



Localization of Accessory Pathways, Insights from the ECG

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The American Heart Journal

VOL. V

AUGUST, 1930

No. 6

Original Communications

BUNDLE-BRANCH BLOCK WITH SHORT P-R INTERVAL IN HEALTHY YOUNG PEOPLE PRONE TO PAROXYSMAL TACHYCARDIA

LOUIS WOLFF, M.D., BOSTON, MASS., JOHN PARKINSON, M.D., LONDON,
ENG., AND PAUL D. WHITE, M.D., BOSTON, MASS.

ABERRANT ventricular complexes of the type generally recognized as indicating bundle-branch block were first produced by Eppinger and Rothberger,^{3, 4} by the experimental division of the right branch of the His bundle. Eppinger and Stoerk⁵ observed similar curves in five patients, and at autopsy demonstrated division of the right branch of the His bundle in two of these. The work of Cohn and Lewis,² and of Carter¹ indicated, however, that gross lesions of the main branches

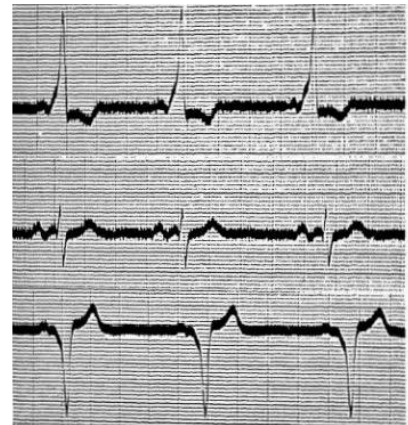
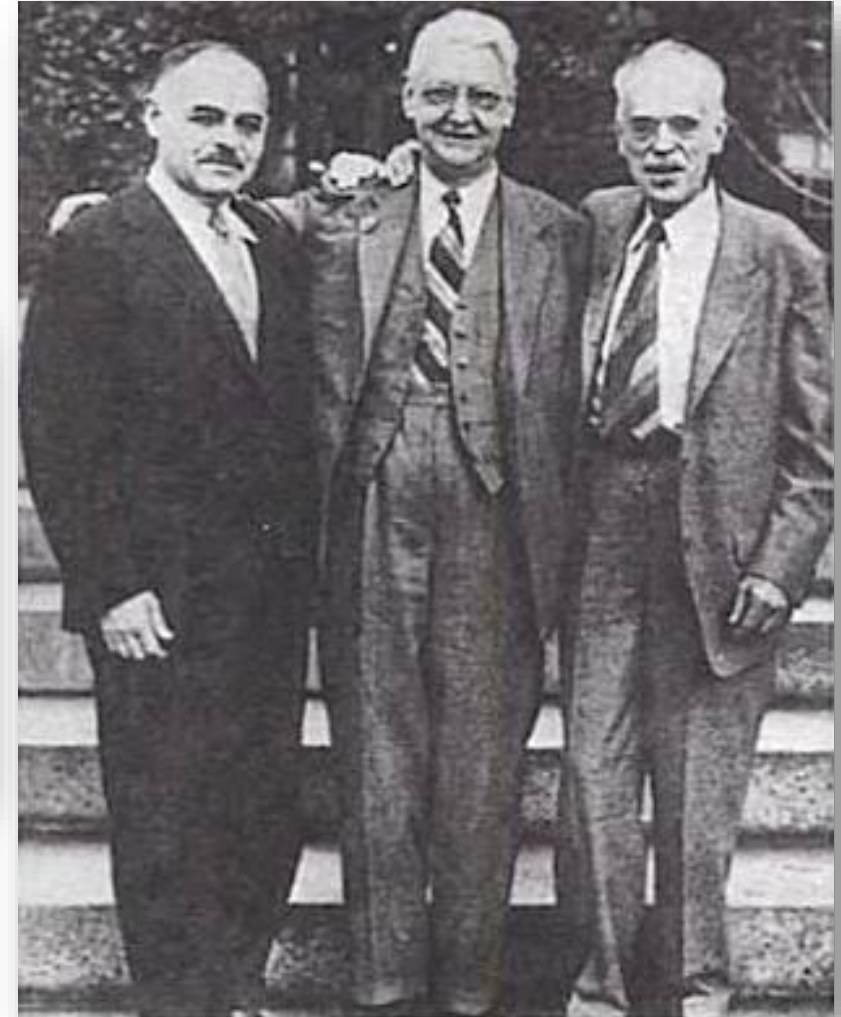
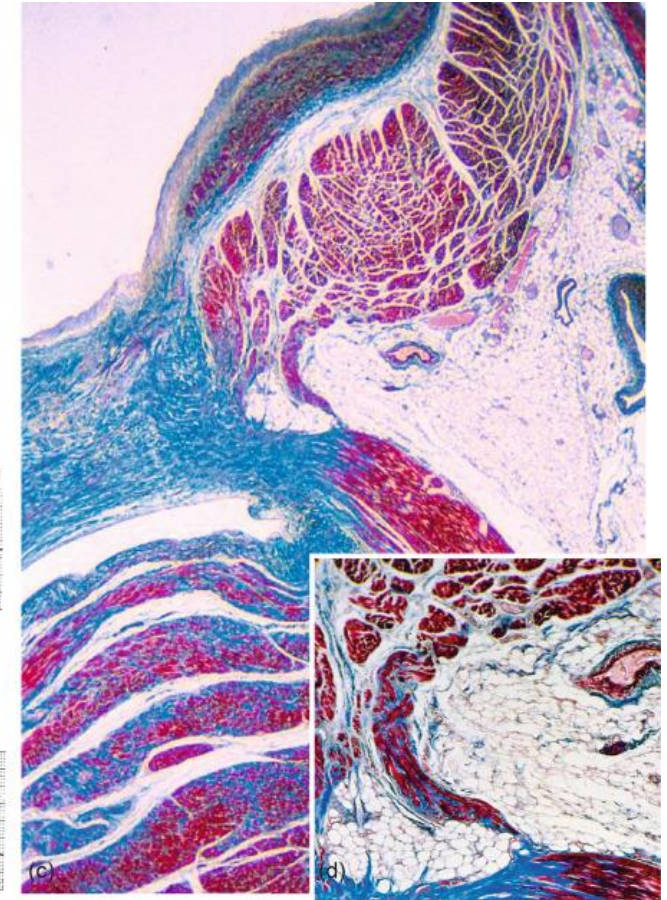
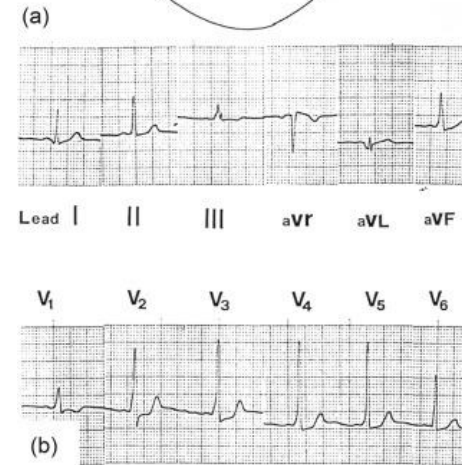
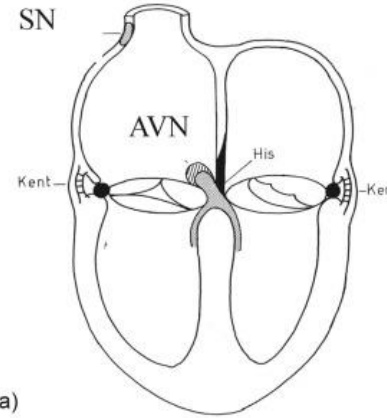
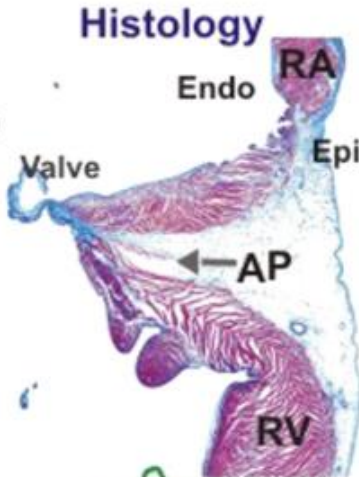
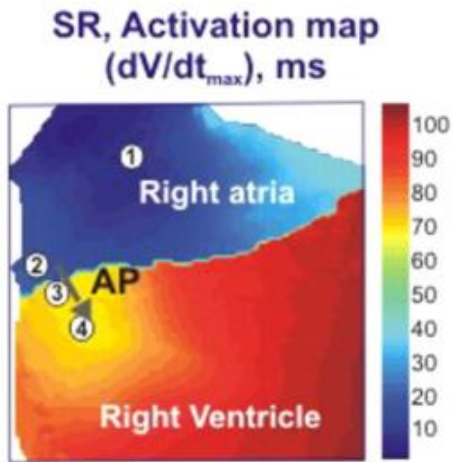
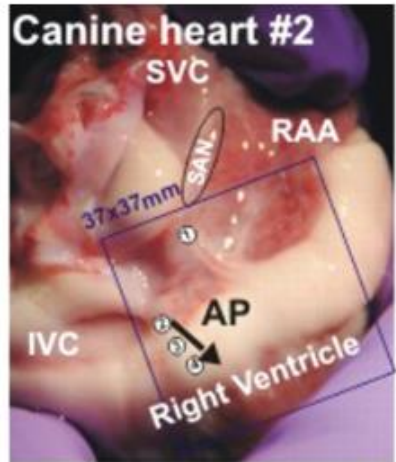


Fig 6. Case III. WPW 1930



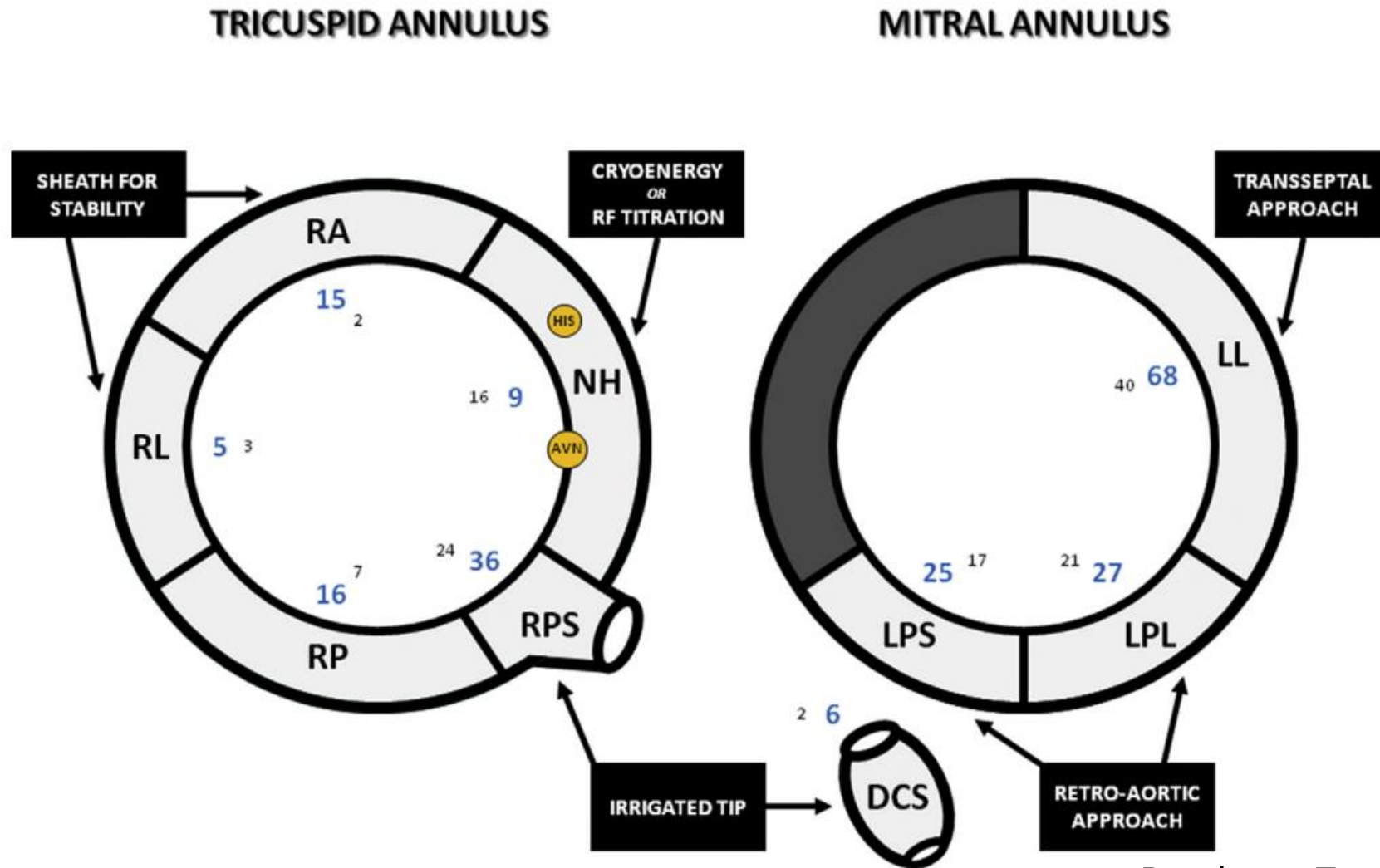
Where is the Accessory Pathway ?



Vadim V Fedorov et al, Circulation 2010

G.Thiene, ... C. Basso, in Cardiovascular Pathology 2016

Procedure Plan by ECG algorithm



Pambrun T et al, JACC EP. 2018

Why localize ?

- Ablation planning
- Patient education of risks vs benefits
- prepare septal puncture
- prepare appropriate tools like curved sheath
- anticipate AV node injury
- just academic curiosity

Googling ...

Wolff-Parkinson-White Syndrome ...

localizing accessory pathways ...

12 Lead electrocardiogram algorithm for ...

Localization of WPW (accessory Path...

rapid localisation of WPW sy...

accessory pathway by the 12-lead ECG ...

An algorithm for ECG localization of an ...

accessory pathway by the 12-lead ECG ...

rapid localisation of WPW syndr...

Wolff-Parkinson-White Syndrome ...

electrocardiogram algorithm ...

localisation of WPW ay...

localization of accessory pathways ...

Localization of WPW (accessory ...

Wolff-Parkinson-White ...

Lead electrocardiogram algorithm for ...

12 Lead electrocardiogram algorithm for ...

WPW pathway ablated from uncommon location

Heart Rhythm
accessory pathway by the 12-lead ECG

EASYPWP - a novel ECG algorithm ...

Maximal Pre-Excitation Based Algo...

Stepwise ECG algorithm ...

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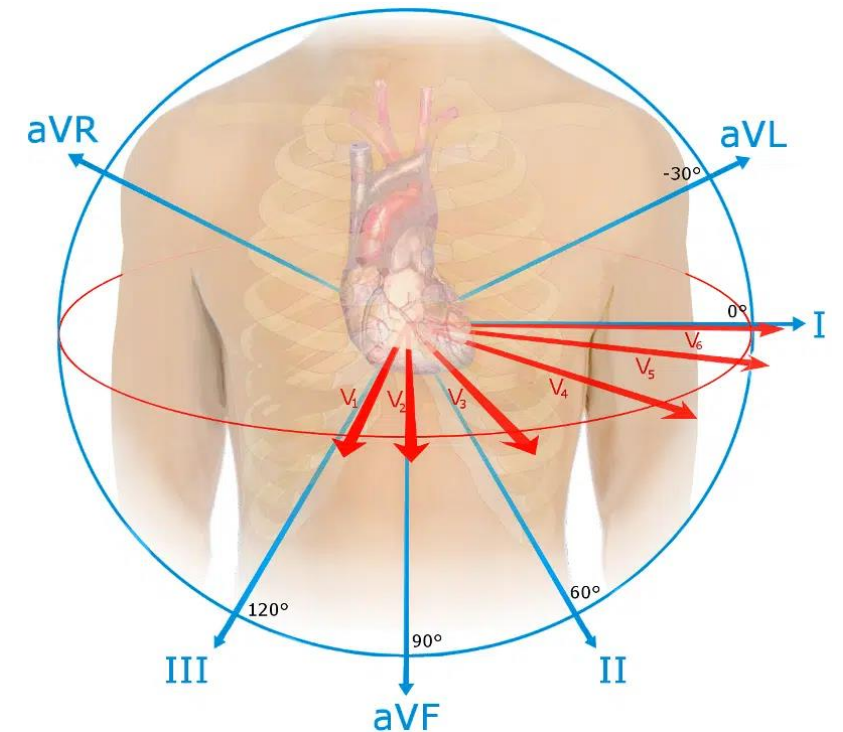
Springer-Verlag
Accessory Pathways Based on ECG ...

Pubmed (many algorithms ...)

- **Arruda MS** et al. Development and validation of an ECG algorithm for identifying accessory pathway ablation site in Wolff-Parkinson-White syndrome. J Cardiovasc Electrophysiol 1998
- Fitzpatrick AP et al. New algorithm for the localization of accessory atrioventricular connections using a baseline electrocardiogram. J Am Coll Cardiol 1994
- **Pambrun T** et al. Maximal Pre-excitation based algorithm for localization of manifest accessory pathways in adults. JACC Clin Electrophysiol 2018
- d'Avila A et al. 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
- Chiang CE et al. An accurate stepwise electrocardiographic algorithm for localization of accessory pathways in patients with Wolff-Parkinson-White syndrome from a comprehensive analysis of delta waves and R/S ratio during sinus rhythm. Am J Cardiol 1995
- Iturralde P et al. Gonzalez-Hermosillo JA. A new ECG algorithm for the localization of accessory pathways using only the polarity of the QRS complex. J Electrocardiol 1996
- **Mustapha EI** et al. EASY-WPW: a novel ECG-algorithm for easy and reliable localization of manifest accessory pathways in children and adults. EP Europace, 2023
-

Today

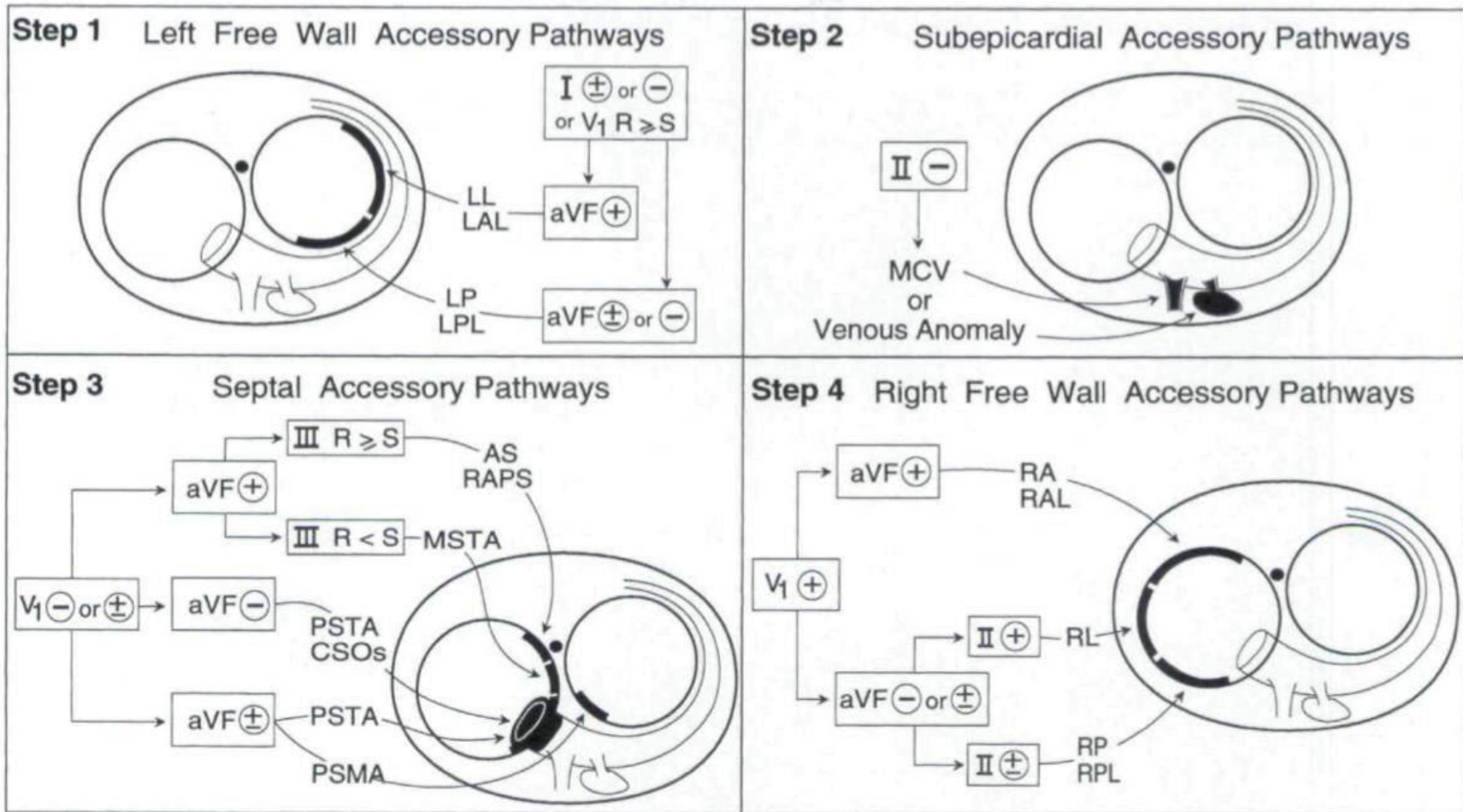
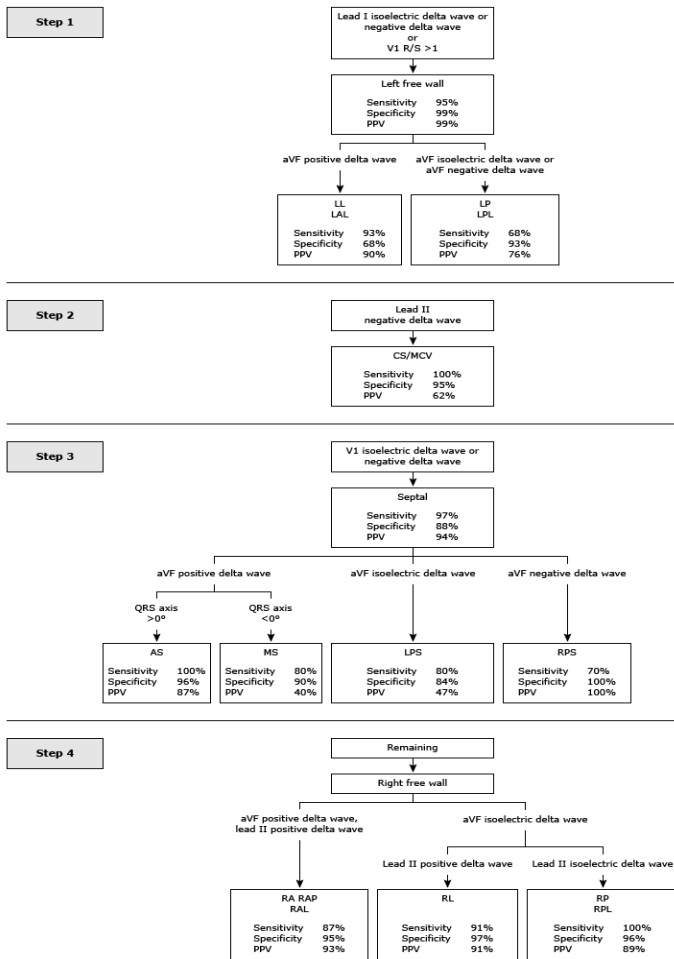
- ✓ Classic algorithm with delta wave and maximal Pre-Excitation QRS
- ✓ Negative p-wave during tachycardia
- ✓ Multiple Accessory pathways
- ✓ Specific site in WPW syndrome



1. Classic algorithm with delta wave or QRS wave



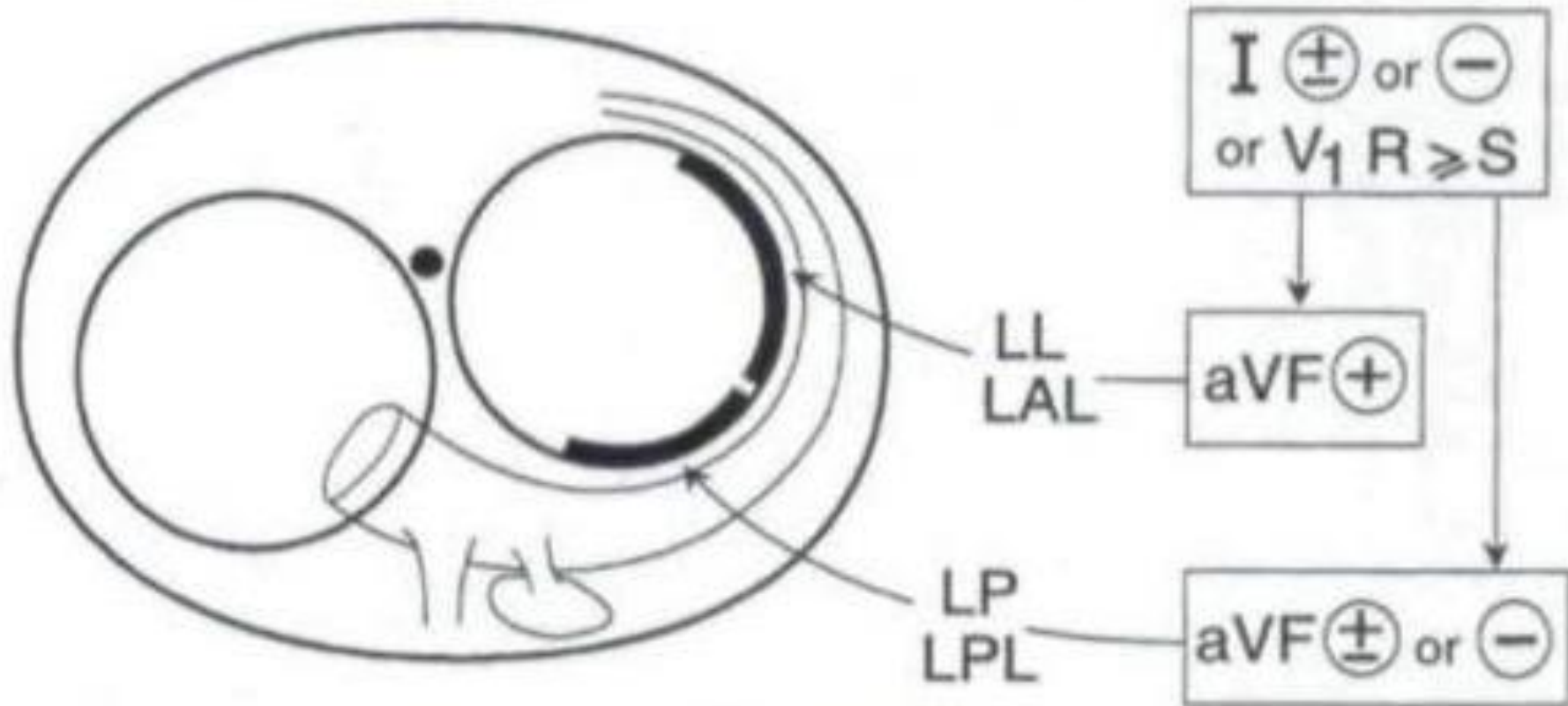
in 1998 Development and Validation of an ECG Algorithm for Identifying Accessory Pathway Ablation Site in Wolff-Parkinson-White Syndrome : The Arruda Algorithm



Arruda, M.S et al, J. Cardiovasc. Electrophys. 1998

The Arruda Algorithm : STEP 1

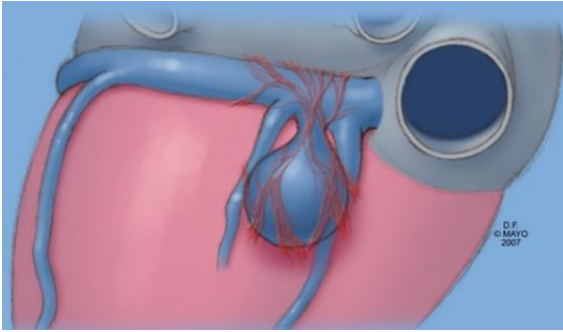
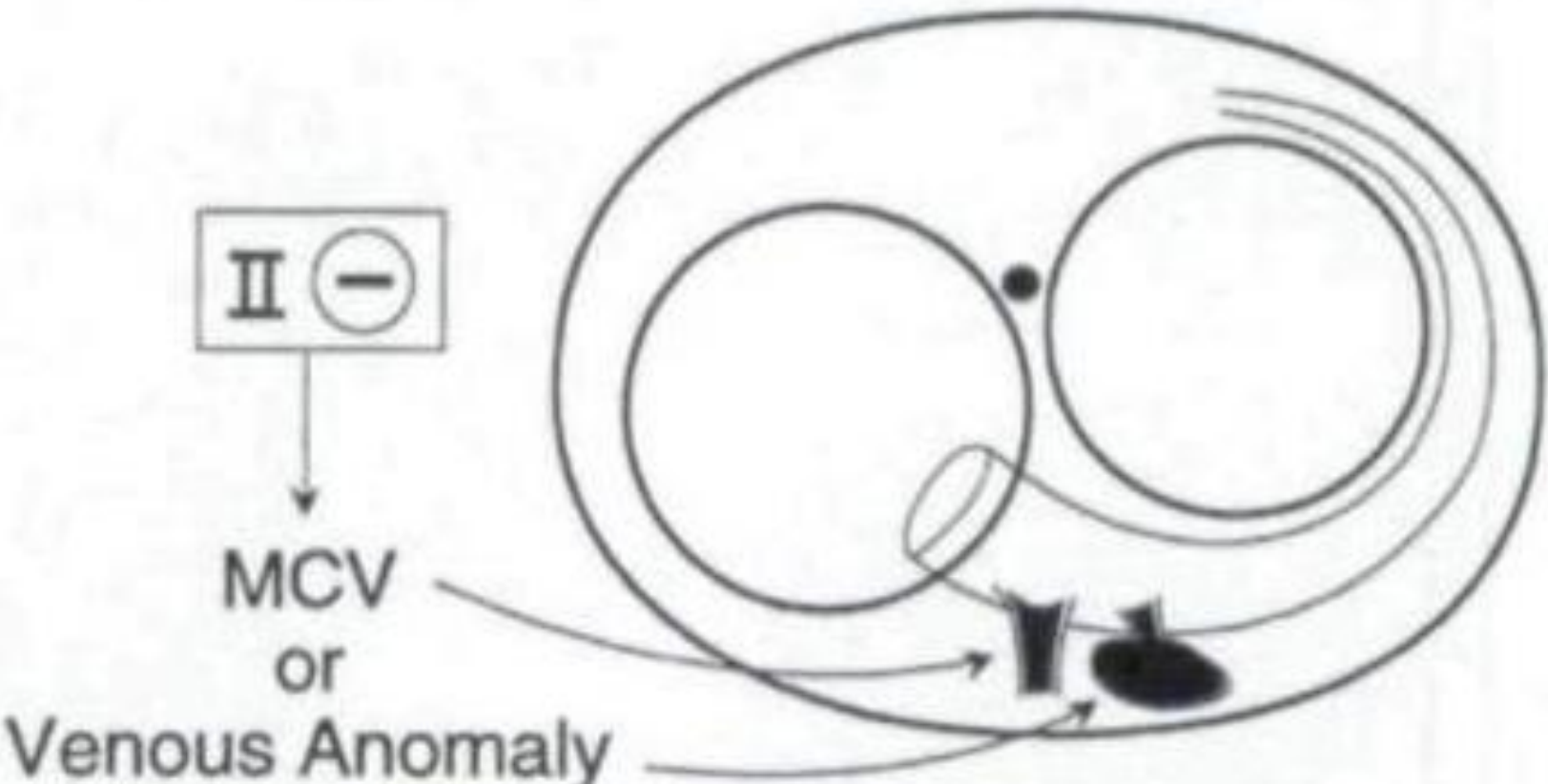
Step 1 Left Free Wall Accessory Pathways



The Arruda Algorithm : STEP 2

Step 2

Subepicardial Accessory Pathways



Lead II
negative delta wave

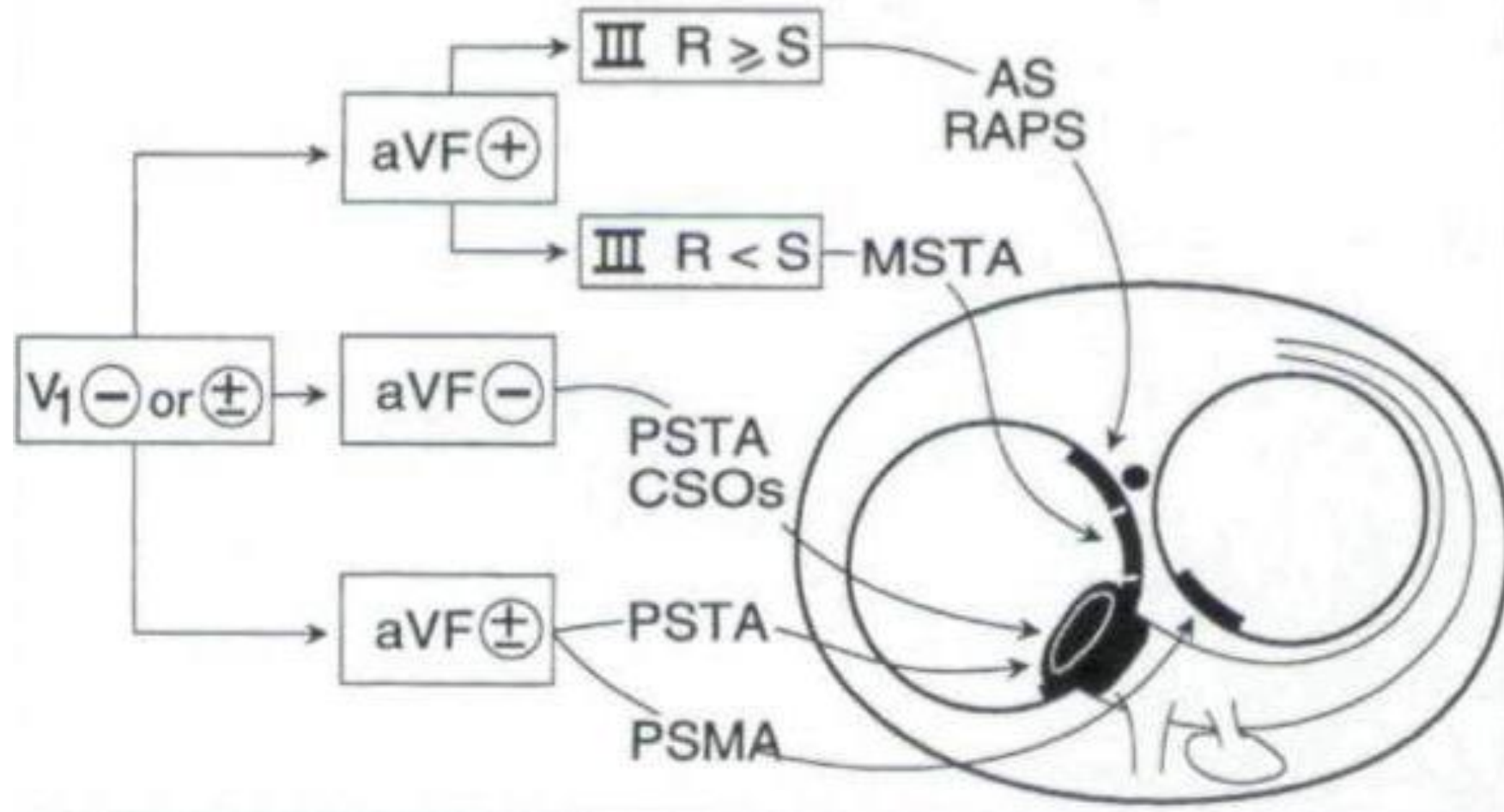
CS/MCV

Sensitivity	100%
Specificity	95%
PPV	62%

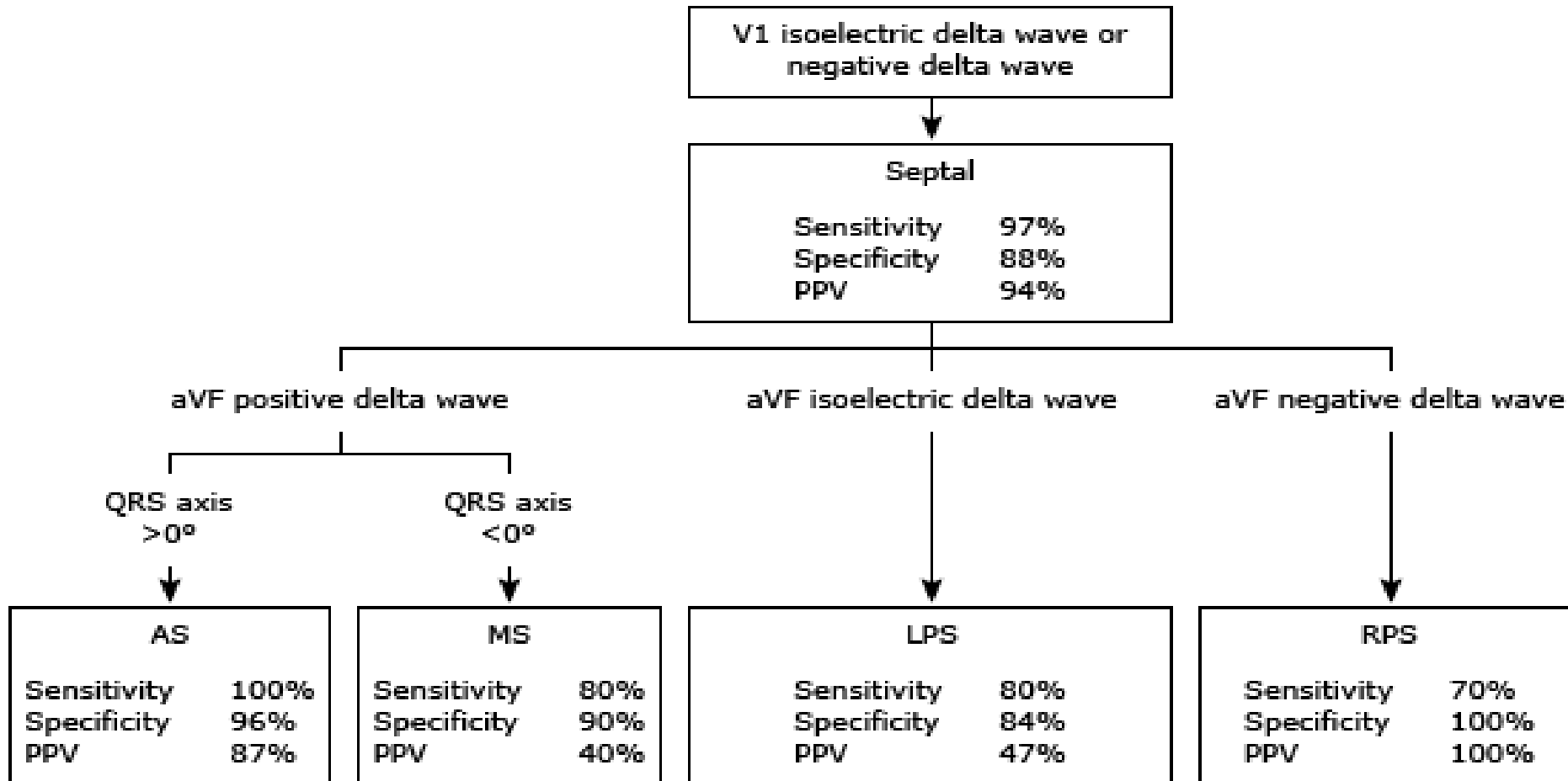
The Arruda Algorithm : STEP 3

Step 3

Septal Accessory Pathways

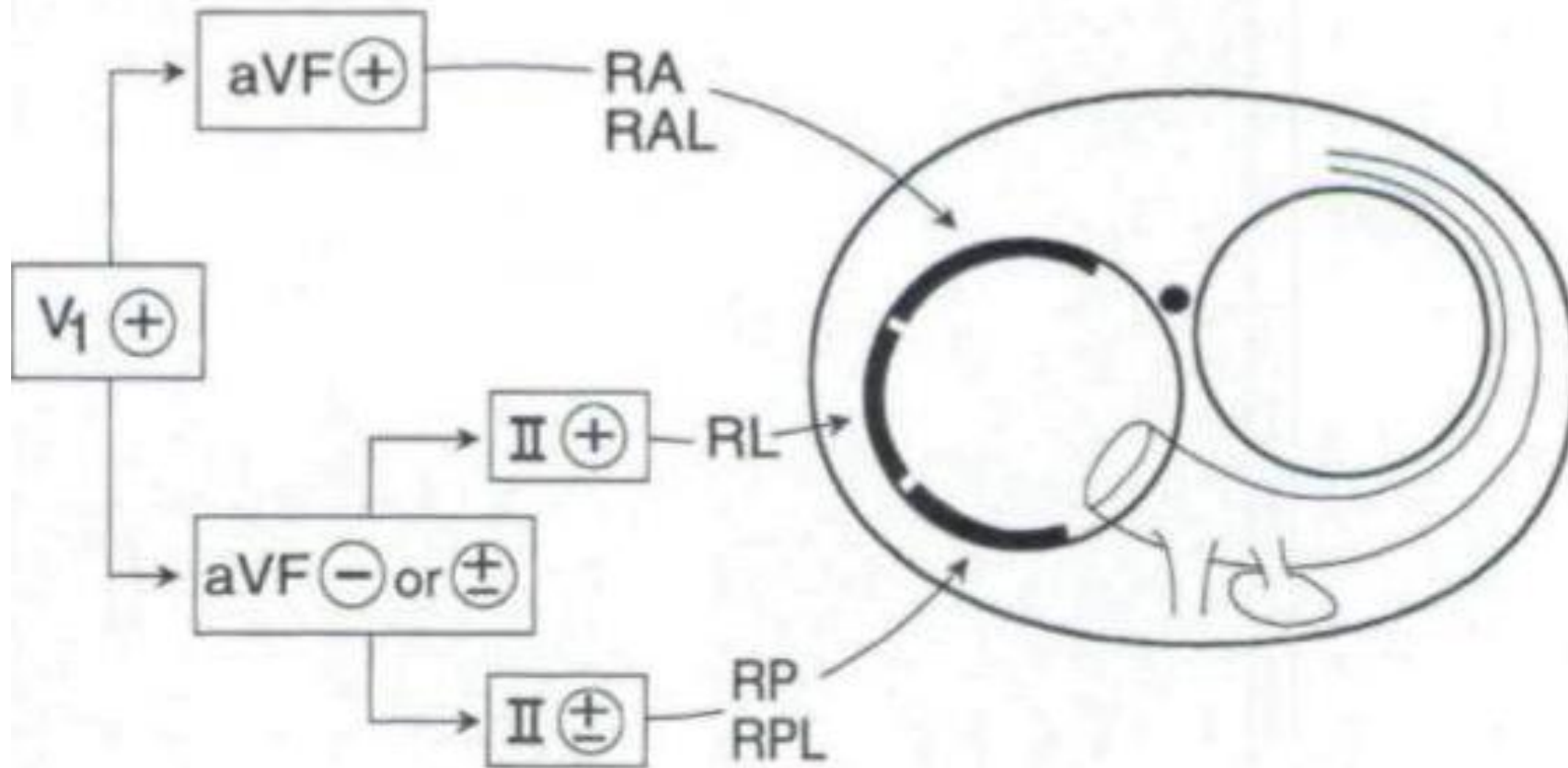


The Arruda Algorithm : STEP 3



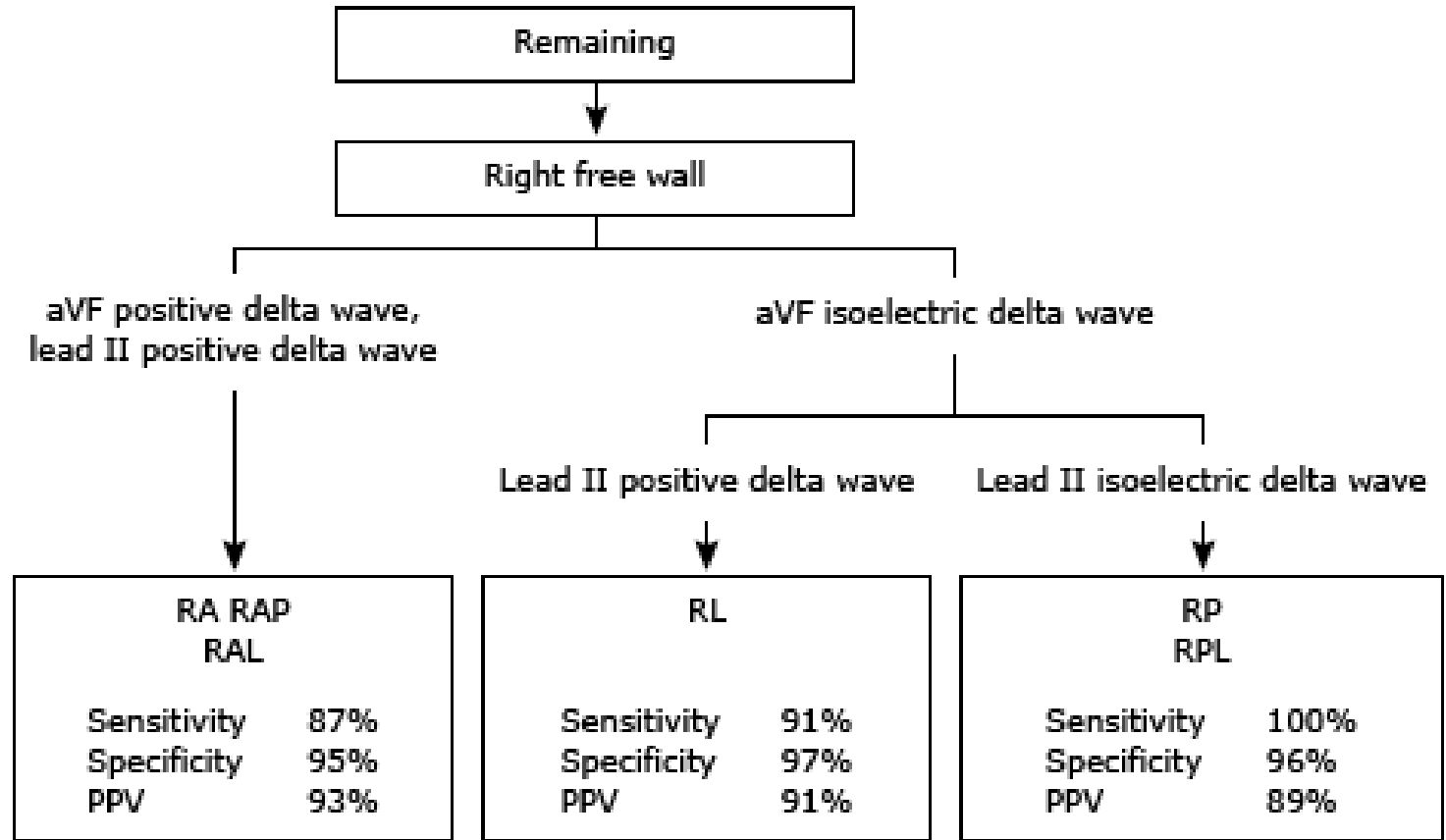
The Arruda Algorithm : STEP 4

Step 4 Right Free Wall Accessory Pathways



The Arruda Algorithm : STEP 4

Step 4





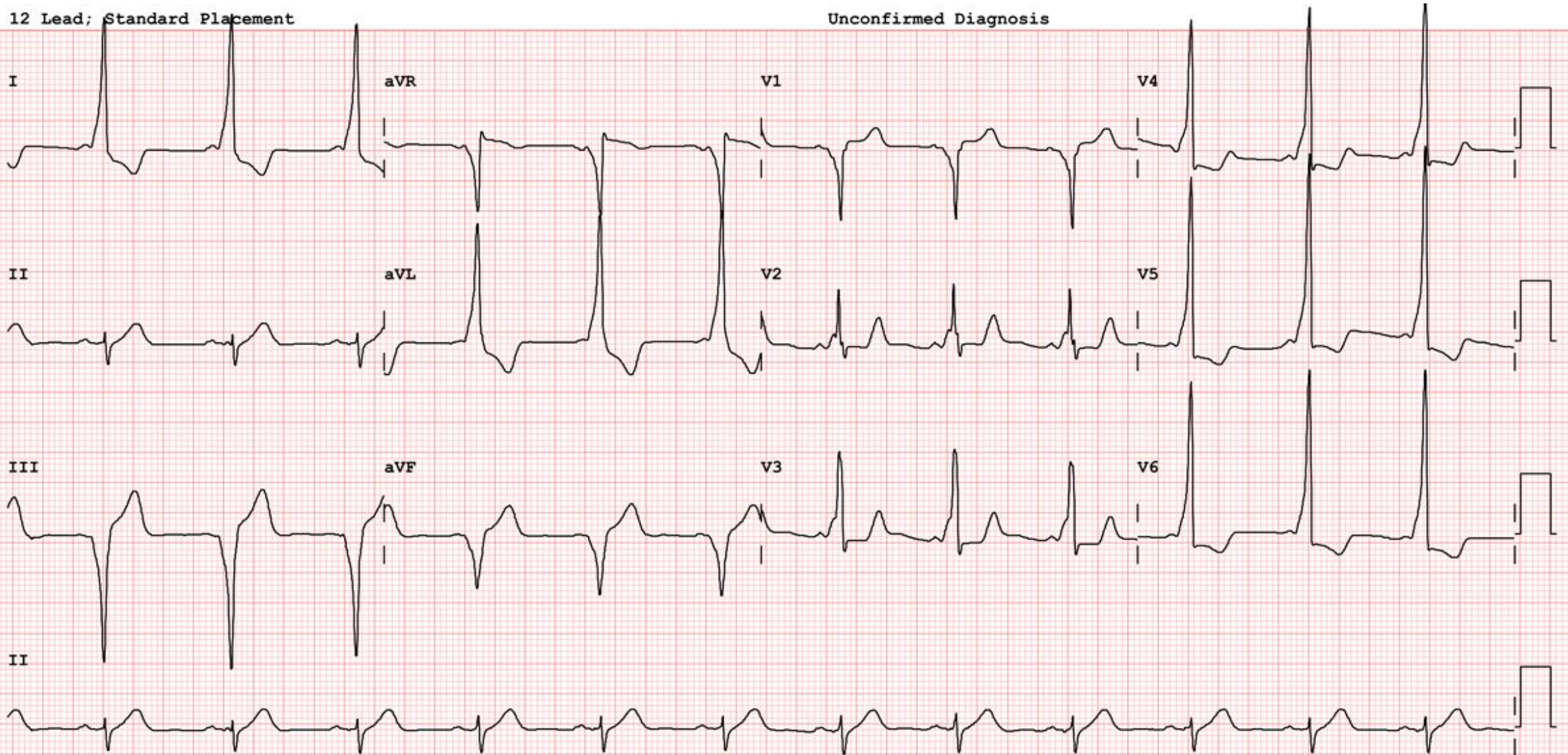
KHRS 2023

- CASE 1 -

M/37 palpitation

12 Lead; Standard Placement

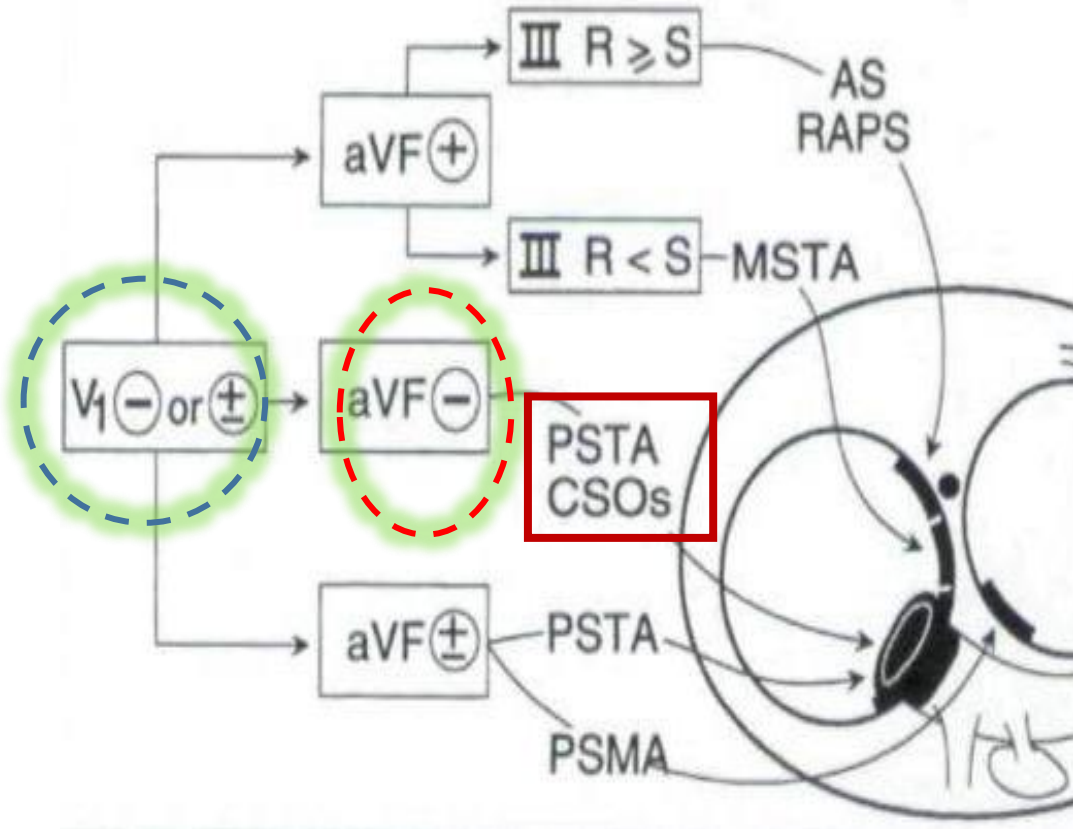
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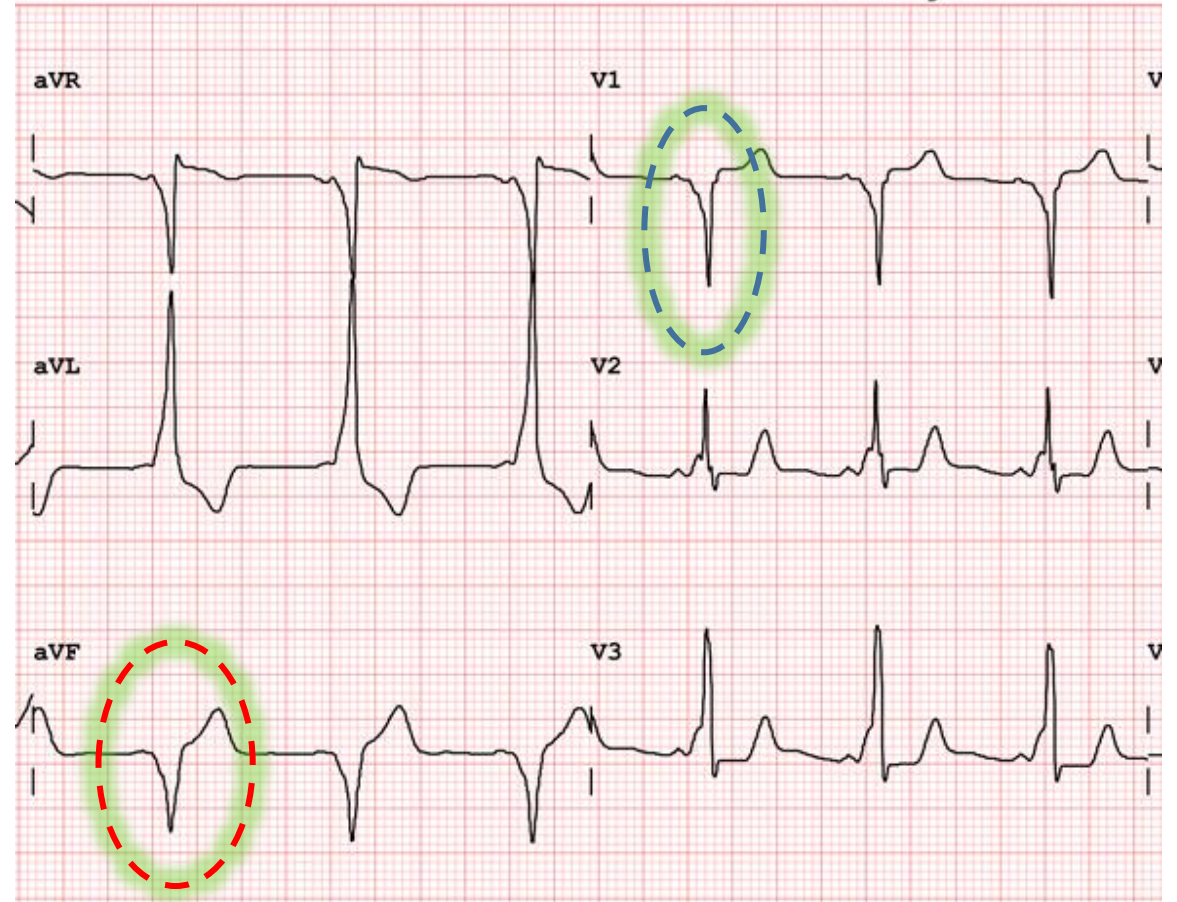
by Arruda Algorithm

Step 3

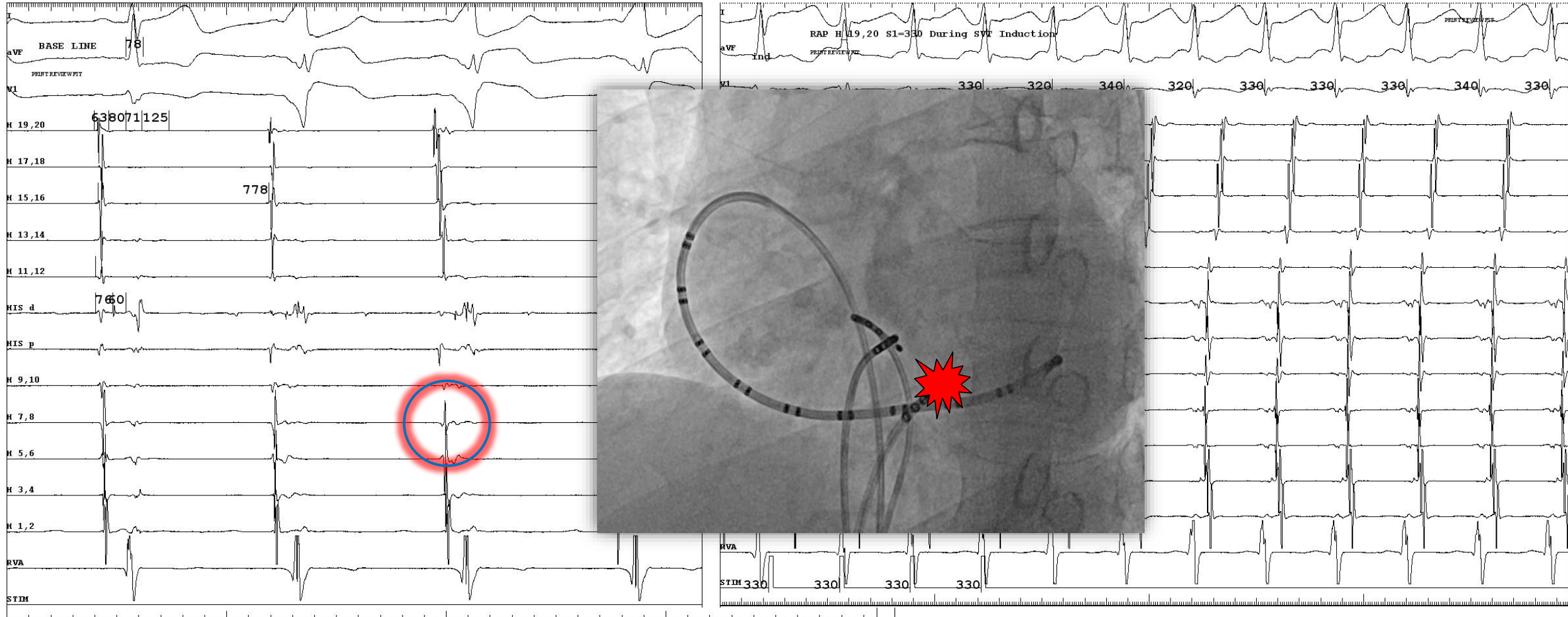
Septal Accessory Pathways



Unconfirmed Diagnosis



EPS & RFCA at CS Os



After RFCA

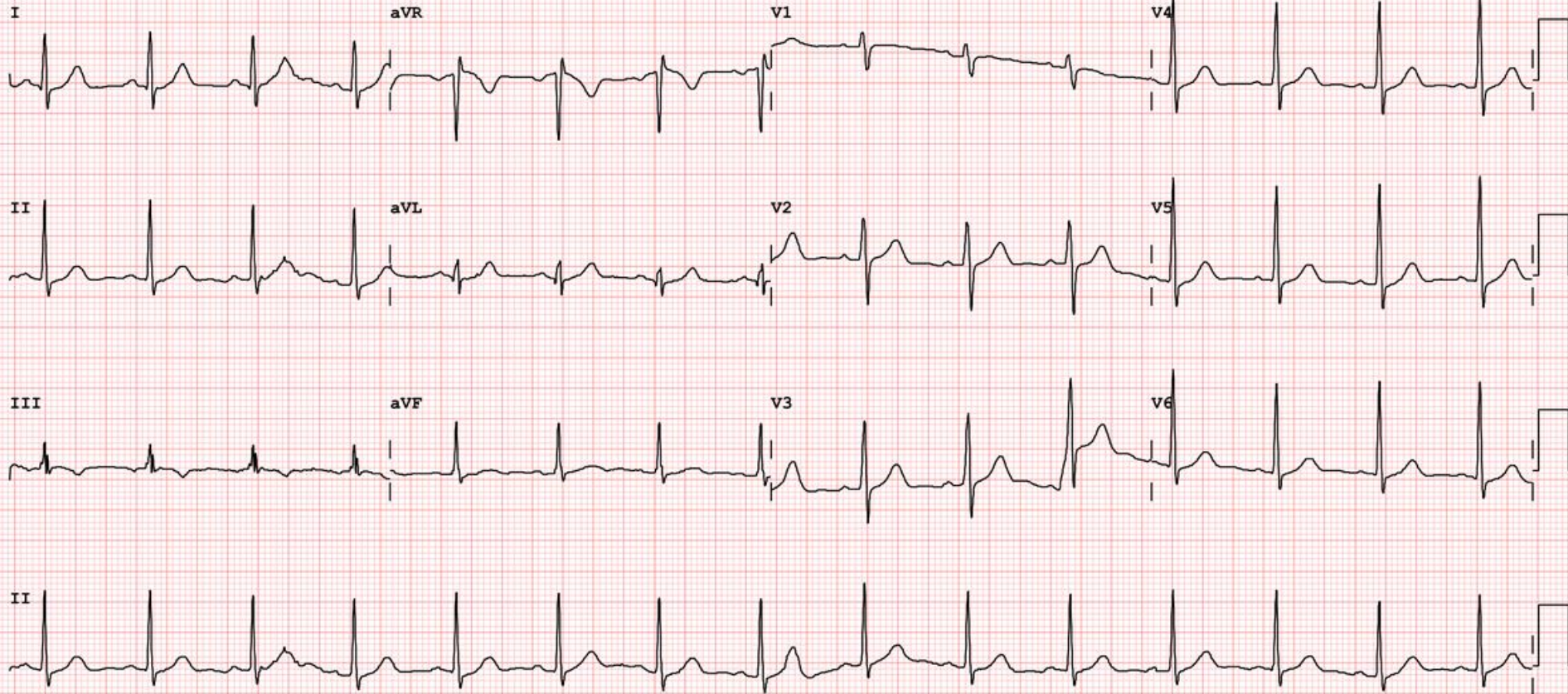
--AXIS--

P -8
QRS 50
T 14

- NORMAL ECG -

12 Lead; Standard Placement

Unconfirmed Diagnosis



Device: 01

Speed: 25 mm/sec

Limb: 10 mm/mV

Chest: 10.0 mm/mV

F 60~ 0.50-100 Hz W

PH090A

P?

in 2018 Maximal Pre-Excitation Based Algorithm for Localization of Manifest Accessory Pathways in Adults: Pambrun algorithm

FIGURE 3 New Stepwise Algorithm Depicted as an Anatomical Scheme

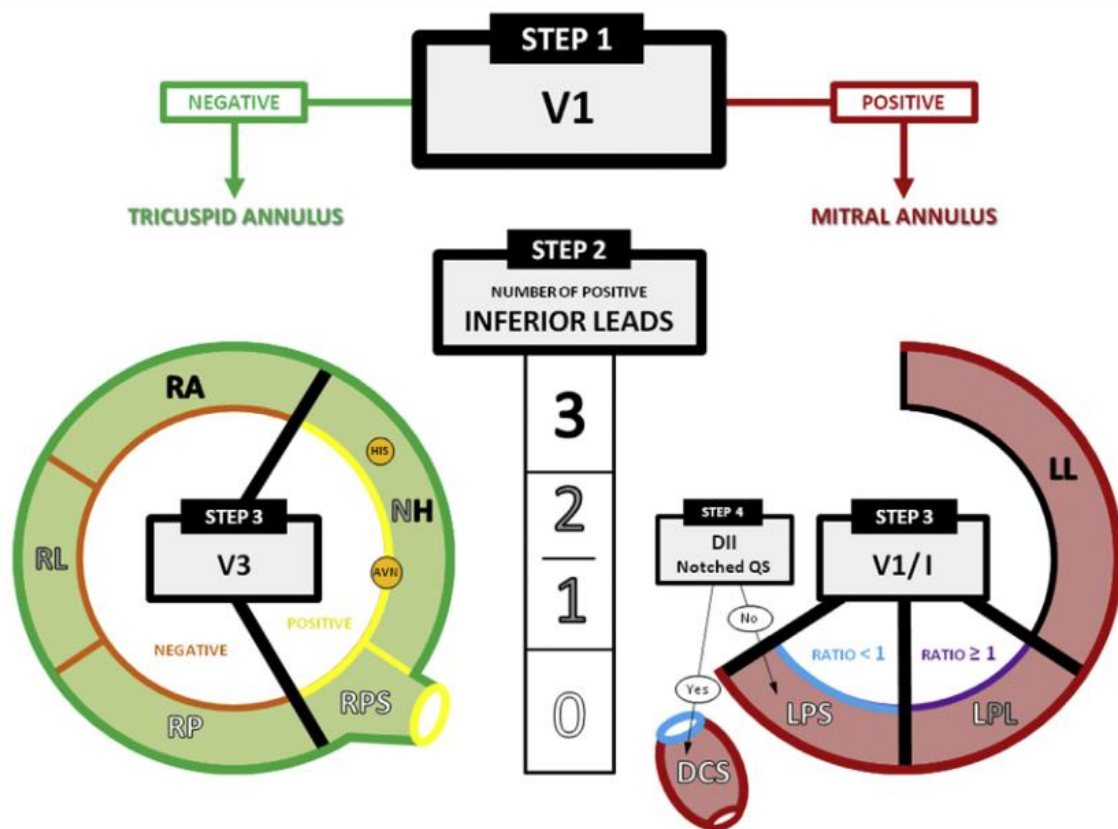
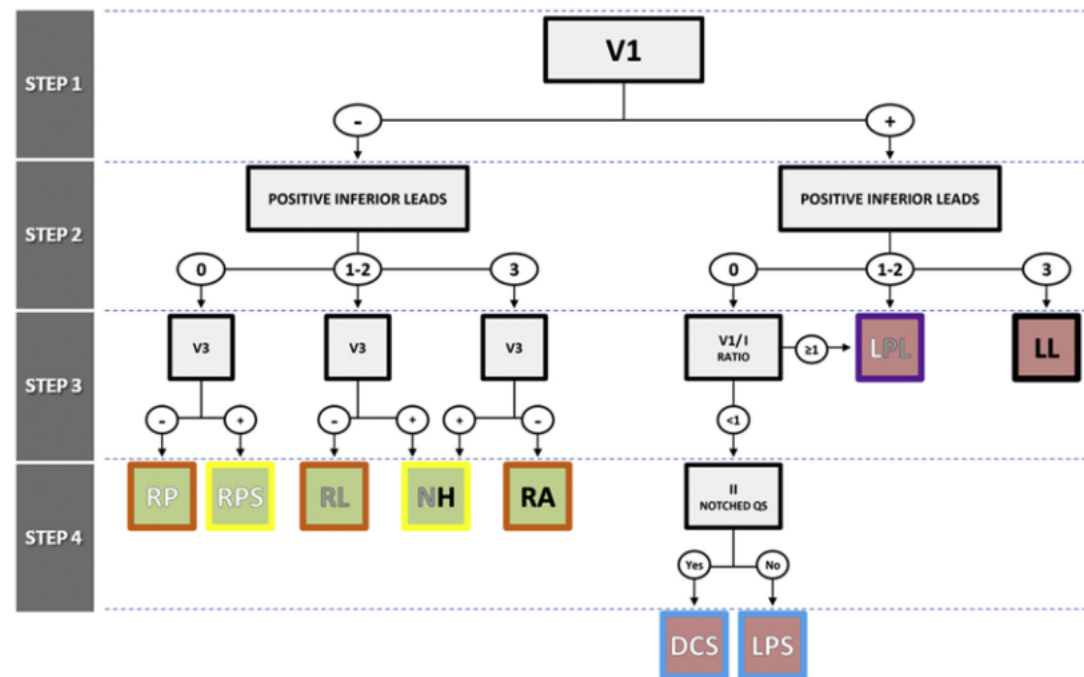
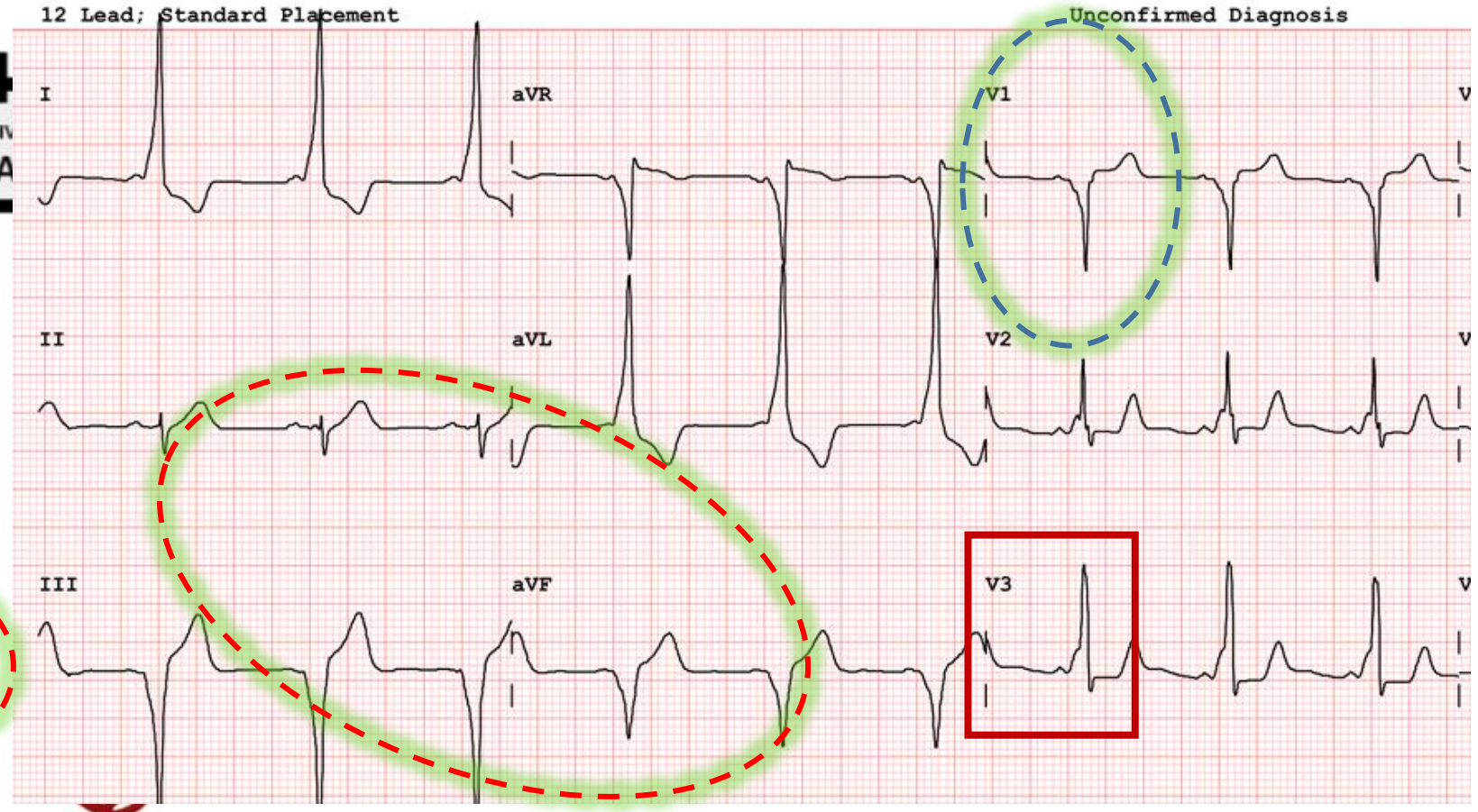
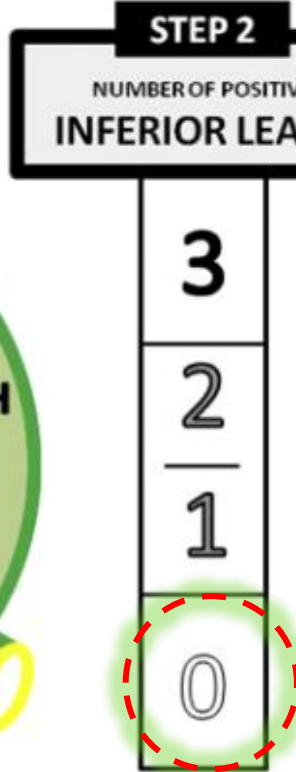
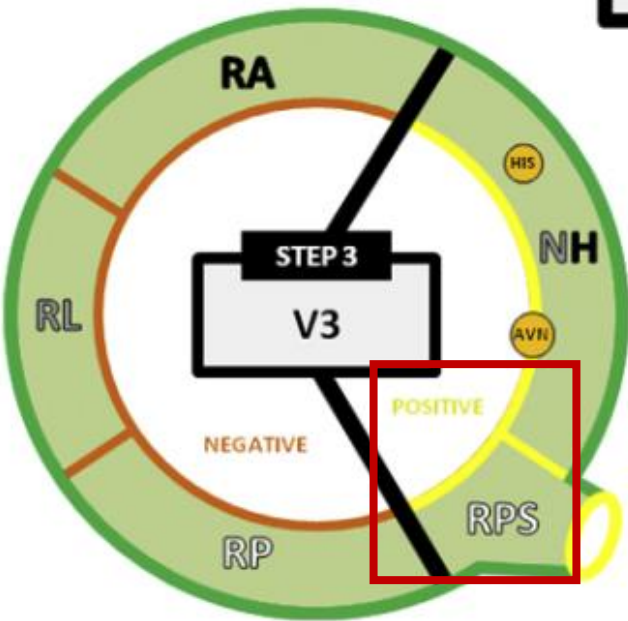
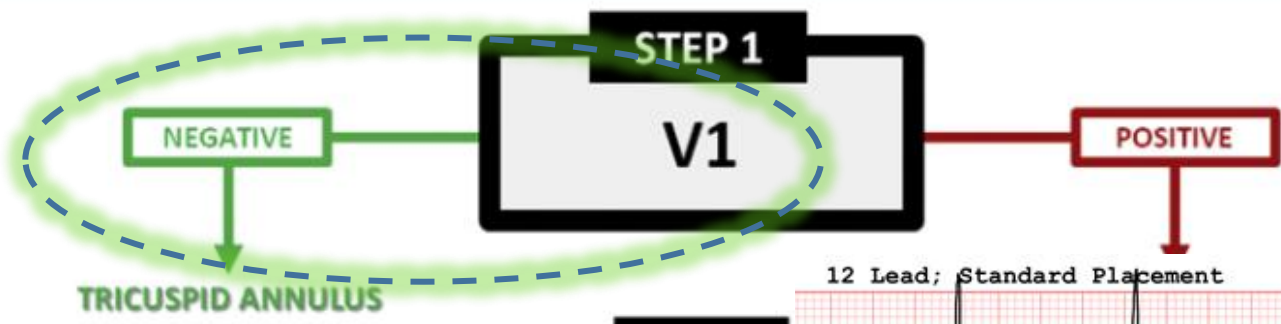
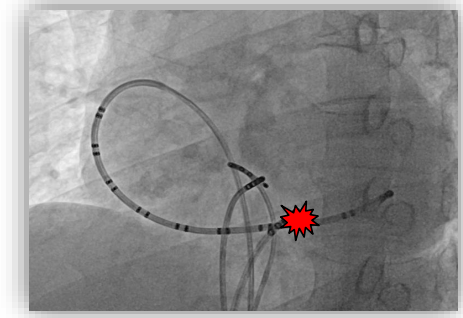


FIGURE 4 New Stepwise Algorithm Depicted as a Decision Tree



Pambrun T et al, J Am Coll Cardiol EP. 2018

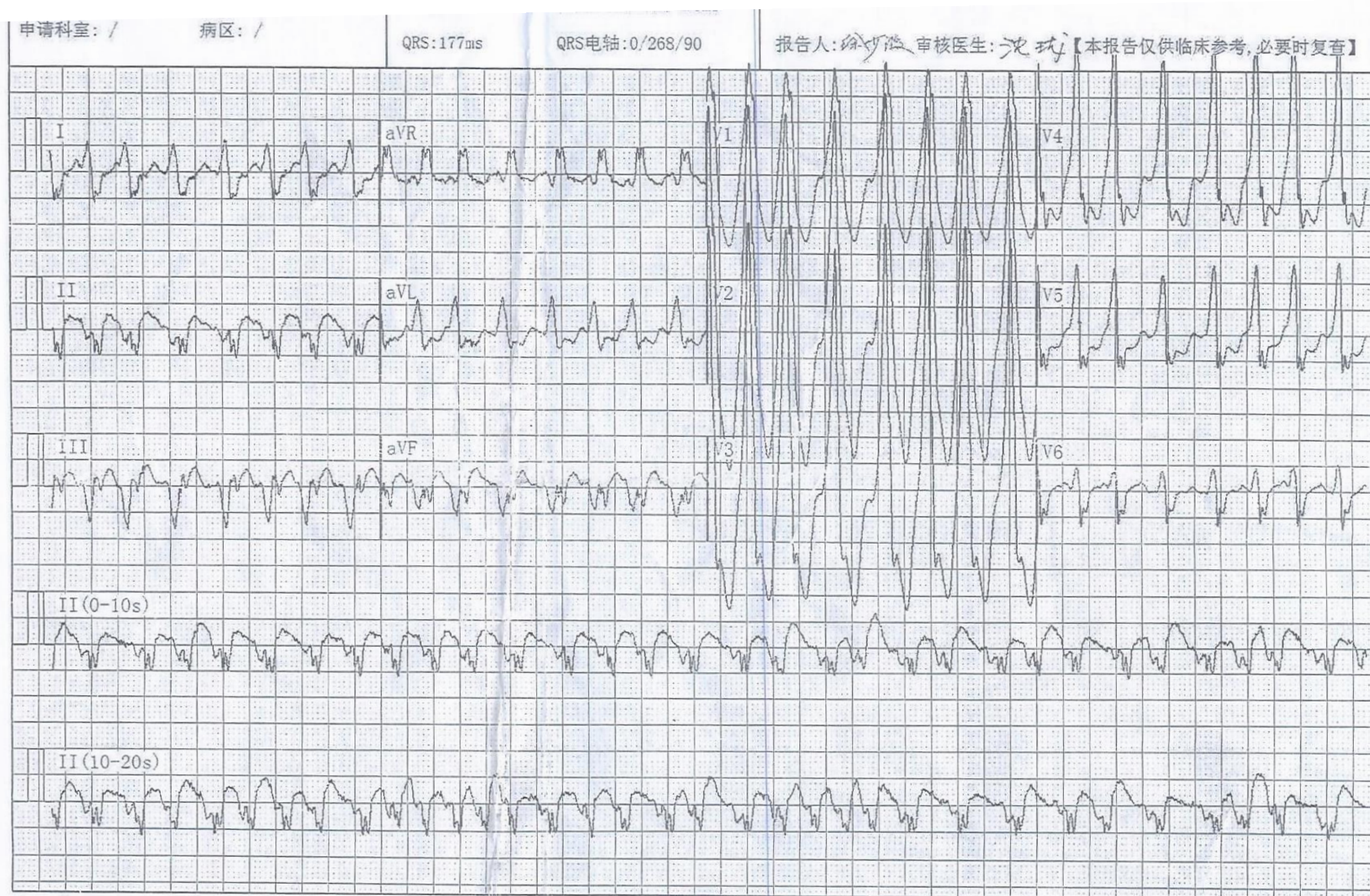
FIGURE 3 New Stepwise Algorithm Depicted as an Anatomical Scheme





- CASE 2 -

22.9.15 M/45 palpitation during exercise in China



送检单位: 松江区九亭医院1

检查科室: 门诊心电图室

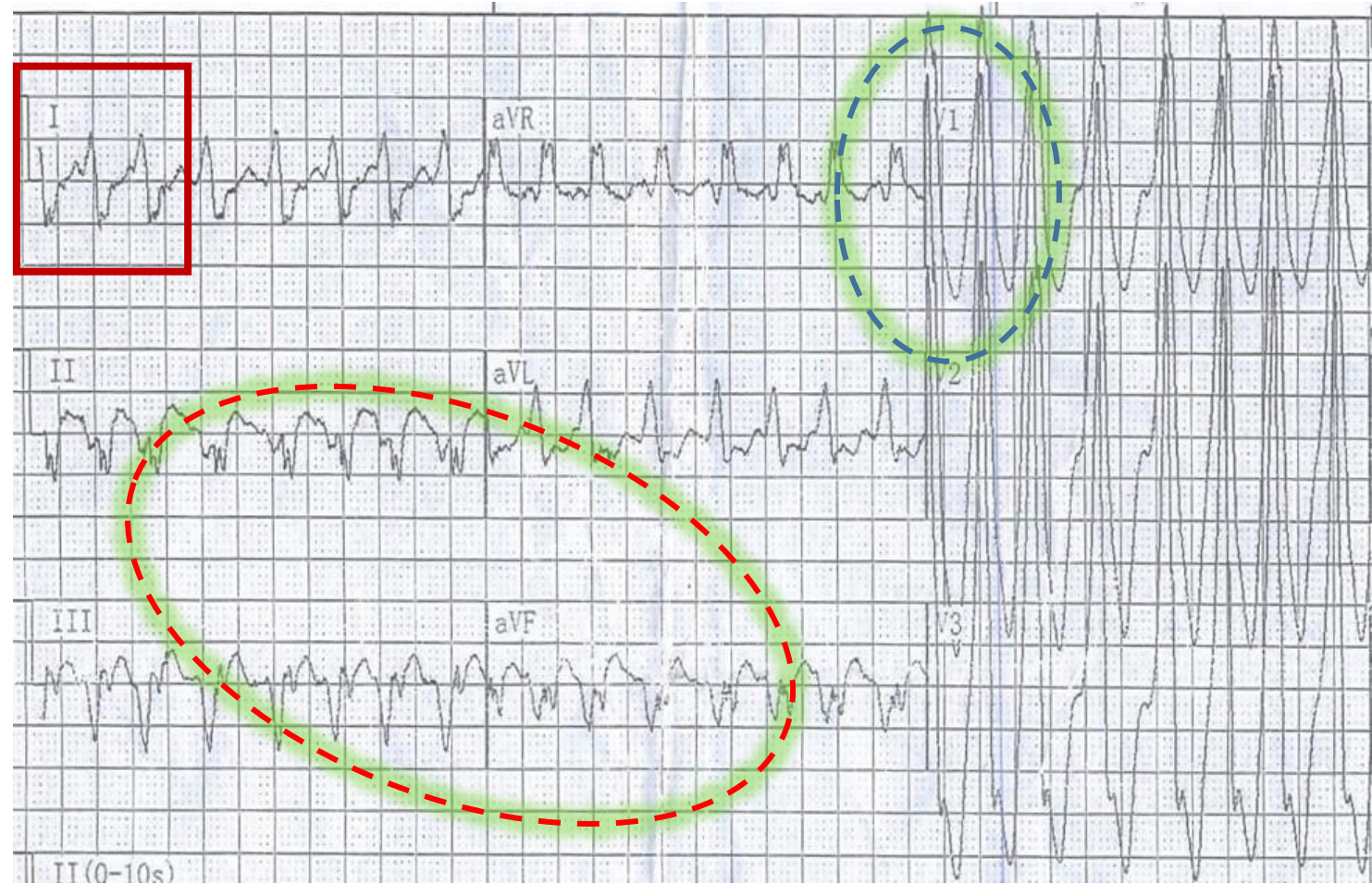
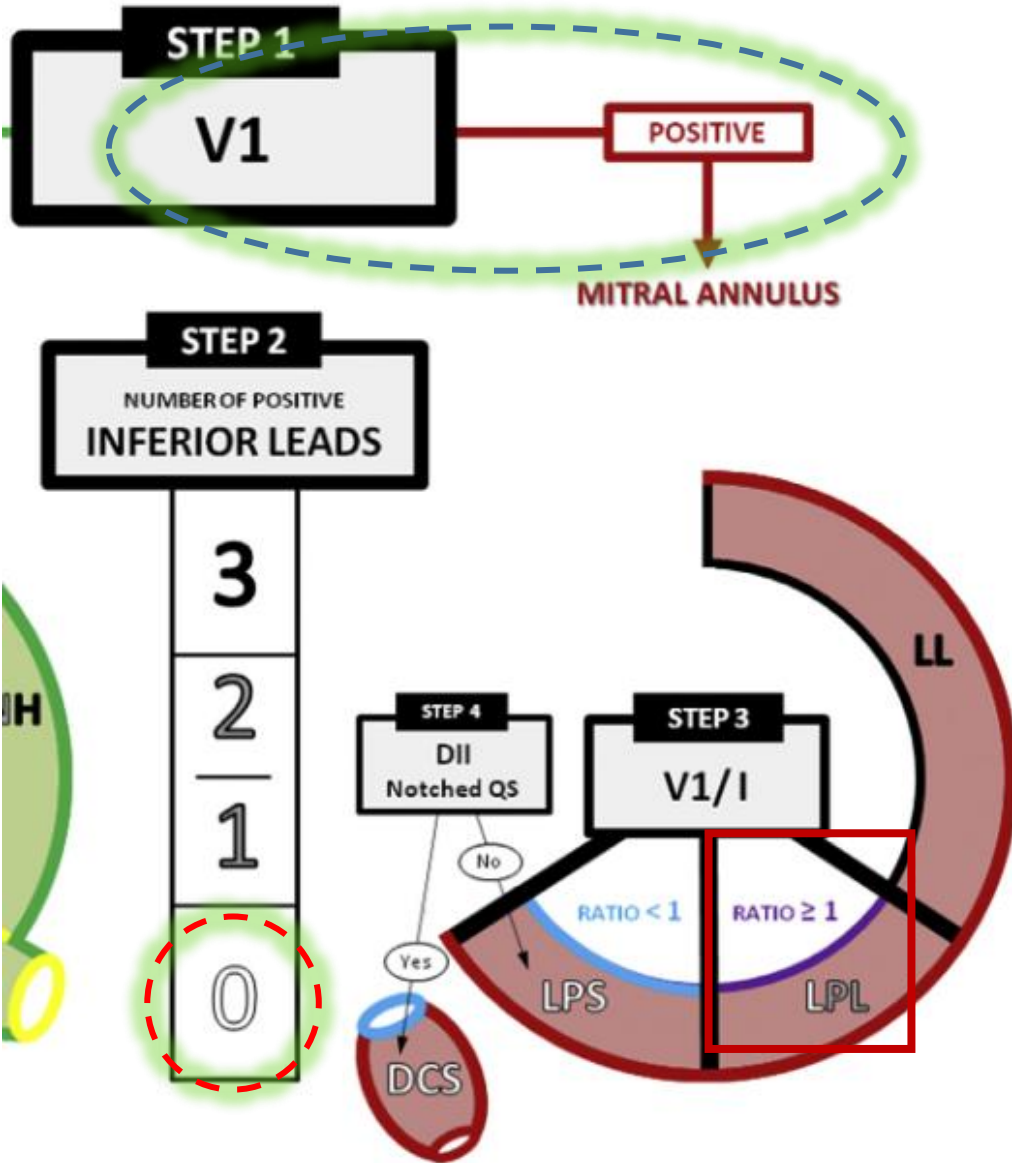
操作者:

纸速: 25mm/s 灵敏度: 10mm/mV

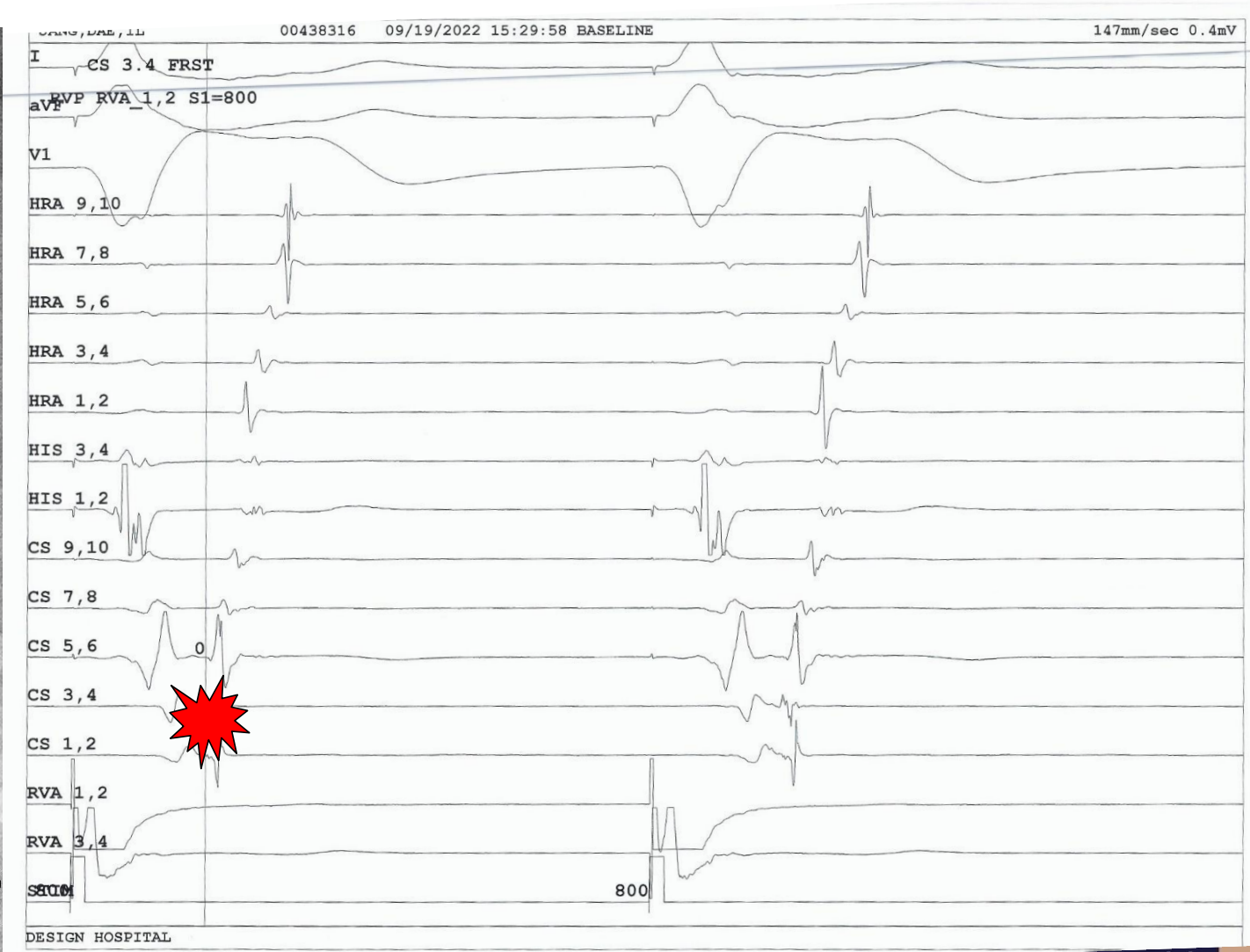
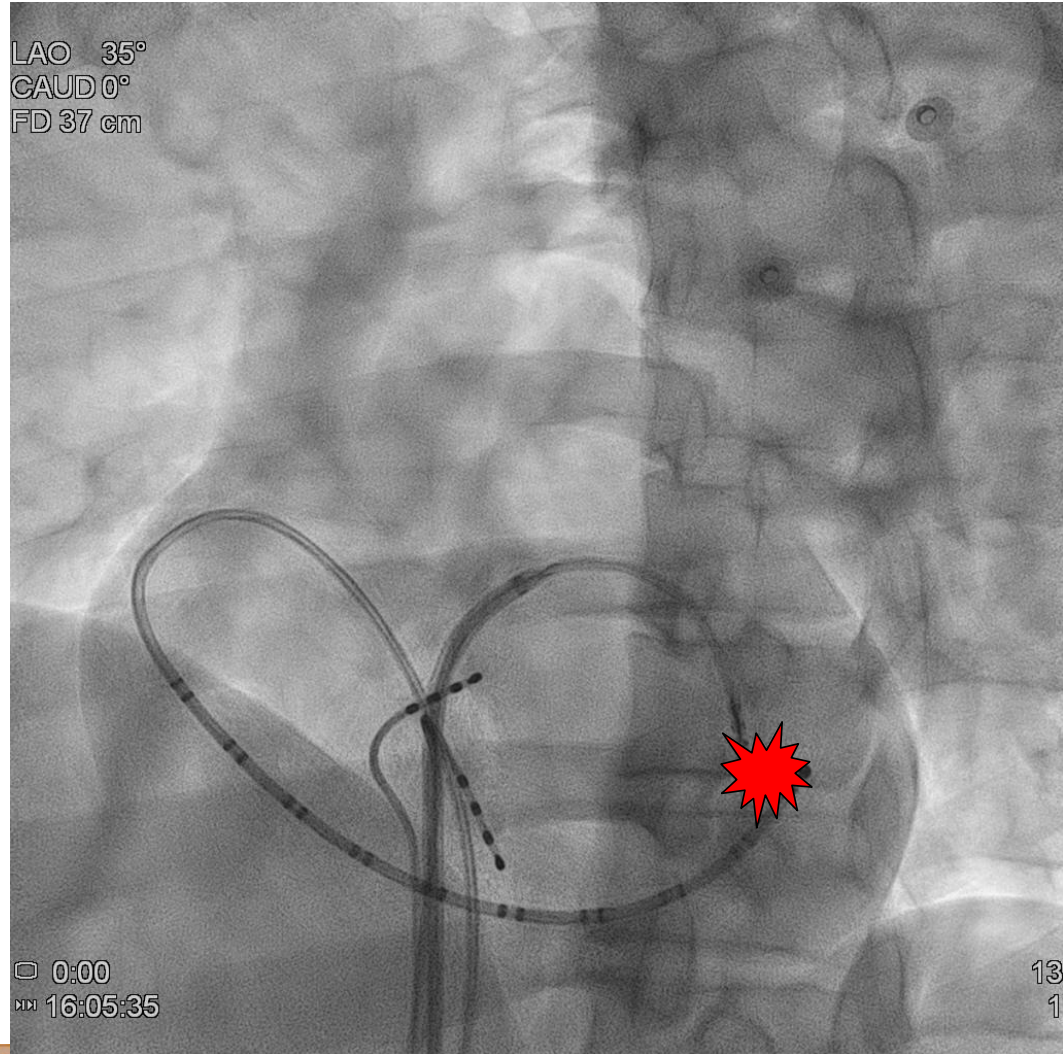
电子签名: gkzuZ6CgrYf6aoG3Fe8EK52+qcHaoZVfWUJ6gSuN3LBzJ1V0b/A6epSYTngZS2+DzYpUK1+8Rk4NKcIPkJKjJnemXa85h9nmr01W0wNveM1AKzUgnmbR8s4V/Rj38359Z3ATLD4YopzRaWvDhq/mJ4ORR9Jj1:9yALi/41.5Wk=

滤波: 0.67Hz, 100Hz AC: 50Hz

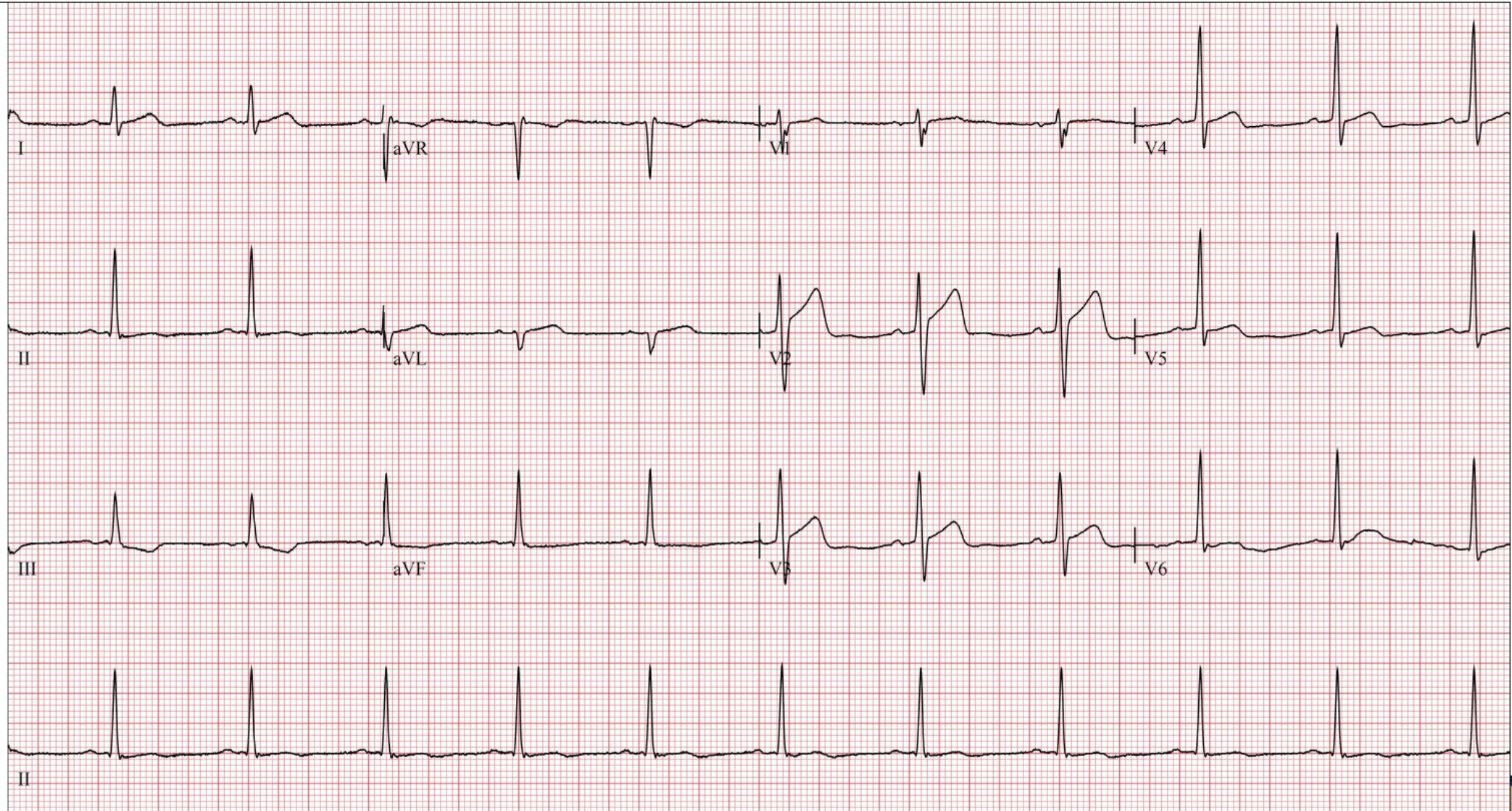
By Pambrun algorithm



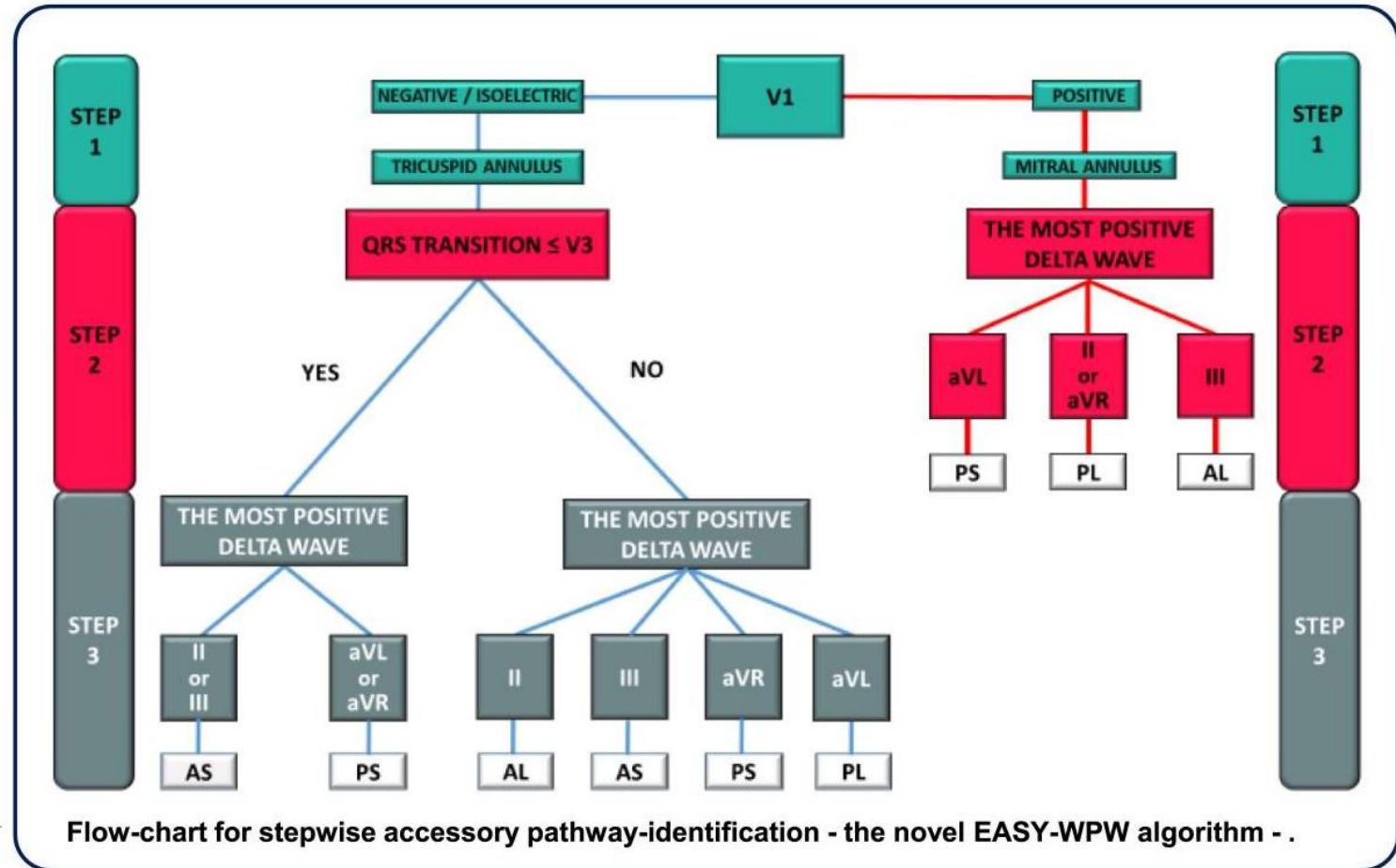
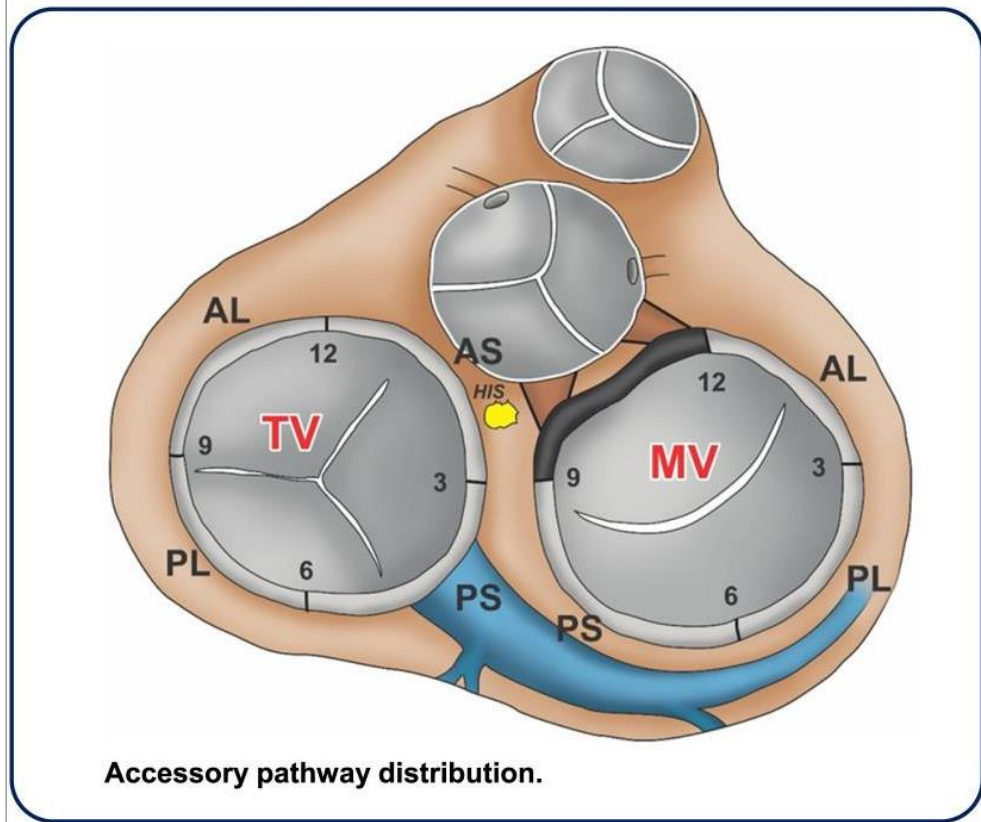
RFCA at left postlateral AV groove



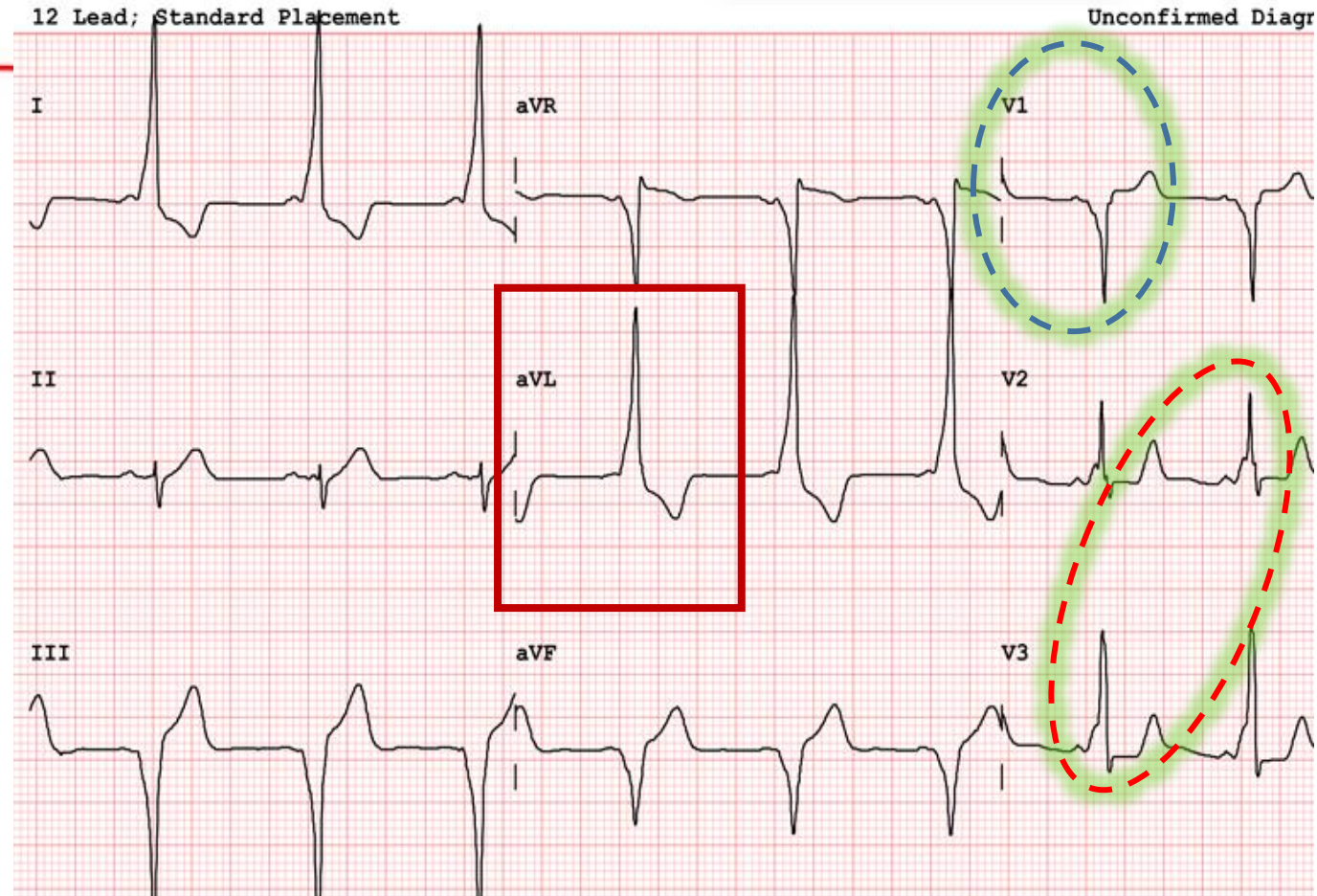
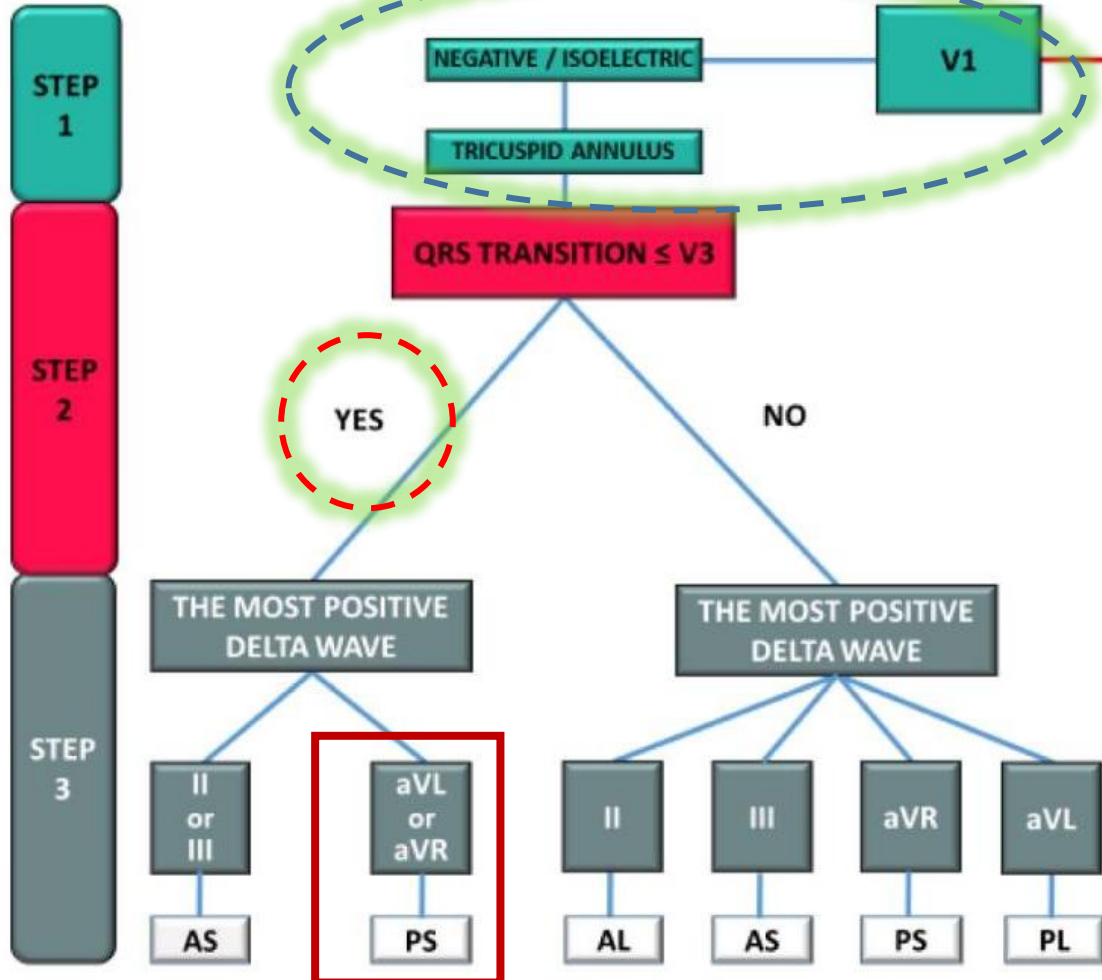
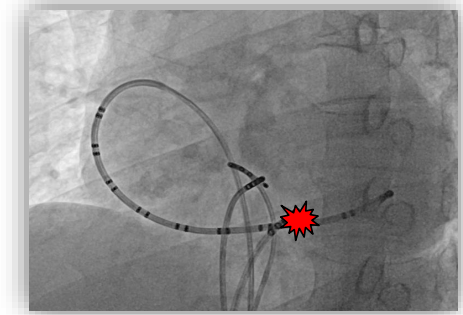
Post RFCA ECG



in 2023 EASY-WPW: a novel ECG-algorithm for easy and reliable localization of manifest accessory pathways in children and adults: Hamriti



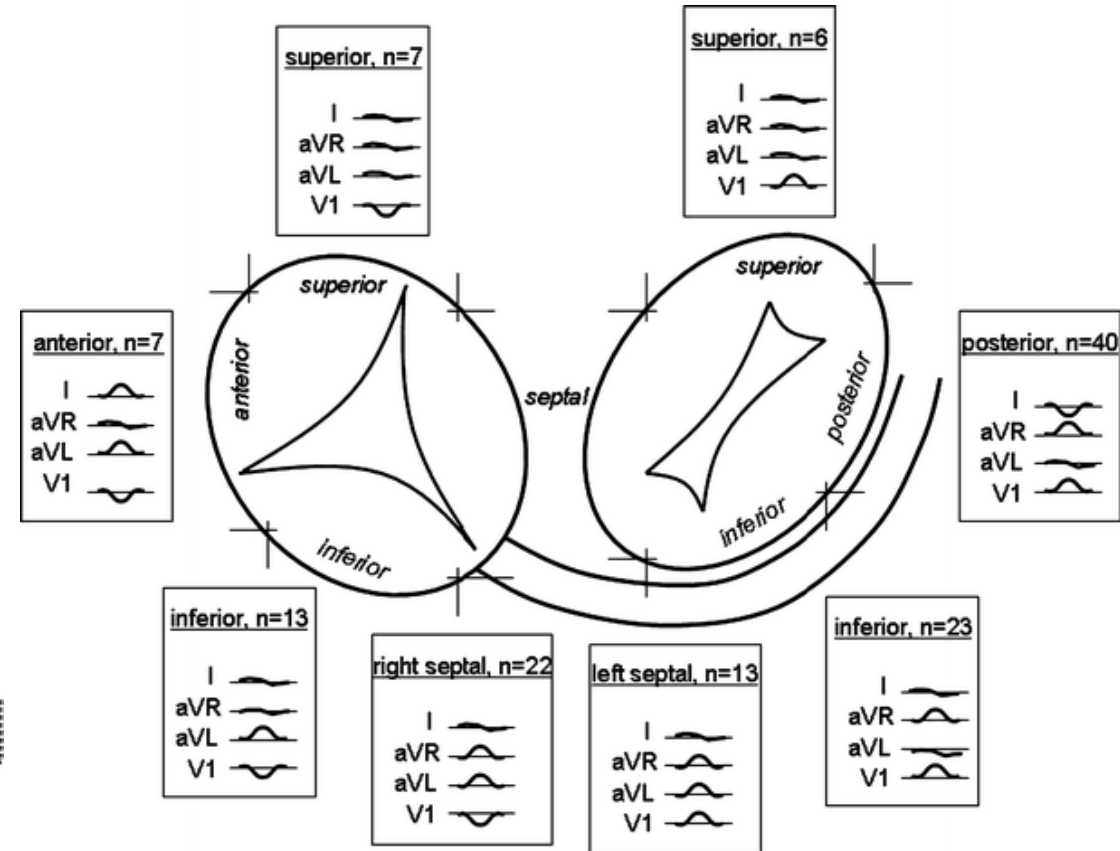
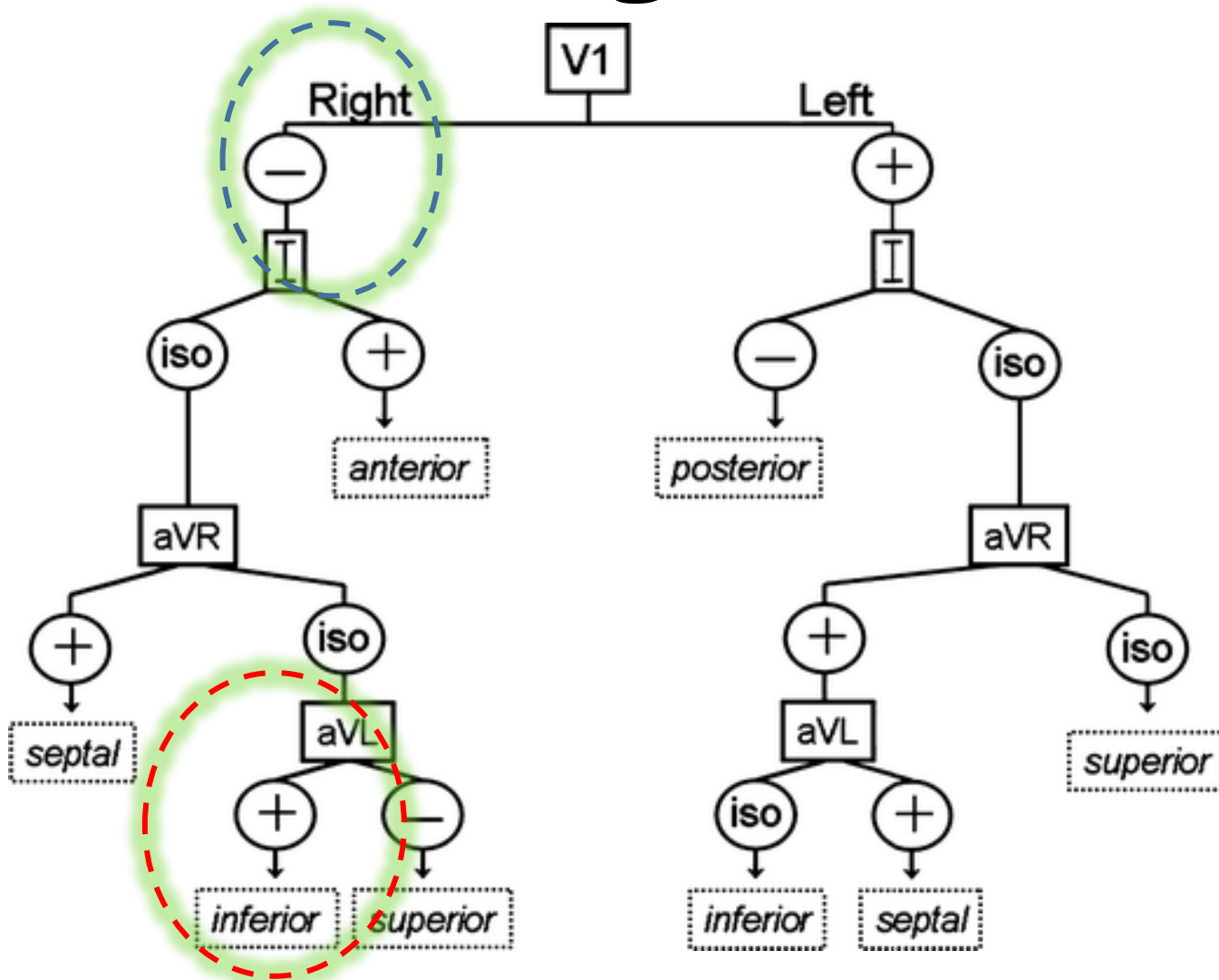
By Hamriti



2. retrograde P-wave polarity during orthodromic AVRT



Retrograde P-wave during oAVRT



Rostock, T et al J Interv Card Electrophysiol 2008

A new algorithm for concealed accessory pathway localization using T-wave-subtracted retrograde P-wave polarity during orthodromic atrioventricular reentrant tachycardia.

- retrograde P-wave polarity during orthodromic AVRT and developed an algorithm to predict the localization of concealed accessory pathways
- Four leads of the surface electrocardiogram (ECG) were identified to accurately distinguish AP locations assigned to four different regions around each AV annulus: I, aVR, aVL, and V1
- Retrograde P-wave in lead I was negative in left posterior APs exclusively and became more positive with an AP location shifting towards right anterior. P-wave polarity in lead aVR demonstrated a shift from a positive polarity from left APs to isoelectric in right APs. The opposite direction (shift from positive to isoelectric) was observed for lead aVL

3. ECG Clue for Multiple Accessory Pathway ?



in 1990, Clue for multiple AP

- Different P wave during orthodromic AVRT

- Discrepancies

- Atrial

- Direct

- Variability

- Change of pre-excitation pattern after AAD

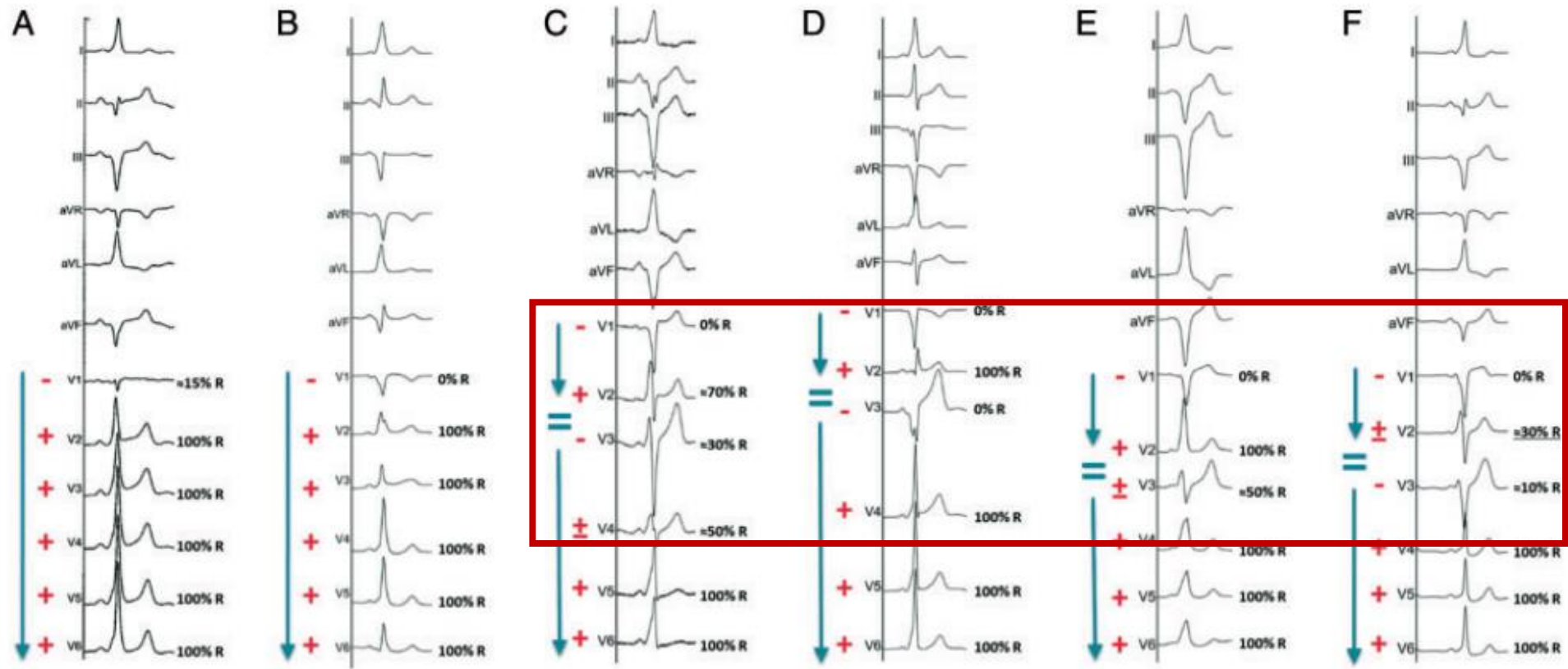
The retrospective nature of this study does not allow conclusions as to the true value of the ECG in predicting the presence of more than one accessory pathway. This issue needs to be evaluated in a prospective study.

(J Am Coll Cardiol 1990;16:745-51)

4. Specific Accessory Pathways

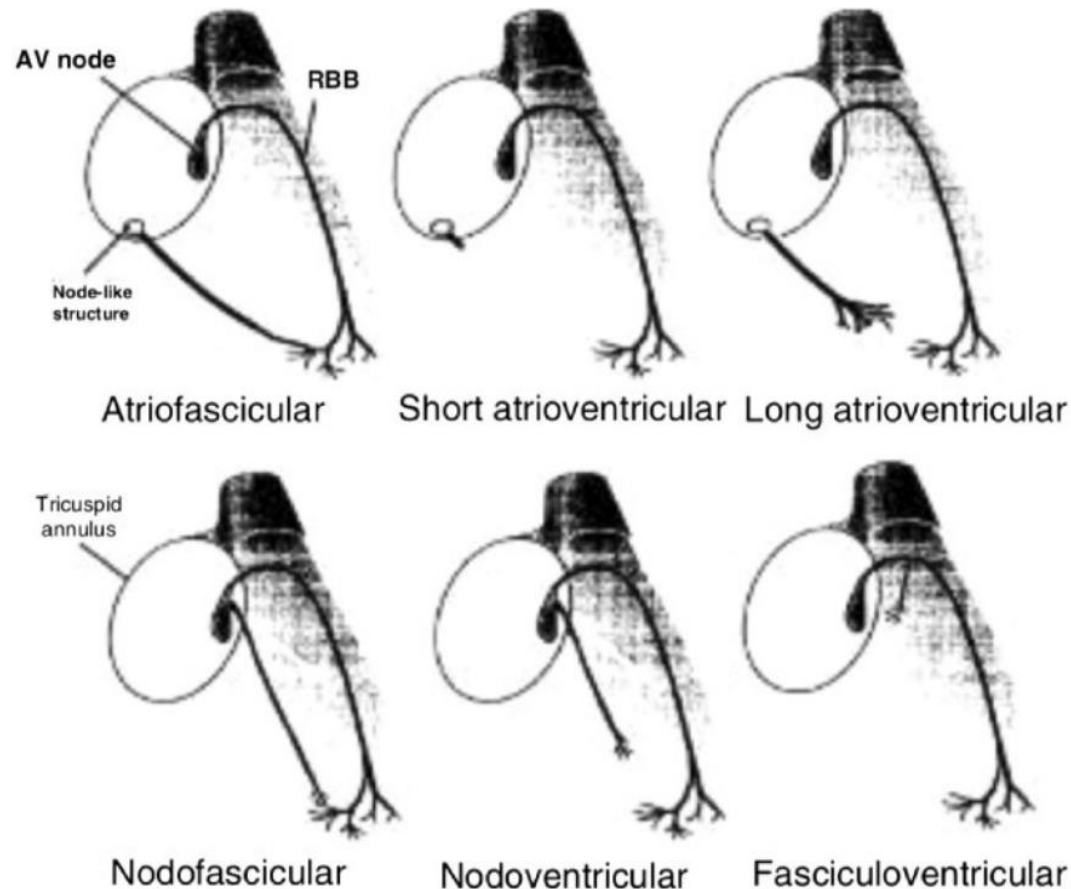


The 'double transition': a novel electrocardiogram sign to discriminate posteroseptal accessory pathways ablated from the right endocardium from those requiring a **left-sided or **epicardial coronary venous** approach**



P. Pascale et al. EROPACE 2020

Atypical bypass tracts: can they be recognized during sinus rhythm?



- Rare anatomic structures often with decremental conduction
- ECG of those structures may be difficult in sinus rhythm
- No overt ventricular pre-excitation is present
- ECG often shows a subtle pre-excitation pattern (less contribution to ventricular activation over the slow and decremental conducting bypass)

J.N. de Alencar Neto et al. EROPACE 2019

Summary

- Localization of Accessory Pathways(AP) is **important for prepare ablation**
- Many algorithm developed based on **delta wave** or **pre-excited QRS waves**. Minimal pre-excitation is not helpful
- **Retrograde P-wave** axis during oAVRT is often useful for localization for AP
- There is weak ECG clue for **multiple AP**
- **Atypical AP** may take into consideration in specific cases.

Thank You for Attentions !!
2023 新DESIGN병원

2023.3.7

심장센터