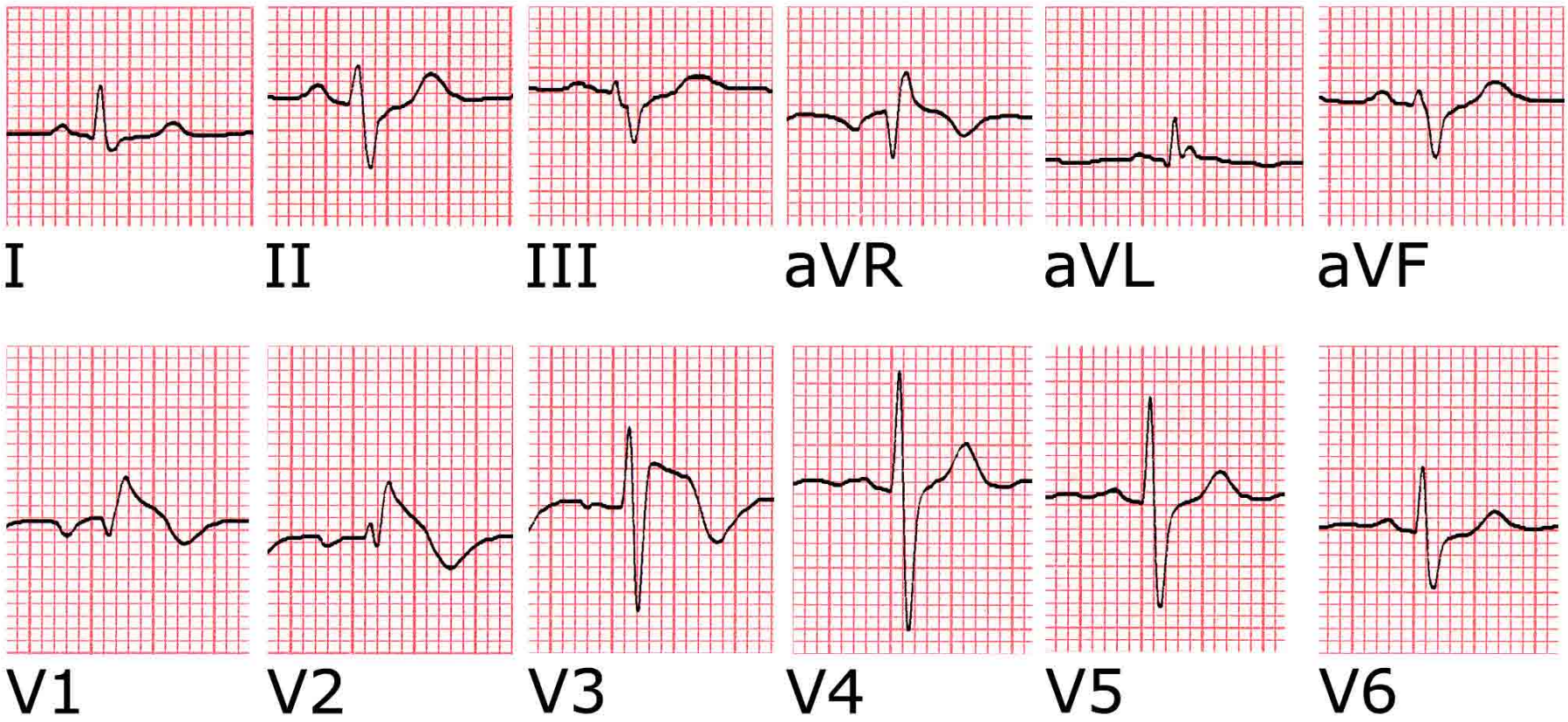


2nd i.s.

FLECAINIDE

V1

V2



Daugther's ECG

I

II

III

aVR

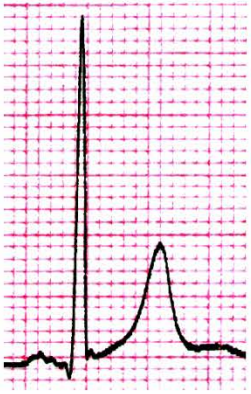
aVL

aVF

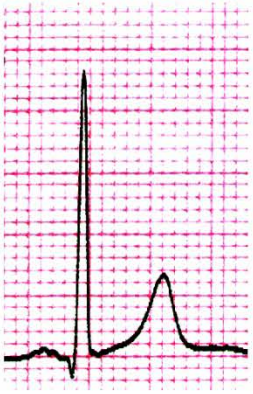
V1

V2

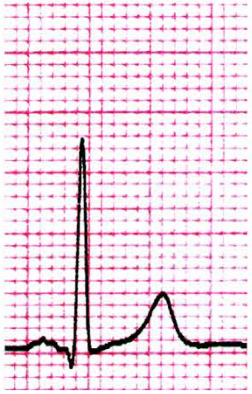
V3



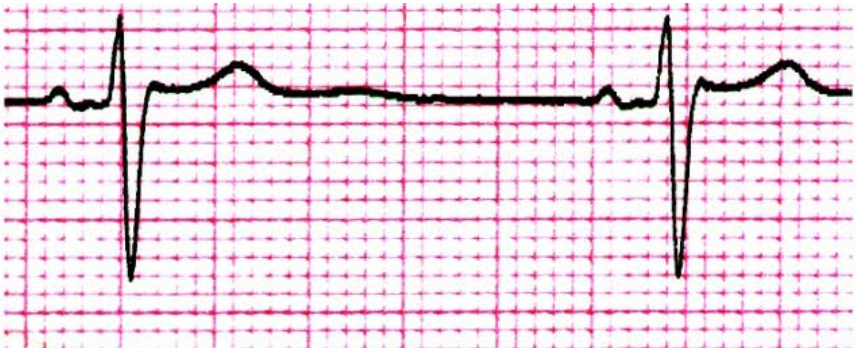
V4



V5

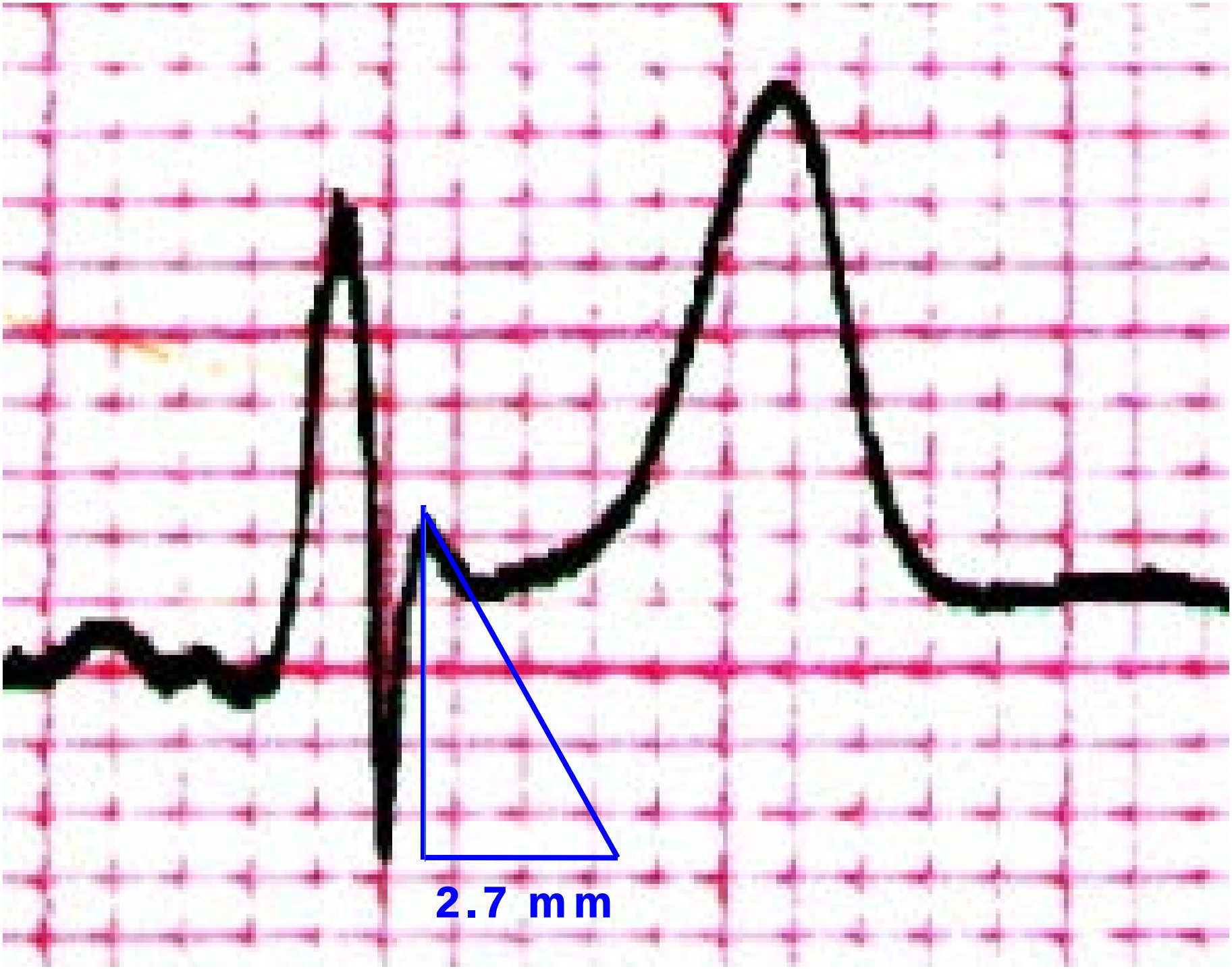


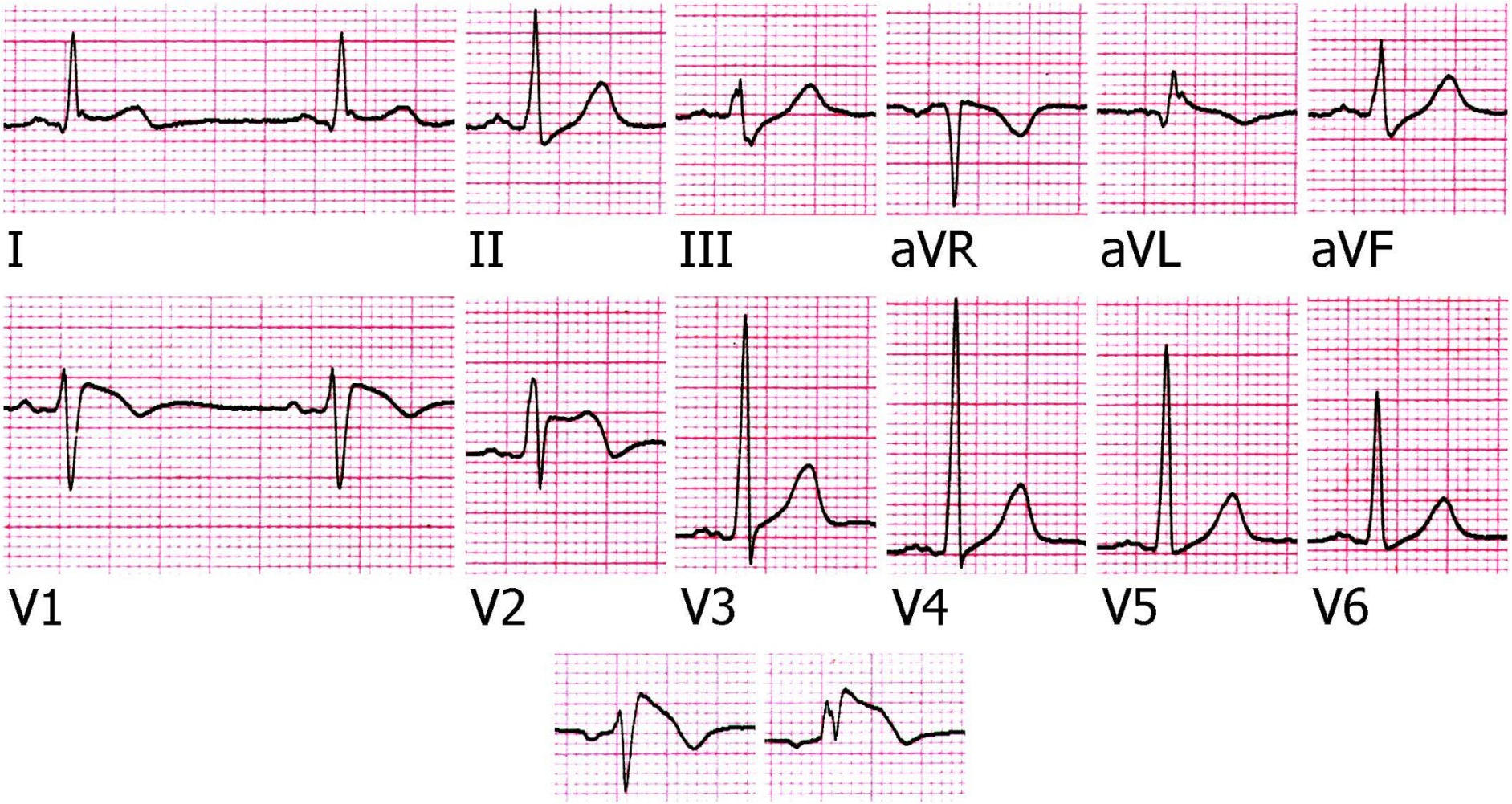
V6



V1

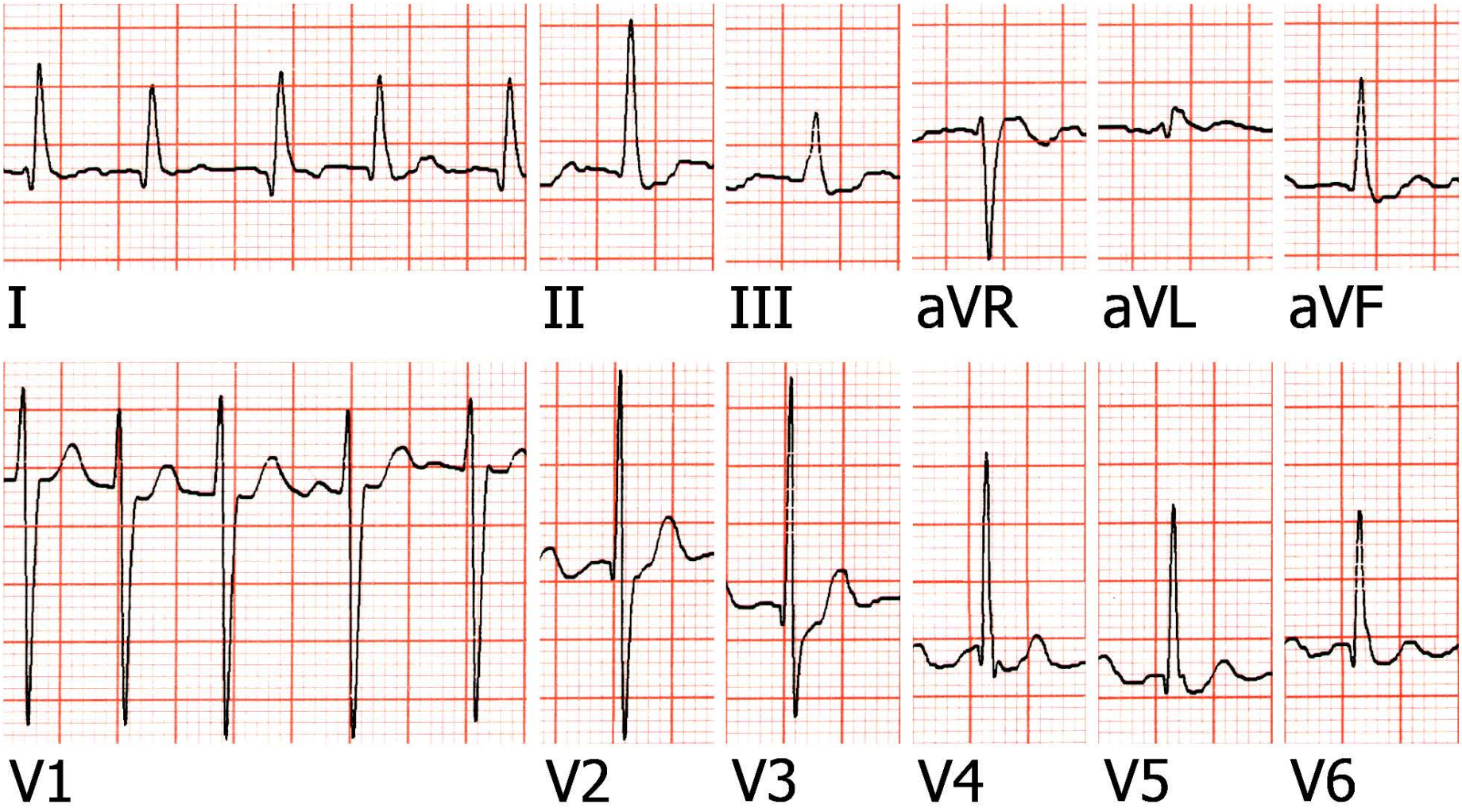
V2

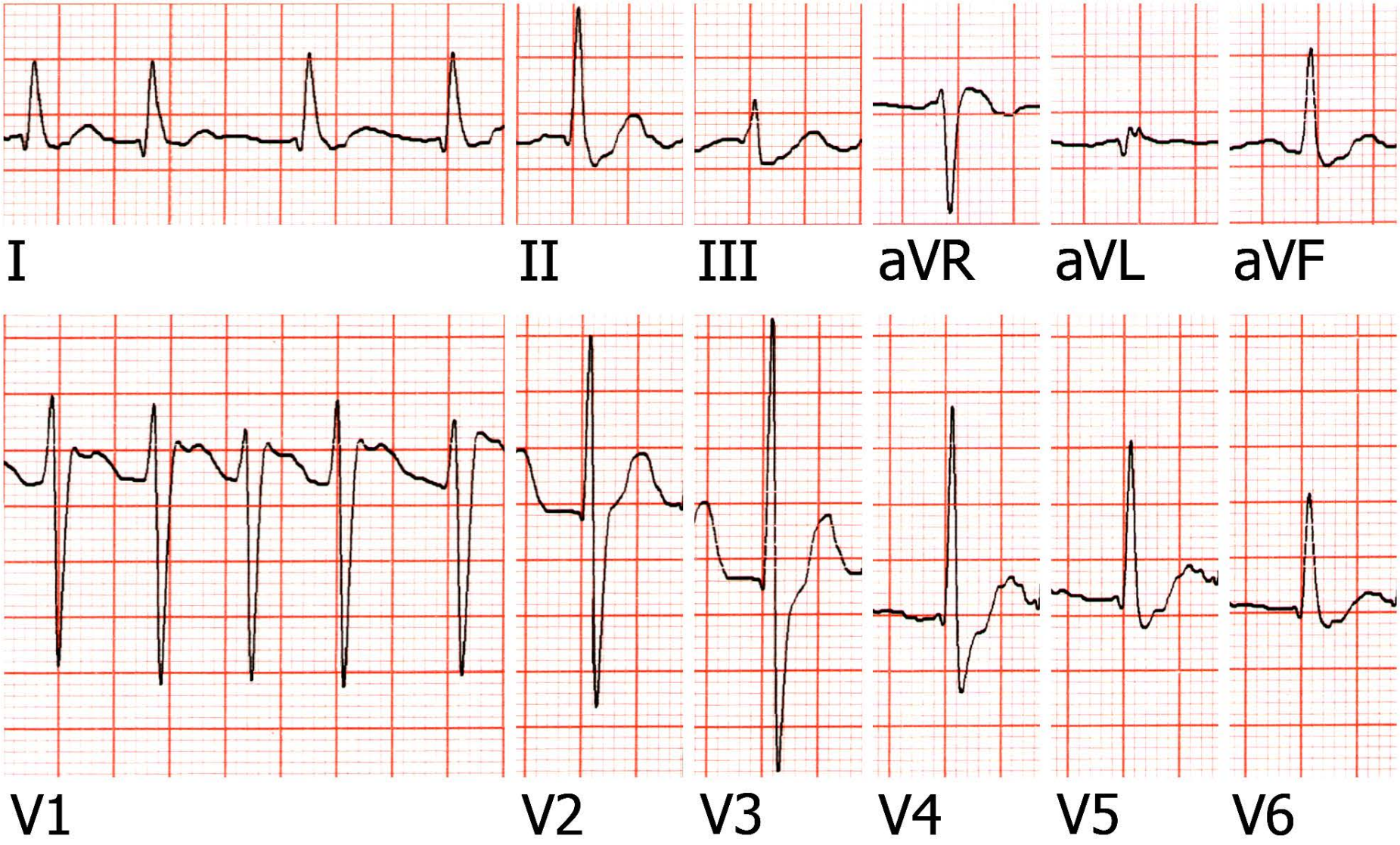

2.7 mm



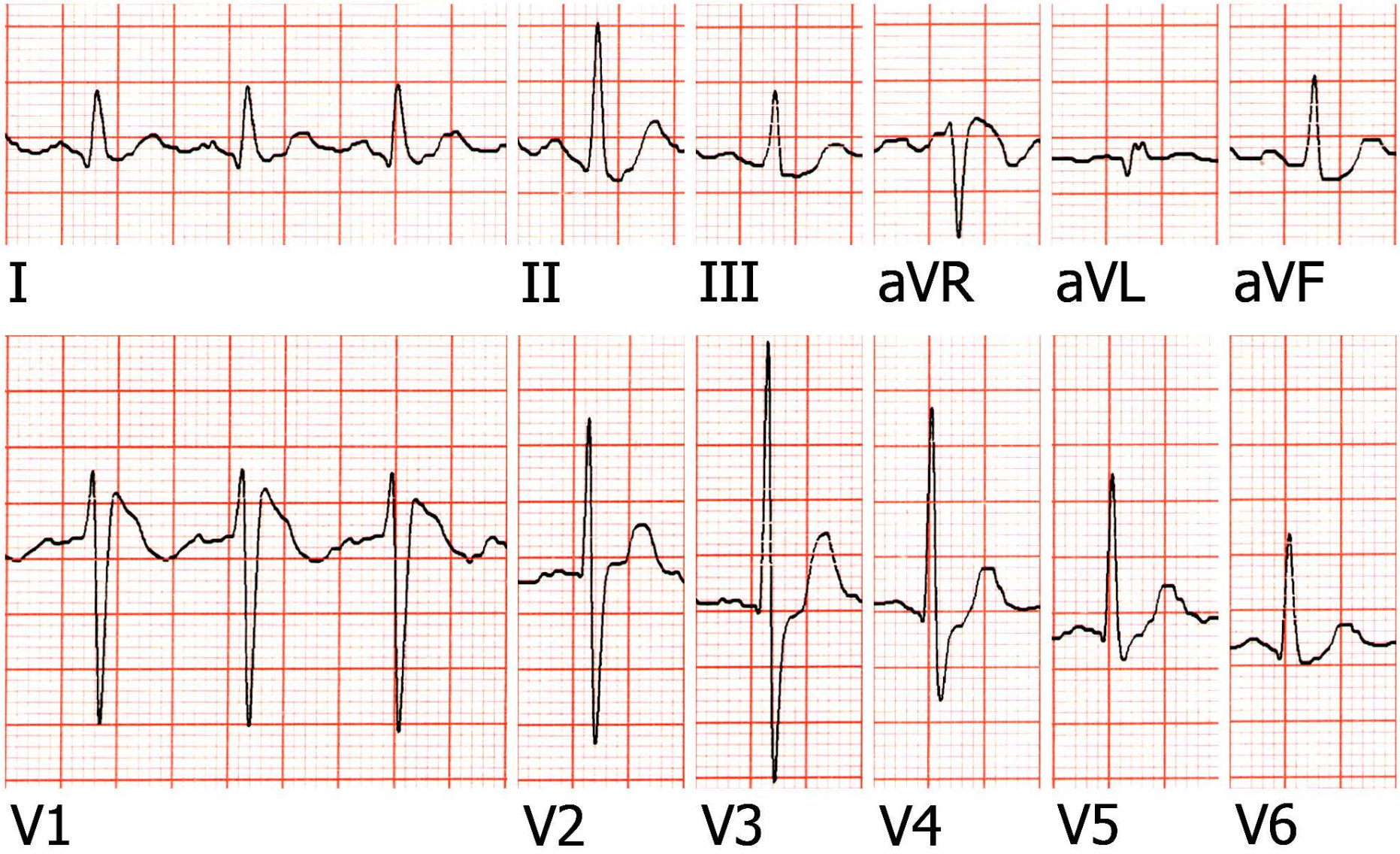
V1 3rd is V2 3rd is

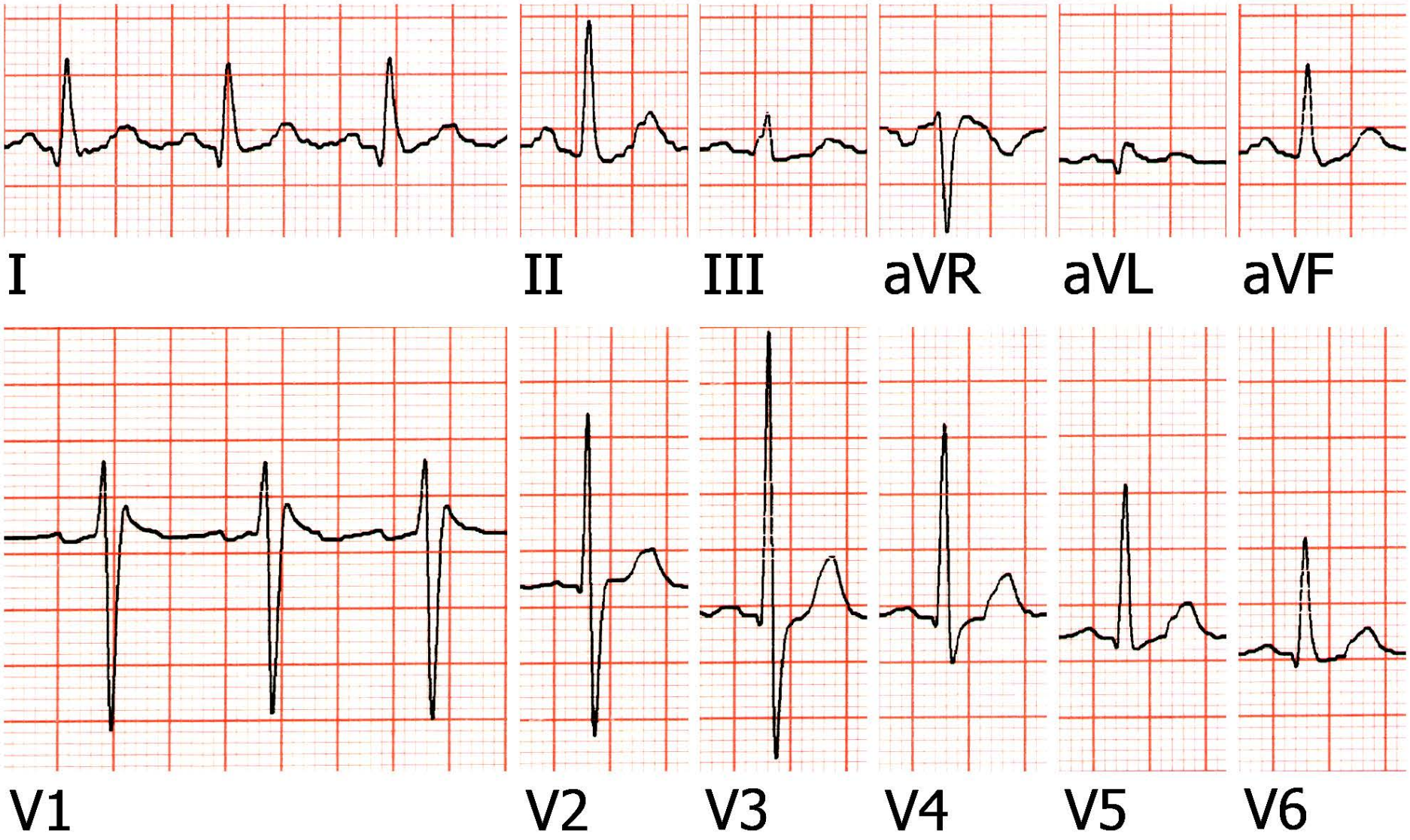
Ajmaline

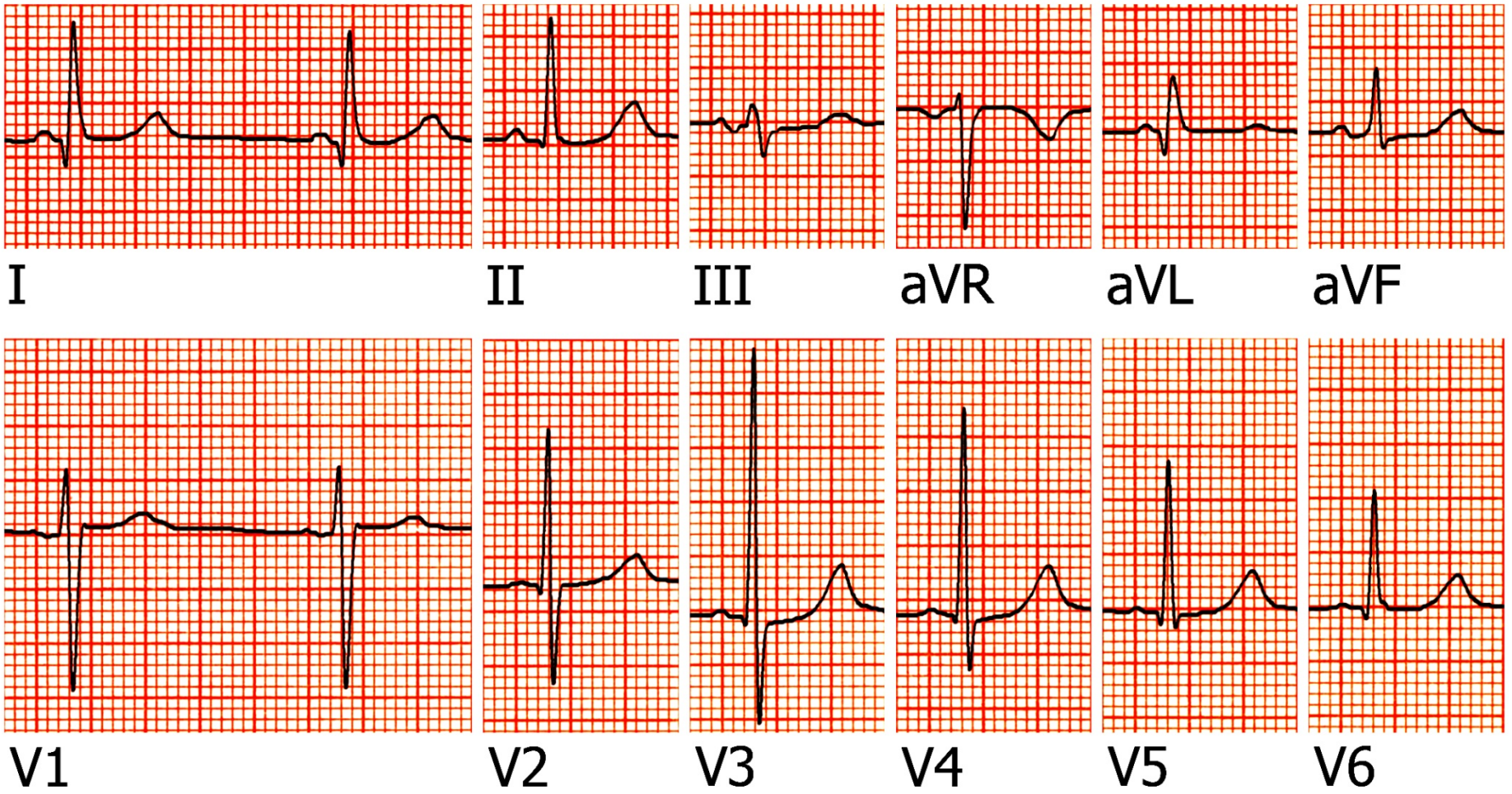

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

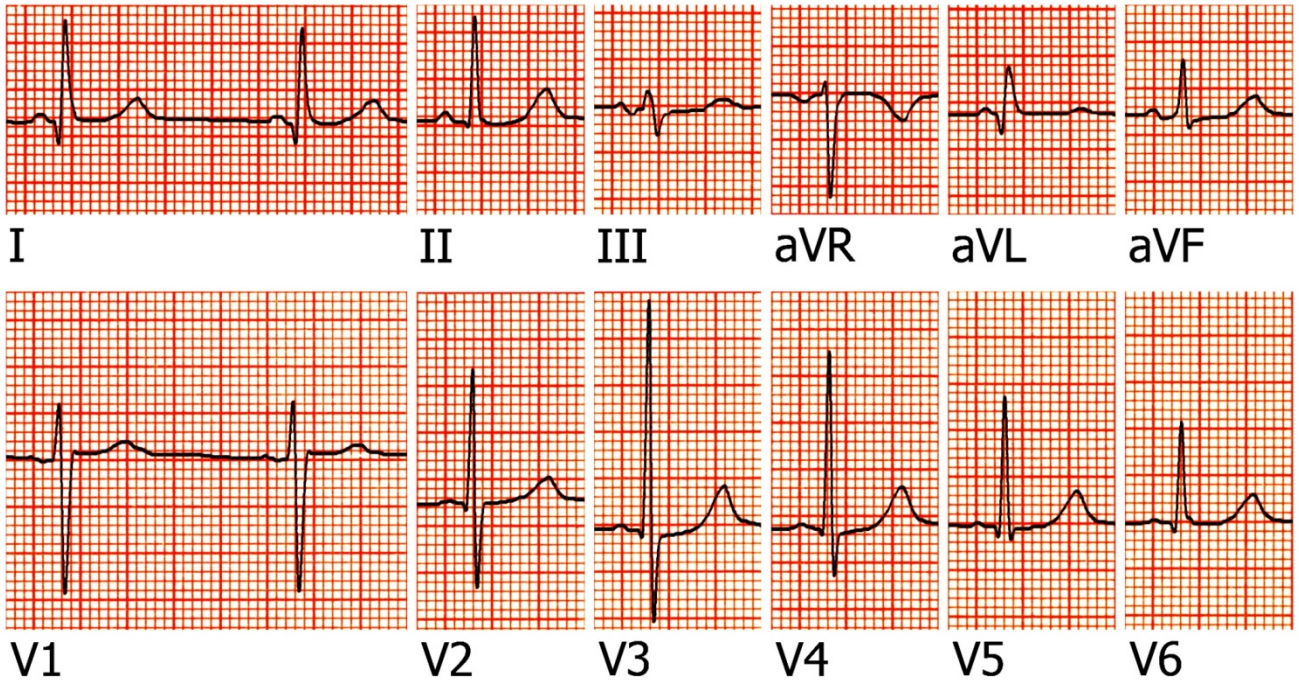


Flecainide 50 mg i.v.

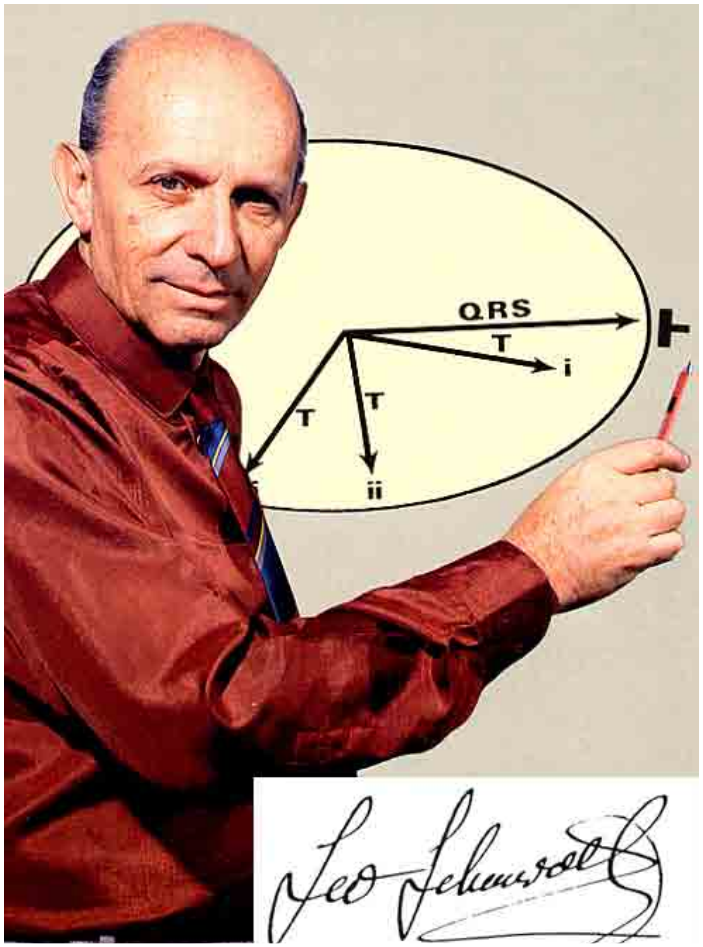

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


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

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT BRUGADA ECG



Thank you !