Arrhythmia Provocation

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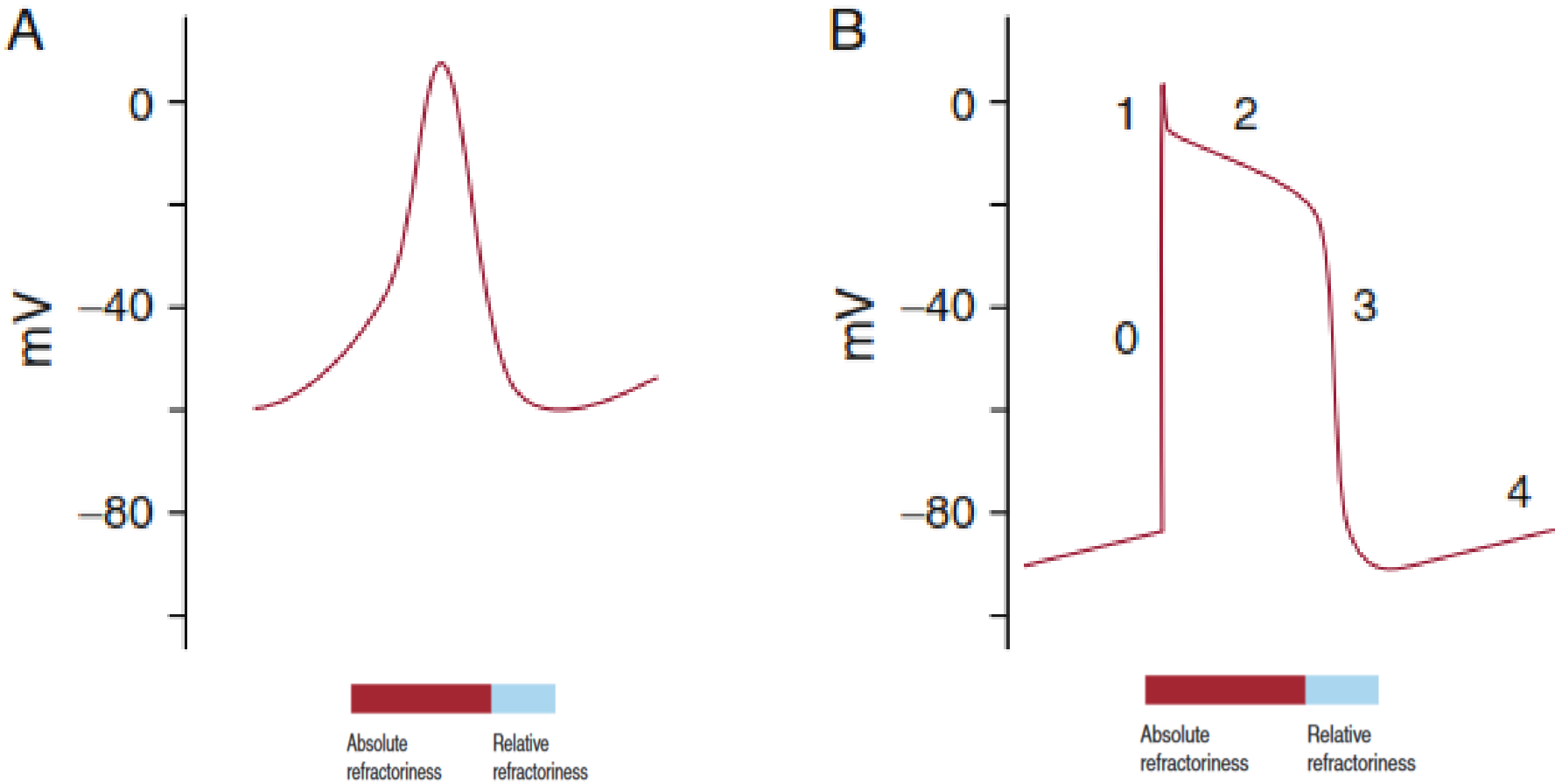
Essex CTC

Tachycardias

- Automatic
- Triggered
- Re-entrant

Cell Physiology



Automatic Tachycardias

- Automaticity provides the normal pacemaker function of the heart.
- Broadly speaking an acceleration of phase 4 activity.
- Can occur in the atria, AV junction or ventricles.
- Uncommon cause of arrhythmia (<10%).

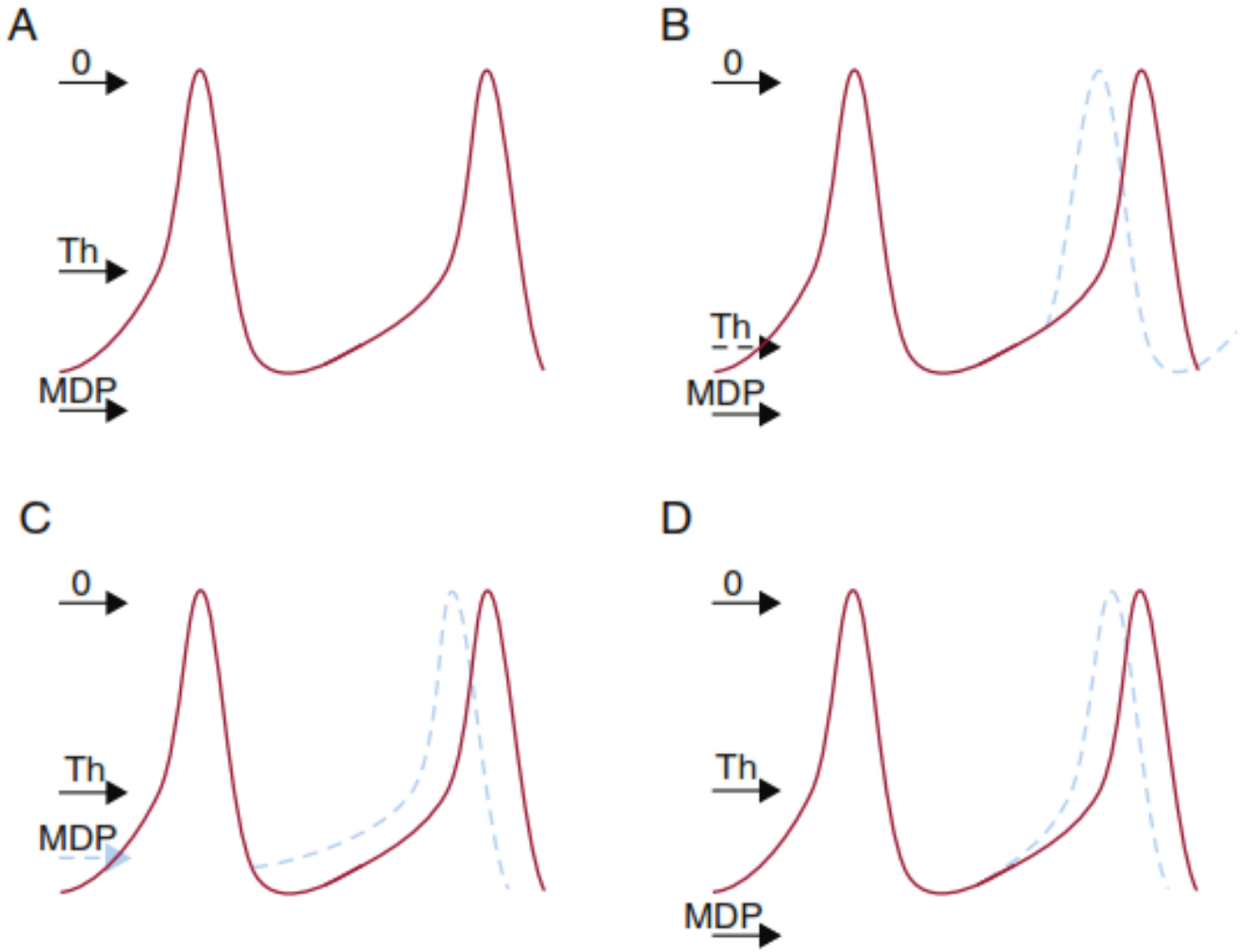


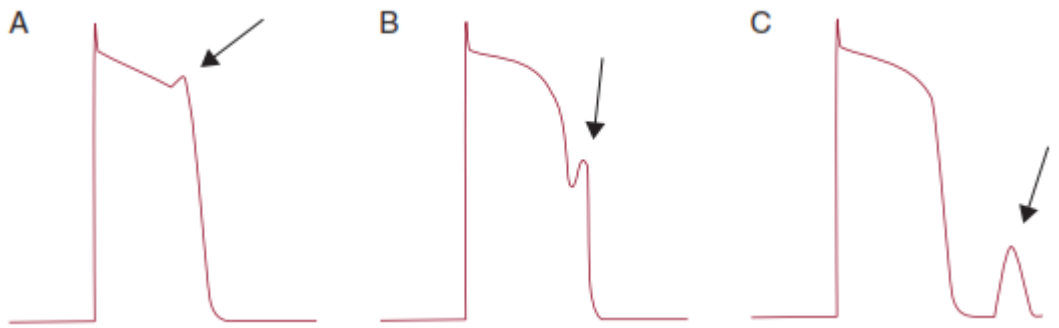
Figure 3. Mechanisms of enhanced automaticity. A: normal. B: increased threshold voltage. C: decreased membrane diastolic potential. D: increased slope phase 4 depolarization. MDP, membrane diastolic potential; Th, threshold.

Automatic Tachycardias

- Display warm-up and warm-down (like sinus tach).
- Often occur secondary to metabolic stress.
- As such they are encountered rarely in the EP lab.
- Provoke with Beta-agonists.
- Cannot be provoked by pacing.

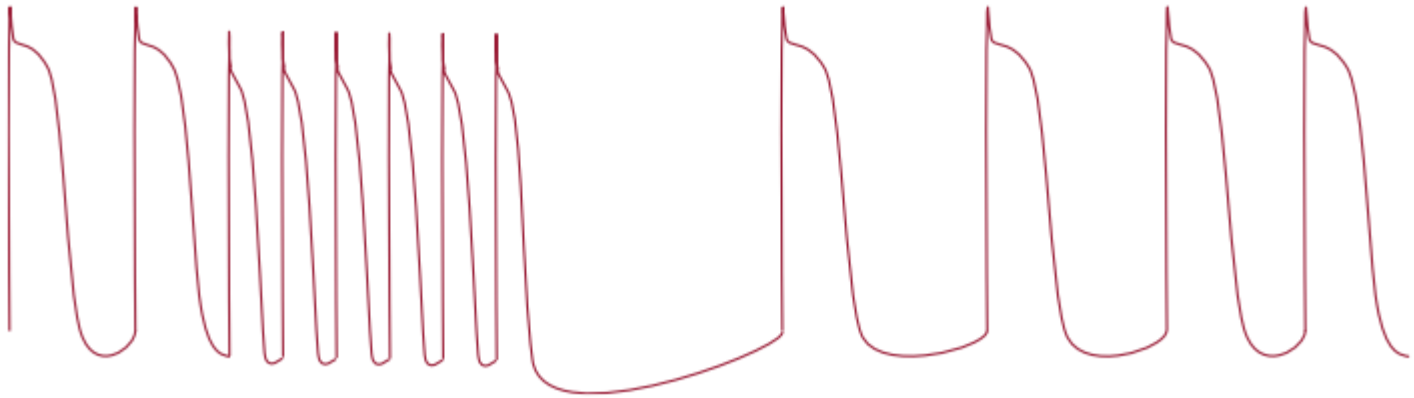
Triggered Tachyarrhythmias

- Cellular level caused by after depolarizations early and delayed.



Triggered Tachyarrhythmias

- Provoke by prolonging the vulnerable phase.
  - Short-long pacing intervals.
  - Sensed extras.

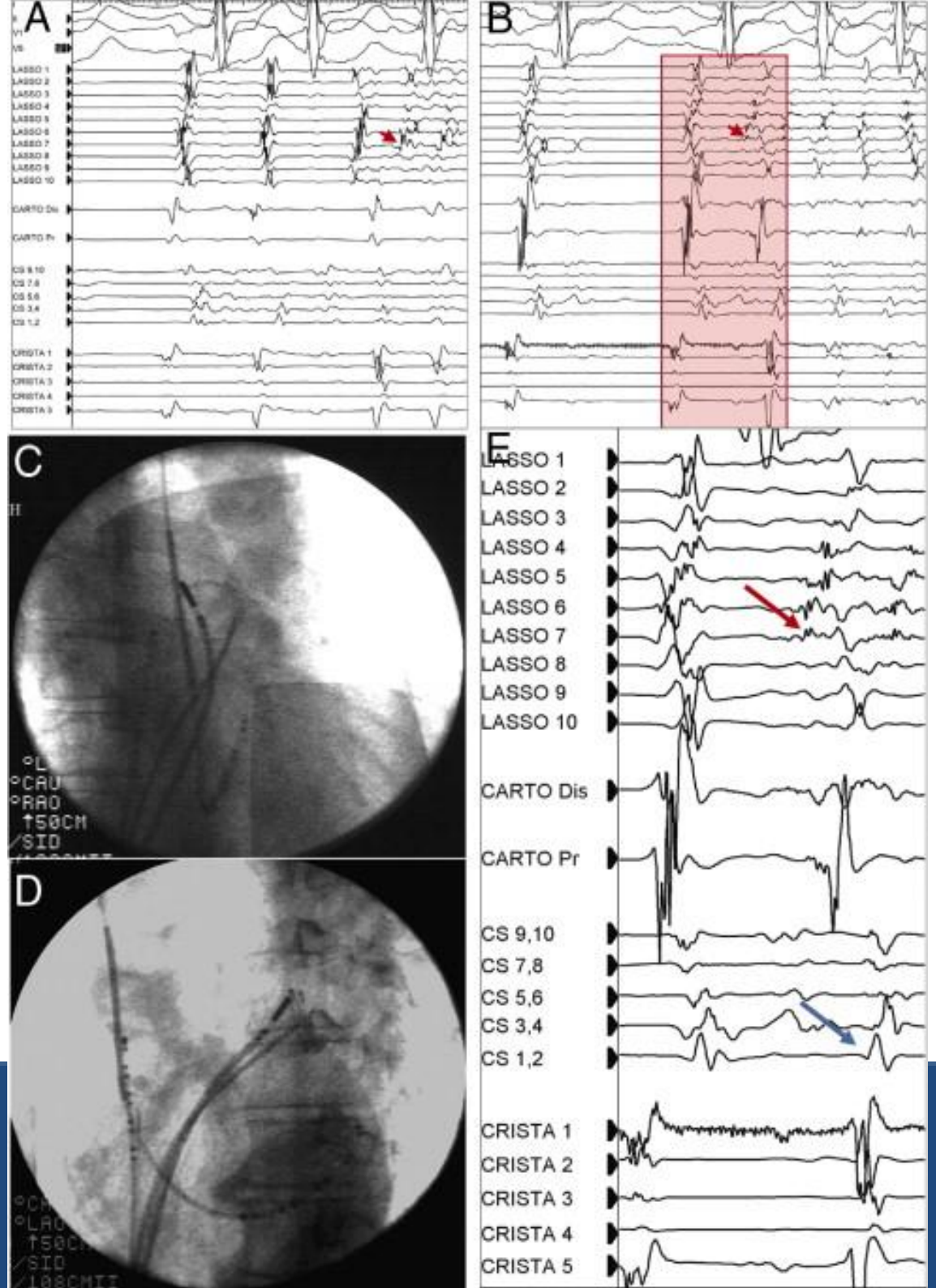


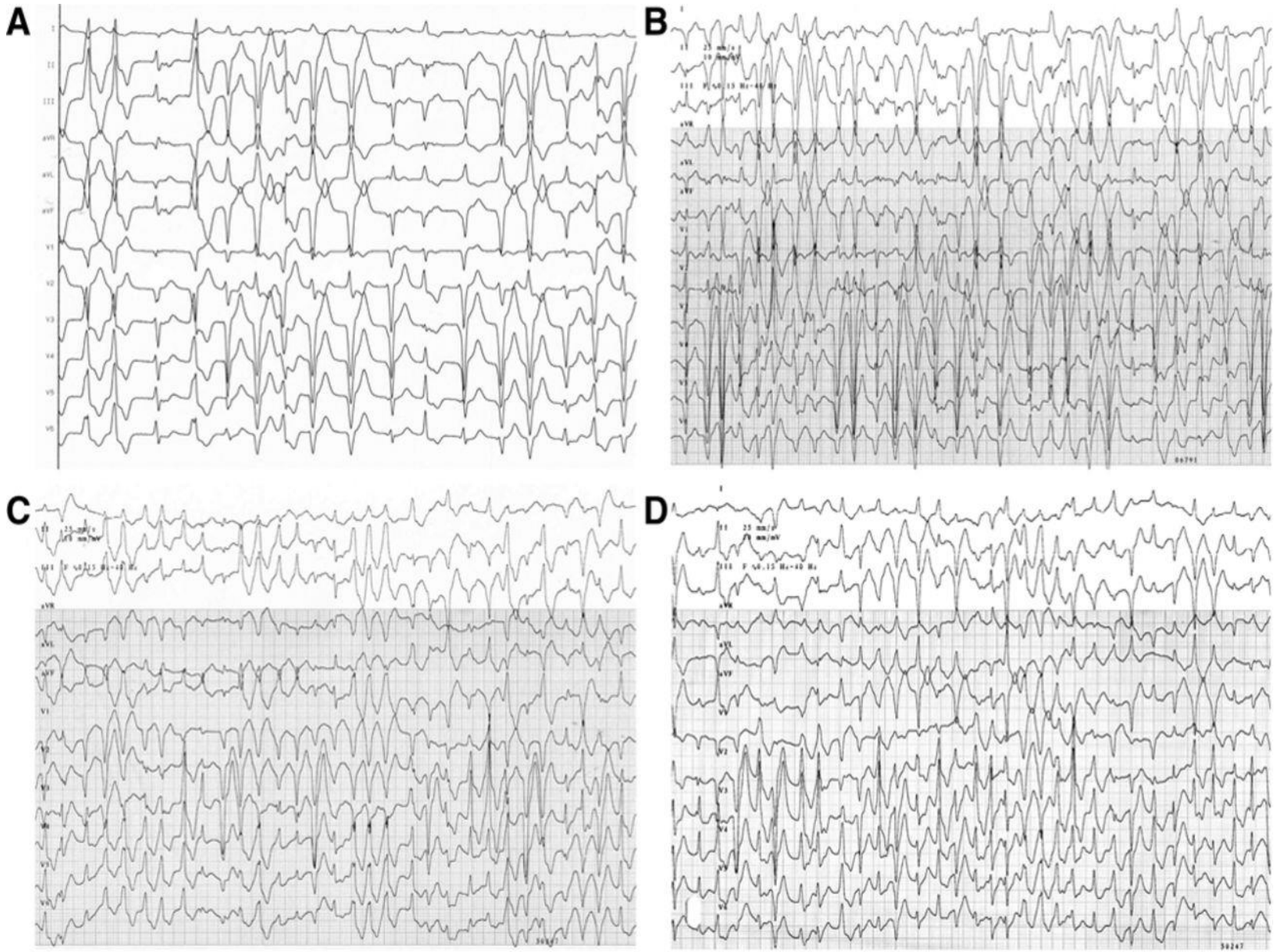
Triggered Tachyarrhythmias

- Provoke by increasing amplitude of the after depolarizations:
  - Exercise:
    - Treadmill
    - Straight leg raising
  - Beta-agonists

Triggered and Automatic Tachyarrhythmias

- Can be difficult to induce in lab:
  - Map outside the lab (exercise ECG,ambulatory ECG/ body surface mapping). Ablate in lab.
  - Start recording ECG early.
  - Pace mapping.
  - Use a lot of Isoprenaline (20-45 mcg/min)


A
B
C
D
E
LASSO 1
LASSO 2
LASSO 3
LASSO 4
LASSO 5
LASSO 6
LASSO 7
LASSO 8
LASSO 9
LASSO 10
CARTO Dis
CARTO Pr
CS 9,10
CS 7,8
CS 5,6
CS 3,4
CS 1,2
CRISTA 1
CRISTA 2
CRISTA 3
CRISTA 4
CRISTA 5



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Re-entrant Tachyarrhythmias

Gonionemus, *Lepas*, *Salpa*, and the loggerhead turtle. If there be marked differences between the reactions of closely related Scyphomedusæ, one may expect even greater disparity between those of vertebrates as compared with invertebrates.

Romanes, Loeb, von Uexküll, Hargitt, and others have caused disks to pulsate temporarily by subjecting them to the influence of NaCl solutions, etc., but in all cases more or less toxic effects resulted from the experiments and the sensibility of the sub-umbrella tissues became impaired or destroyed, so that further stimulation soon became impossible. We will now describe a method by which the disk of *Cassiopea* when deprived of marginal sense-organs may be made to pulsate indefinitely in sea-water with the production of effects no more injurious than those of fatigue. This may be most readily accom-

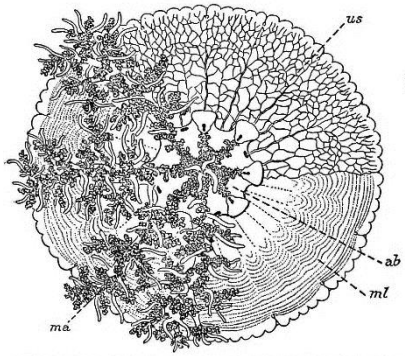
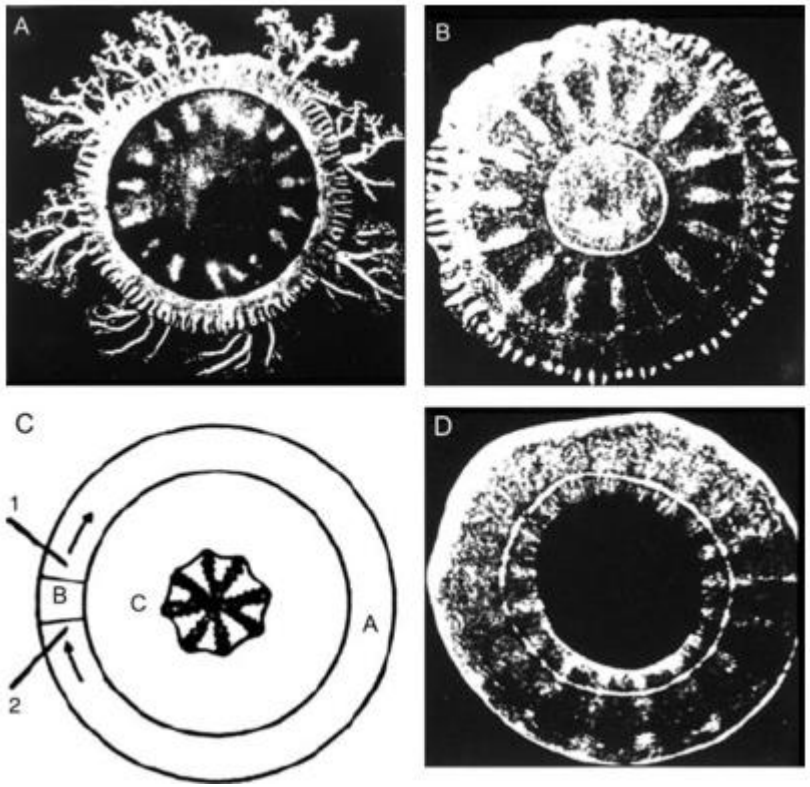


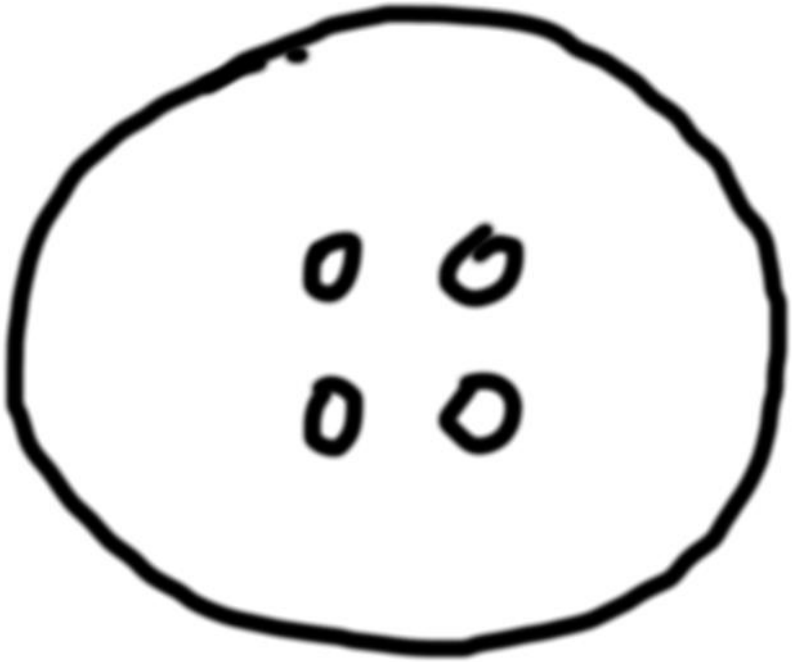
Fig. 7.—Oral view of Cassiopea xamachana. Four of the mouth-arms are cut off, and the muscle layer of the sub-umbrella in the upper right-hand quadrant removed to show the underlying vascular system. ab, Mouth-arm plate; ma, mouth-arm; ml, muscular system of the sub-umbrella; us, vascular canals of the sub-umbrella.

plished by cutting off all marginal sense-organs, and then making a series of concentric, discontinuous, ring-like cuts through the muscular tissue of the sub-umbrella, as is shown in figures 8 to 19.* Then upon stimulating the disk in any manner it instantly springs into rapid rhythmic pulsation, so regular and ceaseless as to remind one of the movement of clockwork. The cuts must be so made as to permit a free passage of contraction waves through sub-umbrella tissue forming a closed circuit. The simplest circuit is, of course, a single ring

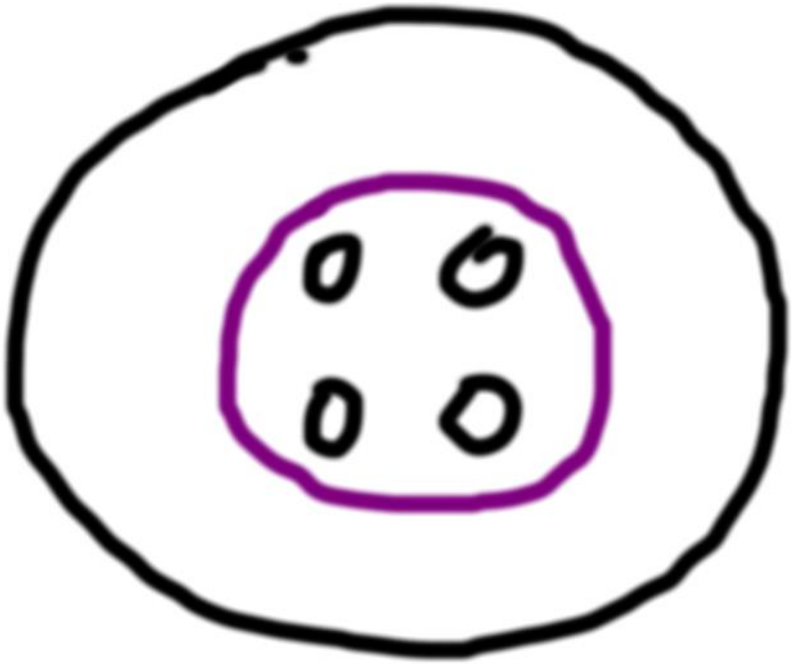
* A glance at figure 7 will show that the muscular area of the sub-umbrella is a wide annulus with the mouth-arm disk and stomach in the center. In figures 8 to 33 we have represented the disk as a circle, the small concentric circle at the center being the mouth-arm disk, while the wide annulus is the sub-umbrella.



Re-entrant Tachyarrhythmias



Re-entrant Tachyarrhythmias



Re-entrant Tachyarrhythmias

Re-entrant Tachyarrhythmias

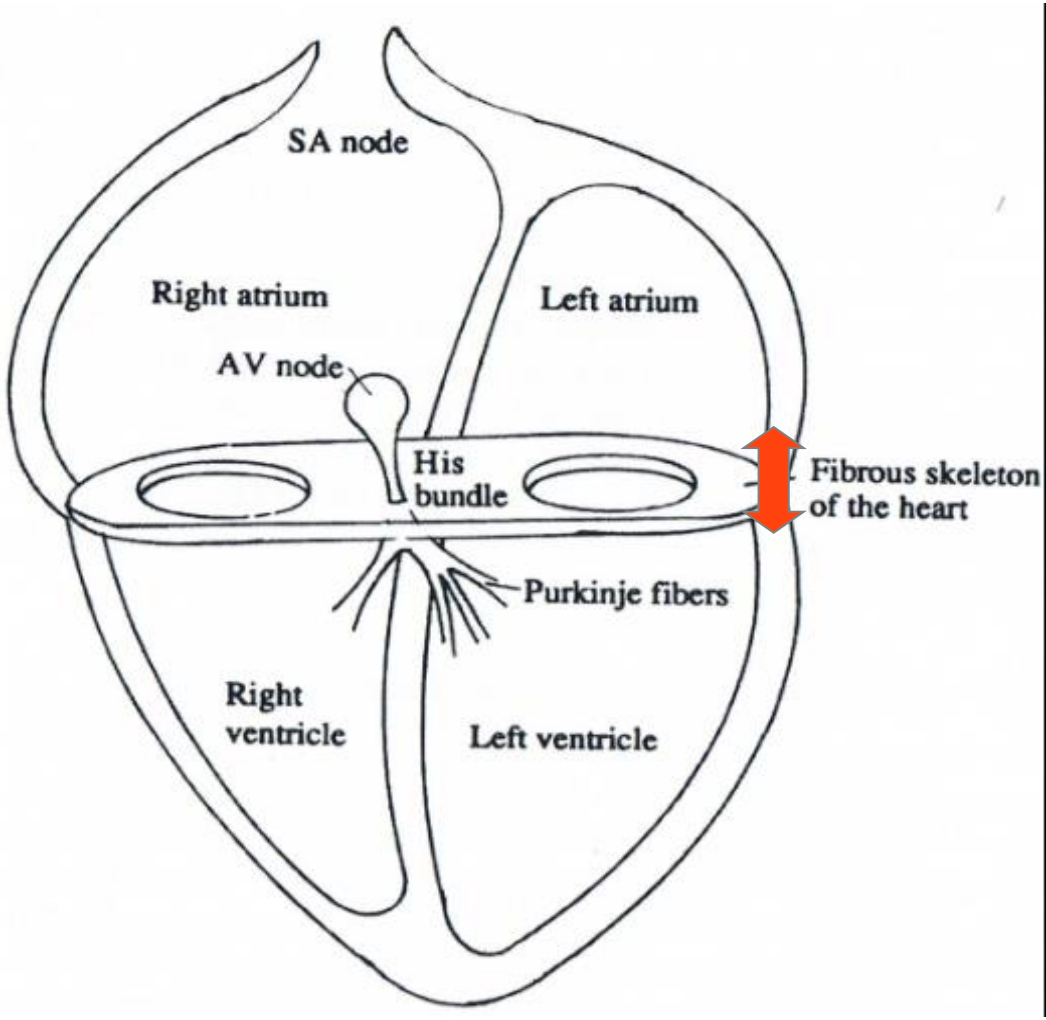
- Require:
  - Potential circuit (no short cuts)
  - Slow conduction.
  - Unidirectional block.

Potential Circuit

- Structural:
  - Whole heart for AVRT's.

Potential Circuit

- Structural:
  - Whole heart for AVRT's



Potential Circuit

- Structural:
  - Whole heart for AVRT's.
- Functional
  - Anisotropic conduction in scar related VT

Potential Circuit

- Structural:
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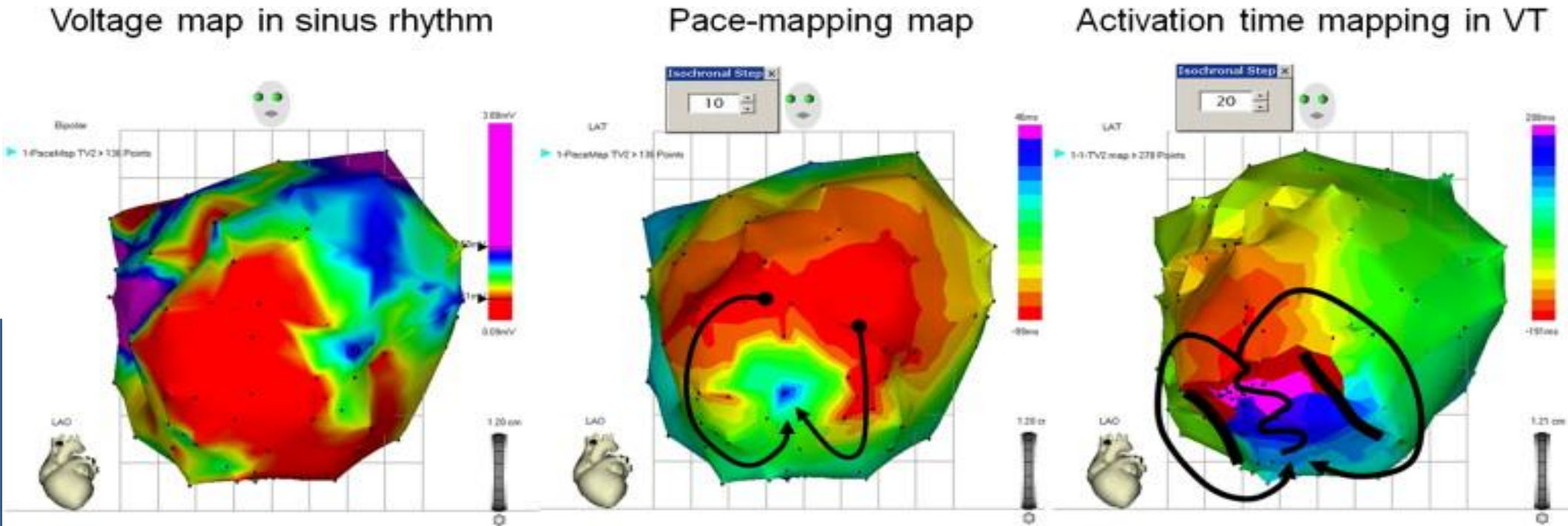
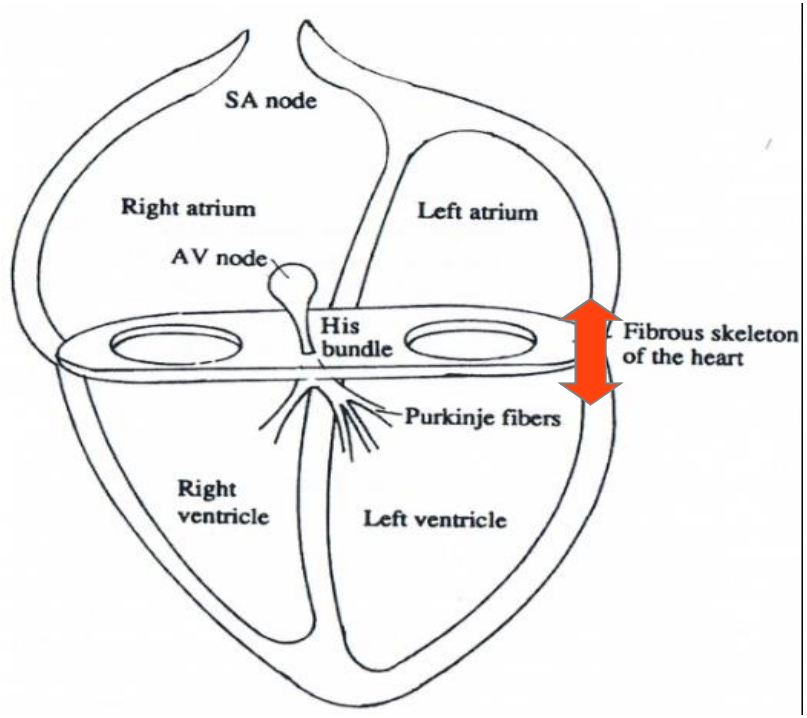
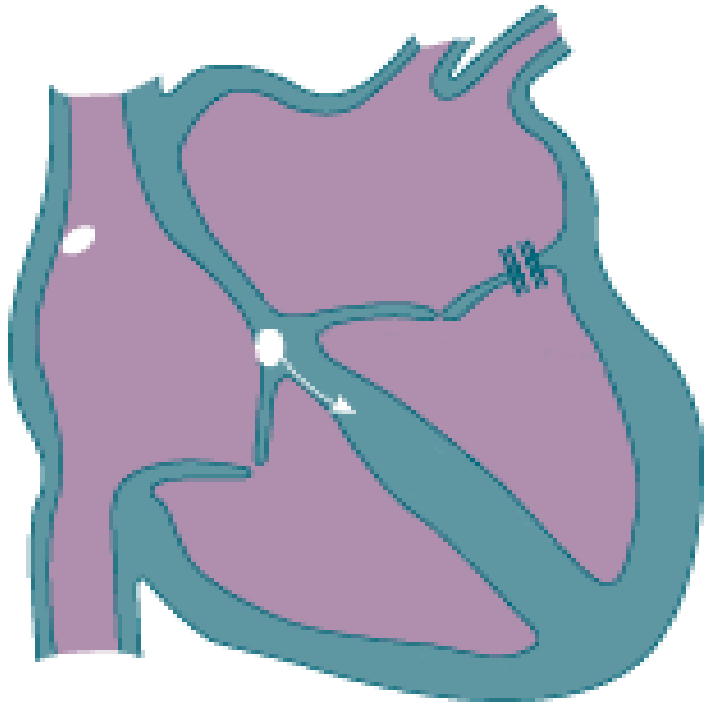


Potential Circuit

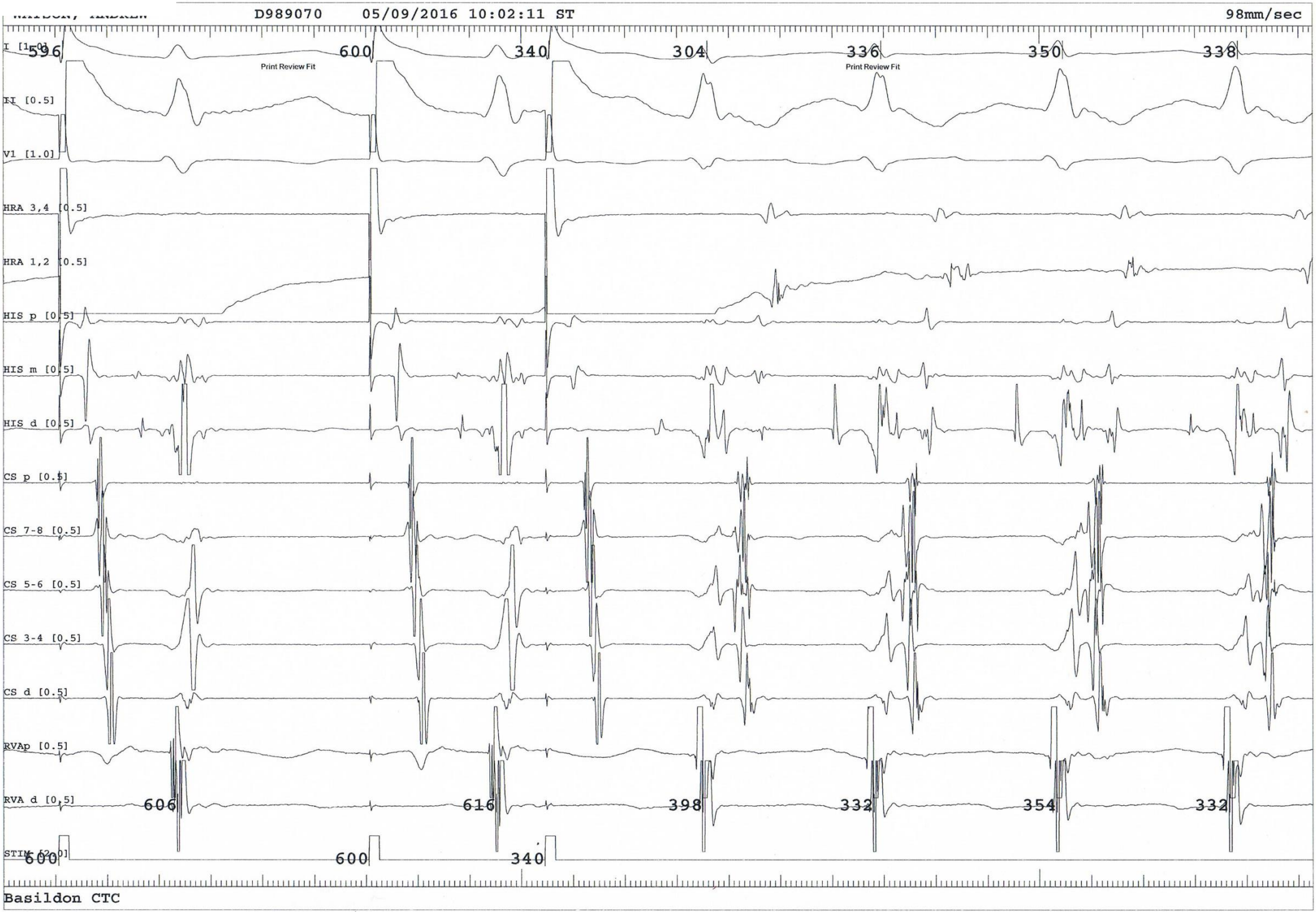
- Stimulate from within potential circuit to maximise chances of arrhythmia induction.





Slow conduction

- Paradoxical in the context of tachyarrhythmia.
- May be physiological:
  - AV node/ Some accessory pathways.
- May be a result of scarring.

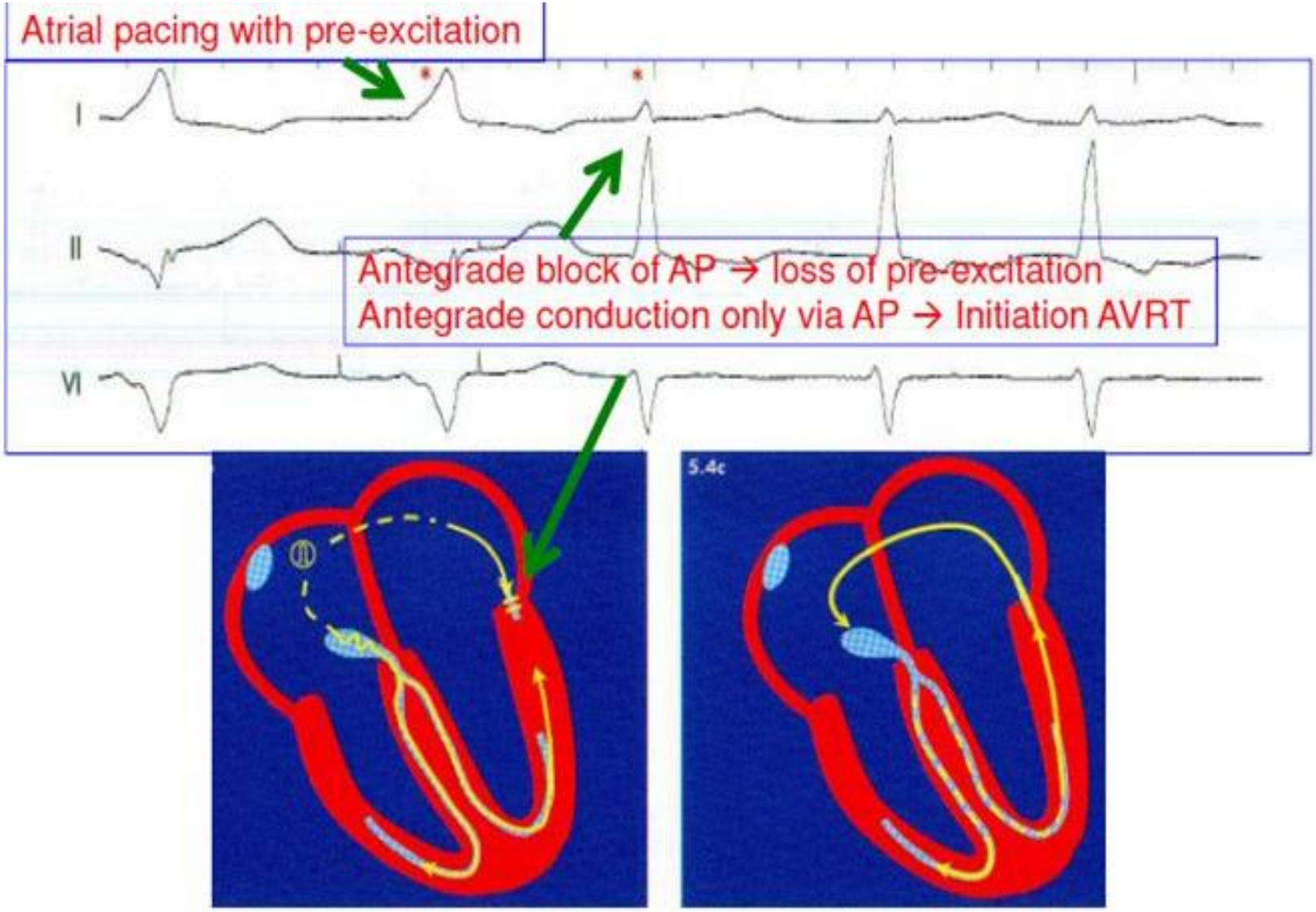

D989070 05/09/2016 10:02:11 ST
98mm/sec
596
600
340
304
336
350
338
Print Review Fit
Print Review Fit
I [1.0]
II [0.5]
V1 [1.0]
HRA 3,4 [0.5]
HRA 1,2 [0.5]
HIS p [0.5]
HIS m [0.5]
HIS d [0.5]
CS p [0.5]
CS 7-8 [0.5]
CS 5-6 [0.5]
CS 3-4 [0.5]
CS d [0.5]
RVAp [0.5]
RVA d [0.5]
STIM [2.0]
606
616
398
332
354
332
600
600
340
Basildon CTC

While working with the AV node

- Autonomic innervation+++:
  - Keep patient awake.
  - Use low dose Isoprenaline (0.5-2 mcg/min)

Unidirectional Block

- May be a physical property of the circuit.
- May be a temporal property due to differing refractory periods (this is the whole point of pacing).


Atrial pacing with pre-excitation
I
II
VI
Antegrade block of AP → loss of pre-excitation
Antegrade conduction only via AP → Initiation AVRT
5.4c

When RP's limit provocation

- We can only pace atrial and ventricular myocardium.
- Critical regions of the circuit may involve AV node/ His-purkinje network.
- Local refractory periods can limit arrhythmia inducibility.

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Final Points

- Keep patient awake where possible.
- Have a plan. Have an ECG of the arrhythmia.
- Low dose isoprenaline/ re-entry.
- High dose isoprenaline/ triggered or automatic.
- Is inducibilty going to be your endpoint.

Syncope

- 46 year old male
- Syncopal whilst jogging
- No sig PMH.

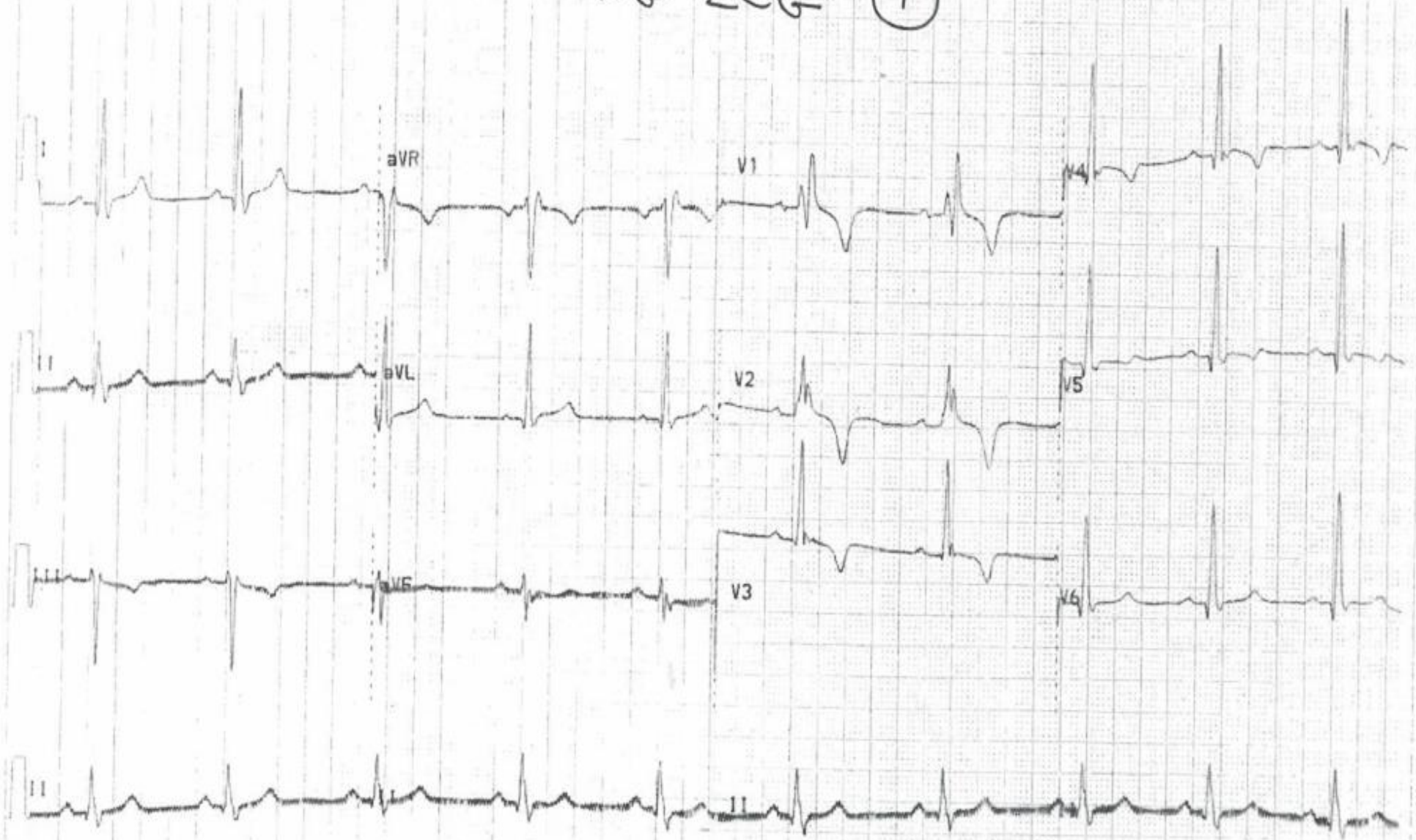
Vent. Rate:	59 bpm
P Duration:	118 ms
QRS Duration:	132 ms
PR Interval:	188 ms
QT Interval:	438 ms
QTc Interval:	435 ms
P-R-T AXIS:	51° -18° 0°

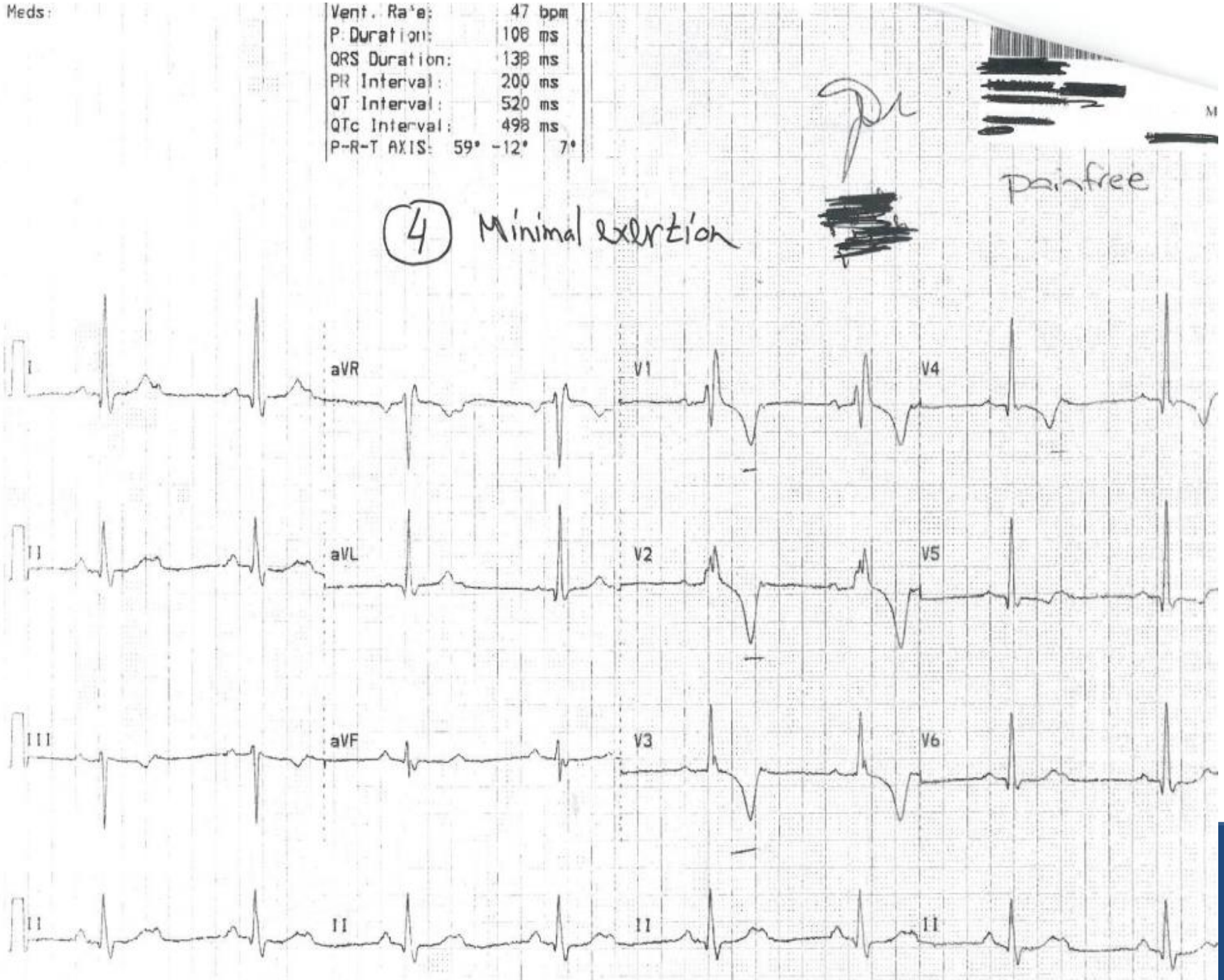
[redacted]

Date .....
Time .....
M
DOB [redacted]

Pandree

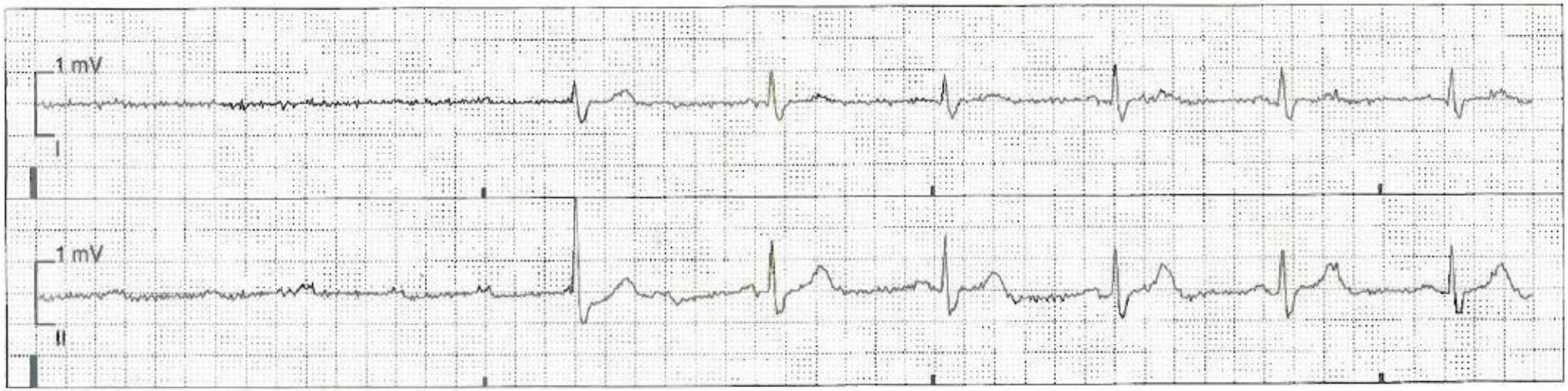
RESTING ECG (1)




Meds:
Vent. Rate: 47 bpm
P Duration: 108 ms
QRS Duration: 138 ms
PR Interval: 200 ms
QT Interval: 520 ms
QTc Interval: 498 ms
P-R-T AXIS: 59° -12° 7°
painfree
4 Minimal exertion
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
II
II
II

Effects of Exercise

- Reduction in vagal tone precedes increase in adrenergic tone.
- Sinus and AV node activity picks up before stimulation of the distal conduction system.



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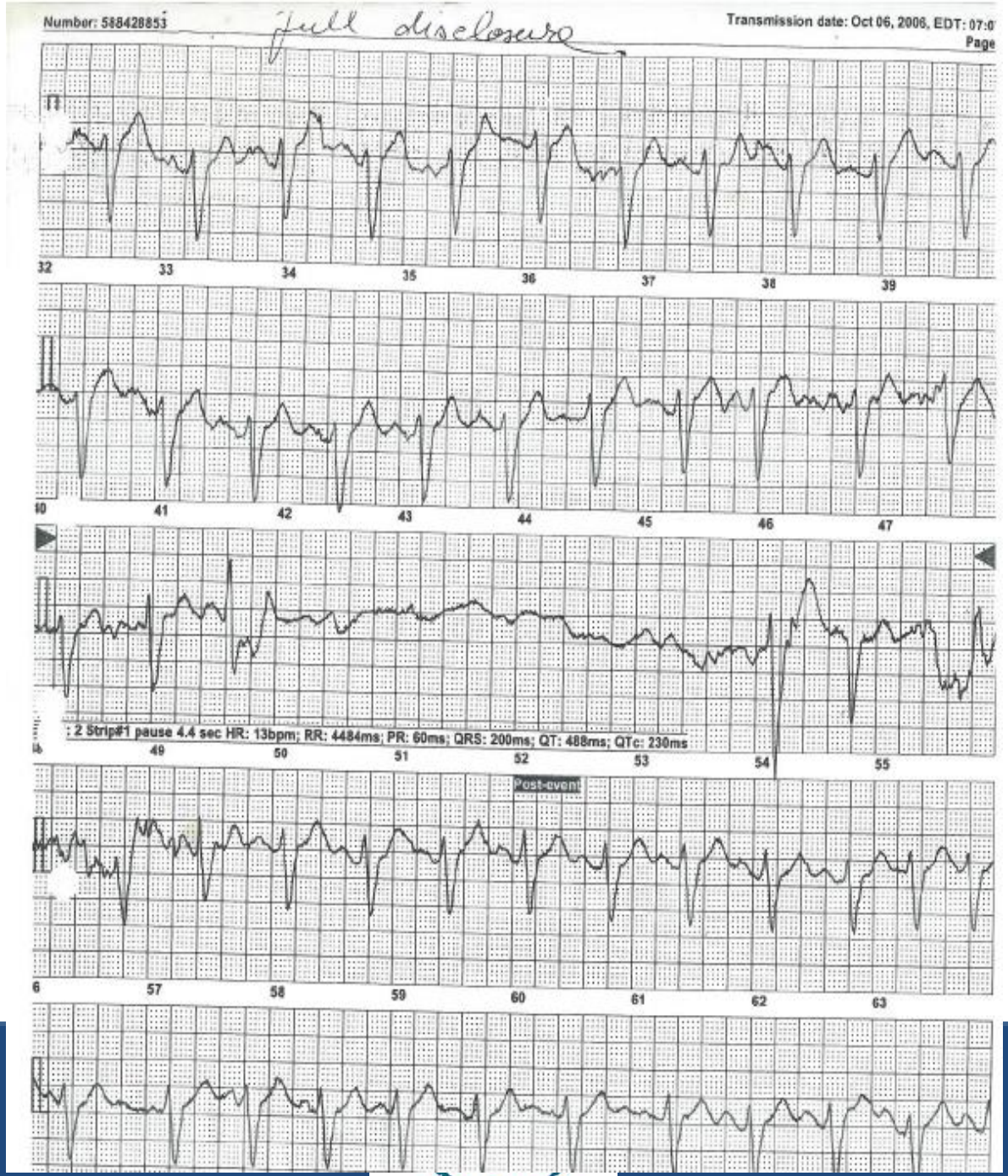
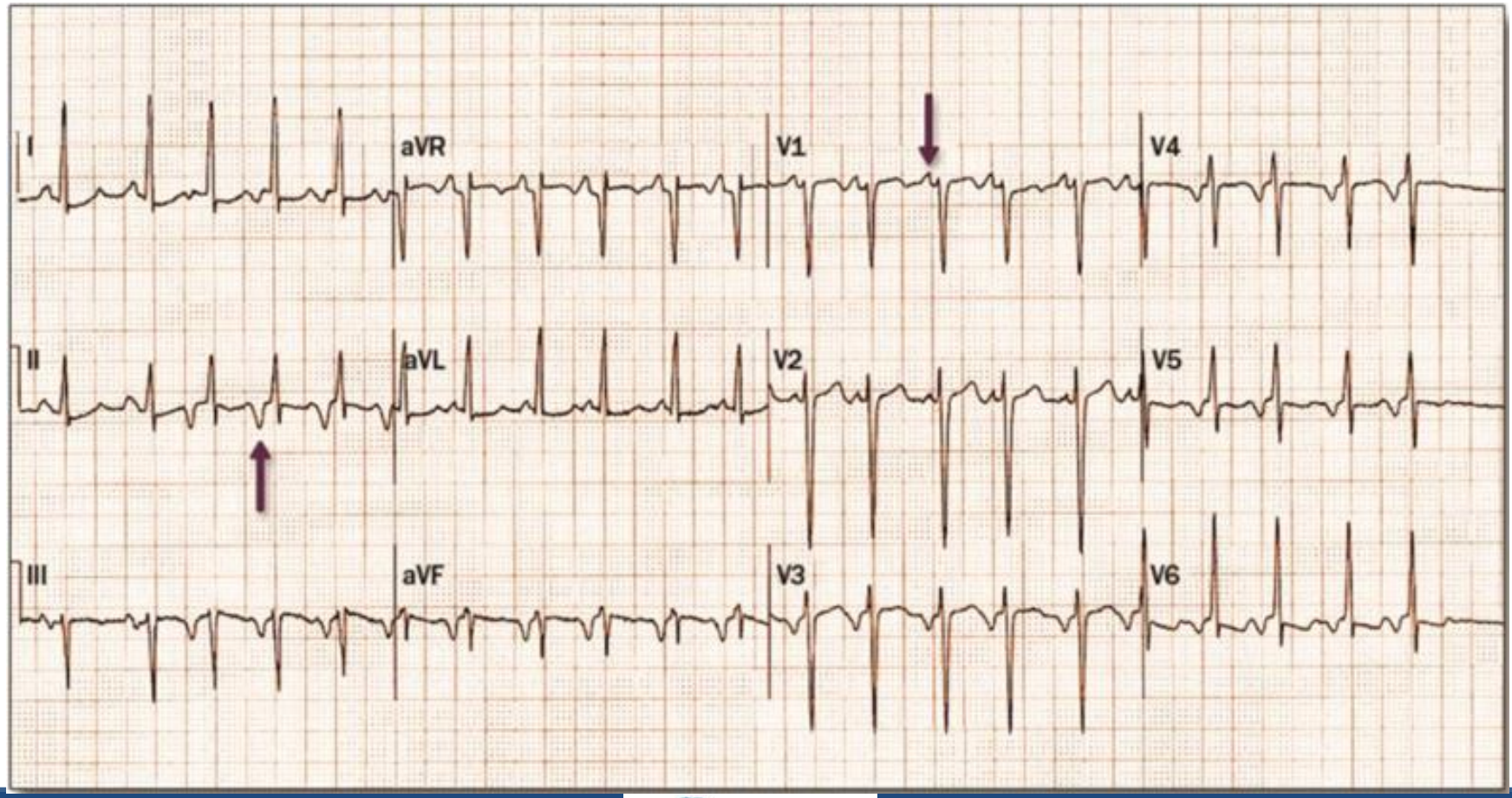

Number: 588428853
full disclosure
Transmission date: Oct 06, 2006, EDT: 07:0
Page
II
32 33 34 35 36 37 38 39
II
40 41 42 43 44 45 46 47
: 2 Strip#1 pause 4.4 sec HR: 13bpm; RR: 4484ms; PR: 60ms; QRS: 200ms; QT: 488ms; QTc: 230ms
49 50 51 52 53 54 55
Post-event
II
56 57 58 59 60 61 62 63
II

PJRT



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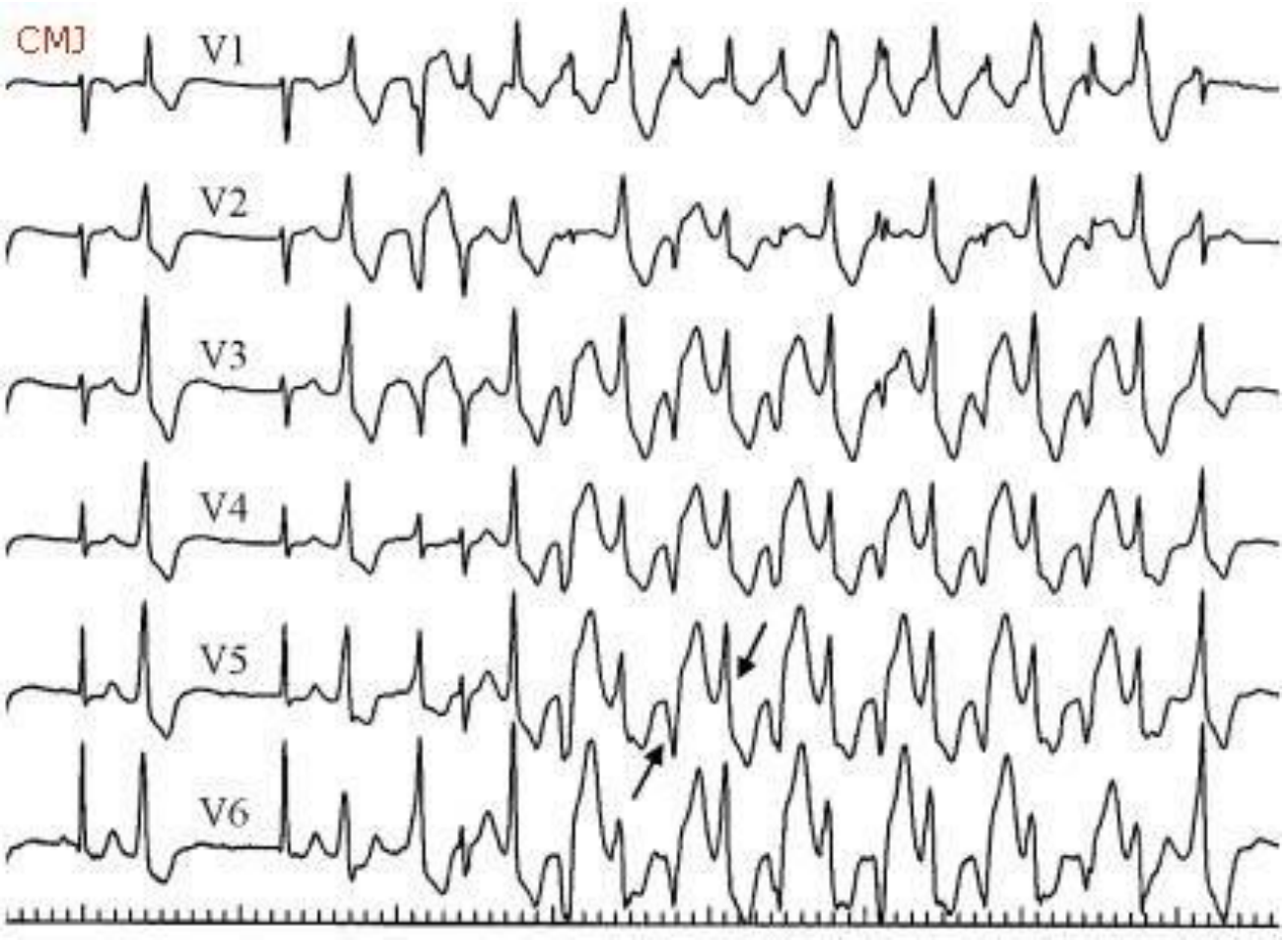
CPVT



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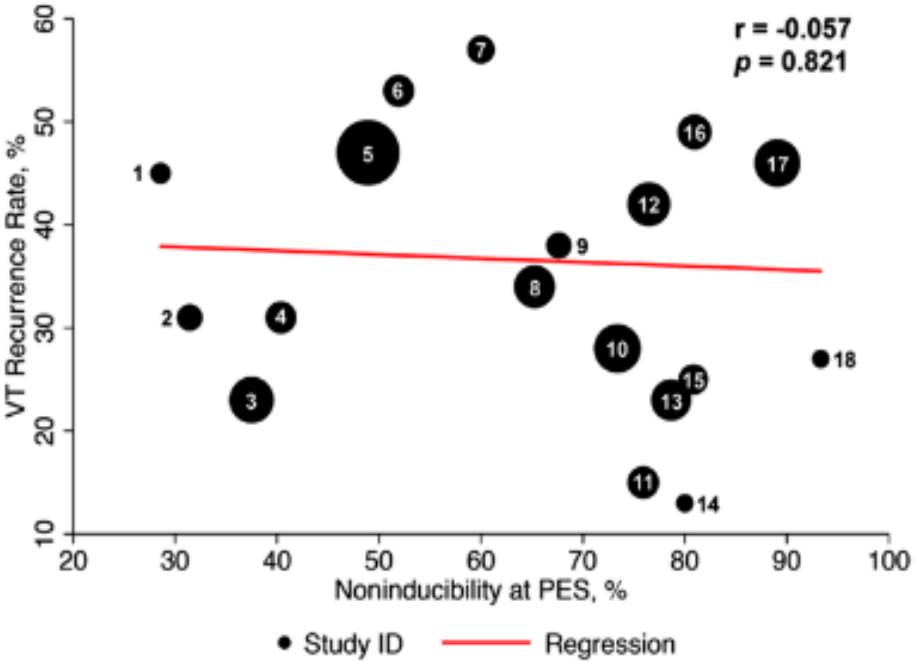
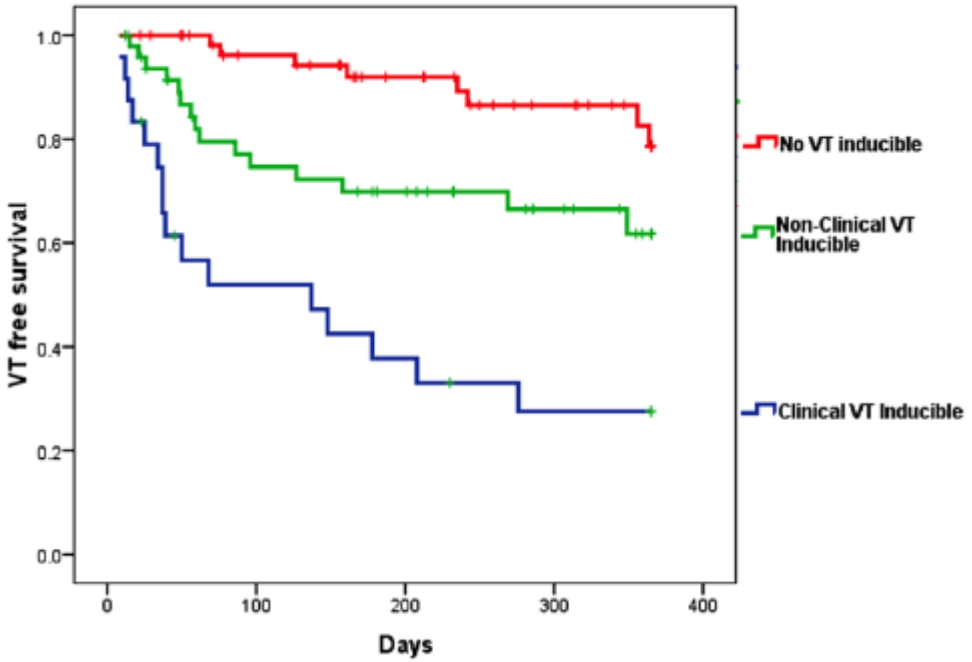
Check your NIPS





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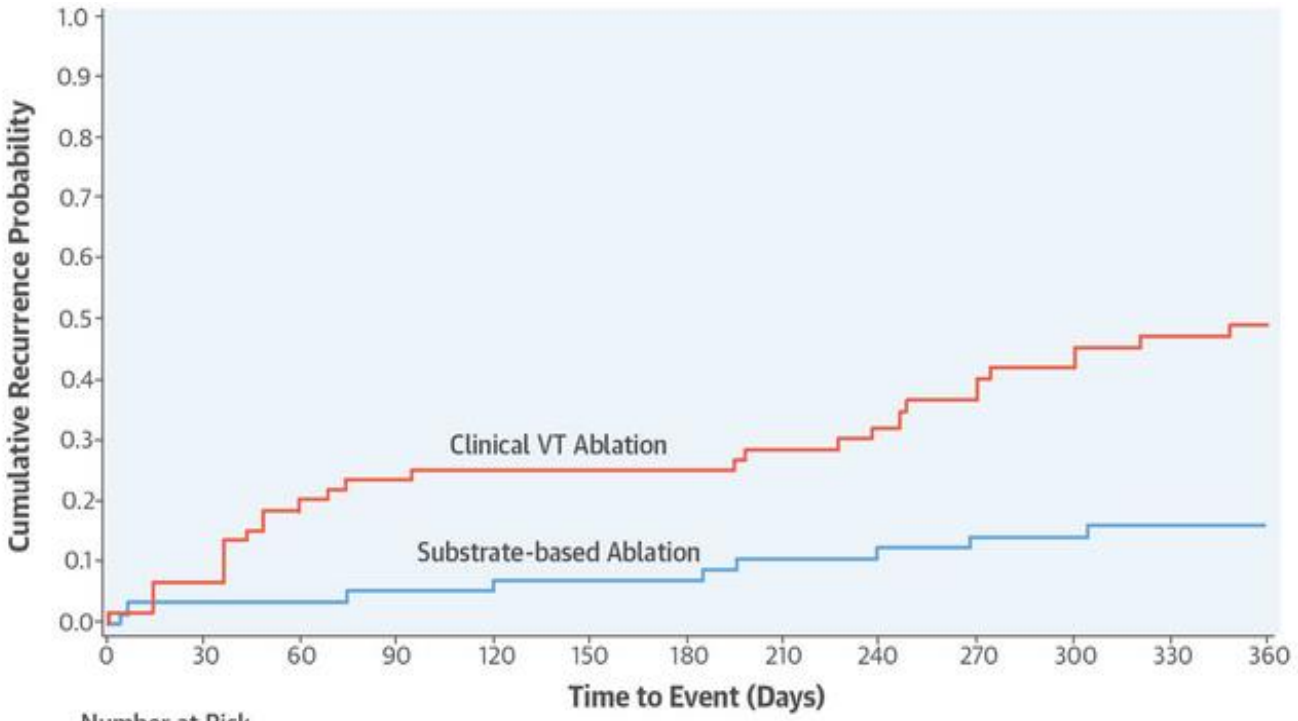
VISTA Trial



Number at Risk

Ablation Strategy													
Substrate-based	58	56	56	55	55	54	54	52	51	50	50	49	49
Clinical Stable VT	60	56	48	46	45	45	45	43	41	38	35	32	31

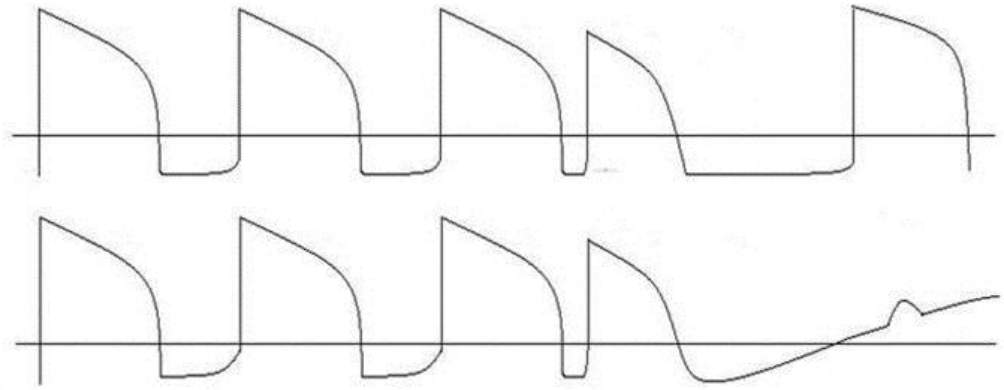
Di Biase, L. et al. J Am Coll Cardiol. 2015; 66(25):2872-82.

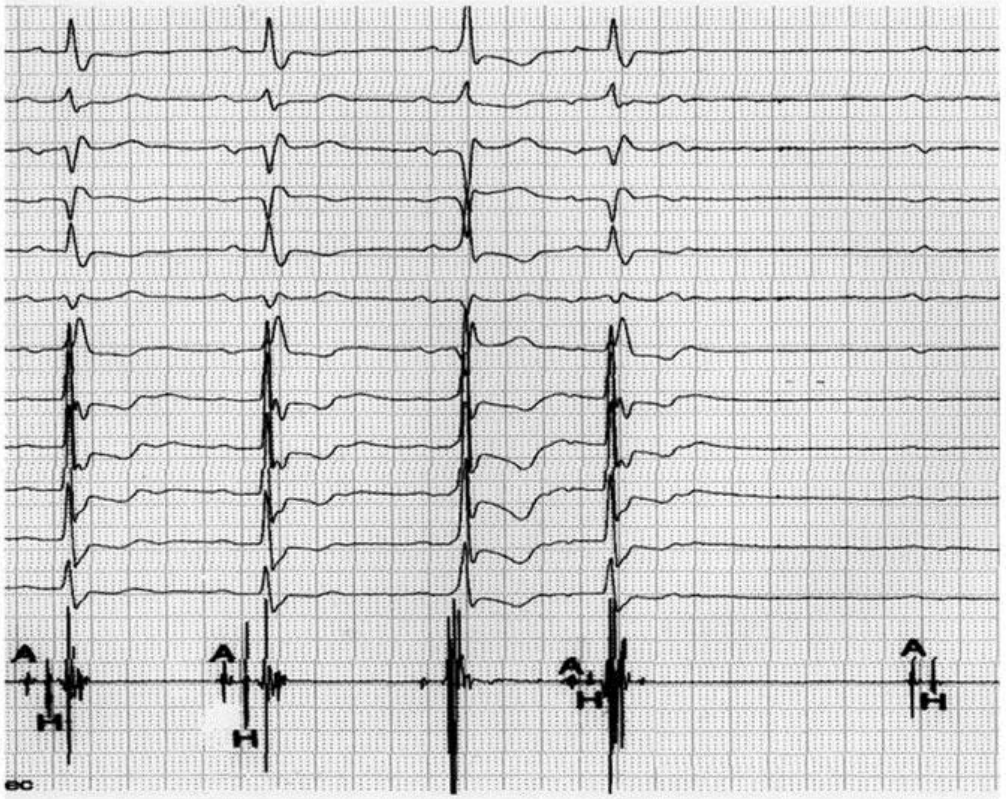

ARR ASY
HR ASY
1 mV
V
1 mV
II
1 mV
V
1 mV
II

Phase 4 Block

Normal HPS

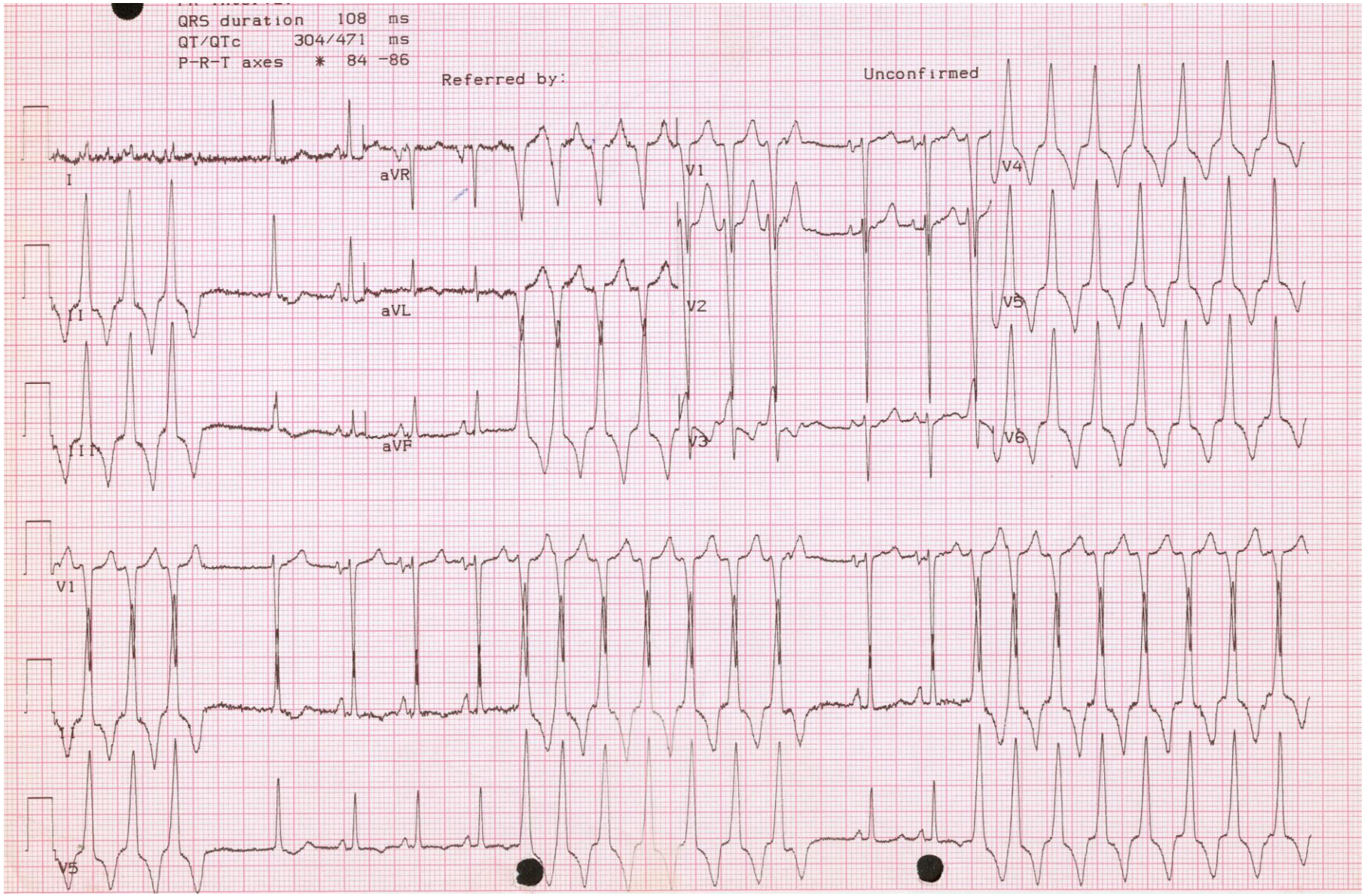
Diseased HPS





Phase 4 block

- Disease HP system.
- Block initiated by pause or ectopic.
- Conduction re-initiated by ectopic beat.



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