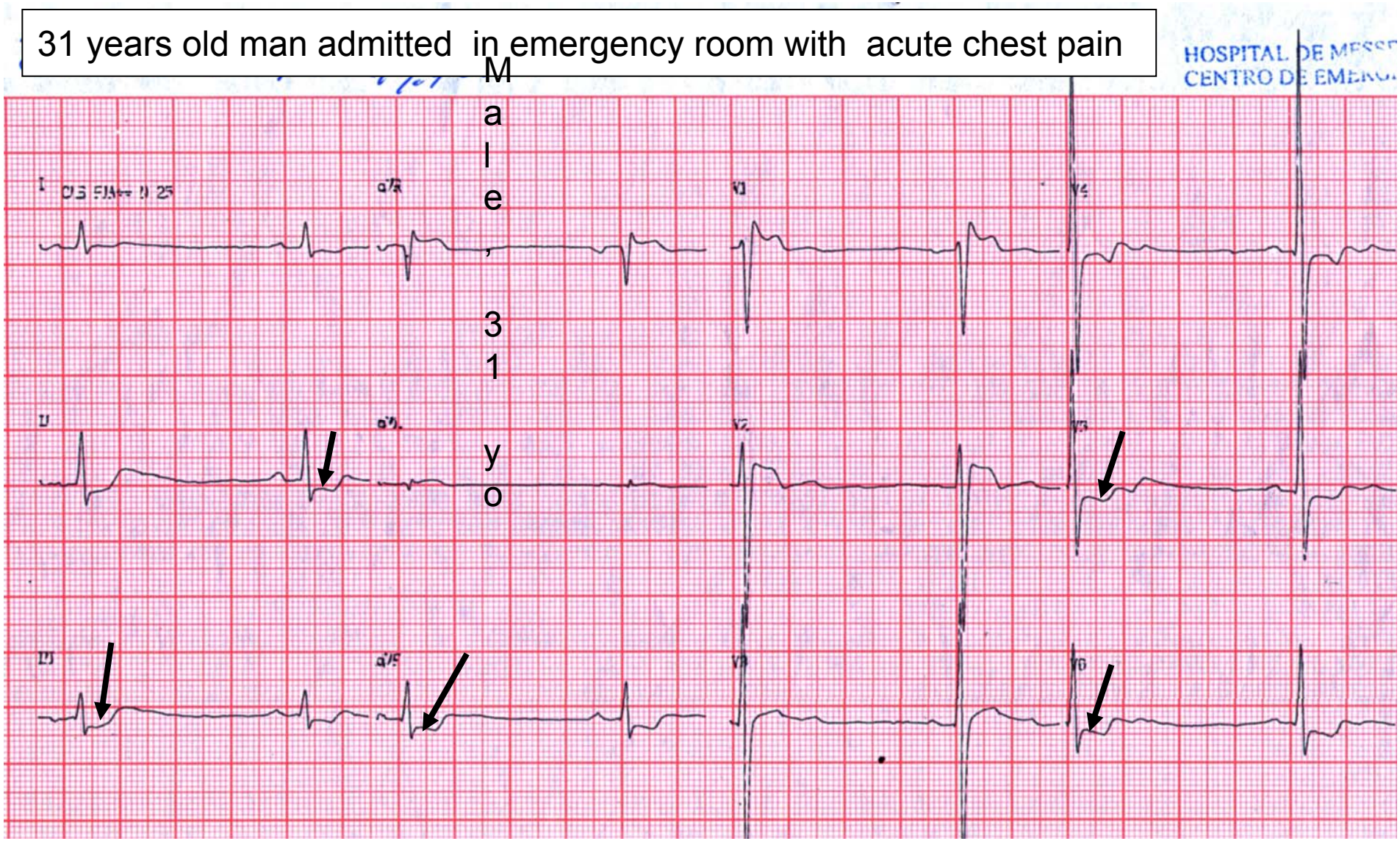
ECG: 1

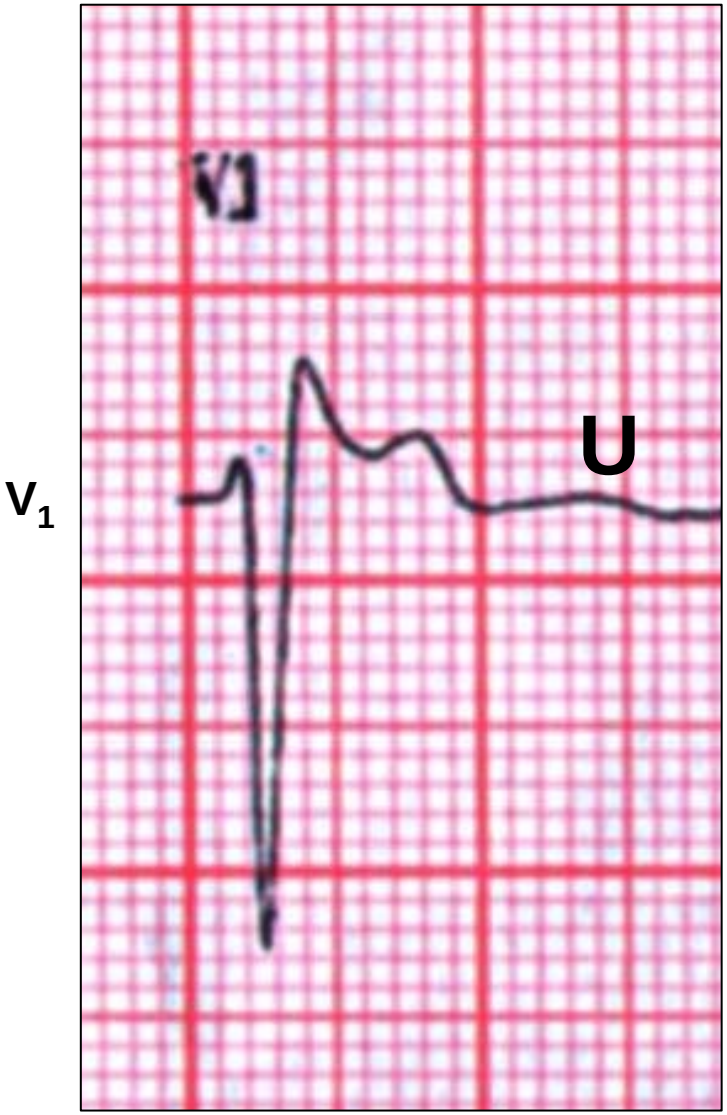
31 years old man admitted in emergency room with acute chest pain



ECG 1 REPORT

- ✓ Sinus rhythm,
- ✓ **Heart rate:** 79bpm
- ✓ SÂP, SÂQRS and SÂT near + 60º.
- ✓ Prolonged PR interval (220ms) = First degree AV block.
- ✓ In V_2 precordial lead spontaneous typical Brugada type 1 ECG pattern: J point and ST-segment elevation (≥ 2 mm) ***coved to the top "coved type"*** followed by a negative T wave.
- ✓ In V_1 and VR type 2 ECG Brugada pattern: J point and ST segment elevation (≥ 2 mm) in the initial portion and in the terminal portion ≥ 1 mm with ***saddleback appearance***, flowed by positive T wave.
- ✓ Mirror image in inferior and apical-lateral leads: ST segment depression (**BLACK ARROWS**)
- ✓ Prominent positive U waves are register from V_2 to V_5.

BOTH ECG BRUGADA PATTERNS TYPES 1 AND 2 CONCOMITANTLY IN A SAME PATIENT



V_1

Saddleback appearance: Type 2

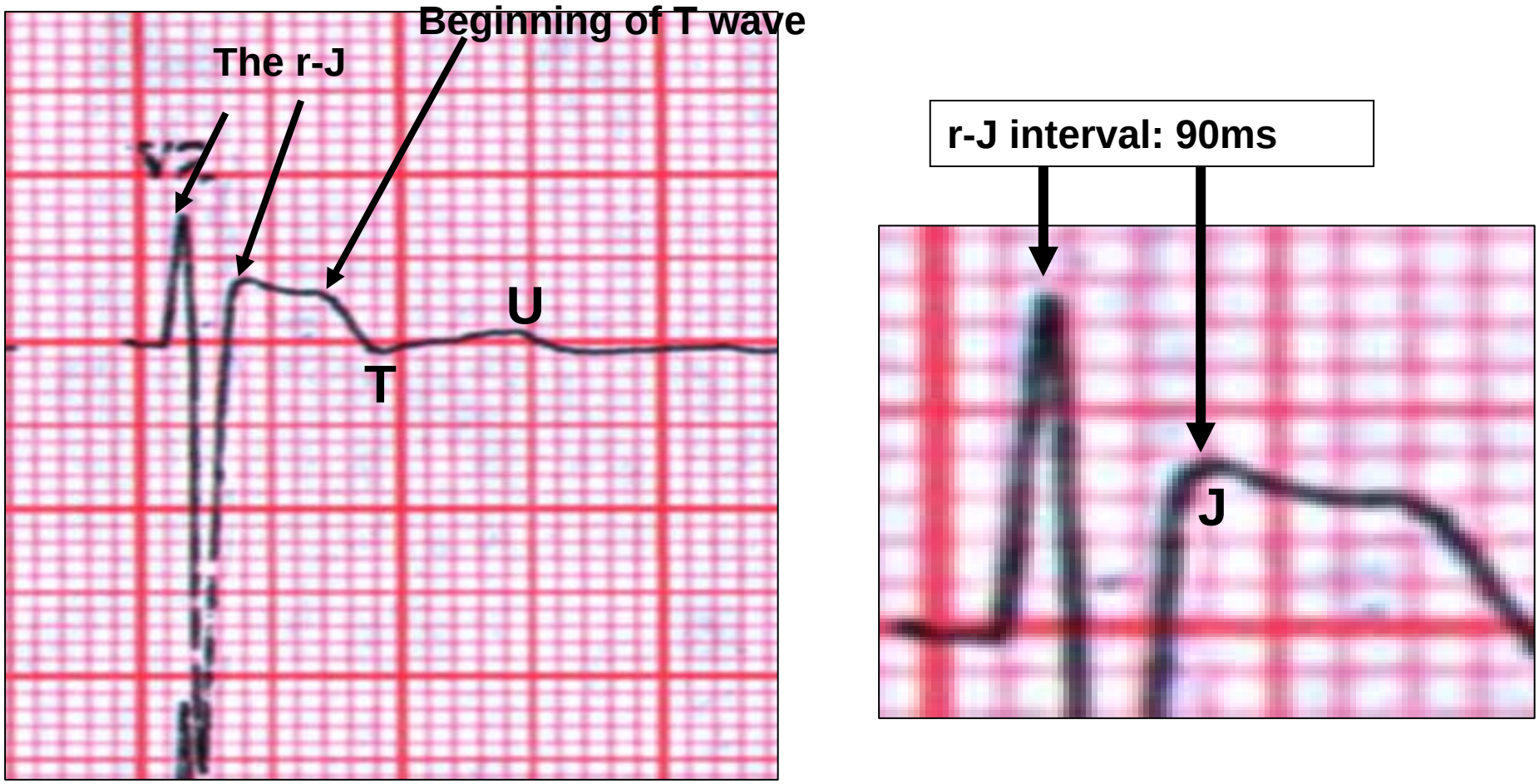
J point and ST segment elevation (≥ 2 mm) and in the terminal portion ≥ 1 mm

V_2

Coved type: Type 1

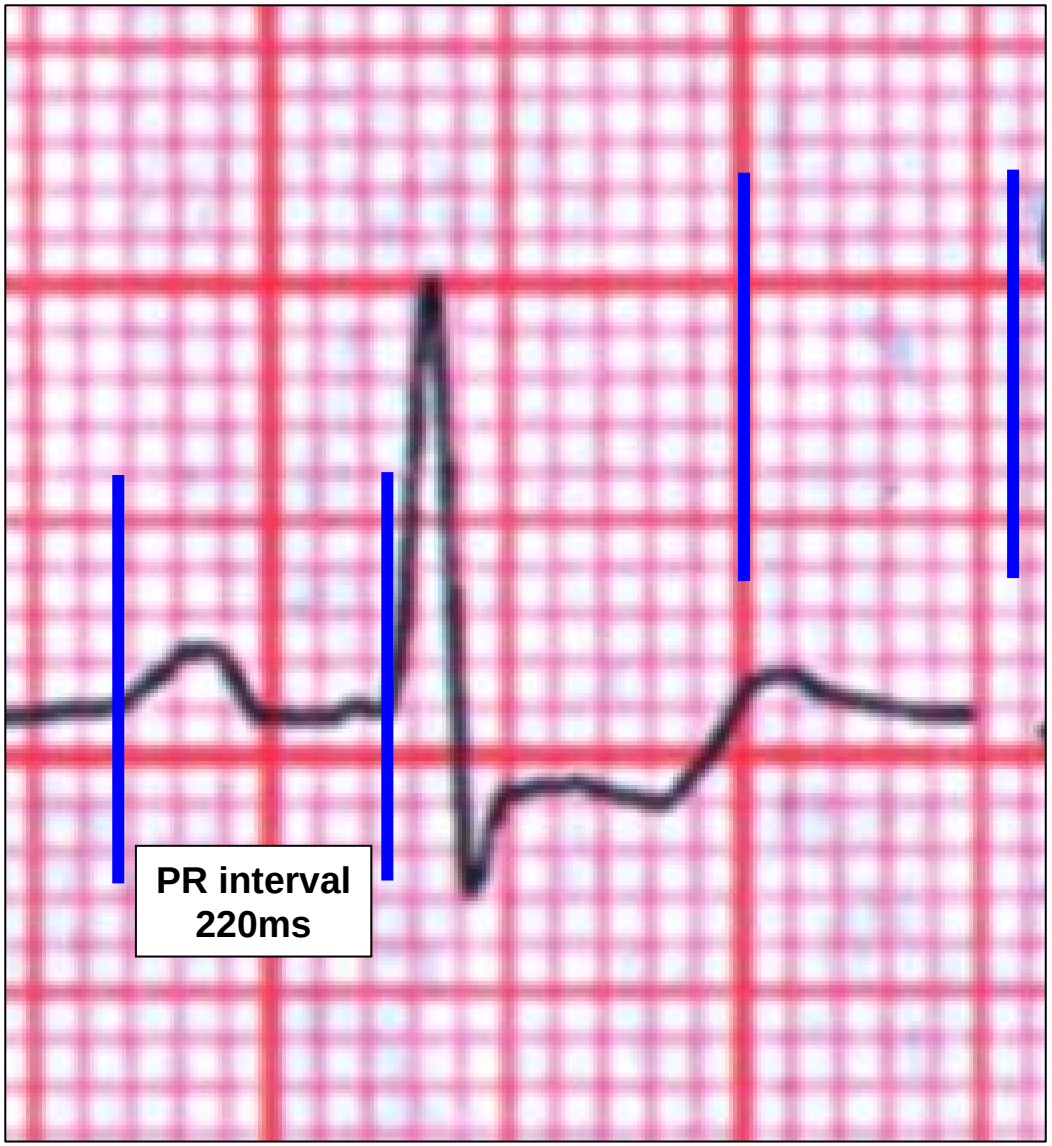
J point and ST-segment elevation (≥ 2 mm) followed by a negative T wave.

The r-J interval in lead V_2

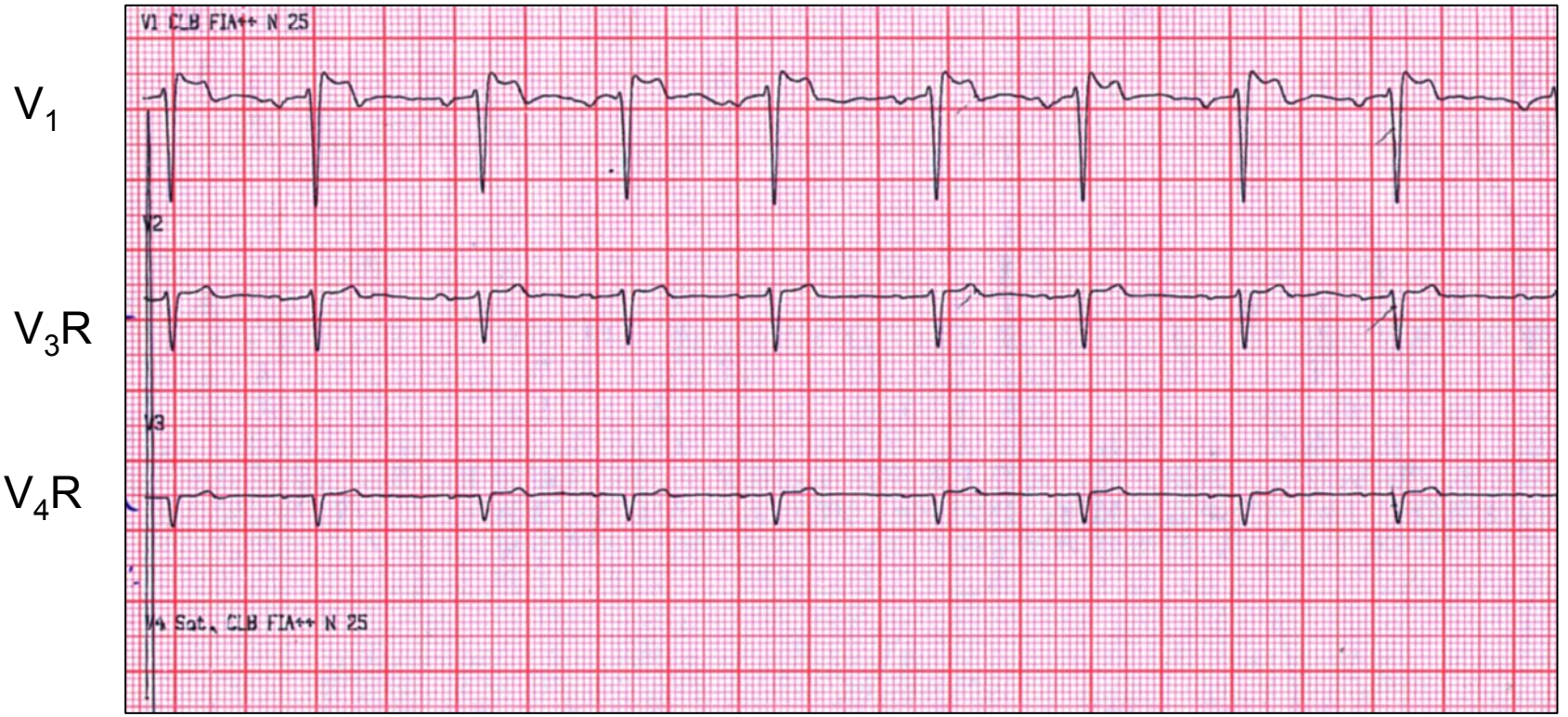


The r-J interval in lead $V_2 \geq 90$ ms is found to be a possible predictor of recurrence of cardiac events in symptomatic patients with Brugada syndrome (1). Prominent U wave.

1) Junttila MJ, et al. J Cardiovasc Electrophysiol. 2008;19:380-383.



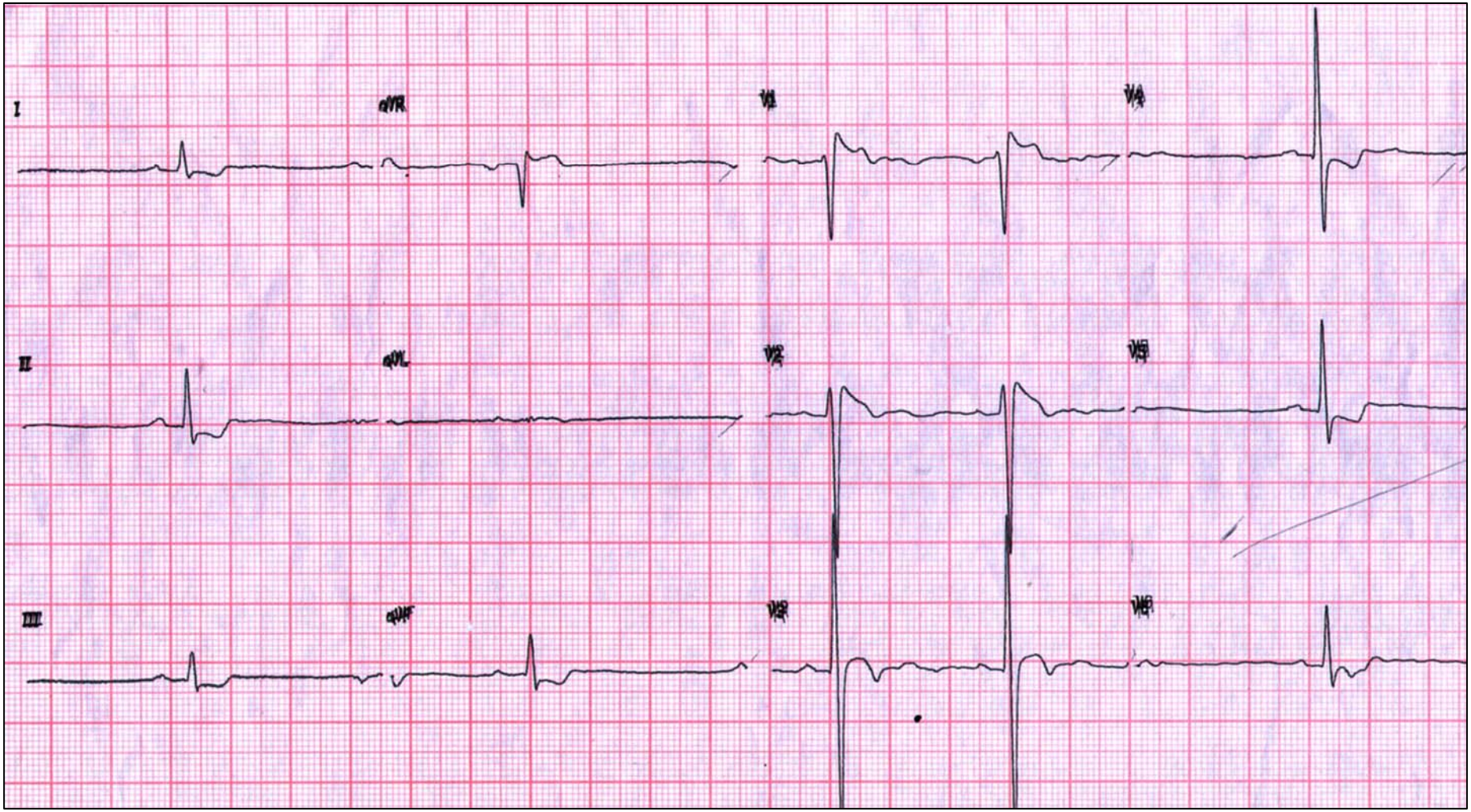
Prolonged PR interval: 220ms
First degree AV block



Normal pattern in accessory right precordial leads V_3R and V_4R. Transitory ST segment elevation of 1 mm (0.1 mV) or more in at least one of the right precordial leads V_3R, V_4R, V_5R and V_6R is characteristic of acute right myocardial infarction. The sensitivity of the ST elevation sign in V_4R is 100% and specificity 70%.

ECG 2

After sublingual nitrate administration



Serial a biomarker for acute myocardial infarction normals (Troponin T,. CK-MB)
Normal Echocardiography. Normal cardiac catheterization /coronary angiography

ECG 2 REPORT

After sublingual nitrate administration type 1 Brugada ECG pattern is observed in both V_1 and V_2 right precordial leads. Concomitantly, bradychardia was precipitate (HR: 51bpm).

Acute myocardial infarction or ischemia of the right ventricle involving the RVOT is reported to mimic ST segment elevation similar to that in Brugada syndrome.

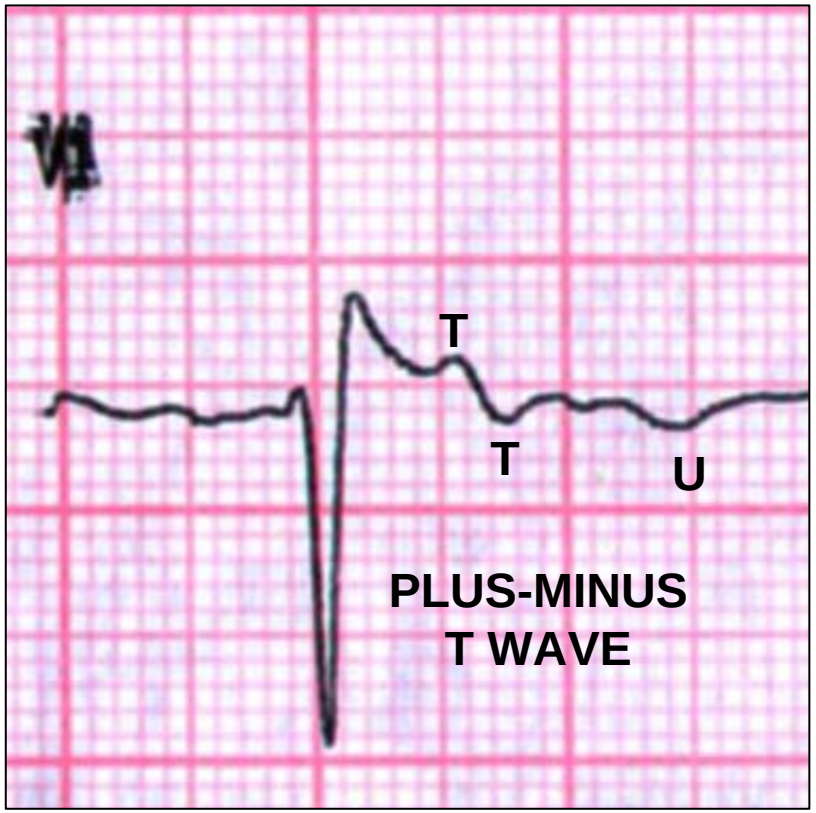
ECG 2 REPORT

Brugada like ST elevation induced by acute ischemia involving the RVOT region is a result of the depression of $I_{Ca\text{-}L}$ and the activation of $I_{K\text{-}ATP}$ during ischemia.

Mild ischemia and vagal influences act in an aditive fashion or synergitically with the substrate responsible for Brugada syndrome to elevate the ST segment and precipitate VF[1].

1) Shimizu W Acquired forms of Brugada syndrome. In The Brugada Syndrome From Bench to Bedside Edited by Charels Antzelevitch With Associate Editors Pedro Brugada, Josep Brugada and Ramon Brugada. 2005, Chapter 14 pp166-177.

“INTERMEDIATE” TYPE 1-2 BRUGADA PATTERN



V_1

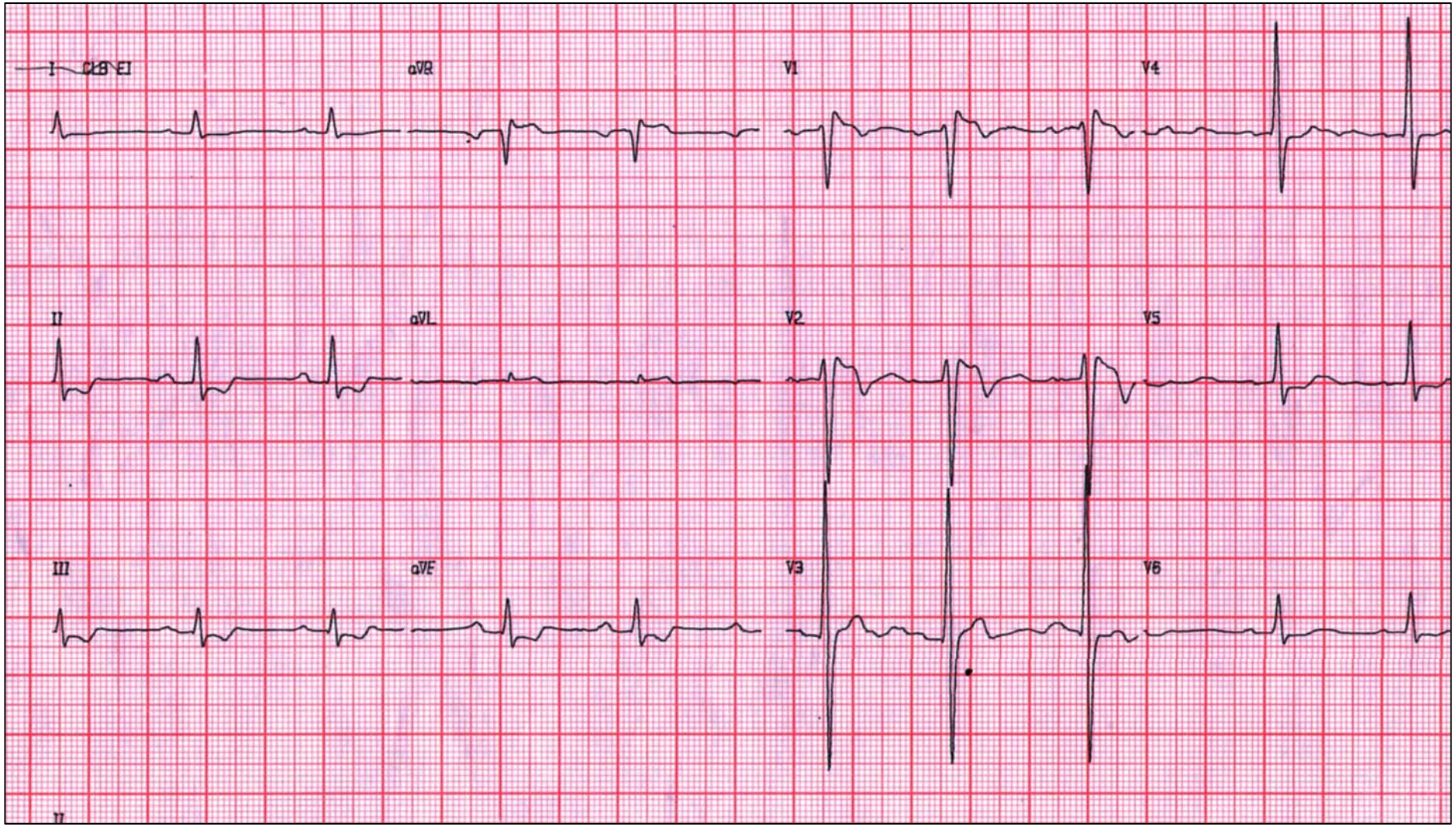
TYPE 1 BRUGADA PATTERN

V_2

U wave inversion is referred in Prinzmetal angina[1].
This is the first related case of inverted U wave in Brugada syndrome

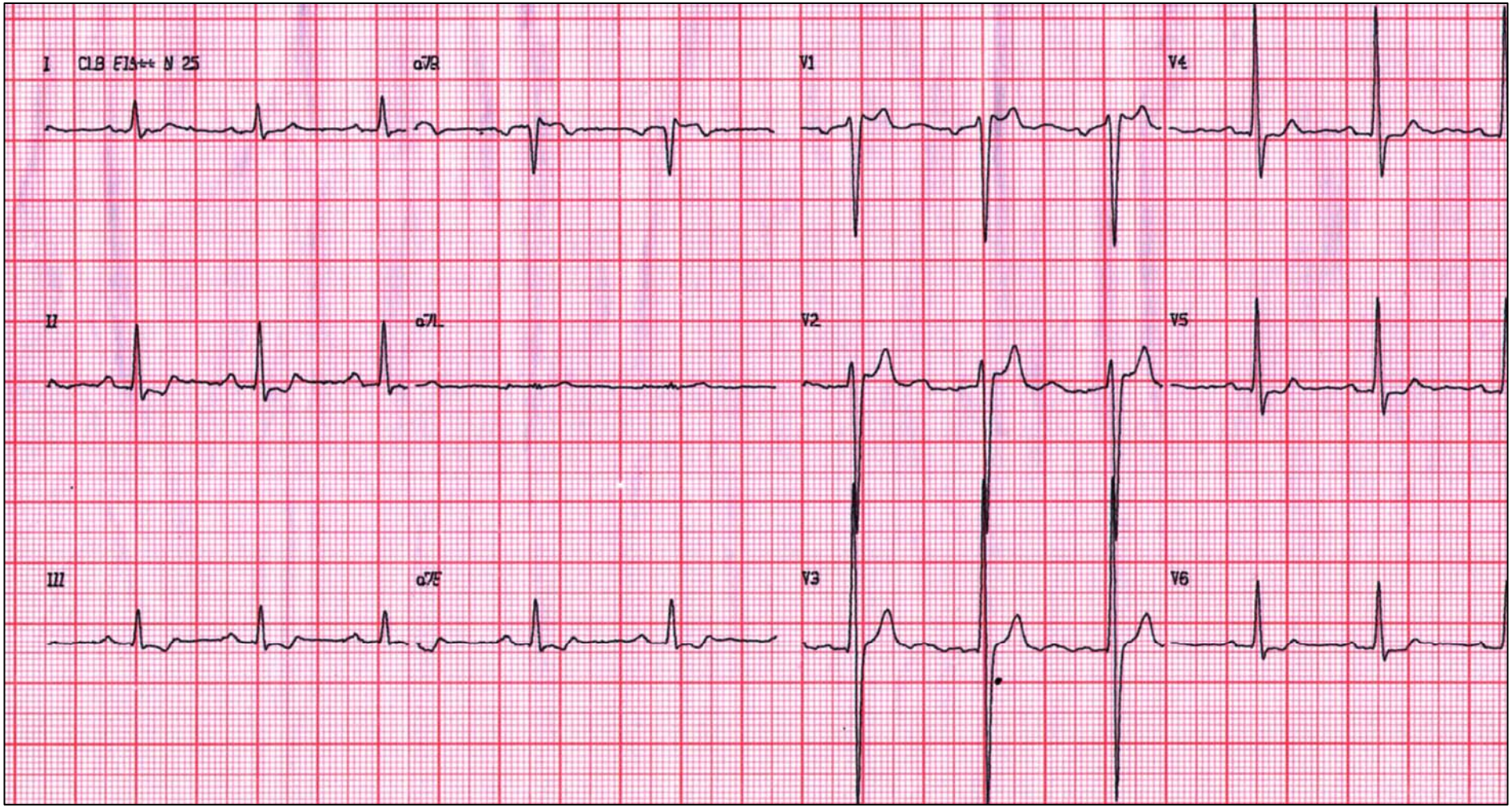
1) Miwa K, et al. Am Heart J. 1993; 125:981-986

After 48 h (asymptomatic)



Type 1 ECG Brugada pattern, Brugada sign, or Brugada phenotype in both right precordial leads V1-V2.

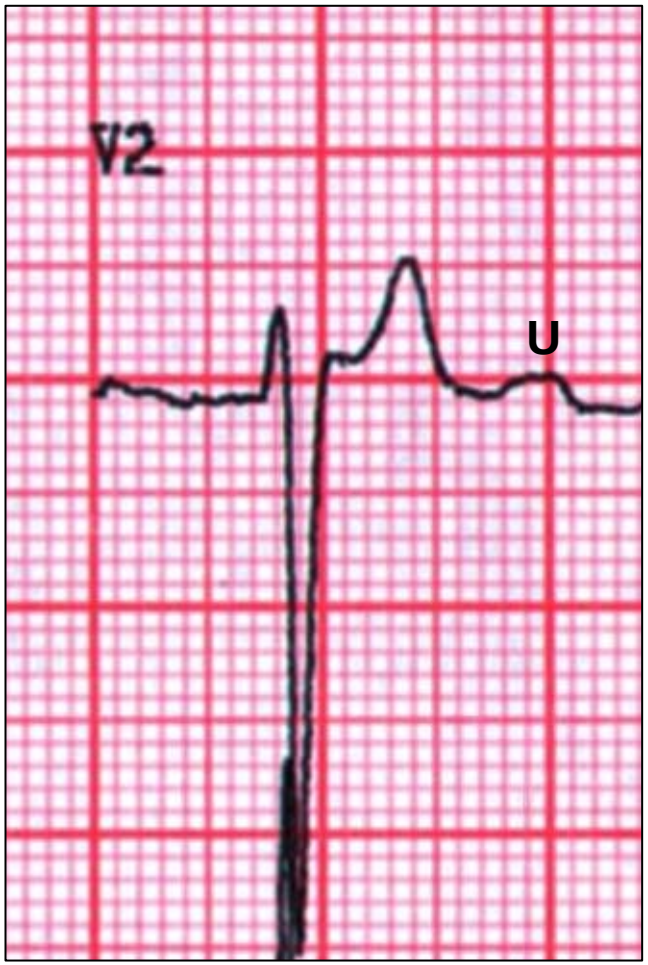
After 72 hours



After three days Brugada type 3 pattern is observed only in V_1.
Prominent positive U wave is observed in V_2 and V_3.
Minimal mirror image is present (ST segment depression) in inferior and low left lateral leads

TYPE 3 BRUGADA ECG PATTERN

POSITIVE PROMINENT U WAVE



In type 3, the ST segment also has saddleback or coved appearance, with elevation in J point and the onset of ST segment ≥ 2 mm and terminal portion ≤ 1 mm followed by positive T wave.

COMMENTARIES

This case is very similar with case reported by Nishizki[1] et al.: A 49-year-old man with chest pain and syncope presented saddleback or occasionally coved type ST elevation in V1-V3.

Coronary spasm in the left anterior descending artery was induced by acetylcholine injection and ST elevation changed from saddleback to coved type in V2-V3 together with ST depression in V4-V5, whereas acetylcholine injection into the right coronary artery did not provoke spasm, but induced augmented and coved type ST elevation in V2 without ST-T changes in V4-V5.

These electrocardiographic changes in response to acetylcholine administration into each coronary artery are compatible with pathogenesis of vasospastic angina and Brugada syndrome, respectively.

1) Nishizaki M et al. Heart Vessels. 2008;23:201-205.

CONDITIONS THAT CAN LEAD TO ST SEGMENT ELEVATION IN THE RIGHT PRECORDIAL LEADS

- EARLY REPOLARIZATION VARIANT
- YOUNG PATTERN
- PECTUS EXCAVATUM, 'FUNNEL CHEST' OR “SUNKEN CHEST”
- ASTENIC HABIT
- RIGHT BUNDLE BRANCH BLOCK
- LEFT BUNDLE BRANCH BLOCK
- LEFT VENTRICULAR ENLARGEMENTE
- ACUTE MYOCARDITIS
- CONCEALED FORMS OF ARRHYTHMOGENIC RIGHT VENTRICULAR DYSPLASIA.
- RIGHT VENTRICULAR ISCHEMIA OR INFARCTION
- VARIANT ANGINA, VASOSPASTIC ANGINA OR PRIZMETAL ANGINA
- DURING PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOPLASTY
- SURGICAL REPLACEMENT OF THE AORTIC VALVE AND CORONARY BYPASS
- DISSECTING AORTIC ANEURISM

CONDITIONS THAT CAN LEAD TO ST SEGMENT ELEVATION IN THE RIGHT PRECORDIAL LEADS

- ACUTE PULMONARY EMBOLISM
- CENTRAL AND AUTONOMIC NERVOUS SUYSTEM ABNORMALITIES
- HETEROCYCLIC ANTIDEPRESSANT OVERDOSE
- DUCHENNE MUSCULAR DYSTROPHY
- FRIEDREICH´S ATAXIA
- THIAMINE DEFICIENCY
- HYPOTHERMIA
- HYPERCALCEMIA
- HYPERKALEMIA
- PROFOUND ELECTROLYTE DISTURBANCE INDUCED BY DIABETIC KETOASIDOSIS
- COCAINE INTOXICATION
- LQTS TYPE 2 LQT3
- MEDIASTINUM TUMOR THAT COMPRESSES THE RVOT
- PERICARDITIS
- BRUGADA SYNDROME

CONDITIONS THAT CAN LEAD TO PROMINENT U WAVE

- Bradycardia
- Early repolarization variant (ERV)
- Hypopotassemia or hypokalemia
- Hypomagnesemia
- Hypocalcemia
- Hypothermia
- Class III antiarrhtymic drugs
- Class IA antiarrhtymic drugs
- Digitalis effect or digitalis action
- Phenothiazines
- Forced inspiration

CONDITIONS THAT CAN LEAD TO PROMINENT U WAVE

- Post-exercise
- Mitral valve prolapse
- Left Ventricular Enlargement
- Alterations of the central nervous system that course with endocranial hypertension
- Cardiomyopathies
- Acquired Complete AV block
- Congenital long QT syndrome
- Left circumflex-related myocardial infarction
- **Brugada Syndrome**

FINAL COMMENTARIES

This is the first case in literature that shows alternating U waves polarity in Brugada syndrome.

The U wave alternans is an electrocardiographic sign of left ventricular failure and/or increased ventricular irritability[1-2].

Additionally, prominent U waves in Brugada syndrome never before had been shown in literature, as far as we know.

1) Ever KM. Am Heart J. 1974; 87:41-45.
2) Bashour T, et al. Chest. 1973; 64: 377-379