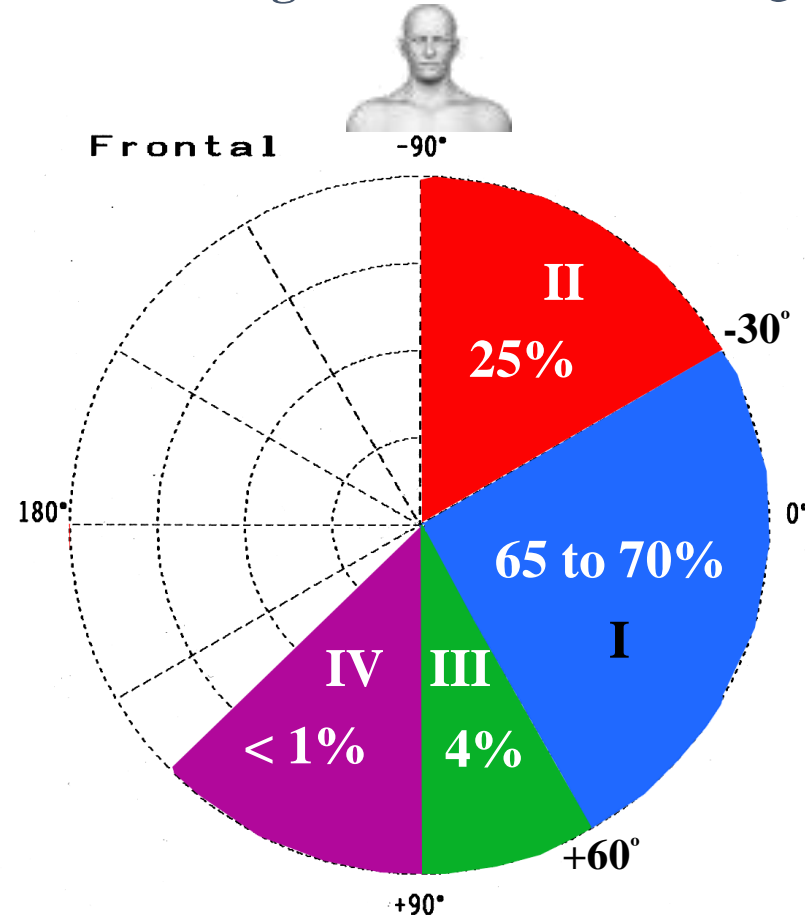
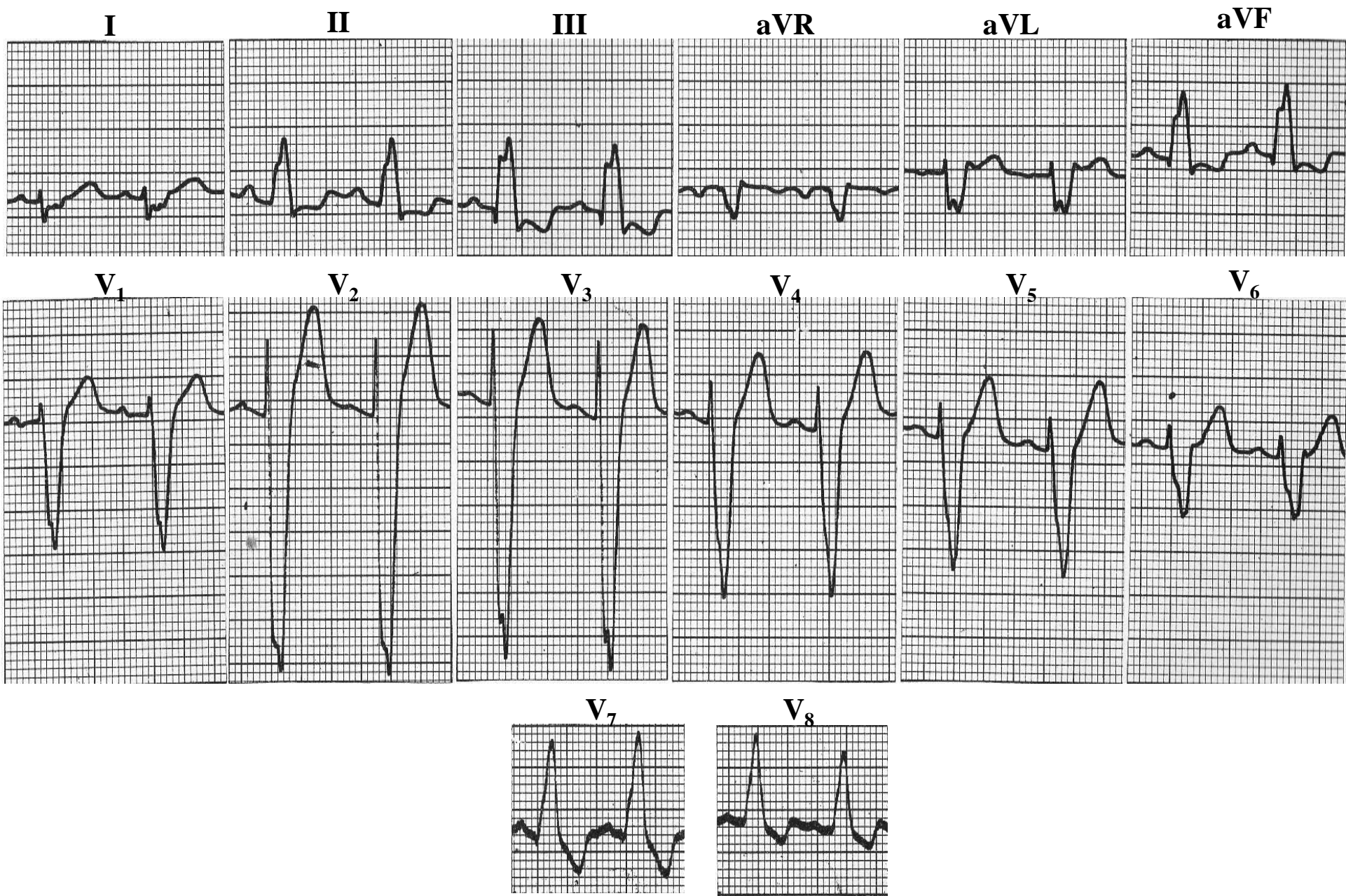


**LBBB with right axis deviation**

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

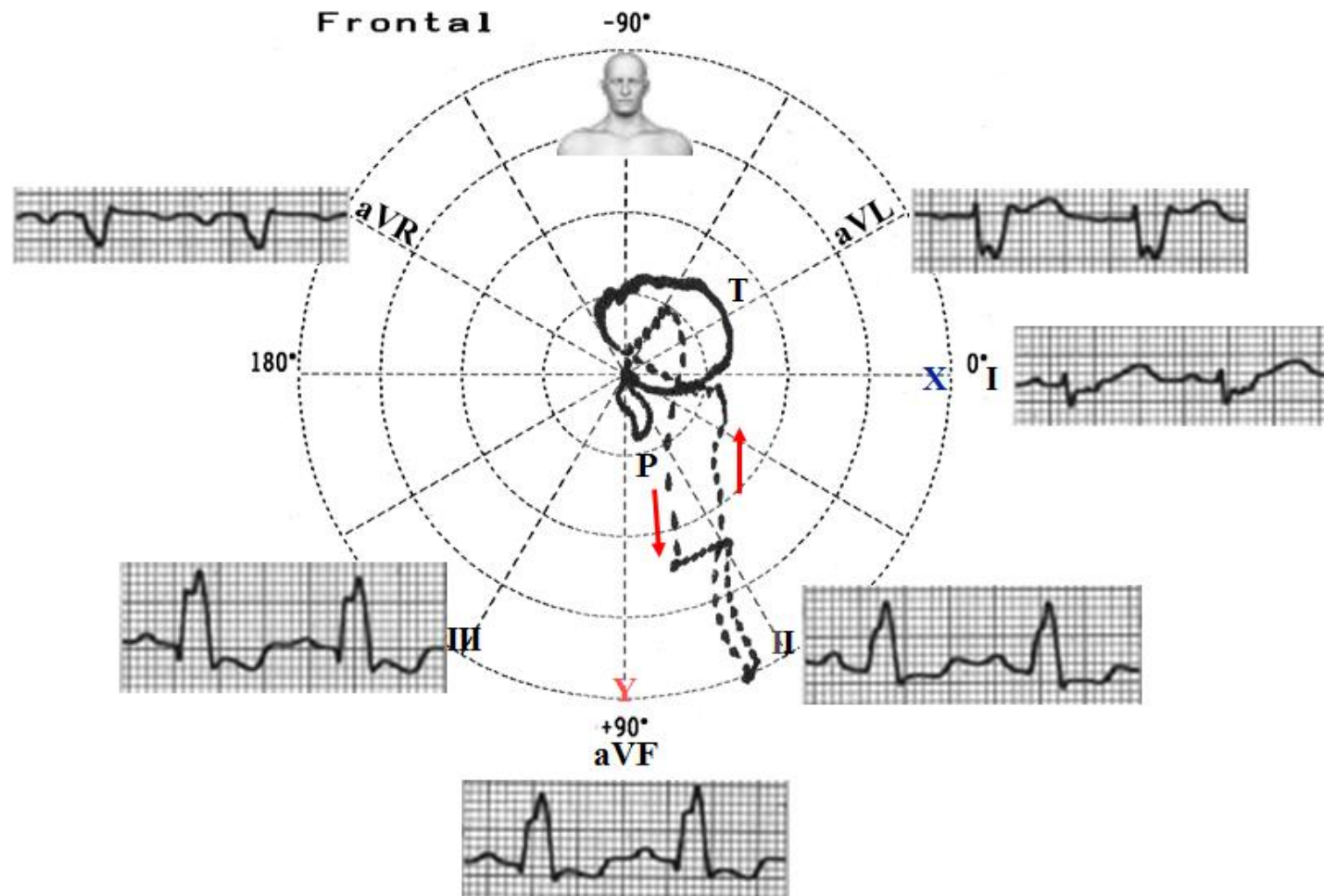


- With QRS axis not deviated: between  $-30^\circ$  and  $+60^\circ$  ( $\approx 65\%$  to  $70\%$  of cases)
- With QRS axis with extreme deviation to the left: beyond  $-30^\circ$  ( $\approx 25\%$  of cases)
- With QRS axis deviated to the right: between  $+60^\circ$  and  $+90^\circ$  ( $\approx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



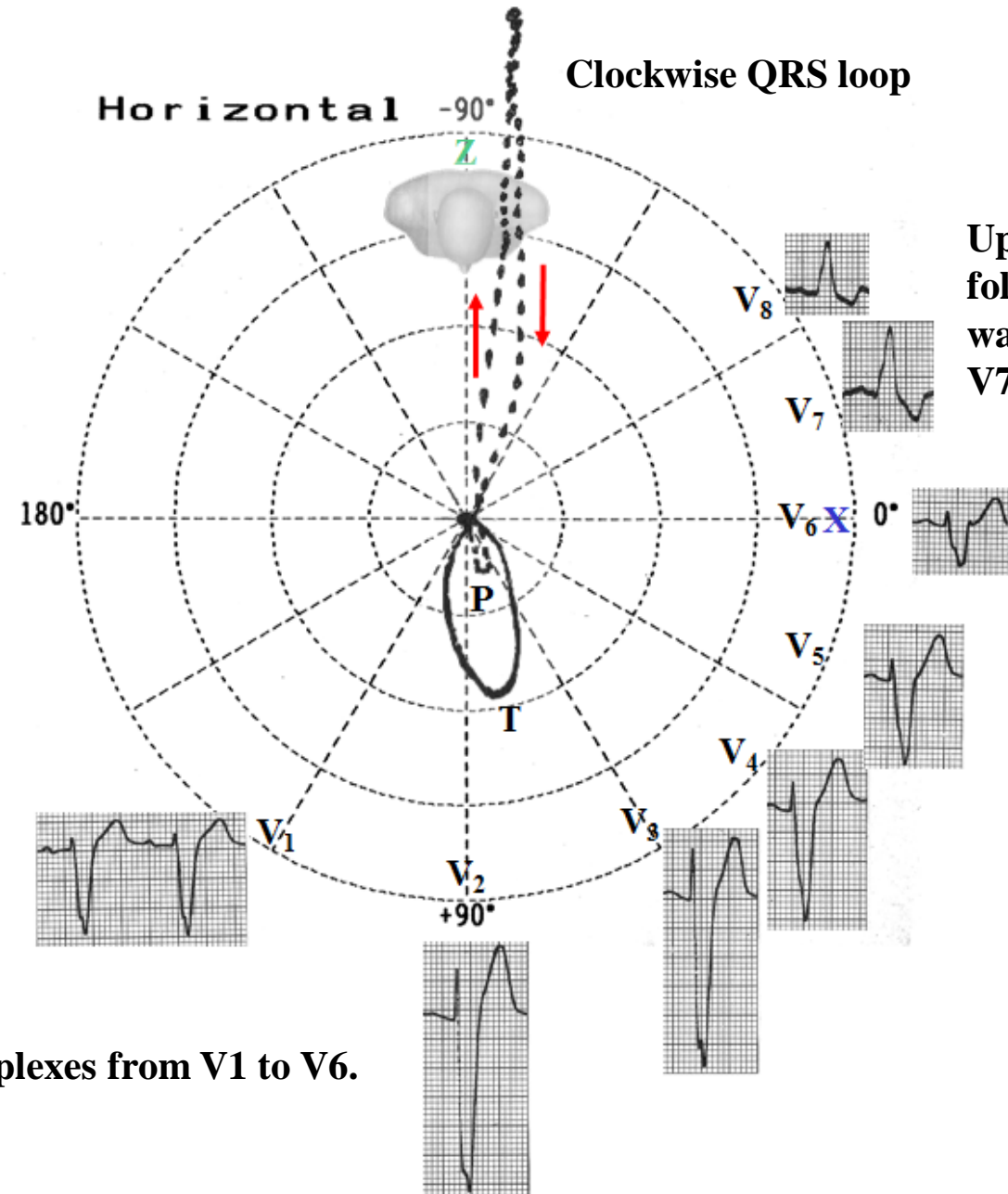
**Atypical LBBB because rs in I and rS in aVL and rS from lead V1 through V6. The typical LBBB upward QRS is observed only in inferior and posterior leads (V7-V8)**

## ECG/VCG correlation on FP



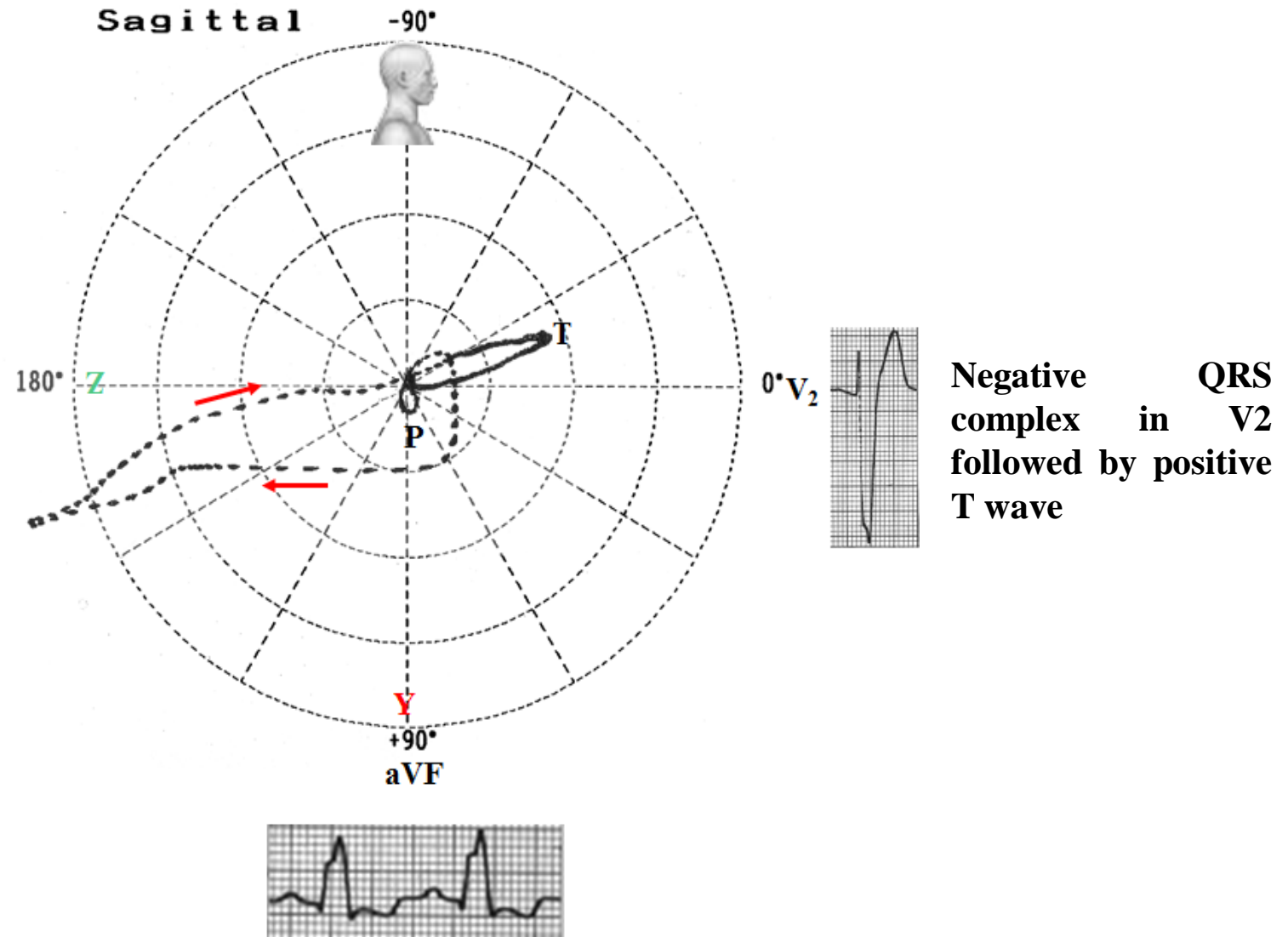
**Right axis deviation.  $\hat{S}\hat{A}QRS$  at  $+110^\circ$ .  
QRS loop with predominant CCW rotation  
with maximal QRS vector  $+74^\circ$ .**

# ECG/VCG correlation on HP



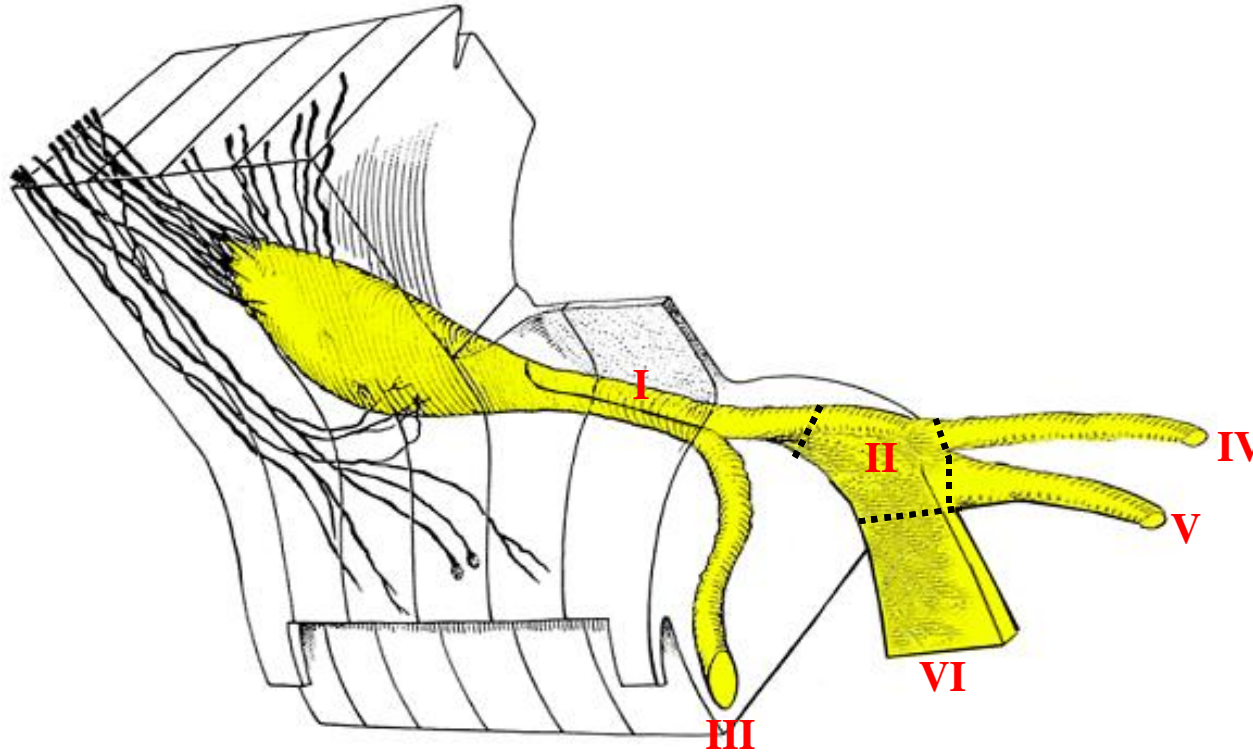
Negative QRS complexes from V1 to V6.

# ECG/VCG correlation on RSP





# **Divisional CLBBB type IV (LAFB + LPFB) by degree of block in LPF greater than the block in LAF**



- I. Penetrating portion of left His bundle**
- II. Stem or truncus of LBB**
- III. Right Bundle Branch (RBB)**

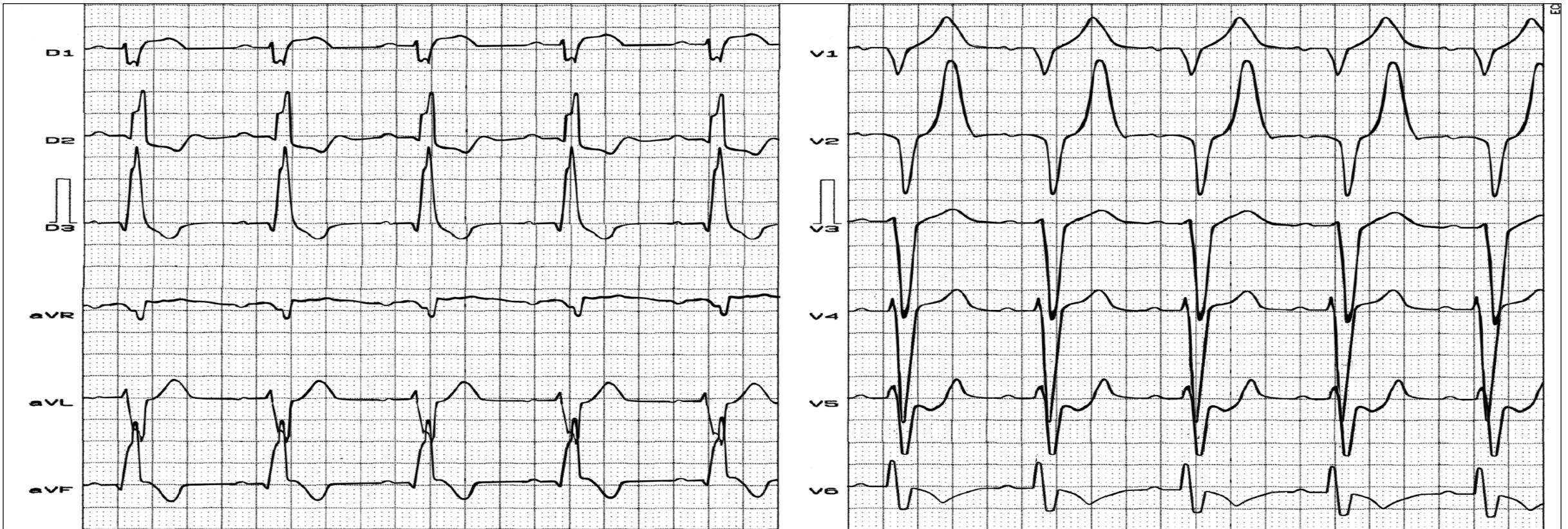
Blocks in I and II are called predivisional, troncular or membranous LBBBs

- IV. Left Anterior Fascicle (LAF)**
- V. Left Posterior Fascicle (LPF)**
- VI. Left Septal Fascicle (LSF)**

Blocks in IV+V+VI are called divisional or fascicular Left Bundle Branch Block

**Name:** ASC; **Sex:** Male; **Age:** 54 yo.; **Race:** White; **Weight:** 86Kg; **Height:** 1.68 m; **Biotype:** Endomorph;

**Date:** 04/03/2003; **Medication in use:** Enalapril 10 mg 2X + Atenolol 50 mg + Chlortalidone 12.5 mg.



**Clinical diagnosis:** Hypertensive heart disease + aortic insufficiency by aortic cause.

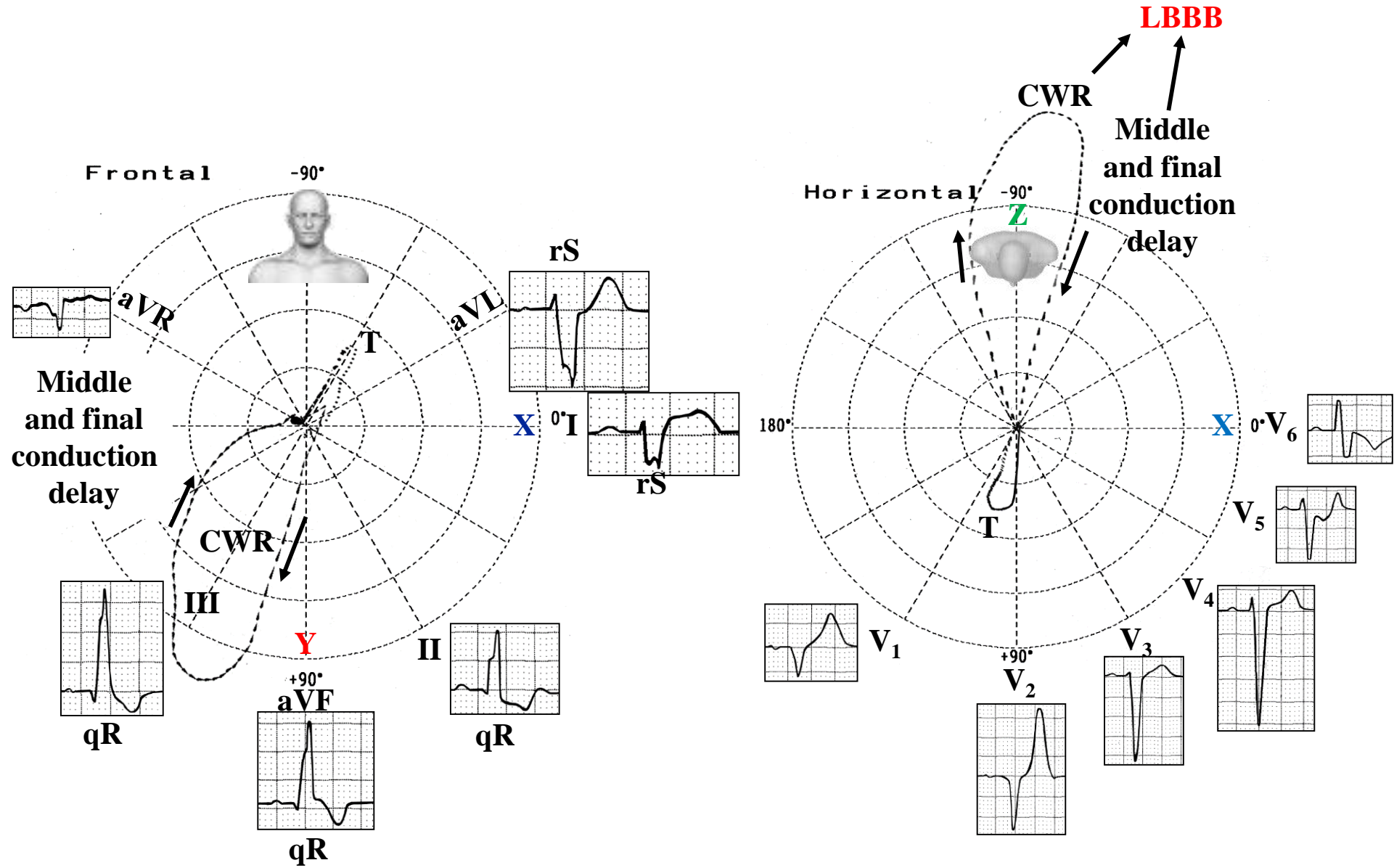
**Echo diagnosis:** Moderate concentric hypertrophy: septum 13 mm and posterior wall 14 mm. Moderate aortic insufficiency.

**ECG diagnosis:** SR; HR: 72 bpm; SAP:  $+60^{\circ}$ ; SAQRS:  $+110^{\circ}$ ; QRSD: 165 ms; I and aVL = rS; DIII = qR; RIII > RII. Which is the electrocardiographic foundation for LPFB diagnosis?  $\hat{S}\hat{A}QRS$  deviated to the right in clinical absence of RVH, vertical heart or lateral infarction; QRS complexes of the rS type in I and aVL; complexes of the qR type in inferior leads with R wave of III > than R wave of II. There are references in literature to aortic insufficiency by regurgitant jet, which thrown on the posteroinferior wall may cause LPFB. On the other hand, the CLBBB has as its most frequent cause hypertension. An accurate diagnosis of LPFB must obligatorily be clinical and electrocardiographic, as in this case, in which in an obese, endomorph, hypertensive patient, the SAQRS is in  $+115^{\circ}$ .

**Conclusion:** 1) CLBBB; 2) LPFB (Left Posterior Fascicular Block).

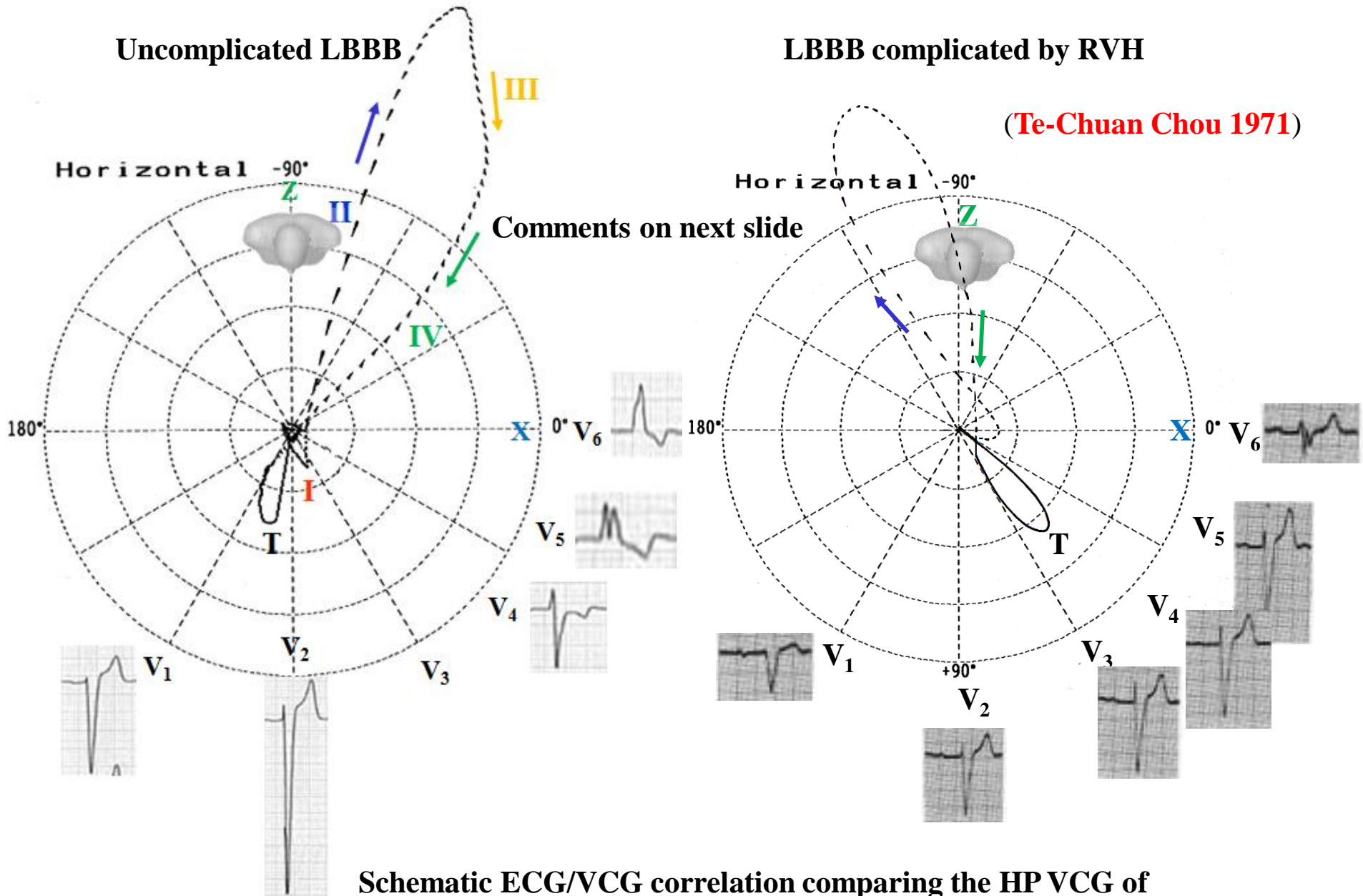


# ECG/VCG correlation on Frontal and Horizontal Plane



$\hat{S}\hat{A}QRS + 110^\circ + RIII > RII + rS I \text{ and } aVL = \text{LPFB}$

### ECG / VCG difference between LBBB and LBBB associated to RVH on HP



### Schematic ECG/VCG correlation comparing the HP VCG of typical LBBB with LBBB complicated by RVH

# VCG characterization of right ventricular hypertrophy in the presence of LBBB

The VCG characteristics are:

- 1. QRS loop duration with prolongation;
- 2. Slow inscription of the mid and late portion of the QRS loop;
- 3. Leftward and inferior orientation of the initial QRS vectors;
- 4. Posterior and rightward displacement of the maximum QRS vector;
- 5. Clock-wise inscription of the major portion of the QRS loop in the HP;
- 6. Anterior and leftward orientation of the ST vector and T-loop.

Final comments:

The changes in the HP VCG differed from the typical LBBB pattern only in the rightward displacement of the QRS loop and leftward orientation of the ST vector and T-loop.

	Isolated LBBB	LBBB + RVH
HP QRS loop	Leftward displacement	Rightward displacement
ST vector and T-loop	Righward orientation	Leftward orientation
ECG lead I	Monophasic R wave	Presence of S wave
QRS axis	From -30° to +60° (≈ 65% to 70% of cases) From −30° to -90° (≈25% of cases)	Beyond +90° (< than 1% of cases)

Left Bundle-Branch Block and Risk Stratification in Heart Disease (Francia P, Balla C, Paneni F, Volpe M. Left bundle-branch block--pathophysiology, prognosis, and clinical management. Clin Cardiol. 2007;30(3):110-5.)

In several studies on chronic and acute CAD, LBBB was found to be an excellent predictor of mortality and events (Freedman RA, Alderman EL, Sheffield LT, Saporito M, Fisher LD: Bundle-branch block in patients with chronic coronary artery disease: Angiographic correlates and prognostic significance. J Am Coll Cardiol 1987;10:73–80. Col JJ, Weinberg SL: The incidence and mortality of intraventricular conduction defects in acute myocardial infarction. Am J Cardiol 1972;29:344–350. Hindman MC, Wagner GS, JaRo M, Atkins JM, Scheinman MM, et al.: The clinical significance of bundle-branch block complicating acute myocardial infarction: Clinical characteristics, hospital mortality, and one-year follow-up. Circulation 1978;58:679–688. Guerrero M, Harjai K, Stone GW, Brodie B, Cox D, et al.: Comparison of the prognostic effect of left versus right versus no bundle-branch block on presenting electrocardiogram in acute myocardial infarction patients treated with primary angioplasty in the primary angioplasty in myocardial infarction trials. Am J Cardiol 2005;96(4):482–488. Wong CK, Stewart RA, Gao W, French JK, Raffel C, et al.: Prognostic differences between different types of bundle branch block during the early phase of acute myocardial infarction: Insights from the Hirulog and Early Reperfusion or Occlusion (HERO)-2 trial. Eur Heart J 2006;27(1):21–28.) (next Table). In 681 patients with acute myocardial infarction (AMI) enrolled in the Thrombolysis and Angioplasty in Myocardial Infarction (TAMI) (McCullough PA, Hassan SA, Pallekonda V, Sandberg KR, Nori DB, et al.: Bundle-branch block patterns, age, renal dysfunction, and heart failure mortality. Int J Cardiol 2005;102(2):303–308.) and Global Utilization of Streptokinase and t-PA for Occluded Arteries (GUSTO) 1 protocols (Newby KH, Pisano E, Krucoff MW, Green C, Natale A: Incidence and clinical relevance of the occurrence of bundle-branch block in patients treated with thrombolytic therapy. Circulation 1996;94:2424–2428), the incidence of LBBB was found to be 7%. The occurrence of both RBBB and LBBB was closely related to factors indicating more extensive myocardial damage (such as number of diseased vessels, peak creatinine phosphokinase, ejection fraction) and mortality. In patients showing persistent rather than transient BBB, the 30 days-risk of death was six times higher than in those without BBB, patients with LBBB mostly contributing to this outcome.



TABLE 2 Outcomes in subjects and patients with left bundle-branch block (LBBB)

First author (Ref No.)	Year	n	Mean age (years)	Sample	Outcome
Eriksson (28)	1998	855	70	Men born 1913	Increased mortality for LBBB only in conjunction with CAD
Fahy (18)	1995	100,000	44	Screening	Increased prevalence of cardiovascular disease at follow-up Increased cardiac mortality for LBBB+CAD No differences in all-cause mortality for LBBB
Schneider (17)	1981	5,209	50	Framingham	Increased mortality for LBBB
Rotman (15)	1975	237,000	35	U.S. Air Force	No increased mortality for LBBB
Hesse (58)	2001	7,073	60	Stress testing	Increased all-cause mortality for LBBB
Freedman (20)	1987	15,609	55	Chronic CAD	Increased mortality for LBBB
Wong (24)	2006	17,073	68	Acute MI	Increased 30-day mortality for LBBB
Guerrero (23)	2005	3,053	69	Acute MI	Increased in-hospital death for LBBB
Stenestrand (27)	2004	88,026	77	Acute MI	Increased unadjusted 1-year mortality
Brilakis (26)	2001	894	76	Acute MI	Lower pre-discharge ejection fraction Higher in-hospital and long-term unadjusted mortality
Baldasseroni (10)	2002	5,517	63	CHF	Increased 1-year mortality and sudden death

*Abbreviations:* CAD = coronary artery disease, MI = myocardial infarction, CHF = congestive heart failure.

28 Eriksson P, Hansson PO, Eriksson H, Dellborg M: Bundle-branch block in a generally male population. The study of men born 1913. *Circulation* 1998;98:2494–2500.

18 Fahy GJ, Pinski SL, Miller DP, McCabe N, Pye C, et al.: Natural history of isolated bundle-branch block. *Am J Cardiol* 1996;77:1185–1190.

15 Rotman M, Thiebwasser JH: A clinical follow-up study of right and left bundle-branch block. *Circulation* 1975;51:477–484.

20 Freedman RA, Alderman EL, Sheffield LT, Saporito M, Fisher LD: Bundle-branch block in patients with chronic coronary artery disease: Angiographic correlates and prognostic significance. *J Am Coll Cardiol* 1987;10:73–80.

24 Wong CK, Stewart RA, Gao W, French JK, Raffel C, et al.: Prognostic differences between different types of bundle branch block during the early phase of acute myocardial infarction: Insights from the Hirulog and Early Reperfusion or Occlusion (HERO)-2 trial. *Eur Heart J* 2006;27(1):21–28

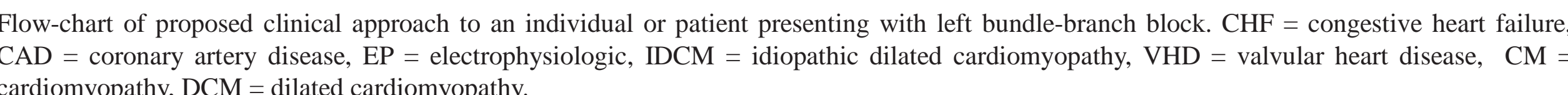
23 Guerrero M, Harjai K, Stone GW, Brodie B, Cox D, et al.: Comparison of the prognostic effect of left versus right versus no bundle-branch block on presenting electrocardiogram in acute myocardial infarction patients treated with primary angioplasty in the primary angioplasty in myocardial infarction trials. *Am J Cardiol* 2005;96(4):482–488.

27 Stenestrand U, Tabrizi F, Lindback J, Englund A, Rosenqvist M, et al.: Comorbidity and myocardial dysfunction are the main explanations for the higher 1-year mortality in acute myocardial infarction with left bundle-branch block. *Circulation* 2004;110:1896–1902.

26Brilakis ES, Wright RS, Kopecky SL, Reeder GS, Williams BA, et al.: Bundle-branch block as a predictor of long-term survival after acute myocardial infarction. *Am J Cardiol* 2001;88:205–209.

10Baldasseroni S, Opasich C, Gorini M, Lucci D, Marchionni N, et al.: for theItalian Network on Congestive Heart Failure Investigators: Left bundle-branch block is associated with increased 1-year sudden and total mortality rate in 5,517 outpatients with congestive heart failure: A report from the Italian network on congestive heart failure. *Am Heart J* 2002;143(3):398–405.





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