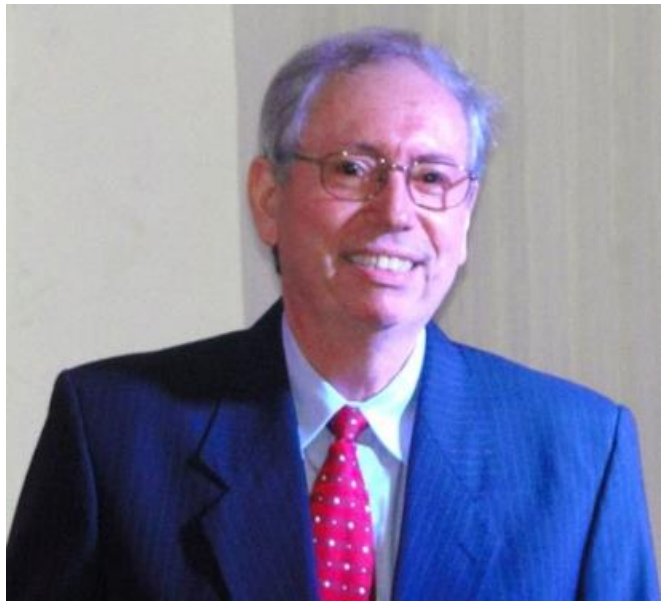
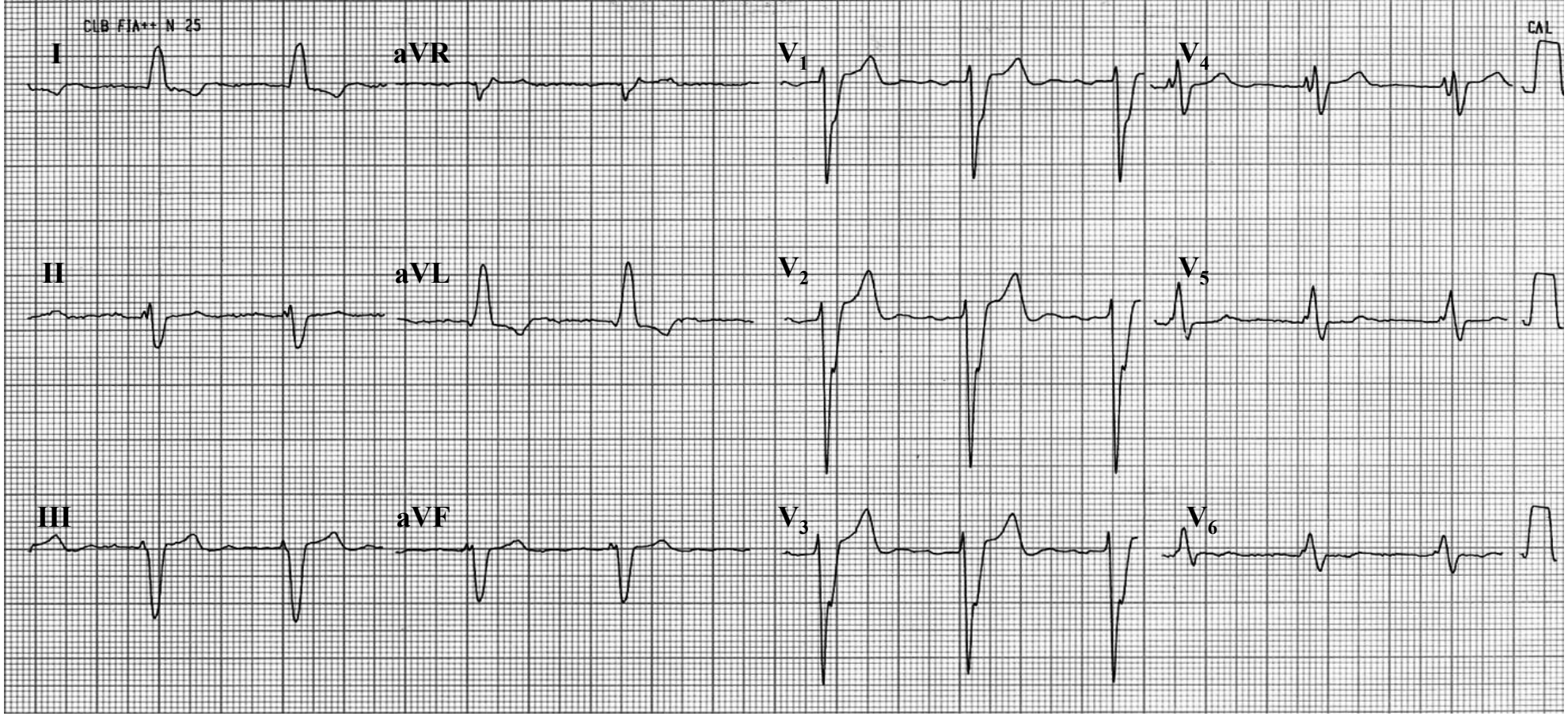
Complete Left Bundle Branch Block associated with free wall chronic myocardial infarction

Andrés Ricardo **Pérez-Riera, M.D. Ph.D.**
Design of Studies and Scientific Writing Laboratory in the ABC School of Medicine, Santo André, São Paulo, Brazil
https://ekgvcg.wordpress.com

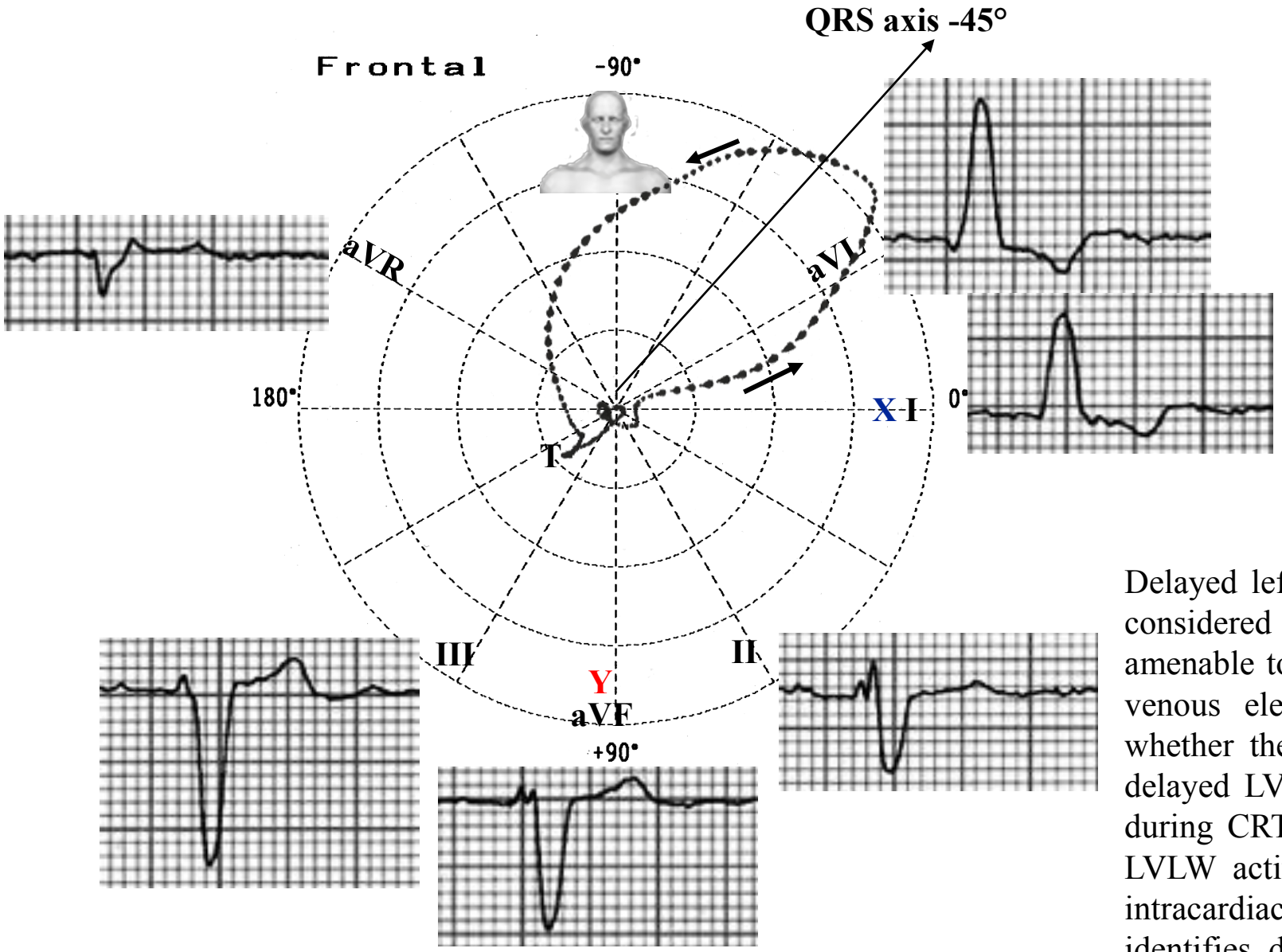


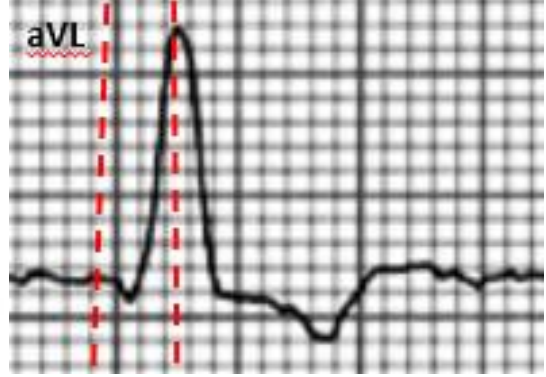
Raimundo **Barbosa-Barros**, MD
Chief of the Coronary Center of the Hospital de Messejana Dr. Carlos Alberto Studart Gomes. Fortaleza – CE- Brazil



Clinical diagnosis: multi-vessel CAD patient, already revascularized, with significant decrease in LVEF = 35%.
ECG diagnosis: sinus rhythm, heart rate 60 bpm, P wave difficult to distinguish, prolonged PR interval (240 ms), QRS axis -45°, QRS duration 170 ms, rS pattern in right precordial leads (V1-V3) with prolongation of S ascending slope in right precordial leads with >55 mm duration in the isoelectric line height. The phenomenon indicates parietal block similar to that found in ARVD (in this case by ischemic fibrosis in anterior wall), monophasic R of slow inscription in I and qR in aVL. Rs/RS pattern in V_5 and V_6 with final S >40 ms (which may correspond to electrically inactive area in the free wall associated to CLBBB and associated LAFB, recording of intermediate precordial leads by counterclockwise rotation in the longitudinal axis in the presence of associated LVE or RVE), "R-Wave Peak Time" or intrinsicoid deflection in I and $V_6 \geq 50$ ms (80 ms) and ST-T opposite to a greater QRS deflection: positive from V_1 to V_3 and negative in left leads I, aVL. **Conclusion:** First degree AV block + CLBBB + LAFB + electrically inactive area in lateral wall and parietal block in the right precordial leads from V1 to V3.

ECG/VCG correlation in the Frontal Plane

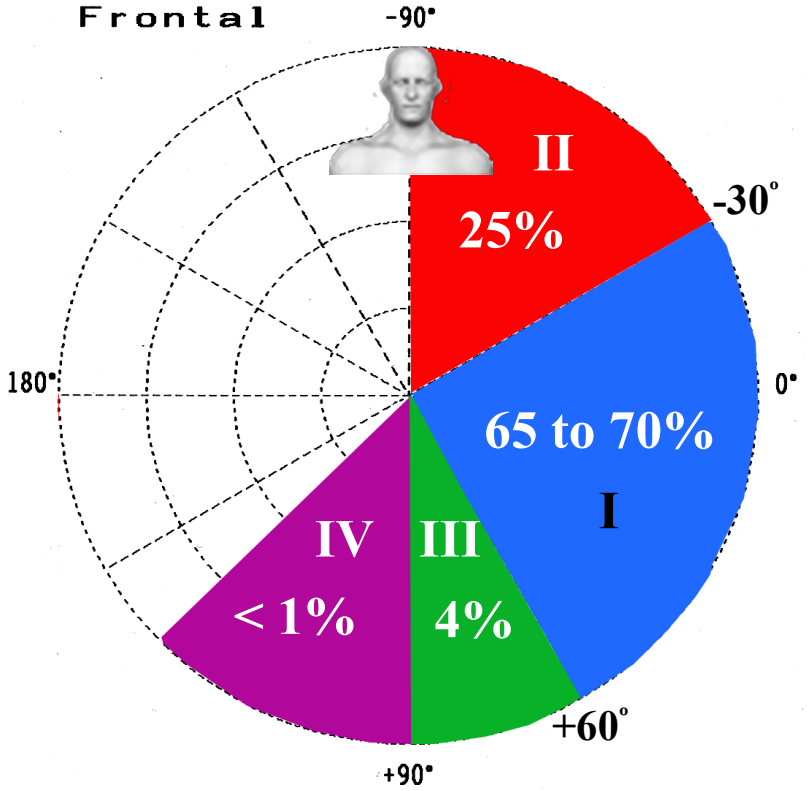




Delayed left ventricular (LV) lateral wall (LVLW) activation is considered the electrical substrate underlying LV dysfunction amenable to cardiac resynchronization therapy (CRT). Coronary venous electroanatomic mapping (EAM) and to investigate whether the QRS area (QRSAREA) on the VCG can identify delayed LVLW activation. Coronary venous EAM can be used during CRT implantation to determine the presence of delayed LVLW activation. QRSAREA is a noninvasive alternative for intracardiac measurements of electrical activation, which identifies delayed LVLW activation better than QRS duration and LBBB morphology (**Mafi Rad 2016**).

Analysis in the following slide

Types of CLBBB according to electrical axis of QRS complex in the FP



- With QRS axis not deviated: between -30° and +60° (≈ 65% to 70% of cases)
- With QRS axis with extreme deviation to the left: beyond -30^0 (≈25% of cases)
- With QRS axis deviated to the right: between +60° and +90° (≈ 3.5 a 5% of cases)
- With QRS axis with extreme deviation to the right: beyond +90° (< than 1% of cases). It is named "paradoxical type of Lepeschkin" (**Lepeschkin 1951**). Causes that determine paradoxical complete LBBB

Extreme left axis deviation occurs when there is block in the left main bundle branch and additional block in the left anterior division of the left main bundle (**Pryor 1966, Rosenbaum 1969**), implying that there is more extensive disease of the left bundle branch system (**Bauman 1979**) when left bundle branch block and left axis deviation are seen on the external ECG than when left bundle branch block occurs with a normal axis.

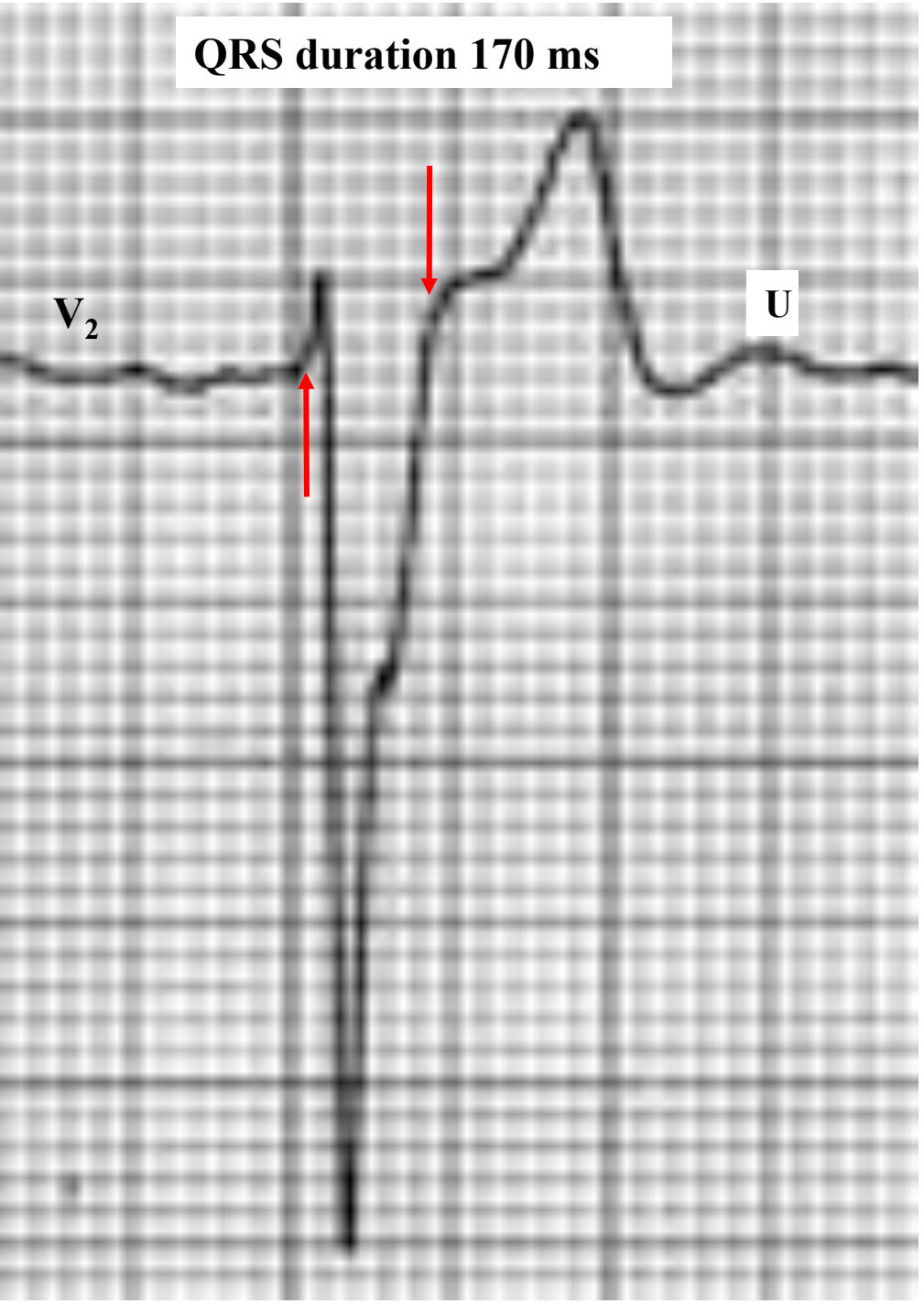
Analysis of VCG/ECG in the Frontal Plane

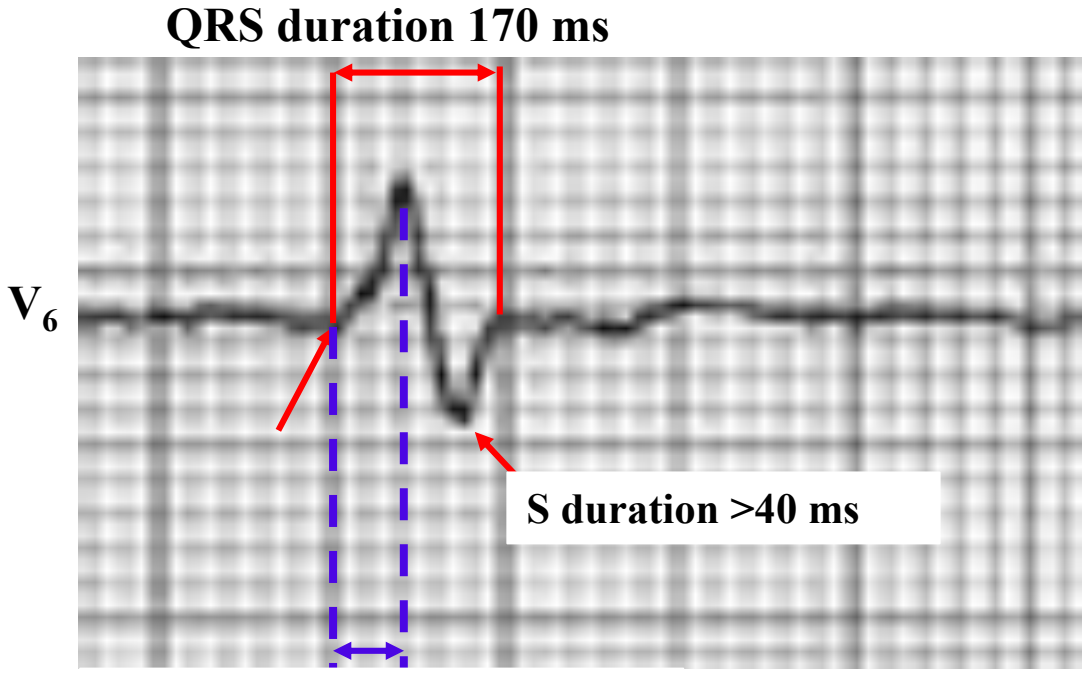
1. **VCG in the Frontal Plane**: Initial 10 ms vector of the QRS loop heading below and to the left, with counterclockwise rotation, duration > 120 ms (>60 dashes), maximum vector of QRS around –40º; most of the loop located predominantly in the left upper quadrant and its final part in the right quadrants. J point (end of QRS loop and onset of T wave) located at the front and right in relation to the end of T loop (point **0**). Both points are very distant, corresponding to significant ST segment elevation in ECG. T loop of location completely opposite to QRS loop constituting QRS/T angle close to 180° and with efferent and afferent limbs of slow inscription, indicating the presence of primary T loop.

2. **ECG in the Frontal Plane:** extreme QRS axis shift to the left and upward (-45°), prolonged QRS duration (170 ms), rS pattern in inferior leads with SIII>SII and qR in aVL.
   Axis of T wave at +130°, which explains positive T waves in III, aVF and III and negative in I and aVL.

The tracing presented mixed characteristics of CLBB and LAFB associated to LV free wall infarction.
The characteristics of CLBBB are the initial 10 ms vector heading to the left and down (in typical LAFB it is heading to the right and down), QRS duration ≥120 ms and increased distance between the J point and point 0 (end of T loop).
The characteristics of LAFB and extreme QRS axis shift in the FP in the left upper quadrant (axis of QRS -45°), SIII>SII, “R-Wave Peak Time” very prolonged in aVL.

Conclusion: CLBBB + LAFB + ischemic T and electrically inactive area in the LV free wall.

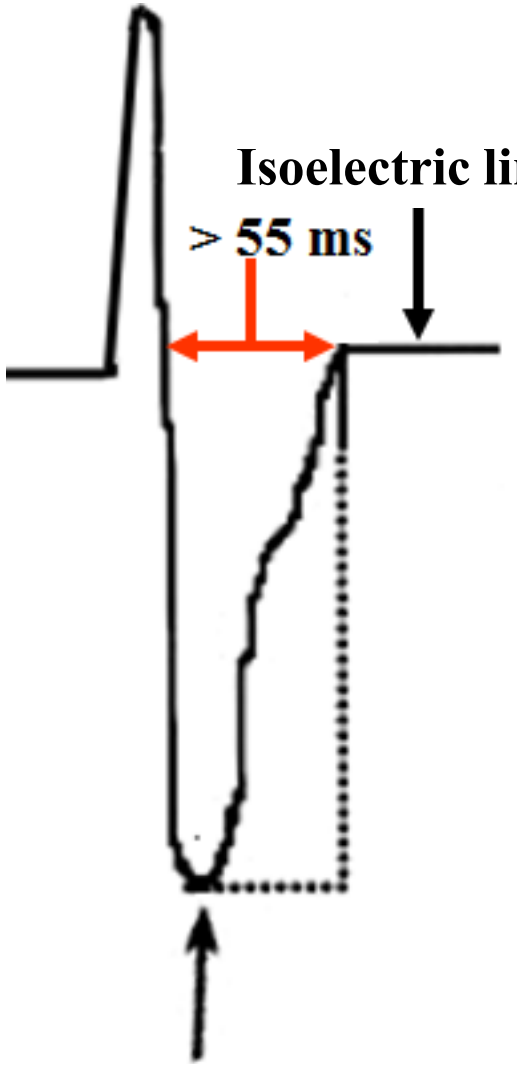




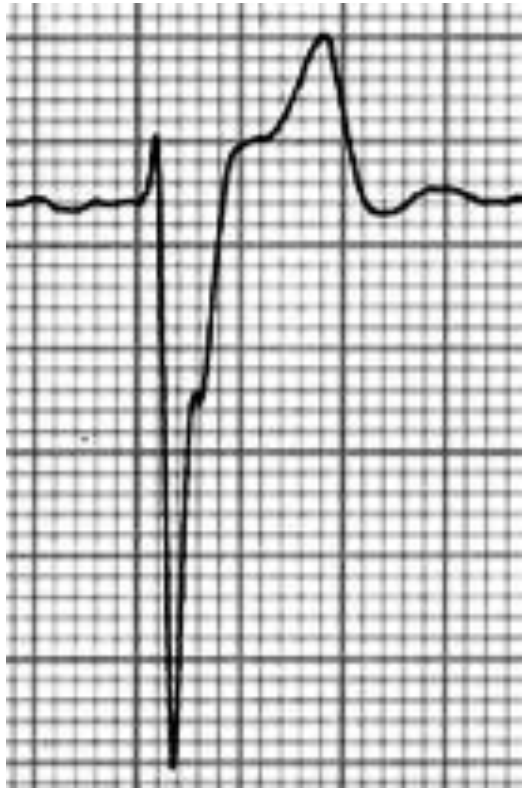
R-wave Peak time = 80 ms

The presence of Rs or RS pattern in the left precordial leads may indicate:

1. Transitional LVE recording
2. Association with LAFB
3. RVE associated to CLBBB
4. Association with electrically inactive area in LV free wall: in this case, the final S is usually >40 ms of duration and/or it presents notching.



V_1

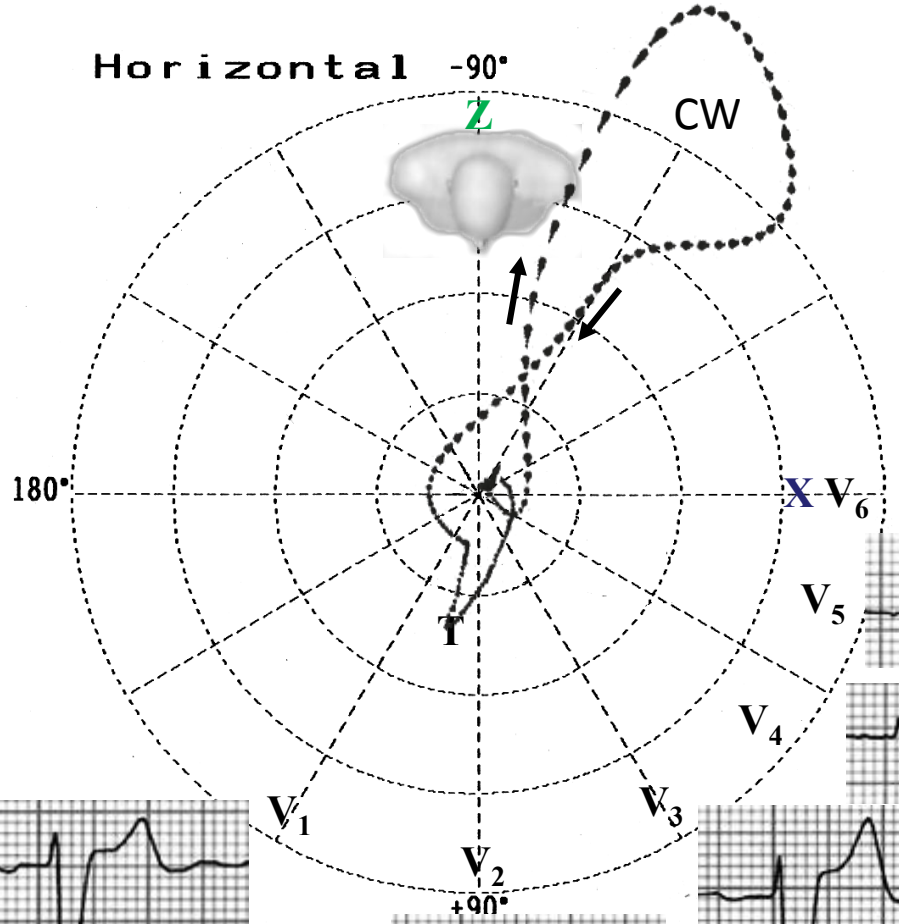


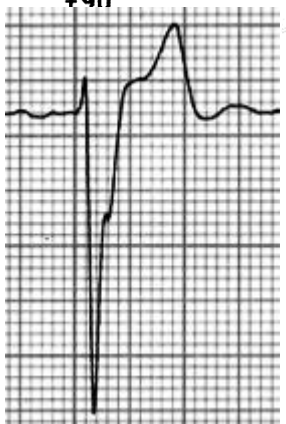
V_2

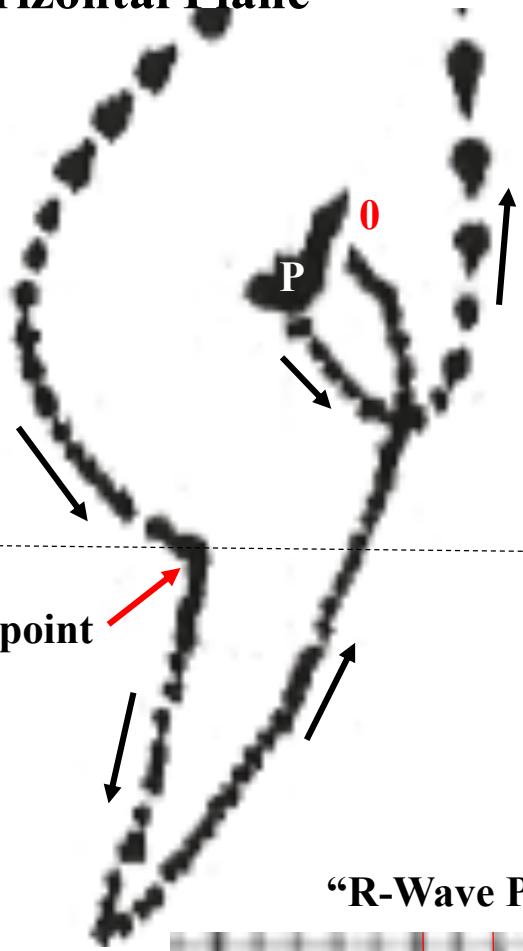
V_3

Prolongation of the ascending S slope in the right precordial leads with duration >55 mm in the isoelectric line height. The phenomenon indicates parietal block similar to that found in ARVD. In this case, by ischemic anterior wall fibrosis.

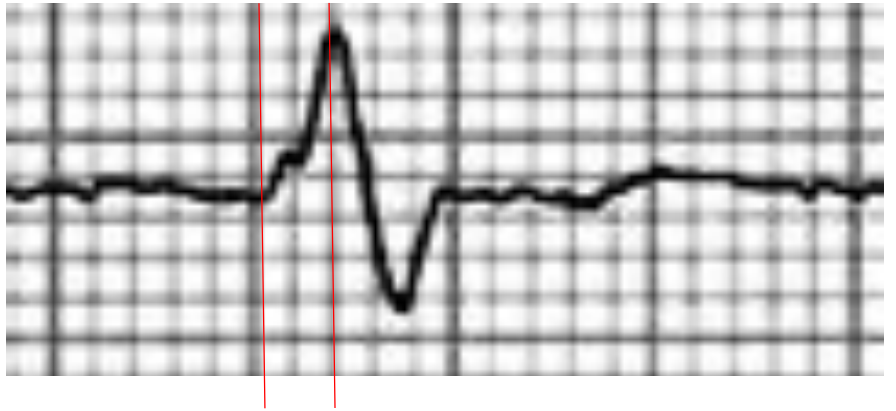
ECG/VCG correlation in the Horizontal Plane







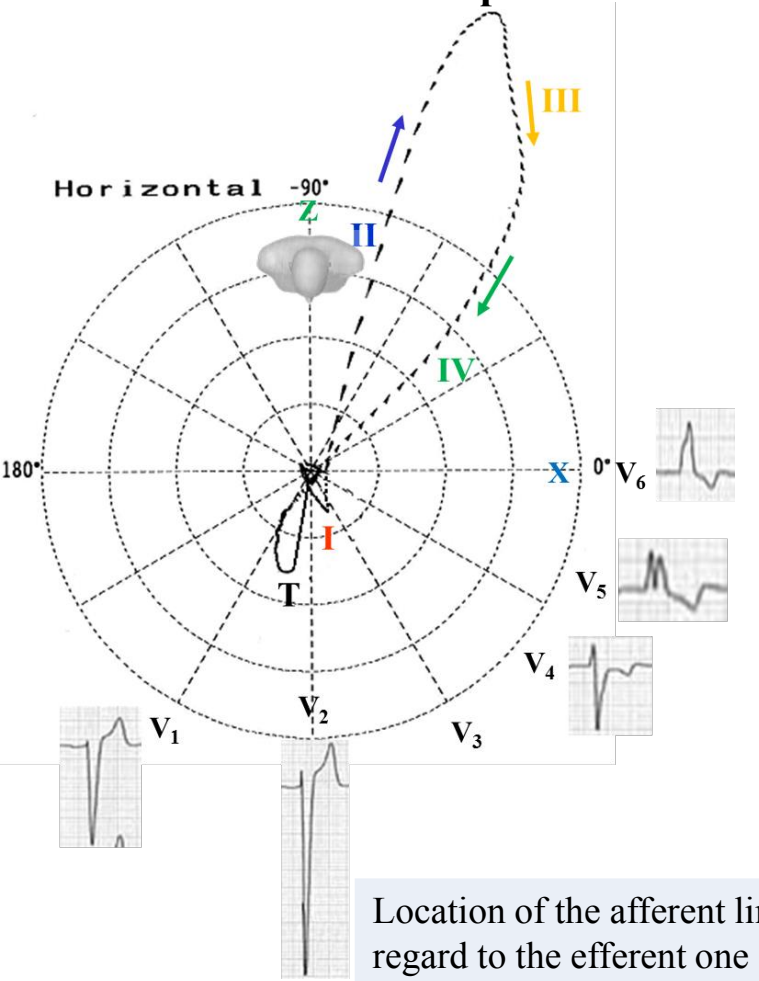
"R-Wave Peak Time 80 ms"

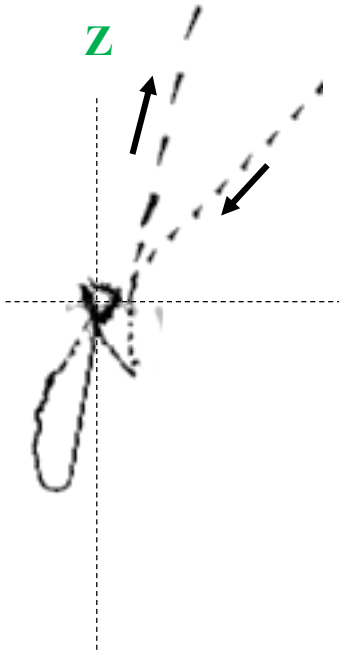


Diagnostic VCG/ECG in the horizontal plane and precordial leads

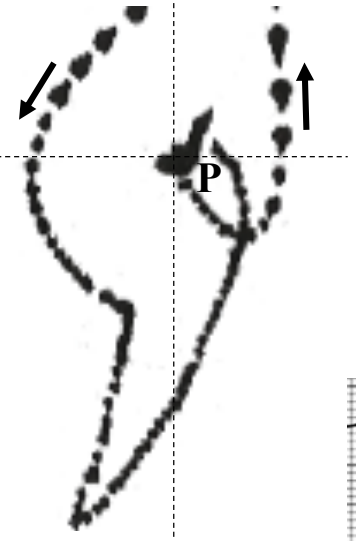
VCG: Initial 10 ms vectors of the QRS loop heading to the front and left (+30°), rotation in eight with main portion of QRS loop of clockwise rotation, middle-end conduction delay, final portion shifted to the right, QRS duration ≥170 ms, narrow, prolonged, efferent or centrifugal limb located at the right in regard to the left one, and of more rapid inscription (dashes more separated from each other) than the afferent or centripetal limb, which is shifted at the right at its end.

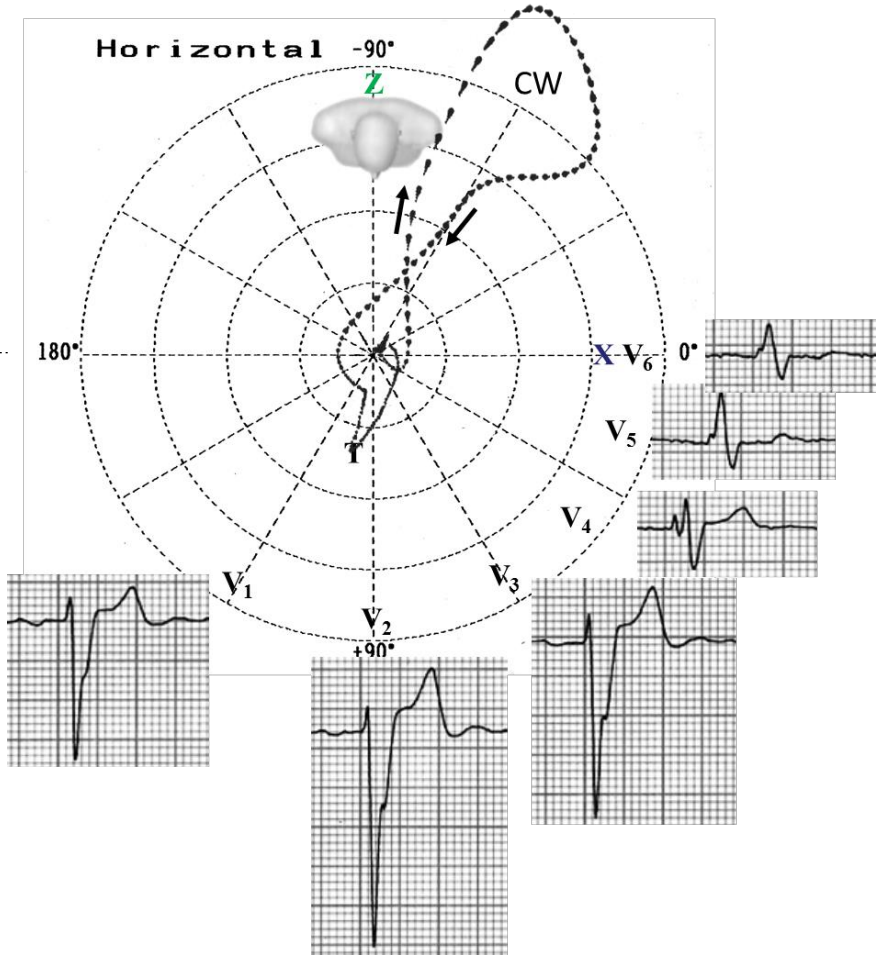
Non-complicated CLBBB





CLBBB complicated with free wall infarction





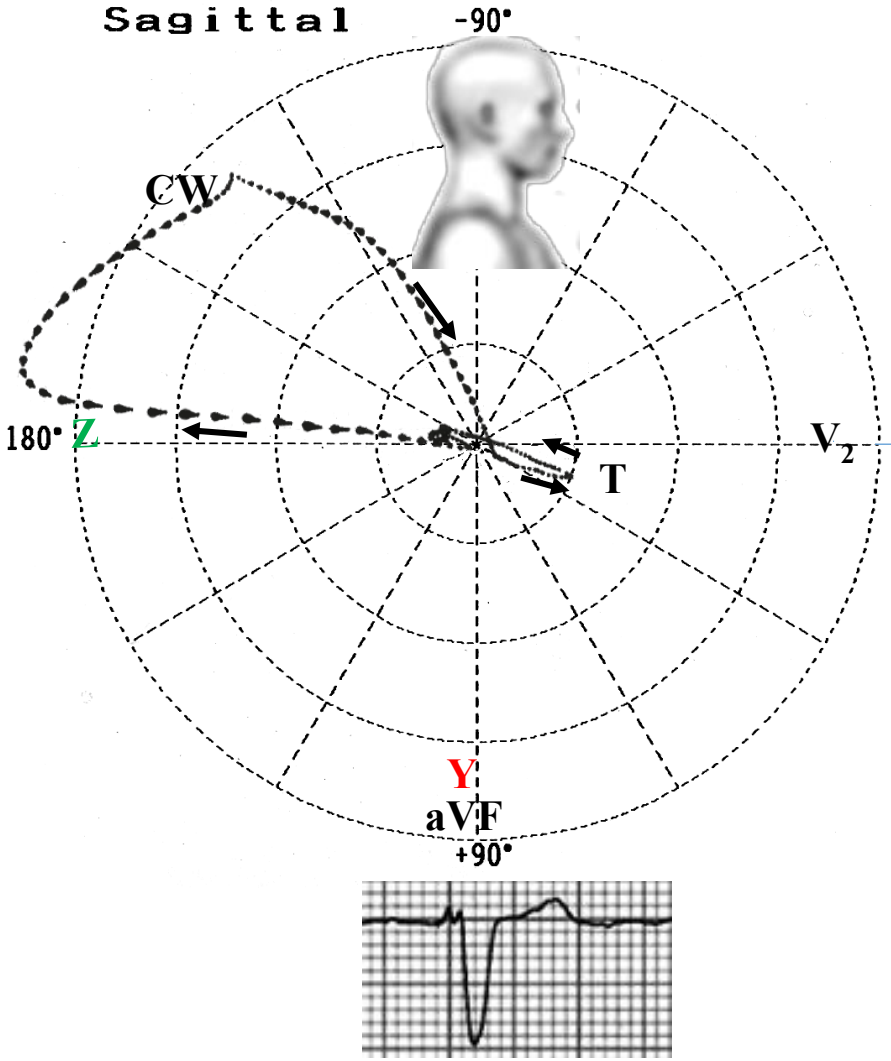
Location of the afferent limb in regard to the efferent one	At the right	At the left
Final portion of QRS loop	In the left quadrants	In the right quadrants

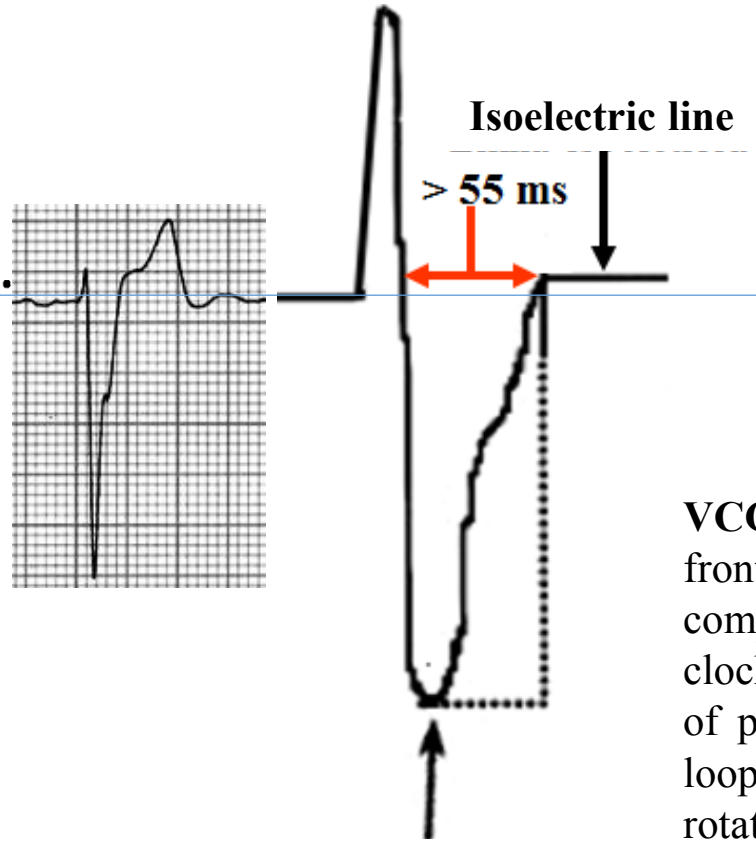
Maximal vector of QRS located in the left posterior quadrant and with increased magnitude (>2 mV).
ST/T vector completely opposite to the QRS loop, constituting an angle close to 180° located in the right anterior quadrant: location opposite from repolarization (ST-T loop) in regard to ventricular depolarization with QRS/ST/T angle of approximately 180° and efferent and afferent limbs of T loop of slow inscription, indicating the presence of primary T loop.
J point (end of QRS and onset of T loop) very distant from point **0** and located at the front and right from this point (corresponding in ECG, to J point and ST segment elevation, typical of CLBBB). T loop of counterclockwise rotation. In V6, prolonged **R-Wave Peak Time 80 ms** (>60 ms).

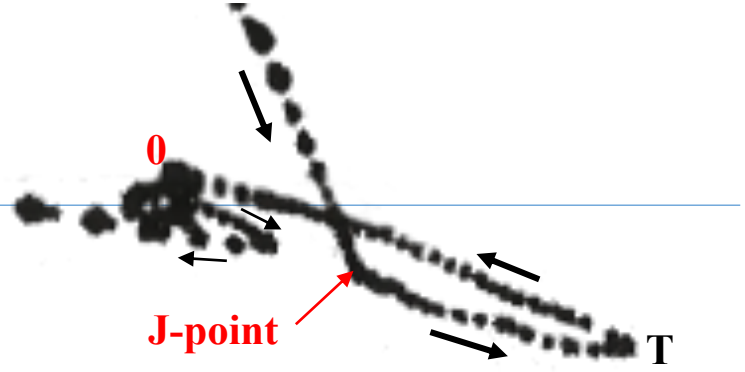
ECG: rS from V1 to V3 with prolongation of S ascending slope; parietal block in right precordial leads (see the next slide) and RS in V5-V6 with final S >40 ms suggesting LV free wall infarction and intra-infarction block association.

Conclusion: Complete left bundle branch block complicated with ischemia and LV free wall infarction by shift to the right of the final portion of the QRS loop, RS pattern in V5-V6 with wide final S wave (>40 ms).

ECG/VCG correlation in the Right Sagittal Plane







VCG: Vector of the initial 10 ms heading to the front and below, QRS loop located nearly completely in the posterior and upper quadrant, of clockwise rotation, mid-end delay, maximum vector of posterior orientation and located near ±180º. T loop opposite to QRS loop and of counterclockwise rotation with both the efferent and afferent limbs with a slow conduction velocity (symmetrical T loop with J point at the front and below point 0. Conclusion: CLBBB + primary T loop.

ECG: rS pattern in V2 with prolongation of S ascending limb: parietal block in the right precordial leads, suggesting intra-anterior infarction block. This pattern is typically observed in ARVD and in Brugada syndrome. rS in aVF.

References

1. Blondeau M. Complete left branch block with strong left axial deviation of the qrs. i. Clinical study. Arch Mal Coeur Vaiss. 1974;67(6):662-34.
2. Lepeschkin E. Modern Electrocardiography, Vol. 1 Baltimore, MD: Williams and Wilkins Co; 1951.
3. Mafi Rad M, Wijntjens GW, Engels EB, et al. Vectorcardiographic QRS area identifies delayed left ventricular lateral wall activation determined by electroanatomic mapping in candidates for cardiac resynchronization therapy. Heart Rhythm. 2016;13(1):217-25.
4. Pryor R, Blount SG Jr. The clinical significance of true left axis deviation. Left intraventricular blocks. Am Heart J. 1966;72(3):391-413.
5. Rosenbaum MB. Types of left bundle branch block and their clinical significance. J Electrocardiol. 1969;2(2):197-206.