64-year-old man with narrow and broad tachycardia

Hombre de 64 años con taquiarritmias estrechas y anchas

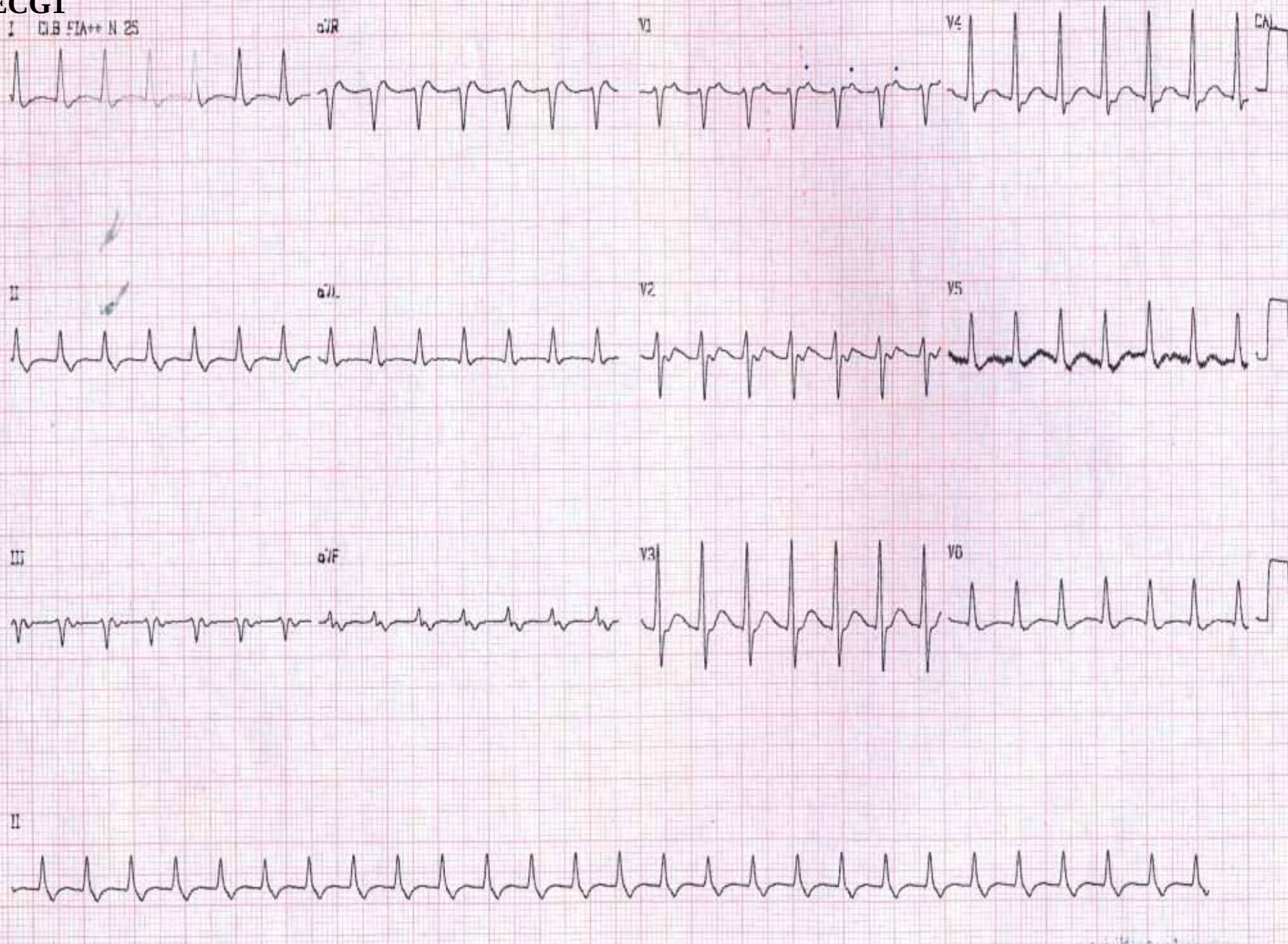
Homem de 64 anos com taquiarritmias estreitas e largas

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

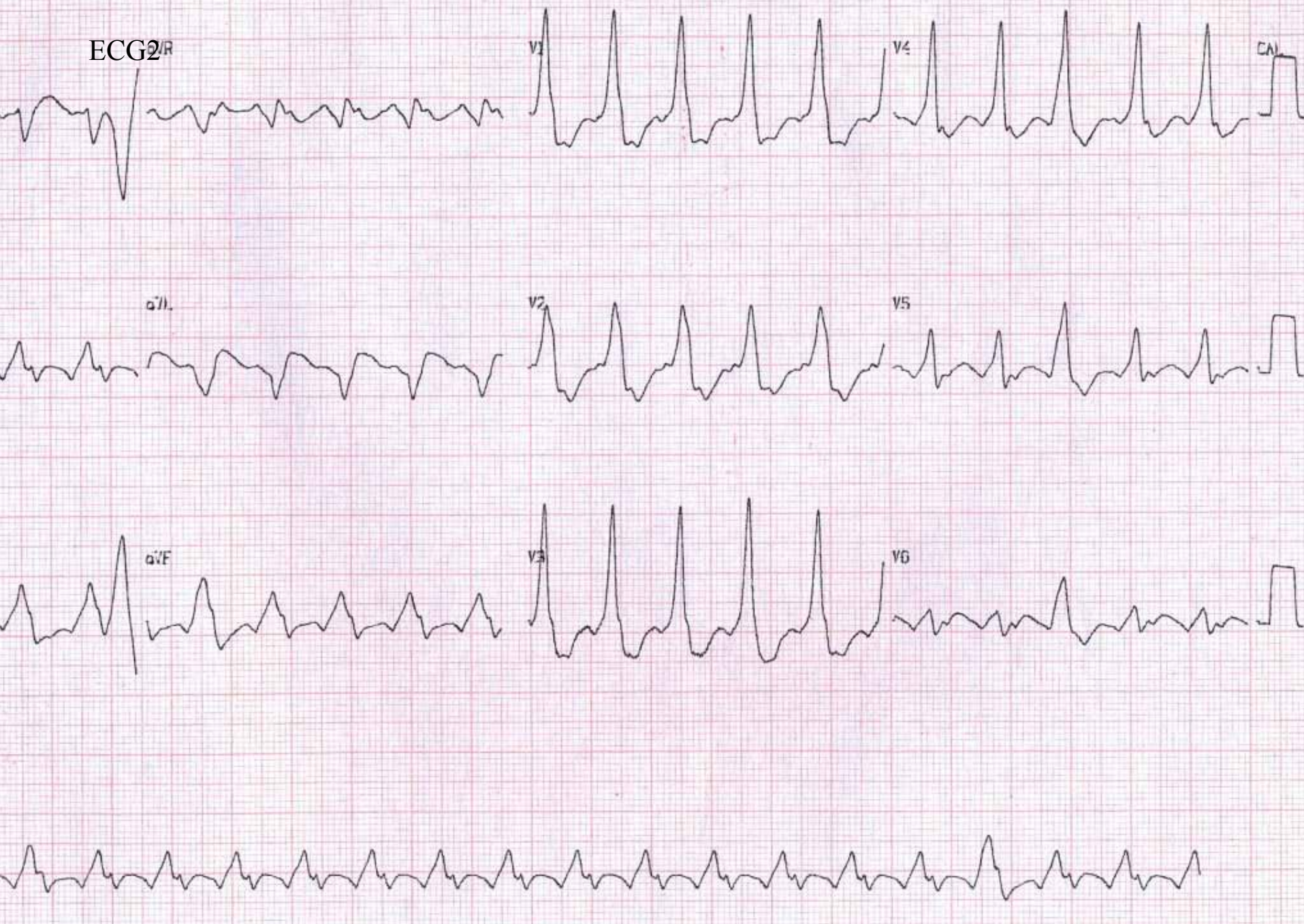
Hello, Master,
This case was sent to me by a colleague, and I think it is worth discussing it (basically electrocardiographic analysis, since the clinical data are poor). This is a 64-year-old man that was admitted in another service with "tachycardia" and pressure drop. He was referred for a tertiary care hospital, where he was admitted with the ECG1. Initially he did not respond to vagal maneuvers. As there was no adenosine, EV verapamil was administered + new massage of carotid sinus. He reverted to sinus rhythm for a few seconds, going immediately into the rhythm in ECG2. After some minutes, the patient presented symptoms of low output associated to ECG3. This time, electrical cardioversion was applied, and recorded in ECG4.
Note: Regrettably, there are no other clinical data.
What is the diagnosis and management?
Regards,
Raimundo Barbosa-Barros M.D. Fortaleza-Ceará

Hola maestro. Este caso me foi enviado por um colega e acho que vale à pena discutir (basicamente apenas a análise eletrocardiográfica, já que os dados clínicos são pobres).Trata-se de um homem de 64 anos que foi atendido em outro serviço com "taquicardia" e queda da pressão.Foi transferido para um hospital de cuidados terciários onde deu entrada com o ECG1.Inicialmente não respondeu à manobra vagal. Como não havia adenosina foi administrado verapamil EV + nova massagem do seio carotídeo.Reverteu para o ritmo sinusal durante poucos segundos passando em seguida para o ritmo no ECG2. Após alguns minutos o paciente passou a apresentar quadro de baixo débito associado ao ECG3.Nesta ocasião foi realizada uma cardioversão elétrica e registrado novo ECG4.
Obs: não outros dados clínicos infelizmente
Qual o diagnóstico e conduta
Um abraço
Dr. Raimundo Barbosa-Barros

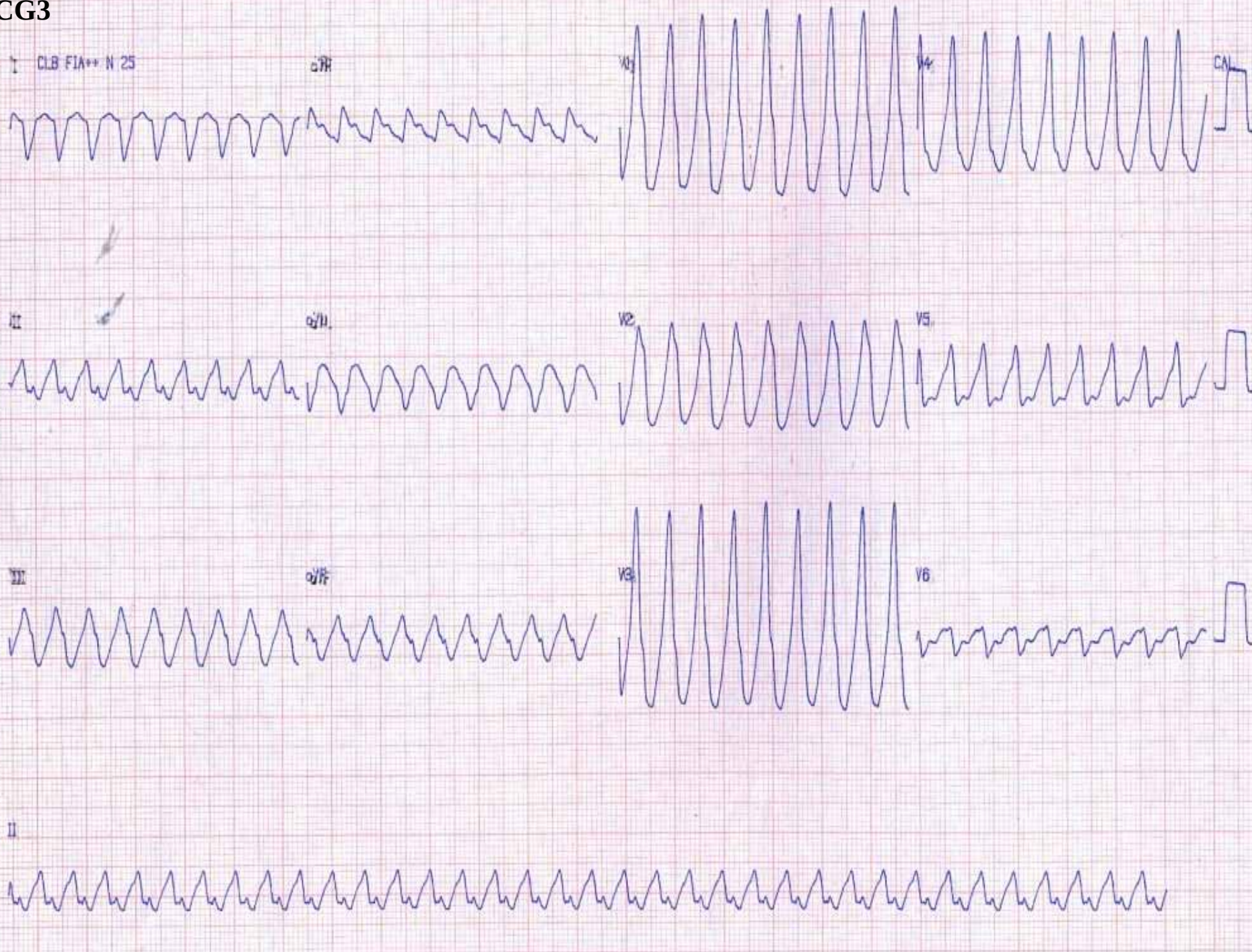
ECG1

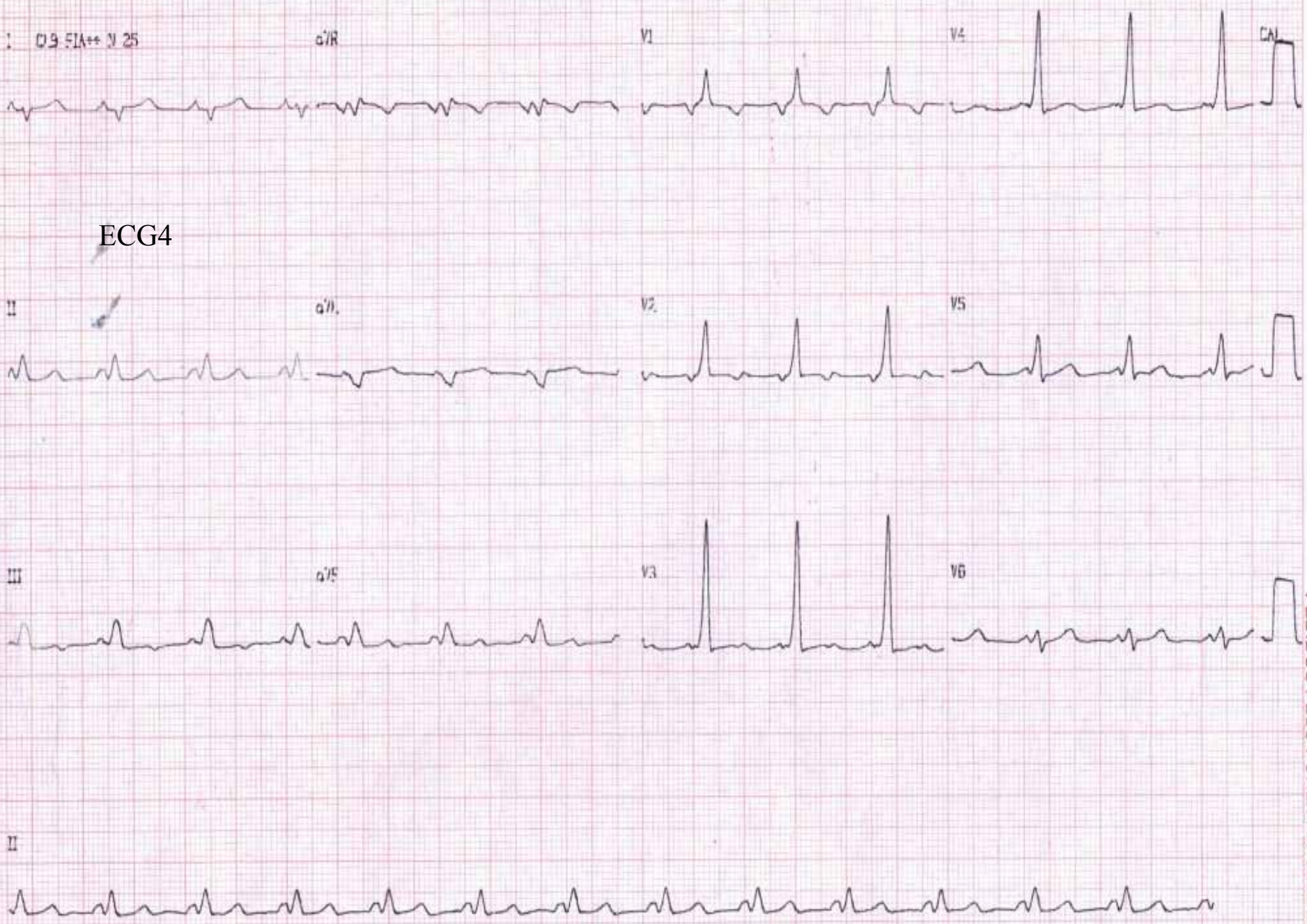


ECG2



ECG3





ECG4

Colleagues opinions

Hermoso caso: ECG 1: taquicardia ortodromica. ECG 2: me impresiona un Aleteo auricular 2:1 con conducción anterograda por una Vía accesoria lateral izquierda. ECG 3: me impresiona un Aleteo Auricular 1:1 con conducción anterograda por VA lateral izquierda y compromiso hemodinámico
ECG 4: Creo que revierte el aleteo pero impresiona una taquicardia auricular 2:1 con conducción anterograda por la VA
Diagnóstico final: Sindrome de WPW (VA lateral o anterolateral izquierda) con multiples taquicardias.
Conducta: sin lugar a dudas ablación de la VA, y posteriormente evaluaría la posibilidad de ablacionar el istmo cavotricuspideo y finalmente vería si se puede o no inducir altura otra taquicardia auricular la cual pueda formar parte de la clínica del paciente, o solo fue un epifenomeno luego de la medicación y cardioversión, lo cual podría ser dado que suelen ser automáticas y no reentrantes, con mala respuesta a fármacos y/o cardioversión,
Saludos Pancho

Beautiful case:
ECG 1: orthodromic tachycardia
ECG 2: I'm impressed a 2:1 atrial flutter with antegrade conduction by left lateral accessory pathway
ECG 3: I'm impressed atrial flutter with 1:1 antegrade conduction by left lateral VA and hemodynamic compromise
ECG 4: I think it reverses the flutter but impressive 2:1 atrial tachycardia with antegrade conduction through the VA.
Final diagnosis: WPW Syndrome (VA lateral or left anterolateral) with multiple tachycardias.
Conduct: surely the VA ablation, and then evaluate the possibility to ablate the cavotricuspid isthmus and finally see if you can not induce or other atrial tachycardia height which can be part of the patient's clinical or was only an epiphenomenon after medication and cardioversion, which could be as they are usually automatic and non-reentrant, with poor response to drugs and / or cardioversion.
Greetings
Pancho Francisco Femenía M.D. Hospital General de Mendoza

Superb case indeed. My interpretation of the ECG's is as follows:
ECG # 1: AVNRT and not AVRT consisting of slow/fast-intermediate mechanism (CL 360smec)
ECG # 2: atrial flutter CL 220msec with 2:1 conduction over a left lateral accessory pathway.
ECG # 3: most probably atrial flutter CL 250msec with 1:1 conduction over the same accessory pathway (DD: antidromic tachycardia involving the pathway)
ECG # 4: sinus rhythm with 1:1 conduction over the accessory pathway
Many years ago(1), I co-authored a paper in French on the topic of coexistence of dual AV nodal pathways and accessory pathways.
Congratulations+++++++++

De hecho espléndido caso. Mi interpretación de los ECGs es como sigue:
ECG # 1: TIN(AVNRT) y no AVRT que consistente en mecanismo lento / rápido, intermedia (CL 360smec)
ECG # 2: Aleteo auricular CL 220msec con conducción 2:1 sobre una vía accesoria lateral izquierda.
ECG # 3: lo más probable aleteo auricular CL 250msec con conducción 1:1 por la misma vía accesoria (DD: taquicardia antidrómica con la participación de la vía anómala).
 # 4 ECG: ritmo sinusal con conducción 1:1 por la vía accesoria.
Hace muchos años, fui co-autor de un manuscrito en francés (1), sobre el tema de la coexistencia de dos vías nodales AV y vías accesorias.
Felicitatciones + + + + + + + + +

Prof. Belhassen, Bernard. Director, Cardiac Electrophysiology Laboratory
Tel-Aviv Sourasky Medical Center
Tel-Aviv 64239, Israel. Tel/Fax: 00.972.3.697.4418
bblhass@gmail.com

1. ***Motté G, Belhassen B, Bodereau P. Obvious or inapparent Wolff-Parkinson-White syndrome associated with duality of nodal conduction. Apropos of 4 cases. Arch Mal Coeur Vaiss. 1979 Mar;72(3):231-240.***

Final comments

By Andrés Ricardo Pérez-Riera M.D. Ph.D.

Patients who have an accessory pathway (AP) of atrioventricular (AV) conduction may develop circus movement tachycardia (CMT) otherwise known as atrioventricular re-entrant tachycardia (AVRT). Orthodromic AVRT is the most common form. It occurs as a result of antegrade conduction through the normal AV conduction system and retrograde conduction to the atria via the AP.

Less commonly, conduction occurs in the opposite direction resulting in antidromic AVRT.

Tachycardia may also involve multiple APs which may provide both antegrade and retrograde conduction and may alternate antegradely or retrogradely.

Tachycardia may occur in which the AP simply acts as a bystander, and does not participate in the tachycardia mechanism.

When AF is conducted to the ventricles via and AP, the resultant ventricular rate may be extremely rapid, placing the patient at risk of developing VF and cardiac arrest.

The normal AV annulus is composed exclusively of electrically inert fibrous tissue. The AV node and His bundle normally act as the sole route of electrical conduction. APs occur at all points along the AV ring, and usually occur as isolated abnormalities, although a proportion of patients have associated congenital abnormalities. This is particularly true of right-sided APs. Most APs exhibit non-decremental conduction properties, and conduct faster than normal AV conduction tissue.

In many patients with APs the surface ECG reveals clear evidence of preexcitation, and a good idea of AP localization is possible using one or more of several algorithms which have been developed.

Patients with latent preexcitation, intermittent preexcitation, and patients with concealed APs have not evidence of preexcitation on a proportion or all of their surface ECGs.

Patients present with a history of paroxysmal palpitations, often with associated symptoms such as chest discomfort. Syncope is a rare presenting symptom. Unless bundle branch block is present, patients with orthodromic AVRT exhibit a narrow complex tachycardia on the surface ECG.

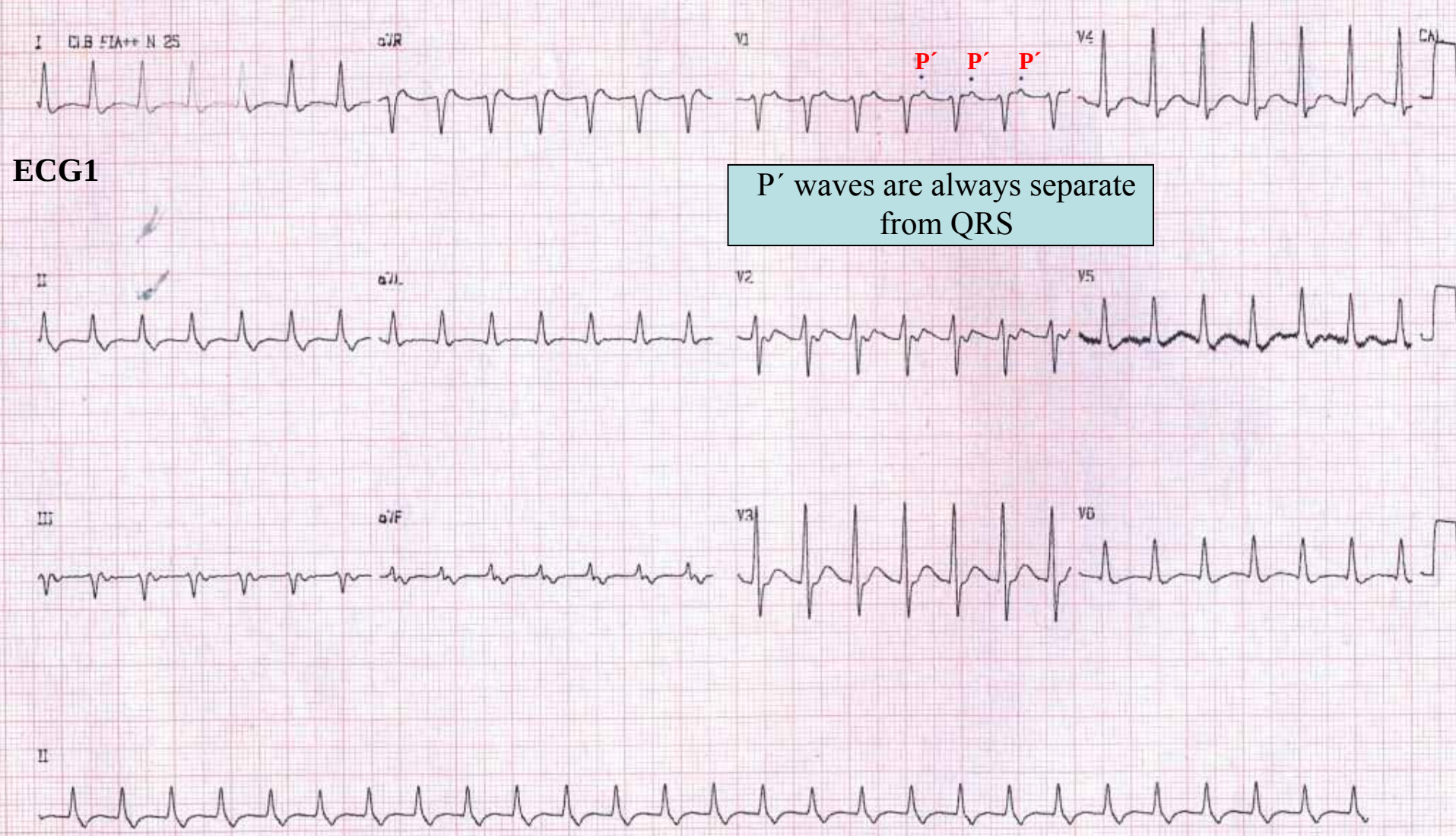
Patients with preexcited tachycardia including antidromic AVRT, and other forms of SVT in which the AP conducts to the ventricles as a bystander but does not participate in the tachycardias mechanism, present as broad complex tachycardias on the surface ECG which may be difficult to distinguish from VT.

Adenosine is increasingly used for this purpose since it is highly efficacious and has an extremely short half-life. Adenosine is also very useful in the diagnosis of broad-complex tachycardia, and in unmasking latent preexcitation during sinus rhythm.

The administration of adenosine during atrial tachycardia usually terminates the arrhythmia or induces AV block and makes the diagnosis clear. Adenosine results in atrial fibrillation (AF) in12% of patients undergoing electrophysiological evaluation for supraventricular tachycardia. If a patient presenting to the emergency room with a narrow QRS complex tachycardia also has manifest preexcitation during sinus rhythm, adenosine administration may result in preexcited AF with a rapid ventricular response and hemodinamic deterioration.

AF is not an uncommon side effect of adenosine administration. Hemodynamic collapse may occur if an antegrade-conducting AP allows for a rapid ventricular response.(1) Electrophysiology study in these patients is frequently performed at the same time as an attempt at catheter ablation; it aims to diagnose, localize and determine the functional characteristics of an AP, and to characterize the role of the pathway in tachycardia. AVRT can be reliably terminated by effective AV nodal blockade. Drug therapy for the prevention of AVRT is useful for temporary control whilst awaiting more definitive measures and in certain cases as long-term management. No class of drug stands out as 'therapy of choice', and physician preference, pro-arrhythmic effects and associated conditions need to be taken into account such that an individual choice can be made in each patient. The management of patients with AVRT has been revolutionized in recent years with the advent of catheter-based techniques for their cure. Whilst this method of treatment is highly effective and has low complication rates, pathways in particular locations such as the septal region remain challenging.

1. **Kaltman JR, Tanel RE, Shah MJ, Vetter VL, Rhodes LA. Induction of atrial fibrillation after the routine use of adenosine.Pediatr Emerg Care. 2006 Feb;22:113-115.**



ECG1

P´ waves are always separate from QRS

Sustained regular narrow QRS paroxysmal supraventricular tachycardia (PSVT) Atrioventricular reentry tachycardia (AVRT), type Orthodromic Circus Movement Tachycardia (CMT) or Orthodromic Reciprocicanting Tahcycardia (ORT) HR 167bpm. It is usually initiated by an atrial premature beat (APB*) and supported by atrioventricular maco-reentry circuit that uses the AV node normal conduction system anterogradely and a rapidly conducting accessory pathway retrogradely. CMT is the second most common mechanism o PSVT The sequence of activation is atria ---AV node--- ventricles--- accessory pathway---atria.

ATRIOVENTRICULAR REENTRY TACHYCARDIA (AVRT), Orthodromic Circus Movement Tachycardia (CMT) or Orthodromic Reciprocicanting Tahcycardia (ORT)

V1

ECG1

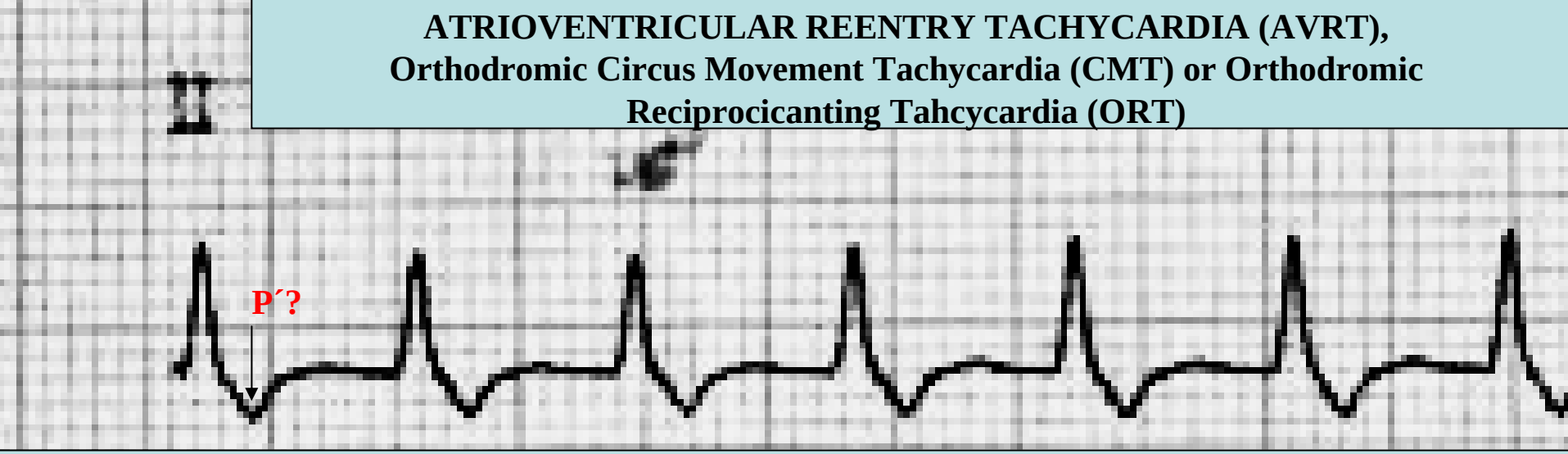
P' waves are separate from QRS

P' P' P'

ATRIOVENTRICULAR NODAL REENTRANT TACHYCARDIA (AVNRT)

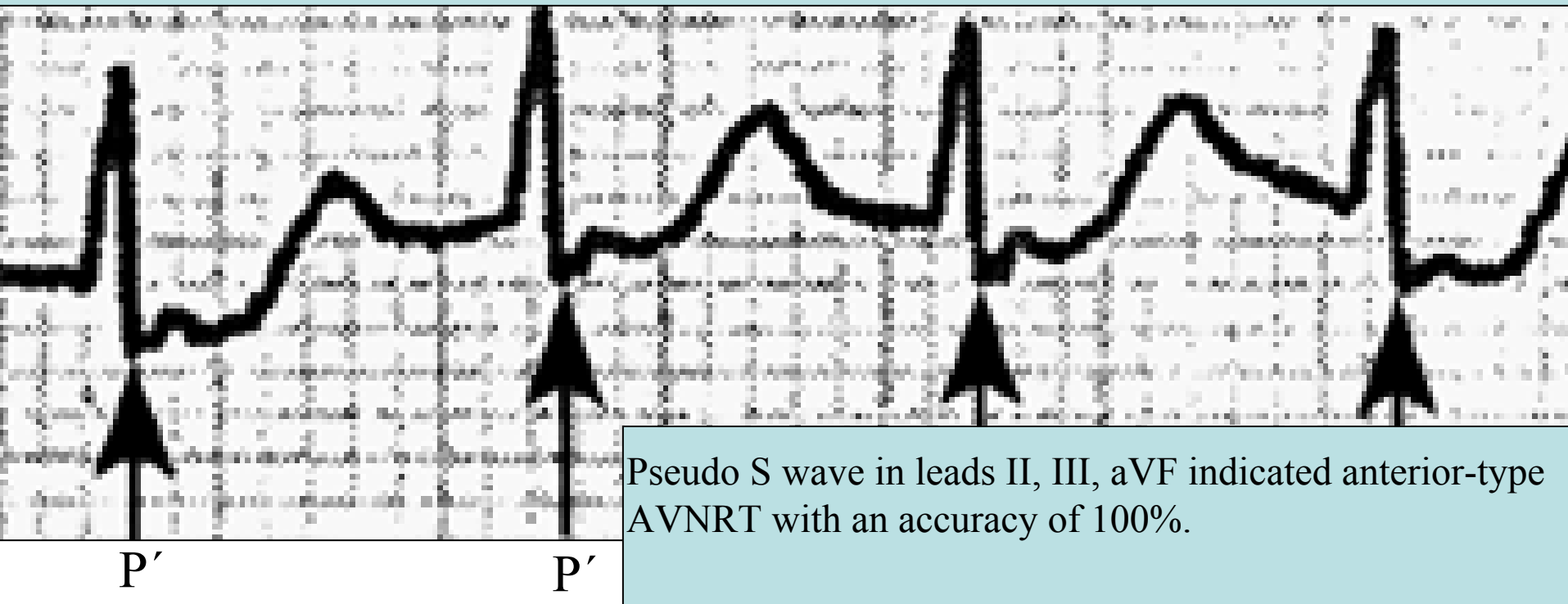
P´ In V1, the P' wave distort the end of QRS, resembling an R': Pseudo Qr´. Pseudo-r' in the lead V1

ATRIOVENTRICULAR REENTRY TACHYCARDIA (AVRT), Orthodromic Circus Movement Tachycardia (CMT) or Orthodromic Reciprocicanting Tahcycardia (ORT)



ATRIOVENTRICULAR NODAL TACHYCARDIA(AVNRT)

In the inferior leads, P' distorts the end of QRS, and it may originate a false S.



Pseudo S wave in leads II, III, aVF indicated anterior-type AVNRT with an accuracy of 100%.

Tai et al(1) studied ECG algorithm, derived from the results of RFCA, to discriminate atrioventricular node reentrant tachycardia (AVNRT) from atrioventricular reciprocating tachycardia (AVRT) and to localize a concealed accessory pathway (AP), prospectively.

406 ECGs (obtained from 406 different patients) that demonstrated narrow QRS complex (< 120ms) supraventricular tachycardia with an RP' interval less than the P'R interval or pseudo r' wave in lead V1 or pseudo S wave in inferior leads, or both, were examined, and the results were confirmed by RFCA. The initial 226 ECGs were analyzed to develop a stepwise algorithm, and the subsequent 180 ECGs were prospectively evaluated by the new algorithm.

The presence of a pseudo r' wave in lead V1 or a pseudo S wave in leads II, III, aVF indicated anterior-type AVNRT with an accuracy of 100%. With the difference of RP' intervals in leads V1 and III > 20 ms, posterior-type AVNRT could be differentiated from AVRT utilizing a posteroseptal AP with a sensitivity of 71% (95% confidence interval [CI] 55% to 89%), a specificity of 87% (95% CI 67% to 97%) and a positive predictive value of 75% (95% CI 56% to 91%). According to the polarity of retrograde P waves in leads V1, II, III, aVF and I during AVRT, the concealed AP could be localized to one of the nine regions on the atrioventricular annuli with an accuracy of 75% (for a right midseptal pathway) to 93.8% (for a left posterior pathway). Overall, the new algorithm had an accuracy of 97.8% in discriminating AVNRT from AVRT and 88.1% in localizing a concealed accessory pathway, prospectively. Prediction was incorrect in only 15 patients (9.1%).

The new ECG algorithm derived from the analysis of retrograde P waves during tachycardia could provide a criterion for differential diagnosis between AVNRT and AVRT and for predicting the location of concealed APs.

1. **Tai CT, Chen SA, Chiang CE, et al. A new electrocardiographic algorithm using retrograde P waves for differentiating atrioventricular node reentrant tachycardia from atrioventricular reciprocating tachycardia mediated by concealed accessory pathway. J Am Coll Cardiol. 1997 Feb;29:394-402.**

Pseudo-r' in the lead aVR

Despite the several ECG criteria, misclassification may still occur in differential diagnosis of the regular paroxysmal supraventricular tachycardia (PSVT). Recently, Haghjoo et al(1) evaluated the diagnostic accuracy of the aVR lead in ECG for differentiation between atrioventricular nodal reentrant tachycardia (AVNRT) and atrioventricular reciprocating tachycardia (AVRT).

A 12-lead ECG was recorded in 150 consecutive patients with drug-refractory regular PSVT during both sinus rhythm and tachycardia.

All ECGs were reviewed by two experienced electrophysiologists who had no knowledge of the tachycardia mechanism.

The ECG recordings were evaluated for standard criteria as well as their newly proposed criterion of pseudo-r' in the lead aVR.

Mechanism of arrhythmia was confirmed by the EPS and the successful catheter ablation.

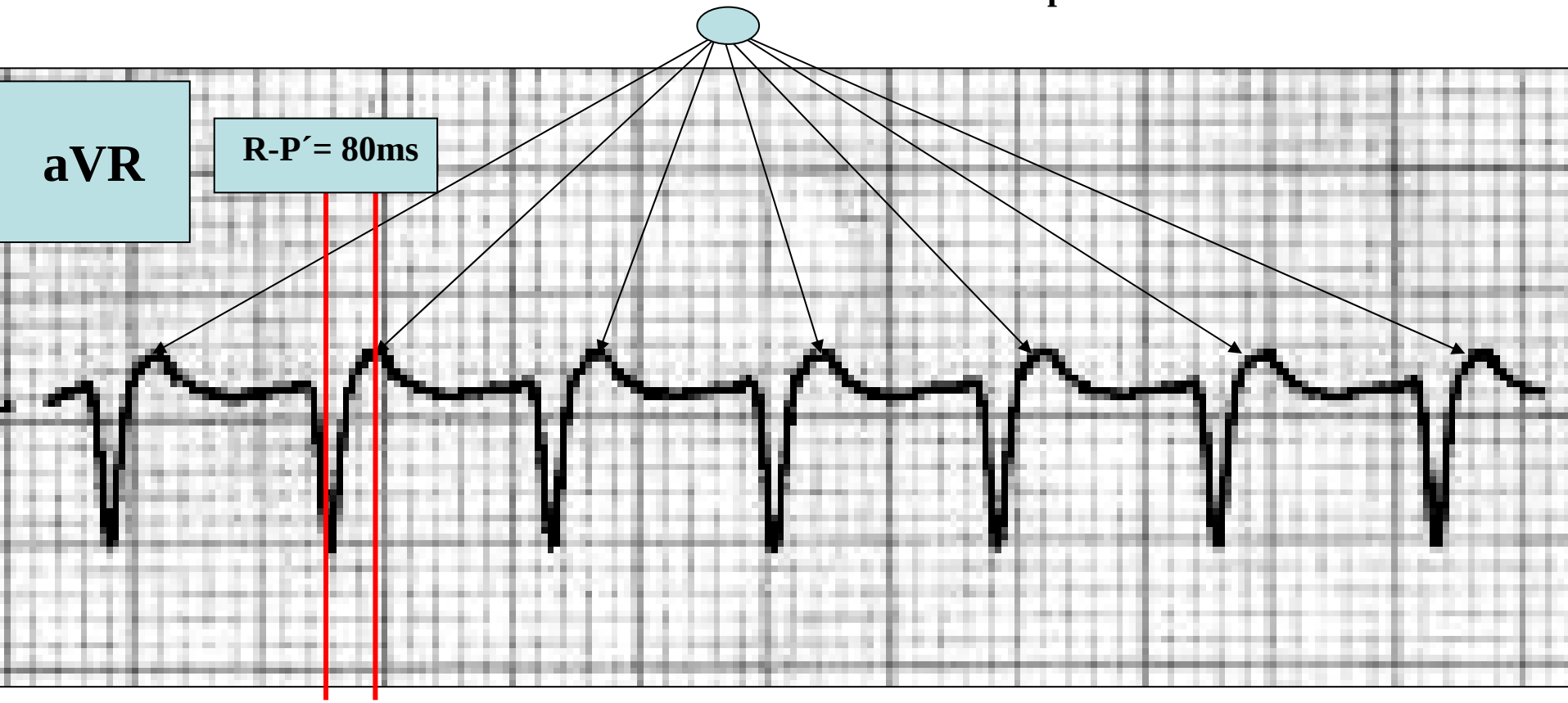
Patients with AVNRT were older, predominantly female, and presented with slower tachycardia.

Among the ECG criteria of the AVRT diagnosis, visible P-wave with RP interval ≥100 ms had highest diagnostic accuracy (sensitivity 79%, specificity 87%, and positive predictive value 79%). For AVNRT diagnosis, pseudo-r' in aVR had a higher sensitivity, specificity, and predictive values compared with the conventional criteria of the pseudo-r' in V1 and pseudo-s in inferior leads (all $P < 0.05$).

If we look back the aVR lead of the ECG-1, the **Pseudo-r' sign in the lead aVR** is clearly present which would give reason to Professor Bernard Belhansen interpretation (He wrote “AVNRT and not AVRT consisting of slow/fast-intermediate mechanism (CL 360smec)”)Contrary to the opinion of Pancho and mine.

1. **Haghjoo M, Bahramali E, Sharifkazemi M, Shahrzad S, Peighambari M. Value of the aVR lead in differential diagnosis of atrioventricular nodal reentrant tachycardia.Europace. 2012 Apr 29. [Epub ahead of print]**

Pseudo-r' in the aVR lead observed in the present case



Pseudo-r' sign in the lead aVR is clearly present in the present case, which would give reason to Professor Bernard Belhansen interpretation (He wrote: "AVNRT and not AVRT consisting of slow/fast-intermediate mechanism (CL 360smec)")Contrary to the opinion of Pancho and mine.

We are no sure rerlated to the diagnosis.

Querido Pablo: A pesar de los varios criterios electrocardiográficos, una clasificación errónea puede ocurrir en 20% de los casos en el diagnóstico diferencial de las taquicardia paroxísticas supraventriculares (TPSV) si utilizamos apenas el ECG .

Recientemente, Haghjoo et al (1) evaluaron la precisión diagnóstica de un nuevo signo: de la derivación aVR en el ECG para la diferenciación entre la taquicardia intranodal (TIN) y la taquicardia recíprocicante (TAV).

Un ECG de 12 derivaciones se registró en 150 pacientes consecutivos con TSV refractaria a fármacos tanto durante el ritmo sinusal cuanto durante el evento taquicárdico.

Todos los ECGs fueron analizados □□por dos electrofisiólogos experimentados que no tenían conocimiento del mecanismo de la taquicardia.

Los registros de ECG fueron evaluados por criterios estándar, así como por el nuevo criterio propuesto de pseudo-r' en aVR.

El mecanismo de la arritmia fue confirmado por posterior estudio electrofisiológico y por el éxito obtenido con la ablación por catéter.

Resutados:

Los pacientes con TRN eran mayores, predominantemente del sexo femenino, y se presentarán con menor FC.

Entre los criterios diagnóstico electrocardiográficos para AVRT una onda P visible con intervalo PR ≥ 100 ms tuvo mayor acurácia (precisión diagnóstica) (sensibilidad 79%, especificidad 87%, y valor predictivo positivo del 79%) para el diagnóstico de TIN, y pseudo-r' en aVR tuvo una mayor sensibilidad, especificidad y valor predictivos en comparación con los criterios convencionales de la pseudo-r' en V1 y pseudo-S-en las derivaciones inferiores (p <0,05)

Si miras ahora la derivación aVR del ECG-1 del caso este signo está claramente presente lo que le daria la razón al Profesor Belhansen!!!! Contrariando la opinion de Pancho y la mia.

Andrés.

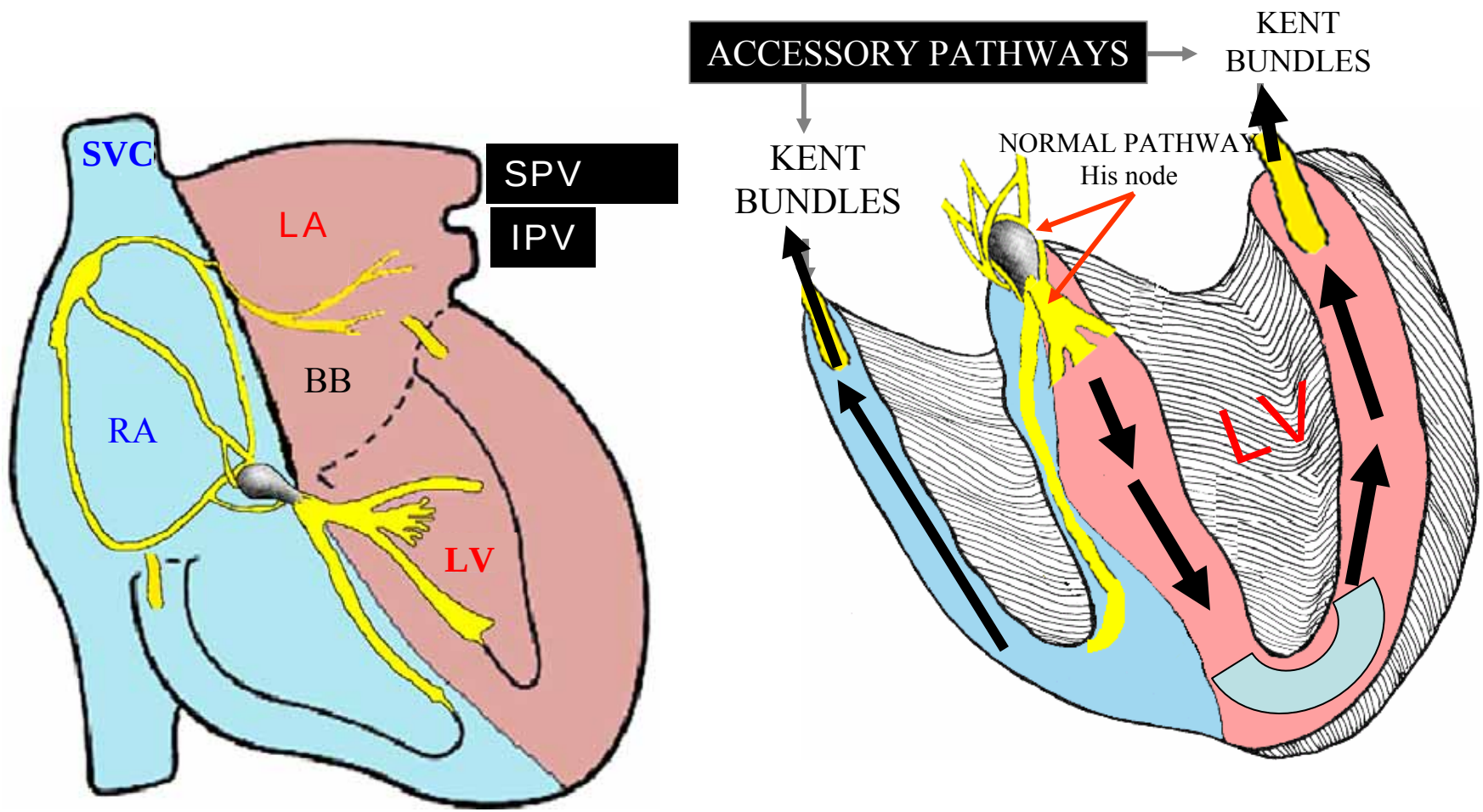
Hola Potro: Al fin concordamos!!!!! Tanto Pancho como yo pensamos en una TSV ortodrómica buscando una hipótesis unitaria, pero claro, dado que la preexcitación anterógrada indicaba las presencia de una vía anterolateral izquierda, la única posibilidad para que la onda P fuese negativa en las derivaciones II-III y AVF y, por supuesto, positiva en aVR, era que la vía accesoria tuviese una orientación oblicua (o eventualmente, una 2da vía accesoria posterior oculta). El comentario de Belhassen introdujo la otra y tal vez más racional posibilidad, que se tratara de una TRNAV. Veremos que sucedió en el estudio electrofisiológico, pero esa posibilidad la veo como la más plausible.
Buen fin de semana.
Un abrazo
Pablo A Chiale "PAC"

Hello Andrés: Finally we agree!! Both Pancho and I think orthodromic SVT looking for a unitary hypothesis, but of course, as the anterograde preexcitation indicating the presence of a left anterolateral route, the only possibility for the P wave is negative in leads II, III and AVF and of course positive in aVR, was that the accessory pathway had an oblique orientation (or possibly later a 2nd hidden accessory pathway). Belhassen's comment introduced the other and perhaps more rational possibility, which were a AVNRT. We will see what happened in the electrophysiological study, but I see that possibility as the most plausible.
Have a nice weekend.

A hug

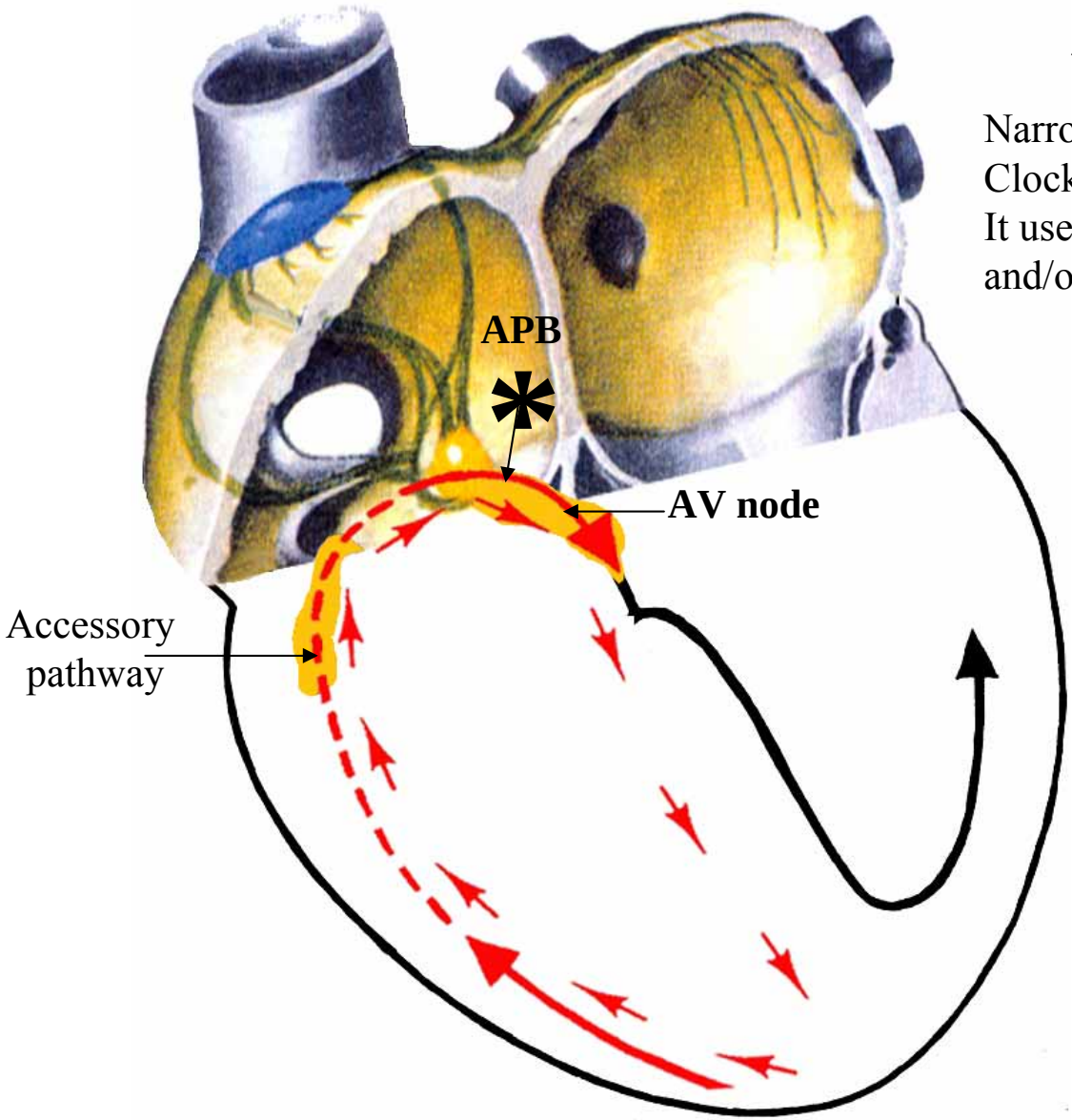
Pablo A Chiale "PAC".
Division of Cardiology, Ramos Mejía Hospital

Anatomical substrate of WPW type preexcitation Atrio-Ventricular Reciprocating Tachycardia (AVRT) A anomalous pathways orthodromic circus movement tachycardia (CMT) or orthodromic reciprocicanting tahcycardia (ORT)



Outline of anatomical substrate of WPW type preexcitation.

Atria ---AV node--- Ventricles--- Accessory Pathway---Atria.



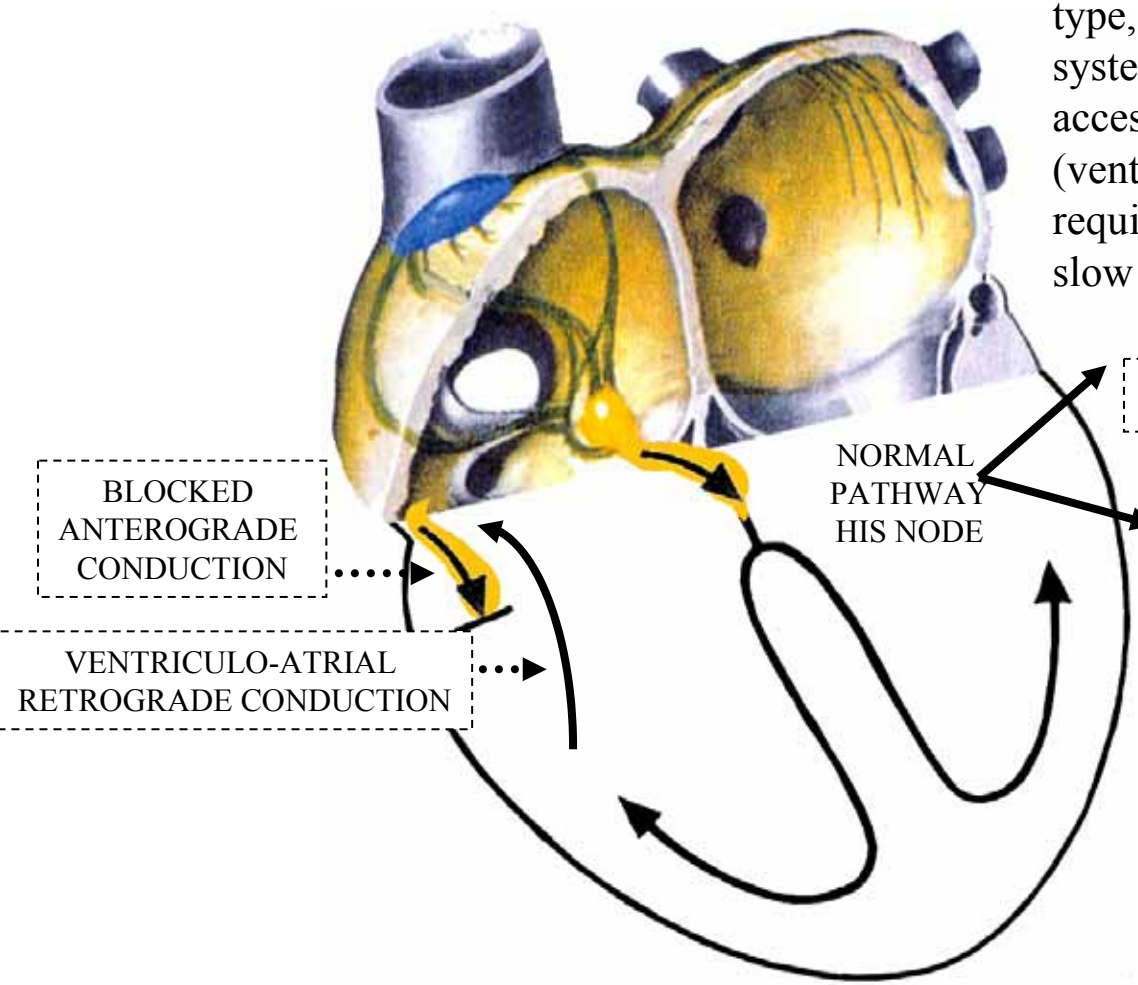
AVRT/CMT/ORT

Narrow QRS.
Clockwise macro-reentry motion.
It uses a normal pathway in anterograde fashion and/or accessory pathway in retrograde fashion.

In this case a schematic representation of reentrant pathway utilizing a right side accessory pathway

DROMOTROPIC OR REENTRY ARRHYTHMIAS.
ANATOMICALLY DETERMINED MACRO-REENTRY CONCEALED WPW SYNDROME

Possible runs of paroxysmal supraventricular tachycardia of the orthodromic macro-reentry type, in anterograde fashion or Node-Hisian system in anterograde fashion, and parallel accessory pathway in retrograde fashion (ventriculo-atrial VA). All anatomic reentry requires the presence of unidirectional block and slow conduction.



It is important to know the WPW syndrome, because it may predispose the appearance of Supraventricular Paroxysmal Tachycardia runs of the orthodromic macro-reentry type, which use the Node-Hisian system in anterograde fashion and the parallel accessory pathway in retrograde fashion (narrow QRS complexes).

Example of anatomical macro-reentry in case of ventricular pre-excitation of the WPW type. The most frequent one is the so-called orthodromic macro-reentry, which uses in an anterograde fashion the His node system, and the anomalous pathway in a retrograde fashion. In this case, the QRS is narrow.

Orthodromic Circus Movement Tachycardia (CMT) or Orthodromic Reciprocicanting Tachycardia (ORT)

Although atrioventricular reentry tachycardia AVRT may occur at any age, it usually occurs in young patients without evidences of structural heart disease. Among patients with PSVT, male gender and onset at a younger age are more likely to be associated with AVRT than atrioventricular nodal reentrant tachycardia or atrial tachycardia.

ECG Characterization

In 20% of cases PSVT are misclassified when the diagnosis is based on only the ECG

1. *Evidence of preexcitation during sinus rhythm in a patient with a a history of tachycardia make AVRT very likely.*
2. *If the tachycardia is initiated with anterograde blocking the accessory pathway, the mechanism is very likely to be due to CMT or ORT.*
3. *Heart rate between 160-150bpm*
4. *Rhythm regular, but my be slightly irregular because of changing conduction through the AV node*
5. *Initiating P´R interval not prolonged*
6. *Narrow QRS complexes*
7. *P´ waves always separate from the QRS complexes The timing of the P´ wave respect to the QRS is a useful clue*
9. *Negative P` waves in I lead is indicative of left-side accessory pathway*

9. *Negative P waves in the inferior leads are consistent with an atrial insertion at the inferiorposterior aspect of the AV valves.*
10. *Upright P waves in the inferior leads are associated with cranio-caudal activation from the anteroseptal aspect of the AV valves.*
11. *Relatively narrow P waves typically are inscribed during ORT utilizing a septal AP, whereas broad P waves are consistent with activation over a free wall AP.*
12. *All individuals with orthodromic tachycardia had a relatively prolonged QRS-P interval.*
13. *In patients with subtle preexcitation due to a left free-wall accessory pathway, a "septal" q wave should not be present in the lateral precordial leads.*
14. *Conduction ratio 1:1*
15. *Frequent aberrant ventricular conduction HR slower with aberrancy*
16. *Frequent QRS alternans (≈30% of cases). Beat-to beat alternation of the QRS amplitude may be more commonly in ORT.*
17. *Begins and ends abrupt*
18. *Right-sided accessory pathways are associated with a greater degree of ventricular preexcitation*
19. *In patients with an equivocal ECG, administration of adenosine is helpful to unmasking preexcitation.*

Electrophysiologic Characterization

1. During sinus rhythm H-V interval <35ms strongly suggest ORT mechanism.
2. Evidence of eccentric Atrial activation during the ventricular pacing support the diagnosis of ORT
3. Lack of ventriculoatrial (VA) conduction makes ORT extremely unlikely
4. During the event if the high atrial electrogram is recorder within or at the end of QRS complex ORT may be rule out
5. A V-A time <70ms as measured on the His bundle electrogram is extremely specific of AV nodal reentrant tachycardia and rule out ORT.
6. An intermittent bundle branch block during supraventricular tachycardia with prolongation of V-A interval is diagnosis of ORT
7. Increase on VA interval >20ms with BBB has a positive predictive value of 100% of ORT.
8. If the VA time >30ms the tachycardia is using a free-wall accessory pathway
9. Prolongation of V-A interval by less that 30ms is consistent with left posterior accessory pathway when a left bundle branch block is present and with anteroseptal accessory pathway whe a right bundle branch block is present.
10. In patients with sudden onset regular tachycardia and a normal ECG during sinus rhythm, a transesophageal VA interval of ≤80 ms has the highest diagnostic accuracy to diagnose AVNRT versus AVRT/ ectopic atrial tachycardia (EAT). Overall, the biphasic distribution of VA intervals suggests considering AVNRT at 90 ms and below and AVRT between 91 and 160 ms (in particular in male patients) while the diagnosis is vague at VA intervals above 160 ms.(1)

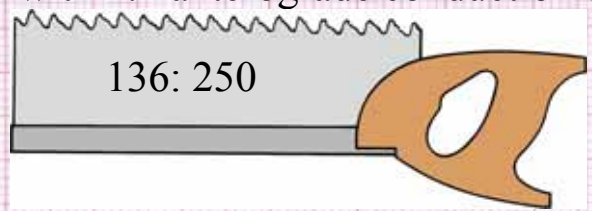
1. **Braunschweig F, Christel P, Jensen-Urstad M, et al. Paroxysmal regular supraventricular tachycardia: the diagnostic accuracy of the transesophageal ventriculo-atrial interval. Ann Noninvasive Electrocardiol.2011 Oct;16:327-335.**

ECG2

Greater or lesser percentage of ventricular activation by the anomalous bundle, broader or narrower QRS respectively

δ δ δ δ

Typical type 1 atrial flutter with 2:1 anterograde conduction over a left lateral accessory pathway.



F F F F F F F F F F F F F F F F

Typical type I atrial "F" waves with saw tooth or picket-fence appearance, observed better in II.

d'ÁVILA'S ALGORITHM TO LOCATE ACCESORY PATHWAY ON THE BASIS OF QRS COMPLEX POLARITY

It is based on QRS complex polarity analysis in 5 electrocardiographic leads, to locate the accessory bundle

SEQUENCE OF THE ANALYSIS

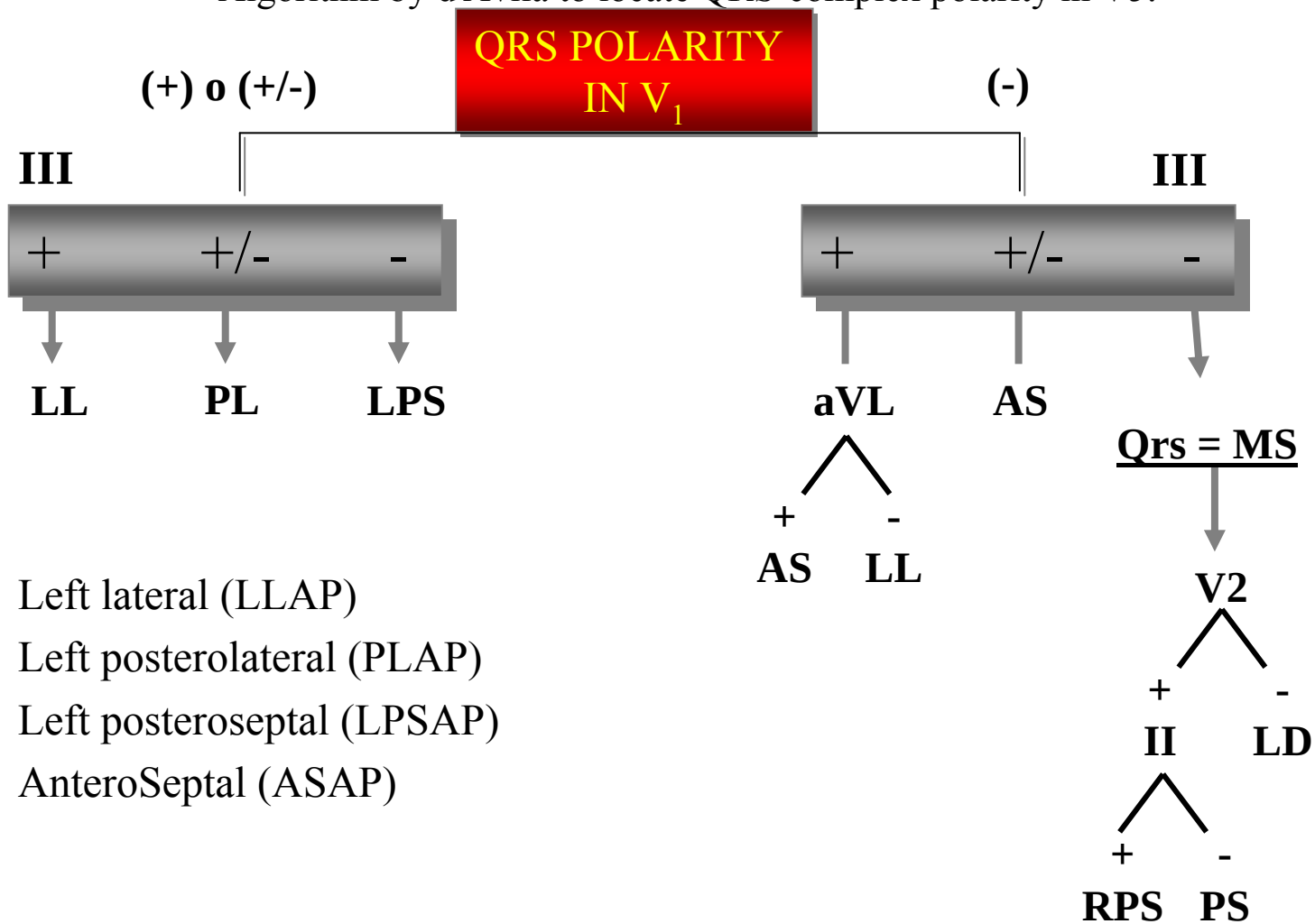
1º STEP: to define QRS complex polarity in V1. Two possibilities: positive or plus-minus or negative;
2º STEP: in case of being positive or plus-minus in V1, the III lead should be checked next. If it is positive, this is a left lateral accessory pathway (LLAP). If it is isodiphasic plus-minus, this is a left postero-lateral pathway (PLAP). Finally, if III is negative, the AP will be left postero-septal (LPSAP).

If polarity in V1 is negative and positive in aVF: anteroseptal (ASAP). If it is negative in aVL, it is left lateral (LLAP). If it is plus-minus in III, it is anteroseptal (ASAP).
The following algorithm shows how our line of reasoning should be.

Algorithm by d'Avila to locate QRS-complex polarity in V5.

d'ÁVILA'S ALGORITHM TO LOCATE THE ACCESSORY PATHWAY ON THE BASIS OF QRS COMPLEX POLARITY

Algorithm by d'Avila to locate QRS-complex polarity in V5.



Left lateral (LLAP)

Left posterolateral (PLAP)

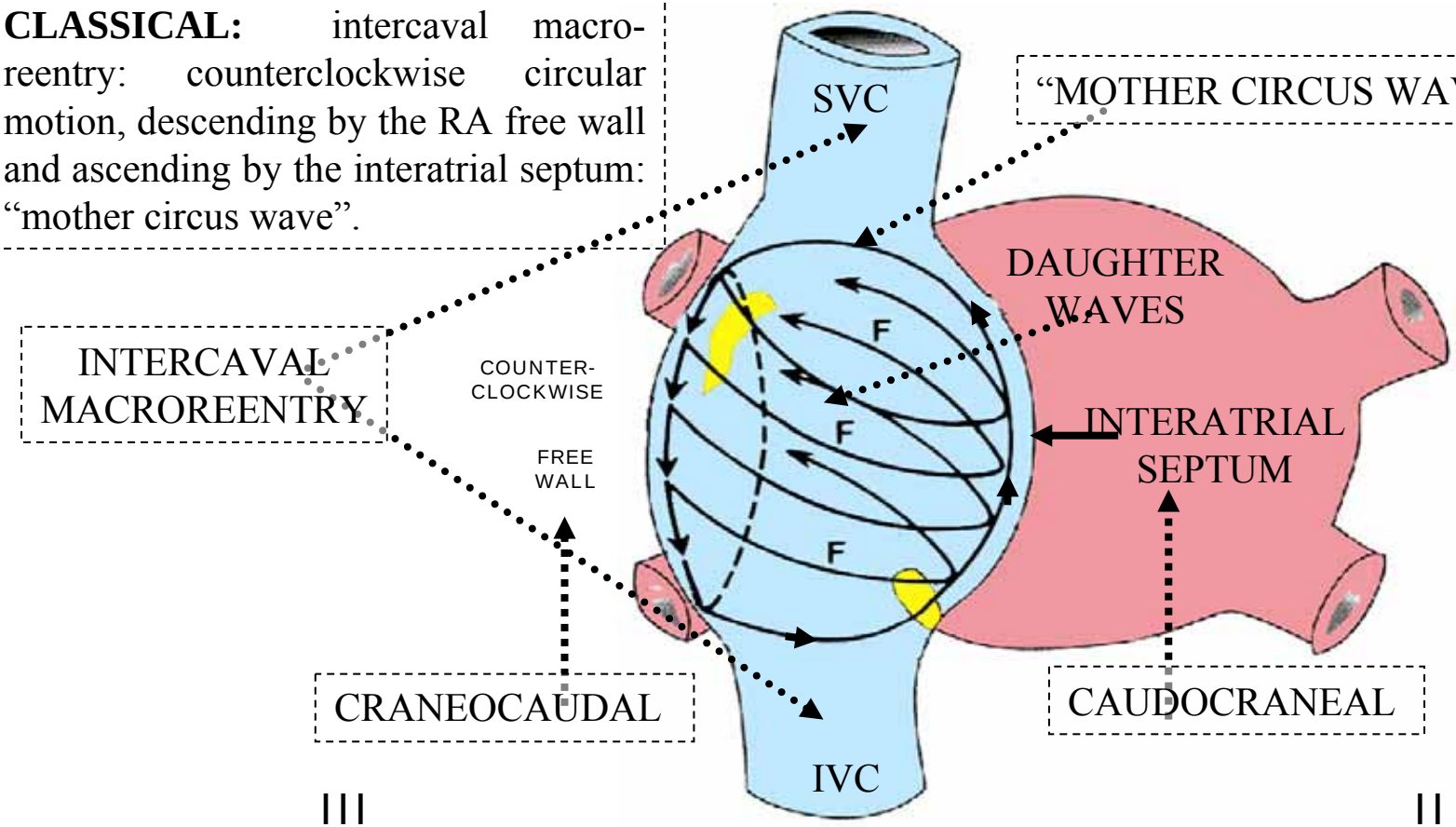
Left posteroseptal (LPSAP)

AnteroSeptal (ASAP)

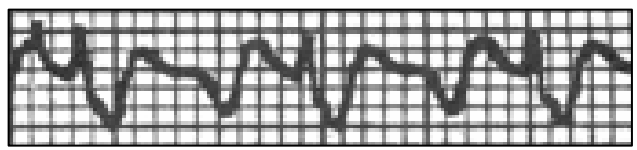
1. **d' Ávila, Brugada J, Skeberis V, Andries E, Sosa E, Brugada P. . A fast and reliable algorithm to localize accessory pathways based on the polarity of the QRS complex on the surface ECG during sinus rhythm.Pacing Clin Electrophysiol 1995;18:1615-1627.**

DROMOTROPIC MECHANISMS BY MACRO-REENTRY IN ATRIAL FLUTTER

FLUTTER TYPE I OR CLASSICAL: intercaval macro-reentry: counterclockwise circular motion, descending by the RA free wall and ascending by the interatrial septum: "mother circus wave".

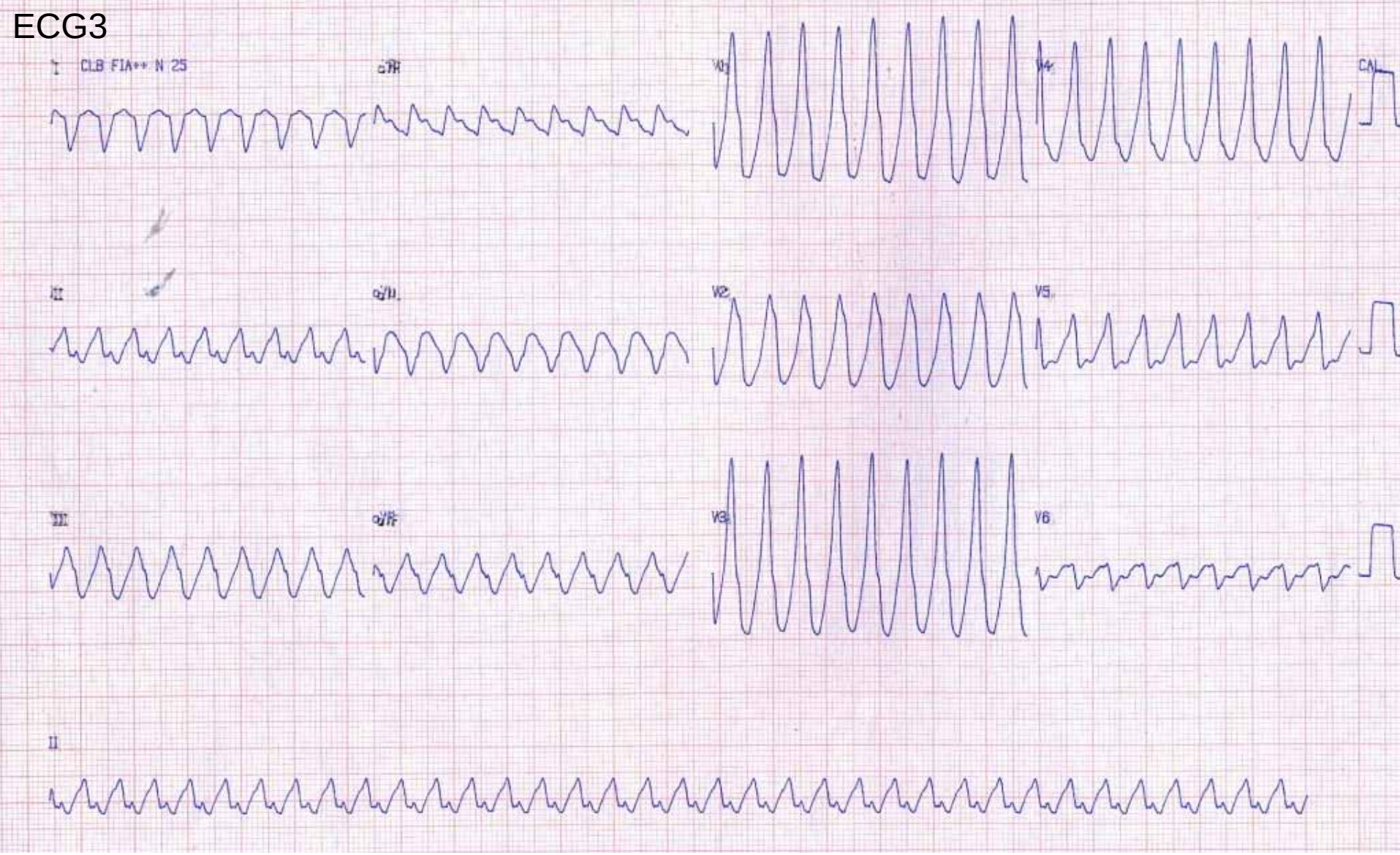


F waves of negative polarity in II, III and aVF without baseline



Outline of macro-reentry in atypical flutter.

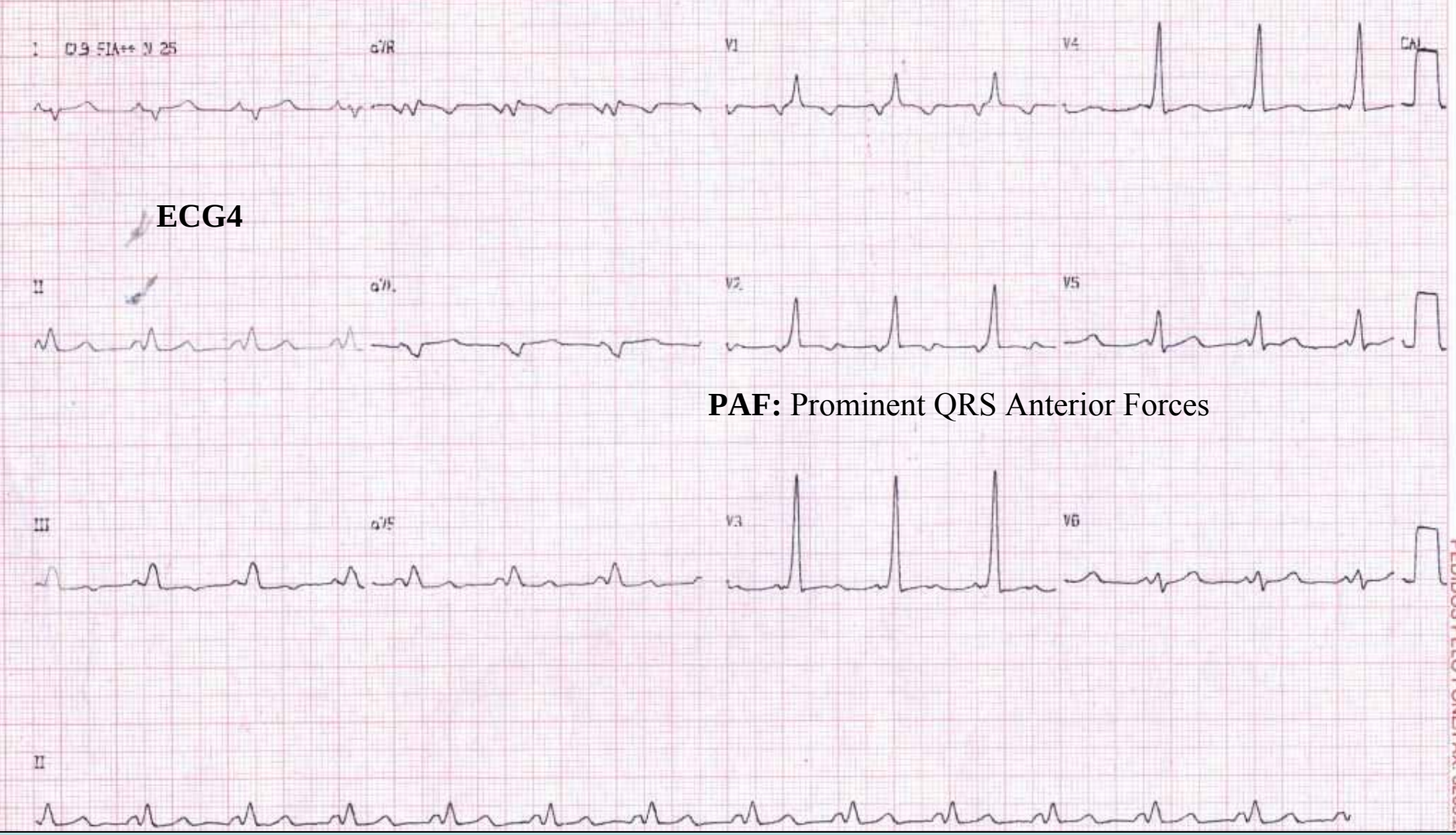
ECG3



Atrial flutter 1:1 conduction over the same accessory pathway (DD: antidromic tachycardia involving the pathway) HR; 240bpm1:1 AV conduction (rare). It is a medical emergency. The ventricular rate near 300 bpm must be treated immediately. 1:1 AV conduction may be found in the following circumstances: Preexcitation of WPW type, because the stimulus is conduced in anterograde fashion by the AP;

Atrial flutter secondary to hyperthyroidism;
Flutter of the pediatric group;
Consequence of initial use of IA class drugs (quinidine, procainamide or disopyramide) by atrial slowing and by vagolytic anti-cholinergic action in the AV junction that this group of drugs causes, especially if the drugs were used without administering dixogin, calcium antagonists or β-blockers previously in order to control the rate of ventricular response.
Some patients with atrial flutter or atrial fibrillation and preexcitation syndrome (Wolff-Parkinson-White syndrome) are at risk for 1:1 conduction via their AP when nodal agents preferentially block the AV node. This can cause ventricular fibrillation.
Because the patient is unstable (hypotension, poor perfusion), synchronous direct-current (DC) cardioversion was the initial treatment (choice approach).
Cardioversion may be successful with energies as low as 25 joules, but since 100 joules is virtually always successful, this may be a reasonable initial shock strength.
If the electrical shock results in atrial fibrillation, a second shock at a higher energy level is used to restore normal sinus rhythm.
Antiarrhythmic drugs alone control atrial flutter in only 50-60% of patients. Since the early 1990s, radiofrequency catheter ablation (RFCA) has been used to interrupt the reentrant circuit in the right atrium and prevent recurrences of atrial flutter. RFCA is immediately successful in more than 90% of cases and avoids the long-term toxicity observed with antiarrhythmic drugs. It is the long-term treatment of choice in patients with symptomatic atrial flutter. Recently, Sud et al(1) describes a 34-year-old male with the WPW syndrome who presented with the unusual finding of a tachyarrhythmia-induced cardiomyopathy secondary to atrial flutter with 1:1 conduction through a left-lateral accessory pathway. RFCA of the accessory connection resulted in complete normalization of cardiac function.

1. **Sud M, Wellens HJ, Jassal DS, Khadem A. Dilated cardiomyopathy: an unexpected complication of rapidly conducted atrial flutter in the Wolff-Parkinson-White syndrome.Can J Cardiol. 2012 Jan-Feb;28:119.e5-7.**



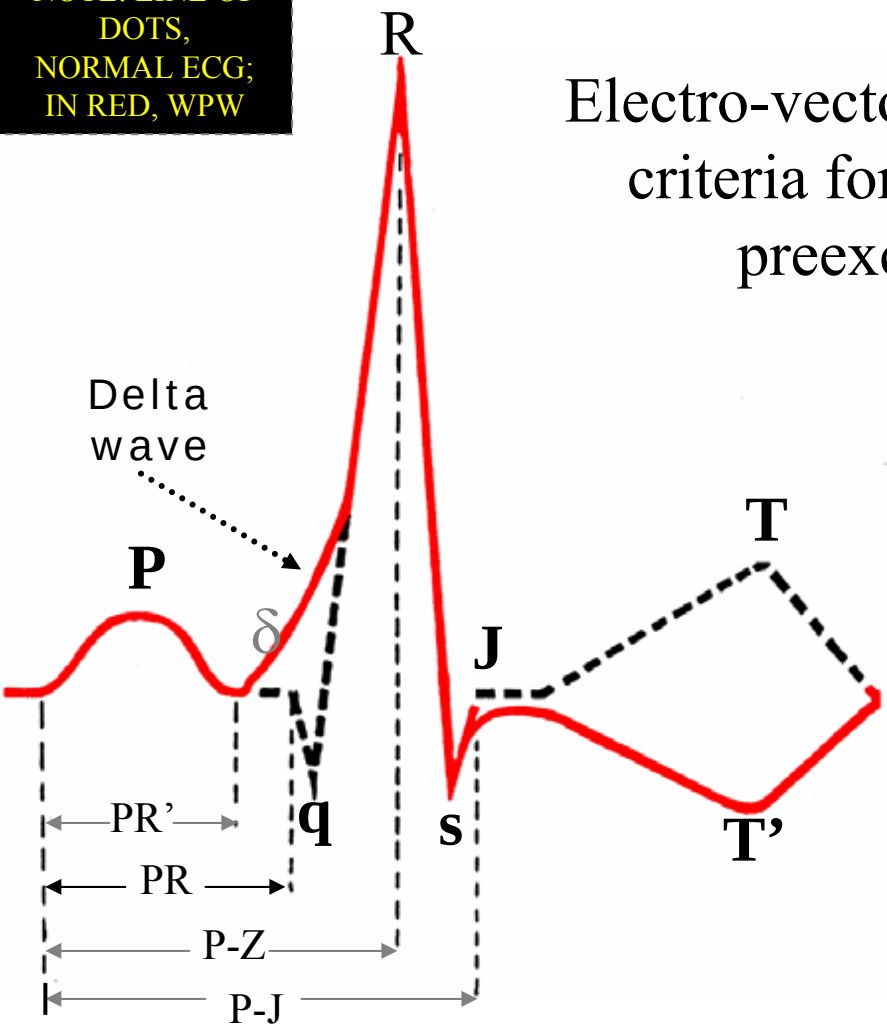
Sinus rhythm, HR= 83bpm, short PRi interval(<120 ms), QRS axis +120º, wider QRS complexes (≥110 ms), thickening or notch at the onset of QRS complexes (delta δ wave), prominent QRS anterior forces from V1 to V4 and complexes with great R voltage with positive delta wave in these leads, positive QRS complex in III, negative delta wave in I and aVL**: Left Lateral Accessory Pathway (LLAP)**

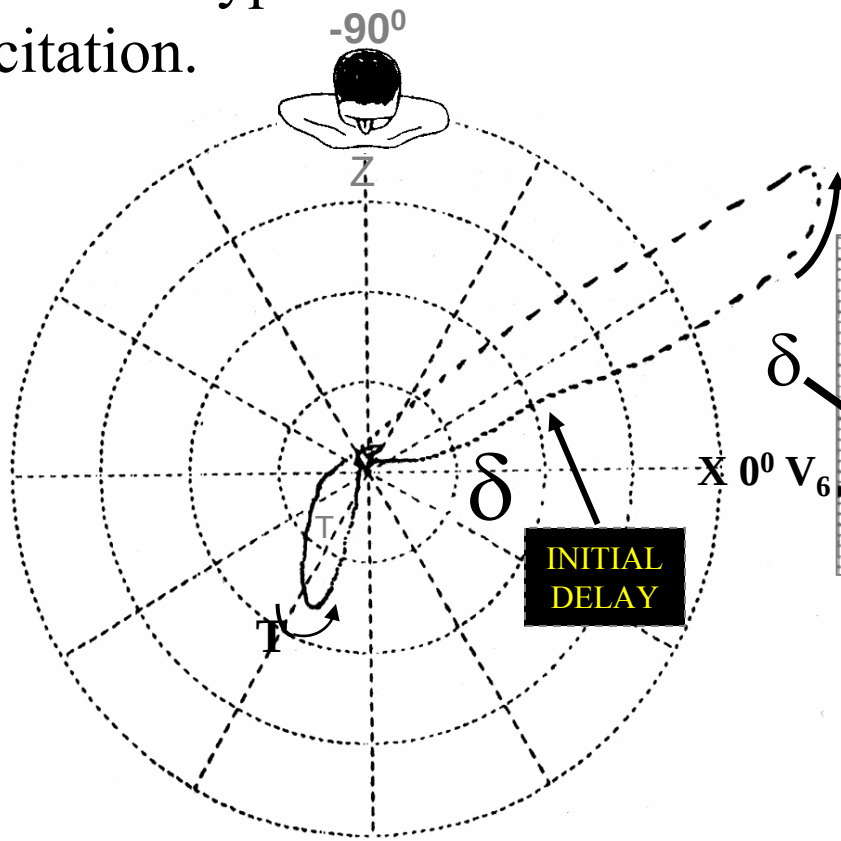
Secondary alterations of ventricular repolarization (ST-T) on right precordial leads: depending on aberrant depolarization.

WPW ECG/VCG CORRELATION

NOTE: LINE OF DOTS, NORMAL ECG; IN RED, WPW

Electro-vectocardiographic criteria for WPW type preexcitation.





PRi or PQ: since the onset of P up to the onset of QRS. It represents the time the stimulus takes to go from the SA node until reaching the ventricles: 120 ms to 200 ms.

PZ: distance between P wave onset until R apex: 150 to 230 ms.

PJ: distance between P wave onset until J point: 180 to 260 ms.

PREEXCITATION BY KENT ACCESSORY PATHWAYS, CLASSICAL OR WPW TYPE ELECTRO-VECTOCARDIOGRAPHIC CRITERIA

1) *Short PRi interval: <120 ms in adults and 90 ms in children;*

2) *Wider QRS complex: ≥100 ms 70% of the cases. 30% < 100 ms;*

3) *Thickening or notch at the onset of QRS complex: DELTA δ wave, duration 30 ms to 60 ms and voltage of up to 5 mm, which corresponds to early depolarization by ventricular mass*

4) *Unaltered P-J interval (*distance between P wave onset until J point:*): 180 to 260 ms*

5) *Unaltered P-Z interval (*distance between P wave onset until R apex*): 230 ms (150 to 230 ms);*

6) *Secondary alterations of ventricular repolarization (ST-T): depending on aberrant depolarization;*

7) *Frequent association with tachyarrhythmias (40% to 80% of cases): if they are absent, "WPW pattern;" if they are present, WPW syndrome: PSVT either orthodromic (90%), antidromic (10%), AF (20%), atrial flutter, or ventricular fibrillation.*

8) *Characteristic initial delay of QRS loop in the three VCG planes (delta loop δ).*

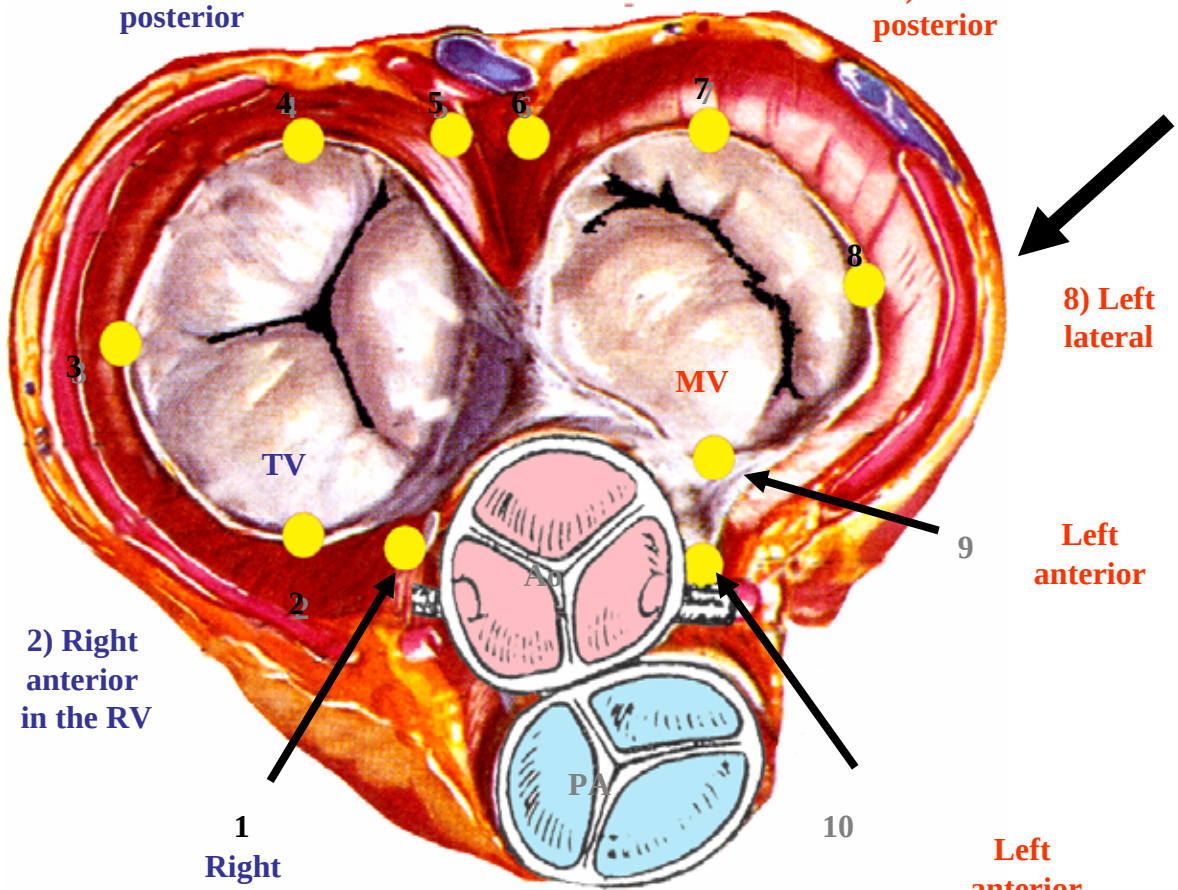
Electro-vectocardiographic criteria for WPW type of preexcitation.

POSSIBLE LOCATIONS OF ANOMALOUS PATHWAYS IN WPW SYNDROME

1) Right anterior paraseptal or anterior septal.
2) Right anterior in the RV.
3) Right lateral.
4) Right posterior.
5) Right posterior paraseptal.
6) Left posterior paraseptal.
7) Left posterior.
8) Left lateral.
9) Left anterior.
10) Left anterior paraseptal or antero-lateral in the LV.

Classification by Gallagher of the possible locations of APs in WPW syndrome.

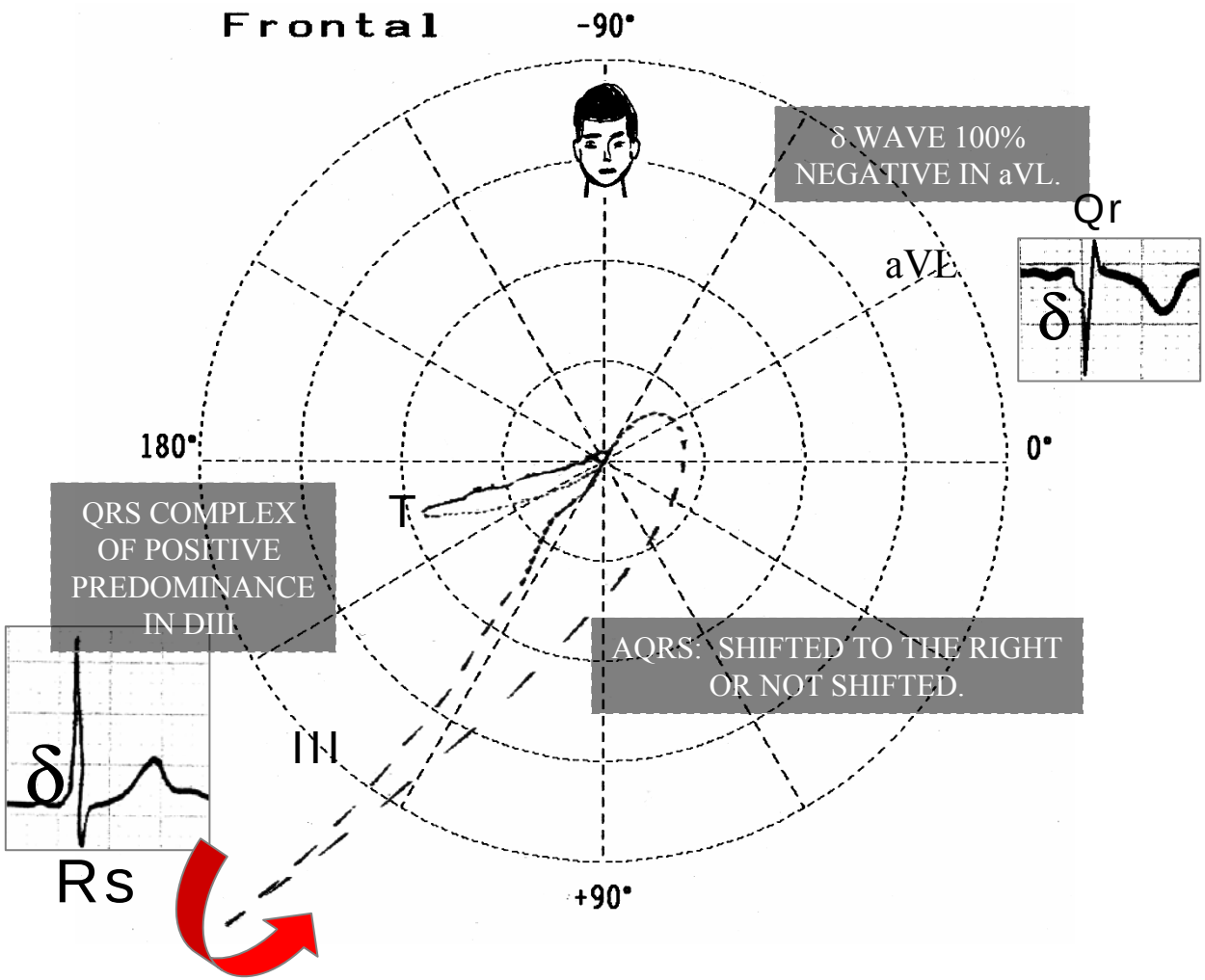
LOCATIONS OF ANOMALOUS PATHWAYS IN WPW



Gallagher JJ Prog Cardiovasc Dis 1978;324:1612-18

Classification by Gallagher of the possible locations of anomalous bundles in WPW syndrome.

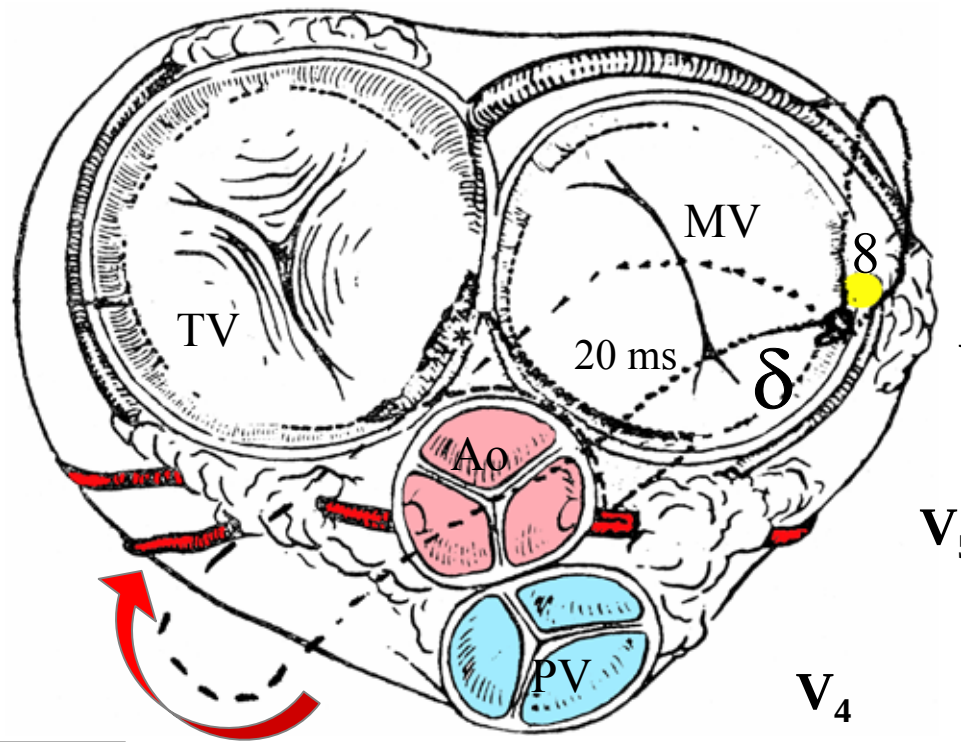
LEFT LATERAL PREEXCITATION IN THE FRONTAL PLANE

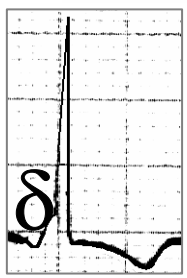


ECG/VCG correlation in the frontal plane. Negative delta wave in aVL in 100% of the cases. QRS axis with frequent shift to the right and delta wave in QRS complexes of positive predominance in III.

PREMATURE VENTRICULAR EPICARDIAL EXCITATION IN THE LV LATERAL FREE WALL

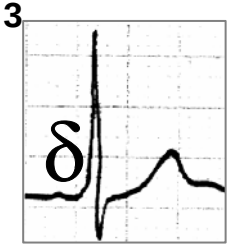
LEFT LATERAL PREEXCITATION IN THE HORIZONTAL PLANE





R > S or R from V_1 to V_3

: positive δ from V_1 to V_3



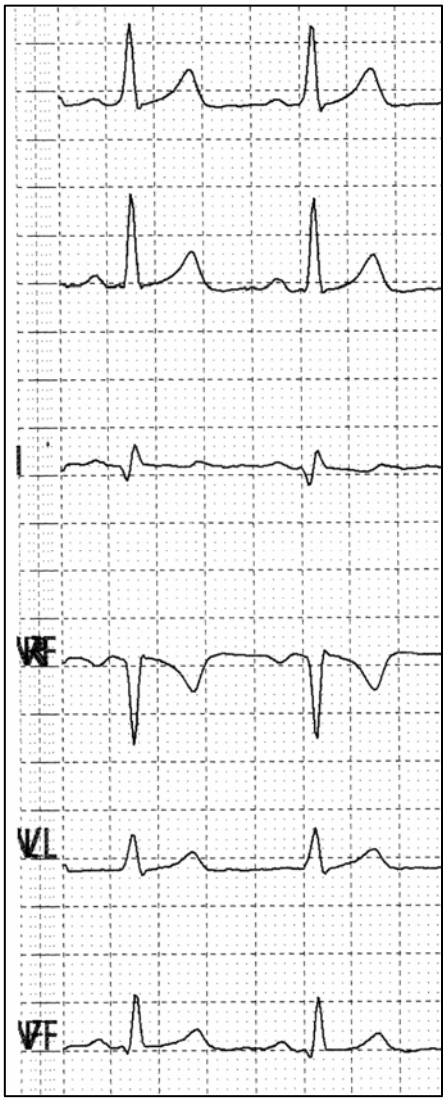
DIFFERENTIAL DIAGNOSIS WITH LATERAL OR ANTEROLATERAL MI.

IT CORRESPONDS TO C TYPE WPW OF ROSENBAUM, III OF THE EUROPEAN CLASSIFICATION, REGION I OF LINDSAY'S CLASSIFICATION AND POINT 8 OF GALLAGHER.

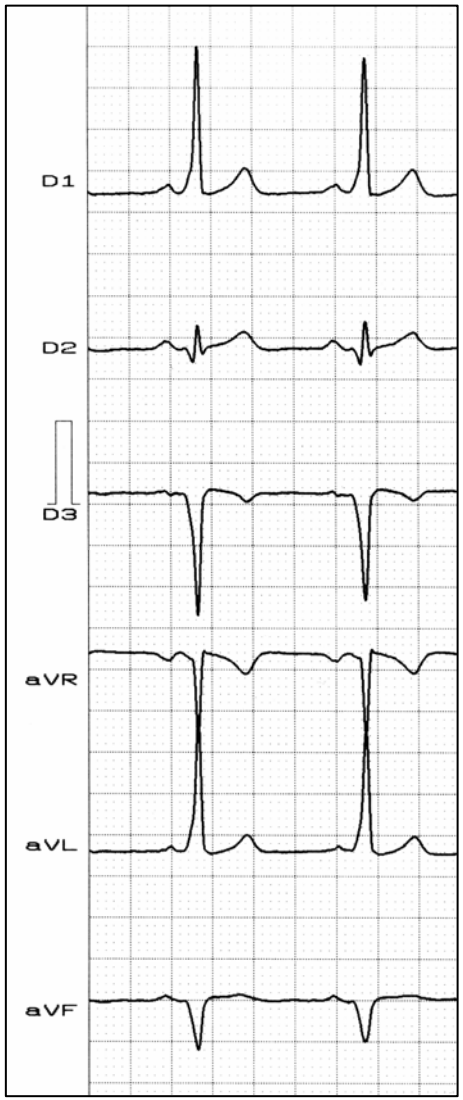
QRS complexes with great voltage in V1, and R > S from V1 to V3 with positive delta wave in these leads.

DIFFERENT DEGREES OF PREEXCITATION
FRONTAL PLANE

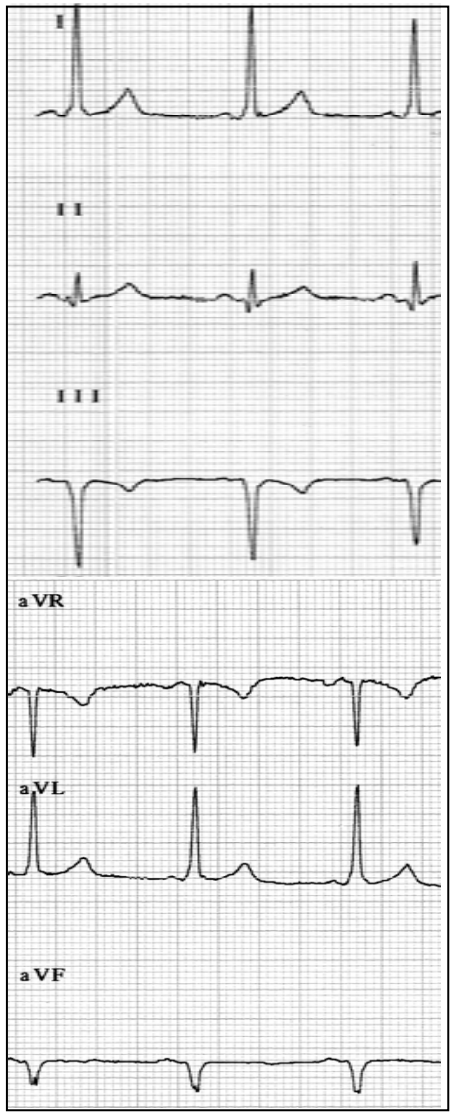
Date: 13/05/2005

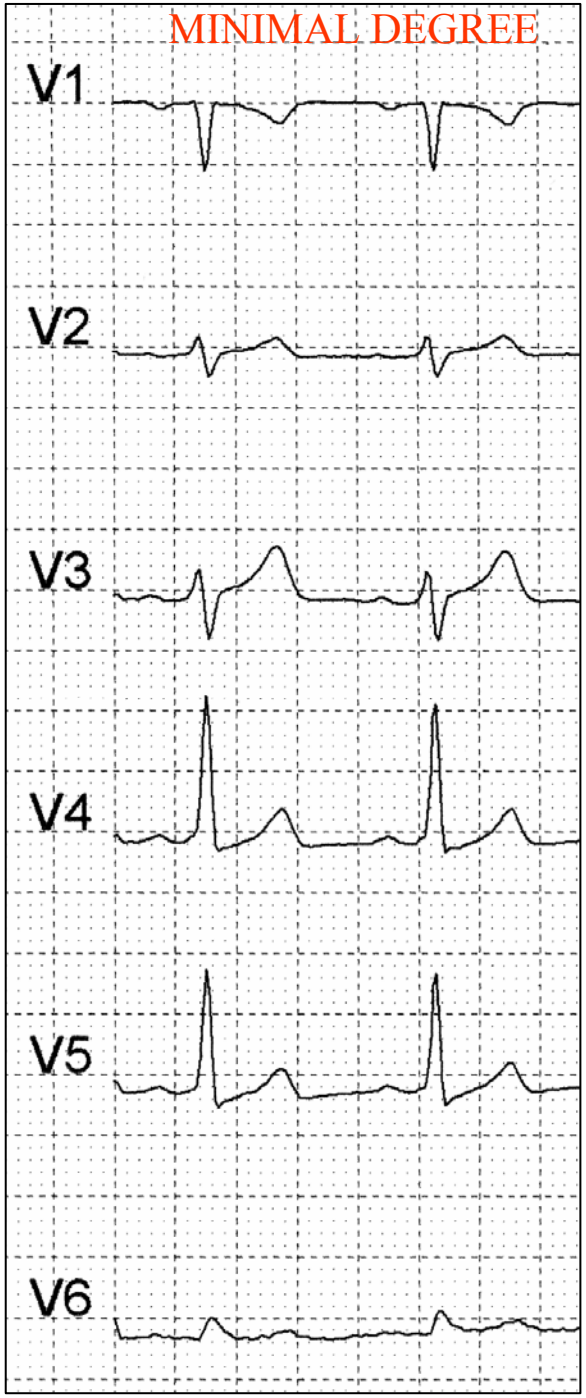


Date: 21/08/2008

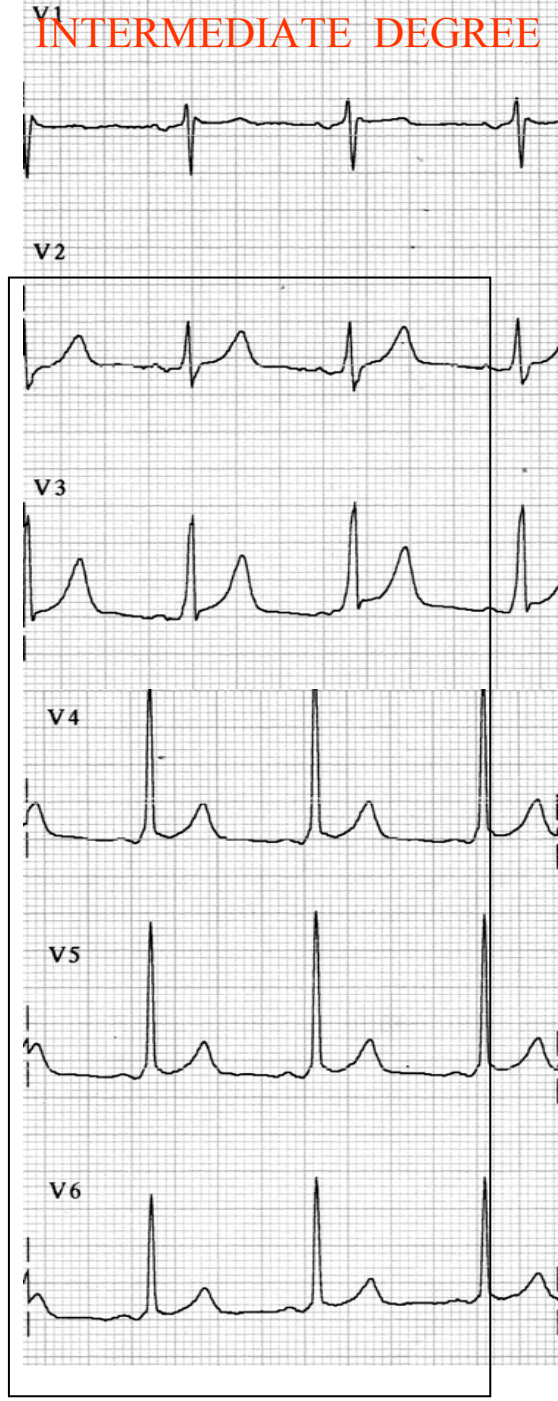


Date: 22/08/2008




MINIMAL DEGREE
V1
V2
V3
V4
V5
V6


MAXIMAL DEGREE
V1
V2
V3
V4
V5
V6


INTERMEDIATE DEGREE
V1
V2
V3
V4
V5
V6