Transient Prominent Anterior QRS Forces
in a man with classical angina pectoris, high blood pressure and diabetes mellitus

Forças do QRS precordiais anteriores proeminentes transitórias em um homem com angor pectoris clássico, pressão alta e diabete mellitus

Fuerzas anteriores del QRS precordiales prominentes transitorias en un hombre con angina de pecho clásica, hipertensión arterial y diabetes mellitus

"IF HEMIBLOCKS DO EXIST, THEY ARE ONLY TWO - IF A THIRD ONE IS POSTULATED, HEMIBLOCKS DO NOT EXIST "

Fernando de Padua M.D. From Portugal

From Raimundo Barbosa Barros M.D.
Coronary Center Hospital de Messejana Dr. Carlos Alberto Studart Gomes Fortaleza-Ceará-Brazil

Finals comments Andrés Ricardo Pérez-Riera M.D. Ph.D.
In charge of Electrovectorcardiogram sector- Cardiology Discipline – ABC Faculty – ABC Foundation – Santo André- São Paulo – Brazil
riera@uol.com.br
Phone Cell (011) 84693388 ; Residence(011) 5044-6243; Office (011) 5621-2390

Holá Maestro
Este paciente hipertenso e diabético foi atendido ontem na sala de emergencia com dor no peito. O que voce acha?
Ele realizou cate que mostrou oclusão de CD(40%) e DA e Cx normais. O segundo ECG foi realizado após cessada a crise de angina após administração de nitratos e aspirina.
Um abraço
Raimundo Barbosa-Barros

¡Hallo Master!

This is a diabetic and hipertensive patient admitted yesterday in the emergency room with typical angor chest pain.

He performed hemodynamic cardiac-coronary catheterization that showed non-significative RCA occlusion(40%), normal LAD and normal LCx.

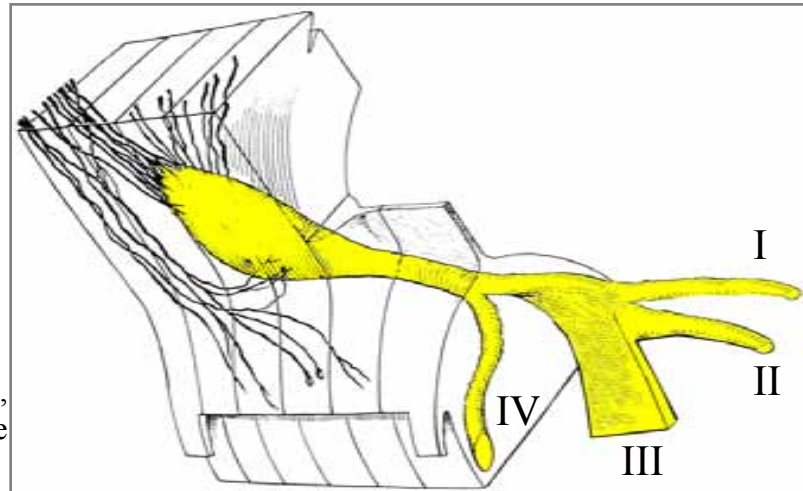
The second ECG was performed 15 minutes after stopped angina episode following adminstration of sublingual nitrate asociated with acetylsalicylic acid

What do you think about both ECG diagnosis?

Dr Elizari and Dr Paulo Chiale what do you think about?. Do exist the hemibloks?

Is the intraventricular conduction system quadriphascicular (RBB+ LAF +LPF +LSF)?

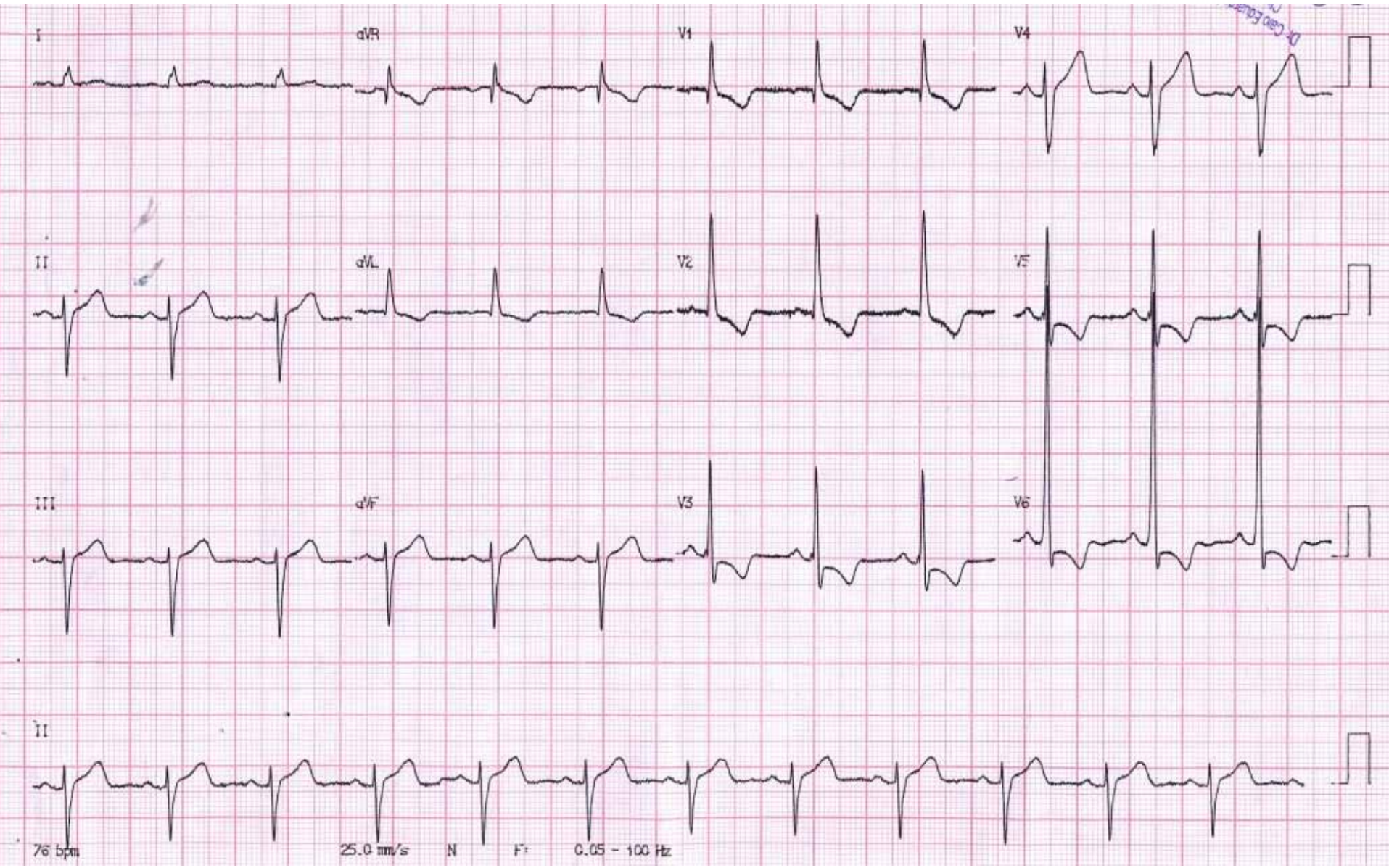
Raimundo Barbosa-Barros M.D.



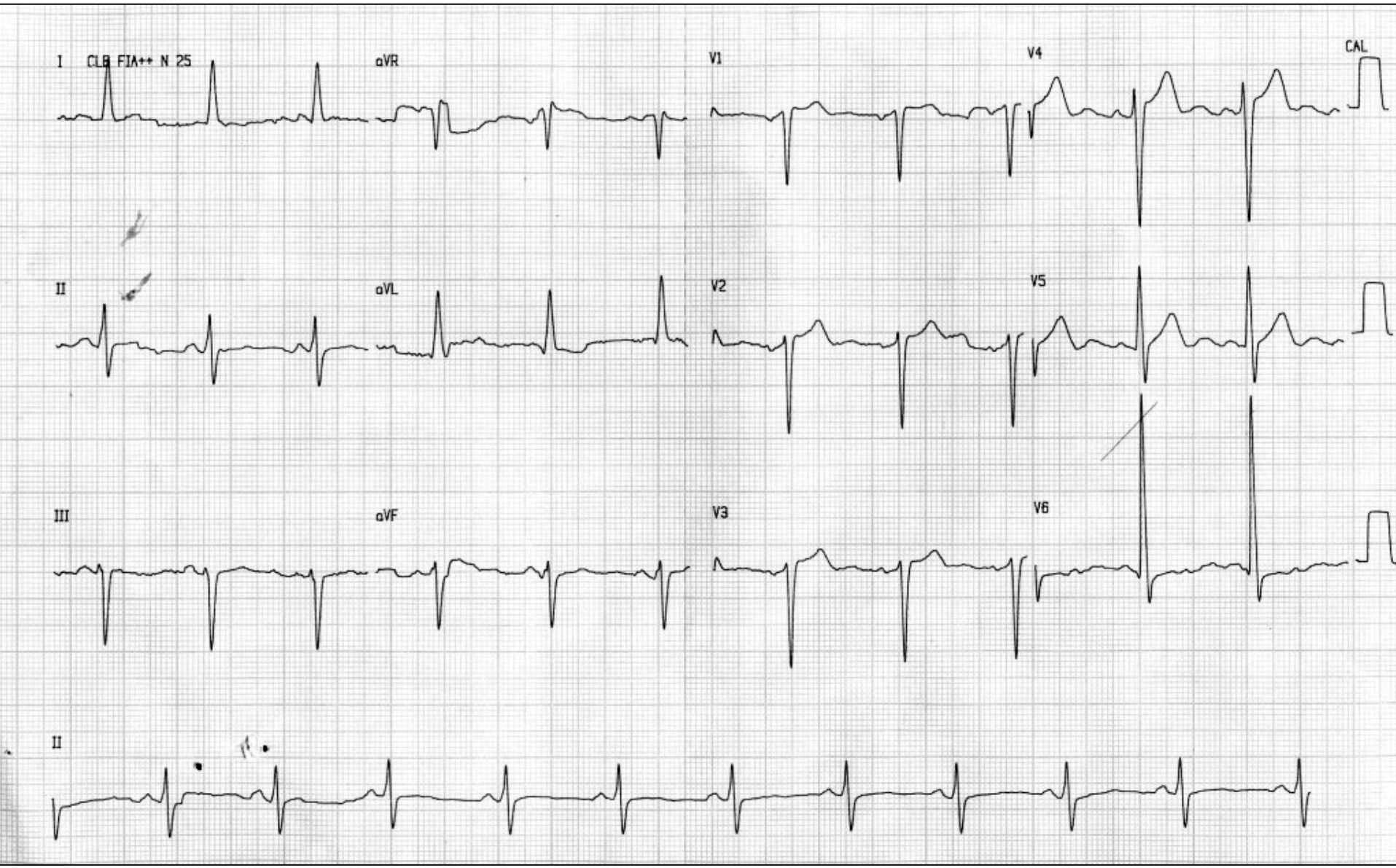
I) Left Anterior Fascicle (LAF)
II) Left Posterior Fascicle (LPF)
III) Left Septal Fascicle (LSF)
IV) Right Bundle Branch (RBB)

1. Uhley HN.: The Quadrifascicular Nature of the Peripheral Conduction System, in Dreifus LS, and Likoff W,.(eds.): Cardiac Arrhythmias (New York): Grune & Stratton. Inc. 1973

ECG-1 Preformed during constrictive precordial pain



ECG-2 Preformed patient without precordial pain. After 15 minutes adminstration sublingual nitrate and acetylsalicylic acid



Colleagues opinions

Isquemia provocada por espasmo de coronária (CD): DCRD, além do BDAS.
Conduta: estudo da perfusão miocárdica com MIBI associada ao Estresse com Teste Ergométrico ou Dipiridamol.
Atenciosamente.

Ischemia caused by coronary spasm (RCA): incomplete right bundle branch block beyond the LSFB. Conduct: study of myocardial perfusion with MIBI stress associated with Exercise Testing and Dipyridamole.
Sincerely.
Severiano Atanes Netto M.D. Brazil.
atanes@apm.org.br

Querido Atanes: um prazer receber sua valiosa opinião. Repare que este paciente já fez cateterismo cardíaco com cinecoronariografia. Você acha necessário MIBI associado ao Teste ergométrico? Com qual intuito? Que subsidio adicional procura com esta prova não invasiva?
Você pensa que o espasmo provocado pela isquemia ocorrera na artéria coronária direita? A artéria coronária direita irriga o ramo direito?
Pensa que o bloqueio incompleto do ramo direito foi causado por espasmo na coronária direita?
Qual a fundamentação eletrocardiográfica para o diagnóstico de distúrbio de condução de ramo direito? Obrigado
Andrés. Dear Atanes: a pleasure receiving your valuable opinion. Note that this patient already preformed heart catheterization with coronary arteriography. Do you think that it is necessary MIBI associated with the exercise test? Which goal with? What additional subsidy has such not invasive test?
Do you think the spasm caused by ischemia occurred in the RCA? Do RCA irrigate RBB?
Do you think that the transient “incomplete RBBB” was caused by RCA spasm? Is the qR pattern an incomplete RBBB?Which are the ECG criteria for the electrocardiographic diagnosis of incomplete RBBB?
Thank you in advance
Andrés.

Finals comments

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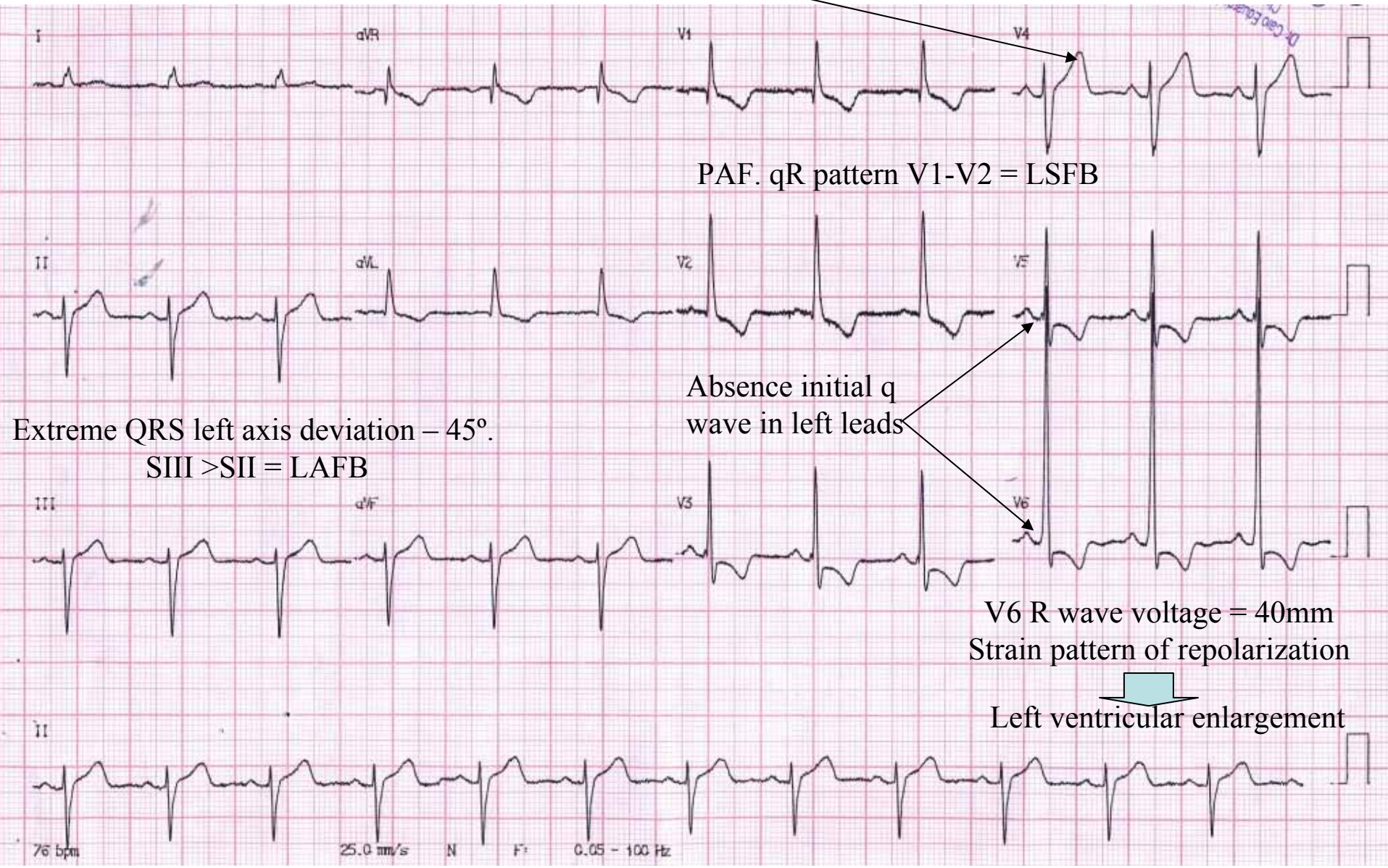
ECG-1 Preformed during constrictive precordial pain

Why T polarity is discordant in V4(+) related the remaining precordial leads (-) artifact?



PAF. qR pattern V1-V2 = LSFB

Absence initial q wave in left leads

Extreme QRS left axis deviation – 45º.

SIII >SII = LAFB

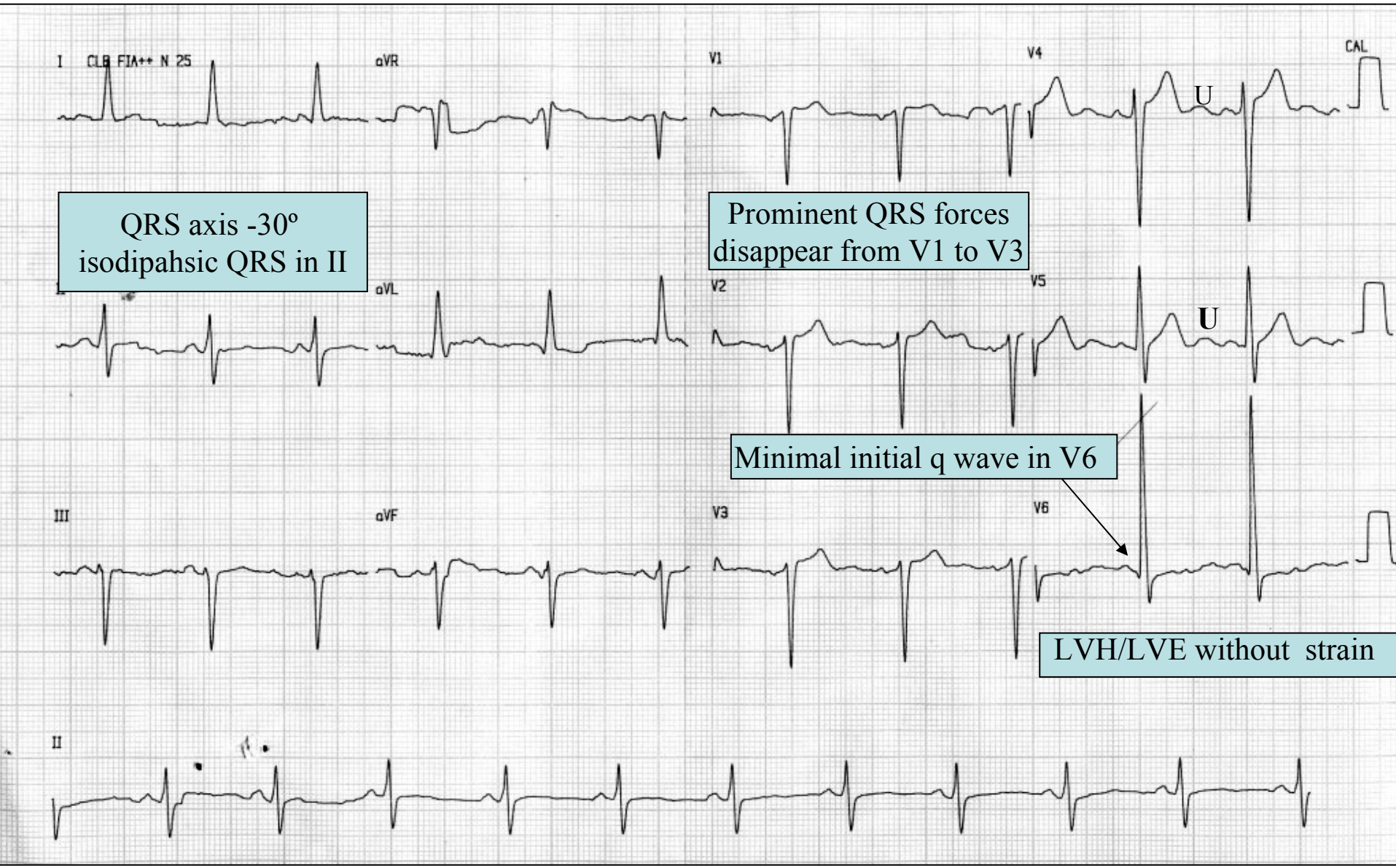
V6 R wave voltage = 40mm

Strain pattern of repolarization

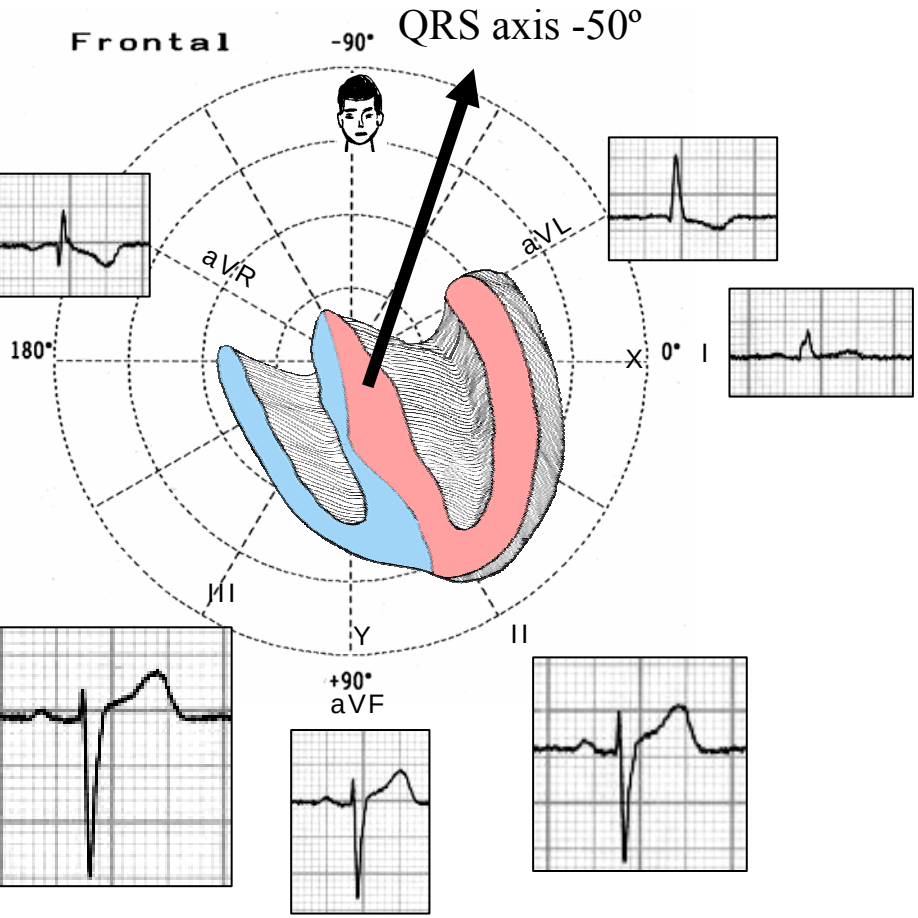
Left ventricular enlargement

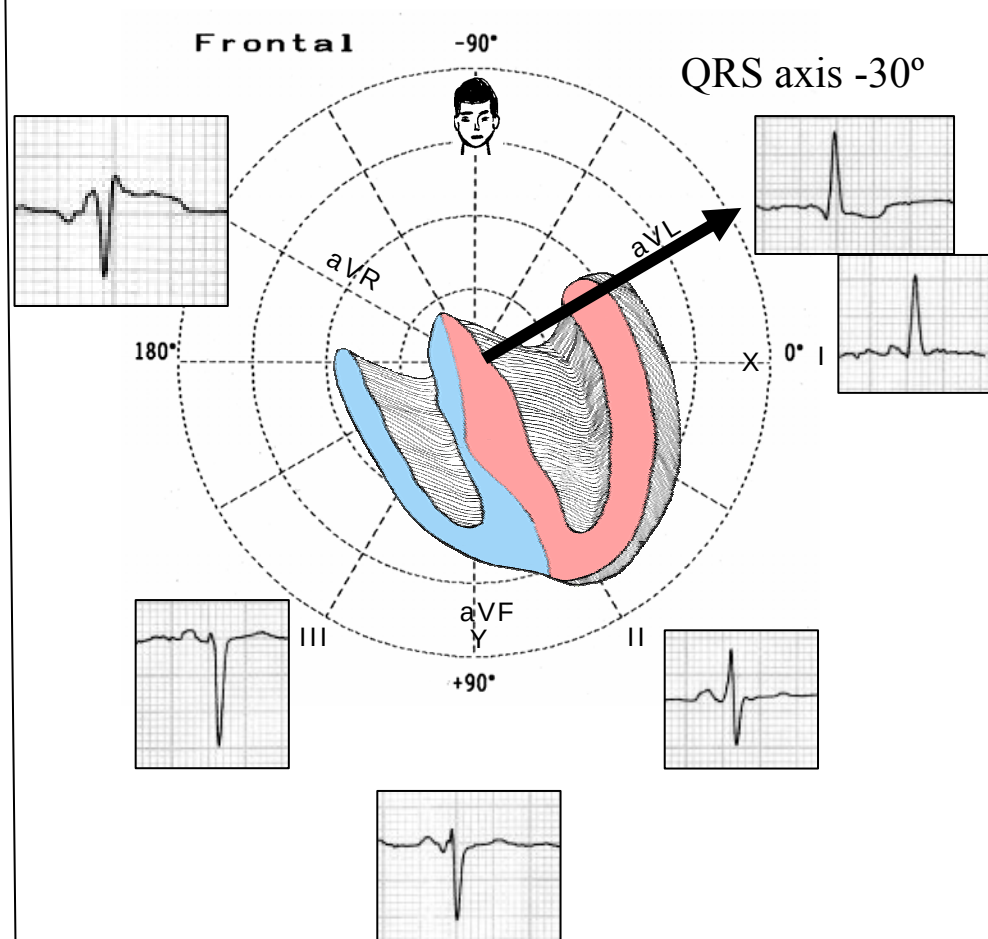
LAFB: left anterior fascicular block.; PAF: Prominent Anterior QRS Forces. LSFB: left septal fascicular block

ECG-2 Preformed without precordial pain. After 15 minutes adminstration sublingual nitrate and acetylsalicylic acid



ECG-1 FRONTAL PLANE Preformed during constrictive precordial pain	ECG-2 FRONTAL PLANE Preformed when the patient without precordial pain. After 15 minutes adminstration sublingual nitrate and acetylsalicylic acid
QRS axis -50º	QRS axis -30º
SIII>SII = LAFB	SIII>SII = degree of LAFB?





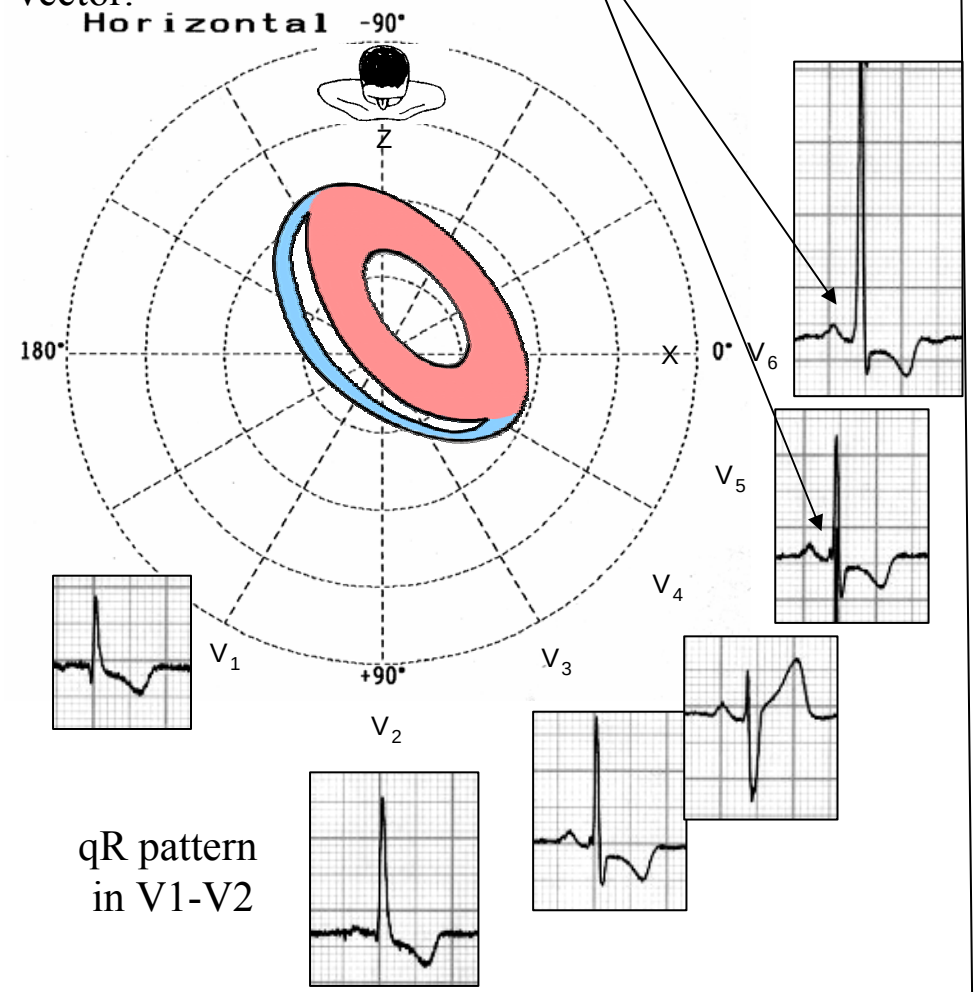
ECG-1 HORIZONTAL PLANE

Preformed during constrictive precordial pain

ECG-2 HORIZONTAL PLANE

Preformed when the patient without precordial pain. After 15 minutes adminstration sublingual nitrate and acetylsalicylic acid

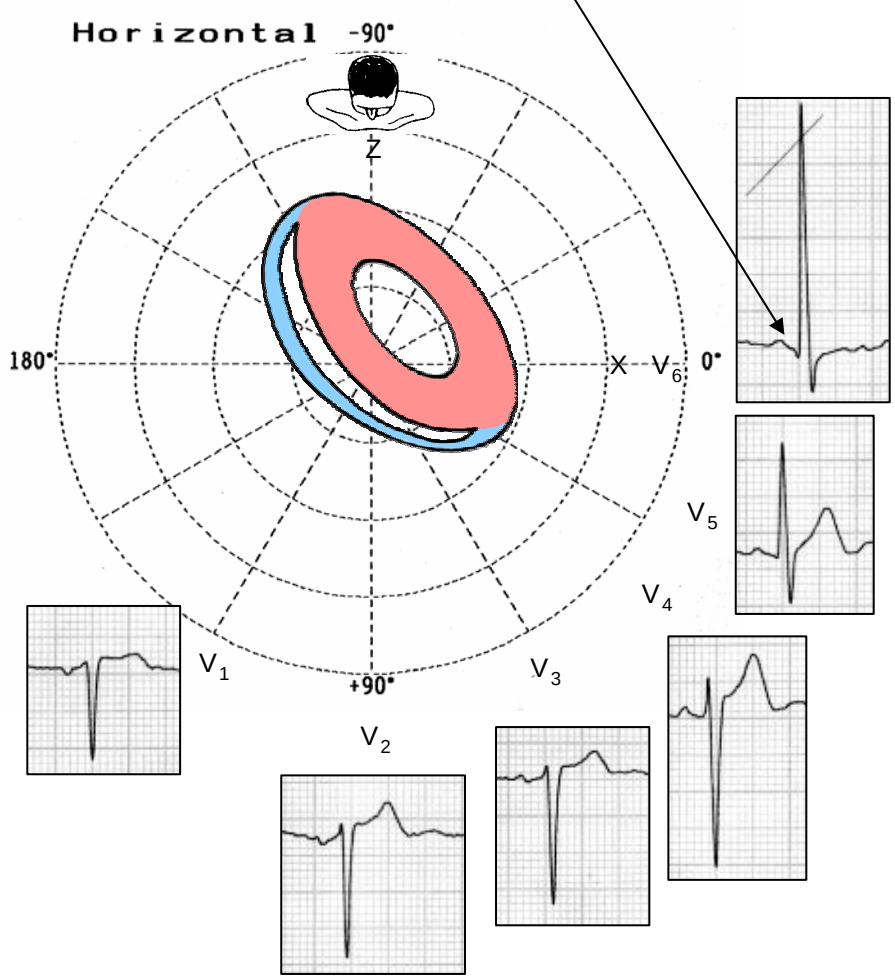
Absence of initial q waves in left leads V5-V6 because absence of first middle septal vector: 1AM vector.



qR pattern in V1-V2

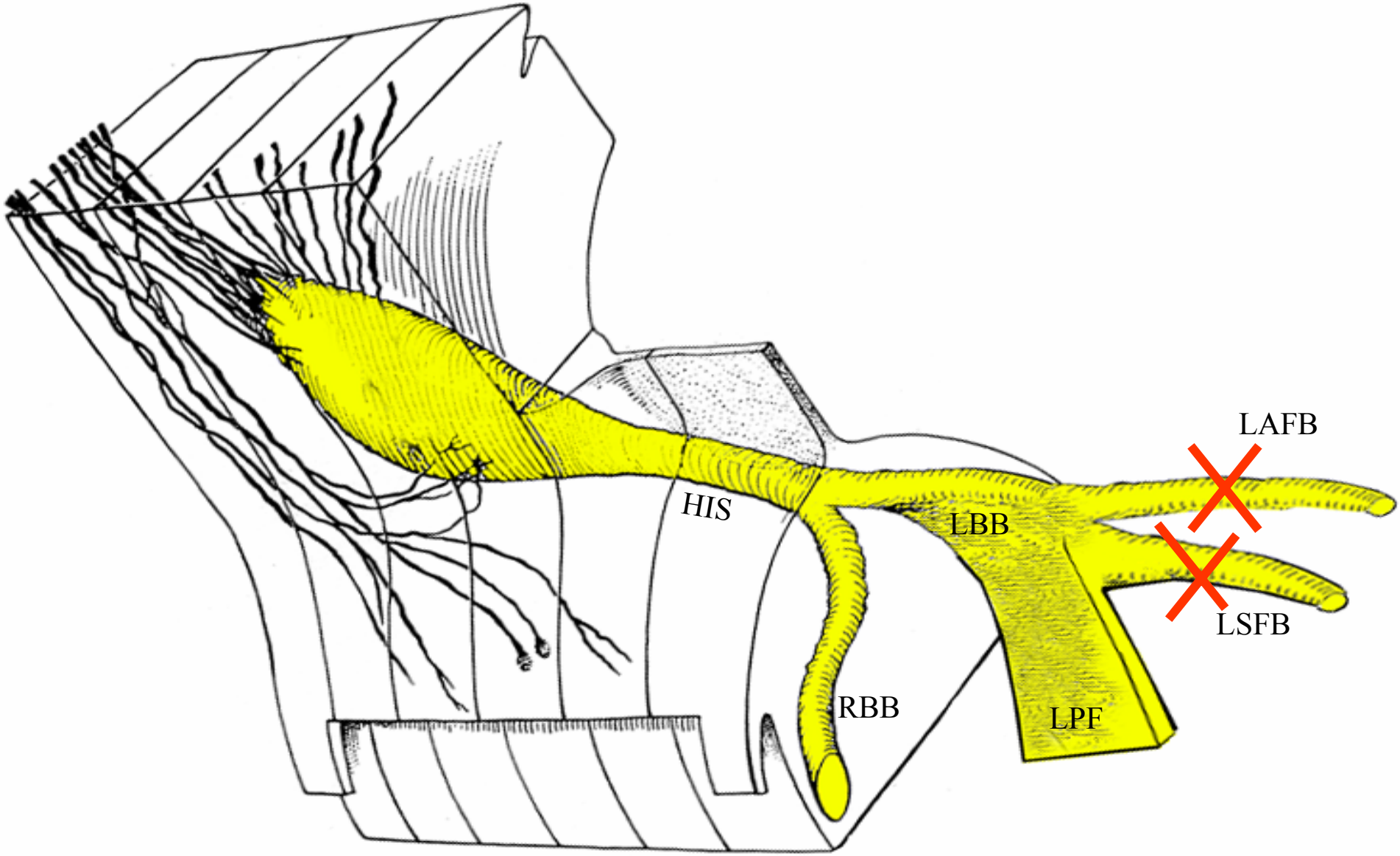
Prominent Anterior QRS Forces

Embryonic initial q waves in V6



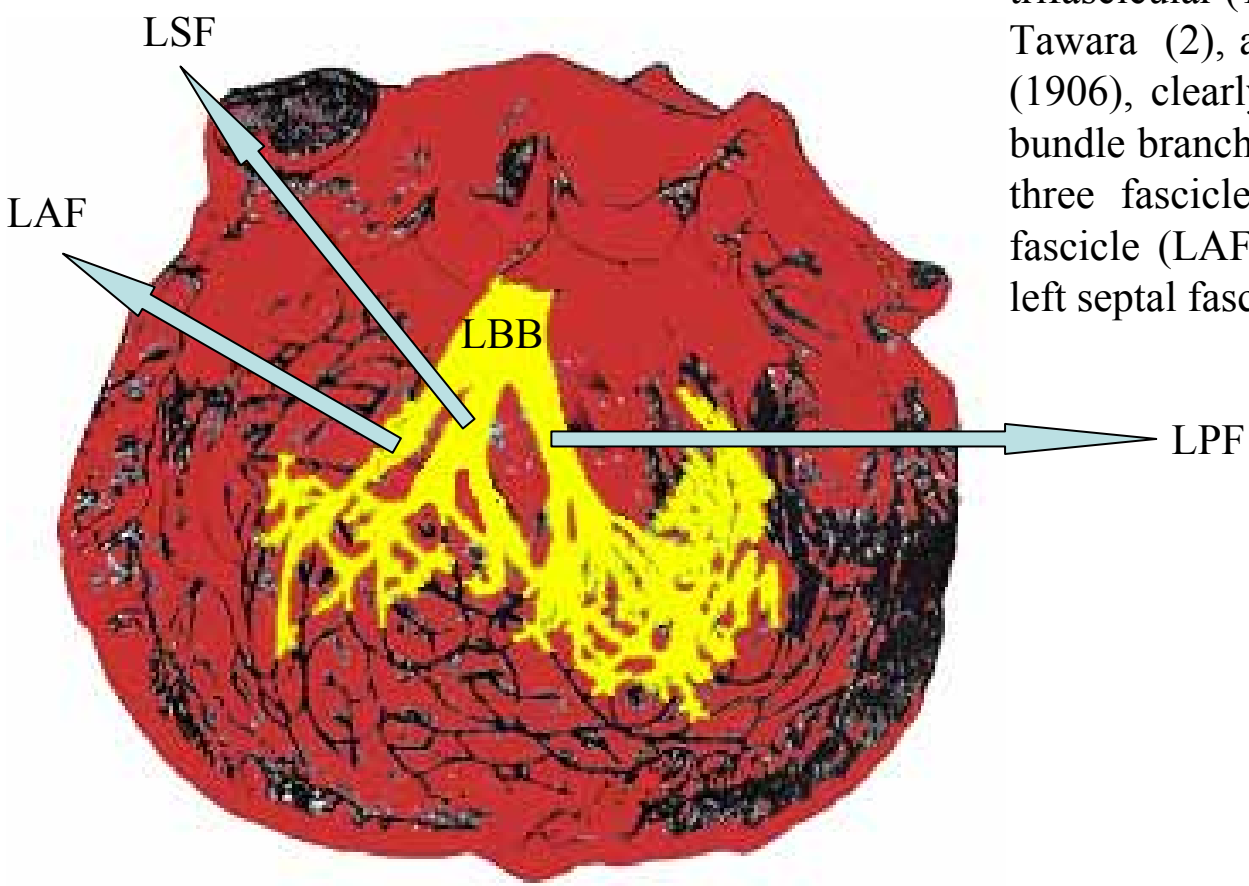
Comparison and differences between ECG-1 and ECG -2

	ECG-1	**ECG-2**
QRS axis on frontal plane	-50º: unquestionable LAFB	-30º LAFB degree?
SII/SIII relationship	SIII>SII	SIII>SII
Prominent Anterior QRS Forces	Present: qR pattern in V1-V2	Absent: rS pattern from V1 to V4
Initial q waves in left leads	Absent, because absence of first middle septal vector: 1_{AM} vector. This is a vector of small magnitude, which represents the initial 10 to 20 ms of depolarization dependent of LEFT SEPTAL FASCICLE.	Present
Modified Sokolow-Lyon index Positive if S wave of V2 + R of V5-6 $\geq$ 35 mm or 3.5 mV	Only R wave V6 voltage has 40mm. There are not S wave in V1-V2. Positive criteria voltage for LVH	V2 + R of V5-6 near 50mm: positive voltage criteria for LVH
Strain pattern in left precordial leads	Present: Systolic or concentric LVH modality. The ST segment and the T wave in the direction opposite to the main QRS vector causes widening QRS amplitude and wide QRS/T angle.	Absent
U wave	Absent	Present
Final diagnosis	LAFB, LSFB, (Left bifascicular block) and LVH.	Minimal degree LAFB, LVH, prominent U wave



ECG 1 diagnosis Left bifascicular block: Left Anterior Fascicular Block, Left Septal Fascicular Block and Left Ventricular Hypertrophy/Enlargement.

THE TRIFASCICULAR NATURE OF THE LEFT HIS SYSTEM



At the end of the 19th century(1893), His described the left His system as being trifascicular (1).

Tawara (2), at the beginning of the 20th century (1906), clearly showed that the trunk of the left bundle branch of the His bundle (LBB) splits into three fascicles and not into two: left anterior fascicle (LAF), left posterior fascicle (LPF) and left septal fascicle (LSF).

1) **His, W. JR. – Die Tatigkeit des embryonalen herzens deren Redeutung für die Lehere von der Herzbewegung beim Erwachsensn. Med. Klin. 1: 14, 1893.**

2) **Tawara S: Das Reizleitungssystsem des Saeugetierherzens: eine anatomhistologische Studie ueber die Atrioventriculaer Buendel und die Purkinjeschen Faden. Jena, Gustav Fischer; 1906.**

Following Rosenbaum´s school (1), it was believed that the intraventricular conduction system had three terminal divisions: right bundle branch (RBBB), left anterior fascicle (LAF) and left posterior fascicle (LPF). According this trifascicular theory of ventricular activation the RBB represents one division and the LAF and LPF of the left bundle branch (LBB), which are true anatomic fascicles, represent the other two fascicles). However, the middle anteroseptal fibers are thought by some authors to represent another division (2, 3). In fact, the experimental work of Durrer in human heart(See next slide) demonstrated that there are 3 points of activation onset in the left ventricular human heart, favouring the quadrifascicular theory of the biventricular activation.(2)

In 1970, Dr. Durren et al from Amsterdam, The Netherlands, demonstrated in a classical manuscript using 870 intramural terminals in isolated human hearts, that three endocardial areas are synchronously excited from 0 to 5 ms after the start of left ventricle (LV) activity potential. To obtain information concerning the time course and instantaneous distribution of the excitatory process of the normal human heart, the authors studied on isolated human hearts from seven individuals who died from various cerebral conditions, but who had no history of cardiac disease. The first LV areas excited were: Central on the left surface of the interventricular septum (IVS) where the LSF ends. Septal activation started in the middle third of the left side of the IVS, somewhat anteriorly and the lower third at the junction of the IVS and posterior wall. The normally functioning LSF, the left middle septum surface and the inferior two-thirds of the septum originate the first vector, vector 1 or first anteromedial (1_{AM})

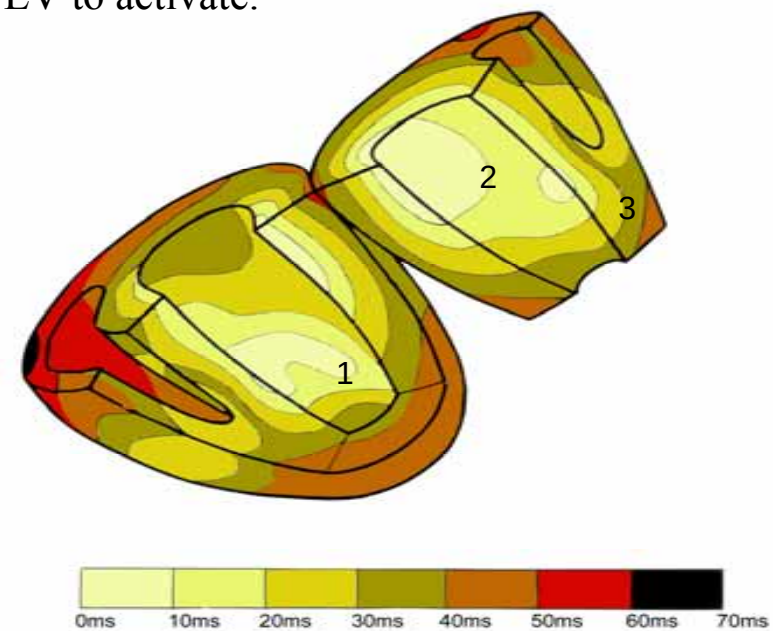
High on the anterior paraseptal wall just below the attachment of the ALPM where the LAF ends; vector and left inferior two-thirds of the IVS (second vector or vector of the inferior 2/3 of IVS);

Posterior paraseptal about one third of the distance from the apex to the base near the base of PMPM where the LPF ends. The posterobasal area is the last part of the LV to activate.

1. **Rosenbaum M, Elizari M, Lazzari E. Los hemibloqueos. Edit Paidos, 1967.**
2. **Uhley HN. The quadrifascicular nature of the peripheral conduction system. In: Dreifus LS,Likoff W (eds.):Cardiac Arrhythmias. New York, Grune & Stratton. Inc., 1973.**
3. **Kulbertus HE, de Leval-Rutten F, Casters P. Vectorcardiographic study of aberrant conduction. Anterior displacement of QRS: another form of intraventricular block. Br Heart J 1976;38:549.**

SEQUENCE OF NORMAL VENTRICULAR ACTIVATION

1. **Central & apical region** on the left surface of the interventricular septum (IVS) where the LSF ends. Septal activation started in the middle third of the left side of the IVS, somewhat anteriorly and the lower third at the junction of the IVS and posterior wall. The normally functioning LSF, the left middle septum surface and the inferior two-thirds of the septum originate the first vector, vector 1, first anteromedial (1_{AM}) Penaloza and Tranchesi vector(2) or 10 to 20 initial vector.
2. **Anterosuperior region,** high on the anterior paraseptal wall just below the attachment of the anterolateral papilar muscle (ALPM) where the LAF ends
3. **Posteroinferior region:** Posterior paraseptal about one third of the distance from the apex to the base near the base of psteromedial papilar muscle (PMPM) where the LPF ends. The posterobasal area is the last part of the LV to activate.

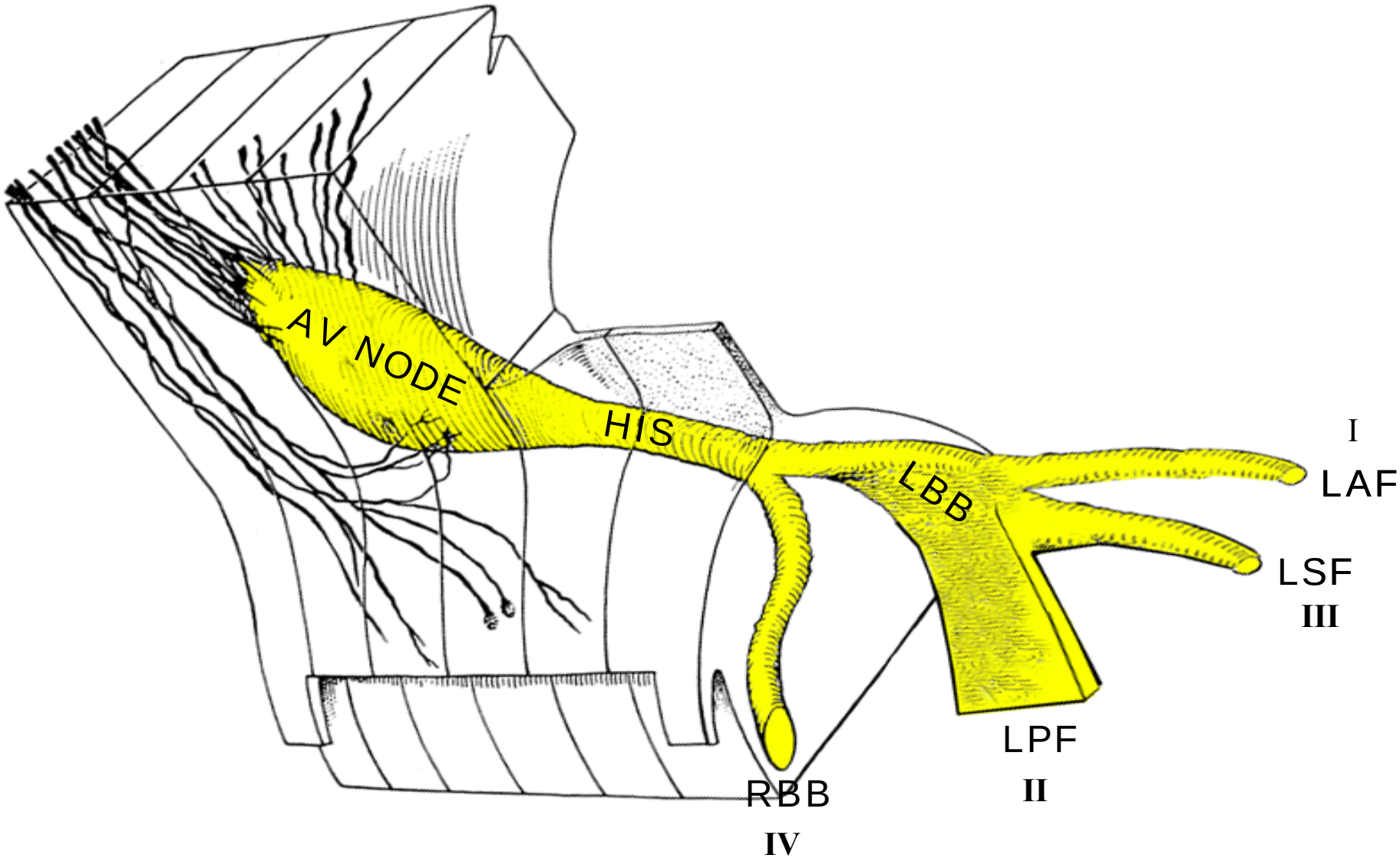


Time sequence of ventricular cone activation, which shows the initial activation in three points.

Initial 0 ms to 10 ms Ventricular activation points 1, 2 and 3

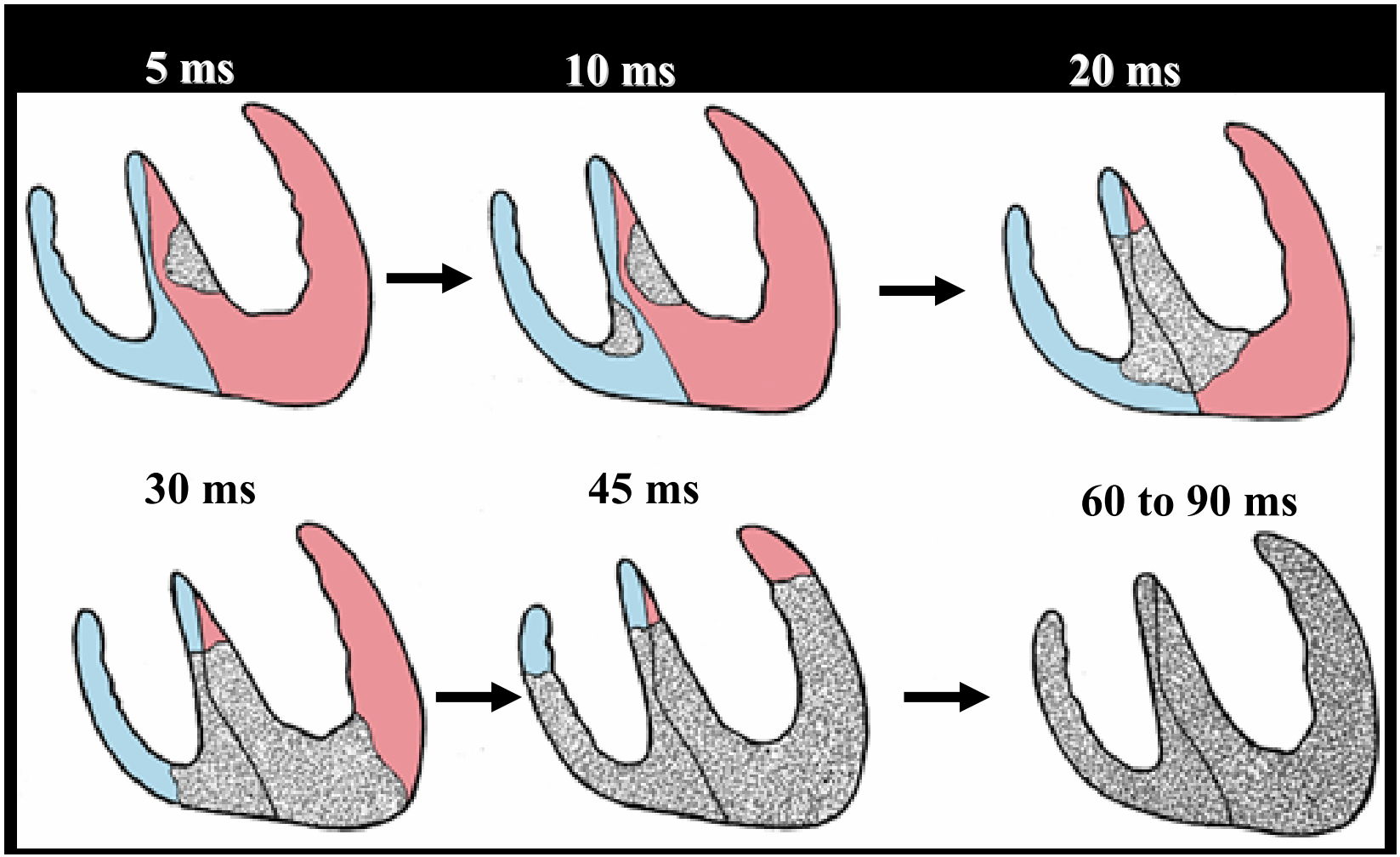
1. **Durrer D, Van Dam R, Freud G, et al. total excitation of the isolated human heart. Circulation 1970;414:899.**
2. **Penaloza D, Tranchesi J. The three main vectors of the ventricular activation process in the normal human heart. I. Its significance. Am Heart J. 1955 Jan;49:51-67.**

THE QUADRIFASCICULAR NATURE OF THE INTRAVENTRICULAR CONDUCTION SYSTEM



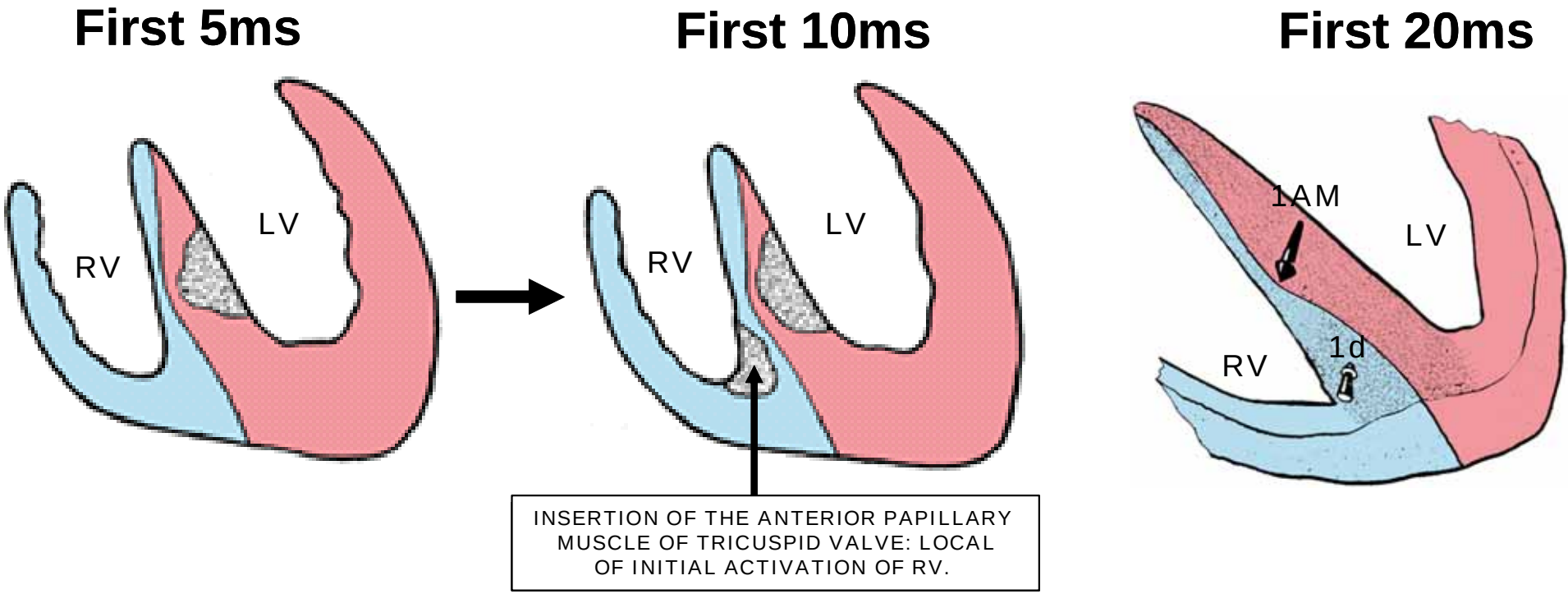
1. Uhley HN. The quadrifascicular nature of the peripheral conduction system. In: Dreifus LS,Likoff W (eds.):Cardiac Arrhythmias. New York, Grune & Stratton. Inc., 1973.

OUTLINE OF THE NORMAL ACTIVATION SEQUENCE OF THE BIVENTRICULAR CHAMBER
FRONTAL VIEW

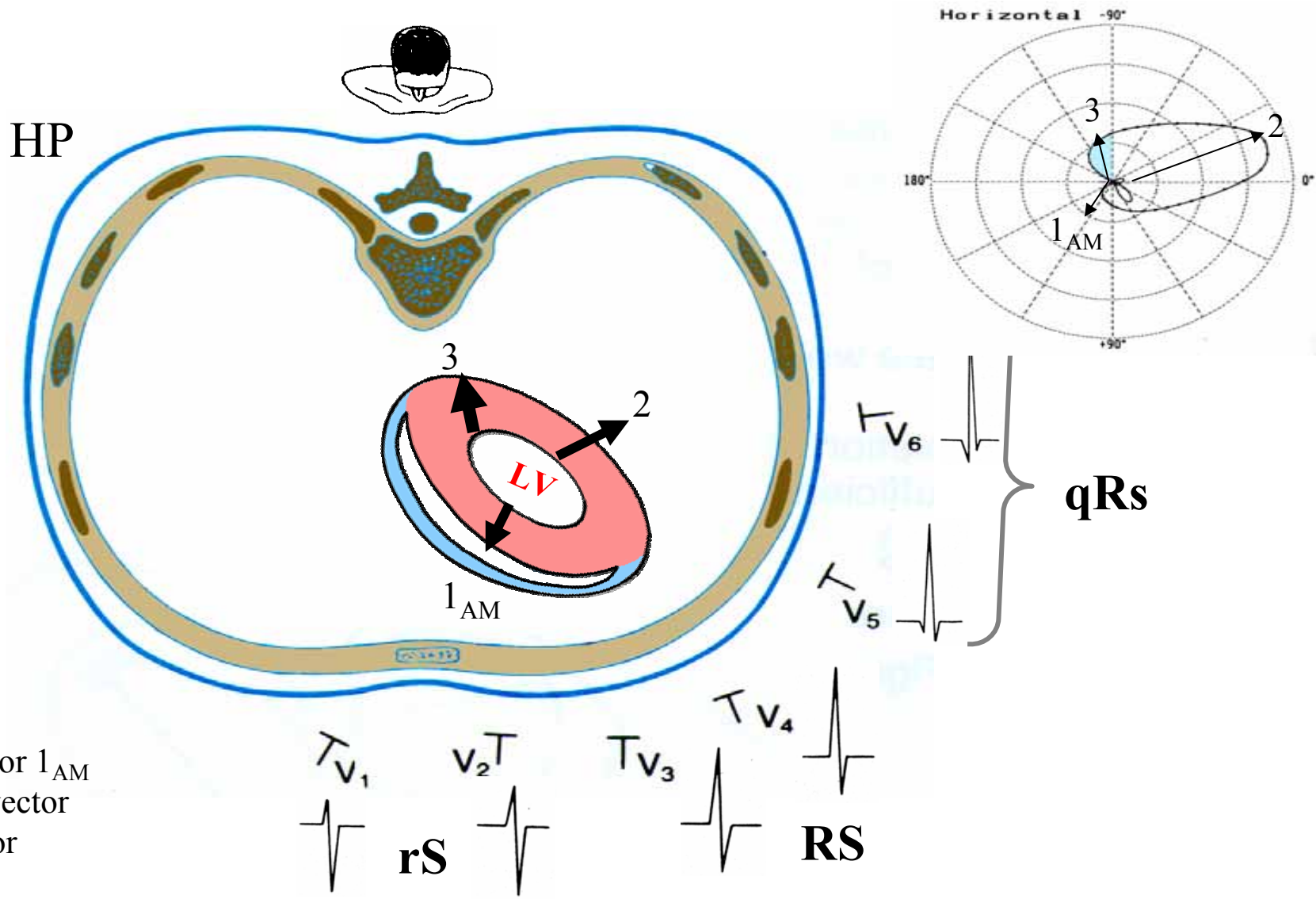


Sequence in milliseconds of ventricular activation.

OUTLINE OF THE NORMAL INITIAL ACTIVATION SEQUENCE OF THE BIVENTRICULAR CHAMBER FRONTAL VIEW



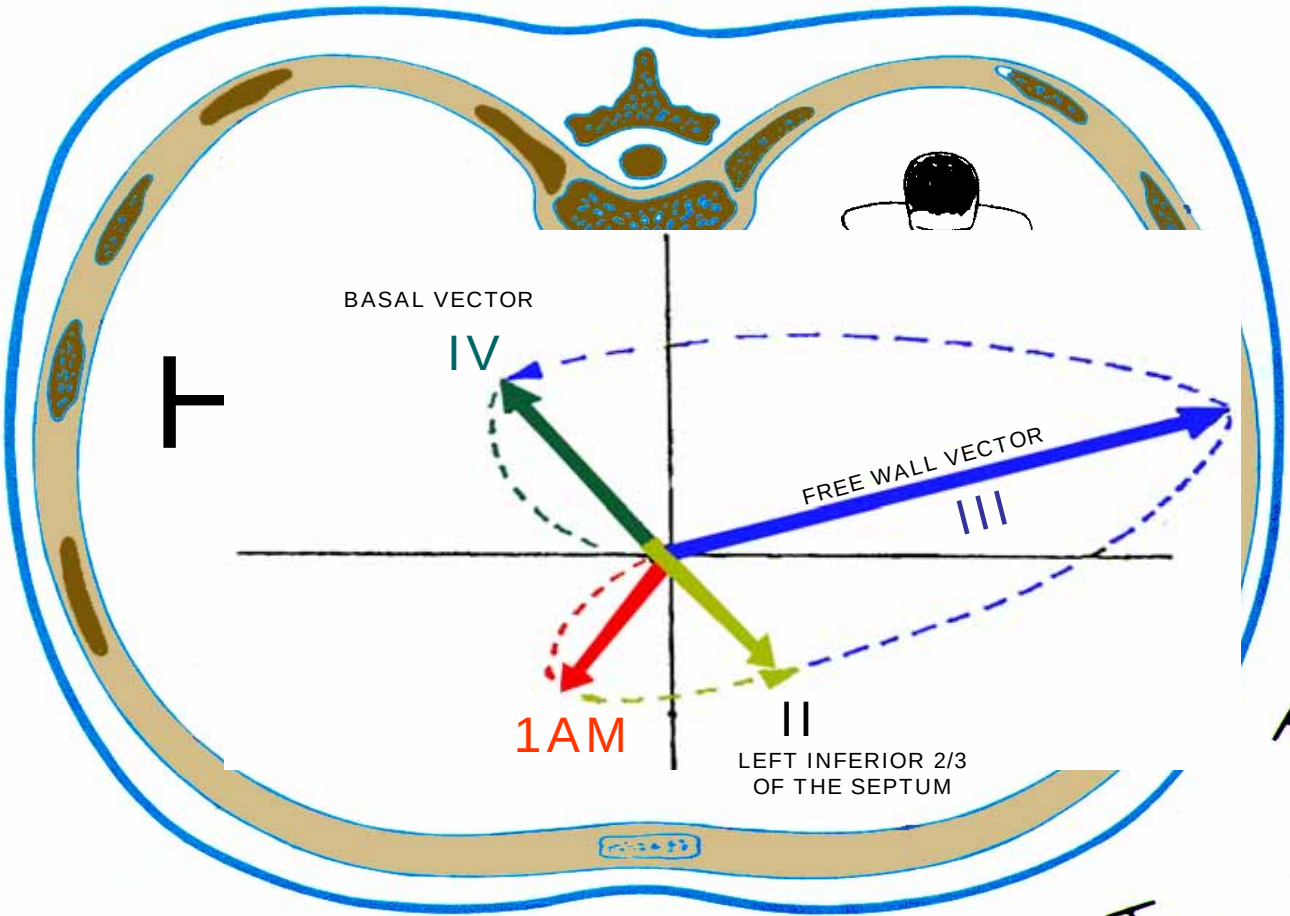
VECTORIAL REPRESENTATION IN THE HORIZONTAL PLANE OF NORMAL VENTRICULAR ACTIVATION AND NORMAL QRS MORPHOLOGIES



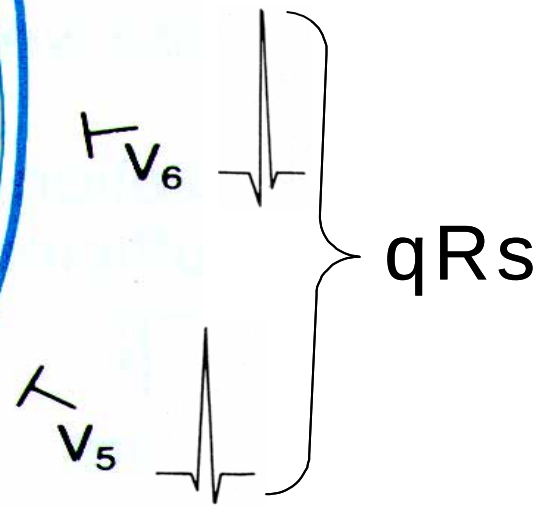
1) Septal vector 1_{AM}
2) Free wall vector
3) Basal vector

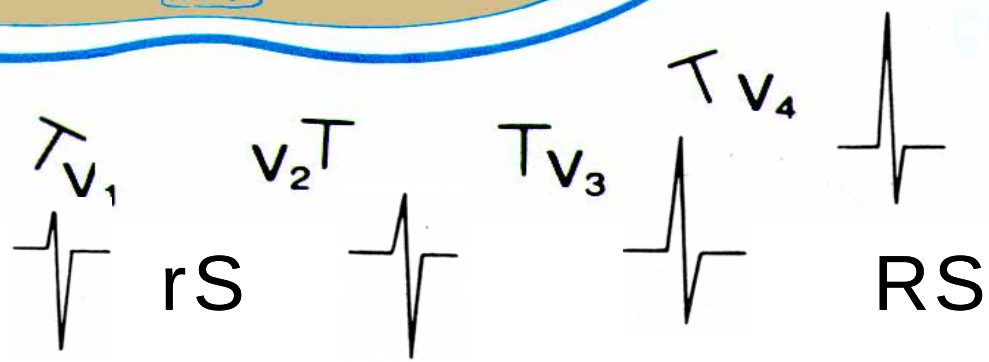
Representation with three vectors of ventricular activation in the horizontal plane and the characteristics of normal QRS pattern in precordial leads.

REPRESENTATION OF VENTRICULAR ACTIVATION WITH FOUR VECTORS IN THE HORIZONTAL PLANE

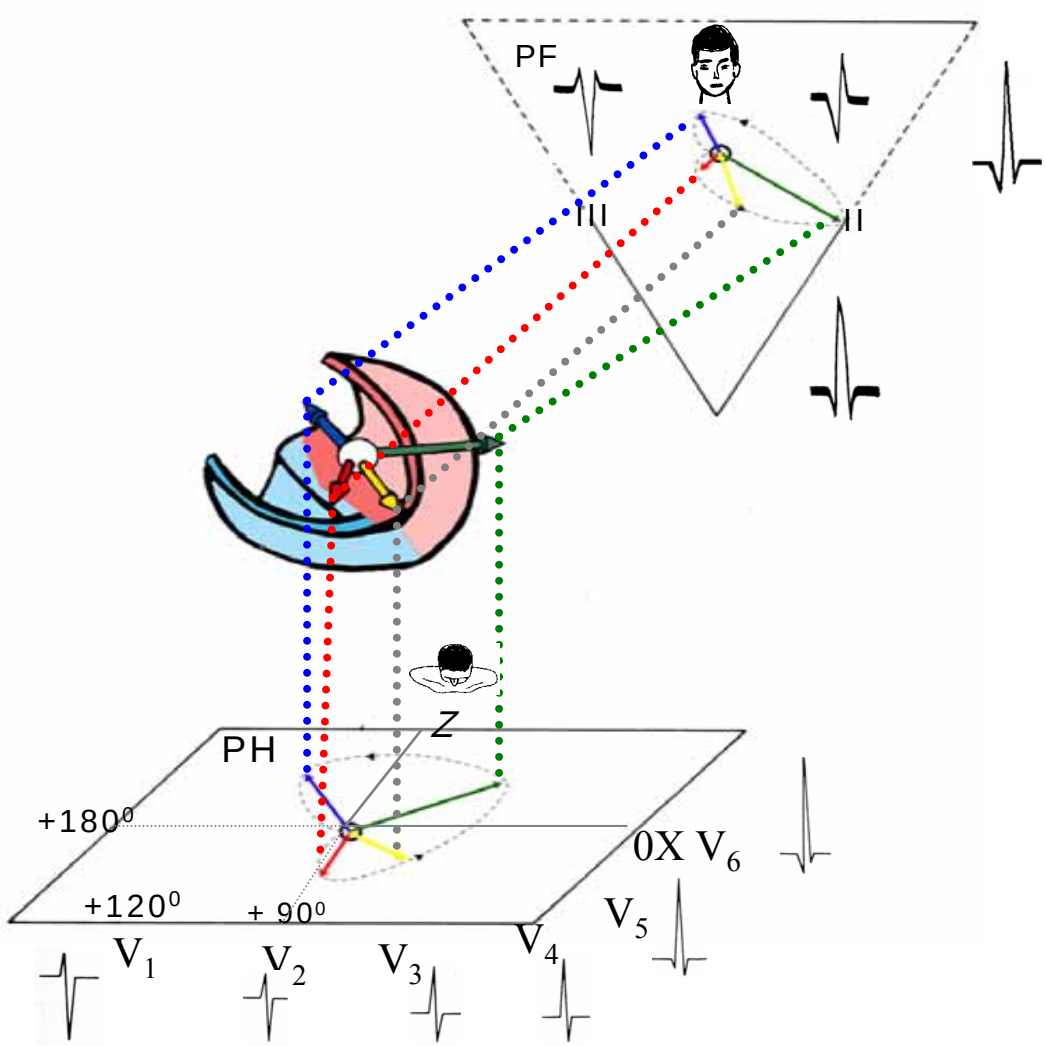


I) SEPTAL VECTOR OR 1AM
II) SECOND VECTOR
III) FREE WALL VECTOR
IV) BASAL VECTOR



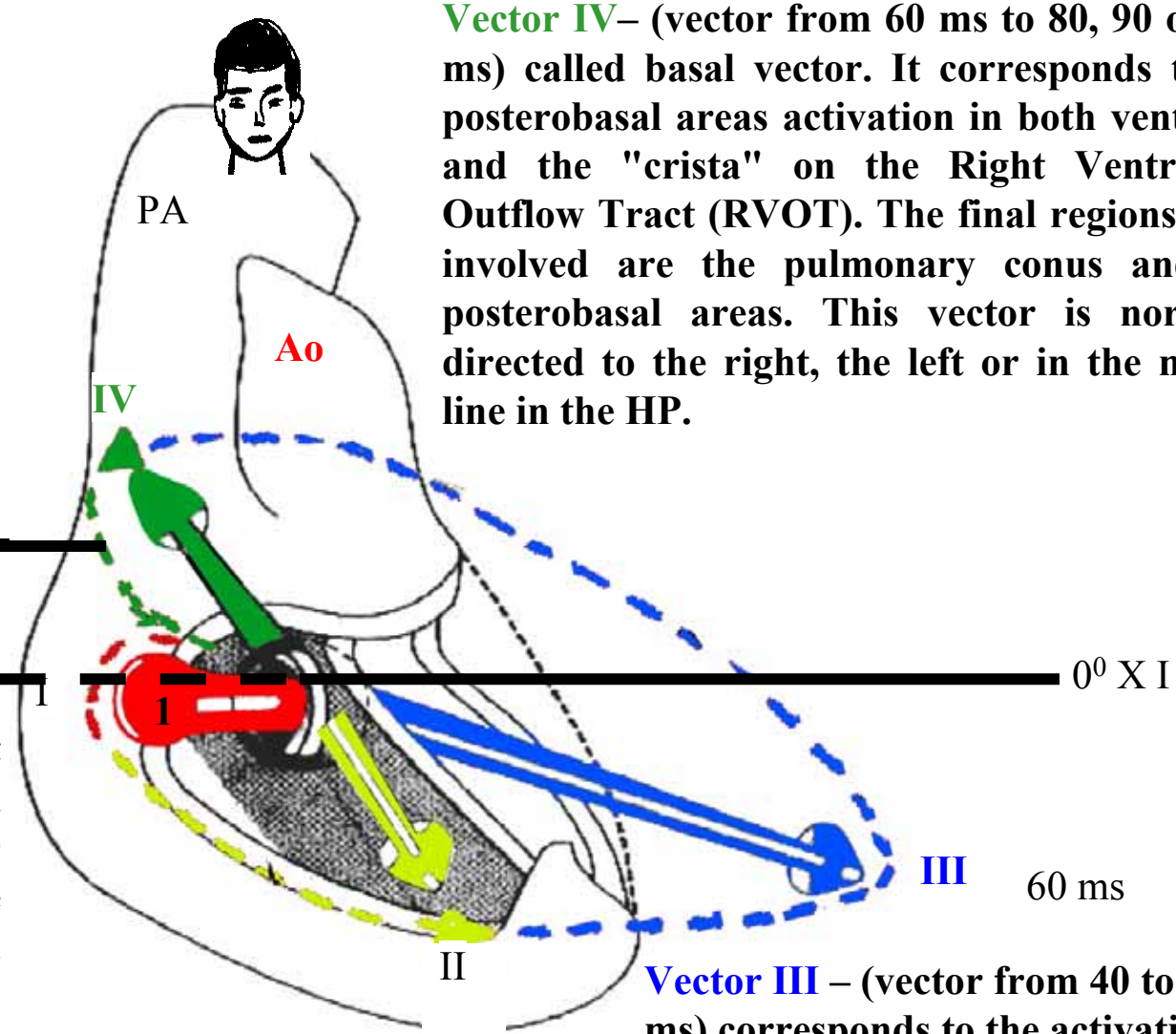


VECTORIAL REPRESENTATION OF NORMAL VENTRICULAR ACTIVATION IN THE FRONTAL AND HORIZONTAL PLANES



Representation of ventricular activation with four vectors in the frontal and horizontal planes.

VENTRICULAR DEPOLARIZATION QRS LOOP IN FRONTAL PLANE REPRESENTED BY FOUR VECTORS



Vector IV– (vector from 60 ms to 80, 90 or 100 ms) called basal vector. It corresponds to the posterobasal areas activation in both ventricles and the "crista" on the Right Ventricular Outflow Tract (RVOT). The final regions to be involved are the pulmonary conus and the posterobasal areas. This vector is normally directed to the right, the left or in the middle line in the HP.

Vector I – septal vector, first 1_{AM} vector or Peñaloza and Tranchesi vector: (first 10-20 ms vector) corresponds to the activation of the middle third of the left septal surface.

Vector II – (vector from 20 to 40 ms) corresponds to the activation of the inferior 2/3 of the left septal surface and apex of RV;

Vector III – (vector from 40 to 60 ms) corresponds to the activation of the free wall of both ventricles. It is directed to the back and to the left in adult hearts.

Arguments in favor the existence of the middle fibers (left septal fascicle) in the left Hiss system and its electro-vectorcardiographic expression

Anatomical,(1) anatomopathological, (2) histopathological,(3) electrocardiographic, (ECG) (4;5;6) vectocardiographic, (VCG) (7;8) and electrophysiological, (9;10) studies have shown that the left bundle branch (LBB) divides into three fascicles or "fan-like interconnected network" in most human hearts (≈ 85% of cases)(2) and the left septal fascicular block has its ECG/VCG hallmark and particular electrophysiological pattern manifest by aberrant ventricular conduction (10;11) with prominent anterior QRS forces(11) and eventual intermittent or transient ECG/ VCG manifestation as expression of severe myocardial ischemia consequence of proximal obstruction of the left anterior descending (LAD) coronary artery before the first septal perforating branch(5).

1. Massing GK, James TN. Anatomical configuration of the His bundle and bundle branches in the human heart. Circulation 1976; 53:609-621.
2. Kulbertus HE, Demoulin J: Pathological basis of concept of left hemiblock. in The conduction system of the heart, Wellens HJJ, LieKI, Janse MJ, editors: Leiden, Philadelphia, 1976, p 287 Lea&Febiger
3. Demoulin JC, Kulbertus HE, - Left hemiblocks revisited from the histopathological view point. Am Heart J 1973; 86:712-713
4. Mori H, Kobayashi S, Mohri S. Electrocardiographic criteria for the diagnosis of the left septal fascicular block and its frequency among primarily elderly hospitalized patients. Nippon Ronen Igakkai Zasshi 1992; 29:293-297.
5. Uchida AH, Moffa PJ, Riera AR, Ferreira BM. Exercise-induced left septal fascicular block: an expression of severe myocardial ischemia. Indian Pacing Electrophysiol J. 2006; 6:135-138.
6. Riera AR, Ferreira C, Ferreira Filho C, Wellens syndrome associated with prominent anterior QRS forces: an expression of left septal fascicular block?.J Electrocardiol. 2008 Nov-Dec;41:671-674.
7. Riera AR, Kaiser E, Levine P,et al, Kearns-Sayre syndrome: electro-vectorcardiographic evolution for left septal fascicular block of the his bundle. J Electrocardiol. 2008 Nov-Dec;41:675-678. ..
8. Riera AR, Kaiser E, Levine P,et al, Kearns-Sayre syndrome: electro-vectorcardiographic evolution for left septal fascicular block of the his bundle. J Electrocardiol. 2008 Nov-Dec;41:675-678. .
9. Dhala A, Gonzalez Zuelgaray J, Deshapande S, et. al.: Unmasking the trifascicular left intraventricular conduction system by ablation of the right bundle block. Am J Cardiol. 1996; 77: 706-712.
10. Sanches PCR, Moffa PJ, Sosa E, et al. Electrical Endocardial Mapping Of Five Patients With Typical ECG of Left-Middle (Septal) Fascicular Block. In Proceeeding of the XXVIII International Congress on Electrocardiology Guarujá SP Brazil. Editor Pastore CA, Heart Institute of the University of São Paulo School of Medicine São Paulo Brazil 2001 Atheneu pp89-95.
11. Cohen SI, Lau SH, Steiner E, et al. - Variations of aberrant ventricular conduction in man: Evidence of isolated and combined block within the specialized conduction system 1968; Circulation 38:899.
12. Nakaya Y, Murayama Y, Hiasa Y, et. al. A cause for prominent anterior QRS forces in ischemic heart disease. Jap Circ J. 1977; 41 (suppl):83

The so-called "atypical complete left bundle branch block" with q wave in left leads

Another strong argument in favor the functional existence of LSF is constituted by the electrophysiological explanation of left bundle branch block (LBBB) cases called "atypical complete LBBB" .

There are divisional or fascicular LBBB cases (LAFB + LPFB) that display a q wave in left leads, making the electrocardiographic pattern of LBBB atypical. Rosenbaum called them "left intraventricular blocks without changes in the initial part of QRS" In this colossal masterpiece did not find an explanation for these cases, and state in the above mentioned book, that they are "difficult to explain" (*1*).

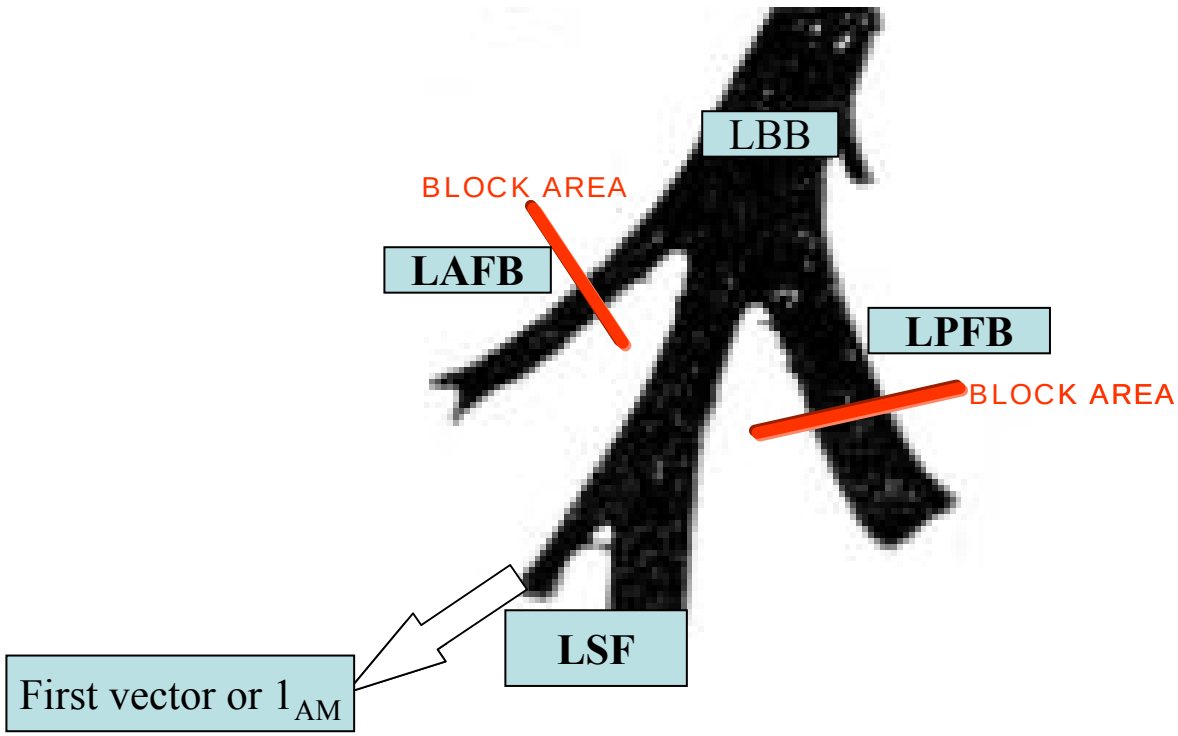
Three years later Medrano et al (*2*) proposed that in these atypical LBBB cases, the fibers of the LSF would originate prior to the site or area of the block in the LPF and LAF, so the middle-septal activation is preserved (1_{AM} vector), originating the q waves of the left V5-V6 leads, and turning the LBBB into an atypical one. These authors suggested that the middle third of the left septum surface activation may be preserved, in cases of fascicular complete left bundle branch block (LBBB) because in this circumstance the LSF arise before the blocked area. This mechanism explain the atypical LBBB pattern with q wave in left lateral leads, I, aVL, V5 and V6 that it may be seen in some case of atypical LBBB pattern.

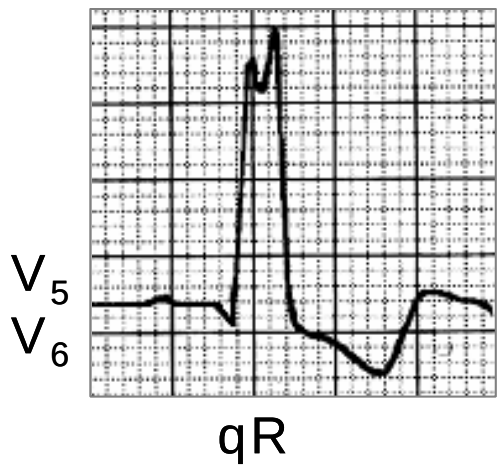
Finally, the same Medrano explanation was provided by Alboni et al (3) six years later, called "LBBB with normal septal activation". The figure in next slide illustrates clearly the mechanism of preserved first vector.

1. **Rosenbaum MB, Elizari M V.; Lazzari J O. - Los Hemibloqueos, Editorial Paidos Buenos Aires 1967. pg 72.**
2. **Medrano GA, Brenes C, De Michelis A, et al. Experimental and clinical electrocardiographic study Arch Inst Cardiol Mex 1970;40:752.**
3. **Alboni P, Malacarne C, Baggioni G, et al. Left bifascicular block with normally conducting middle fascicle. J Electrocardiol 1977; 10401-10404.**

ATYPICAL LEFT BUNDLE BRANCH BLOCK WITH Q WAVES ON LEFT LEADS.

Fascicular complete left bundle branch block: left anterior fascicular block associated with left posterior fascicular block





LBB: Left bundle branch; LAFB: Left anterior fascicular block; LPFB: Left posterior fascicular block; LSF: Left septal fascicle.

ANTERIORIZATION OF VENTRICULAR DEPOLARIZATION: ANOTHER ELECTRO-VECTORCARDIOGRAPHIC EVIDENCE OF MIDDLE LEFT FIBERS BLOCK

Another piece of evidence of the trifascicular nature of the left Hissian system is constituted by the electric or electrovectocardiographic record of the anteriorization of ventricular depolarization, sometimes intermittent or transient, such us this case translated in ECG by R waves with great voltage in right-intermediary precordial leads V2-V3 and V4, and right precordial initial q waves Additionally, in VCG by anterior and leftward shift of QRS loop in the HP; in certain cases of critical proximal obstruction of left anterior descending(LAD) coronary artery before the first septum perforator (S1), in absence of clinical factors capable of causing prominent anterior forces (PAF), (anterior conduction delay) such as dorsal infarction (actual nomenclature lateral), right ventricular enlargement/hypertrophy (RVE/RVH), cardiomyopathies, RBBB, WPW whit posterior anomalous pathway and others. In some patients studied angiographically, coronary disease was concentrated in the LAD and ventricular dysfunction confined to the LV anterior wall. PAF were observed intermittently together with LAFB. These observations, in addition to serial studies following surgery, strongly suggest that the mechanism for PAF in these cases is conduction delay in the LSF.

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ELECTROPHISIOLOGICAL DEMONSTRATIONP OF LEFT SEPTAL FASCULAR BLOCK IN HUMAN HEART

Dhala et al (1) studied twenty-five patients underwent transcatheter right bundle branch block RBB ablation, either for bundle branch reentrant tachycardias, or inadvertent or deliberate RBB ablation during atrioventricular junctional ablation for rate control.
Electrophysiologic data and ECGs before and after RBB ablation were available in all patients.

Group I (N=11): without significant intraventricular conduction abnormalities by surface ECGs. All group I patients had typical ECG changes of RBBB after RBB ablation, with minimal changes in initial or mean QRS axis.

Group II (N=14): had underlying intraventricular conduction delays: 5 patients had an initial 40 ms QRS axis shift of >45º; in 7 patients the mean QRS axis changed significantly (leftward in 4 and rightward in 3), and qR pattern in V1 was seen in 12 of 14 patients, including 2 with structurally normal hearts.

These changes, namely new Q waves, and rightward and leftward axis shifts are most likely the result of LSF, LPF and LAF delay/block, which were exposed by exclusive conduction, via a diseased LBB and its fascicles. The trifascicular nature of left intraventricular conduction is more apparent when diseased and unmasked by concomitant block in the RBB (*80*).

1. **Dhala A, Gonzalez Zuelgaray J, Deshapande S, et. al.: Unmasking the trifascicular left intraventricular conduction system by ablation of the right bundle block. Am J Cardiol 1996; 77: 706-712.**

NOMENCLATURES OF LEFT SEPTAL FASCICULAR BLOCK

1. Focal septal block (1)- septal focal block (2).
2. Left septal fascicular block (3-4-5-6-7-8-9-10-11).

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12. Left anterior septal block (12)
13. Left septal Purkinje network block 13-14.
14. Left septal Purkinje network in the left ventricular conduction system. 15.
15. Anterior conduction delay 16-17.
16. Aberrant conduction. Anterior displacement of QRS(18)
17. Septal fascicular conduction disorders of the left branch (19)

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16. Left medial subdivision block of the left bundle branch (28).
17. Middle fascicle block (29).
18. Block of the anteromedial division of the left bundle branch of his or anteromedial divisional block (**AMDLB**) (30-36)

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CRITICAL ANALYSIS AND SEMANTIC DISCUSSIONS USED FOR THE LEFT SEPTAL FASCICLE BLOCK

The nomenclatures used to call the LSF are numerous, which indicates the need for a consensus to unify terms. The natural place for such discussion should be an International or Worldwide Conference on Electrocardiology. In our country (Brazil), in year 2003, a committee of experts in rest Electrocardiology was created: The Brazilian Guidelines for Interpreting Rest Electrocardiogram. In this consensus, the diagnostic criteria were fixed for the Left Septal Fascicular Block (LSFB).

In our country, the name used most frequently initially was "block of the antero-medial division of the left bundle branch of His" or "antero-medial divisional block (AMDB)". Currently, the name used follows the trend in the newest publications: LSFB.

Next, we include the names used:

1) LEFT SEPTAL FASCICULAR BLOCK (LSFB)

This is the name used in the newest publications; however subject to some criticism since, although the term "septal" gives us the idea that we are dealing with the left branch division located in the septum, i.e. unlike the ALPM and PMPM ones, it would be more clarifying and comprehensive to use the name centro-antero-apical-septal. On the other hand, the LSF does not always display the morphology of a fascicle (a small bundle). Occasionally, it has the aspect of an interconnected network that opens as if it was a fan ("fan-like interconnected network") or it is made up by two fascicles that originate in another two fascicles or divisions: the LAF and the LPF.

2) SEPTAL FASCICLE BLOCK

3) FOCAL SEPTAL BLOCK

4) SEPTAL FOCAL BLOCK

5) LEFT PARIETAL SEPTAL BLOCK

6) SEPTAL FASCICULAR CONDUCTION DISORDERS OF THE LEFT BRANCH

7) LEFT SEPTAL PURKINJE NETWORK BLOCK:
This name highlights the cellular type of the fibers that constitute the LSF (Purkinje cells). Unlike the two other divisions, the LSF is made up by Purkinje cells with more rapid conduction. On the contrary, the LAF and LPF are constituted by bundle cells, which have slightly different electrophysiologic properties, with a somewhat smaller conduction velocity. Furthermore, it informs about the septal location. Finally, the term "network" (meaning a complex, interconnected group or system) seems inappropriate, because more often it is actually a fascicle and not a network or interconnected system.

8) LEFT ANTERIOR SEPTAL BLOCK

9) ANTERIOR FASCICULAR BLOCK

10) LEFT SEPTAL SUBDIVISION BLOCK OF THE LEFT BUNDLE BRANCH

11) LEFT MEDIAN HEMIBLOCK:
The nomencalture that use the term "hemiblock" are inappropriate, since the prefix "hemi" means one half, and there cannot be halves in something that splits into three parts.

12) SUBDIVISION BLOCK OF THE LEFT BUNDLE BRANCH: the name "subdivision block" seems appropriate, since the term subdivision means division of something previously divided, and considering that the His bundle initially divides into the RBB and the LBB, which later subdivide too. Each one of these constitute a subdivision.

13) MIDDLE FASCICLE BLOCK: this term invites the criticism that the middle division does not always have the features of a fascicle, since it may be constituted by a fan-like network or originate in both divisions.

14) BLOCK OF THE ANTERO-MEDIAL DIVISION OF THE LEFT BUNDLE BRANCH OF HIS

15) ANTERO-MEDIAL DIVISIONAL BLOCK (AMDB)

16) BLOCK OF THE ANTERIOR MEDIAN BRANCH OF THE BUNDLE OF HIS :
The terms "block of the antero-medial division of the left bundle branch of His" , "antero-medial divisional block (AMDB)" and "block of the anterior median branch of the bundle of His" initially used by the researchers of our Brazilian school, seem appropriate because they give us the clear and full idea of its location (antero-medial) and it does not involve the morphological aspects of the division.

17) BLOCKING OF THE ANTERIOR-MEDIAL RAMULUS:
This nimenclatures is partially appropriate because it provides a full idea about the location (antero-medial) and the Latin term "ramulus" literally means "one of the terminal divisions of a branch", small branch or thread-like. In certain cases, the division has a network configuration, different from the aspect of a thread.

18) ANTERIOR CONDUCTION DELAY:
this term only indicates the existence of conduction slowing or dromotropic delay in the anterior region activation, which in isolation does not seem too clarifying.

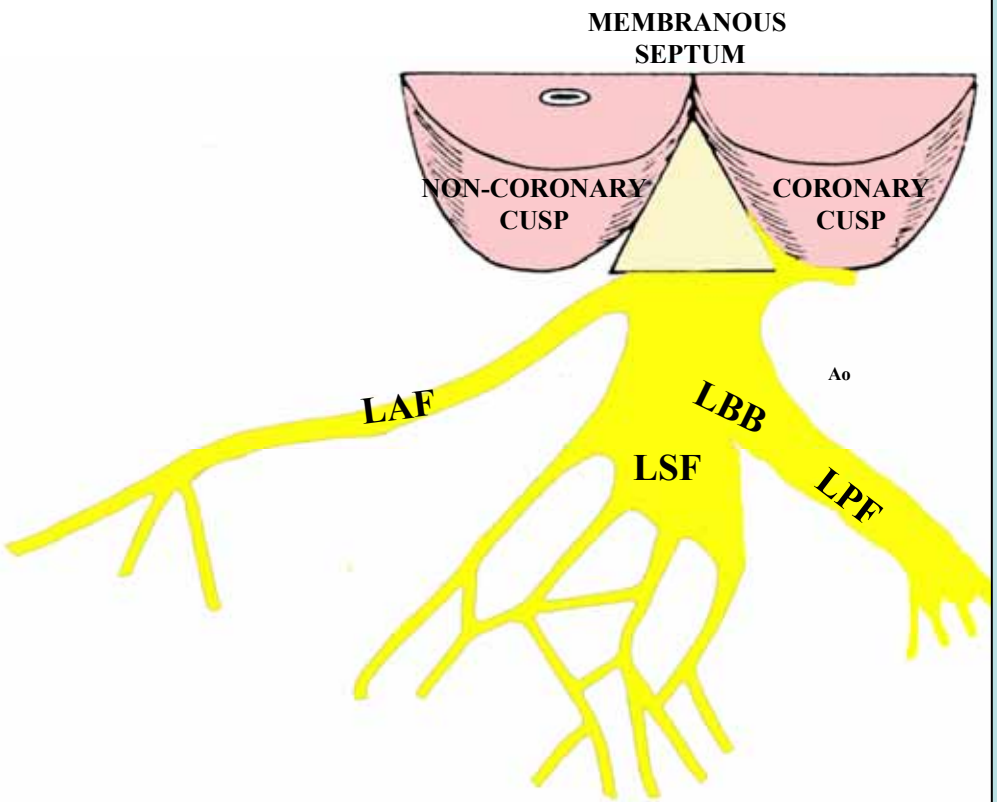
19) INTRAVENTRICULAR ABERRANT CONDUCTION:
this term only indicates the existence of conduction aberration within the ventricle, which in isolation does not seem too clarifying.
Conclusion from the semantic discussion: we are far from being the owners of the truth, and we suggest and gladly accept criticisms and disagreeing opinions, which will surely enrich our permanent search for the truth.

LEFT SEPTAL FASCICLE (LSF) OF THE HIS BUNDLE

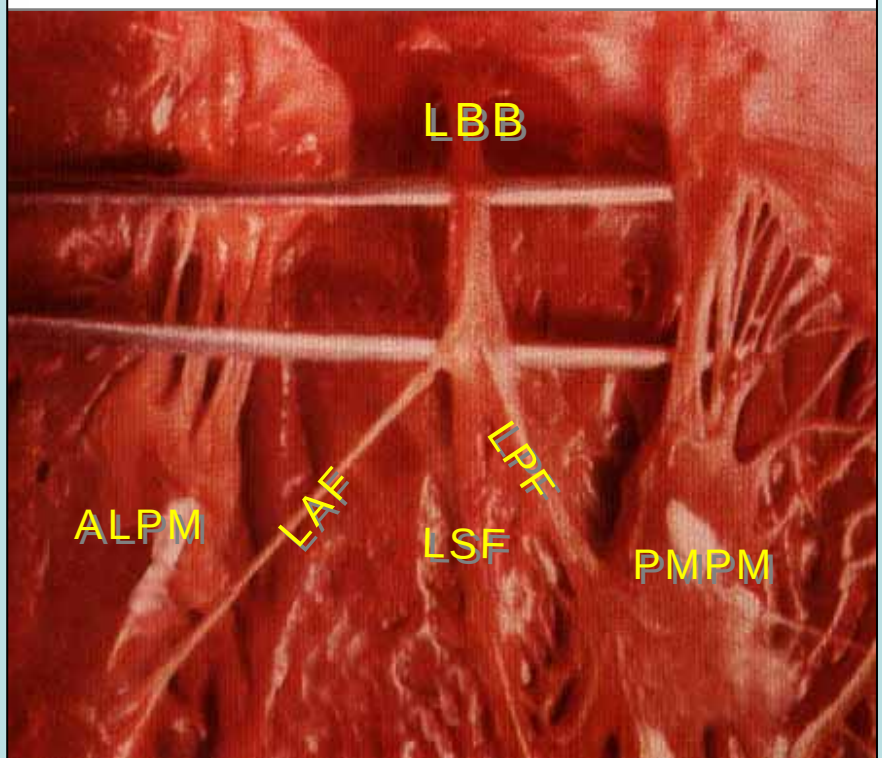
WE WILL SUCCESSIVELY ANALYZE IN THE LSF:

1. Possible Anatomical Variations
2. Conduction Velocity;
3. Location And Trajectory;
4. Blood Supply.

TYPE I



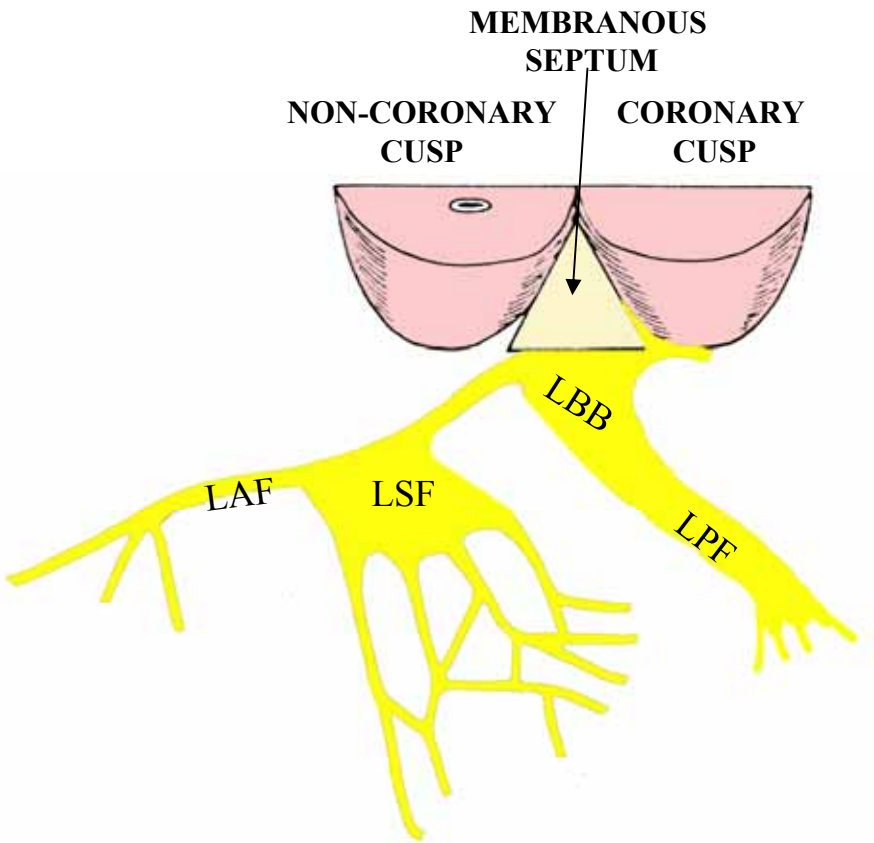
In this sample of the human heart, we observe a lateral view of the left side of the interventricular septum. Undoubtedly, the LSF originates directly from the LBB trunk. This variant is the most frequent one: 65% of the cases.



TYPE I: LSF born independently from the trunk of the left branch (LBB). ≈ 65% of the cases.

Modified from Hecht HH, et al. Am J Cardiol 1973; 31:232-244

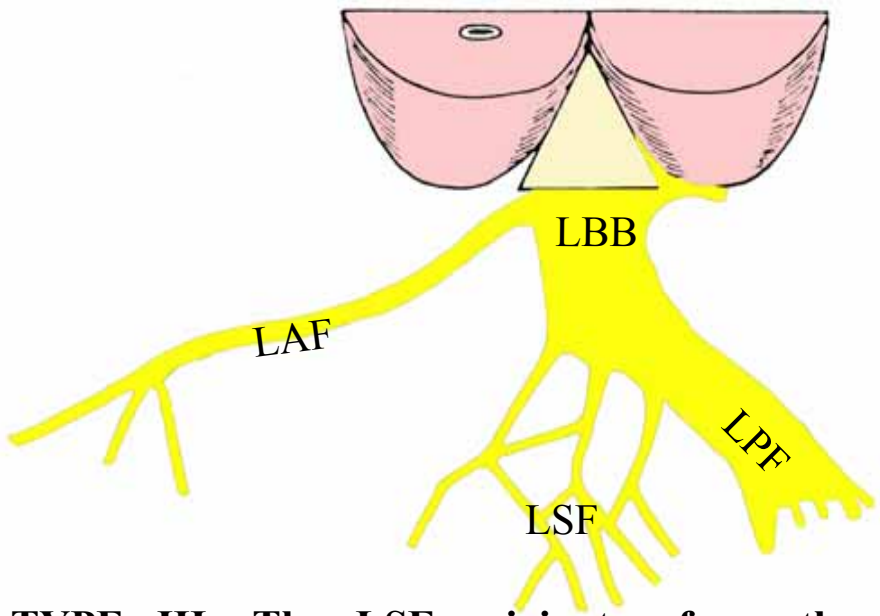
TYPE II



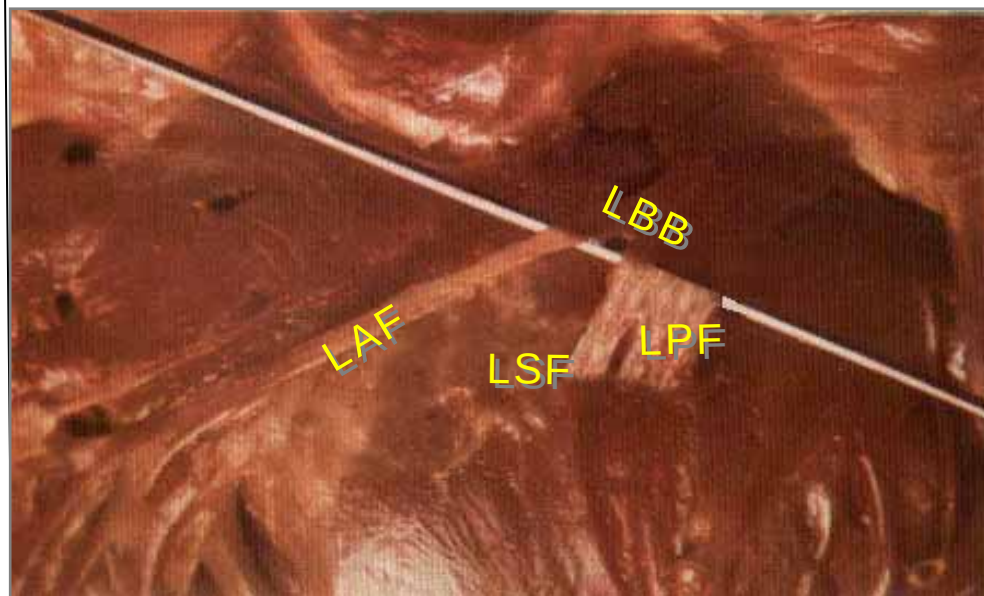
TYPE II: The LSF originates in the left anterior fascicle (LAF) of the LBB.

1. **Rosenbaum MB, Elizari MV, Lazzari JO. Los Hemibloqueos. Editorial Paidos. Buenos Aires, 1967**

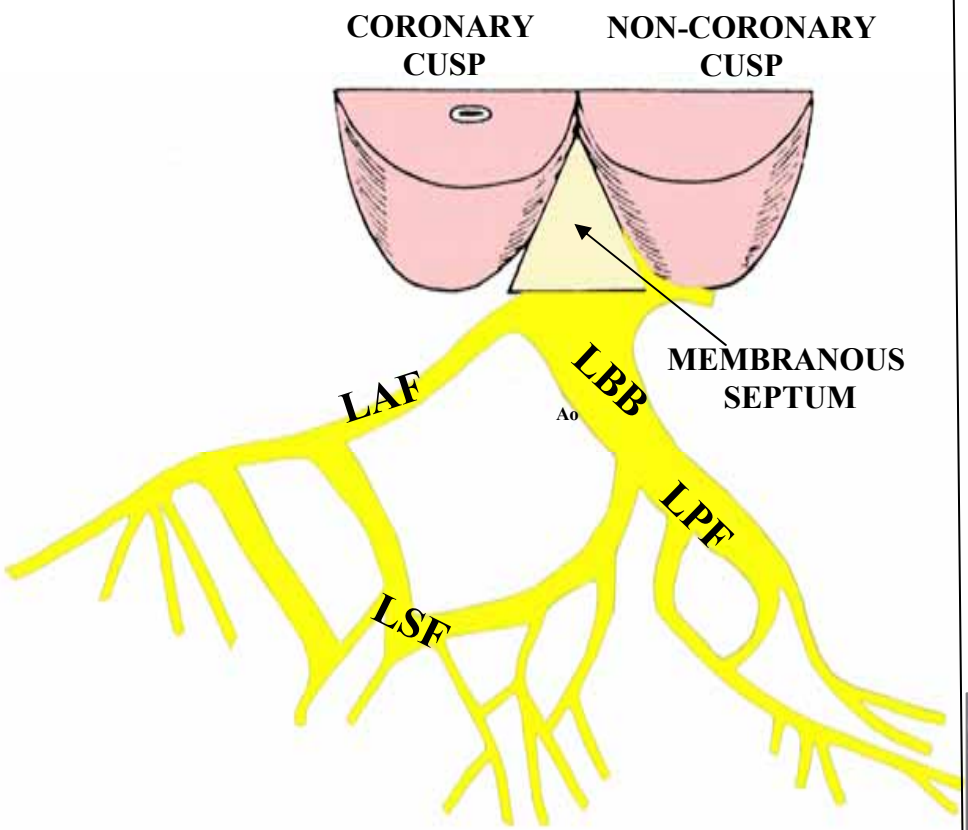
TYPE III



TYPE III: The LSF originates from the left posterior fascicle (LPF). Rosenbaum interpreted it as "false tendons of the LPF".

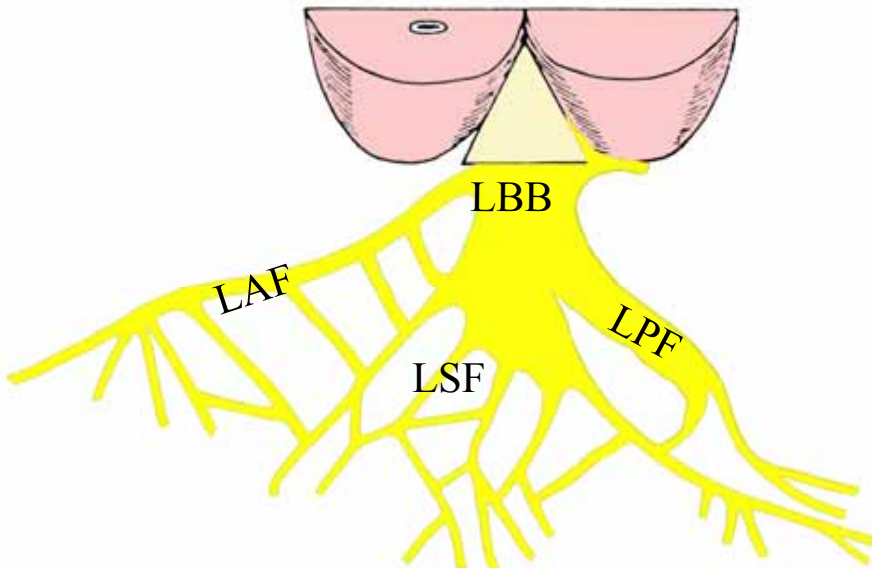


TYPE IV

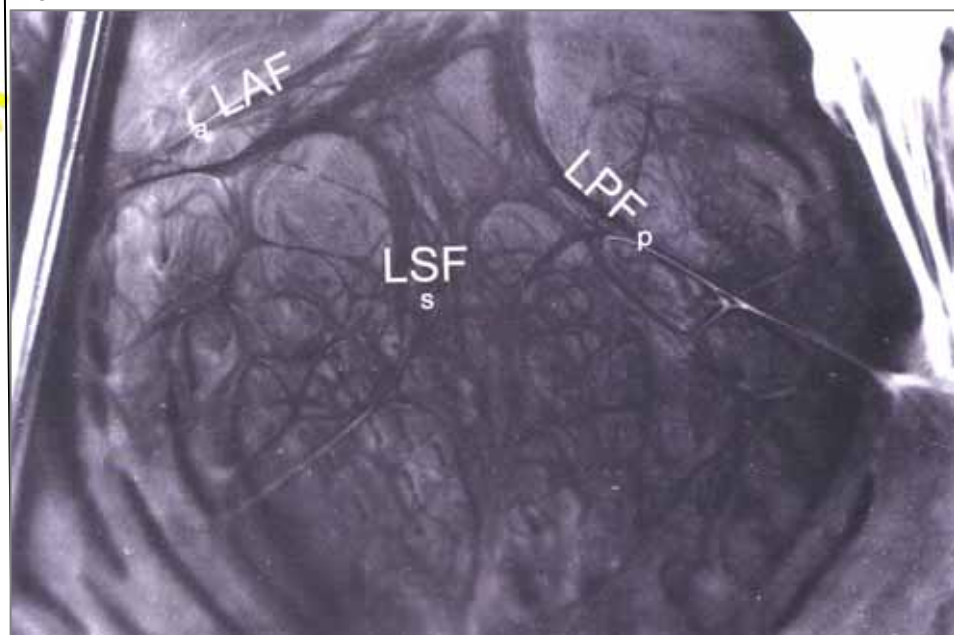


TYPE IV: the LSF is the branch of the other two fascicles of the LBB: LAF and LPF.

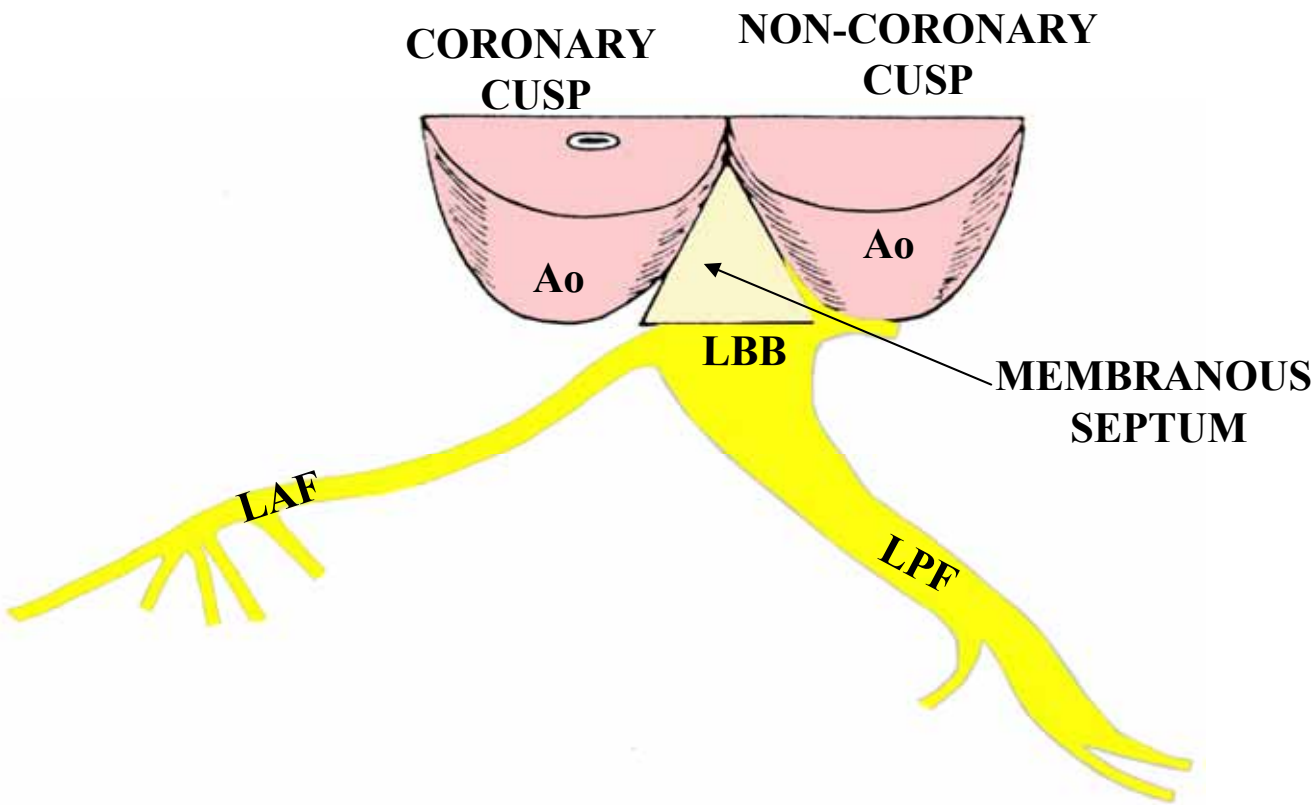
TYPE V



TYPE V: the LSF is a net in a fan shape, which joins both fascicles: LAF and LPF.



TYPE VI



TYPE VI: There is no LSF. 15% of the cases: bifascicular left his system. This percentage rises to 40% in the histopathological work by Kulbertus. (1)

1) **Kulbertus HE, - Concept of left hemiblocks revisited: a histopathological and experimental study. Advances in Cardiology 1975; 14,126-132.**

CONCLUSIONS ON THE CONTROVERSY OF THE BIFASCICULAR OR TRIFASCICULAR NATURE OF THE HUMAN LEFT HIS FASCICLE

Taking as basis the commented aspects, we conclude that in most cases, the left his system is predominantly trifascicular and not bifascicular. consequently, the term “hemiblock”, established by Rosenbaum and his school (1-2) is inappropriate.

We believe that the following thought by Fernando de Pádua, researcher of the portuguese school, is extremely appropriate (3-4-5):

“IF HEMIBLOCKS DO EXIST, THEY ARE ONLY TWO - IF A THIRD ONE IS POSTULATED, HEMIBLOCKS DO NOT EXIST !”

1) Rosenbaum, M B, Elizari M V and Lazzari, J O: Los Hemibloqueos. Paidos, Buenos Aires, 1968

2) Rosembaum MB, Elizari MV, Lazzari JO: The Hemiblocks: Diagnostic criteria and clinical significance. Mod Concepts Cardiovsc Dis 1970 39:141

3) De Pádua F, Lopes VM, Reis DD, et al. - O hemibloqueio esquerdo mediano - Uma entidade discutível. Bol Soc Port Cardiol 1976

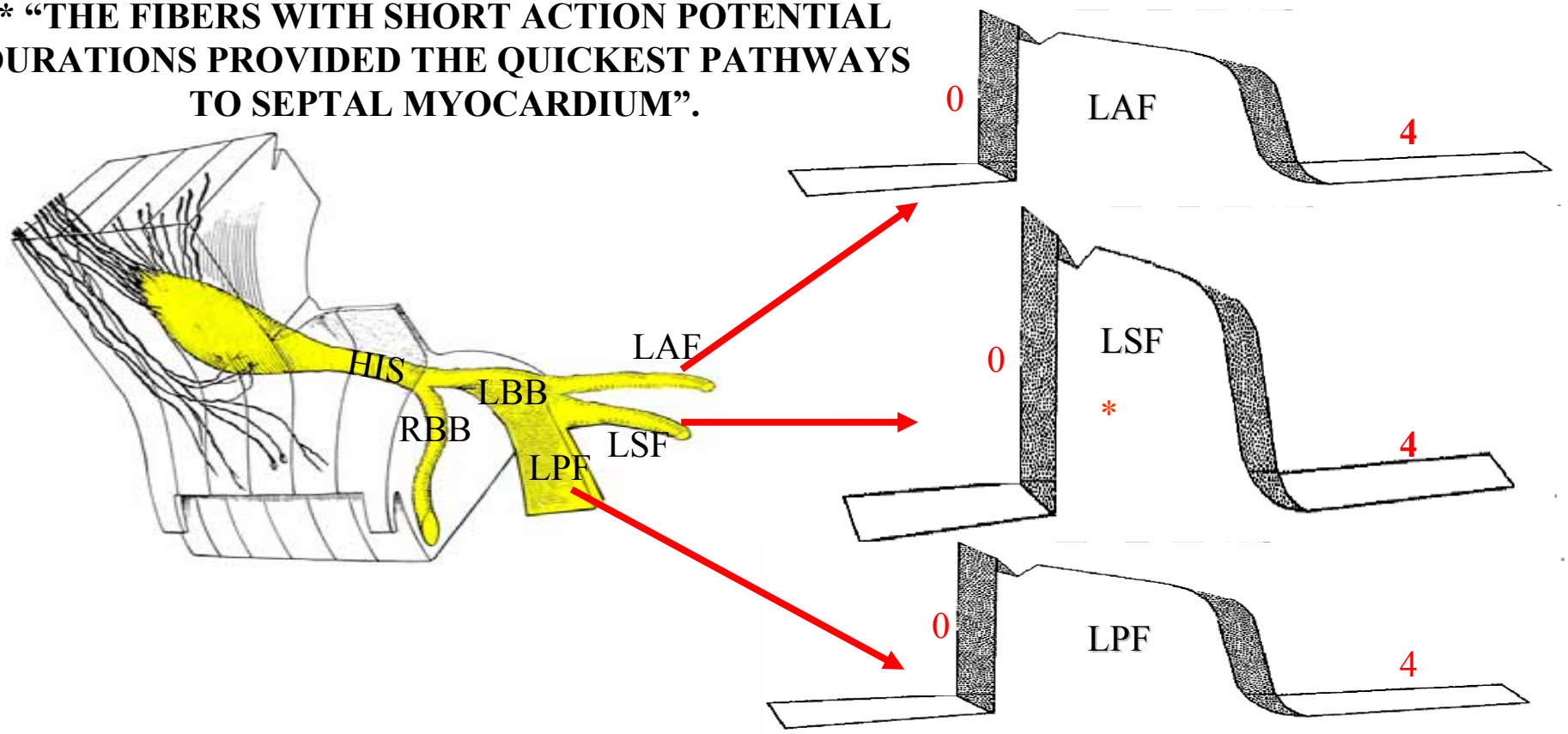
4) De Pádua F, Reis DD, Lopes VM, et al. - Left median hemiblock - a chimera? In: Rijlant P; Kornreich F, eds. 3rs Int. Congr. Electrocardiology. (17th Int. Symp. Vectorcardiography). Brussels, 1976

5) De Pádua F. Bloqueios fasciculares – os hemibloqueos em questão – Rev Port Clin Terap 1977; 3:199-200

CONDUCTION VELOCITY INSIDE LEFT FASCICLES

DIFFERENTIAL PROFILE OF THE LSF ACTION POTENTIAL (AP)

*** "THE FIBERS WITH SHORT ACTION POTENTIAL DURATIONS PROVIDED THE QUICKEST PATHWAYS TO SEPTAL MYOCARDIUM".**



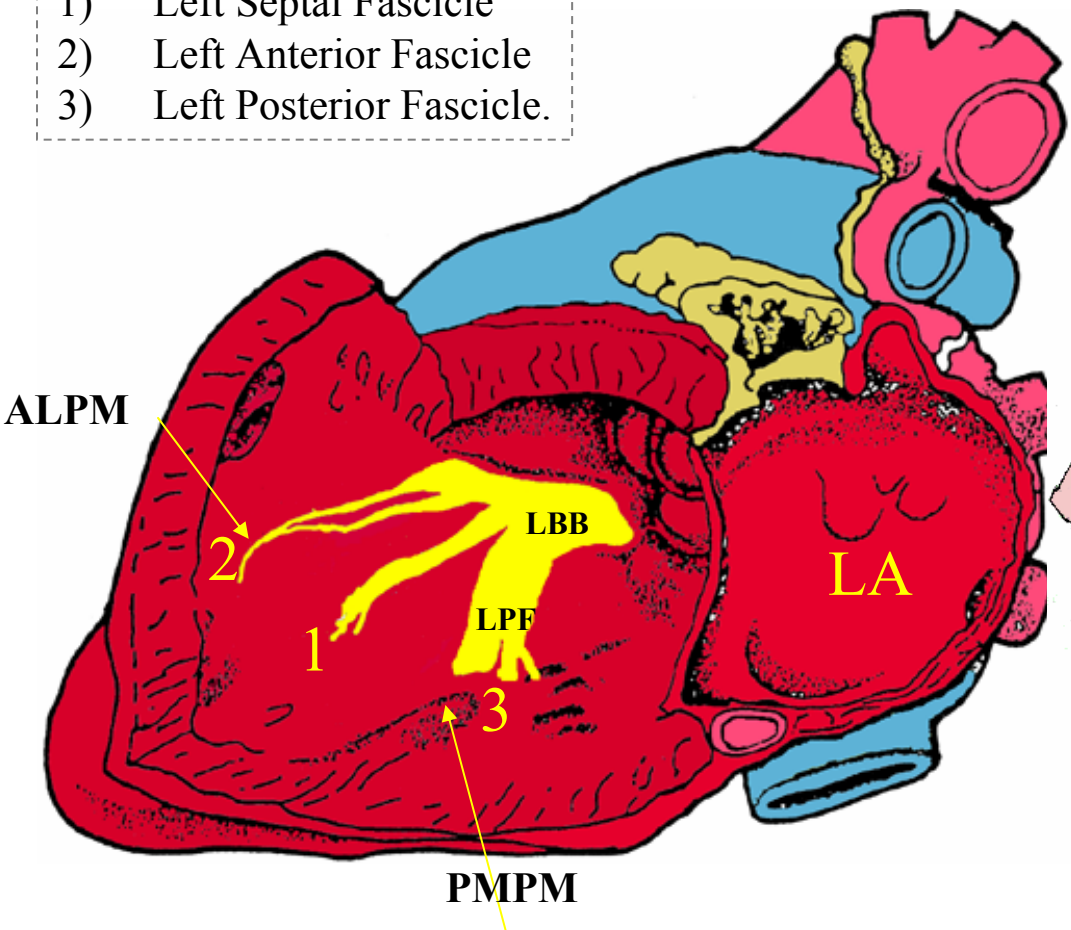
Note that the AP and absolute, relative and functional refractory periods are significantly shorter in the LSF. Phase 0 of the LSF is wider and consequently, conduction velocity is greater (1) which justifies the middle fibers region activating 5 ms before the anterior and posterior ones. The three have an automatic phase 4, i.e. with discrete spontaneous elevation or diastolic depolarization.

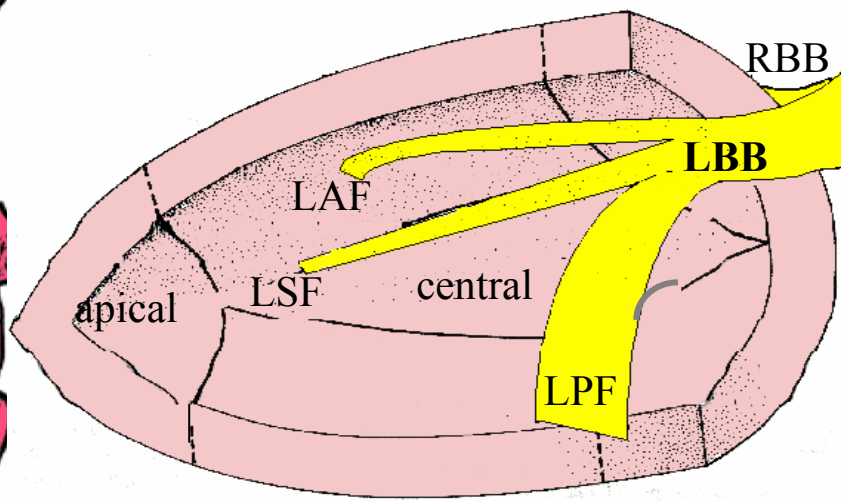
1. **Lazzara R, El-Sherif N, Befeler B, Scherlag BJ . Regional refractoriness within the ventricular conduction system. An evaluation of the "gate" hypothesis. Circ Res 1976; 39:254-262.**

DISTRIBUTION AND TRAJECTORY OF LEFT FASCICLES

THE LEFT INTRAVENTRICULAR HIS SYSTEM IS CONSTITUTED BY THREE FASCICLES

1) Left Septal Fascicle
2) Left Anterior Fascicle
3) Left Posterior Fascicle.

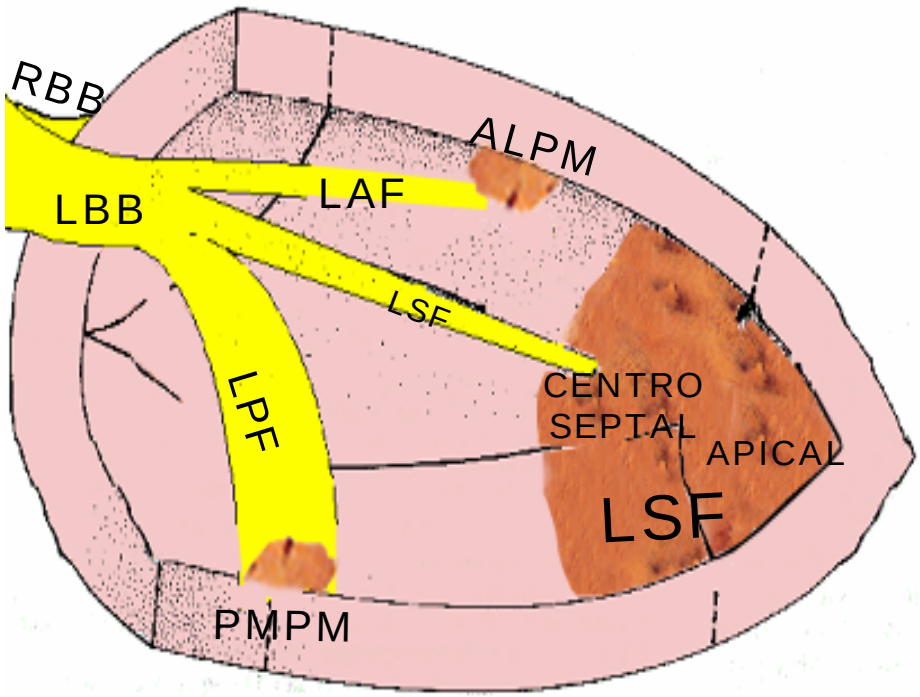




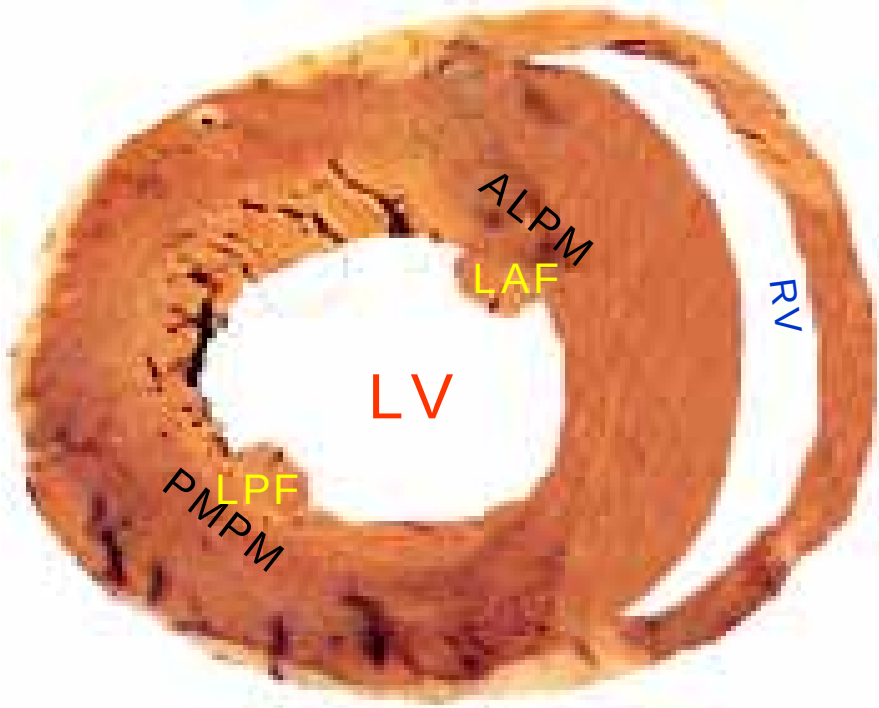
Left lateral view of the distribution and trajectory of the three fascicles of the left His system.

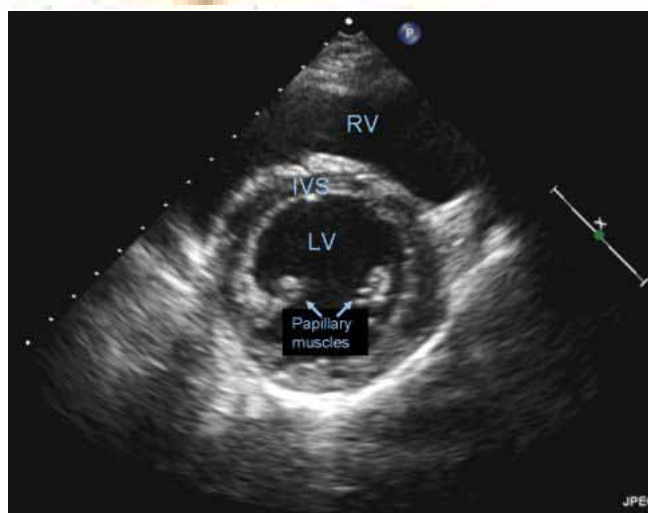
DISTRIBUTION AND TRAJECTORY OF LEFT FASCICLES

RIGHT LATERAL VIEW
MAJOR AXIS



VIEW
SHORT AXIS





ALPM – Anterolateral Papillary Muscle: LAF

Centro-Apical Region: LSF

PMPM – Posteromedial Papillary Muscle: LPF

BLOOD SUPPLY OF THE LEFT FASCICLES(1)

RESPONSIBLE SYSTEM	LAF	LPF	LSF
Branches of the LAD	40 %	10 %	100 %
Double irrigation (LAD & RCA)	50 %	40 %	0 %
RCA branches	10 %	50 %	0 %

LAD - ANTERIOR DESCENDING ARTERY
RCA - RIGHT CORONARY ARTERY
LAF – LEFT ANTERIOR FASCICLE
LPF – LEFT POSTERIOR FASCICLE
LSF - LEFT SEPTAL FASCICLE

The LSF is irrigated exclusively by the septal perforating branches of the Left anterior descending artery (LAD). Critical lesions of the LAD before first septal perforating branch(5), constitute the main cause of LSFB in the developed countries..

1. **Frink RJ, James TN. The Normal blood supply to the human His bundle and proximal branches Circulation 1973; 47: 8-18.**
2. **Riera AR, et al. Wellens syndrome associated with prominent anterior QRS forces: an expression of left septal fascicular block? J Electrocardiol. 2008 Nov-Dec; 41: 671-674.**

Irrigation of the three left fascicles of the left bundle branch.

POSSIBLES ETIOLOGIES

Literature and our own experience, showed to us the following etiological causes for LSFB

1) Chronic Chagas cardiomayopathy ([1;2])
2) Coronary Artery Disease (CAD): critical lesion of LAD and/or its septal perforating branches before the first septal (S_1) one([3;4])
3) Coronary Artery Disease with Wellens syndrome ([5])
4) Diabetes Mellitus ([6]) Present in this case report
5) Non-Obstructive Hypertrophic Cardiomyopathy (NO-HCM) ([7])
6) Obstructive Hypertrophic Cardiomyopathy (O-HCM)([7]);
7) Papillary Muscle Dysfunction ([8])?
8) Kearns-Sayre syndrome(9)

1) Vichi FL. Et al. The prevalence of branch and left fascicular blocks in the bundle of His in Chagas' cardiomyopathy. Arq Bras Cardiol 1982;39:87- 88.
2) Moffa PJ, et al. The left anterior septal block in Chagas' disease. Jap Heart J. 1982; 23:163-165.
3) Moffa PJ, et al. The left-middle (septal) fascicular block and coronary heart disease. In Liebman J, ed. Electrocardiology'96 – From the cell to body surface. Cleveland, Ohio, Word Scientific, 1996;547-550.
4) Uchida AH, et al .Exercise-induced left septal fascicular block: an expression of severe myocardial ischemia. Indian Pacing Electrophysiol J. 2006 Apr 1; 6: 135-138.
5) Riera AR, et al. Wellens syndrome associated with prominent anterior QRS forces: an expression of left septal fascicular block? J Electrocardiol. 2008 Nov-Dec; 41: 671-674.
6) Magnacca M, al. Diagnostic value of electrocardiogram in septal fascicular conduction disorders of the left branch in diabetics Minerva Cardioangiolica 1988; 36:361-363
7) Cheng CH, et al, - ECG pattern of left ventricular hypertrophy in non obstrutive hypertrophic cardiomiopathy: The significance of the mid-precordial changes. Am Heart J 1979; 97: 687-695.
8) Kobashi A. et al. Solitary papillary muscle hypertrophy as a possible form of hypertrophic cardiomyopathy. Jpn Circ J. 1998 Nov; 62: 811-816.
9) Riera AR, Kaiser E, Levine P, et al. Kearns-Sayre syndrome: electro-vectorcardiographic evolution for left septal fascicular block of the his bundle. J Electrocardiol. 2008 Nov-Dec;41:675-678.

A) ELECTROCARDIOGRAPHIC CRITERIA OF THE LEFT SEPTAL FASCICULAR BLOCK

1) Normal QRS duration or with a discrete increase (up to 110 ms).
2) FP leads with no modifications: normal QRS.
3) Increased intrinsicoid deflection of V_1 and V_2.
4) R wave voltage of $V_1 \geq$ than 5 mm;
5) R/S ratio in $V_1 > 2$;
6) R/S ratio in $V_2 > 2$
7) S wave depth in V2 < 5 mm
8) Possible small q wave in V2 or V1 and V2
9) R wave of V2 > 15 mm
10) RS or Rs in V2 and V3 (frequent rS in V1) with R wave "in crescendo" from V1 to V3 and decreasing from V5 to V6
11) Absence of q wave in V5, V6 and DI (by absence of the vector 1_{AM}).

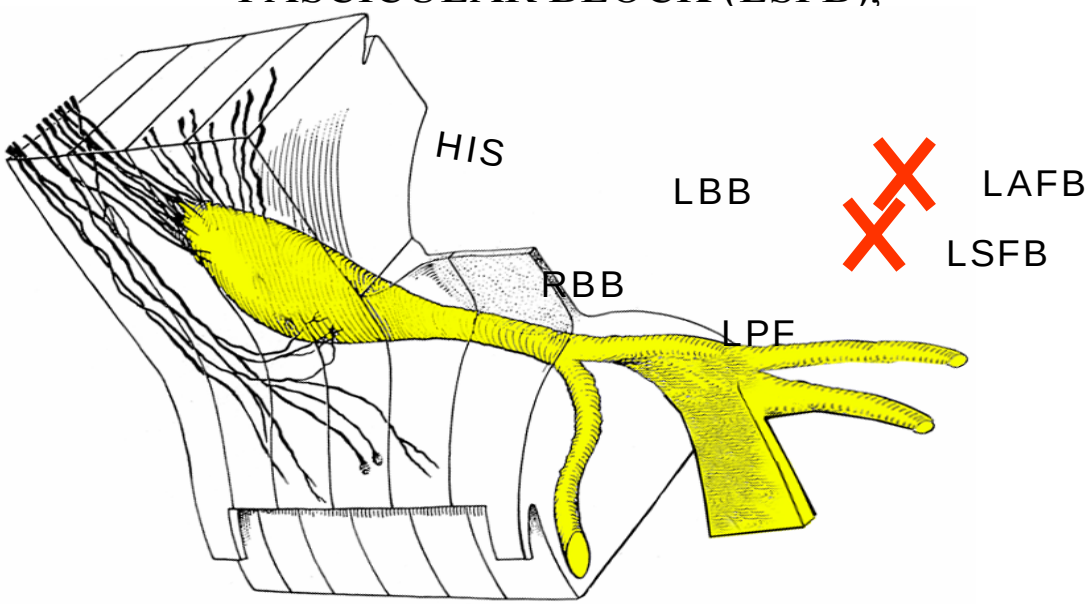
B) VECTOCARDIOGRAPHIC CRITERIA (all in the HP)

1. QRS loop in the HP with an area predominantly located in the left anterior quadrant ($\geq {}^2/_3$ of the QRS loop facing the orthogonal X line);
2. Absence of normal convexity to the right of the initial 20 ms of the QRS loop;
3. Discrete dextro-orientation with moderate delay of the vector from 20 ms to 30 ms;
4. Anterior location of the vector from 40 to 50 ms;
5. Posterior location with a reduced magnitude of the vector from 60 to 70 ms
6) Maximal vector of the QRS loop located to the right of + 30º;
7) T loop of posterior orientation (useful for the differential diagnosis with dorsal infarction);
8) The QRS loop rotation may be:
   (8a) Counterclockwise: incomplete LSFB.
   (8b) Clockwise: advanced LSFB or in association with CRBBB, LAFB or LPFB.

References in next slide.

1) **Mori H, Electrocardiographic criteria for the diagnosis of the left septal fascicular block and its frequency among primarily elderly hospitalized patients. Nippon Ronen Igakkai Zasshi 1992;29:293-297.**
2) **Uchida AH, Moffa PJ, Riera AR, Ferreira BM. Exercise-induced left septal fascicular block: an expression of severe myocardial ischemia. Indian Pacing Electrophysiol J. 2006; 6:135-138.**
3) **Riera AR, Ferreira C,, Wellens syndrome associated with prominent anterior QRS forces: an expression of left septal fascicular block?.J Electrocardiol. 2008 Nov-Dec;41:671-674.**
4) **Riera AR, Kaiser E, Levine P,et al, Kearns-Sayre syndrome: electro-vectorcardiographic evolution for left septal fascicular block of the his bundle. J Electrocardiol. 2008 Nov-Dec;41:675-678. ..**
5) **Riera AR, Kaiser E, Levine P,et al, Kearns-Sayre syndrome: electro-vectorcardiographic evolution for left septal fascicular block of the his bundle. J Electrocardiol. 2008 Nov-Dec;41:675-678.**
6) **Pérez-Riera AR, Ferreira C, Ferreira Filho C, et al. . Electrovectorcardiographic diagnosis of left septal fascicular block: anatomic and clinical considerations. Ann Noninvasive Electrocardiol. 2011 Apr;16:196-207.**

LEFT ANTERIOR FASCICULAR BLOCK (LAFB) ASSOCIATED WITH LEFT SEPTAL FASCICULAR BLOCK (LSFB).



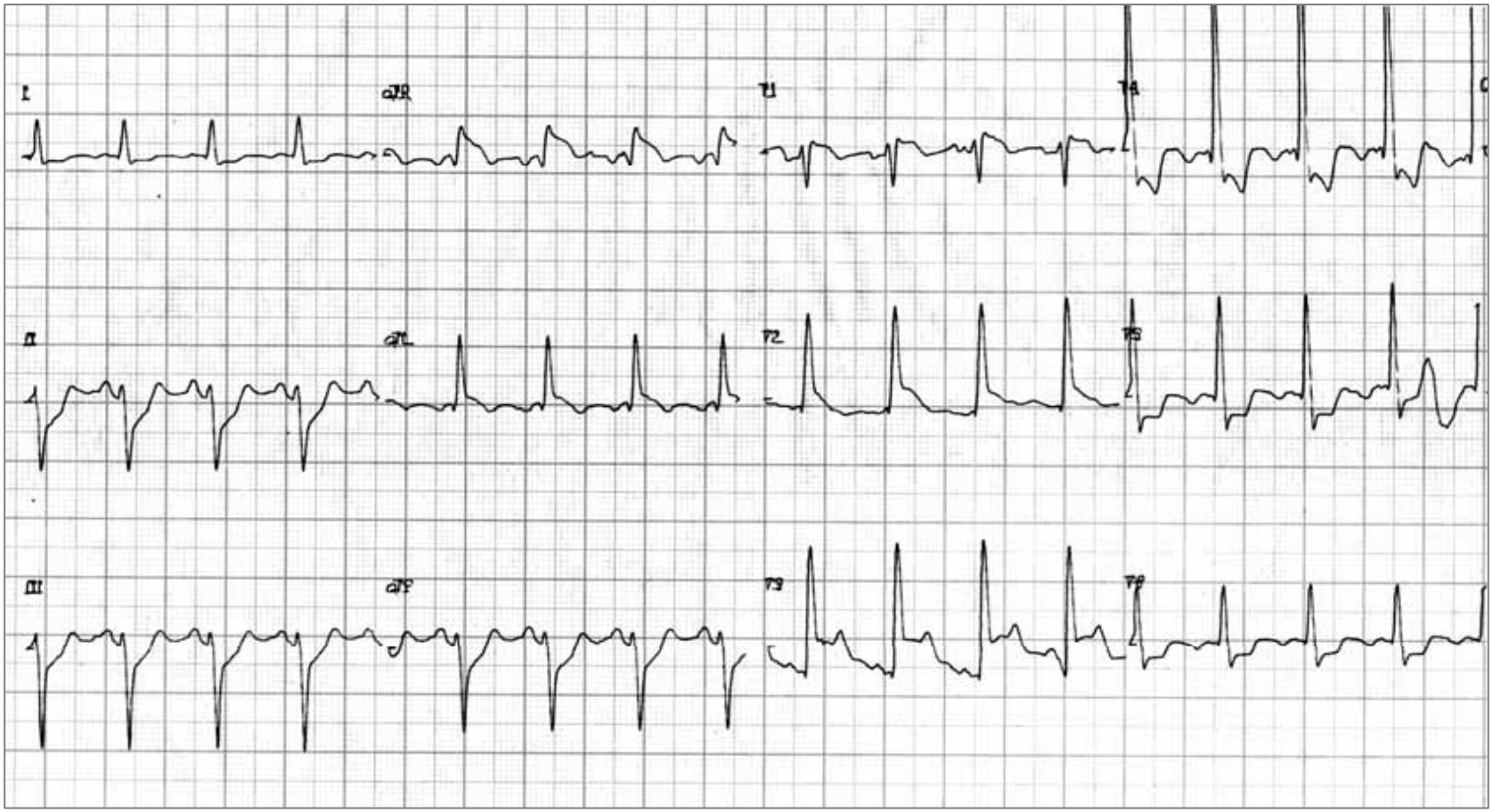
POSSIBLE CAUSES OF PROMINENT ANTERIOR FORCES (PAF)

1) Normal variant: counterclockwise rotation in the longitudinal axis. Normal subjects: PAF are observed in only 1% of normal subjects (*1*). We distinguish two main types: Normal variant with CCW rotation of the heart around the longitudinal axis(2) and Athlete's heart.(3)
2) Misplaced precordial leads
3) RVE types A and B.(4)
4) LVE of the diastolic, eccentric or volumetric overloading type: CCC heart rotation arround the longitudinal axis or septal hypertrophy.
5) Strict or posterior dorsal infarction (actual lateral).
6) Posterolateral or posterolatero-inferorbasal infarction.
7) Right bundle branch block.
8) Wolff-Parkinson-White with anomalous pathway on posterior location: Type A WPW
9) Hypertrophic cardiomyopathy: obstructive and non-obstructive forms, mainly apical HCM
10) Duchenne-Erb disease, pseudo hypertrophic muscular dystrophy linked to sex or infantile malignant (DMD), X-linked muscular dystrophy, pseudo hypertrophy or childhood muscular dystrophy
11) EndOmyocardial fibrosis
12) Left Septal Fascicular Block (LSFB).
13) Associations of the previous ones: E.g.: RVE + CRBBB (next slide)

1. Mattu A, Brady WJ, Perron AD, et al. Prominent R wave in lead V1: electrocardiographic differential diagnosis. Am J Emerg Med. 2001; 19: 504-513.
2. Zema, MJ: Electrocardiographic tall R waves in the precordial leads. J Electrocardiol 1990; 23:147-156.
3. MacKenzie R. Tall R wave in lead V1. J Insur Med. 2004; 36:255-259.
4. Mathur VS, Levine HD: Vectocardiographic differentiation between right ventricular hypertrophy and posterobasal myocardial infarction. Circulation 1970; 42:883-894.

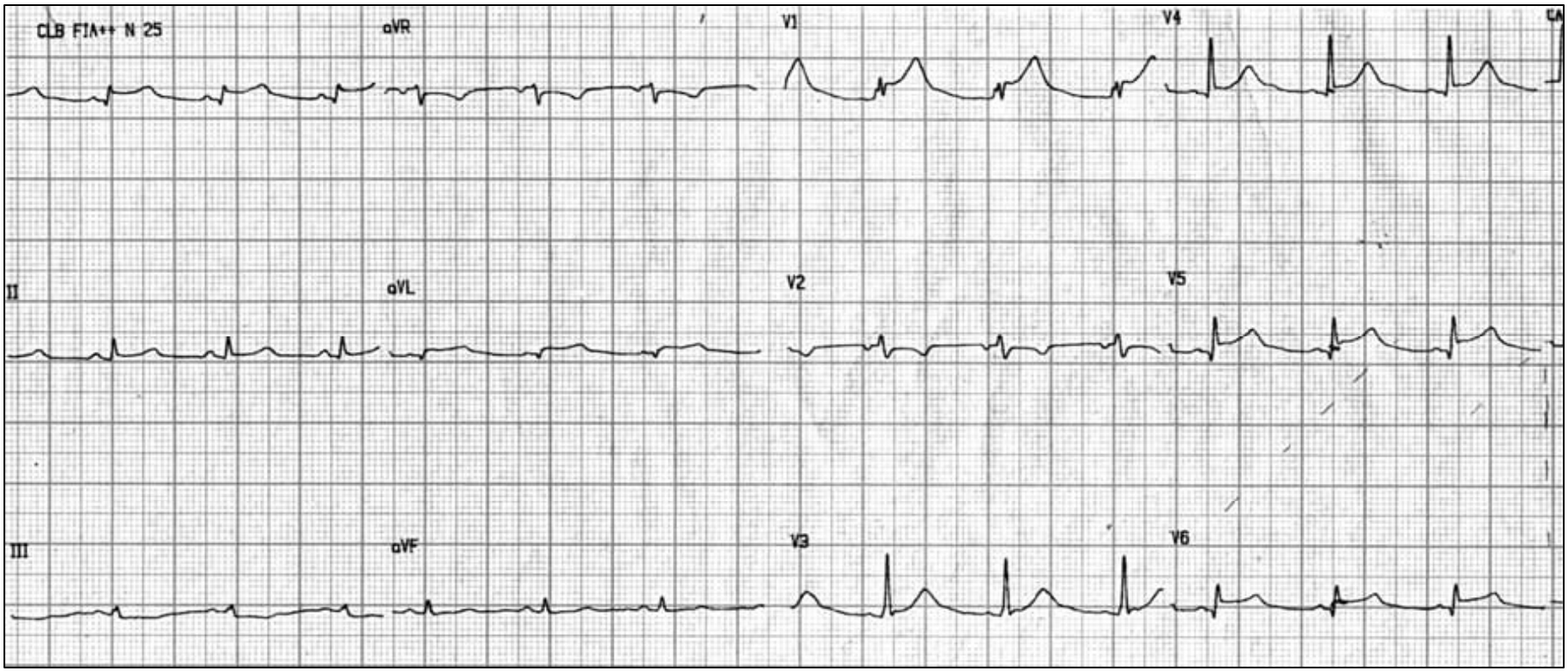
Others ECGs similar examples

Name: AR **Date:** 01/05/2009 **Age:** 72 yo **Gender:** Male
Ethnic Group: Caucasian **Weight:** 72 Kg; **Height:** 1.74 m; **Biotype:** Mesomorphic;
Management: Coronary Artery Bypass Graft (CABG) 72 hours ago.



Clinical features: Acute coronary syndrome: 72-year-old male patient, admitted in the emergency room with typical precordial pain that yielded after the administration of IV nitroglycerin.
Electrocardiographic diagnosis: 1) Left Anterior Fascicular Block (LAFB) + 2) Left Septal Fascicular Block (LSFB): prominent anterior forces + lesion block + aVR lead with ST segment elevation suggestive of obstruction in the left main coronary artery (LMCA)
Laboratory: There was no increase of necrosis markers (CK-MB/troponin).
The coronary angiography revealed LMCA spasm + proximal critical lesion of the anterior descending artery.
Management: The patient was urgently revascularized, successfully.(Coronary Artery Bypass Graft).

Name: AR **Date:** 01/05/2009 **Age:** 72 yo **Gender:** Male
Ethnic Group: Caucasian **Weight:** 72 Kg; **Height:** 1.74 m; **Biotype:** Mesomorphic;
Management: Coronary Artery Bypass Graft (CABG) 72 hours ago.



Electrocardiogram conducted on the third day after successful surgery.
Both divisional blocks have disappeared: the extreme shift of QRS electric axis to the left in the frontal plane (LAFB) is not seen, and prominent anterior forces (LSFB) has disappeared.

Date:
02/01/2009

Date:
05/01/2009

I

II

III

WITH
LAFB

WITHOUT
LAFB

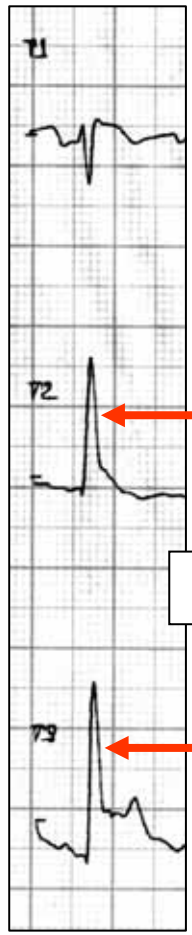
Date:
02/01/2009

Date:
05/01/2009

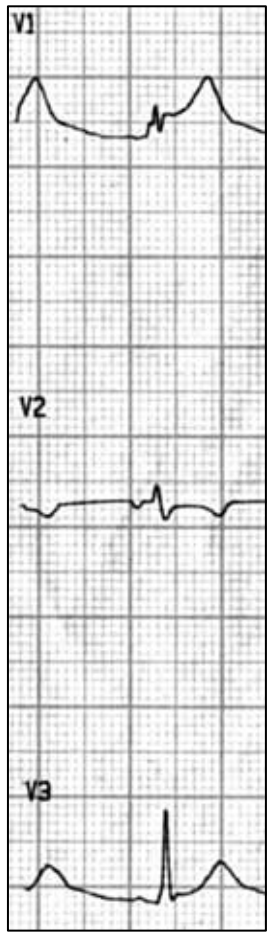
V_1

V_2

V_3



PAF



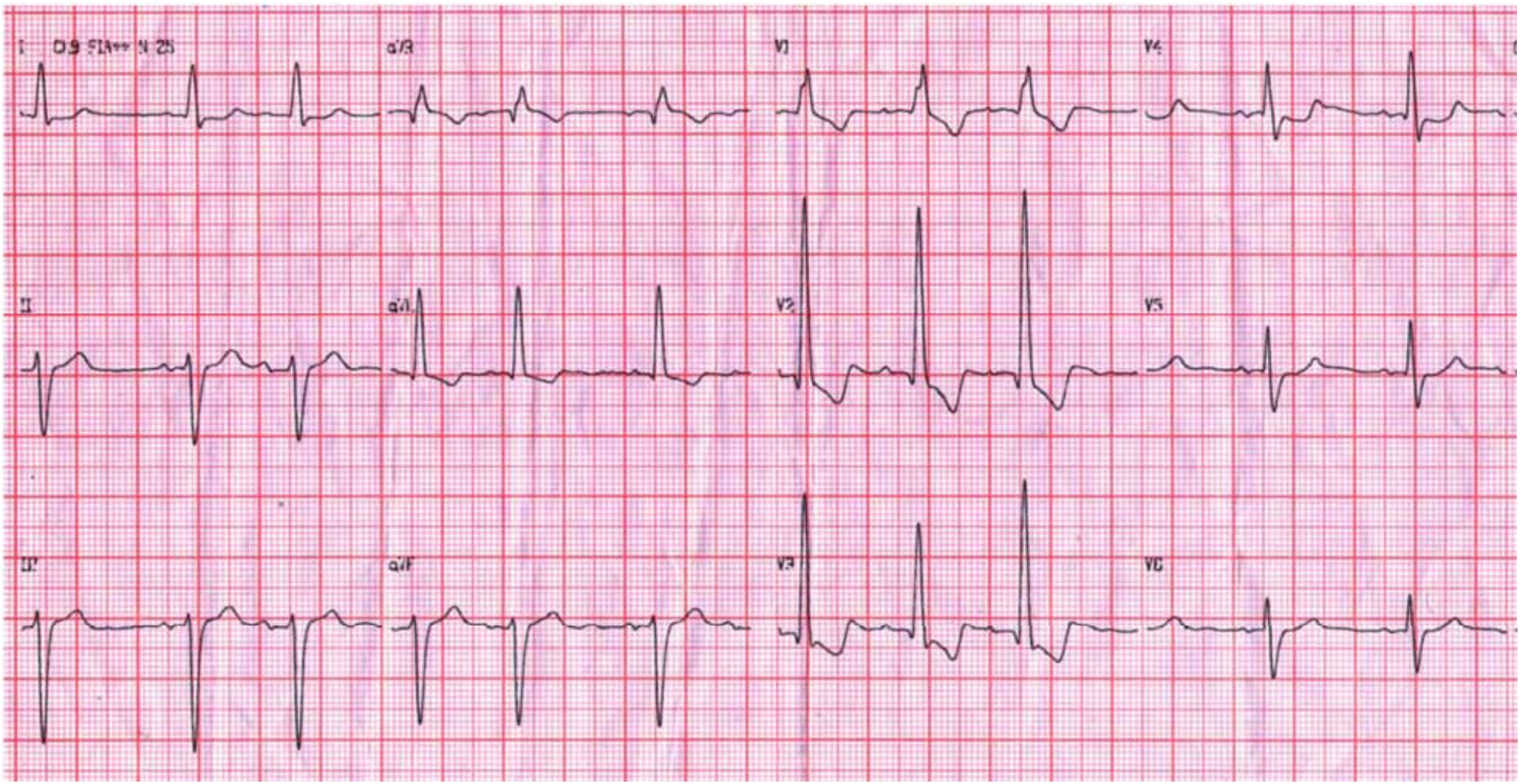
WITH
PAF: LSFB

WITHOUT
PAF: LSFB

First ECG

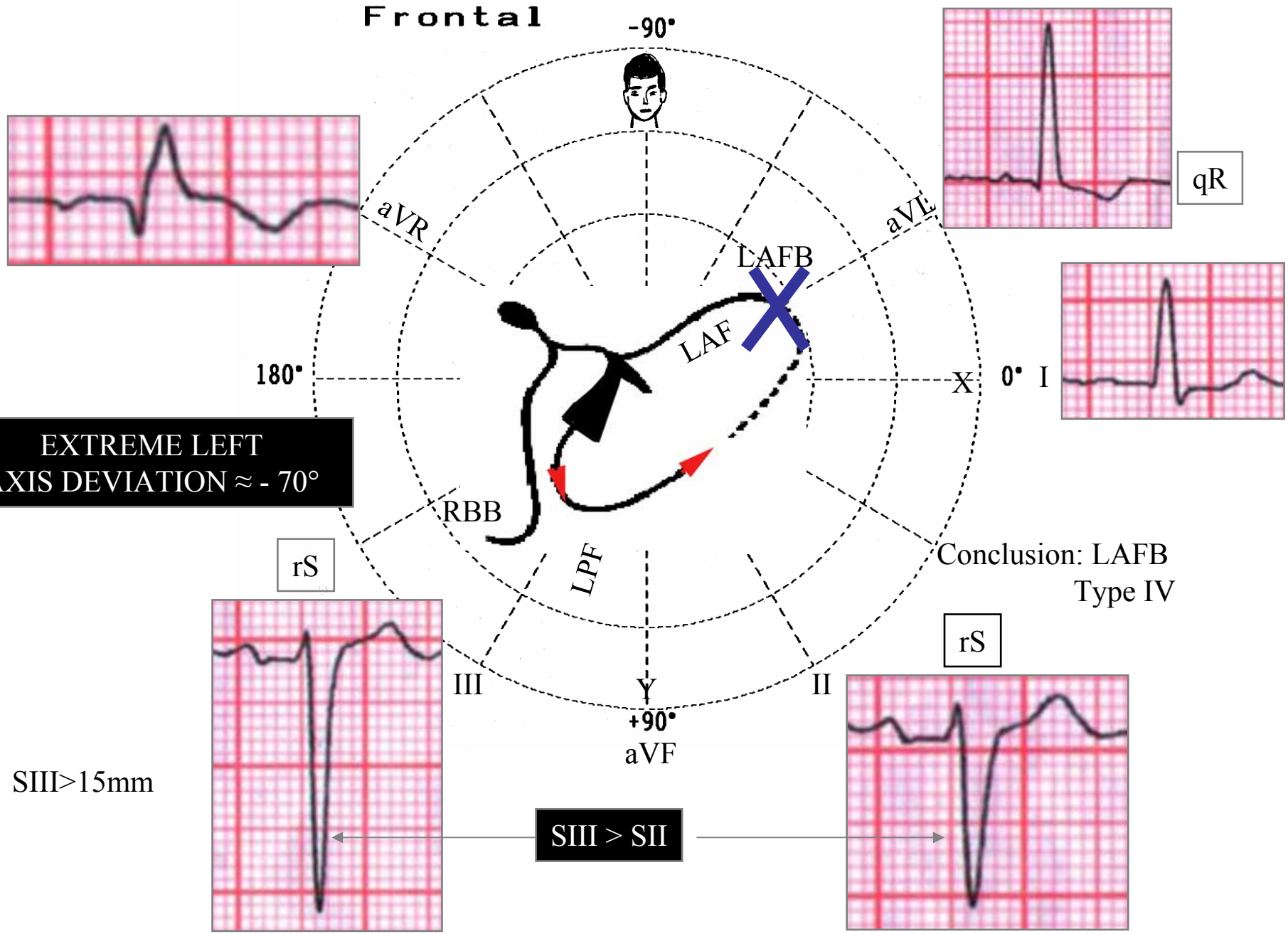
Female, 85-year-old patient, with history of syncope.

Echo (preserved left ventricular function). Normal coronary angiography.



What is the report ECG? What is the probable etiological diagnosis?

R-peak time or Intrinsicoid deflection in aVL ≥ 45 ms



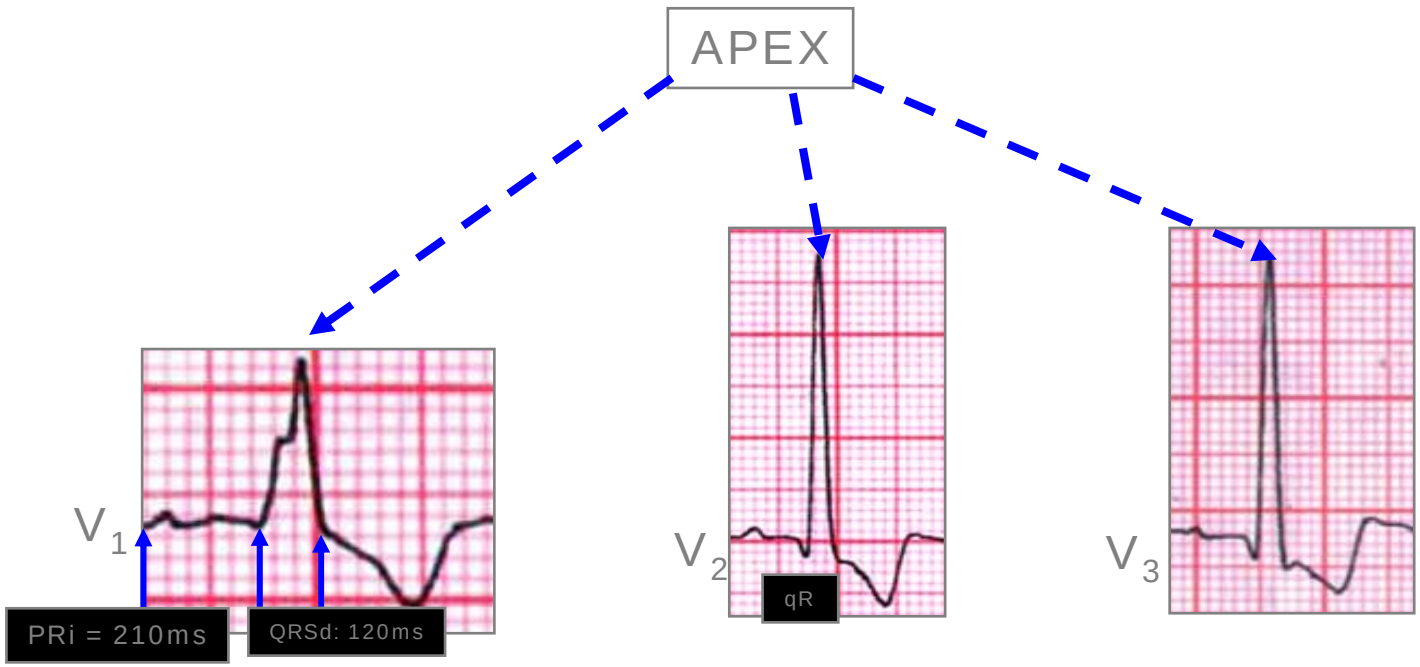
EXTREME LEFT
AXIS DEVIATION ≈ - 70°

Conclusion: LAFB
Type IV

SIII>15mm

HORIZONTAL PLANE

1. **R wave V1 > 5mm (=8mm) and R wave V2>15mm(27mm)**
2. **R wave "in crescendo" from V_1-V_2**
3. **R wave decreasing from V_3 through V_6;**
4. **R waves with great voltage in intermediary right precordial leads (mid-precordial changes) V_2-V_3**
5. **QRS complex with initial embryonic q wave in V_2-V_3 because the 10 to 20 ms initial vector heading backward dependent of LPF.**



6. **Absence of initial q wave in left leads precordial leads by absence of vector 1AM.**
7. **Prominent Anterior Forces (PAF) in precordial intermediate leads**
8. **R V_3 ápex before R V_2 apex or R V_2 apex before R V_1 apex**
9. **Negative T waves from V_1 to V_3. In LSFB, the T waves most of the times, are negatives in right precordial leads.**

Observation: all these criteria are valid in absence of RVH, septal hypertrophy lateral MI and other clinical causes of PAF.

Observation: THE DIAGNOSIS ALWAYS MUST NECESSARILY BE CLINICAL-ELECTRO-VECTORCARDIOGRAPHIC IN THE SAME WAY THAT THE LPFB.

QRS duration in LSFB

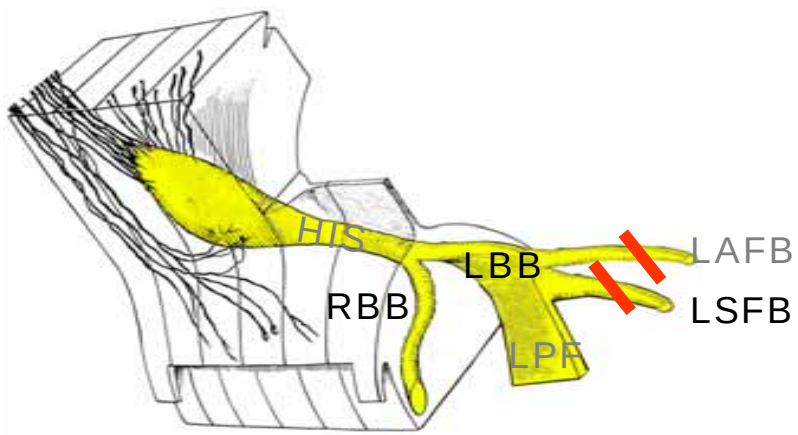
Why QRSd ≥ 120ms? Complete RBBB in association?

- In isolated LSFB QRS duration < 120 ms, in general, close to 100 ms.
- The appearance of LSFB does not increase QRSD by more than 25 ms, due to multiple. interconnections between the fascicles of the LBB ("passage way zone" of Rosenbaum).
- The QRS complex is slightly prolonged: between 100 ms to 115 ms.
- LSFB pattern with a prolonged QRSD(≥120ms) indicates the presence of additional conduction disturbances such as: other fascicular blocks, RBBB, MI, focal block, or a combination of these.
- In this case we have LAFB+ LSFB not Complete RBBB.

1) **Mori H, Electrocardiographic criteria for the diagnosis of the left septal fascicular block and its frequency among primarily elderly hospitalized patients. Nippon Ronen Igakkai Zasshi 1992;29:293-297.**
2) **Feldman T, Chua KG, Childers RW. R wave of the surface and intracoronary electrogram during acute coronary arterial occlusion. Am J Cardiol 1986; 58: 885-900.**

FINAL DIAGNOSIS CONCLUSION FIRST ECG

- **Left Anterior Fascicular Block (LAFB)** Rosembaum type IV: association of LAFB + LVE. It is characterized by frequent presence of LAE, SIII > 15 mm, Inverted T wave in one or more of the left leads(In this case only in aVL).
- **Left Septal Fascicular Block (LSFB): diagnosis clinical-electro-vectorcardiographic**
- **Left bifascicular block**

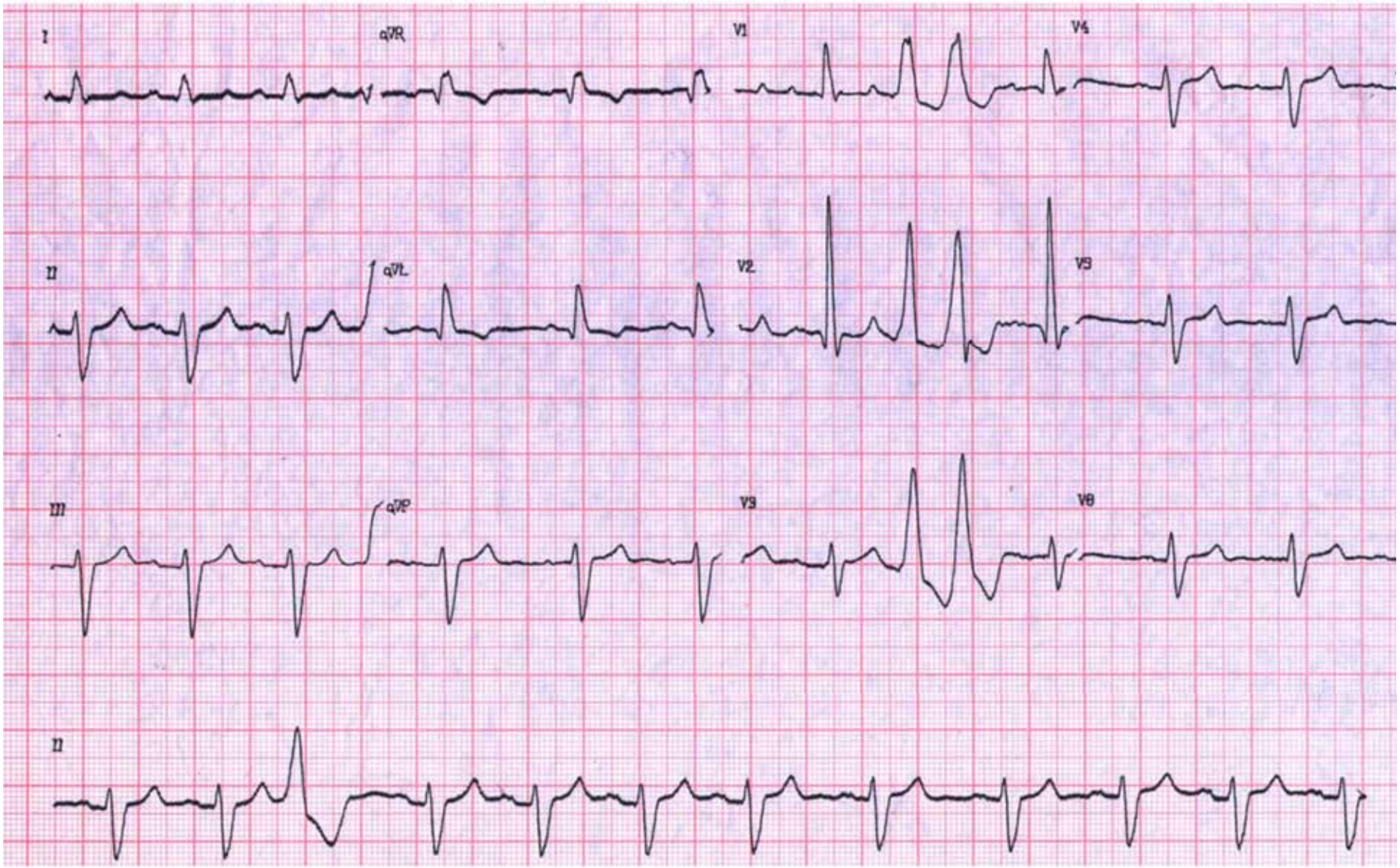


- **Left Ventricular Enlargement (LVE) or LVH**

And what is the probable etiological diagnosis? See next slide

Second ECG

Female, 83-year-old patient, with history of palpitations and syncopes.



What is the report ECG? What is the probable etiological diagnosis?

SECOND ECG DIAGNOSIS

1) Left Atrial Enlargement (LAE)

2) Firts-degree AV Block

3) Left Anterior Fascicular Block(LAFB)

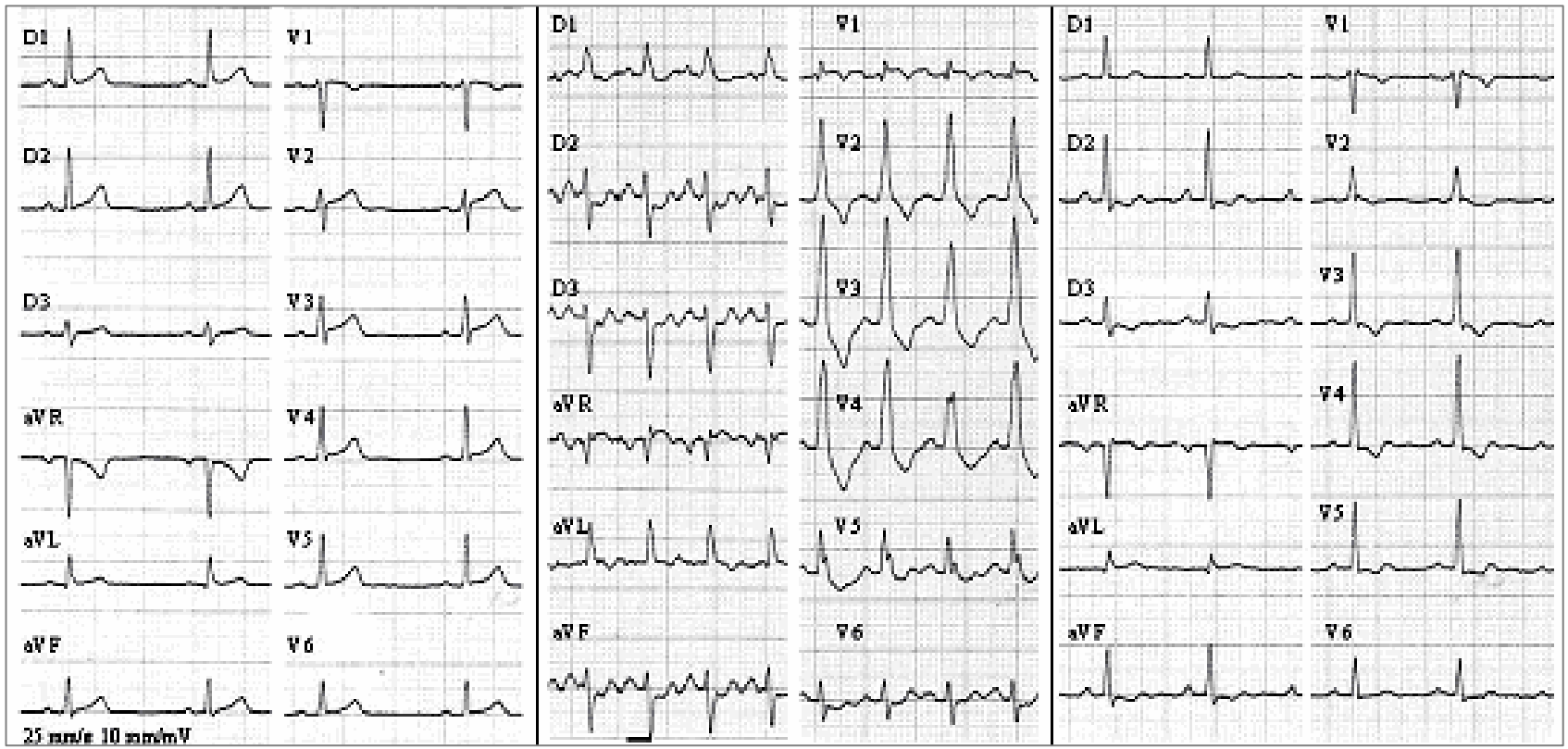
4) Premature Ventricular Contractions (PVCs) from left ventricle focus couples and isolated

5) Prominent Anterior Forces: LSFB.

Cause? Critical obstruction of left anterior descending coronary artery before the first septal perforating branche (S1)

INTRA-STRAIN INTERMITTENT LSFB

PREVIOUS ECG | ECG AT MAXIMAL STRAIN | POST-STRAIN ECG

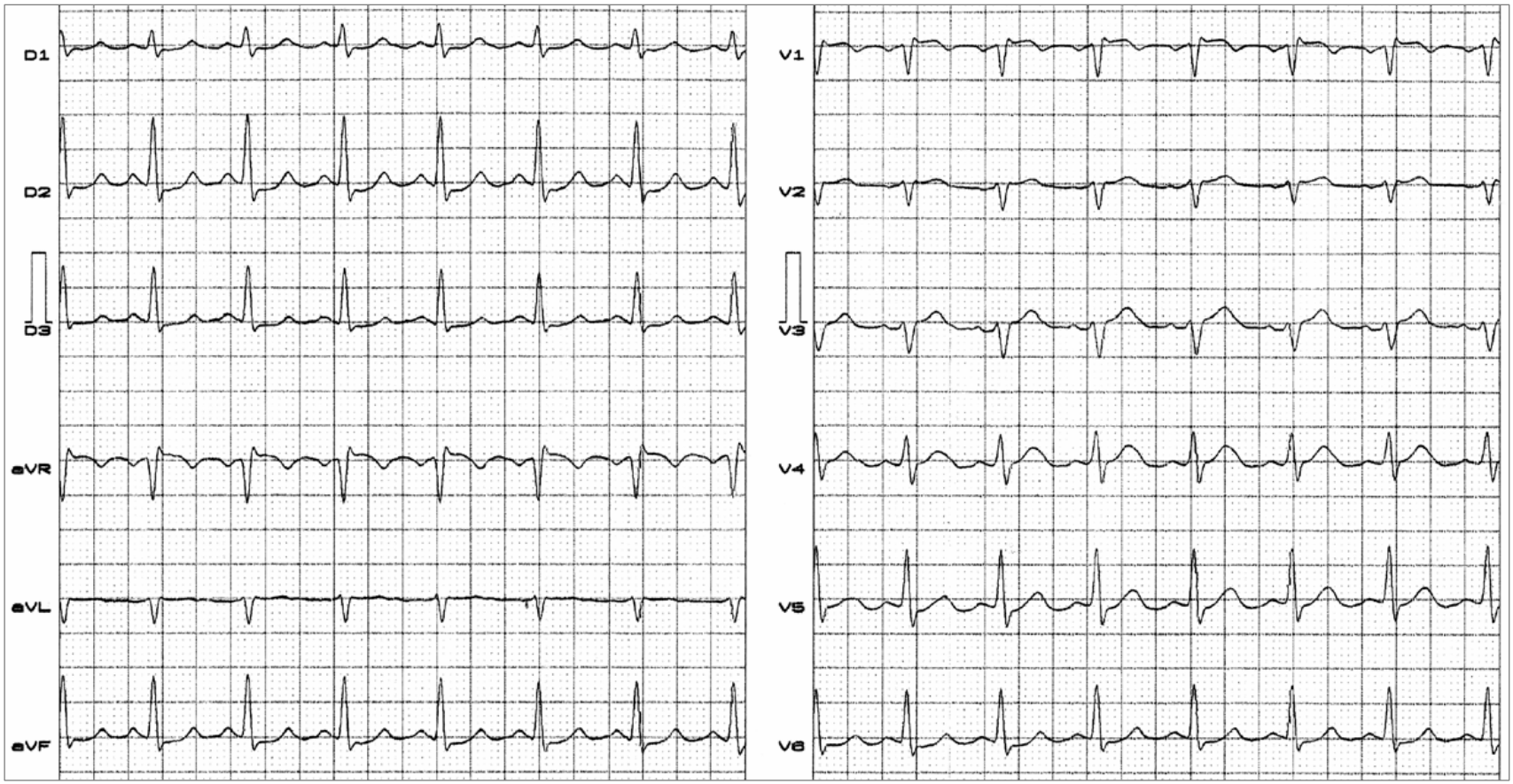


Cortesia Prof. Augusto Uchida e Prof. Paulo Jorge Moffa – InCor – São Paulo

In the central tracing, it is possible to see the sudden appearance intra-strain of prominent R wave from V1 to V4 by intermittent LSFB and LAFB (extreme shift of the axis to the left), which disappears in post-strain ECG; however, prominent R waves remain from V2 to V4. Catheterization shows critical injury of the ADA before the 1st septal artery. Intermittent appearance of LSFB associated to LAFB in a patient with coronary disease with critical lesion of the anterior descending artery during stress test.

ERGOMETER TEST: STAGE 1 ONSET OF STRAIN

NAME: P. R. T; **DATE:** 04/11/2002 ; **AGE:** 48 Y0; **SEX:** M. **RACE:** M; **WEIGHT:** 82 Kg .
HEIGHT: 1.84 m. **BIOTYPE:** ATHLETIC **MEDICATION IN USE:** NOTHING STATED.

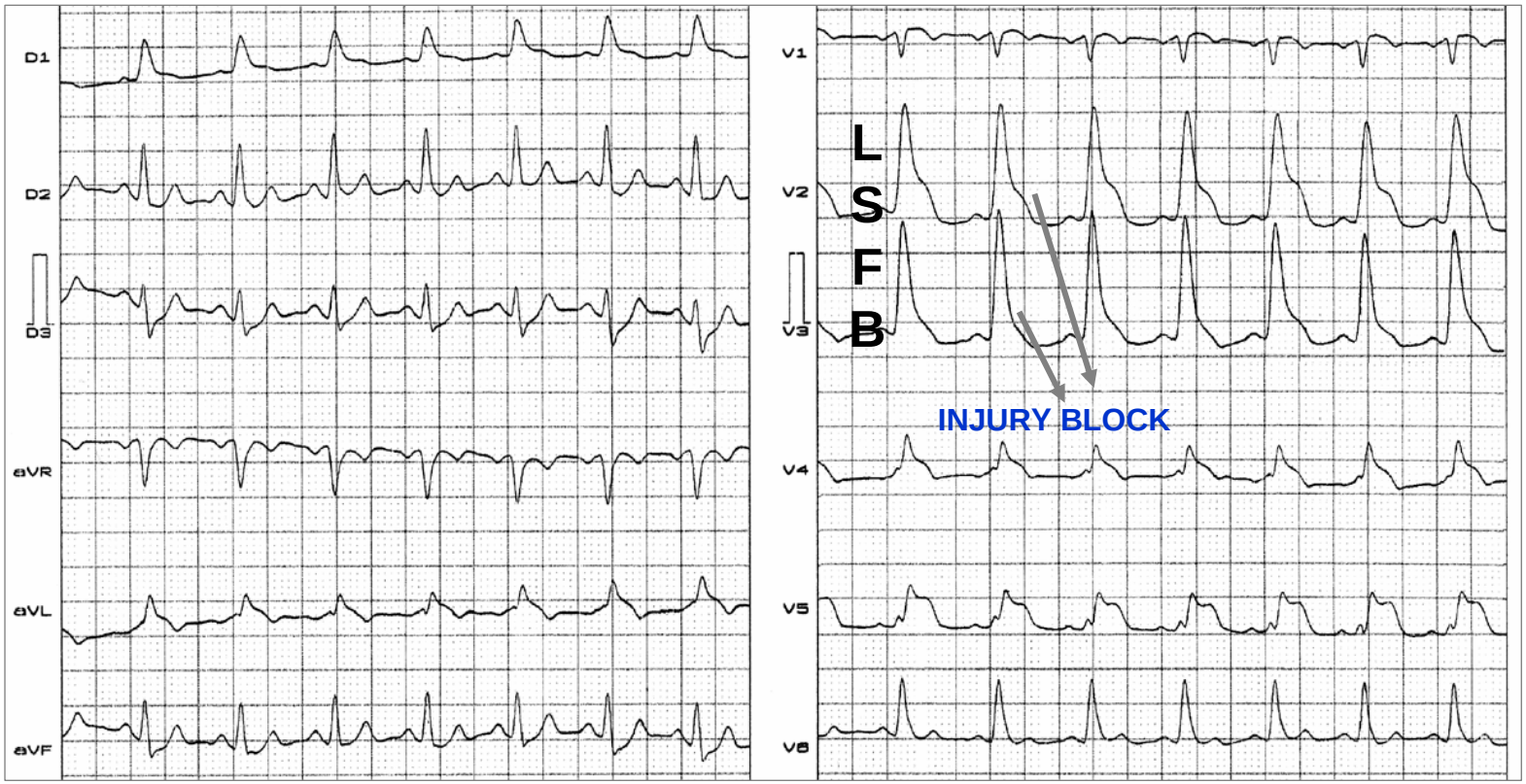


Clinical Diagnosis: angor pectoris of strain, inveterate smoker (30 cigarettes per day), stress. Absence of diabetes, high blood pressure, dyslipidaemias and others.

ECG diagnosis: tracing of onset of strain, HR 109 bpm, discrete end conduction delay by one of the RBB fascicles: aVR and V_1 Qr. Tracing of a patient during the stress test, which shows LSFB in the sequence, with prominent anterior forces and injury block followed by a run of monomorphic sustained ventricular tachycardia, which disappears at recovery.

ERGOMETER TEST
STAGE 2 INTRASTRAIN: INJURY BLOCK ASSOCIATED TO LSFB

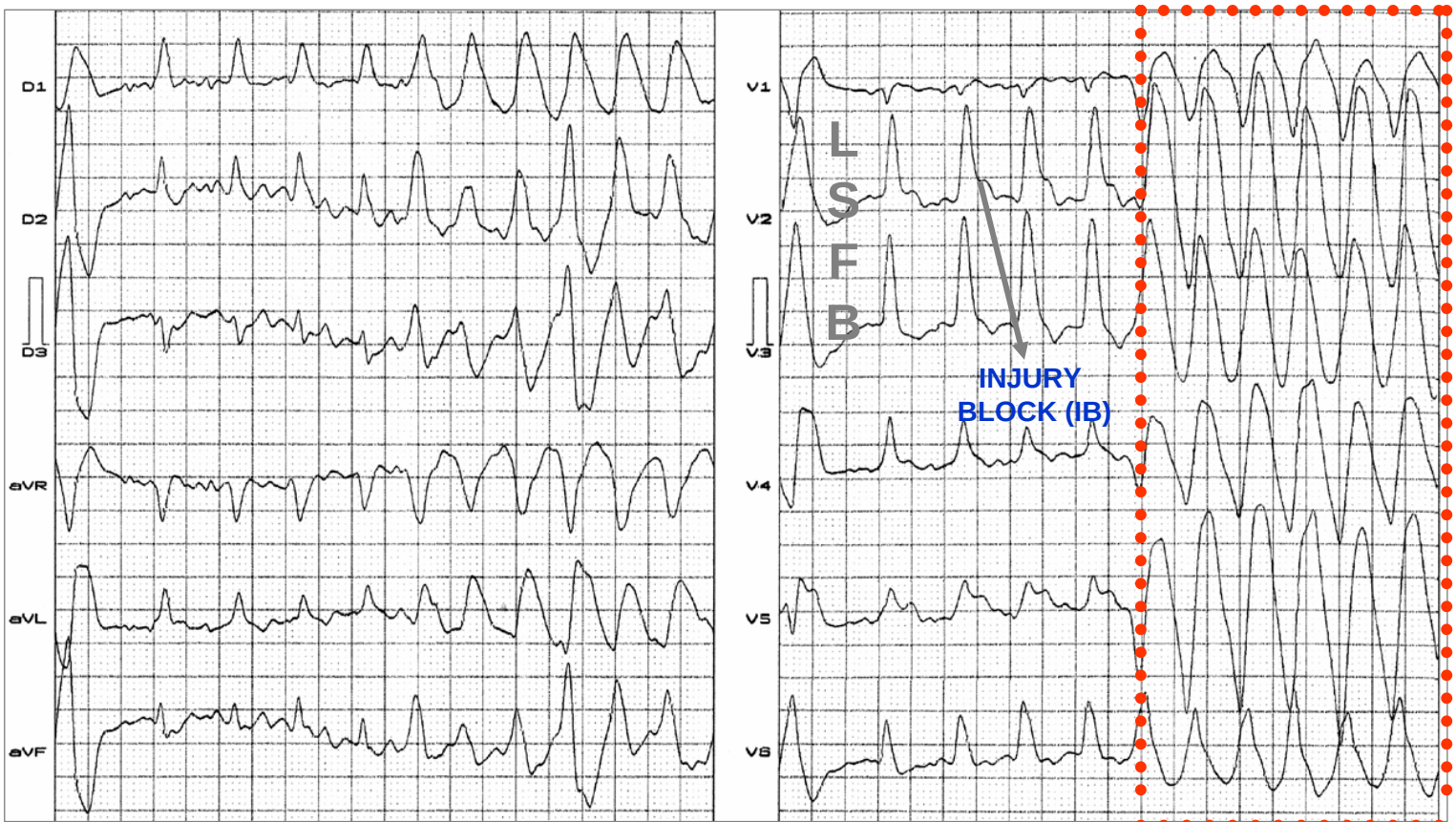
NAME: P. R. T; **DATE:** 04/11/2002 ; **AGE:** 48 YO. **SEX:** M. **RACE:** M; **WEIGHT:** 82 Kg ; **HEIGHT:** 1.84 m.
BIOTYPE: ATHLETIC **MEDICATION IN USE:** NOTHING STATED.



In the second stage of the ergometer test, the typical pattern known as injury block appeared in the anterior wall, which is characterized by the distortion of the terminal portion of the QRS complex. This IB is characterized by the emergence of the J point at a level above the inferior half of the R wave, the disappearance of the S wave in leads with RS configuration, as in this case V_2 and V_3. Besides, a significant increase of R wave voltage is observed in V_2 and V_3 PAF, indicating the appearance of LSFB. The hemodynamic study revealed proximal critical injury of the ADA before the first septal perforating artery. Tracing of a patient during the stress test, which shows LSFB in the sequence, with prominent anterior forces and injury block followed by a run of monomorphic sustained VT, which disappears at recovery.

ERGOMETER TEST
STAGE 3 INTRASTRAIN: LSFB + IB + VT

NAME: P. R. T **DATE:** 04/11/2002 **AGE:** 48 Y. **NUMBER:** 616
SEX: M. **RACE:** M. **WEIGHT:** 82 Kg . **HEIGHT:** 1.84 m. **BIOTYPE:** ATHLETIC



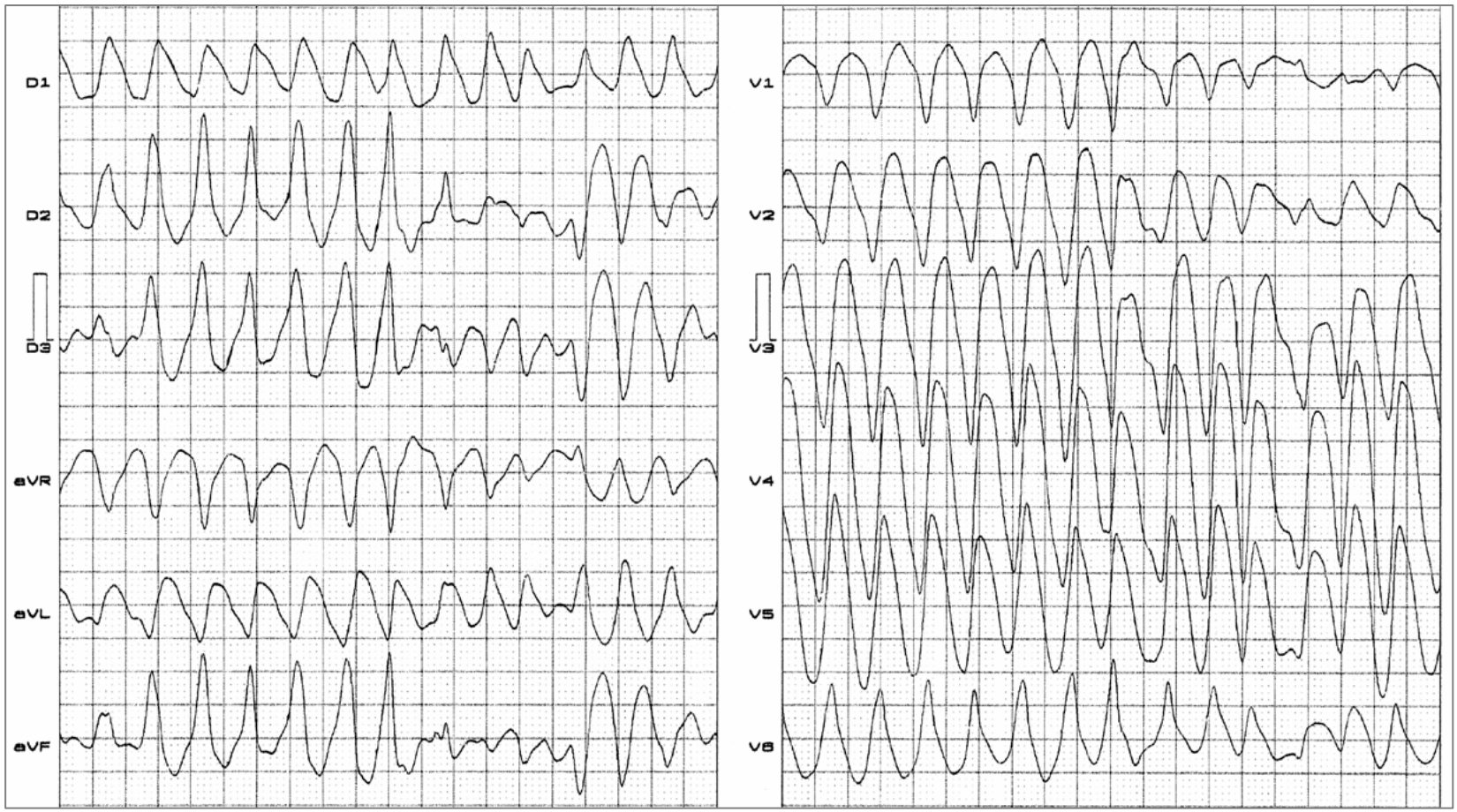
VENTRICULAR TACHYCARDIA (VT)

VENTRICULAR TACHYCARDIA (VT)

Tracing of a patient during the stress test, which shows LSFB in the sequence, with prominent anterior forces and injury block followed by a run of monomorphic sustained ventricular tachycardia, which disappears at recovery.

ERGOMETER TEST
STAGE 4 INTRASTRAIN: VT

NAME: P. R. T **DATE:** 04/11/2002 **AGE:** 48 Y. **NUMBER:** 616
SEX: M. **RACE:** M. **WEIGHT:** 82 Kg . **HEIGHT:** 1.84 m. **BIOTYPE:** ATHLETIC



Tracing of a patient during the stress test, which shows LSFB in the sequence, with prominent anterior forces and injury block followed by a run of monomorphic sustained ventricular tachycardia, which disappears at recovery.