

# Interpreting E.P Signals Part 1 – The basics

*Jonathan Sibley*

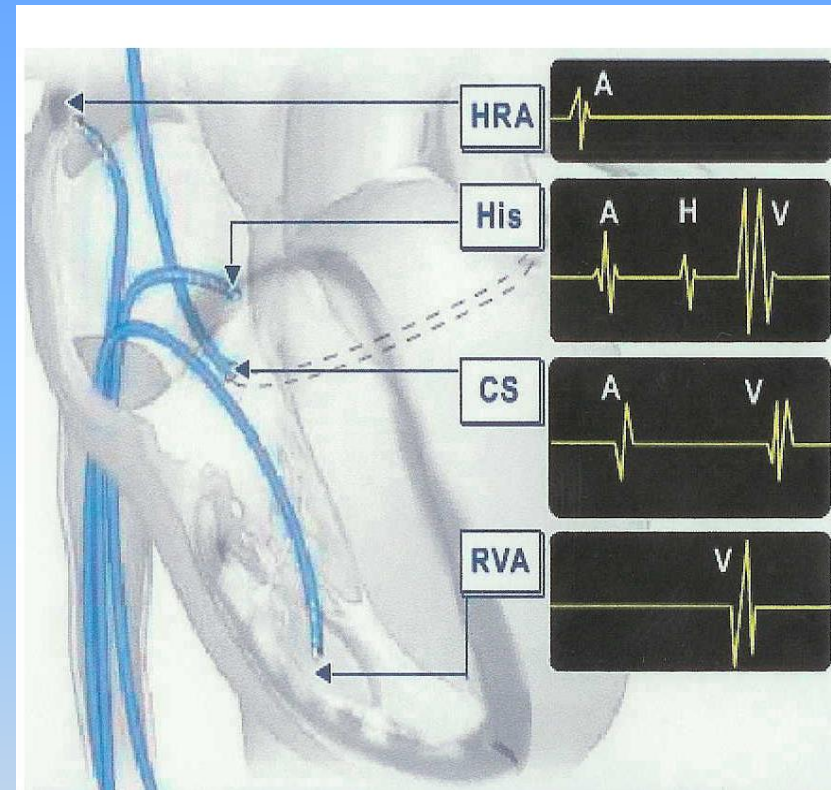
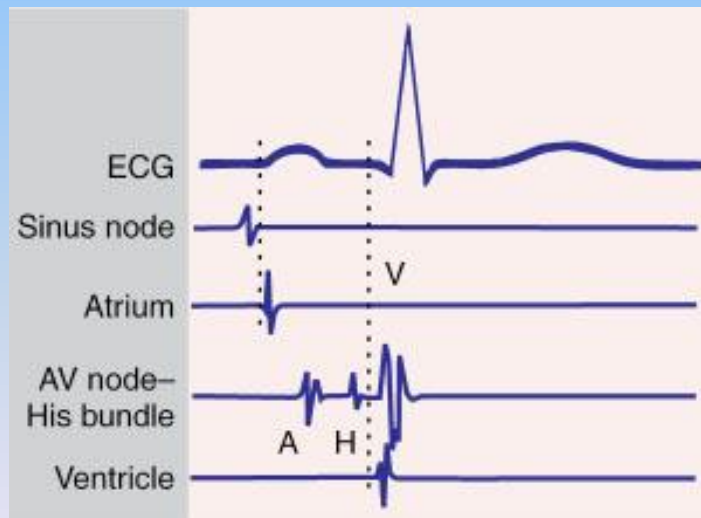
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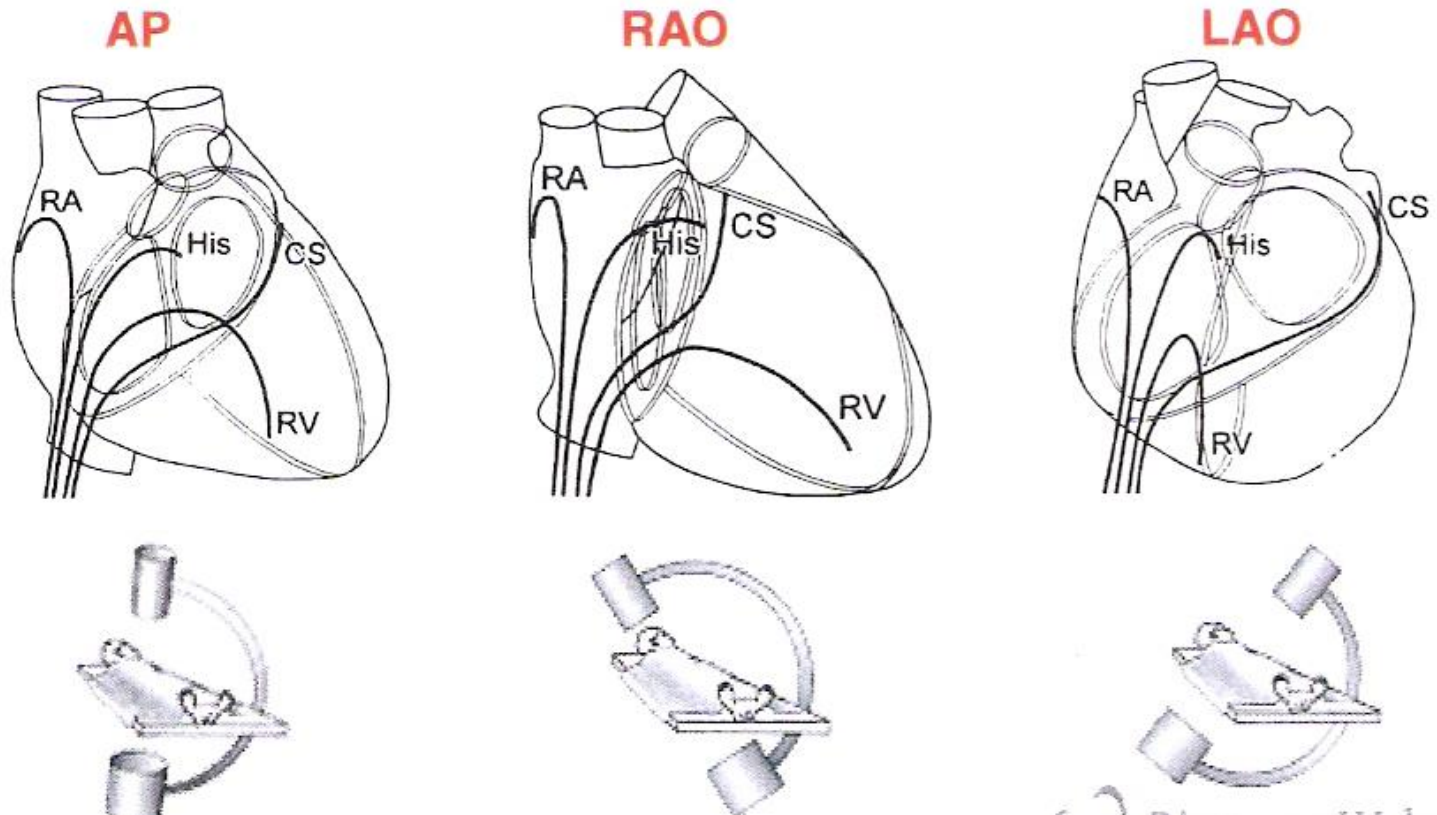
# Standard Electrode Placement

- **HRA** - SA node (near junction of SVC)
- **His** - for recording and marking AV node
- **CS** - for recording/pacing
- **RVA** - for recording/pacing

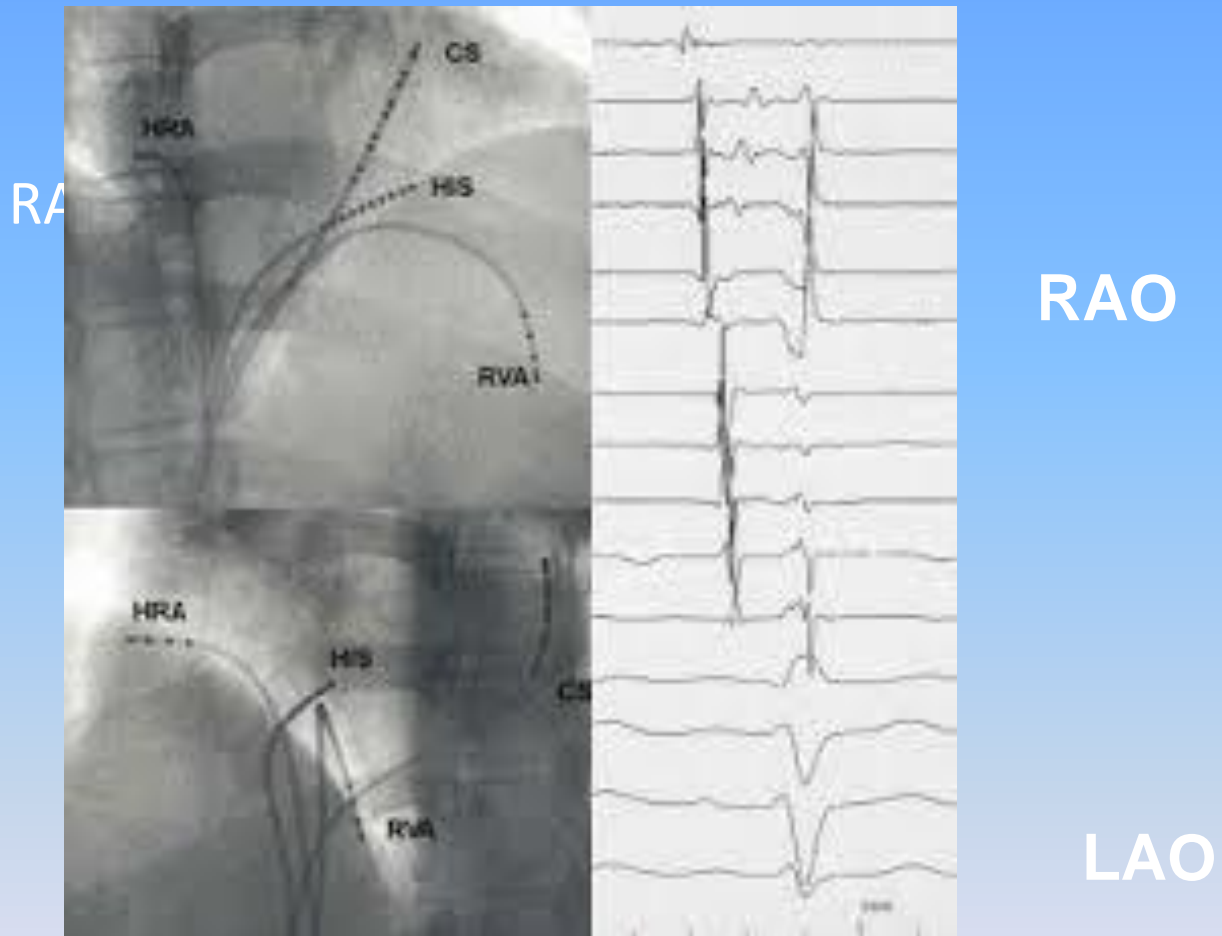


# Catheter Placement - Projection

## The Standard EP Procedure



# Standard diagnostic Catheter Placement

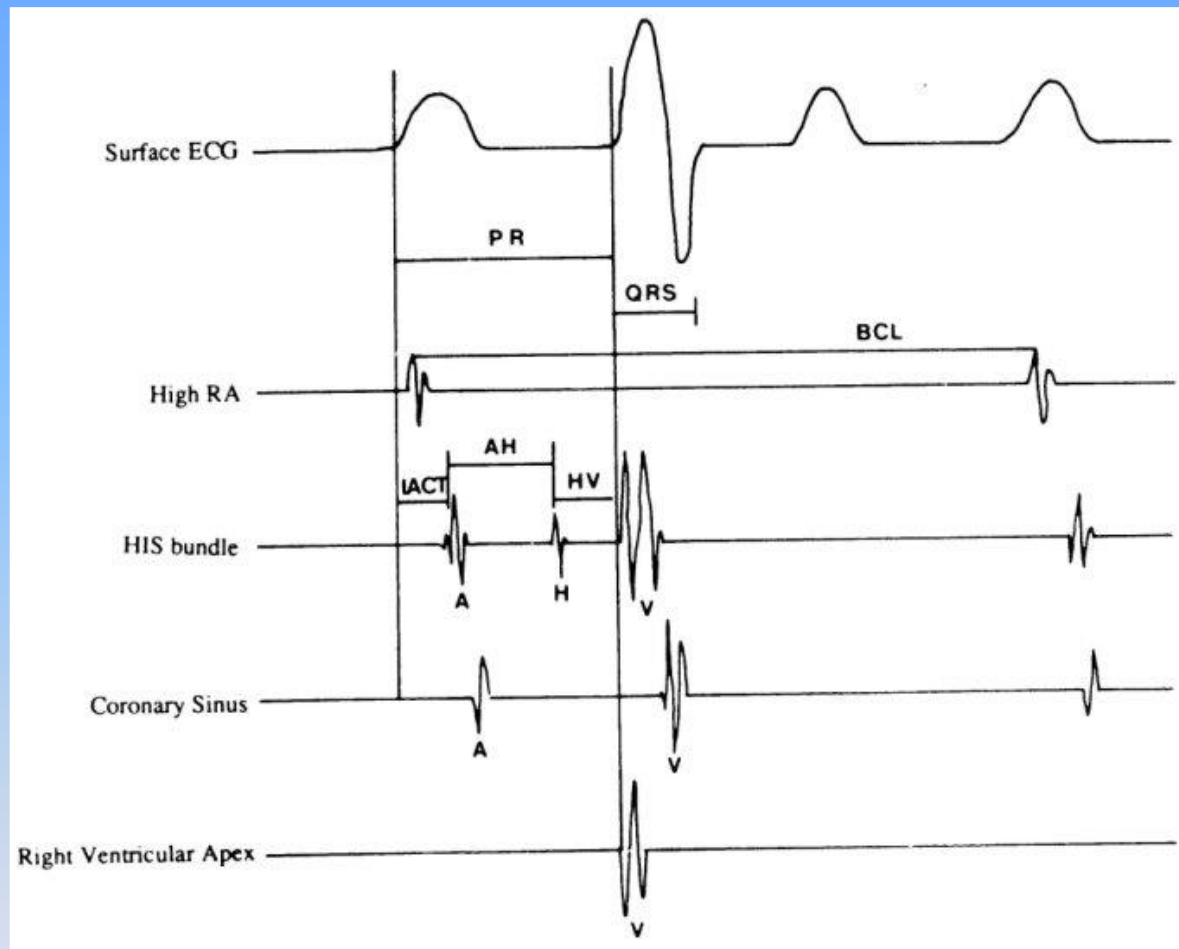


# Evaluation of Conduction system

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- **Analyzing the HIS electrogram, the conduction properties of AV conduction system can be deduced.**
  - **AH interval**- conduction time through the AV node (50-120 msec).
  - **HV interval**- conduction time through the His-Purkinje system (35-55 msec).
  - **Basic cycle length** A to A wave from HRA catheter (as close to SA Node).
  - **PR, QRS**, from surface ECG
  - **Intra-atrial conduction interval** - beginning of P wave to A spike on His electrogram.
- **Retrograde conduction (V to A).**
- **Stimulus - QRS**

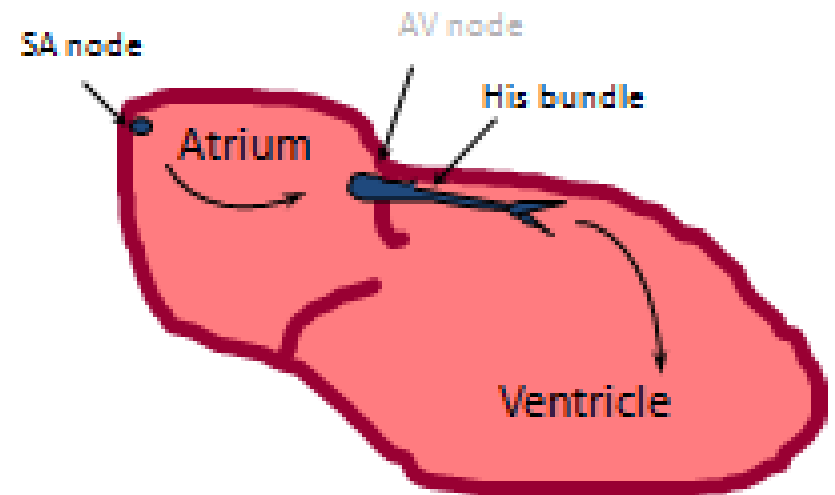
# Baseline Recording of IC EGM



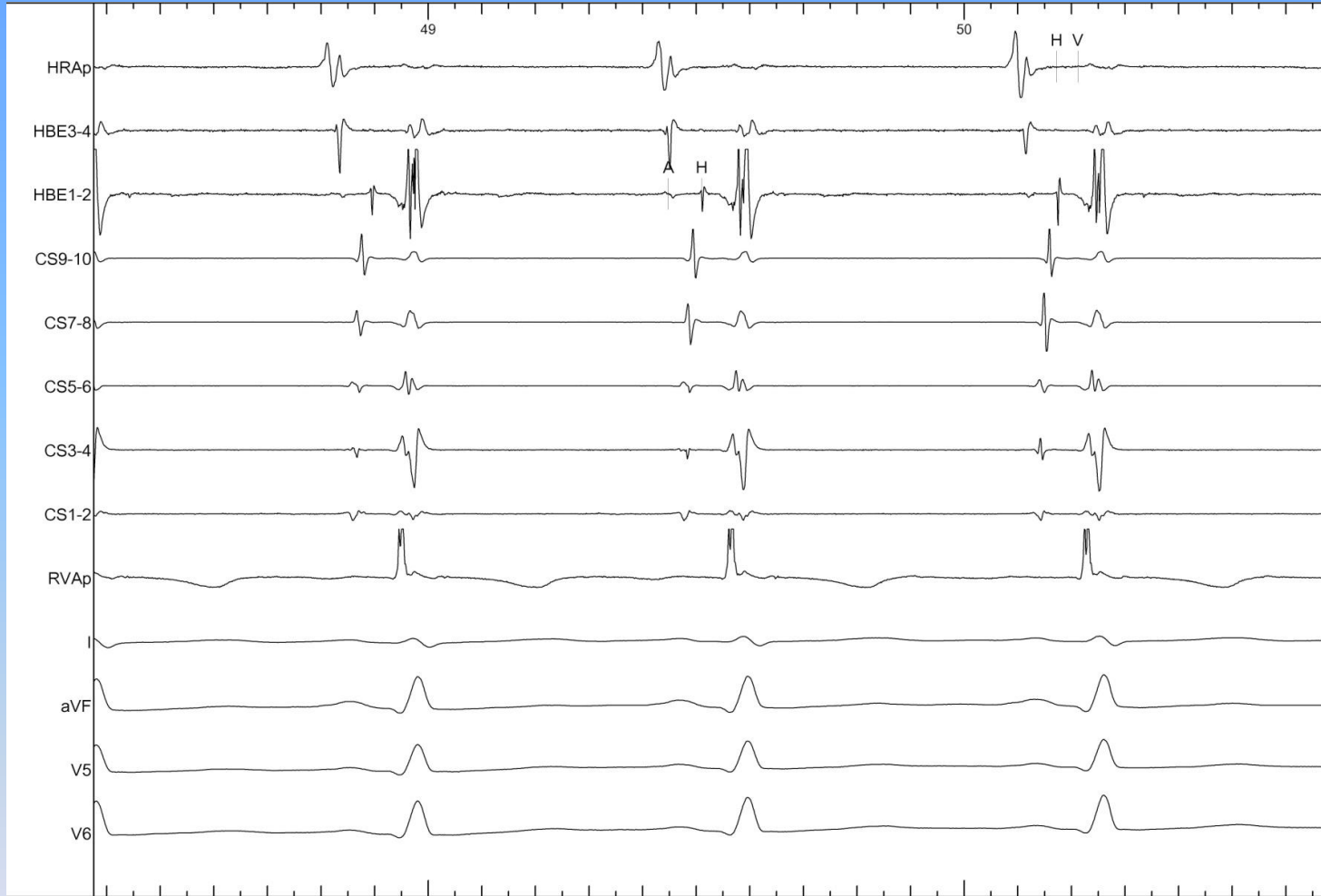
# Intracardiac Signals

The conductive system:

- Normal conduction intervals
  - AH: 50-150 msec
  - His: 10-25 msec
  - HV: 30-55 msec



# Baseline Intervals



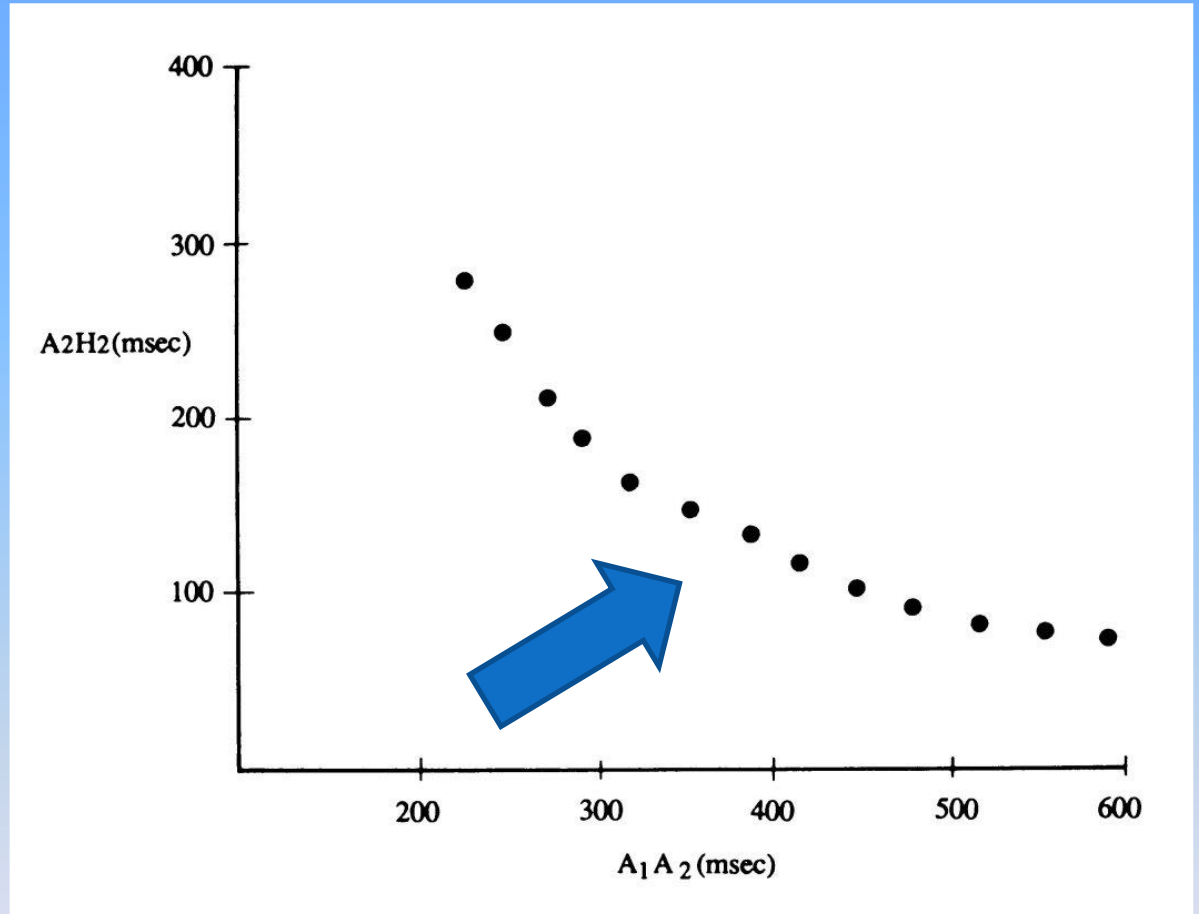


# Normal AV Conduction Curve

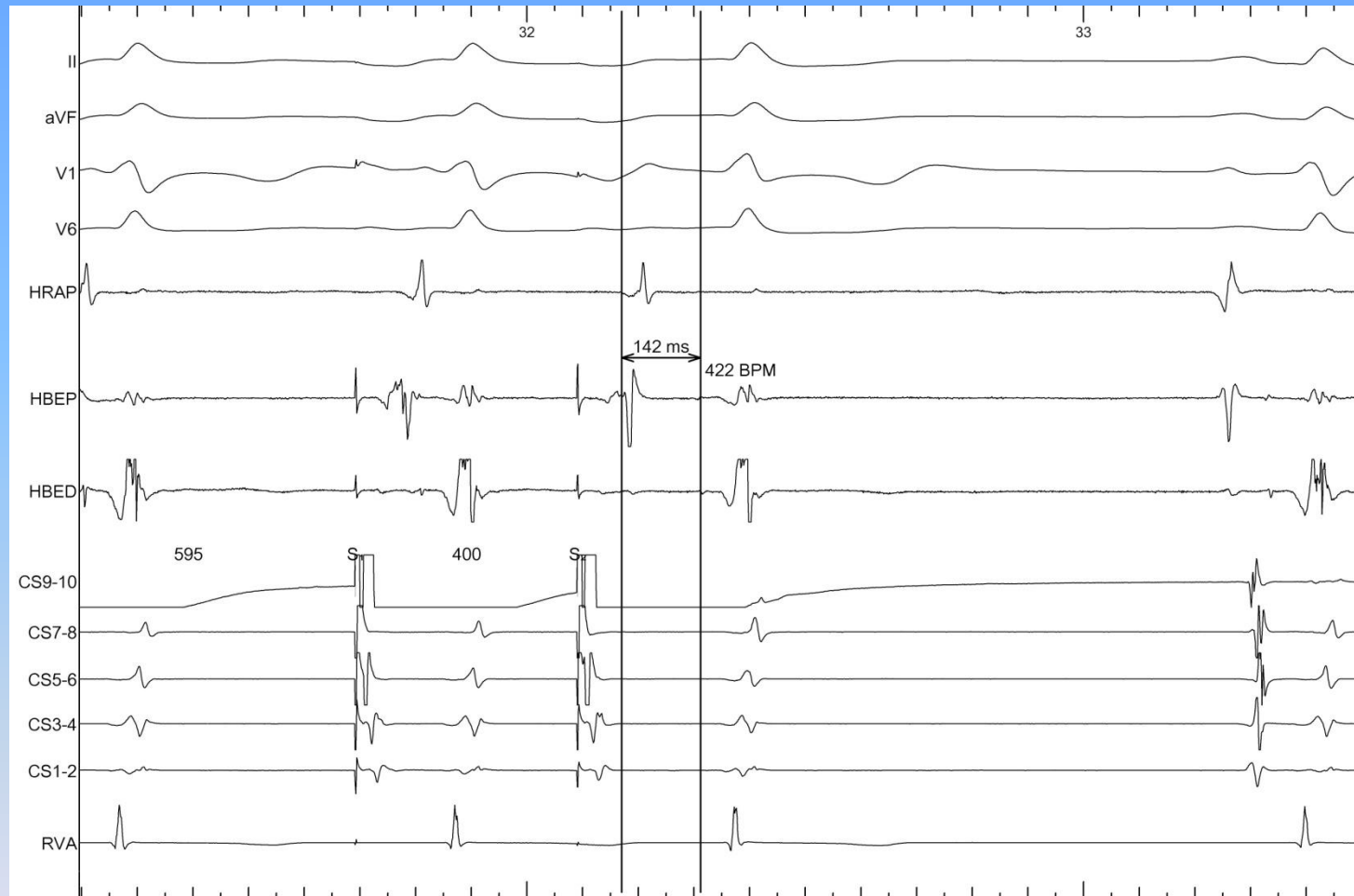
Shorter coupling  
intervals ( $A_1A_2$ )

=>

Progressive conduction  
delay ( $A_2H_2$ )

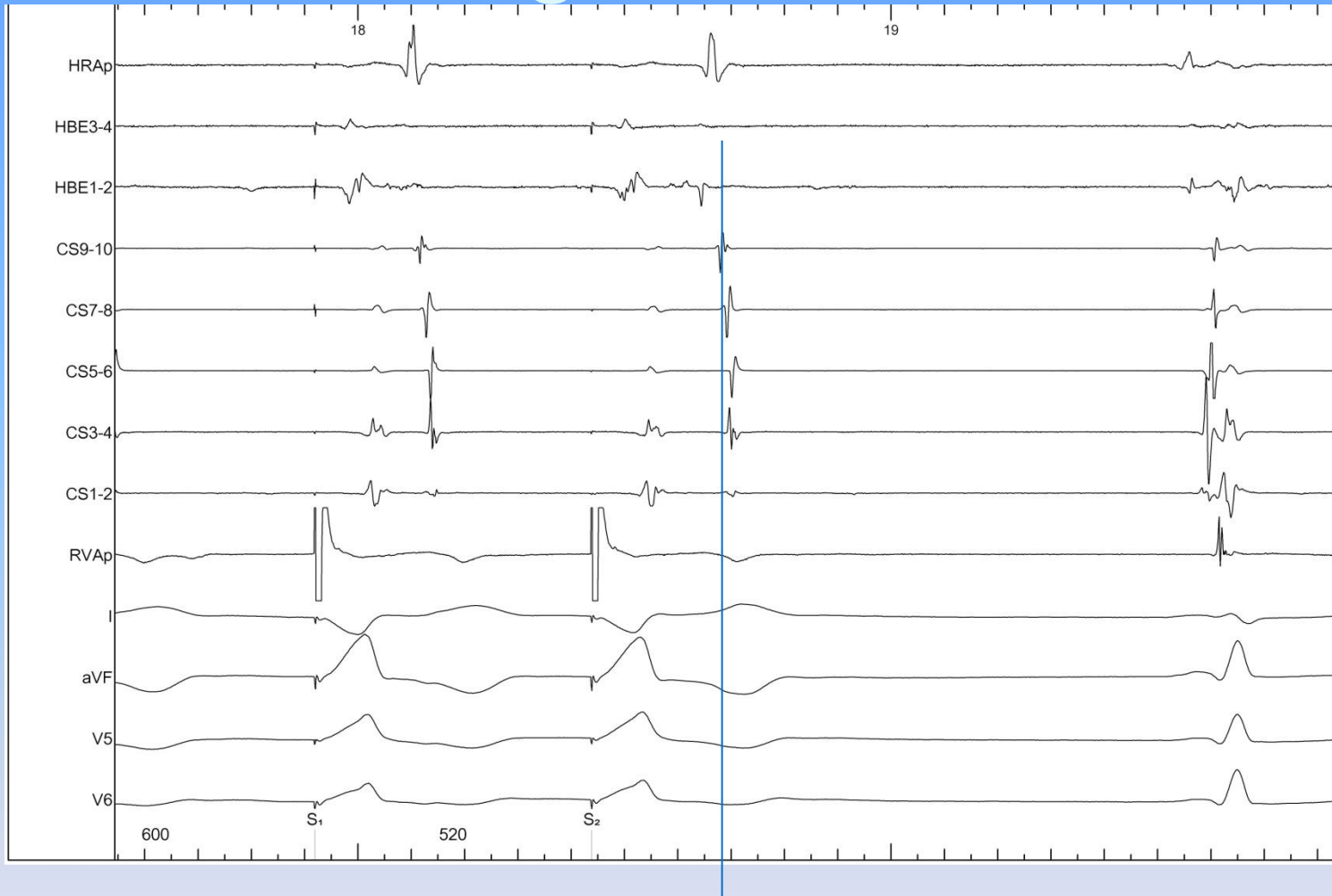


# Anterograde Curve



The ECG recording displays multiple leads: HRAp, HBE3-4, HBE1-2, CS9-10, CS7-8, CS5-6, CS3-4, CS1-2, RVAp, I, aVF, V5, and V6. The leads show a regular rhythm with a heart rate of approximately 45 bpm. The leads are labeled on the left side of the strip. The bottom of the strip has a time scale with markers for S1, S2, and S3, and a heart rate of 400 bpm. The leads show a regular rhythm with a heart rate of approximately 45 bpm. The leads are labeled on the left side of the strip. The bottom of the strip has a time scale with markers for S1, S2, and S3, and a heart rate of 400 bpm.

# Retrograde Curve



# Retrograde Block



# Interpreting EP signals Part 2 – Arrhythmia mechanisms

# Arrhythmia mechanisms

- Automatic
- Re-entrant
  - Macro
  - Micro
- Triggered automaticity
  - Delayed after depolarisations
  - Early after depolarisations

# Macro re-entry

- 2 “limbs” with different conduction velocities and refractory periods
- Joined by common viable conductive tissue
- Catalyst to initiate

Atrial Flutter

Ischemic Ventricular tachycardia

Bundle Branch Tachycardia

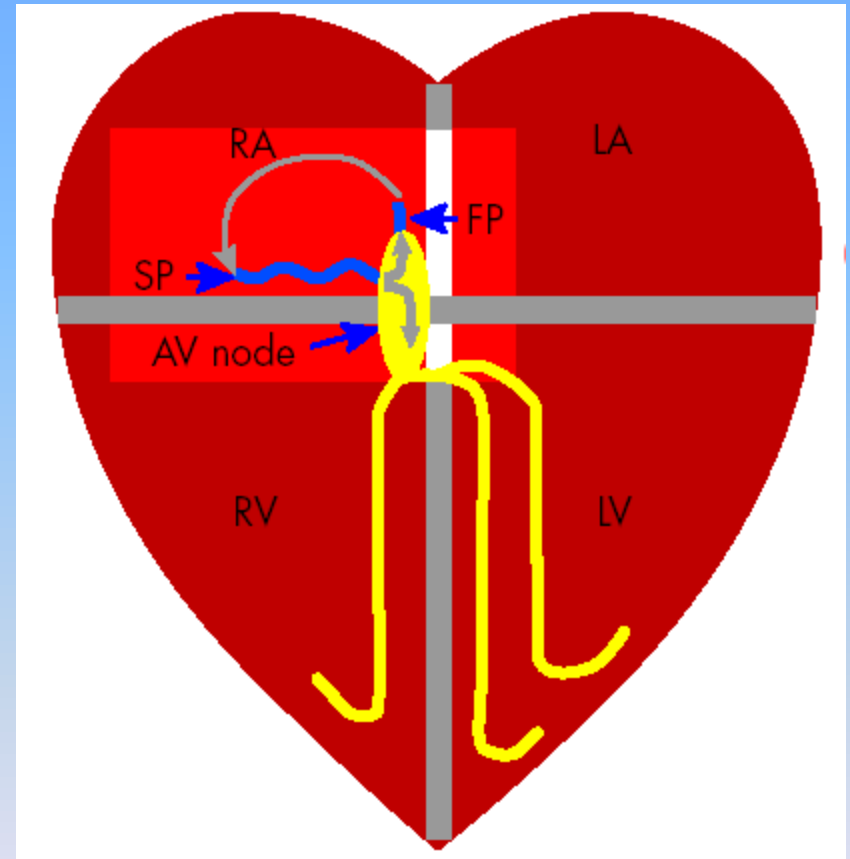
AVNRT and AVRT



# AVNRT

## (AV Nodal Re-entry Tachycardia)

- Dual AV Nodal Physiology
- Differential diagnosis by jump in AH interval of  $>50\text{ms}$  for a decrement of  $10\text{ms}$  in S2
- Circuit *does not* involve V
- Fast pathway “blocks” refractory, therefore conduction via slow pathway
- Premature Atrial beat or other tachycardia usually initiates
- Usually slow anterograde, fast retrograde (anticlockwise)



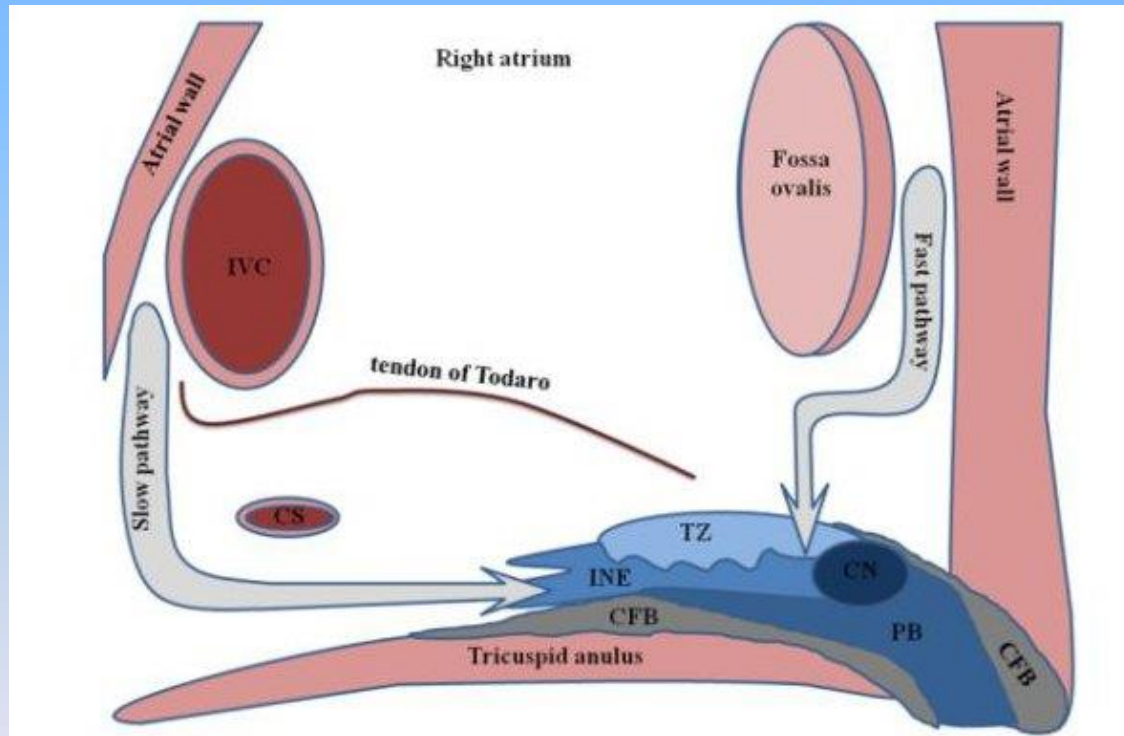
# Slow and Fast Pathways

- Rapid conduction ,  
long refractory period

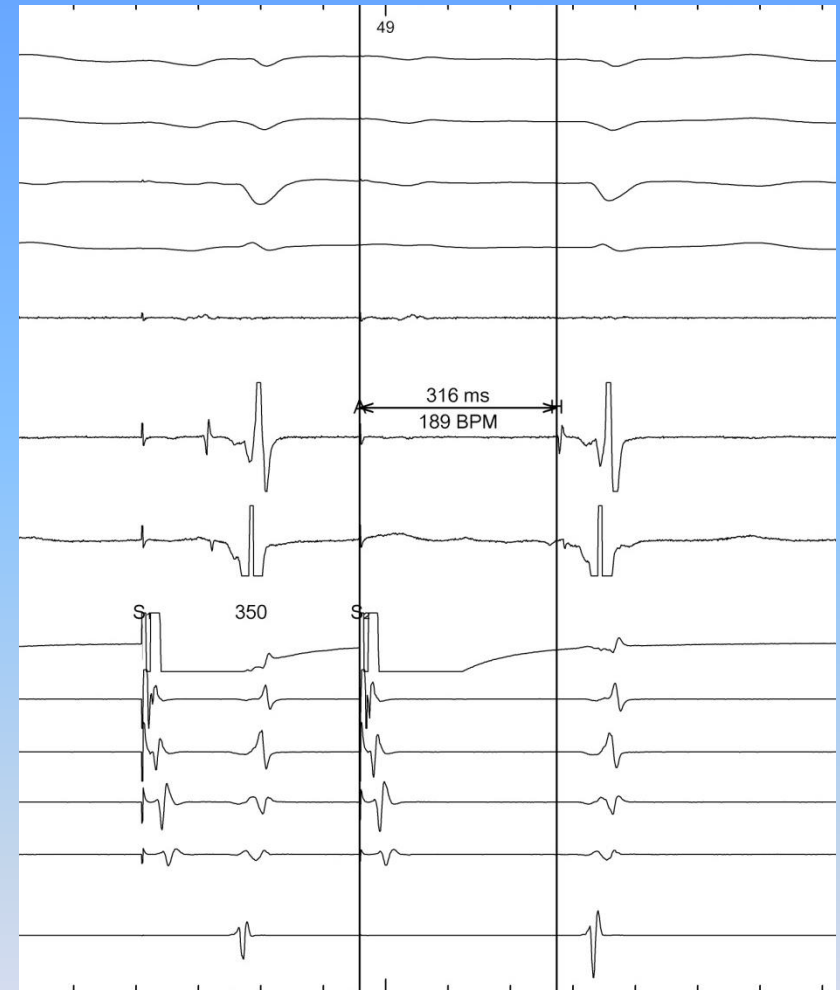
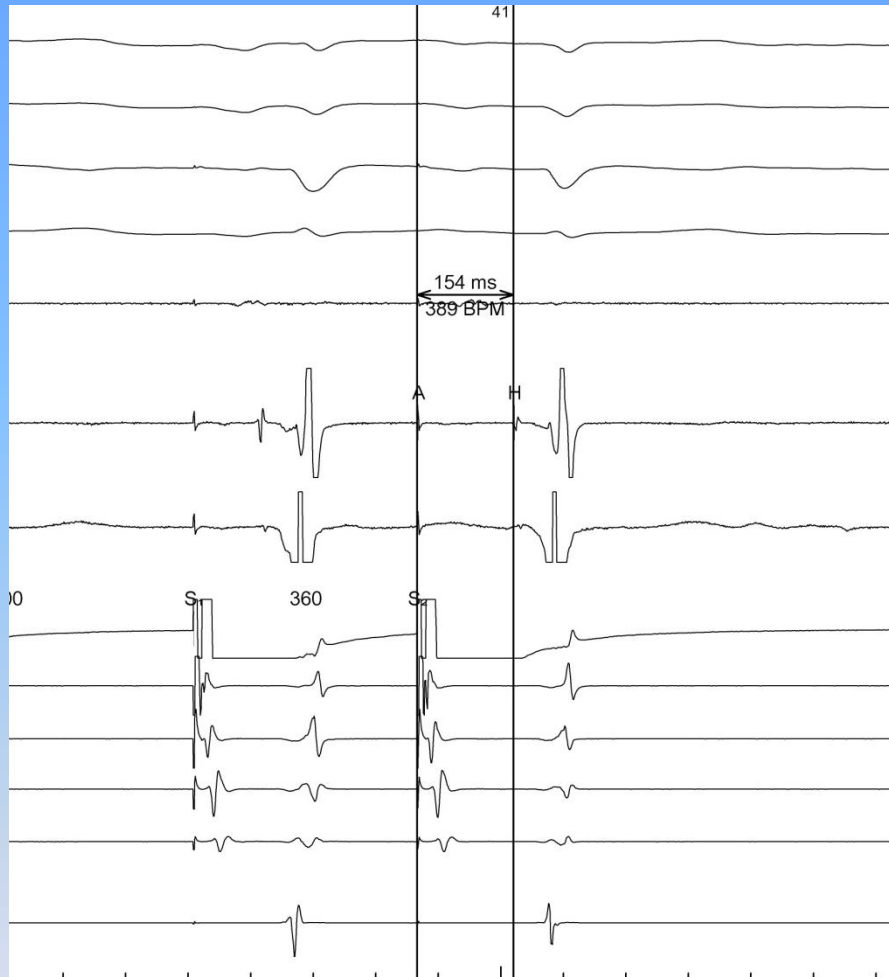


- Slow conduction, short  
refractory period

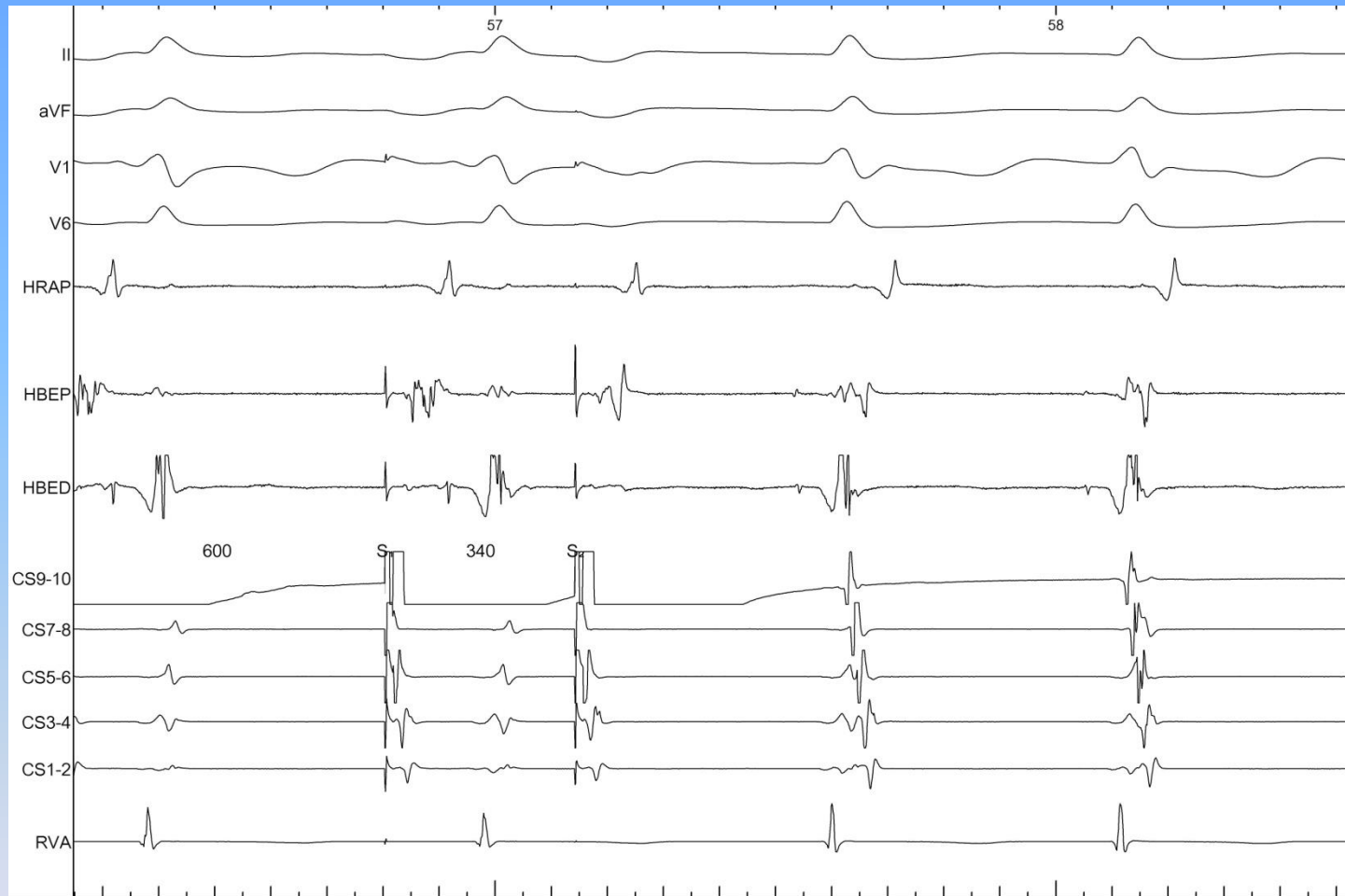
# Pathway Locations



# AH Jump (Dual AV Nodal Physiology)



# AVNRT induction



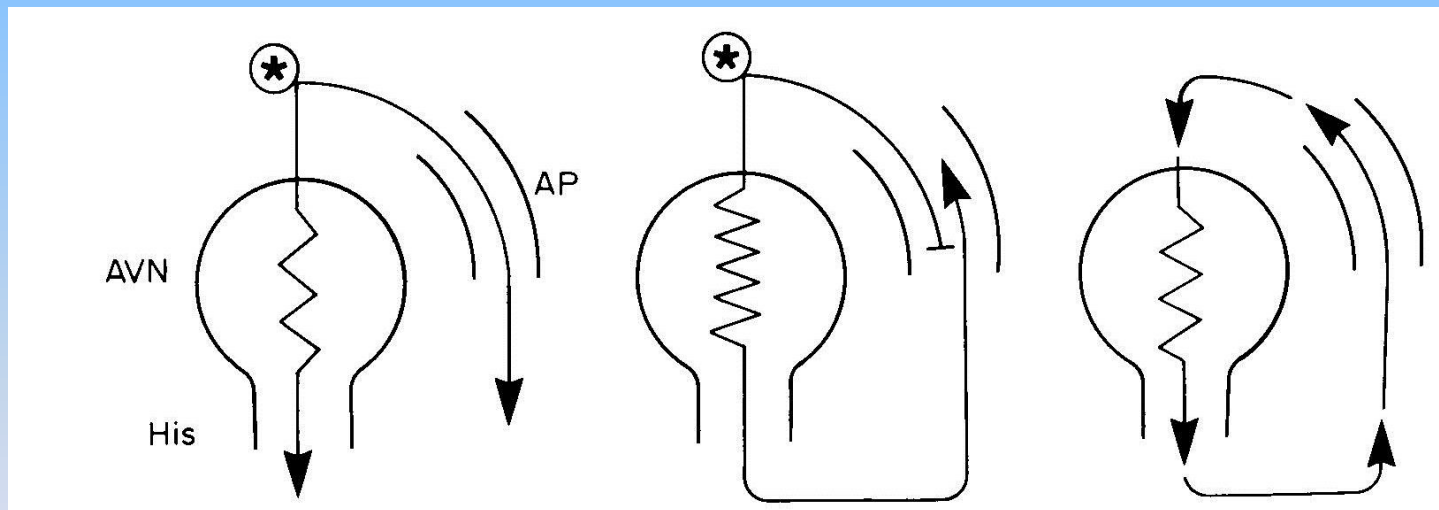
# His Synchronous pacing

- His Synchronous pacing – Pace from the RV during sustained tachycardia at a rate slightly higher than TCL. Measure atrial CL did you advance the A? If so there is evidence of a pathway, as the AV node couldn't conduct as it would be refractory.
- Failure to advance the A does not rule out a pathway, as you may just be pacing too far from the pathway to capture it.

# AVRT

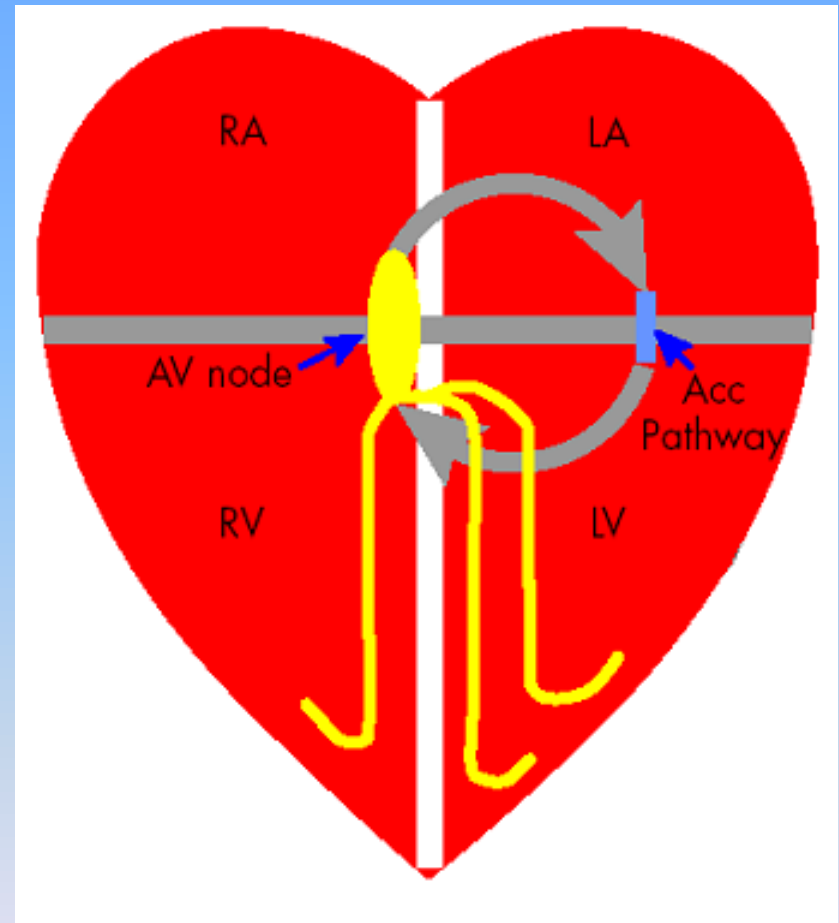
## (Atrio-Ventricular Re-entry Tachycardia)

- Re-entry Mechanism / Accessory Pathway



# AVRT Cont'd

- Re-entry Mechanism
  - Ventricular myocardium involved
  - Concealed or manifest pathways
  - Reveal with adenosine
  - WPW

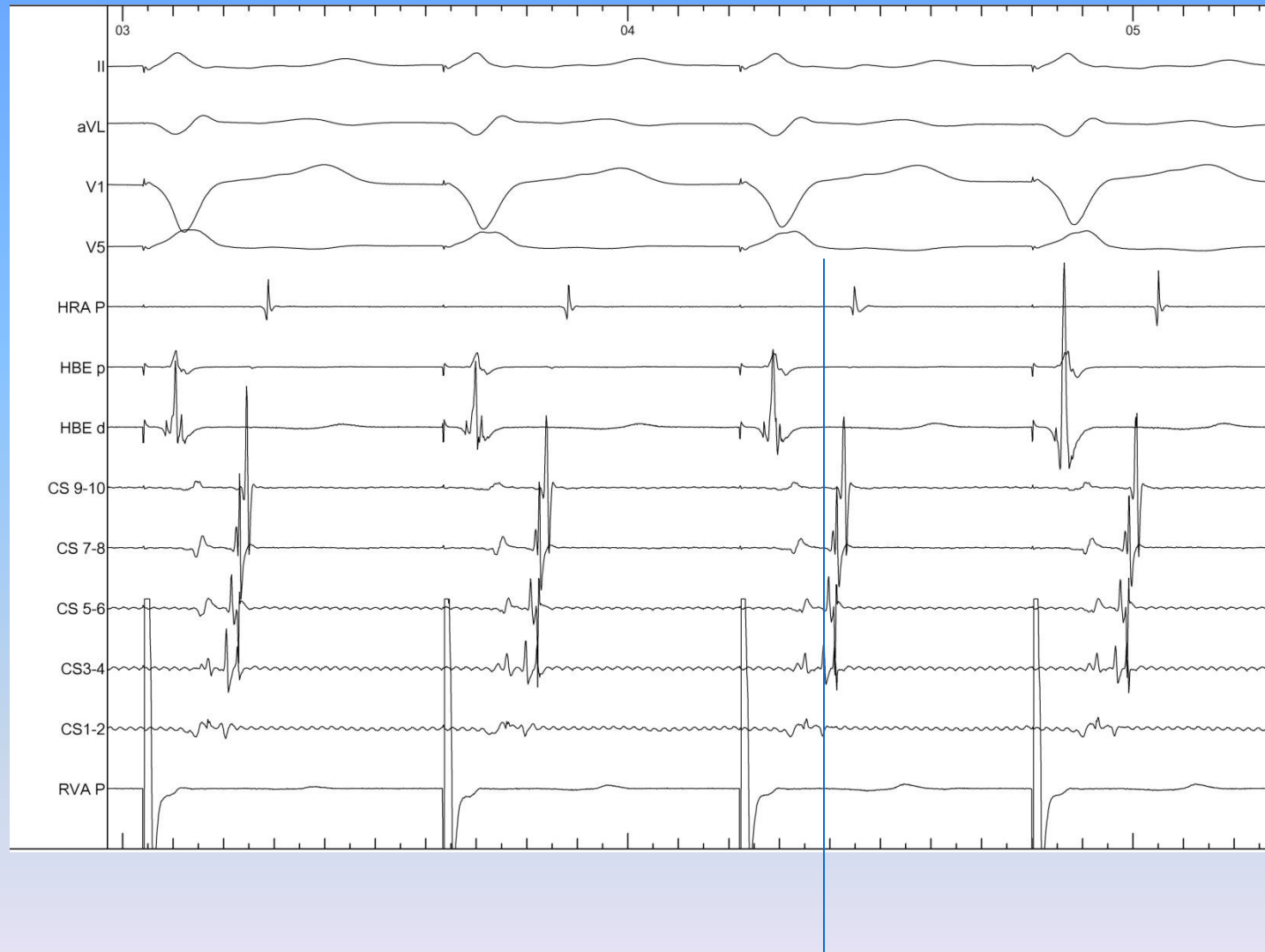




# AVRT



# RV pacing with left sided pathway

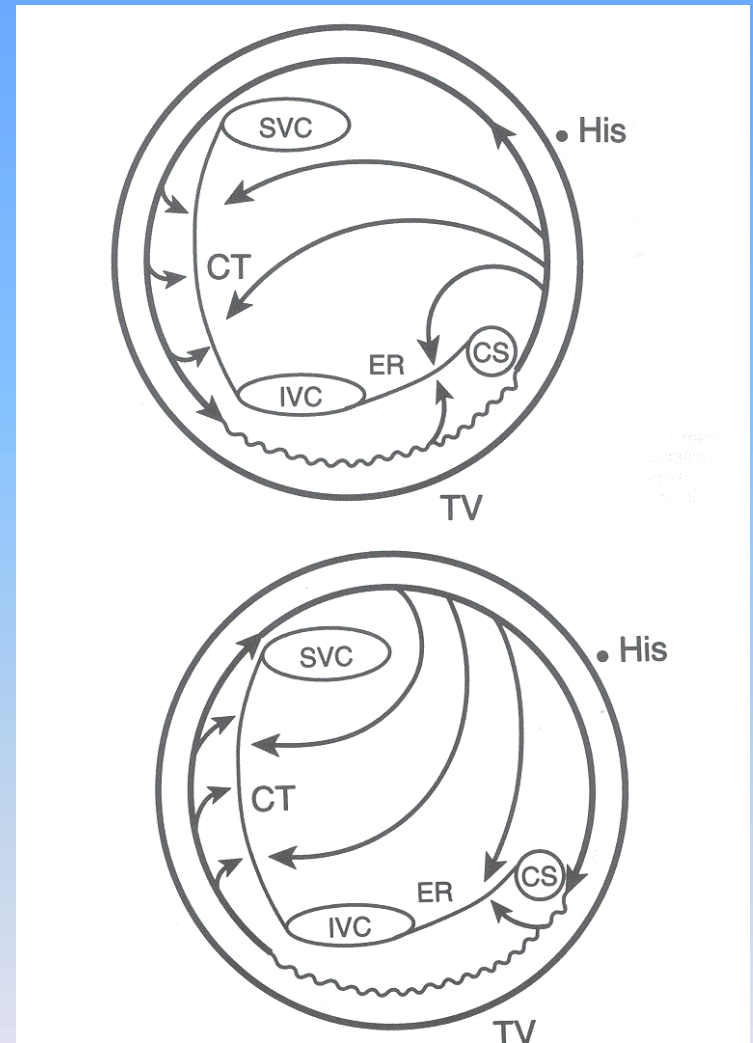


# Atrial Flutter



# Atrial Flutter

- Macro re-entry circuit
  - Typical = anti-clockwise around tricuspid valve
  - Atypical = clockwise
  - Isthmus between TV and IVC



# Atrial Fibrillation - Theories

Sueda  
Ann Thorac Surg 1997

Microreentrant  
circuits

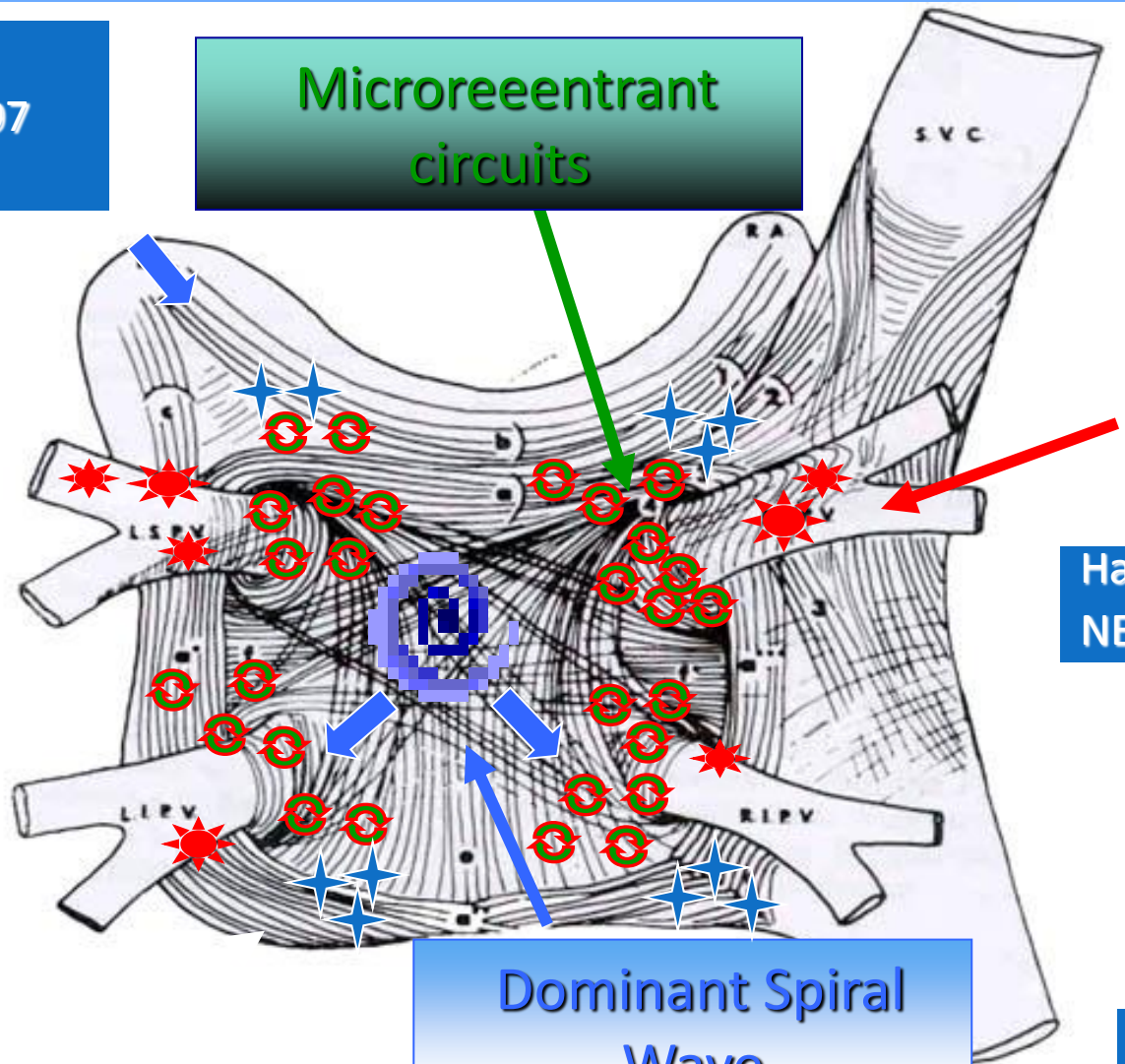
PV foci

Haissaguerre  
NEJM 1998

Dominant Spiral  
Wave

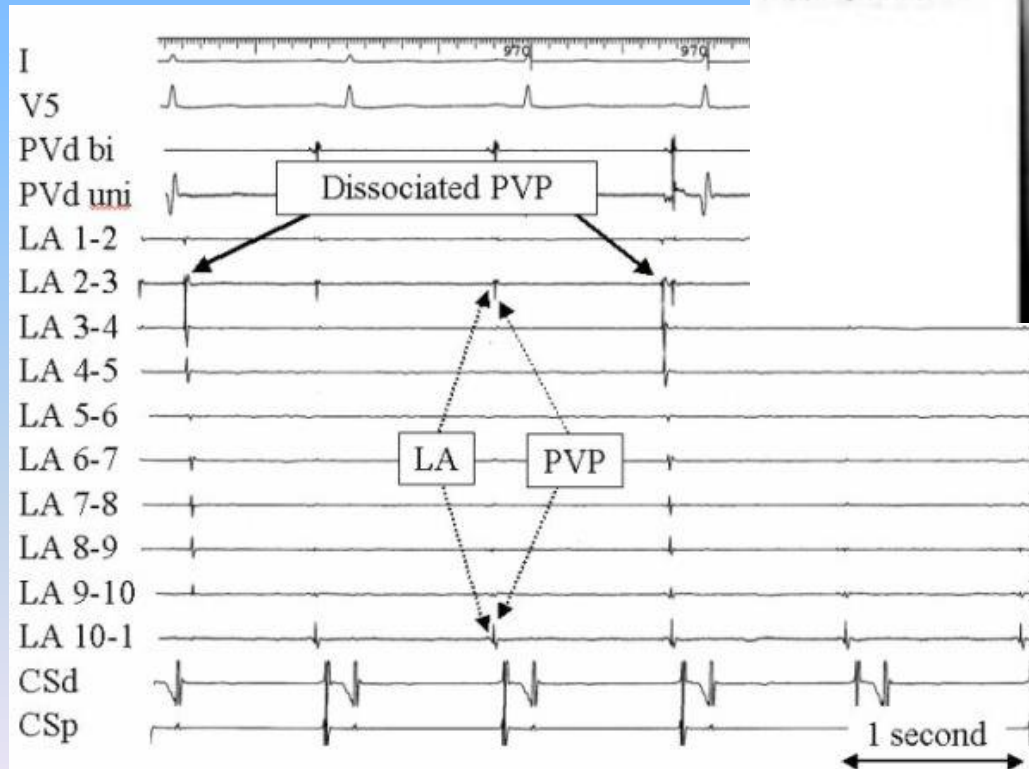
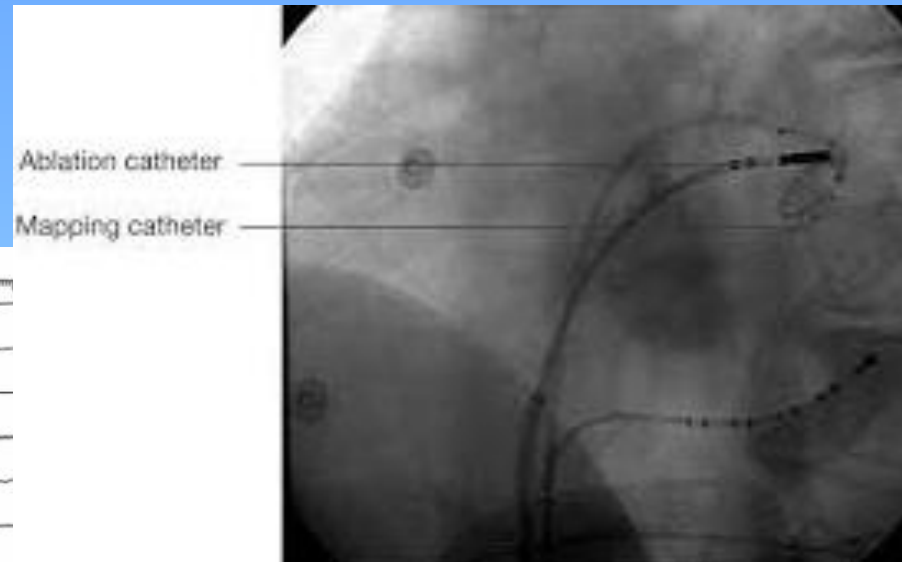
Vagal Ganglia

Mandapati  
Circulation  
2000



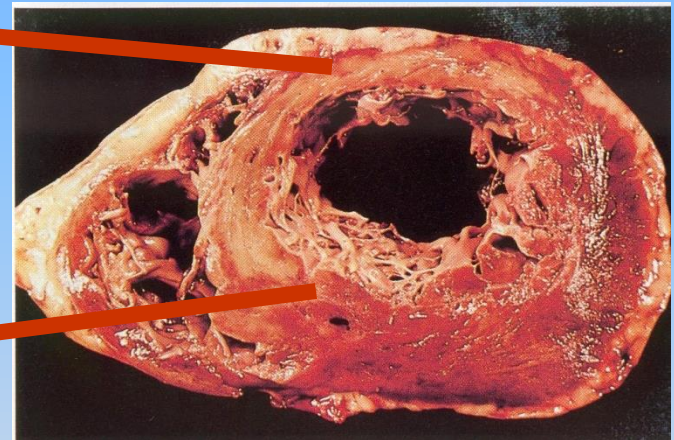
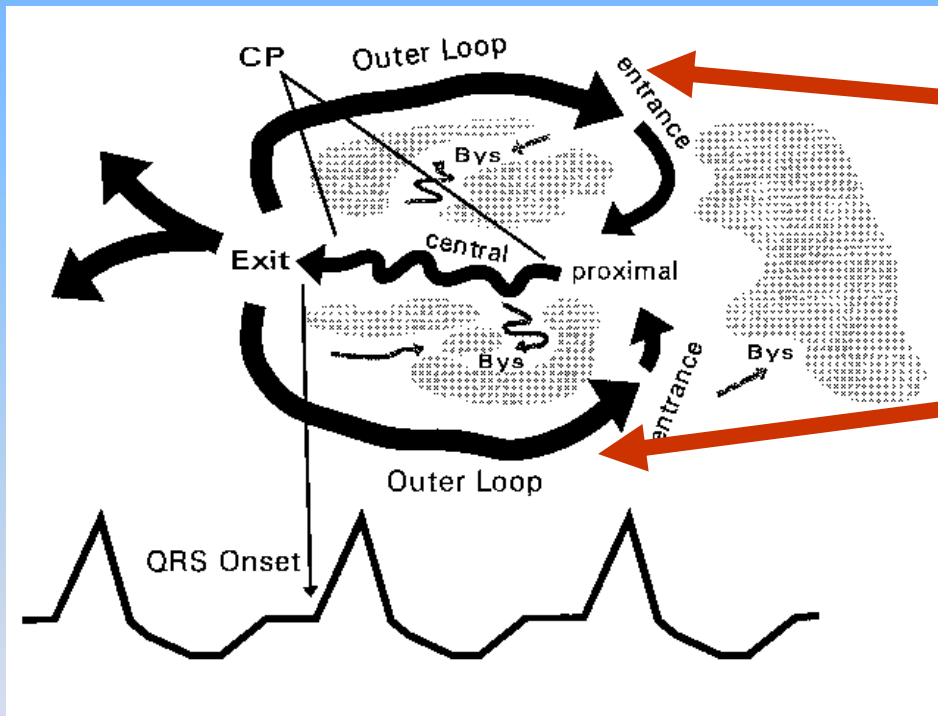
Pappone  
Circulation  
2004

# Pulmonary Vein Potentials

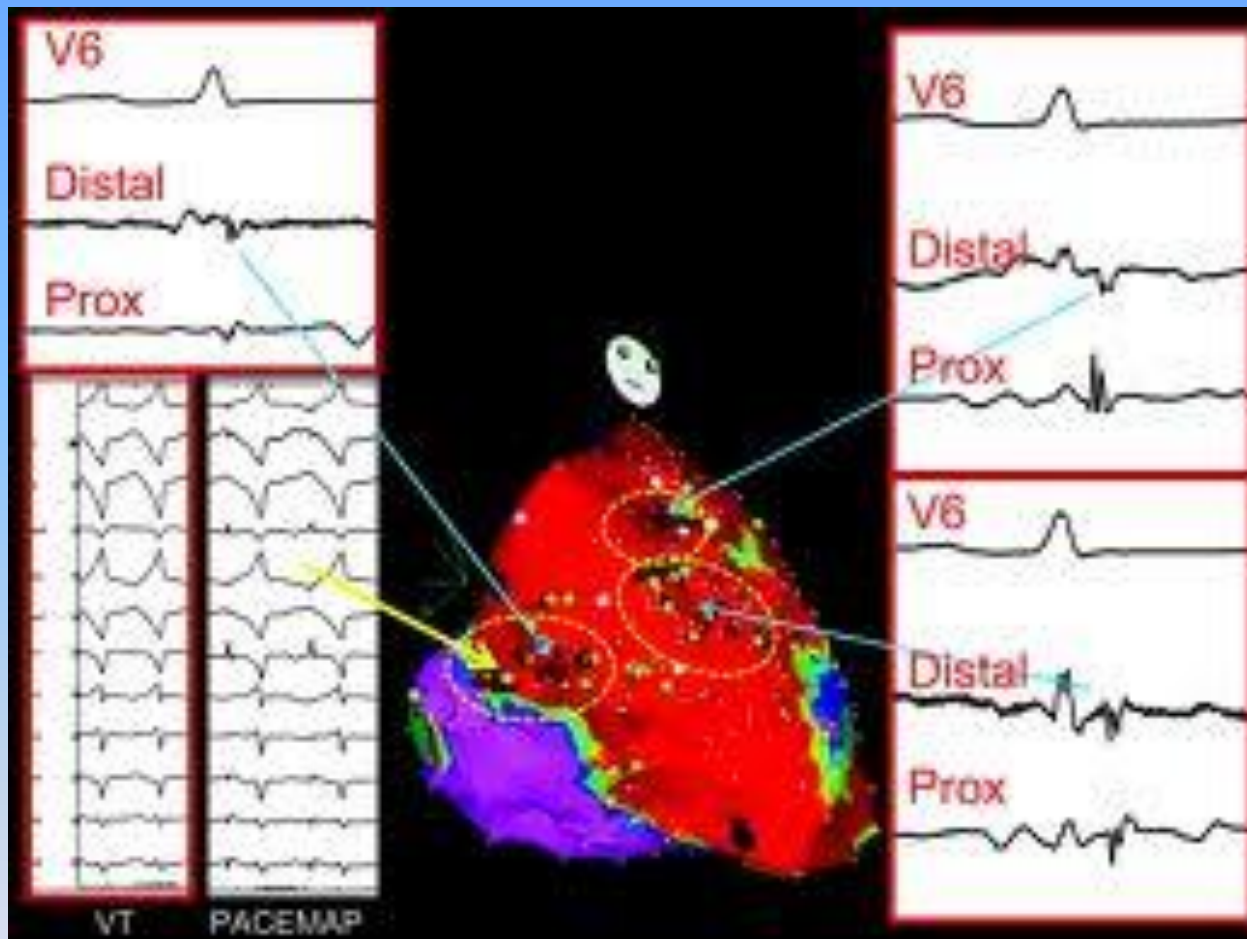




# Ischemic VT – Macro re-entrant

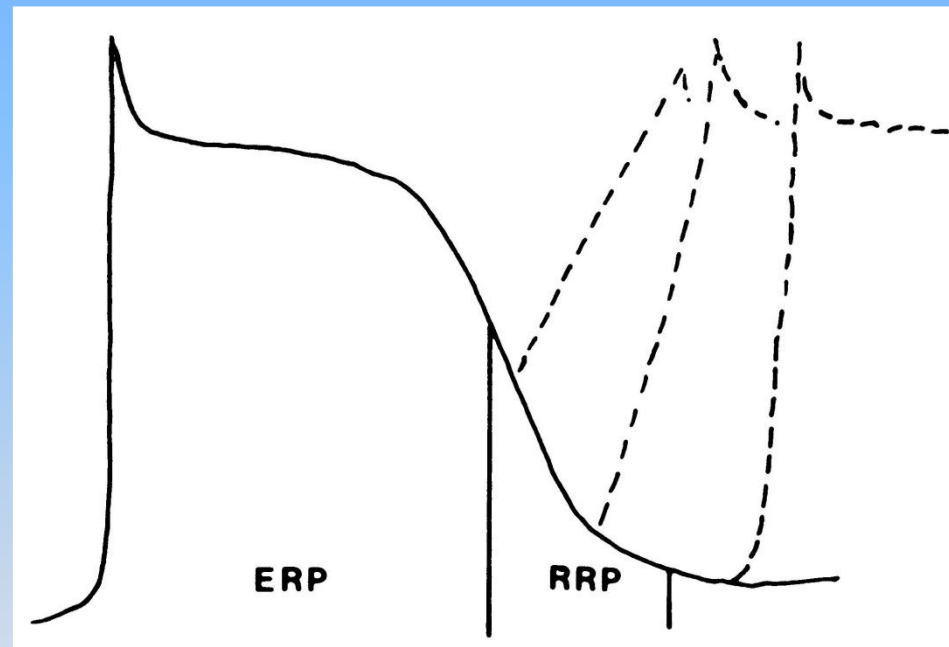


# Late potentials





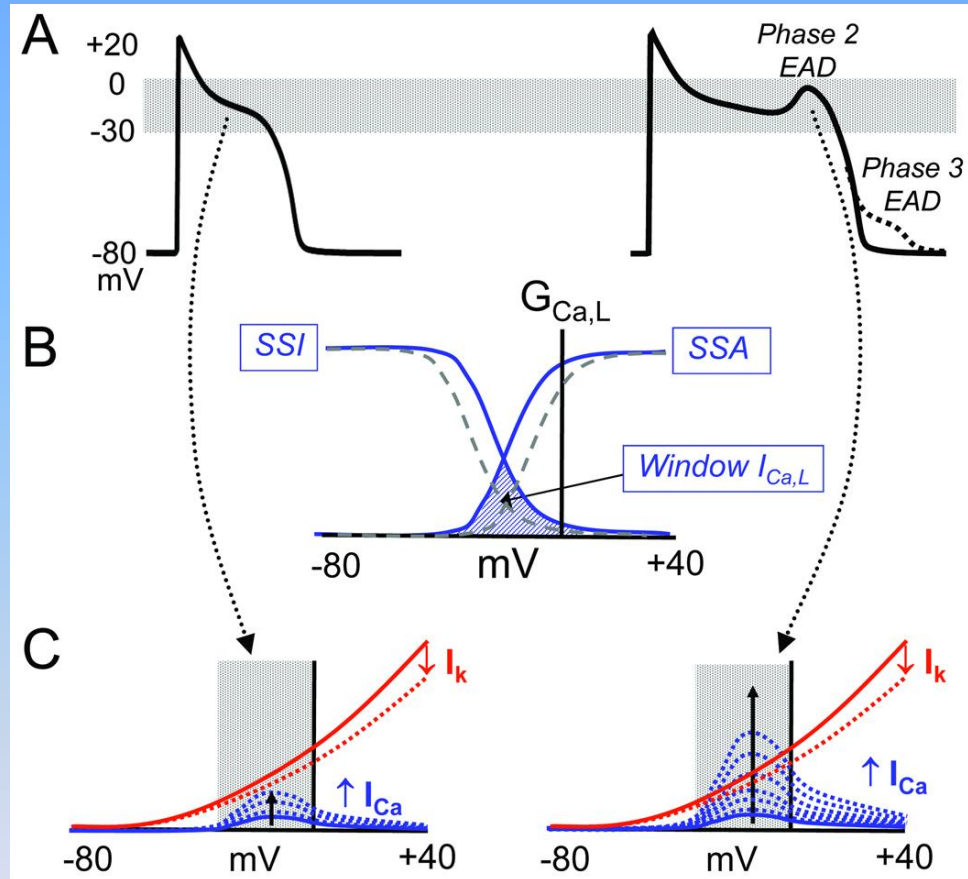
# Late after potentials



End

*Questions ?*

# Early After potentials



# Differential Diagnostic manoeuvres

- Para Hisian pacing –
- Right sided and septal pathways
  1. Pace at the base of the RV just below the his on the septum –should result in a narrow QRS
  2. Reduce the pacing output until you see LBBB, now you are only capturing the RBB. Does VA conduction time extend?
  3. Keep reducing output until you only achieve local capture and loose NB capture. Is there still VA conduction?
  4. NB: note changes in HIS D and P and HRA timing