Atleta Maratonista veterano com padrão eletrocardiográfico de sobrecarga ventricular esquerda e teste ergométrico positivo

Master marathon athlete with electrocardiographic pattern of left ventricular enlargement and positive ergometer test

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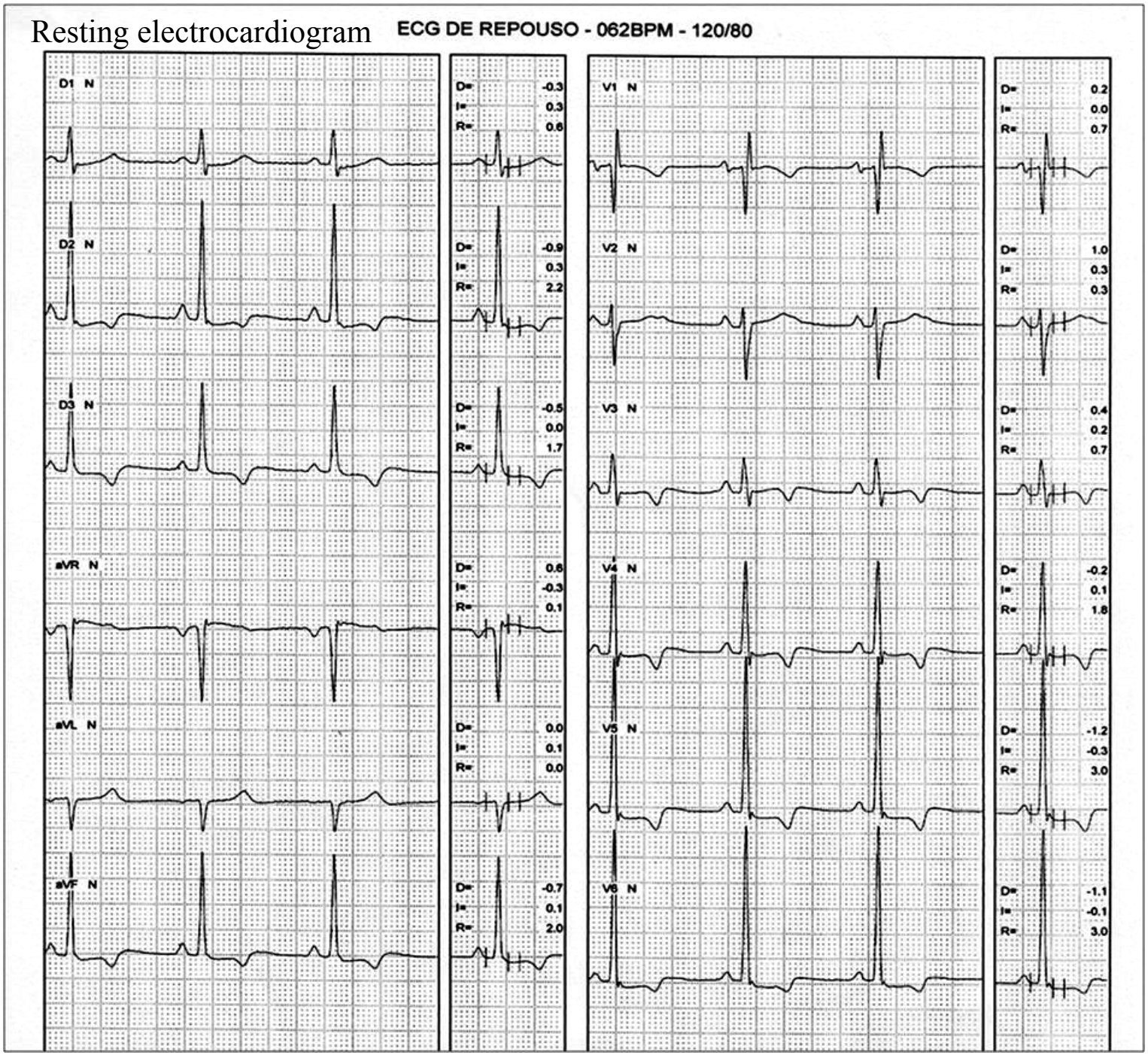
Clinical Discussion

- A F C
- Male patient
- Race: Mulatto
- Height: 175m
- Weight: 69Kg
- 46 years old
- General Assistant – Marathon athlete
- Personal history: Nothing worth mentioning
- Medication: Nothing worth mentioning
- Family history: father – systemic hypertension, AMI 67 years old; mother – DM2

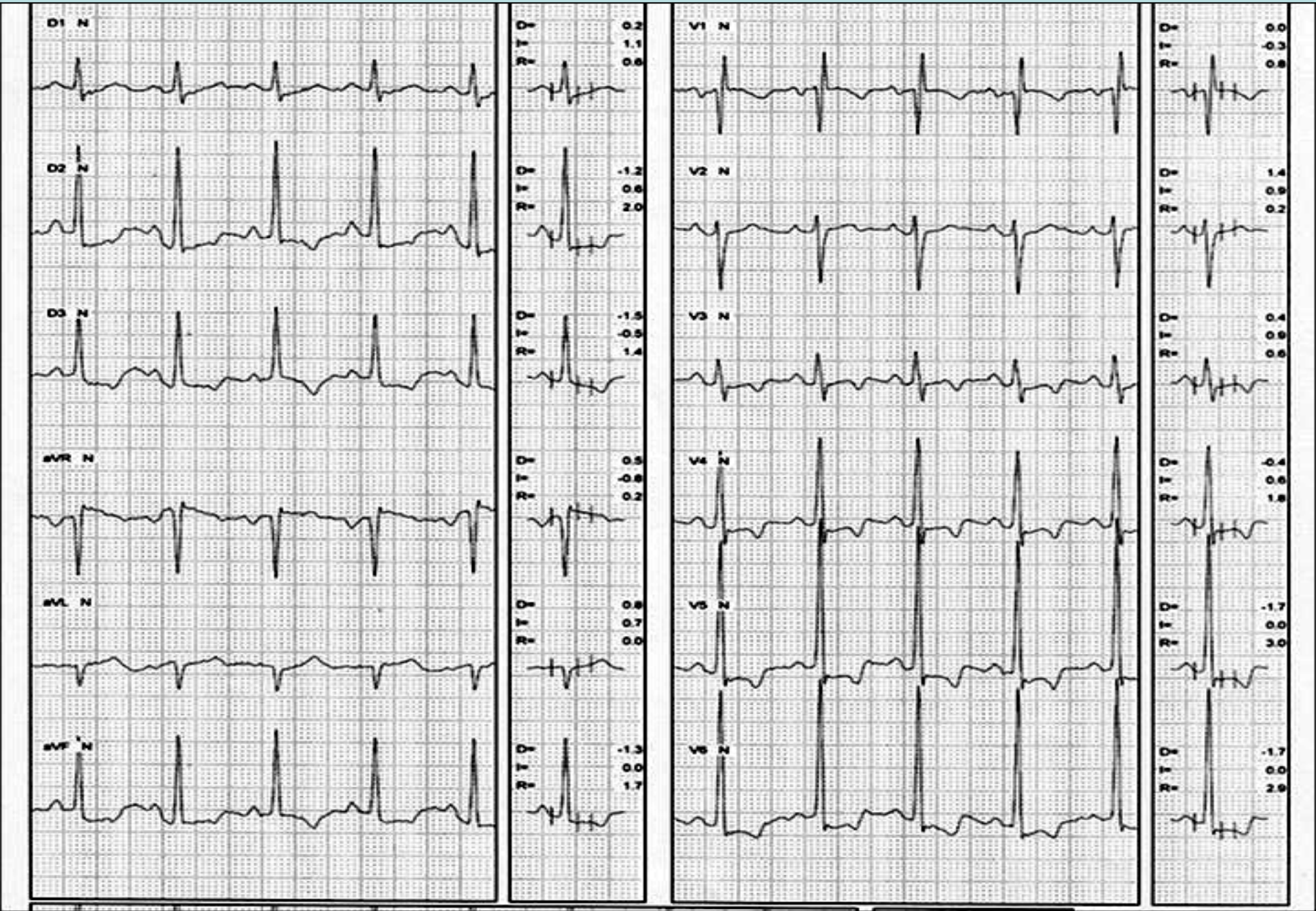
Discussão clínica

- ***A F C***
- ***Masculino***
- ***Raça: mulato***
- ***175m altura***
- ***Peso 69Kg***
- ***46 anos***
- ***Ajudante geral – Maratonista***
- ***AP: NDN***
- ***Medicamentos: NDN***
- ***AF: pai – HAS, IAM 67 anos***
  mãe – DM2

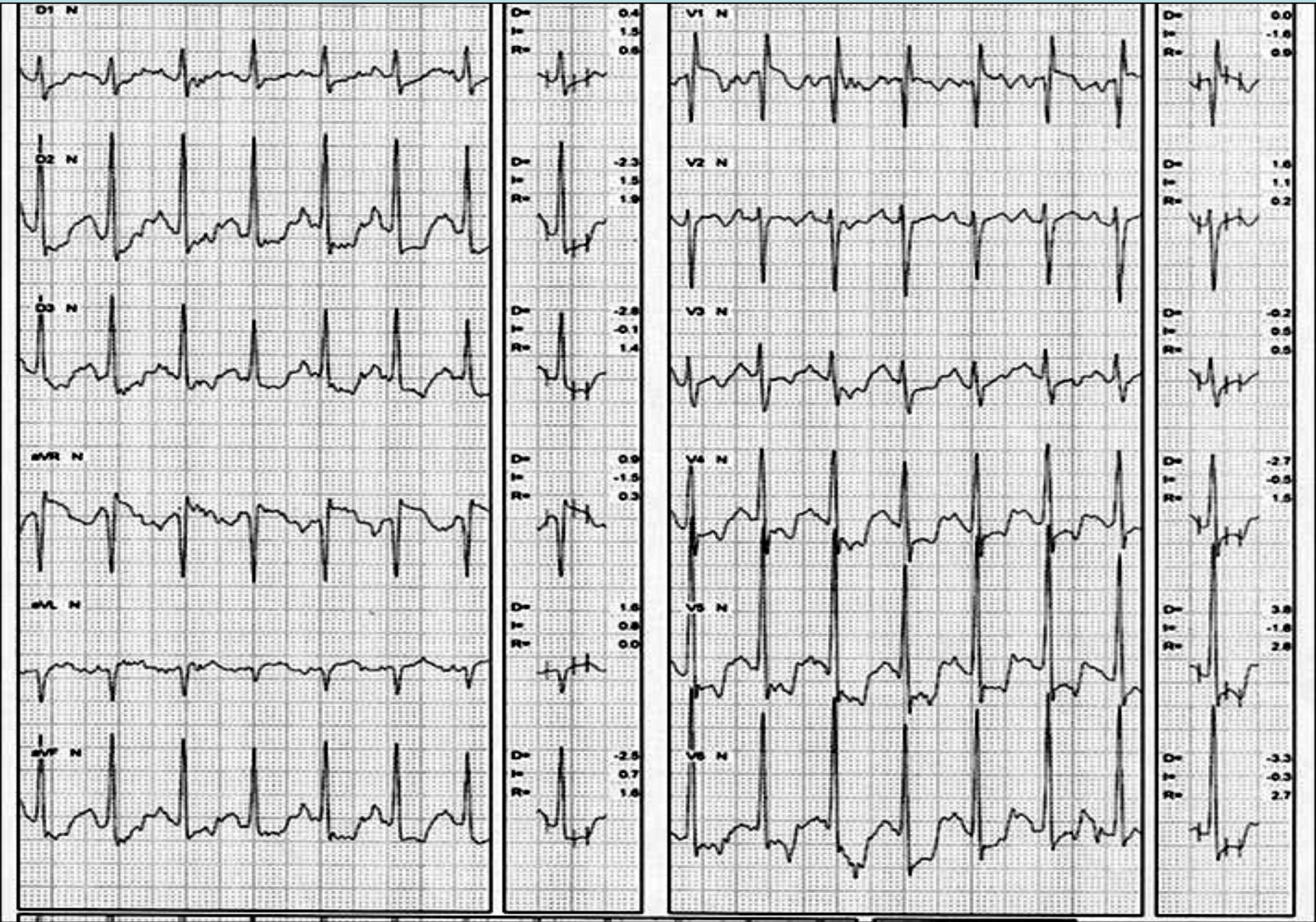
Resting electrocardiogram



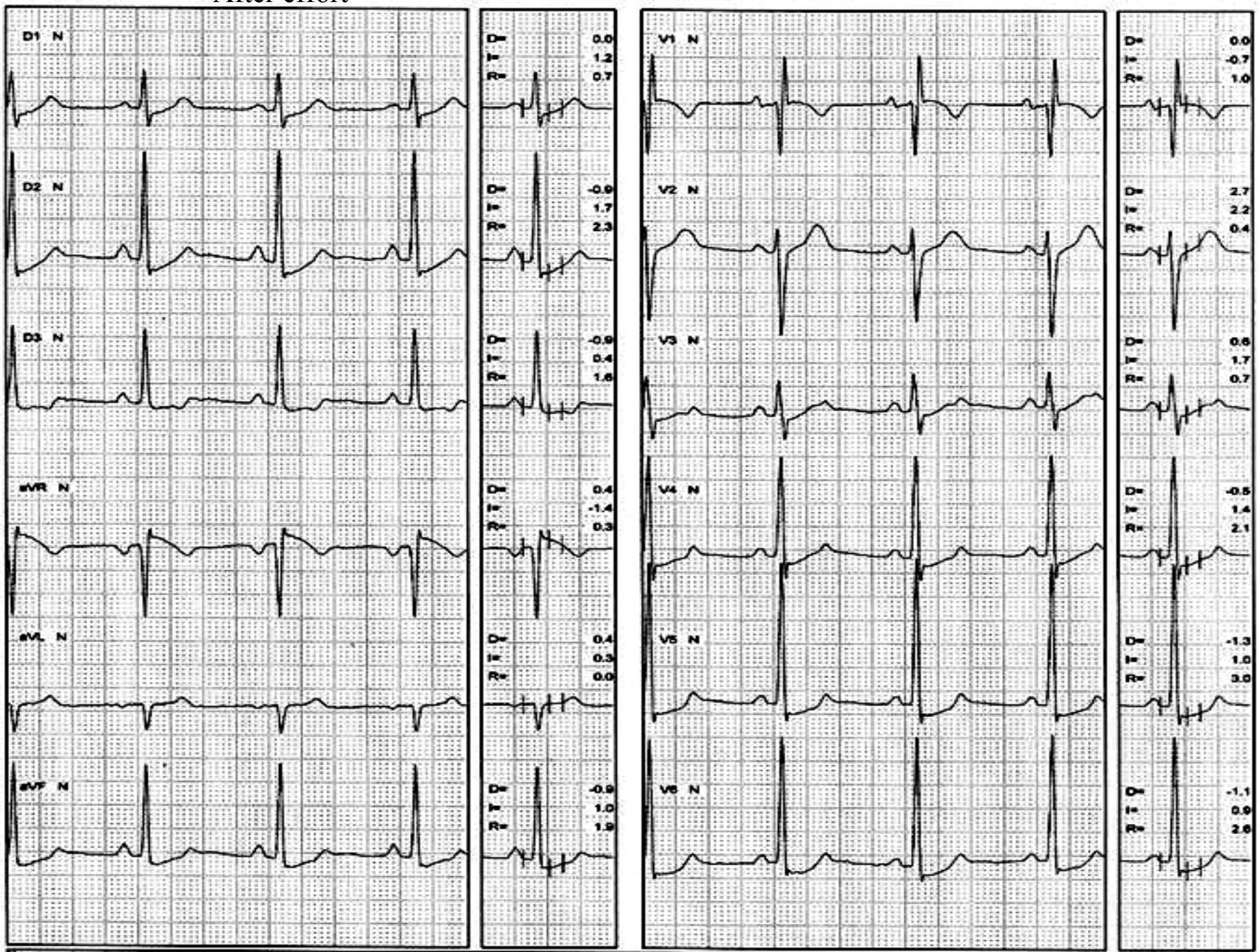
Electrocardiogram during exercise – 3BPMPH-03% 102BPM- 140/80



Electrocardiogram during exercise – 6BPMPH-03% 102BPM- 150/80



After effort



Lab tests

	September 2012
Hemoglobin	15.1
Hematocrit	44.8
Leukocytes	5500
Platelets	95000
Sodium	145
Potassium	4.9
Urea	33
Creatinine	0.90
Uric acid	3.9

Laboratório

	Setembro 2012
Hemoglobina	15,1
Hematócrito	44,8
Leucócitos	5500
Plaquetas	95000
Sódio	145
Potássio	4,9
Uréia	33
Creatinina	0,90
Ácido Úrico	3,9

Lab tests

	September 2012
Total cholesterol	188
HDL	68
LDL	107
Triglycerides	65
Jejunal glycemia	82
Hb1AC	5.2
TSH	1.70
T4L	1.52
CPK	28
CKMB	12
Troponin	Non reagent

Laboratório

	Setembro 2012 /
Colesterol total	***188***
HDL	***68***
LDL	***107***
Triglicérides	***65***
Glicemia jejum	***82***
Hb1AC	***5,2***
TSH	***1,70***
T4L	***1,52***
CPK	***28***
CKMB	***12***
Troponina	***Não reagente***

Echocardiogram

	09/24/2012
Aorta	27
Left atrium	38
Left ventricle – diastolic	49
Left ventricle – systolic	31
Interventricular septum	09
Posterior wall	09
Ejection fraction	66%
Notes	Preserved dimensions, preserved functions, unaltered pericardium, absence of pulmonary HTN

Parâmetros ecocardiográficos

	24/09/2012
Aorta	***27***
Átrio Esquerdo	***38***
Ventrículo Esquerdo diâmetro diastólico –	***49***
Ventrículo Esquerdo – diâmetro sistólico/	***31***
Septo Interventricular/espessura	***09***
Parede Posterior/Espessura	***09***
Fração de Ejeção do Ventrículo esquerdo	***66%***
Comentários	*Dimensões preservadas, funções preservadas, pericárdio sem alterações, ausência HAP*

dr. ghelfond
diagnóstico médico

Medico
Paciente
Proced.
Numero : 02-02-006.817/4 - 24/09/2012
RG / Pasta: .0 Sexo : M Idade : 0 /

EXAME REALIZADO NO HOSPITAL ANCHIETA

ECODOPPLERCARDIOGRAMA

ECOCARDIOMETRIA		Valores normais
Descrição		
Aorta (raiz)		27 mm (20 a 37)
Atrio esquerdo		38 mm (20 a 40)
Ventrículo esquerdo	(Diâmetro diastólico)	49 mm (35 a 55)
	(Diâmetro sistólico)	31 mm (25 a 40)
Septo Interventricular	(Espessura Diastólica)	09 mm (7 a 11)
Parede posterior	(Espessura Diastólica)	09 mm (7 a 11)
Fração de ejeção		0,66

Parâmetros descritivos:
Janela acústica adequada.

- Exame realizado com paciente em ritmo cardíaco regular.
- Câmaras cardíacas e raiz da Aorta com dimensões preservadas.
- Espessura miocárdica normal.
- Função sistólica biventricular preservada.
- Função diastólica do ventrículo esquerdo preservada.
- Valvas cardíacas sem anormalidades morfofuncionais.
- Pericárdio sem alterações.
- Ausência de sinais indiretos de hipertensão arterial pulmonar.

dr. ghelfond
diagnóstico médico

Medico
Paciente
Proced.
Numero : 02-02-006.817/4 - 24/09/2012
RG / Pasta: .0 Sexo : M Idade : 0 /

Test performed at the Anchieta Hospital
Doppler Echo

Echocardiometry

Description		Normal values
Aorta (root)		27 mm (20 to 37)
Left atrium	(diastolic diameter)	38 mm (20 to 40)
Left ventricle	(systolic diameter)	49 mm (35 to 55)
	(diastolic thickness)	31 mm (25 to 40)
Interventricular septum	(diastolic thickness)	09 mm (7 to 11)
Posterior wall		09 mm (7 to 11)
Ejection fraction		0,66 to

Descriptive parameters:
Proper acoustic window

- Test made in a patient in regular heart rate
- Heart chambers and aortic root with preserved dimensions

- Normal myocardial thickness
- Preserved biventricular systolic function
- Preserved left ventricular diastolic function
- Cardiac valves without morphological or functional anomalies
- Unaltered pericardium
- Absence of indirect signs of pulmonary hypertension

Colleagues opinions

Spanish

Estimado Potro:
Previo a analizar sus puntos como me conoce tengo algunos interrogantes
1. Cual fue la indicacion de la prueba ergometrica?
2. Presentando en el ECG basal trastornos del segmento ST y de la onda T, porque al decidir la realizacion de un estudio de apremio no se realizo un estudio de perfusion si deseaban descartar y evaluar isquemia miocardica?
3. Me llama la atencion la plaquetopenia que presenta el paciente, se valoro estudios de coagulacion?
4. Mulato se refiere a raza negra?
En el ECG presentado:
1. En el ECG basal ritmo sinusal con eje electrico normal. Los indices de HVI por el indice de SOKOLOW-LYON es limitrofe y no presenta criterios de CORNELL positivos. Lo que contrasta con las tratosnos de la repolarizacion con infradesnivel del segmento ST en cara anterolateral e inferior y rectificacion del mismo y prolongacion de su duracion con ondas T negativas casi simetricas, no impresionan las T del strain pattern de la HVI. Y presenta supradesnivel del segmento ST en AVR. Lo que lleva a sospechar isquemia miocardica.
2. En la ergometria presenta a baja carga profundizacion de los cambios electrocardiograficos con ST descendente y supra ST en AVR, no refieren si presento angor o equivalentes anginosos. Pero es positiva para isquemia miocardica.
3. Por le que exprese una cinecoronariografia deberia ser realizada, ya que la sospecha es enfermedad coronaria de multiples vasos o TCI. Que no presente angor es posible por el preacondicionamiento por su practica deportiva que elevo el umbral de sus sintomas.
Un saludo querido Potro

Martin Ibarrola

Dear Potro (Nickname of Andrés),

Before analyzing your points, as you know, I have some questions:

1. What was the indication for the ergometer test?
2. Since he presented in baseline ECG ST segment and T wave disorders, why when deciding to perform a provocative test, a perfusion study was not conducted, if what you wanted was to rule out and evaluate myocardial ischemia?
3. The thrombocytopenia the patient presents is odd to me, were there coagulation studies carried out?
4. By mulatto you mean black race?

In the ECG presented:

1. In baseline ECG, sinus rhythm with normal electrical axis. The indices of LVH by the SOKOLOW-LYON index are borderline and he does not present positive CORNELL criteria. This is in contrast to repolarization disorders with ST segment depression in anterolateral and inferior sides, and correction of it and prolongation of duration with almost symmetrical negative T waves; they do not seem to be the Ts of strain pattern of LVH.

And he does present ST segment elevation in aVR. What leads to the suspicion of myocardial ischemia.

2. In the ergometer test he presents at a low load, an enhancement of electrocardiographic changes with descending ST and ST elevation in aVR; there is no mention about whether he presented angor or angina equivalent. But it is positive for myocardial ischemia.
3. Considering what I said, a cineangiography should be carried out, since the suspicion is CAD by multiple vessels or left main coronary artery disease. Him not presenting angor is possible due to the preconditioning by his practice of sports that increased the threshold of his symptoms.

Regards dear Potro,

Martin Ibarrola

Respuestas a las preguntas de Dr Martin/ Answer to Martin´s questions/

Querido Martin paso a responder a sus cuestionamientos:
En este caso no huvo una indicación clínica. Se trata de un atleta, En nuestra institución los atletas son evaluado en forma periódica y forma parte del protocolo de pesquiza en atletas la realización de ergometria. Mas el paciente no tenia quejas.
El estudio de perfusión se ha realizado en un paso adelante
Fue pesquizado y apesar de la plaquetopenia el paciente tenia el tiempo de sangramiento y la retracción del coágulo normales. Fue solicitado interconsulta con hematólogo que no resultó en nada.
Mulato forma parte de los pardos o mestizos. Pardo es un término oficial en Brasil formalmente utilizado para descrivir alguien de origem multirracial. Existen en Brasil aproximadamente 45% de pardos. Mulato es el descendiente de blanco con negro, Los pardos incluyen a los mulatos, mameluco o caboclos(blanco con indio) y y cafuzos. Son hibridos.
Dear Martin,
I will answer your questions.
In this case there was no clear clinical indication. This is an athlete. In our institution, athletes are evaluated periodically, and ergometer test is part of a research protocol in athletes. But the patient had no complaints.
The perfusion study was carried out later.
He was investigated and in spite of the thrombocytopenia, the patient had normal bleeding time and clot retraction tests. Interconsultation was requested with an hematologist, which led to nothing.
A mulatto is part of “pardos” or mixed races with black people. “Pardo” is an official term in Brazil, formally used to describe someone with a multiracial origin. In Brazil there is approximately 45% of “pardos”. A mulatto descends from white and black people. “Pardos” include mulattos, “mamelucos,” “caboclos” (white and native people) and “cafuzos”. They are hybrid
Andrés Ricardo Pérez-Riera “Potro”

Spanish

Estimado Prof : Pérez Riera :
Atleta de alta competencia de 46 años con evidencias de HVI en el ECG y cambios del ST durante el ejercicio :
Me parece una prueba de esfuerzo con cambios con baja probabilidad Bayesiana de isquemia , dado la presencia de HVI en el ECG de base y no hay reporte de isquemia sintomática ni modificadores de la prueba de esfuerzo (caida de la presión arterial o signos de bajo gasto durante la prueba) .... no los veo reportados
Igualmente los grosores de cámara en el Eco no son tan marcados y tiene excelente FE
No creo que tenga lesiones coronarias y no le pediría cath lab ..
Mauricio Rondón MD
Cardiología
Sección de Electrofisiología y Marcapasos
Hospital Universitario de Caracas / Venezuela

Dear Prof. Perez Riera,
High-competition athlete, 46 years old, with evidence of LVH in ECG and ST changes during exercise.
It seems to me a stress test with changes with low Bayesian probability of ischemia, given the presence of LVH in the baseline ECG and not being a report of symptomatic ischemia or modifiers in the stress test (drop of blood pressure or signs of low output during the test)… I do not see them reported.
Likewise, the chamber thickness in Echo is not so remarkable and there is excellent EF.
I don't think he has coronary lesions and I would not request a cath lab test.
Mauricio Rondón MD
Cardiología
Sección de Electrofisiología y Marcapasos Hospital Universitario de Caracas / Venezuela

Respuesta al Dr Rondón/ Answer to Dr. Rondon

Estimado Rondon. Muchas gracias por si valiosa opinión.
Usted concluye que no le haria cinecoronariografia.
Le pregunto: le diria esta todo bien puede ir tranquilo para casa y continue ejercitandose, o le solicitaria algun otro examen no invasivo de mayor sensibilidad? Tipo cintilografia O talvez una tomo coronária computadorizada? No lê preocupa la elevacion del segmento ST en aVR?
Gracias nuevamente
Andres

Dear Rondon,
Thank you very much for you valuable opinion.
You conclude that you would not perform cineangiography.
Let me ask you: would you say to him, you can rest assured that everything is right and go home, and continue practicing sports, or would you request any other noninvasive test with a greater sensibility? A scintillography? Or maybe a coronary CAT? Are you not worried about the ST segment in aVR?
Thanks again,
Andres

Baseline ECG shows a pattern of LVH and ST/T wave abnormalities which may be seen in elite athletes. In a follow up study by Barry Marron it was found that a small proportion of patients with these abnormalities may evolve into a clinical picture of hypertrophic cardiomyopathy. Reassuring is the normal Echo.
The Exercise test is clearly abnormal and while this might be a false positive result,coronary angiography is indicated to rule anomalous coronary origin or coronary artery disease.
El ECG basal muestra un patrón SVI con anomalías de ST / T que se pueden ver en los atletas de élite. En un estudio de seguimiento realizado por Barry Marron se encontró que una pequeña proporción de pacientes con estas alteraciones electrocardiográficas puede convertirse en una miocardiopatía hipertrófica. Tranquiliza el eco normal.
La prueba de esfuerzo es claramente anormal y si bien esto puede ser un resultado falso positivo, la angiografía coronaria está indicada para descartar origen anómalo de coronaria o enfermedad arterial coronaria.

Melvin M Scheinman, Professor of Medicine Department of Cardiac Electrophysiology, University of California San Francisco, San Francisco, California, USA. Address:
UCSF Electrophysiology Service 500 Parnassus AvenueSan Francisco, CA 94143-1354Telephone/FAX/E-mail: Phone: (415) 476-5706Fax: (415) 476-6260 email:
scheinman@medicine.ucsf.edu

Spanish:

El ECG basal muestra un patrón de SVI con anomalías de ST /T que se puede ver en los atletas de élite. En un estudio de seguimiento realizado por Barry Maron se encontró que una pequeña proporción de pacientes con estas alteraciones electrocardiográficas puede convertirse en una miocardiopatía hipertrófica. Tranquiliza el eco normal.

La prueba de esfuerzo es claramente anormal y si bien esto puede ser un resultado falso positivo, la angiografía coronaria está indicada para descartar origen anómalo de coronaria o enfermedad arterial coronaria.

Prof. Riera Esperava pelo ECG uma Miocardiopatia hipertrófica, que foi afastada pelo ECO. O Teste ergométrico é claramente isquêmico e com sinais de isquemia grave no 2º estágio(ST infra de 5mV de V4-V6 e **supra em aVR**

Deficit cronotrópico: 102 mantido - Inotropismo normal PA= 150x80. .Indico cateterismo coronário.

Adail

Respostas - Answers - Respuestas:

1. Sobrecarga Ventricular Esquerda com ST tipo strain, mas pode ser considerado um padrão de ECG de atleta - Left Ventricular Hypertrophy or Athlete pattern - Sobrecarga de Ventrículo Izquierdo ou patrón atletico

2. Teste ergométrico positivo sinalizando grave lesão de tronco, da descendente anterior ou triarterial: aVR com supra > 2 mV mV -

Positive Stress test with signals of acute lesion of Left Main coronary artery, left anterior descending or Triple arteries lesion: -aVR with ST segment elevation > than 2 mm

Prueba de esforzo positiva com señales de pseudo daño del tronco principal izquierdo o de la arteria descendiente anterior ou multiples lesiones de las coronarias

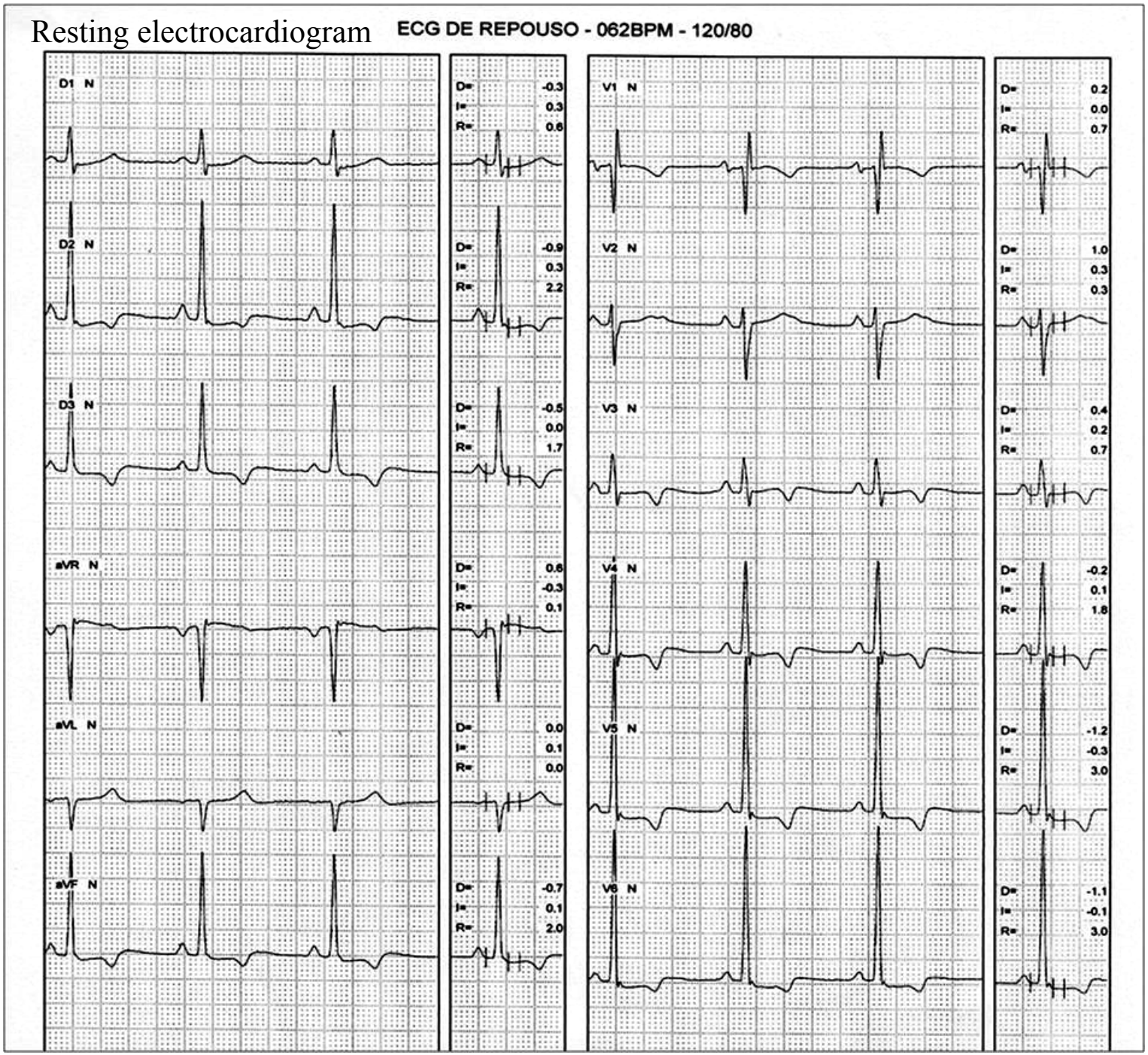
3. Conducta; Cateterismo cardíaco - Cath lab - Cateterización cardíaca

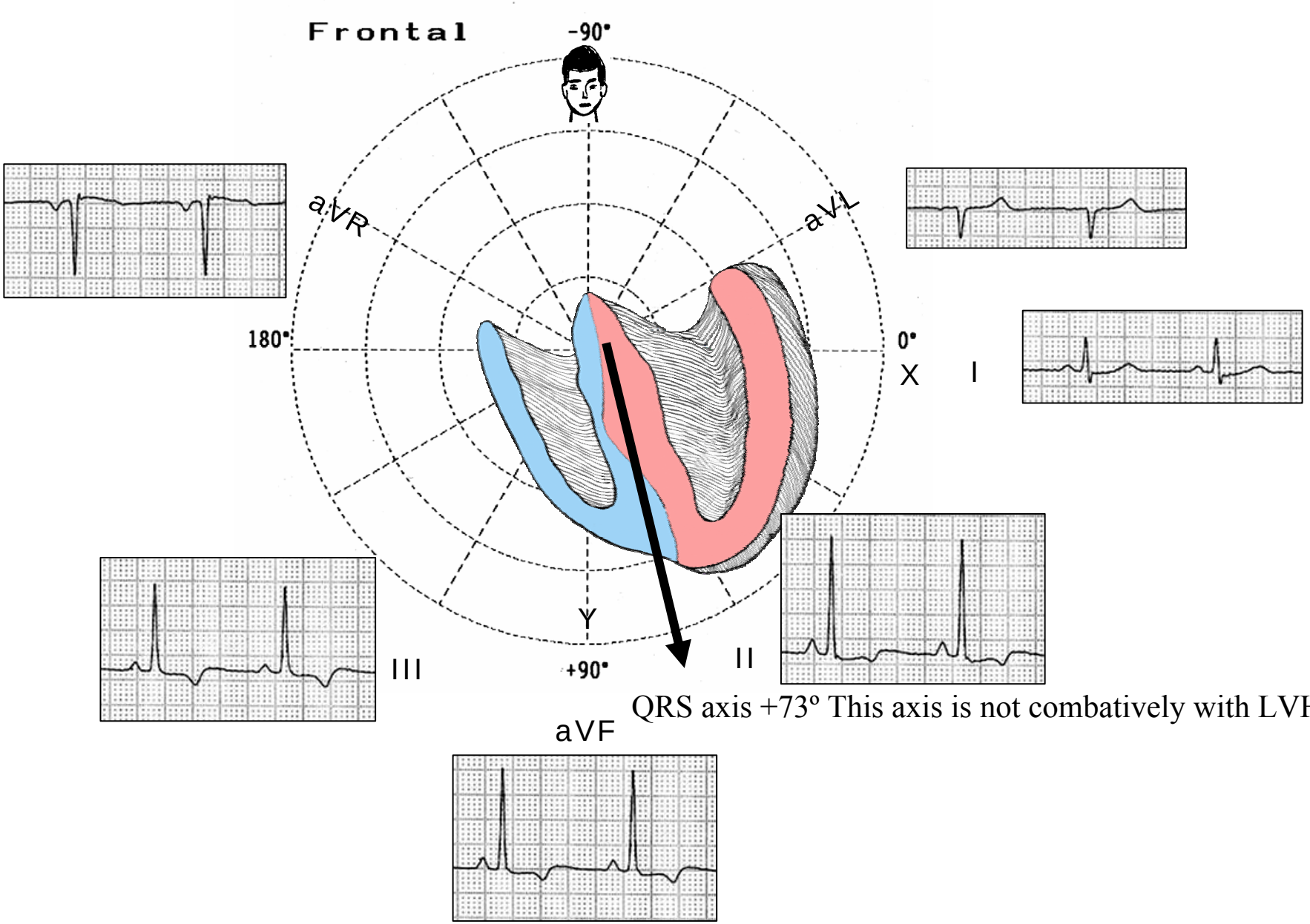
Adail - Bahia – Brasil

Final comments

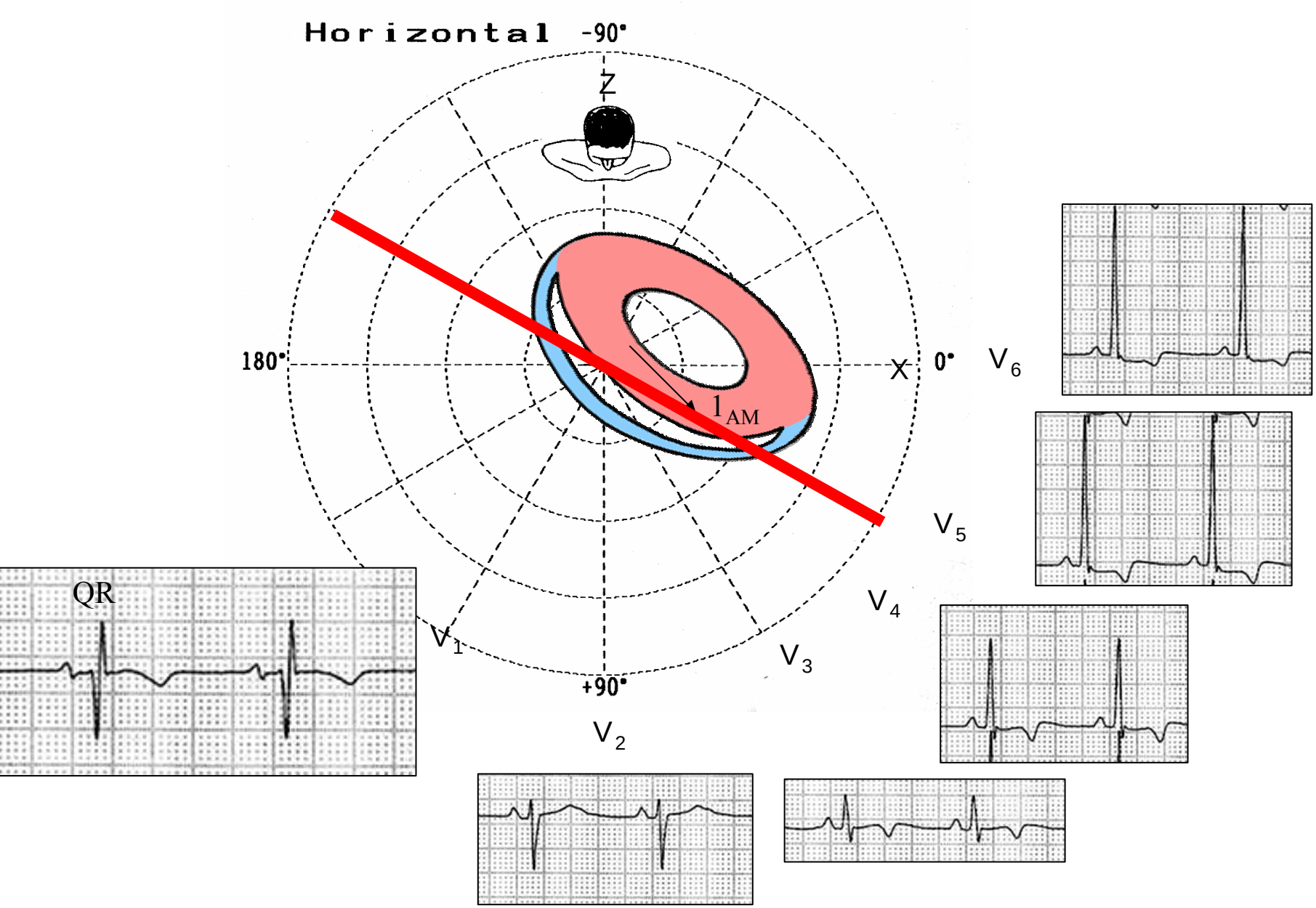
By Andrés Ricardo Pérez-Riera M.D.Ph.D.
riera@uol.com.br
Institution: Faculdade de Medicina do ABC Fundação do ABC. Santo André, São Paulo, Brazil.

Resting electrocardiogram





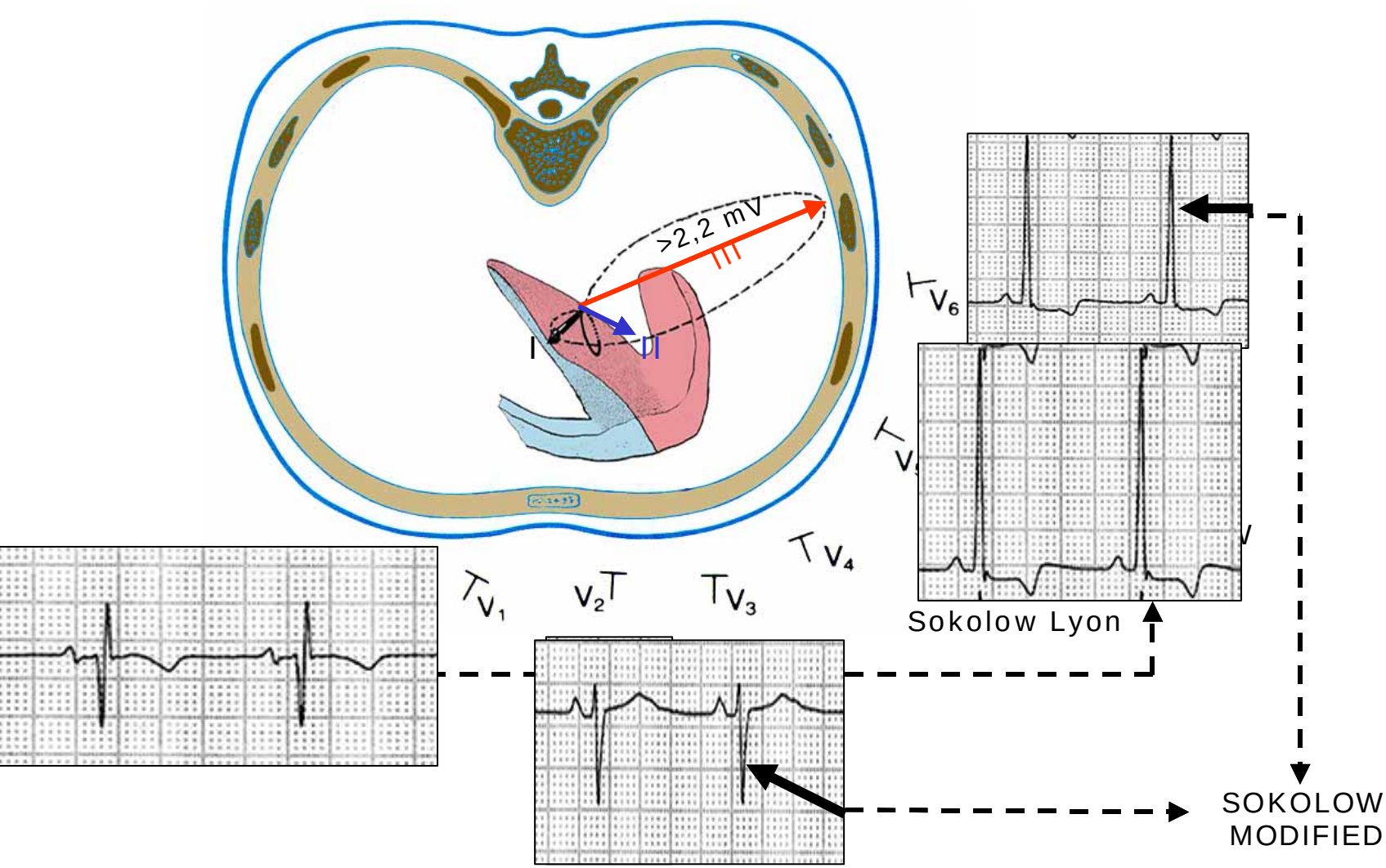
QRS axis +73º This axis is not combatively with LVH



First depolarization vector 1_{AM} is located in negative hemifield of V1: QR pattern

SOKOLOW INDEX & MODIFIED FOR LVH

S of V_2 + R of V_5 or $V_6 \geq 35$ mm is indicative of LVE



Positive Sokolow Lyon voltage criteria for LVH: S wave V2=10mm+ R wave V5= 29mm = 39mm

POINT SCORE SYSTEM FOR LVE/LVH OR ROMHILT-ESTES SCORE (1968)

The authors attribute values from 1 to 3 points to the different existing criteria, 5 or more points: certain LVE; 4 points: probable LVE/LVH.

ECG finding	Scoring
Voltage criteria Voltage Criteria (any of): R or S wave in limb leads ≥20 mm S wave in V1 or V2 ≥30 mm R wave in V5 or V6 ≥30 mm	3 points
ST-T vector opposite to QRS without digitalis ST-T vector opposite to QRS without digitalis	3 points 1 point
Left atrial abnormality terminal negativity of the P wave in V1 >1mm in deep with a duration of ≥0.042	3 points
Left axis deviation ≥30º	2 points
QRS duration > 90 ms	1 point
Delayed intrinsicoid deflection in V5 or V6 (>0.05 sec) or ventricular activation time in V5 and V6 ≥50ms	1point

In this case 6 points R wave in V5 or V6 ≥30 mm + ST-T vector opposite to QRS without digitalis: Positive Score system for LVH/LVE

1. **Romhilt DW, Estes EH Jr. A point-score system for the ECG diagnosis of left ventricular hypertrophy. Am Heart J. 1968; 75:752-758.**

PERUGIA SCORE SYSTEM FOR LVE/LVH(1)

- The Perugia score[1] carried the highest population-attributable risk for cardiovascular morbidity and mortality compared with classic methods for detection of LVH. Traditional interpretation of standard electrocardiography maintains an important role for cardiovascular risk stratification in essential hypertension. ECG-LVH.
- Perugia Score requires positivity of one or more of the following criteria:
  - SV3+ RaVL >2.4mV (men) or >2.0mV (women);
  - Left ventricular strain pattern
  - Romhil-Estes score of ≥ 5 points.

- The Perugia score has a low sensitivity. They showed that the prevalence of LVH in the hypertensive population is highest using the Perugia score, followed by the Sokolow-Lyon Voltage criteria.
- When compared with traditional criteria for ECG diagnosis of LVH, the Perugia score showed the highest sensitivity (34%) at the expense of a slight decrease in specificity (93%), whereas, for example, the Cornell voltage yielded a sensitivity of 16% and a specificity of 97%.

- In this case Perugia score is positive for LVH

1) Verdecchia P, et al. Prognostic value of a new electrocardiographic method for diagnosis of left ventricular hypertrophy in essential hypertension. J Am Coll Cardiol. 1998; 31:383-390.

Score system of Perugia for LVE.

CORNELL LIMB LEAD CRITERION, CORNELL INDEX[1] (CI)* OR CASALE CRITERION FOR LVH/LVE

CI = R aVL + SV3: >28 mm (>2.8 mV)in men or > 20 mm(>2.0 mV) in women suggests LVE/LVH.
Gender-specific Cornell voltage (SV3 + RaVL >2.8 mV male and >2.0 mV (female)
The criterion has high sensitivity and specificity for LVH, is the best ECG criterion to evaluate LVH.

Cornell limb lead criterion is negative in this case

CORNELL PRODUCT[2;3] (CorP.)*CORNELL VOLTAGE-DURATION PRODUCT

It is the product of Cornell QRS voltage and QRS duration (QRS voltage-duration product) Cornell voltage-duration product (RaVL + SV3 with 6 mm added in women x QRS duration. Values ≥ 2440 mm/ms are diagnostic of LVH (Positive criteria of LVH CP≥2440 mm x ms).
The Cornell product is a useful ECG marker, reflecting not only left ventricular mass but also LV geometry and diastolic function in Japanese hypertensive patients[4].
Reduction in Cor P ECG LVH during antihypertensive therapy is associated with fewer hospitalizations for HF, independent of blood pressure lowering, treatment method, and other risk factors for HF[5].

Cornell product is negative in this case.

1) Casale PN, et al. Electrocardiographic detection of left ventricular hypertrophy: development and prospective validation of improved criteria. J Am Coll Cardiol. 1985; 6: 572–580.
2) Molloy TJ, Okin PM, Devereux RB, et al. Electrocardiographic detection of left ventricular hypertrophy by the simple QRS voltage-duration product. *J Am Coll Cardiol*. 1992;20(5):1180-1186.
3) Okin PM, et al. Electrocardiographic identification of increased left ventricular mass by simple voltage-duration products. J Am Coll Cardiol. 1995; 25: 417–423.
4) Shirai T, et al.Evaluation of hypertensive cardiac abnormalities using the Cornell product.Circ J. 2007;71:731-735.
5) Okin PM, Devereux RB, Harris KE, Jern S, Kjeldsen SE, Julius S, Edelman JM, Dahlöf B; LIFE Study Investigators. Regression of electrocardiographic left ventricular hypertrophy is associated with less hospitalization for heart failure in hypertensive patients. Ann Intern Med. 2007 Sep 4;147(5):311-319.

Cornell/strain index

The Cornell/strain [C/S] index, a simple electrocardiographic (ECG) index for left ventricular hypertrophy (LVH) defined by the presence of either a classic strain pattern or a Cornell voltage (sum of R in aVL + S in V(3)) >2.0 mV in women or 2.4 mV in men, or both.
After adjustment for age, sex, smoking, and other counfounders, the C/S index identified subjects with hypertension at increased risk of events (relative risk 1.76; 95% confidence interval 1.32-2.33). The C/S index achieved the highest population-attributable risk (16.1%) for cardiovascular events in hypertensive patients.

Cornell strain index is positive in this case.

1. **Verdecchia P, Angeli F, Reboldi G, et al.. Improved cardiovascular risk stratification by a simple ECG index in hypertension. Am J Hypertens. 2003 Aug;16:646-652.**

FRAMINGHAM CRITERION(1)

Coexistence of a definite strain pattern and at least one of the following voltage criteria:

1. Sum of the amplitudes of the R wave on lead I and the S wave on lead III ≥2.5 mV
2. Sum of the amplitudes of the S wave on lead V1 or V2 and the R wave on lead V5 or V6 ≥3.5 mV,
3. The S wave on the right precordial lead ≥2.5 mV and the R wave on the left precordial lead ≥2.5 mV

COMBINATING CRITERIA OF LV HYPERTROPHY

- The combination of Cornell (RaVL+SV3>2.8 mV in men and>2.0 mV in women) with Lewis (RI+SIII-RIII-SI>1.7 mV) and Gubner-Ungerleider (RI+SIII>2.5 mV) indices displayed the highest net sensitivity (80.0% and 76.7%, respectively) while retaining excellent specificity (88.9% and 91.6%, respectively).
- The combination of the Cornell and the Lewis or Gubner voltage criteria showed the greatest net sensitivity and specificity for the LVH diagnosis of HCM in a cardiovascular examination conducted in young people.

1. **D Levy, SB Labib, KM Anderson, JC Christiansen, WB Kannel, WP Castelli Determinants of sensitivity and specificity of electrocardiographic criteria for left ventricular hypertrophy Circulation, 81 (1990), pp. 815–820**
2. **Erice B, et al. Diagnosis value of different voltage criteria diagnosis for hypertrophy cardiomyopathy. Scand J Med Sci Sports. 2009;19:356-363.**

Common electrocardiographic criteria for the diagnosis of left ventricular hypertrophy (LVH)
Cornell voltage criteria SV3 + RaVL ≥ 2.0 mV (28 mm) in men SV3 + RaVL ≥ 2.8 mV (20 mm) in women (some variations use a lower cutoff value in men)
Cornell product criteria SV3 + RaVL (+8 in women **A**) × QRS duration ≥ 2,440 mm × ms
Sokolow-Lyon voltage criteria SV1 + RV5 or RV6 ≥ 3.5 mV (35 mm) B orRaVL ≥ 1.1 mV (11 mm)
Romhilt-Estes point score system (a score ≥ 5 is diagnostic of LVH, a score of 4 is "probable" LVH)Voltage criteria (3 points): Any S or R in limb leads ≥ 20 mm SV1, SV2, RV5, or RV6 ≥ 30 mm ST-T wave changes of LVH (3 points, 1 point on digitalis)Left atrial abnormality (3 points): Terminal component of the P wave in V1 ≥ 1 mm and ≥ 40 ms Left axis deviation (2 points): QRS axis of −30 degrees or more negative Prolonged QRS duration (1 point): ≥ 90 ms Delayed intrinsicoid deflection time (1 point): ≥ 50 ms in V5 or V6

A A modification of +6 instead of +8 in women may be more accurate and was used in the Losartan Intervention for Endpoint Reduction in Hypertension (LIFE) study(1)

B A cutoff value of 38 mm has also been used, eg, in the LIFE study

1. **Okin PM, Devereux RB, Jern S,** et al.**Regression of Electrocardiographic Left Ventricular Hypertrophy During Antihypertensive Treatment and the Prediction of Major Cardiovascular Events JAMA. 2004 Nov 17;292:2343-2349.**

A systematic review of 21 studies,(**1)** published in 2007, found that all the criteria were less sensitive than specific:
Of note, the ranges of the published values were extremely broad. For example, the ranges in sensitivity were:
Cornell voltage—median sensitivity 15%, median specificity 96%

Cornell product—median sensitivity 19.5%, median specificity 91%

Sokolow-Lyon voltage—median sensitivity 21%, median specificity 89%

Romhilt-Estes point score—median sensitivity 17%, median specificity 95%.

The ranges in sensitivity were:
Cornell voltage—2% to 41%

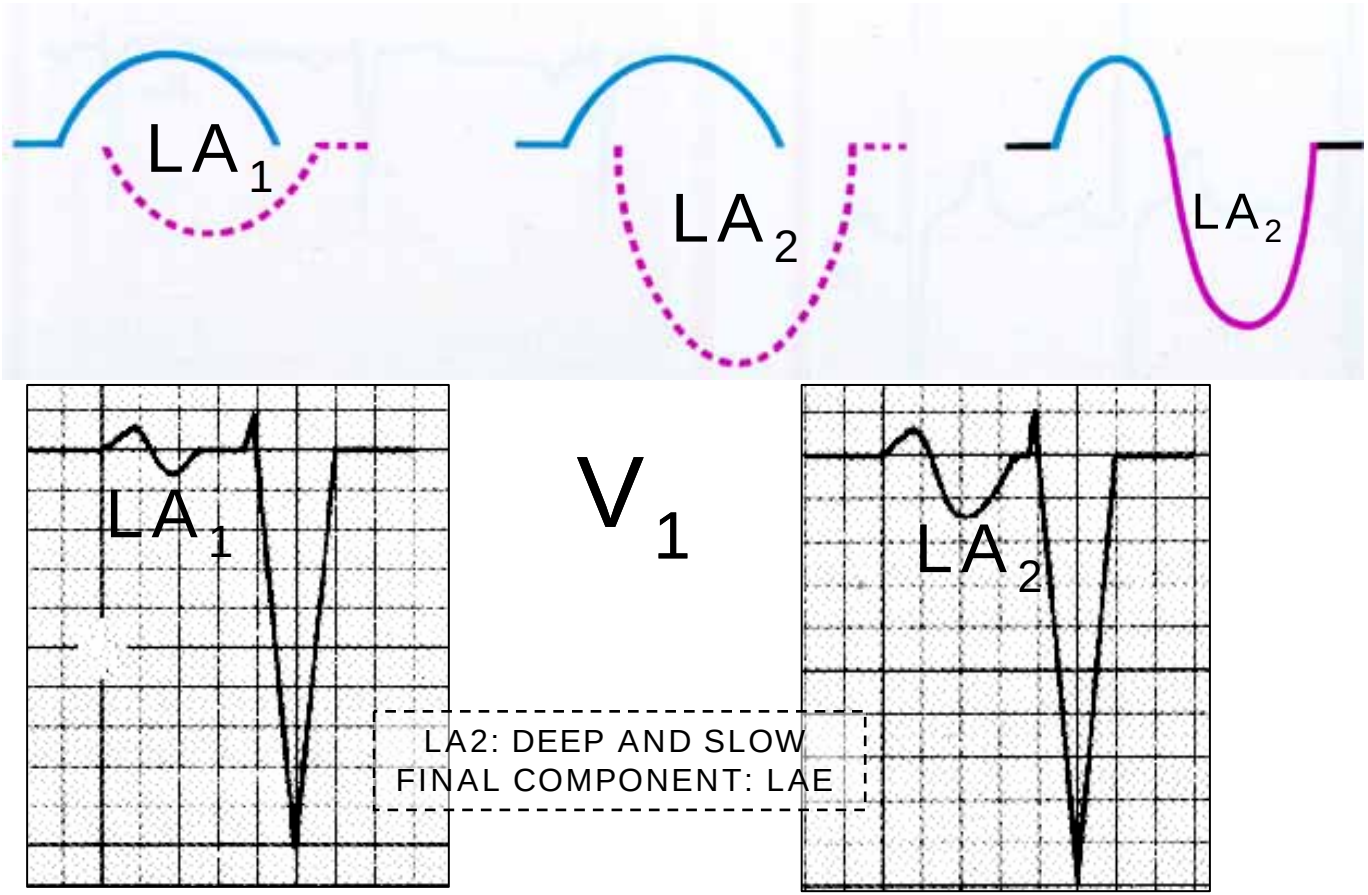
Cornell product—8% to 32%

Sokolow-Lyon voltage—4% to 51%

Romhilt-Estes point score—0% to 41%.

1. **Pewsner D, Jüni P, Egger M, Battaglia M, Sundström J, Bachmann LM. Accuracy of electrocardiography in diagnosis of left ventricular hypertrophy in arterial hypertension: systematic review. BMJ. 2007 Oct 6;335(7622):711.**

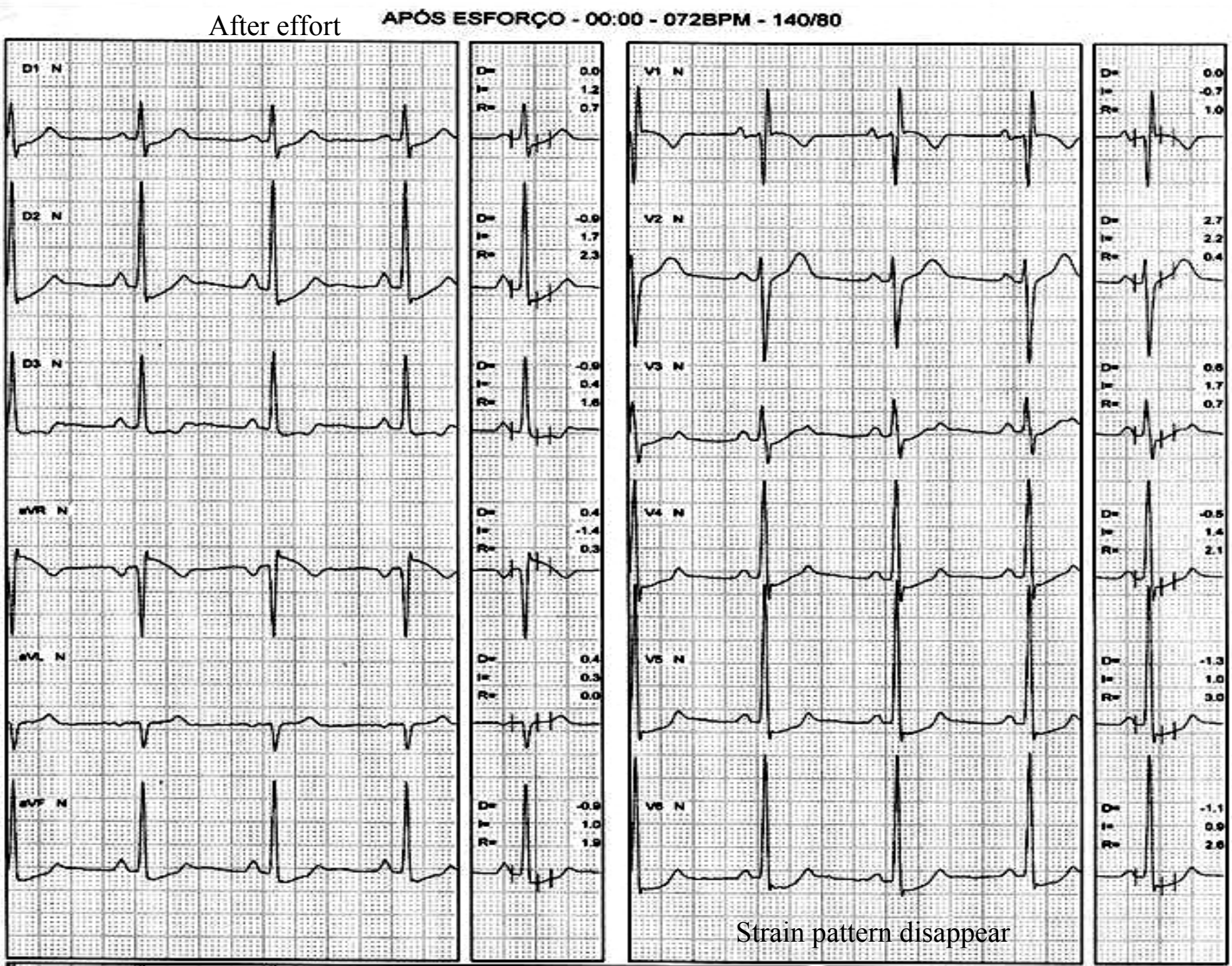
INDIRECT MORRIS CRITERIA FOR LVE/LVH

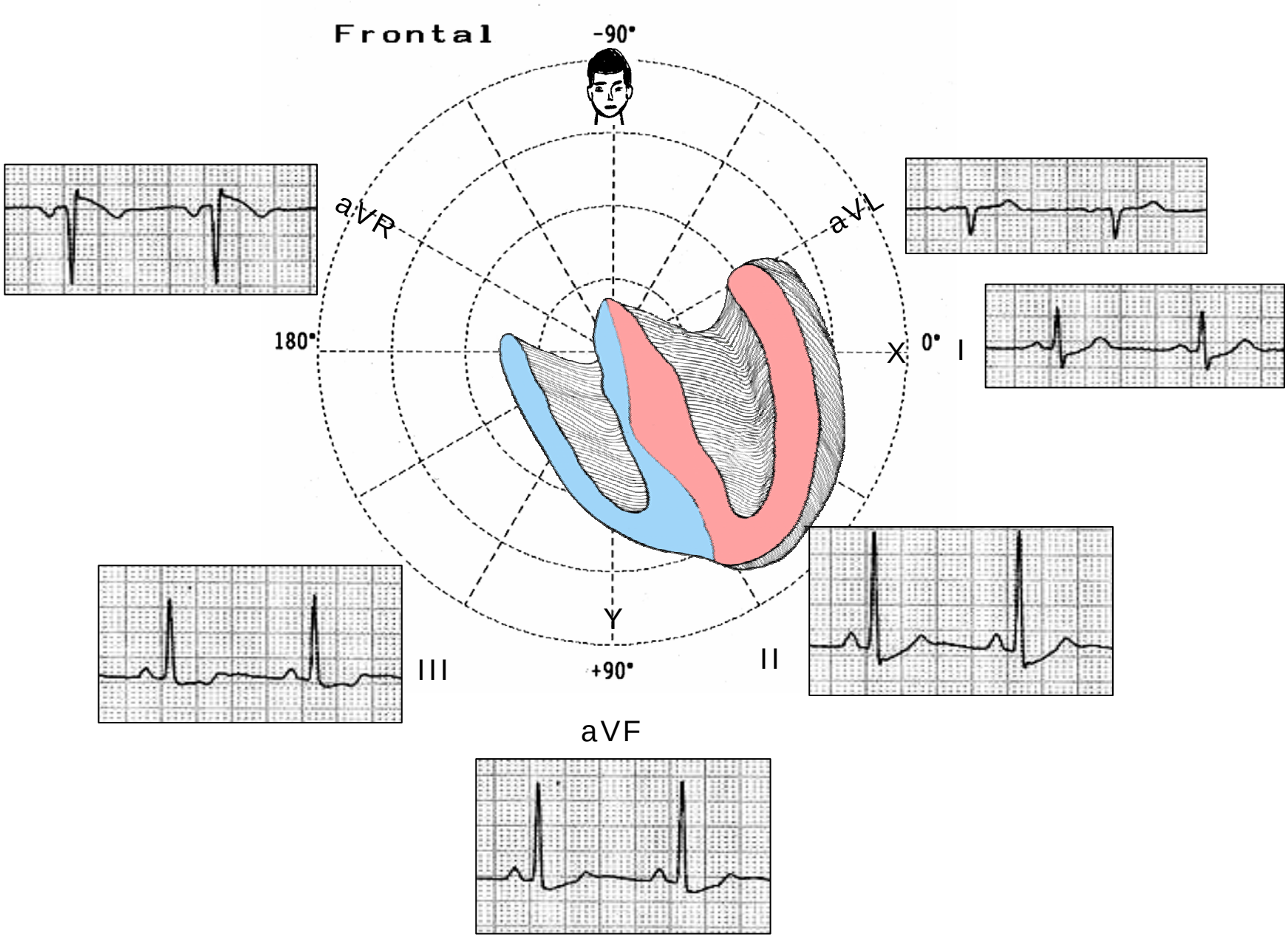


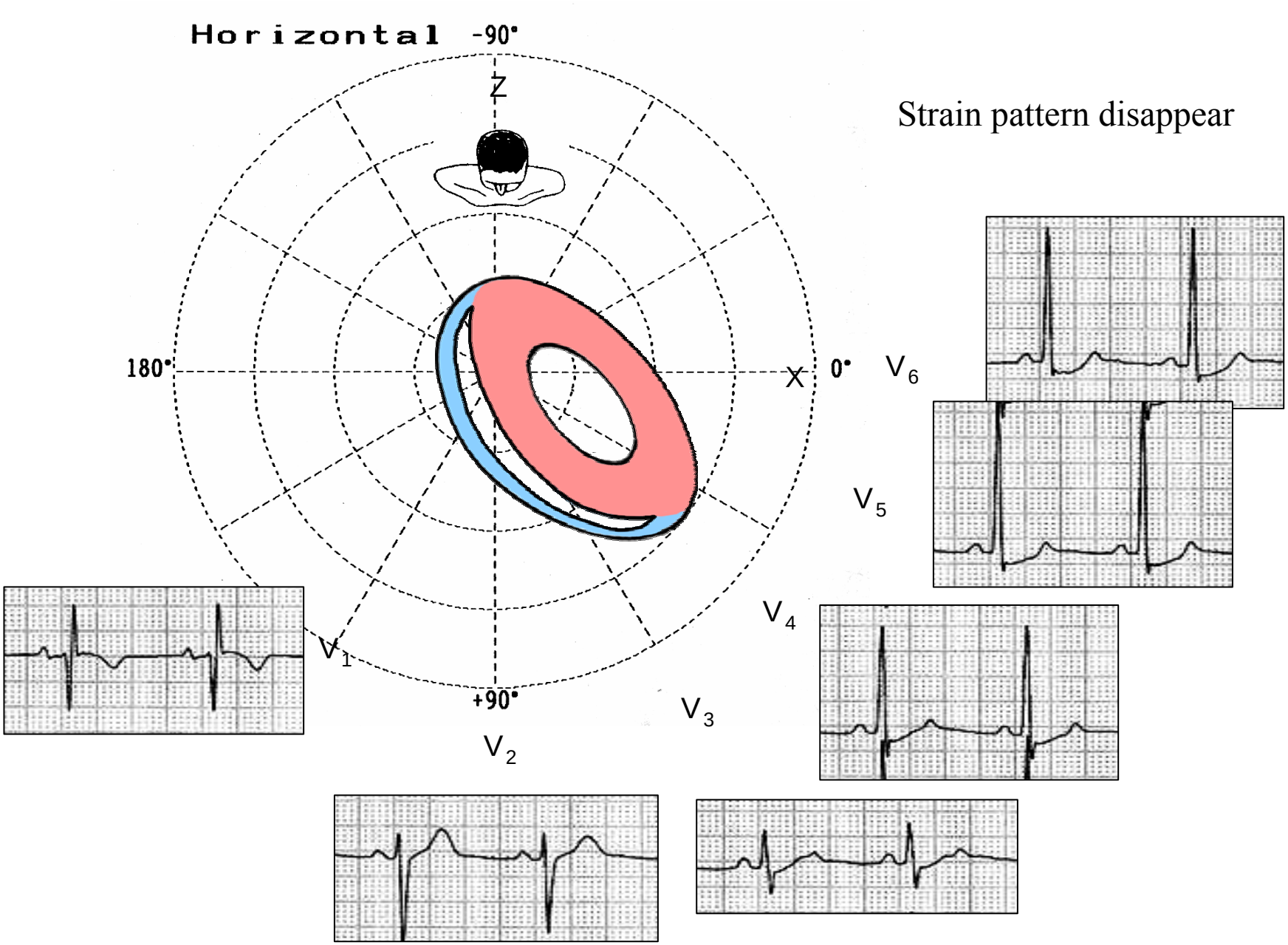
Amplitude in seconds x depth in mm. Values above 0.03 mm x second indicate a positive criterion, which is considered of high value for LVE diagnosis. (Value of 3 points in Romhilt criteria.)

Morris criterion is negative in this case

Indirect criteria for Morris sign for LVE.

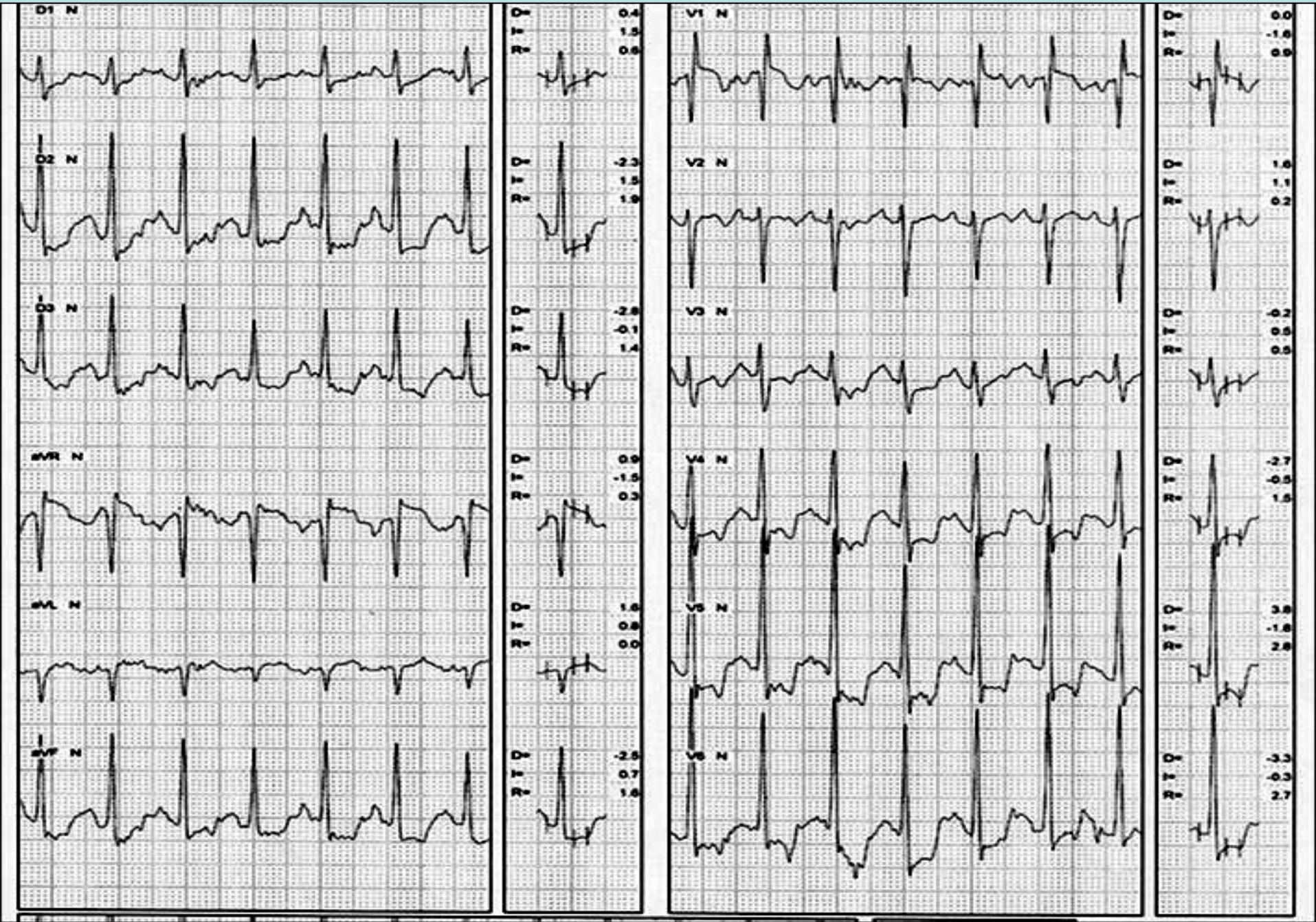

After effort
APÓS ESFORÇO - 00:00 - 072BPM - 140/80
D1 N
D2 N
D3 N
aVR N
aVL N
aVF N
V1 N
V2 N
V3 N
V4 N
V5 N
V6 N
Strain pattern disappear


Frontal
-90°
aVR
aVL
180°
0°
I
X
Y
+90°
III
II
aVF



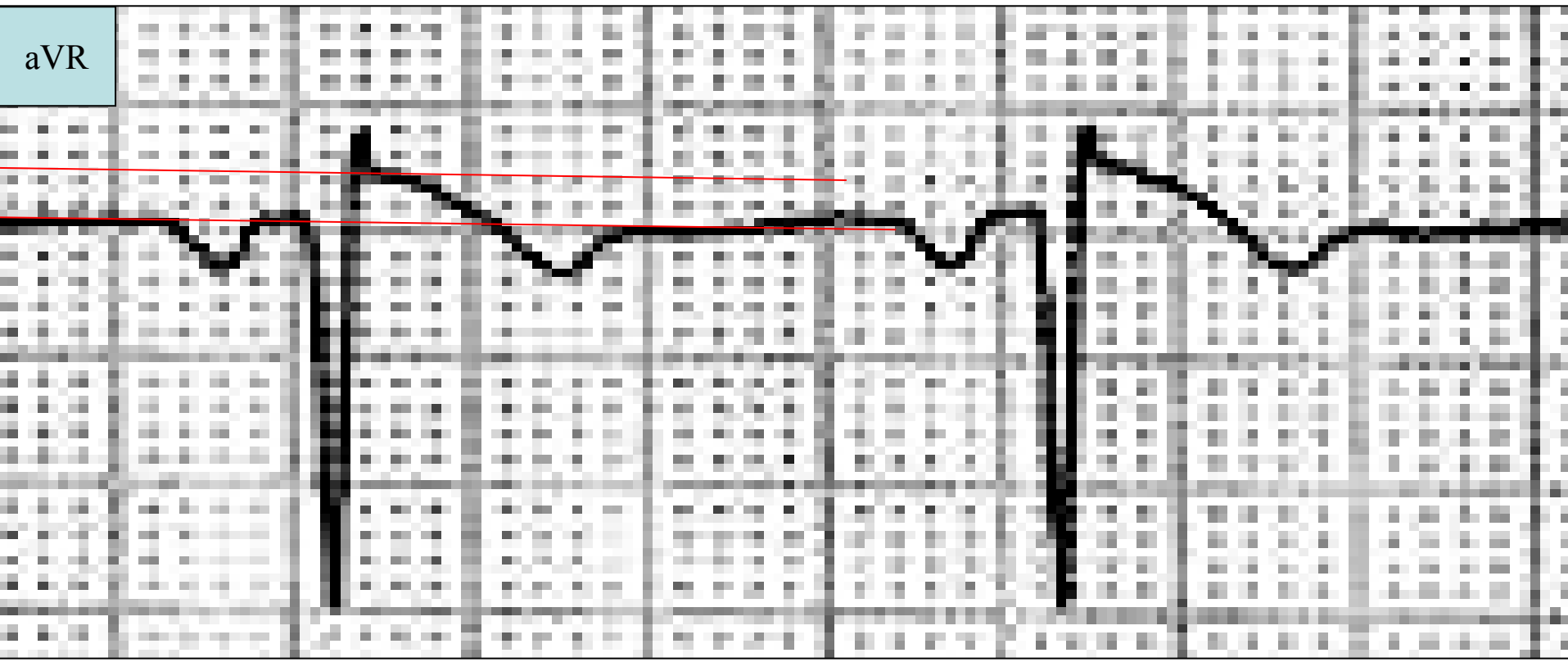
Strain pattern disappear

Electrocardiogram during exercise – 6BPMPH-03% 102BPM- 150/80



The cause of SCD in the vast majority of master athletes is coronary artery disease (CAD), which based on available postmortem data usually consist of severe(>75%) narrowing of the cross sectional area by atherosclerotic plaque in one o more of the major extramural coronary arteries.

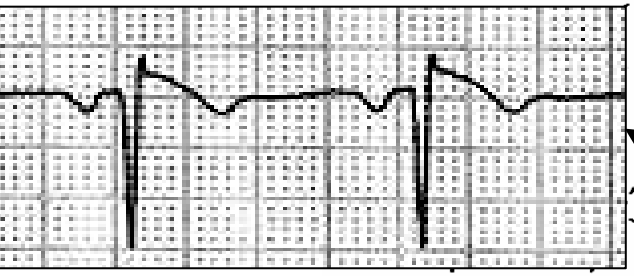
The finding of false positive ST segment depression in elderly athletes, although still not fully understood, may be related to the physiological cardiac remodeling induced by regular training. Thus athletes with exercise induced ST segment depression, with no associated symptoms and/or complex ventricular arrhythmias, and no adverse findings at second level cardiological testing, should be considered free from CAD and safe to continue athletic training.(1) However the present case is different because is very clear the ST segment elevation in aVR.

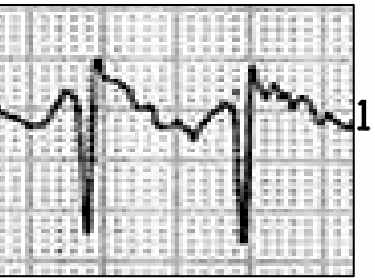


The ST injury vector pointing to aVR

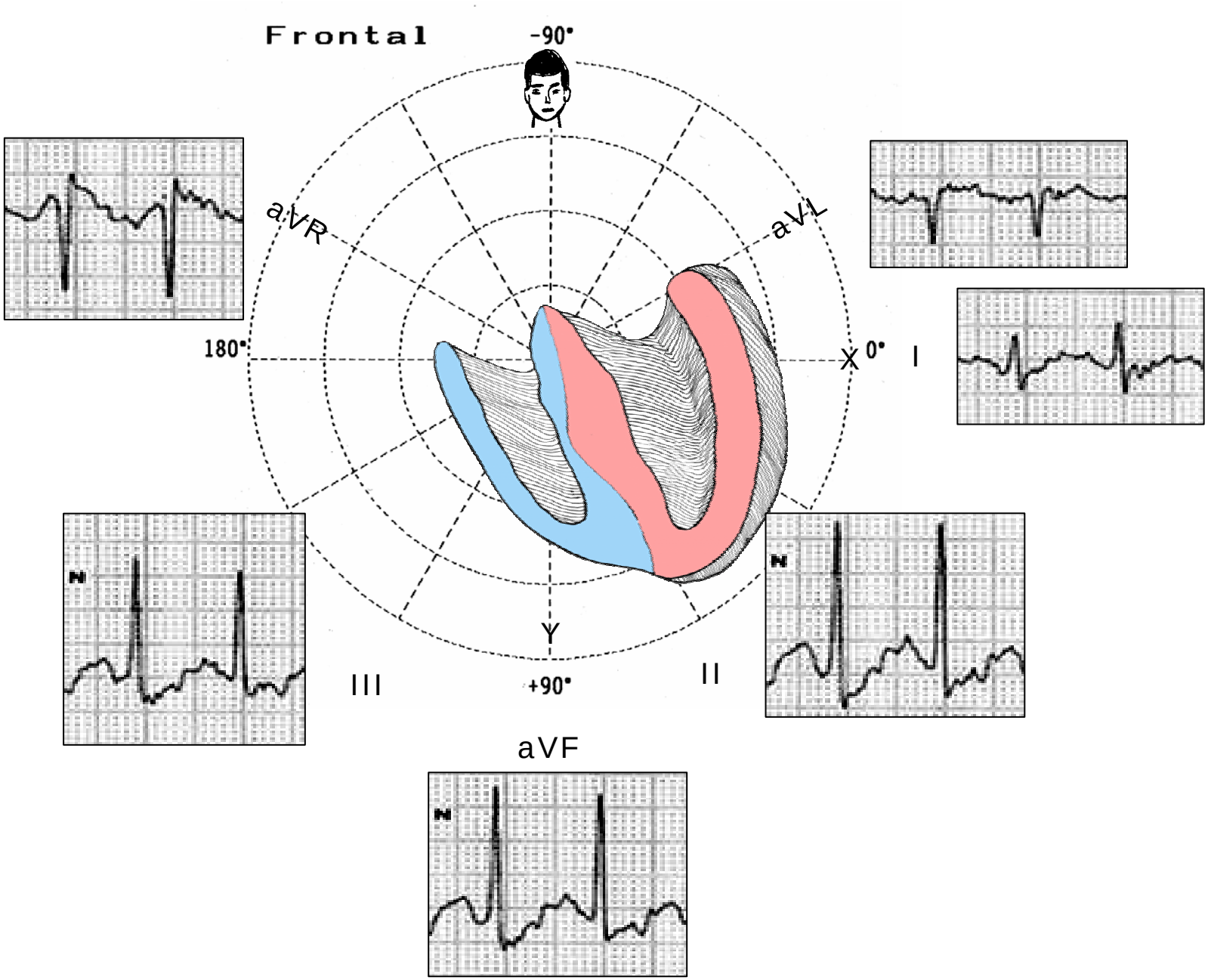
Frontal

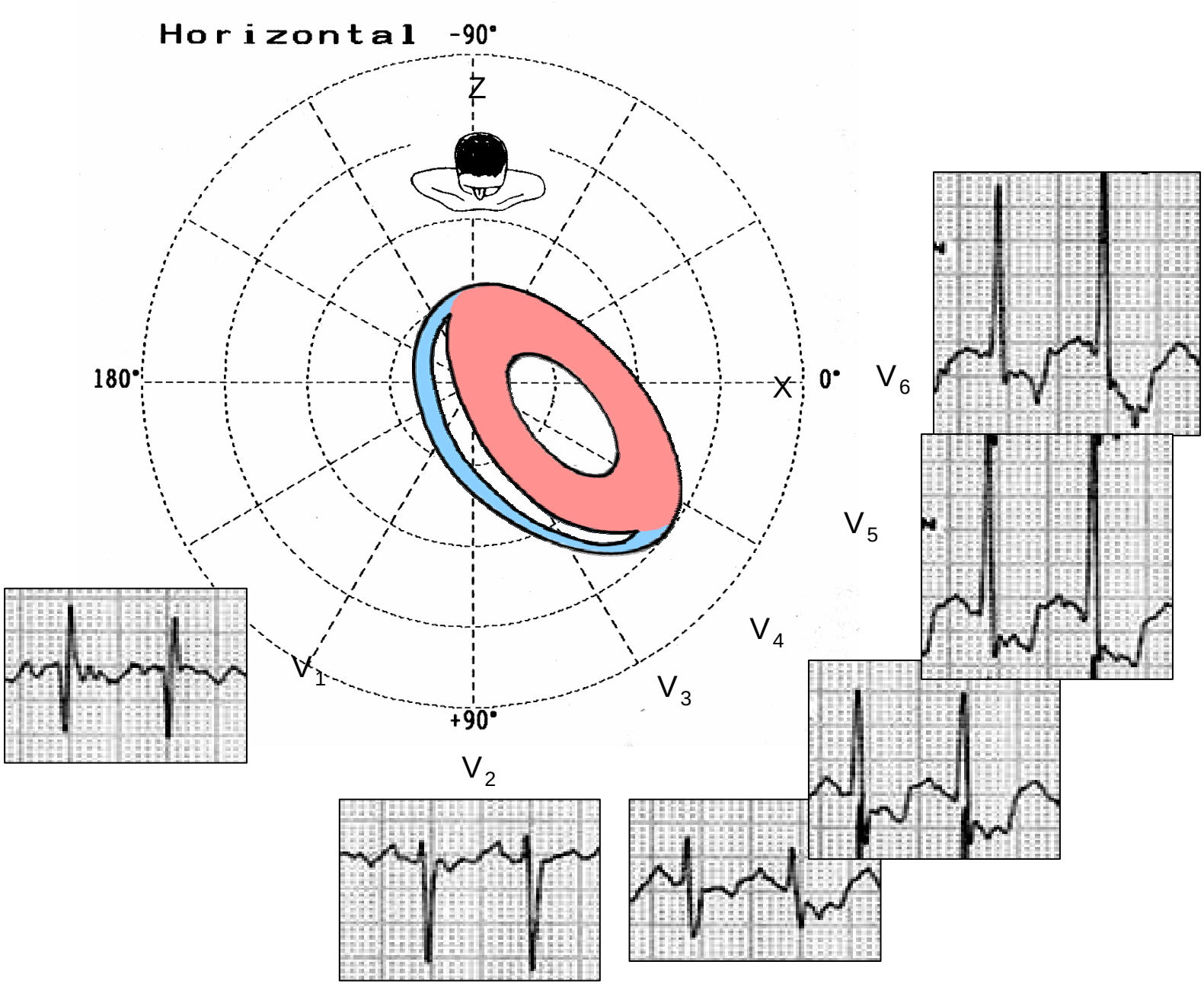
ST segment elevation



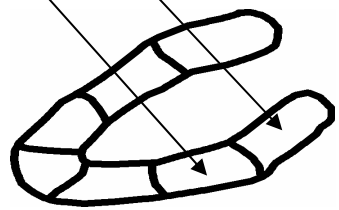


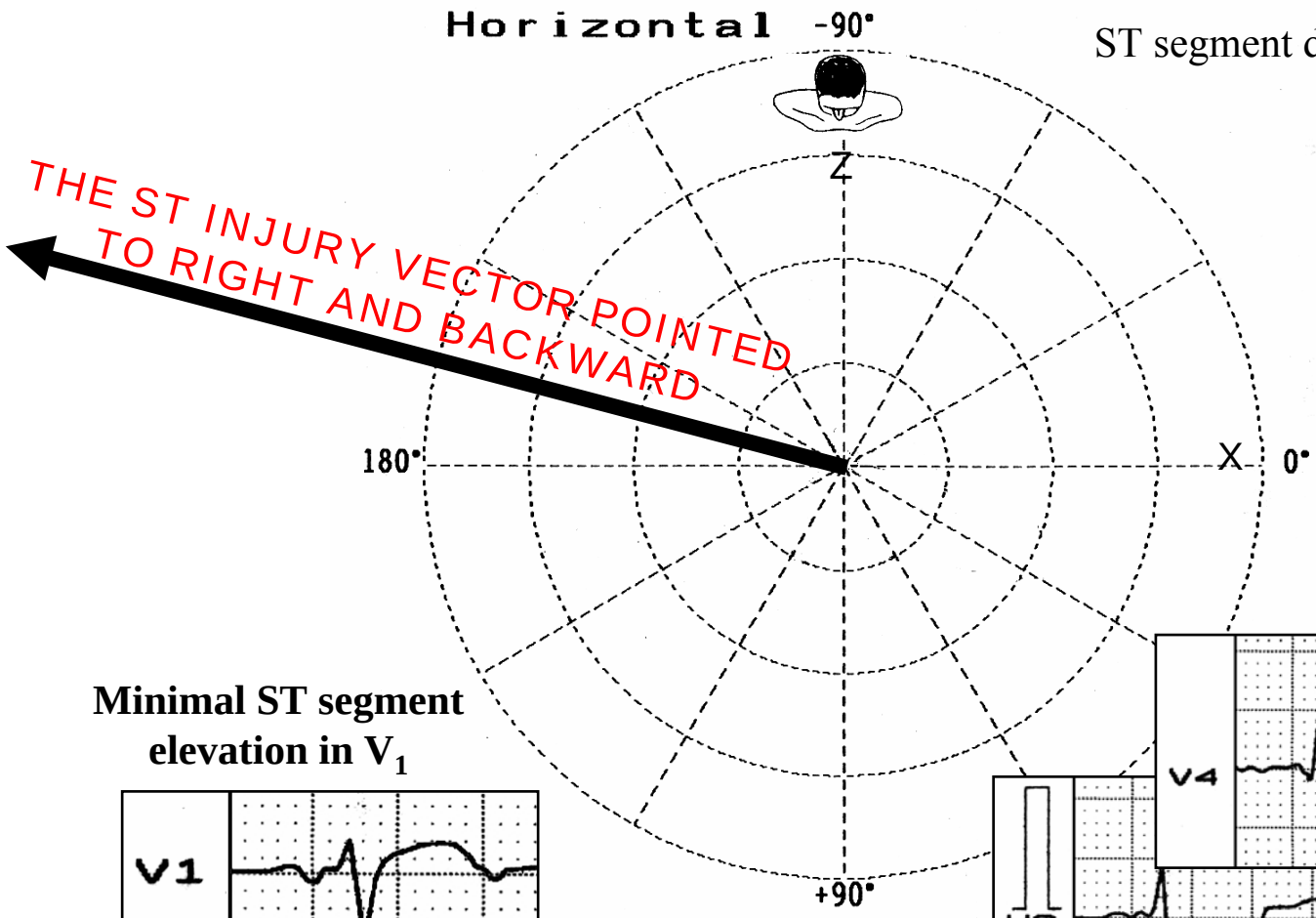
ST segment depression in II and I


Frontal
-90°
aVR
aVL
180°
0°
I
III
+90°
II
aVF

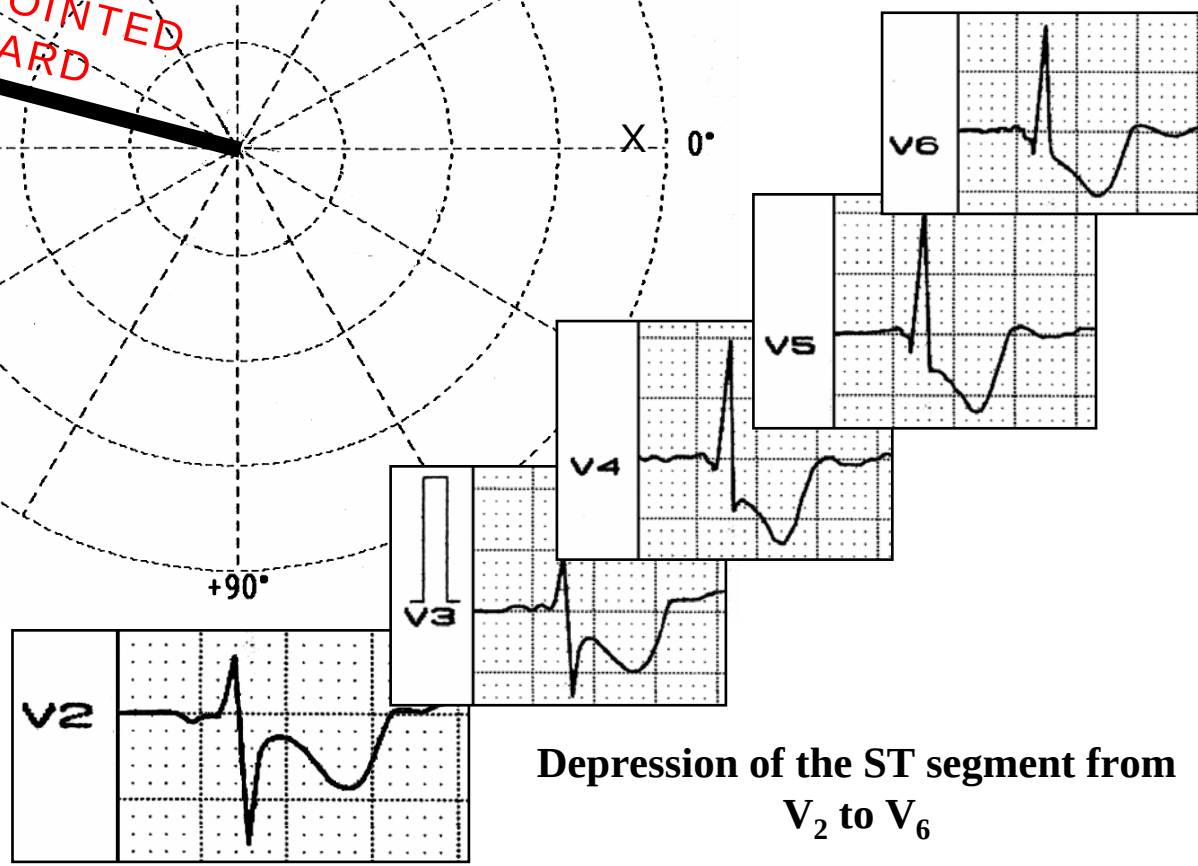

Horizontal
-90°
Z
180°
X
0°
+90°
V1
V2
V3
V4
V5
V6

Ischemic evidences on inferobasal wall:
ST segment depression from V_4 to V_5





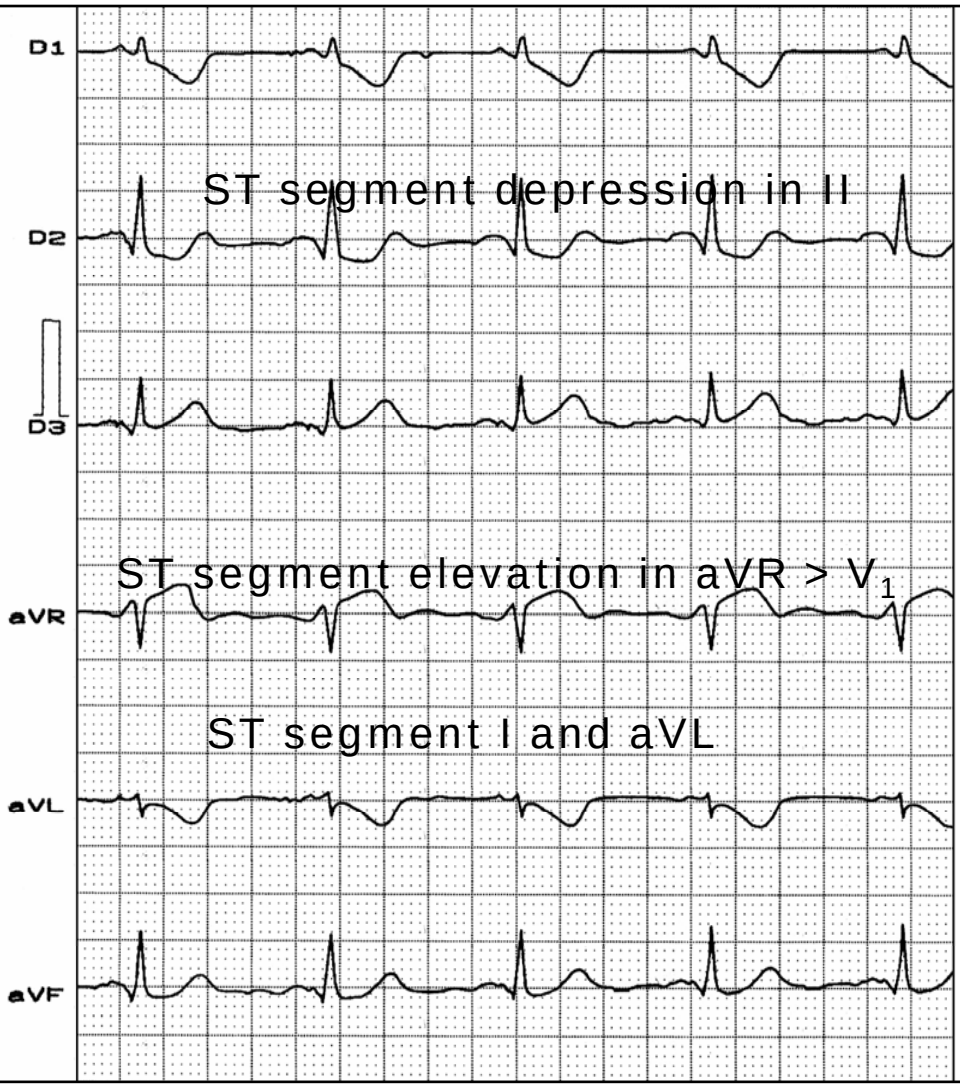
Minimal ST segment elevation in V_1

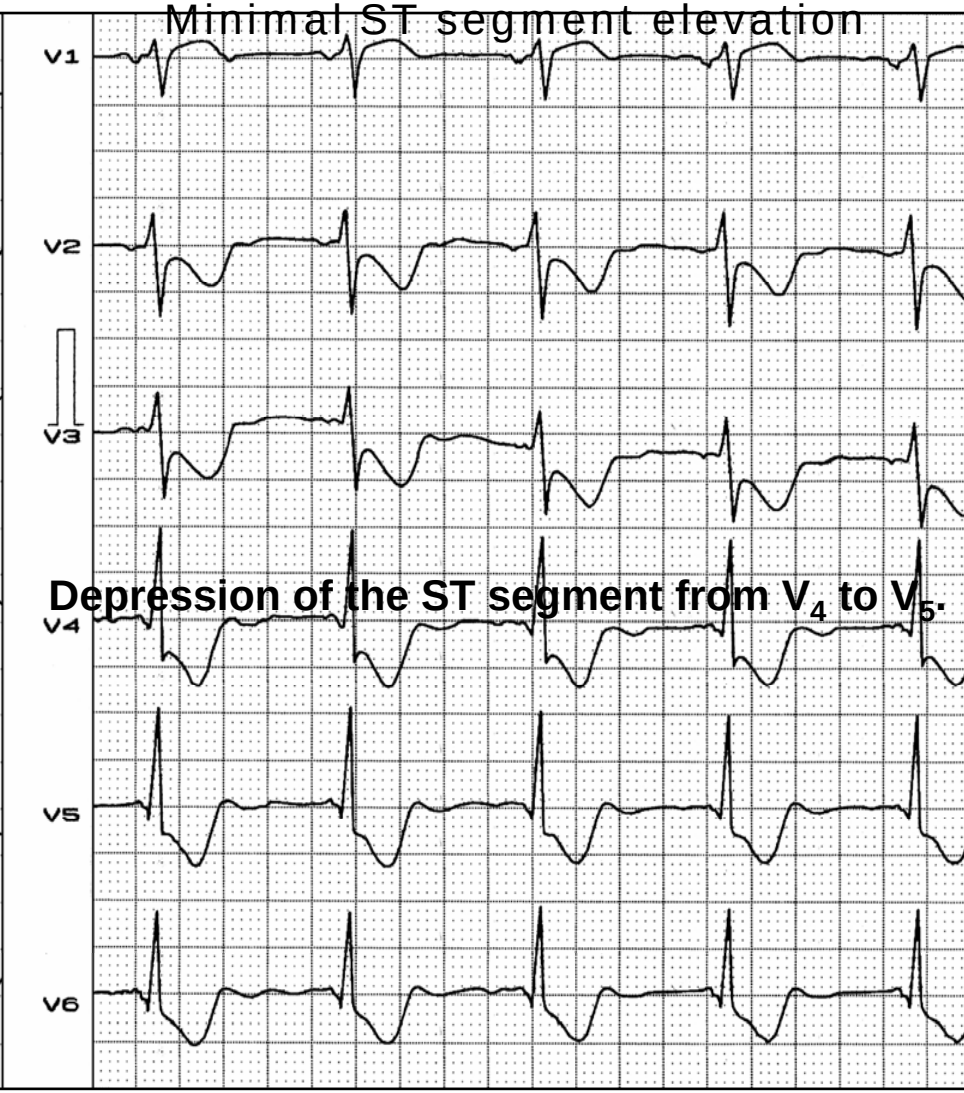


Depression of the ST segment from V_2 to V_6

TYPICAL ECG PATTERN OF LMCA OCCLUSION

Diffuse ST segment depression in the inferolateral leads



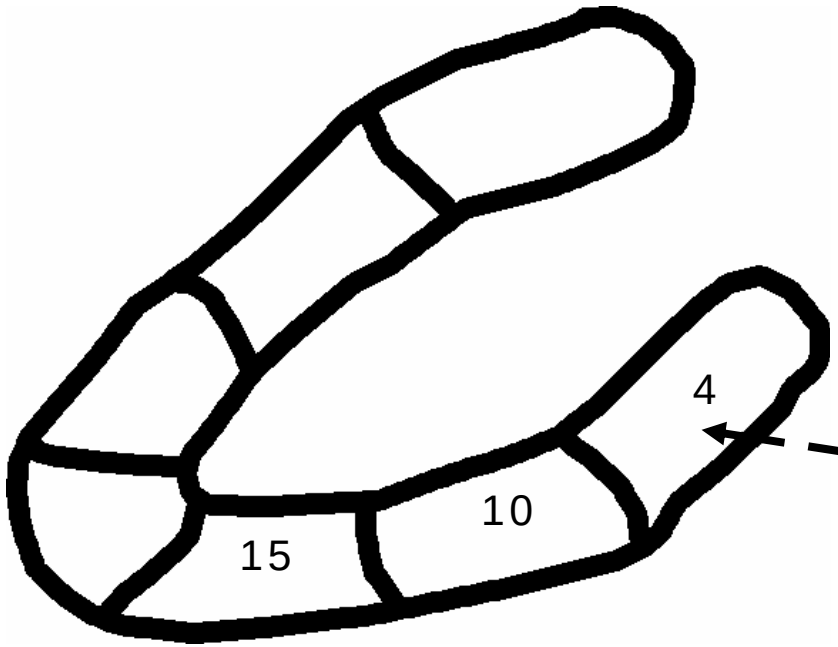


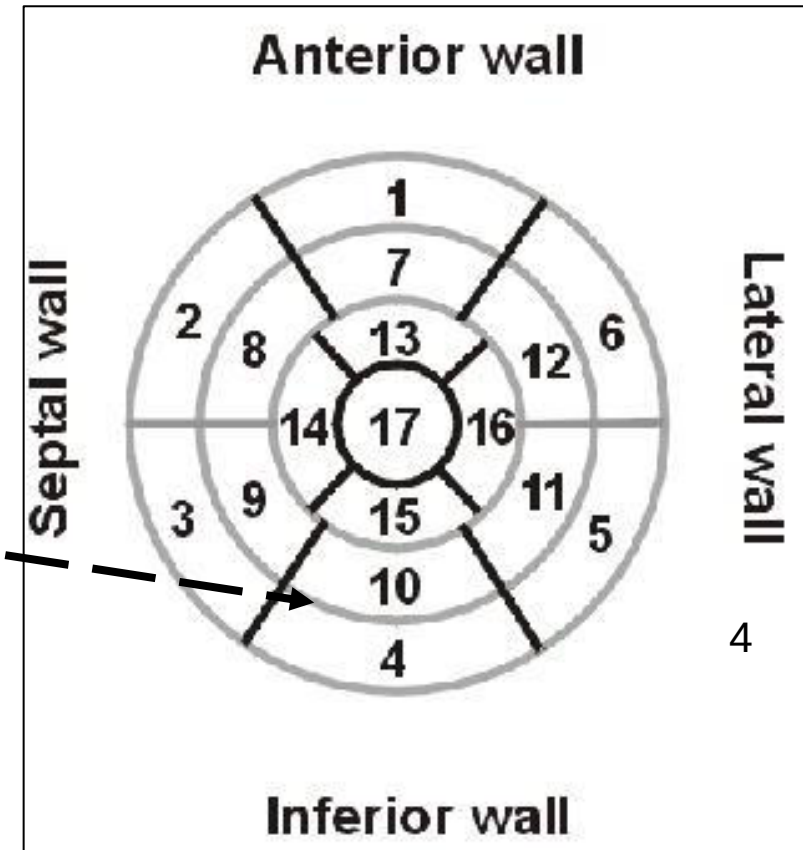
Why this pattern is observed?

ST segment depression in V_6 > ST segment elevation in V_1.

LMCA OCCLUSION ECG CRITERIA

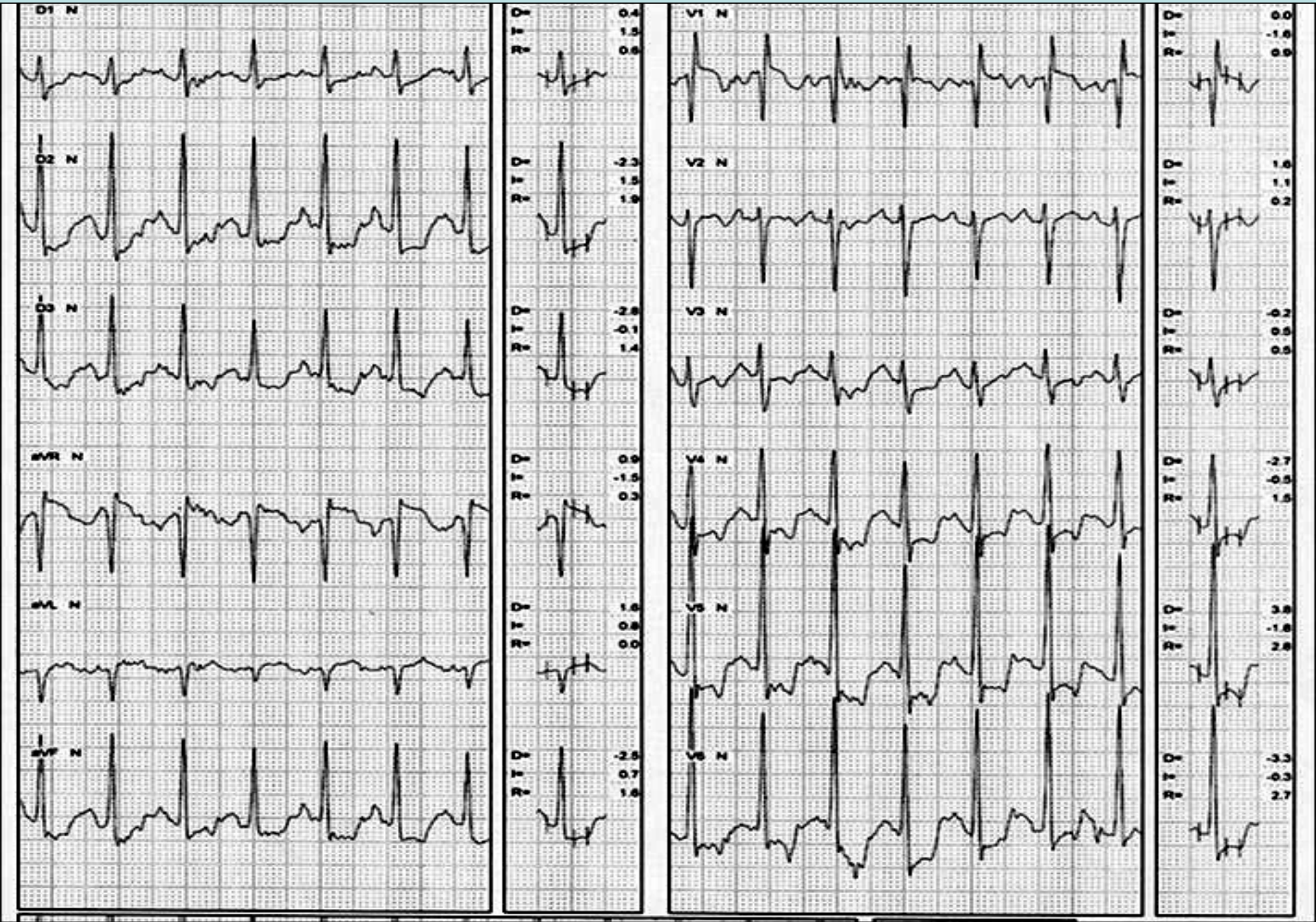
- ST segment elevation in aVR, and V_1
- ST segment elevation in aVR > V_1
- Ischemic evidences in inferobasal* wall: depression of the ST segment in II and from V_4 to V_5
- ST segment depression in II or in inferior leads II>III
- Depression of ST segment in V_6 > ST segment elevation in V_1
- Diffuse ST segment depression in the inferolateral leads
- Eventually observation of RBBB, LAFB and/or LSFB.





* Formally called inferodorsal wall

Electrocardiogram during exercise – 6BPMPH-03% 102BPM- 150/80



Stress (ETT)-induced STE in lead aVR is an important indicator of significant LMCA or ostial LAD stenosis and should not be ignored.(1) coronary CTA is a very sensitive modality for the detection of high-risk coronary anatomy (left main disease or three or two vessel disease including the proximal left anterior descending (LAD) artery) as coronary CTA can visualize these large proximal vessels very well.(2).

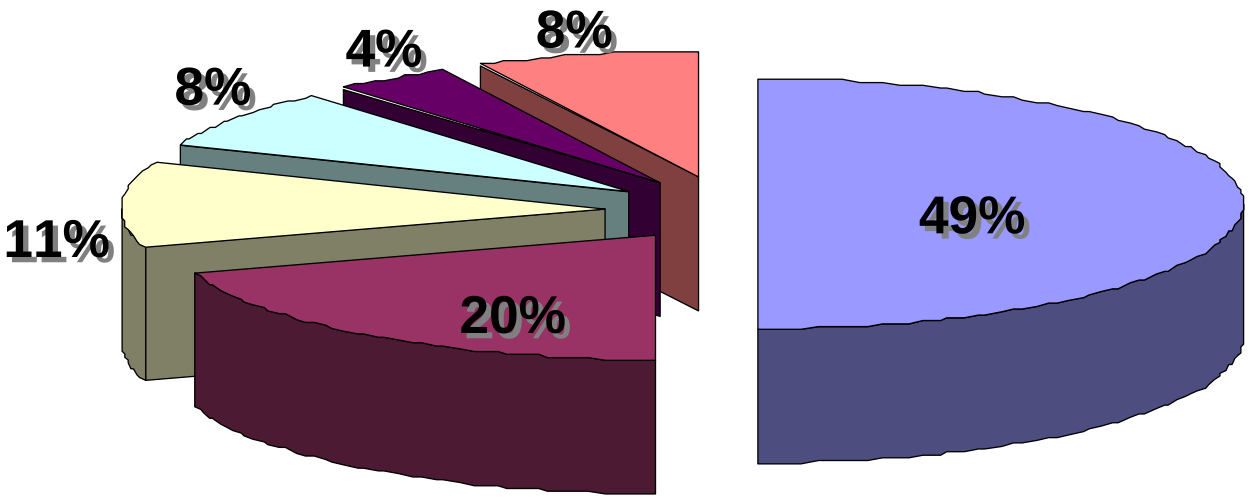
Additionally, CTA is the only non-invasive modality that can detect non-obstructive atherosclerosis, and some research (eg, POISE) offers clues that non-obstructive CAD may be responsible for a substantial proportion of the perioperative MIs that occur in the non-cardiac surgery setting through plaque rupture and thrombosis.

Finally, coronary CTA can provide a comprehensive anatomic characterization of the coronary arteries prior to surgery, and this has substantial potential to shed important insight into the extent of preoperative coronary atherosclerosis in culprit vessels that are associated with perioperative myocardial infarction.(3)

1. **Pigozzi F, Spataro A, Alabiso A, et al. Role of exercise stress test in master athletes. Br J Sports Med. 2005 Aug;39:527-531.**
2. **Uthamalingam S, Zheng H, Leavitt M, et al. Exercise-induced ST-segment elevation in ECG lead aVR is a useful indicator of significant left main or ostial LAD coronary artery stenosis. JACC Cardiovasc Imaging. 2011 Feb;4:176-186.**
3. ***Sheth T, Amlani S, Ellins ML, et al.CT coronary angiographic assessment of high risk coronary anatomy in patients with suspected coronary artery disease and intermediate pre-test probability. Am Heart J 2008;155:918–923.***

CAUSES OF SUDDEN DEATH IN MASTER ATHLETES

(>35 YEARS OLD)



Our indication was the integration of CTA and SPECT. Both data may provide important information which may be useful for patient management. Coronary computed tomography angiography (CTA) CT scanning—sometimes called CAT scanning using 320-detector row computed tomography, which provides 16-cm craniocaudal coverage in 350 ms and can image the entire coronary tree in a single heartbeat, representing a significant advance from previous-generation scanners. Noninvasive 320-detector row CT coronary angiography provides high diagnostic accuracy across all coronary segments, regardless of size, cardiac rhythm, or image quality.(1)

Its indications are: suspected abnormal anatomy of the coronary arteries, low or medium risk for CAD including patients who have chest pain and normal, non-diagnostic or unclear lab and ECG results, non-acute chest pain, new or worsening symptoms with a previous normal stress test result, unclear or inconclusive stress test results, new onset heart failure with reduced left ventricle function and low or medium risk for coronary artery disease, medium risk of coronary artery disease, before non-coronary cardiac surgery a nd coronary artery bypass grafts.

Cleveland Clinic's Cardiovascular Imaging Laboratory currently supports the careful use of coronary CTA for patients who have:

1) Intermediate risk profiles for coronary artery disease with suspicious cardiac symptoms

2) Unusual symptoms for coronary artery disease (such as chest pain unrelated to physical exertion) with low to intermediate risk profiles for coronary artery disease

3) Unclear or inconclusive stress-test results

4) Those with suspected congenital abnormalities of coronary arteries

1. Nasis A, Leung MC, Antonis PR, et al. Diagnostic Accuracy of Noninvasive Coronary Angiography With 320-Detector Row Computed Tomography. Am J Cardiol. 2010 Nov 15;106:1429-1435.

Limitations

Coronary computed tomography angiography (CAT) is limited in its ability to detect myocardial ischemia. A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Vavere et al (1) describe the design of the CORE320 study ("Combined coronary atherosclerosis and myocardial perfusion evaluation using 320 detector row computed tomography"). This prospective, multicenter, multinational study is unique in that it is designed to assess the diagnostic performance of combined 320-row CTA and Stress myocardial computed tomography perfusion imaging (CTP) in comparison with the combination of invasive coronary angiography and single-photon emission computed tomography myocardial perfusion imaging (SPECT-MPI). CTP is a novel examination that provides both anatomic and physiological information(i.e. myocardial perfusion).

The trial is being performed at 16 medical centers located in 8 countries worldwide. CT has the potential to assess both anatomy and physiology in a single imaging session. The co-primary aim of the CORE320 study is to define the per-patient diagnostic accuracy of the combination of coronary CTA and myocardial CTP to detect physiologically significant coronary artery disease compared with (1) the combination of conventional coronary angiography and SPECT-MPI and (2) conventional coronary angiography alone. If successful, the technology could revolutionize the management of patients with CAD. Cardiac CT has been proven to have numerous clinically relevant applications, including coronary artery calcium scoring, coronary computed tomography angiography (CTA), global and regional LV function assessment, and the assessment of myocardial CT perfusion (CTP) (3).

1. **Vavere AL, Simon GG, George RT, Diagnostic performance of combined noninvasive coronary angiography and myocardial perfusion imaging using 320 row detector computed tomography: design and implementation of the CORE320 multicenter, multinational diagnostic study. J Cardiovasc Comput Tomogr.2011 Nov-Dec;5:370-381.**
2. **Achenbach S., Ulzheimer S., Baum U.; et al. Noninvasive coronary angiography by retrospectively ECG-gated multislice spiral CT, Circulation 102 2000 2823-2828.**
3. **Meijboom W.B., Meijs M.F., Schuijf J.D.; et al. Diagnostic accuracy of 64-slice computed tomography coronary angiography: a prospective, multicenter, multivendor study, J Am Coll Cardiol 52 2008 2135-2144.**

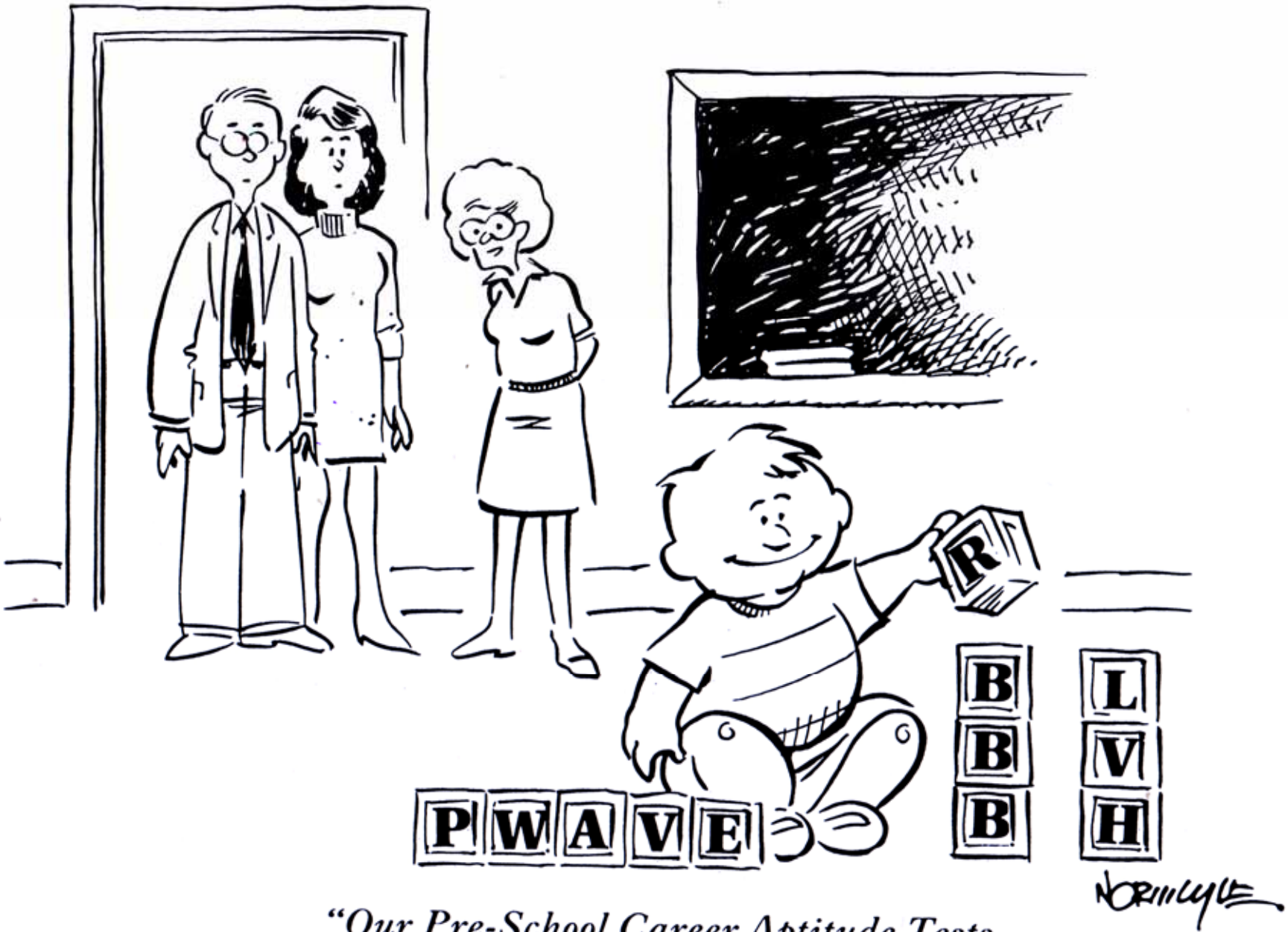
The majority of cardiac CT exams performed today are coronary CTAs, aiming to elucidate the patient's coronary anatomy noninvasively. Coronary CTA has been shown by several multicenter trials to have excellent diagnostic accuracy in the detection and exclusion of significant CAD as compared with invasive coronary angiography (1)

Myocardial perfusion imaging (MPI) by Single Photon Emission Computed Tomography (SPECT) investigates the pathophysiological consequences of luminal obstructive CAD, while multislice computed tomography coronary angiography (CTA) indicates the presence, extent and location of coronary atherosclerosis. The integration of CTA and SPECT data may provide noninvasively important information which may be useful for patient management.

There is evidence suggesting that assessment of MPI is less effective at identifying significant three-vessel CAD as well as left main coronary artery disease. This limitation can be overcome, to a certain extent, by incorporating other imaging findings as well as clinical and stress testing parameters that help identify individuals at an increased risk of adverse cardiac events and hence those with severe and extensive CAD. Quantification of myocardial perfusion reserve using currently available radiotracers as well as simultaneous non-invasive assessment of coronary anatomy and atheromatous plaque may enhance the diagnostic performance of MPI in this subset of high-risk patients.(2)

We are waiting for the result of CAT+ Myocardial perfusion imaging (MPI) by Single Photon Emission Computed Tomography (SPECT)

1. Budoff M.J., Dowe D., Jollis J.G.; et al. Diagnostic performance of 64-multidetector row coronary computed tomographic angiography for evaluation of coronary artery stenosis in individuals without known coronary artery disease: results from the prospective multicenter ACCURACY (Assessment by Coronary Computed Tomographic Angiography of Individuals Undergoing Invasive Coronary Angiography) trial, J Am Coll Cardiol 52 2008 1724-1732.
2. Reyes E. Detection of left main stem and three-vessel coronary artery disease by myocardial perfusion SPECT imaging. EuroIntervention 2010 May;6 Suppl G:G72-78.



"Our Pre-School Career Aptitude Tests indicate little Mark will make a very fine cardiologist".