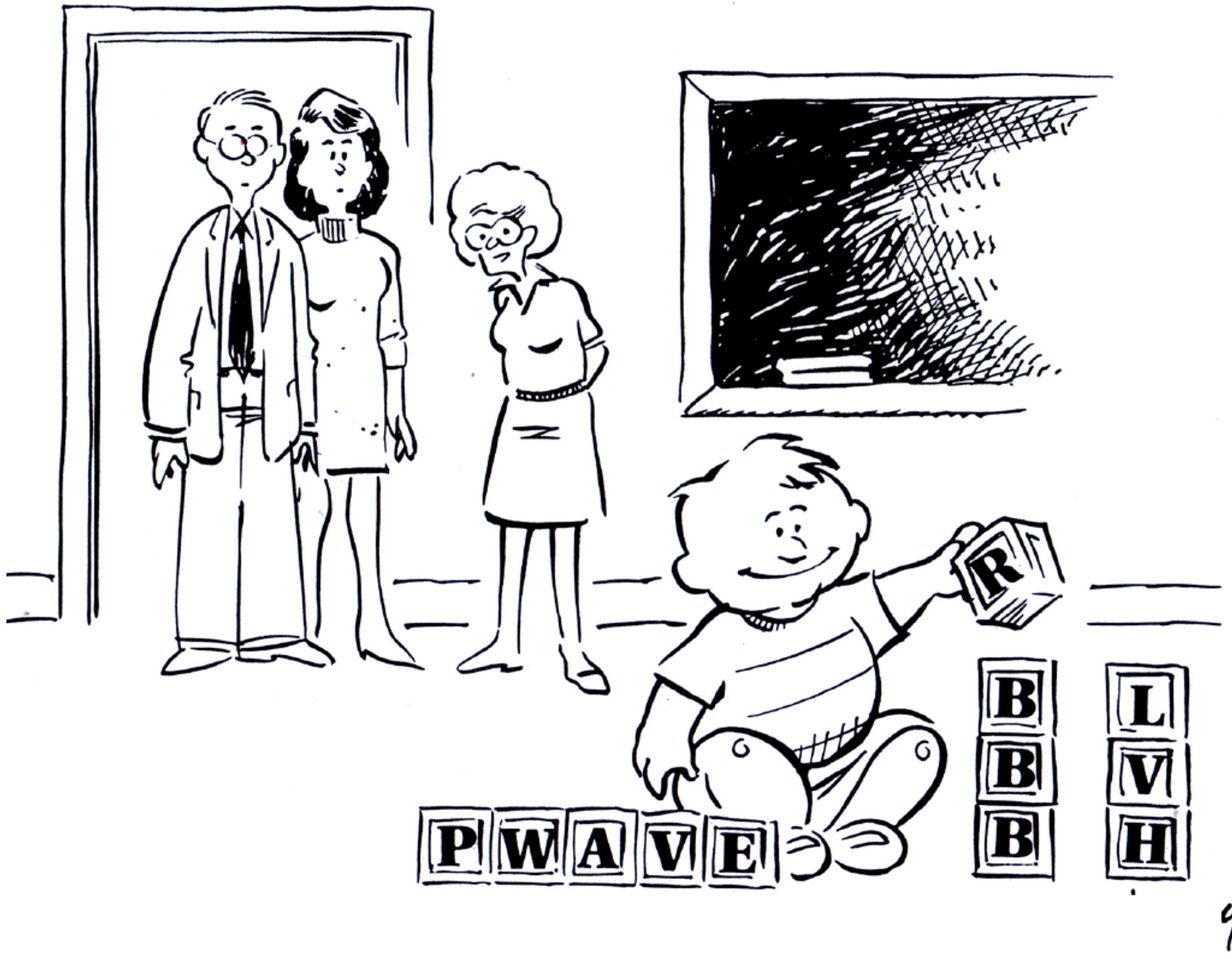
2022 CV Update
ECG Interpretation

Heart Block: What is it?

Three Locations and Three Degrees

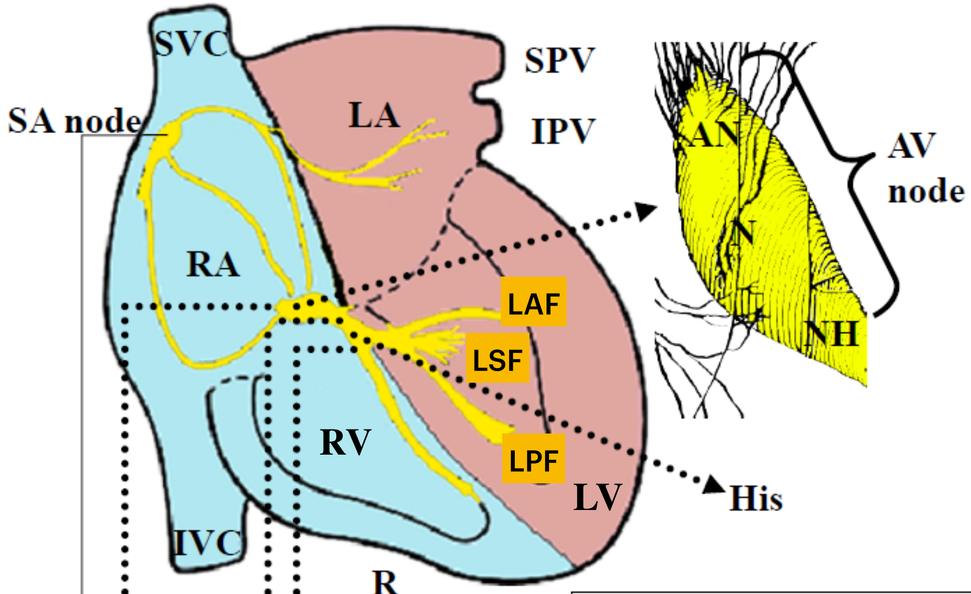
Frank Yanowitz, MD
Professor of Medicine (Retired)
University of Utah School of Medicine
Intermountain Medical Center
http://ecg.utah.edu

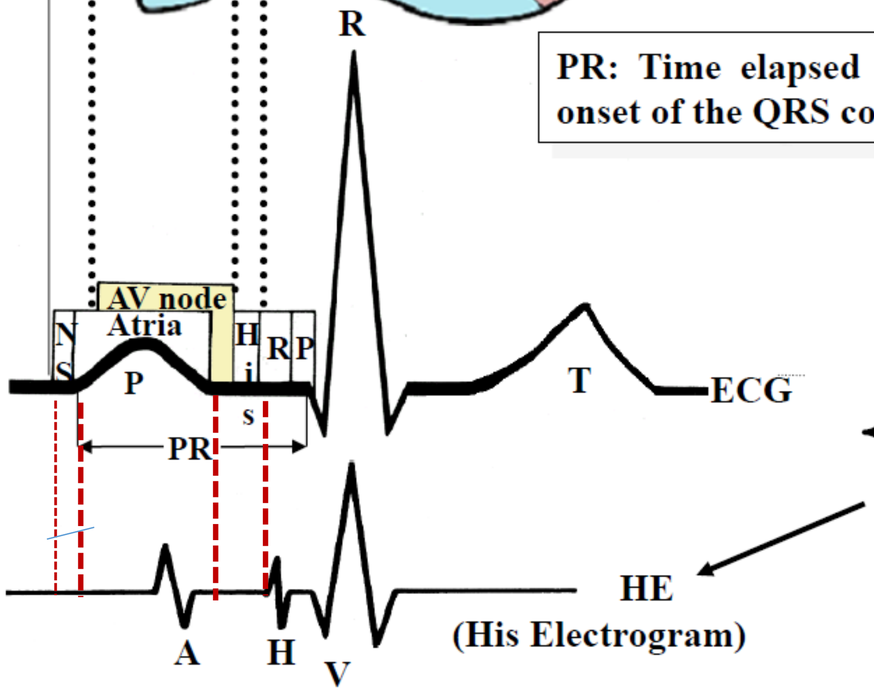


"Our Pre-School Career Aptitude Tests indicate little Franky will make a fine cardiologist"

SA node ➔ RA & LA ➔ AV node ➔ His Bundle ➔ Bundle Branches ➔ Fascicles & Purkinje Network ➔ RV/LV muscle cells

The Electrical Activation of the Heart & The Conduction System





PR: Time elapsed between the onset of P wave and the onset of the QRS complex. VN: 120 to 200 ms

Interval	Reference value
PA	30 to 50 ms
AH	50 to 120 ms
HV	35 to 55 ms

(AV node conduction)

(His-Bundles-ventricular muscle)

A: First deflection of HE corresponding to inferior RA;
H: Electrical activity of His bundle;
V: Ventricular activation.

Three Locations

Three Degrees	Sino-Atrial Junction	AV Junction: (AV Node, His Bundle)	Intraventricular Pathways
First (1°) Always conducts, but slower)	?	1° AV Block (PR >200 ms)	Incomplete RBBB Incomplete LBBB
Second (2°) Sometimes conducts, sometimes doesn't	2nd degree SA Block	Mobitz I (AV node) (aka: Wenckebach) Mobitz II (His bundle)	Type II (Mobitz), Rate related BBB's & Fascicular blocks
Third (3°) Never conducts	?	3° AV Block	RBBB LBBB LAFB LPFB LSFB Bi- & Tri-fascicular Blocks Bilateral BBB

Location 1: Sino-Atrial Junction

3 Degrees of SA Block

Only 2nd degree can be recognized on the ECG

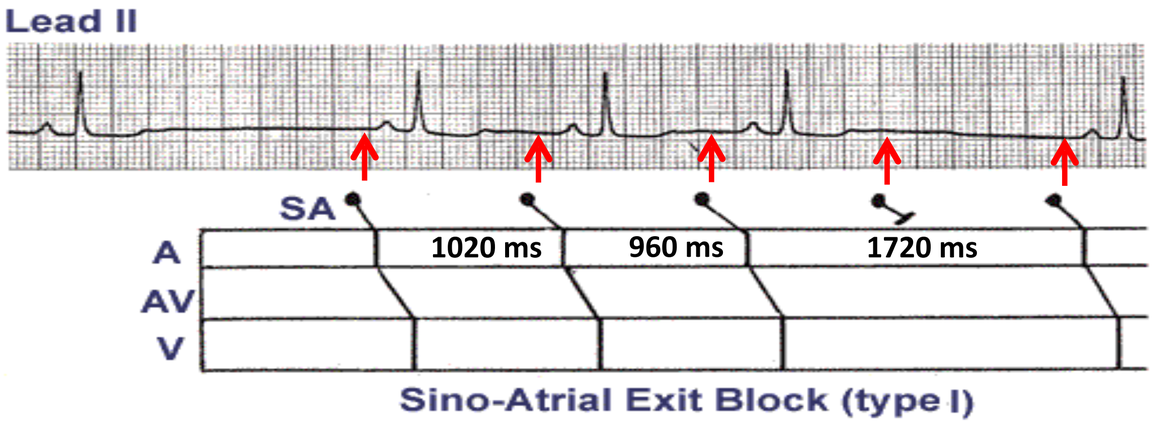
- **First degree**: sinus fires but takes longer to get to atria (P wave);
  - Can't recognize this because we don't see where the sinus node fires on ECG;
- **Second degree**: sinus node fires, sometimes gets to atria (resulting in a P-wave), sometimes doesn't;
  - On the ECG: we see an **unexpected** pause without the **expected** P wave;
  - Can we recognize 2 types (type I vs. type II) of 2nd degree SA block? (**Sometimes!**)
    - Does it really matter? (**No!**)
    - R/O other causes of 'unexpected' pauses (e.g., marked sinus arrhythmia, nonconducted PACs, etc)
- **Third degree:** sinus node fires, but never conducts to the atria (no P waves);
  - Does the heart stop beating? (hopefully not, because of backup (escape) pacemakers in AVJ or ventricles)
  - Or, does some other rhythm take over? (e.g., atrial fibrillation)
  - We can't differentiate this from sinus arrest or sinus failure (sick sinus)

2nd degree SA Block: type I vs. type II

Does it matter clinically?

No !…..it doesn't matter

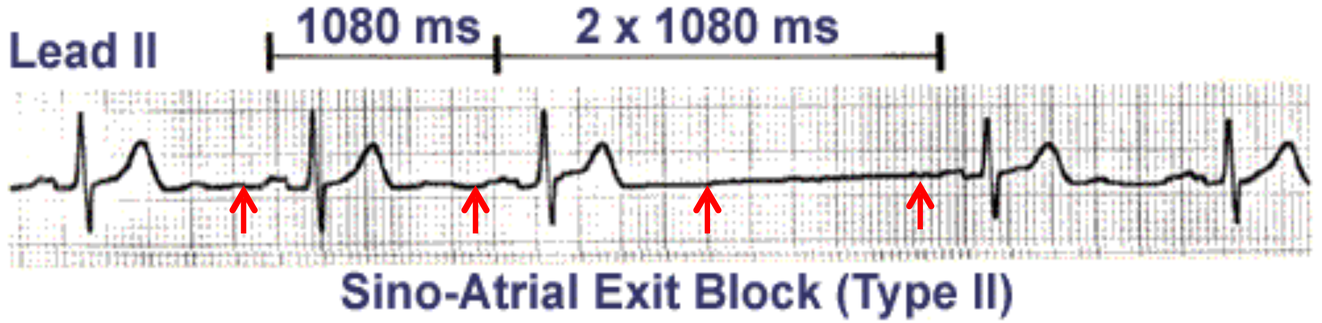
A.



SA Wenckebach 'Rules'

- PP intervals shorten up to the pause
- PP of pause < the 2 preceding PP intervals
- PP after pause > PP just before pause
- Assumes constant or regular) sinus rate
  - doesn't always happen if sinus arrhythmia (varying PP intervals)

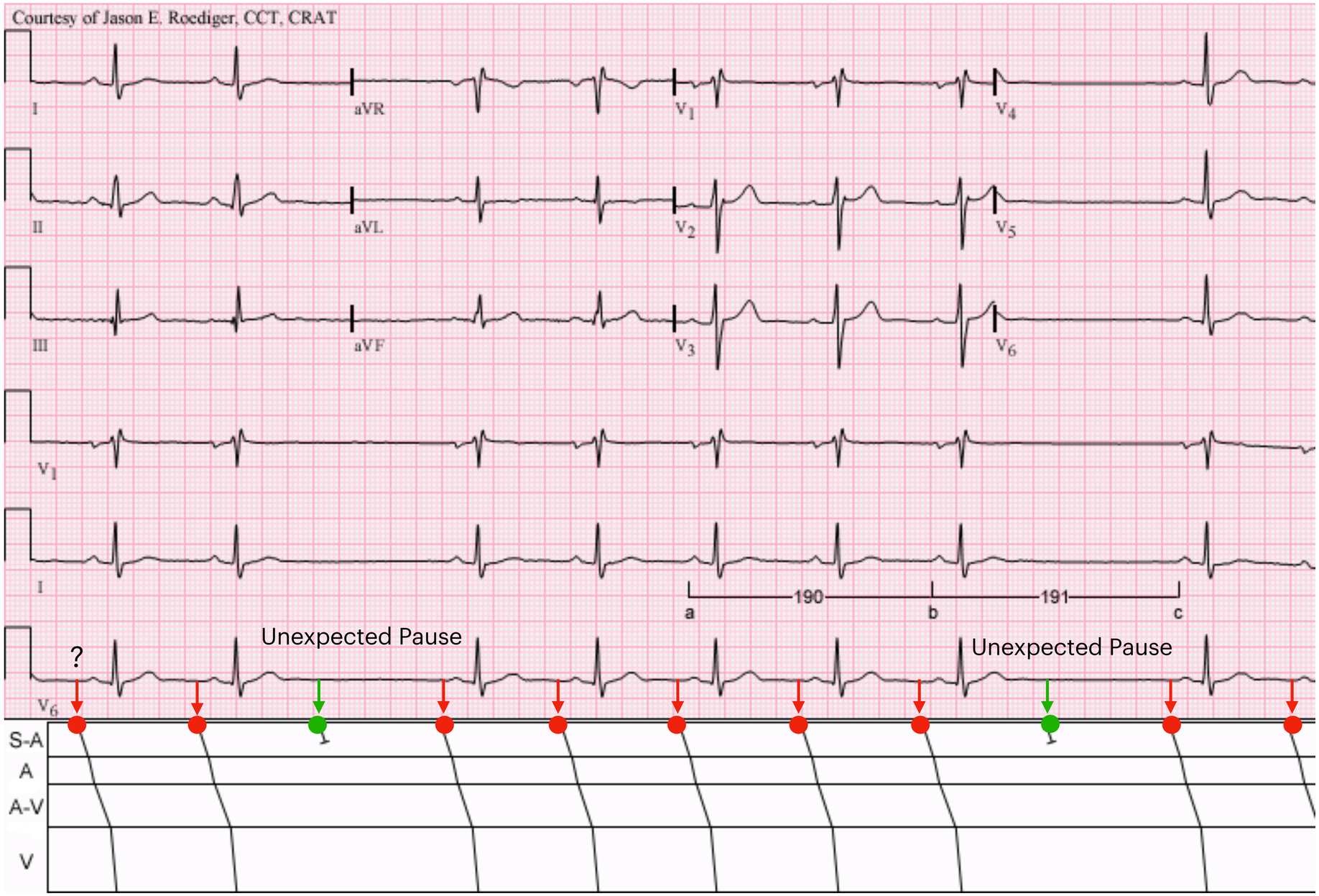
B.



(Note: the location of the red arrows are only in my imagination!)

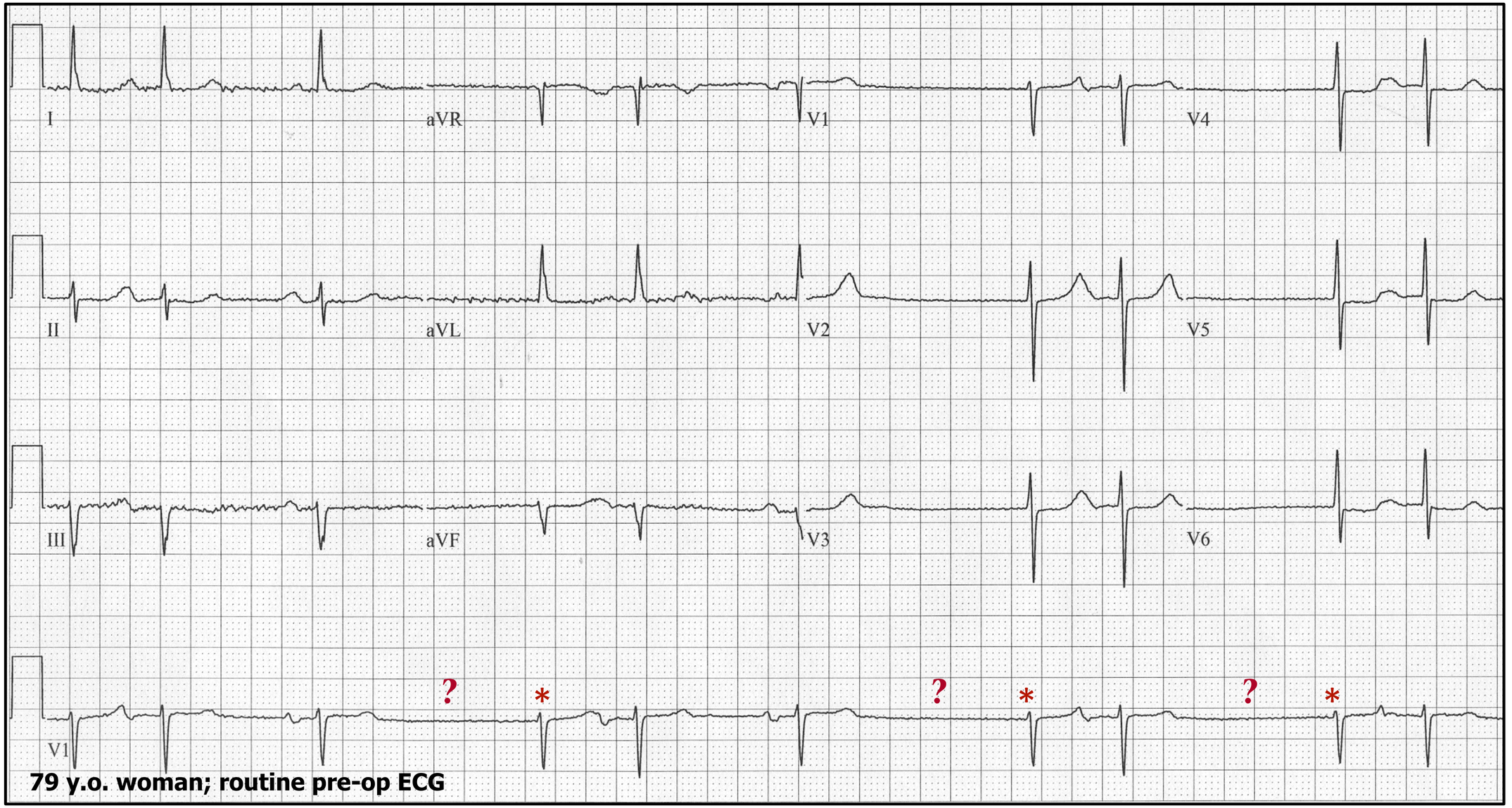
2nd Degree
S-A 'exit' block

(Maybe type II)



Look for an **<u>unexpected</u>** pause without the **<u>expected</u>** P wave!

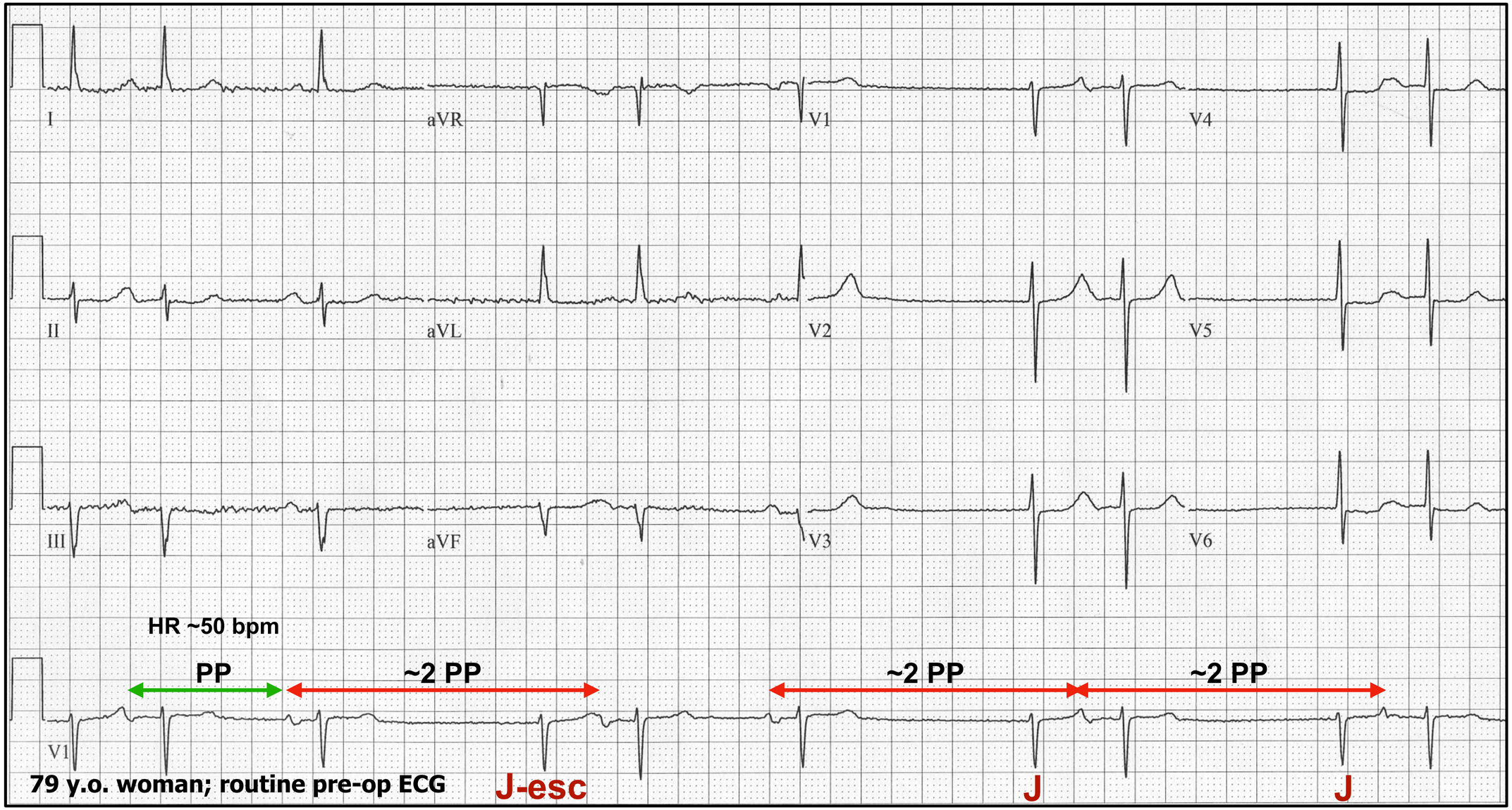
165.



79 y.o. woman; routine pre-op ECG

Differential diagnosis of unexpected pauses (?)

What sometimes ends a long pause in the rhythm (*)?



Look for the <u>unexpected</u> pause without the <u>expected</u> P wave! (i.e., 2nd degree SA block);
Escape beats (junctional or ventricular) prevent the heart rate from getting too slow.

Location 2: AV Junction

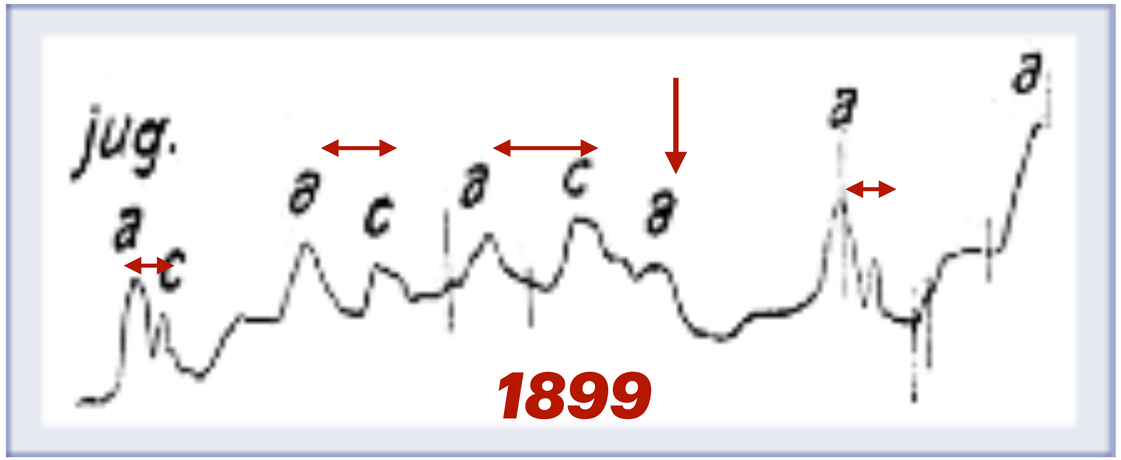
Karel Frederick Wenckebach (1864–1940): A giant of medicine

Andrés Ricardo Pérez-Riera, MD[1], Francisco Femenía, MD[2], William F. McIntyre MD[3], Adrian Baranchuk, MD, FACC[3]

Cardiology Journal 2011, Vol. 18, No. 3, pp. 337–339

* General physician 1881 (Netherlands)
* Academic physician (Utrecht University, 1896)
* Fascinated with rhythms of the beating hearts, listening by auscultation
* **Observed a patient with 'missing' beats (brachial artery pulsations)**
* Tracked moment of jugular venous pulse: .....

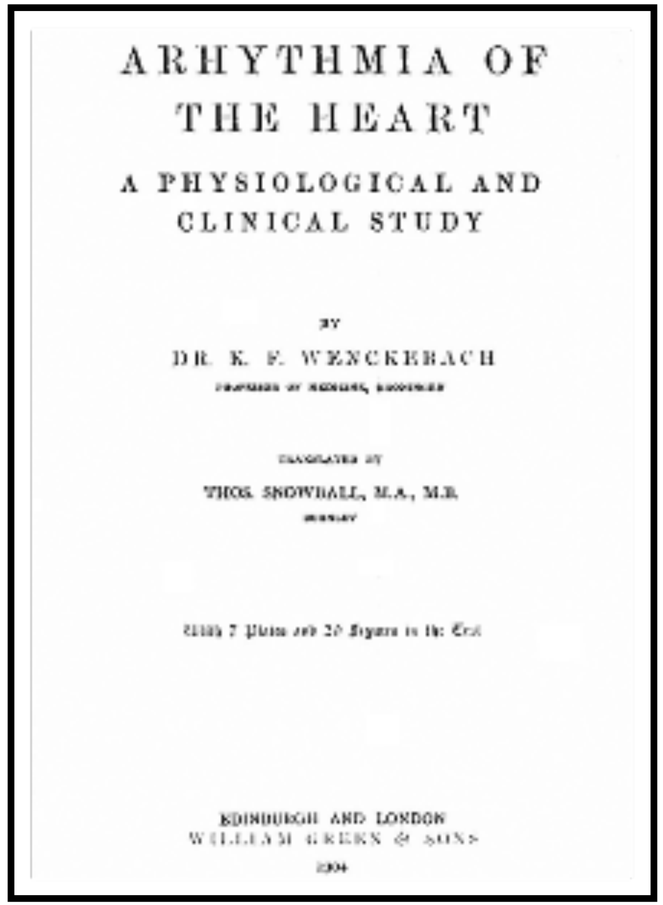
Note: increasing a-c intervals until a wave w/o a c-wave!



1899

Wenckehach KF. On the analysis of irregular pulses. **Z Klin Med, 1899; 37: 475–488**.

Note: the ECG hadn't been invented when Wenckebach made his observations!



ARHYTHMIA OF THE HEART

A PHYSIOLOGICAL AND CLINICAL STUDY

BY

DR. K. F. WENCKEBACH

TRANSLATED BY

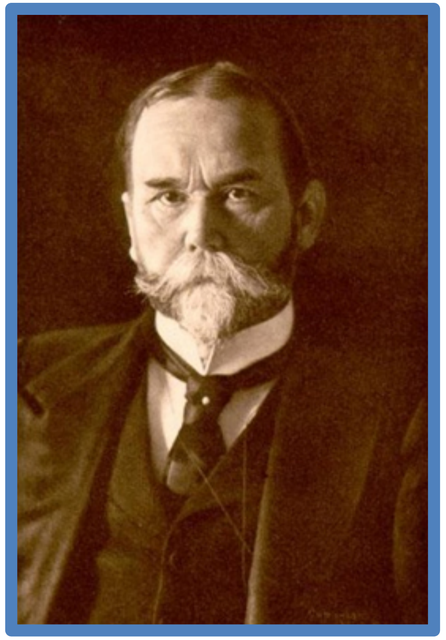
THOS. SNOWBALL, M.A., M.B.

EDINBURGH AND LONDON
WILLIAM GREEN & SONS

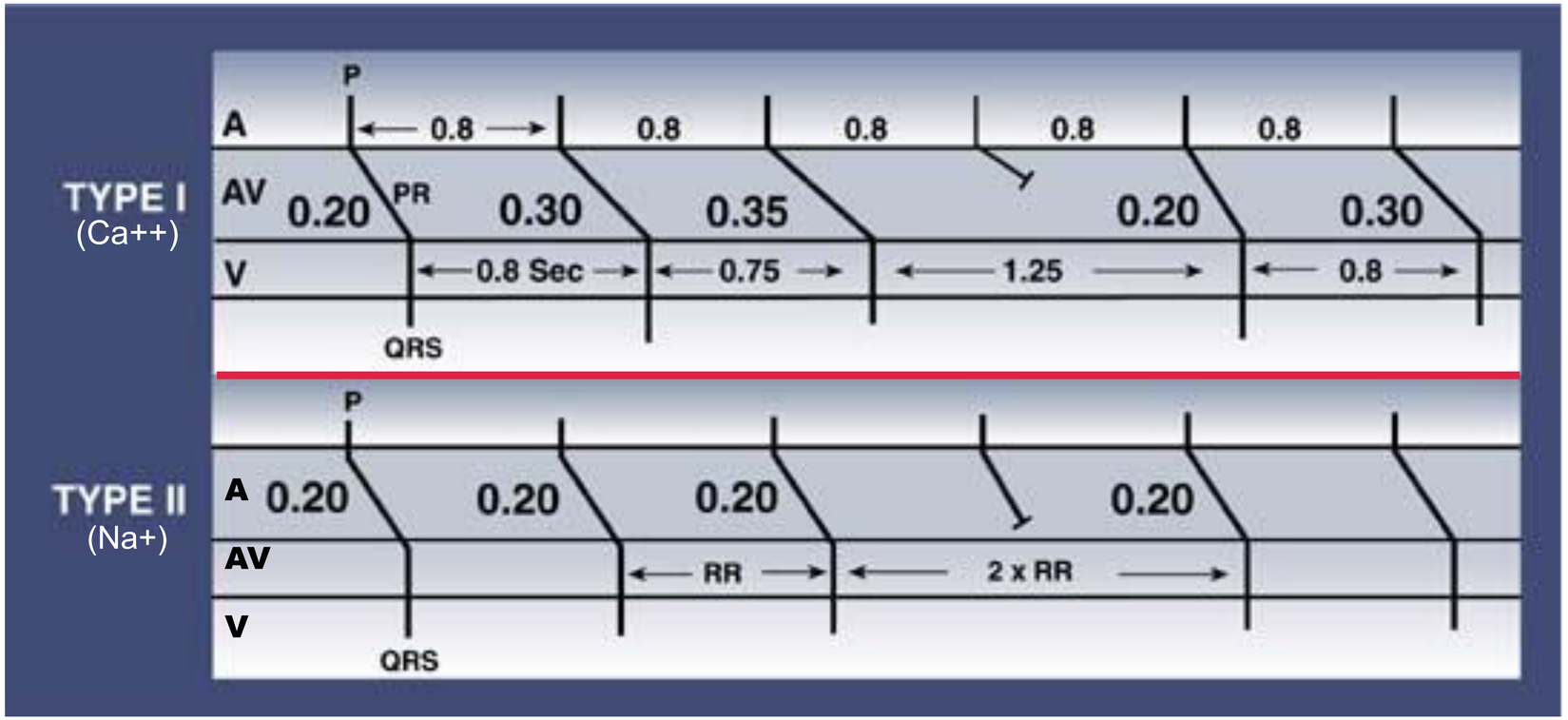
1904

1904

• **1924** – Mobitz published his classic article on '[partial block of AV conduction in human hearts](#)'

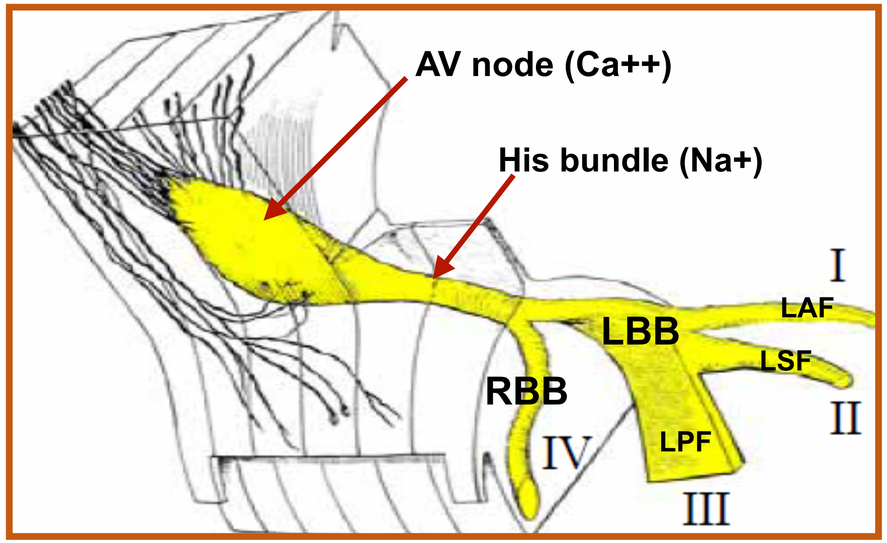


Woldemar Mobitz
1889 - 1951

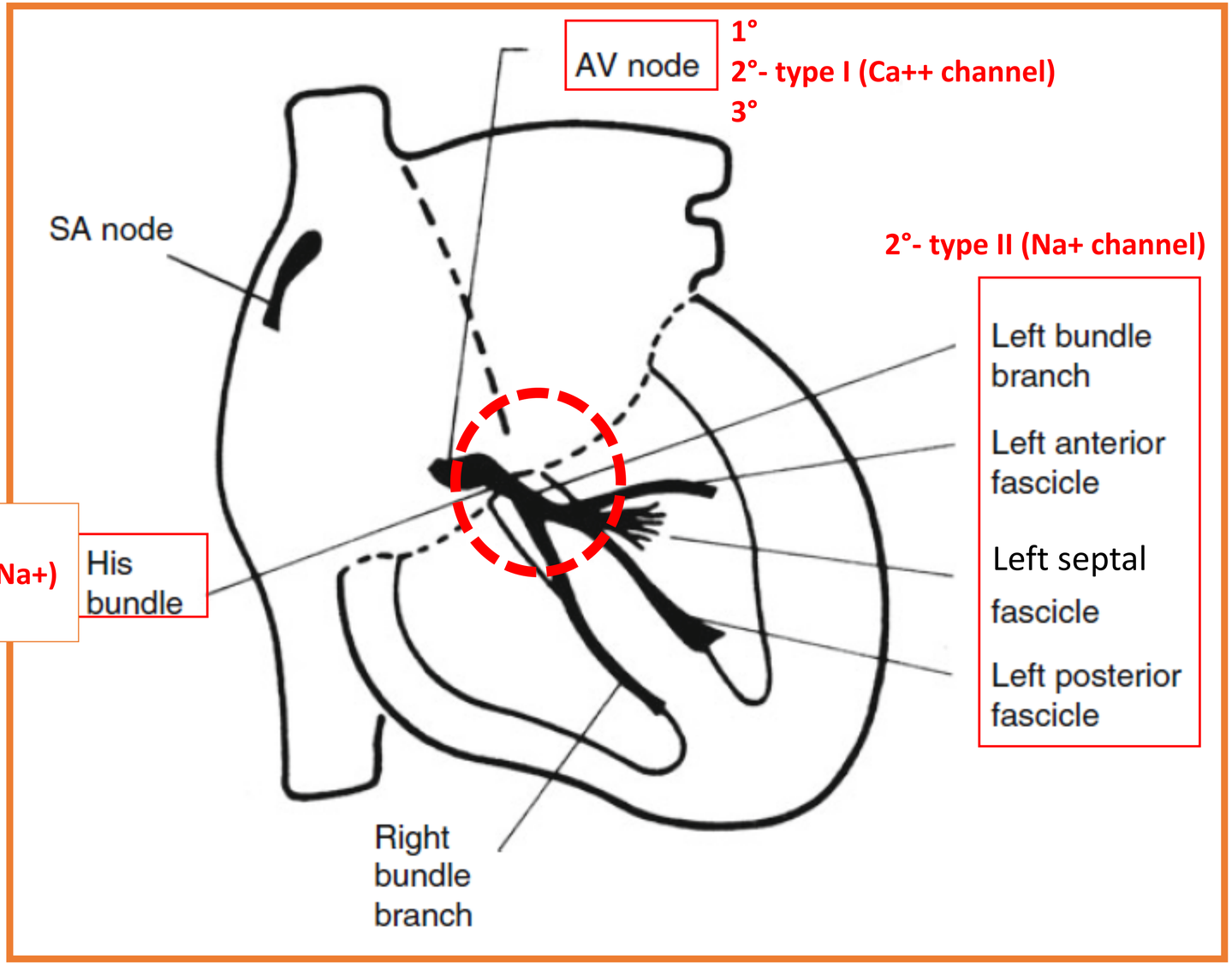


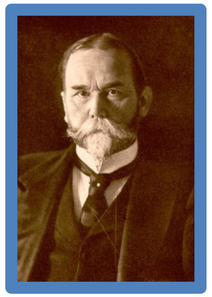
Why two types of 2nd degree blocks?

Two systems of conducting cells:
Ca++ channel cells (in AV node)
Na+ cells (in His and BB's)

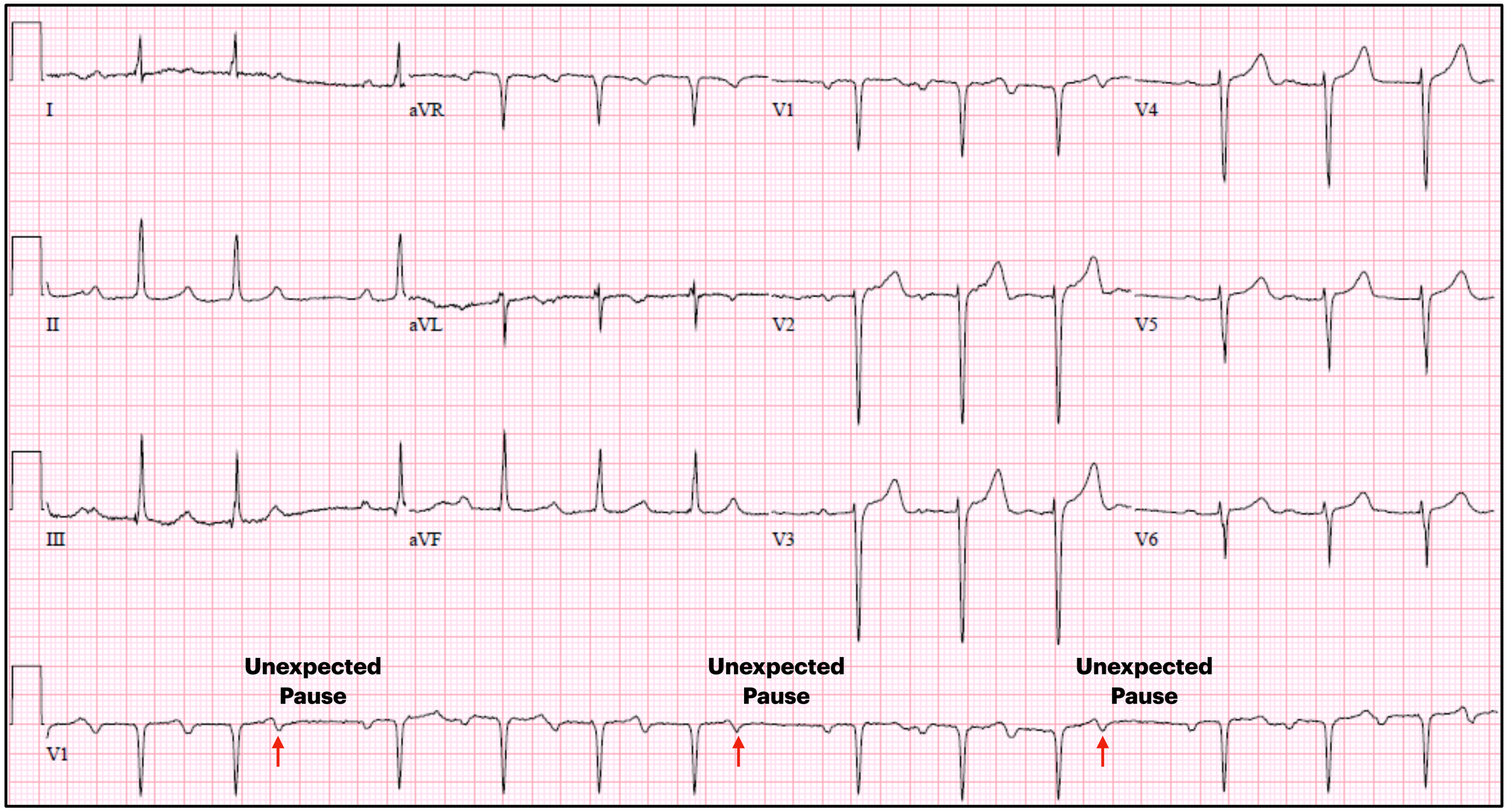


“AV” Block: Possible Locations and Possible Degrees



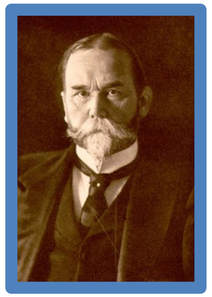


Mobitz Type I



86 y woman; recent CVA; hx hypertension, diabetes, hyperlipidemia

What are the “Footprints of Wenckebach” ?



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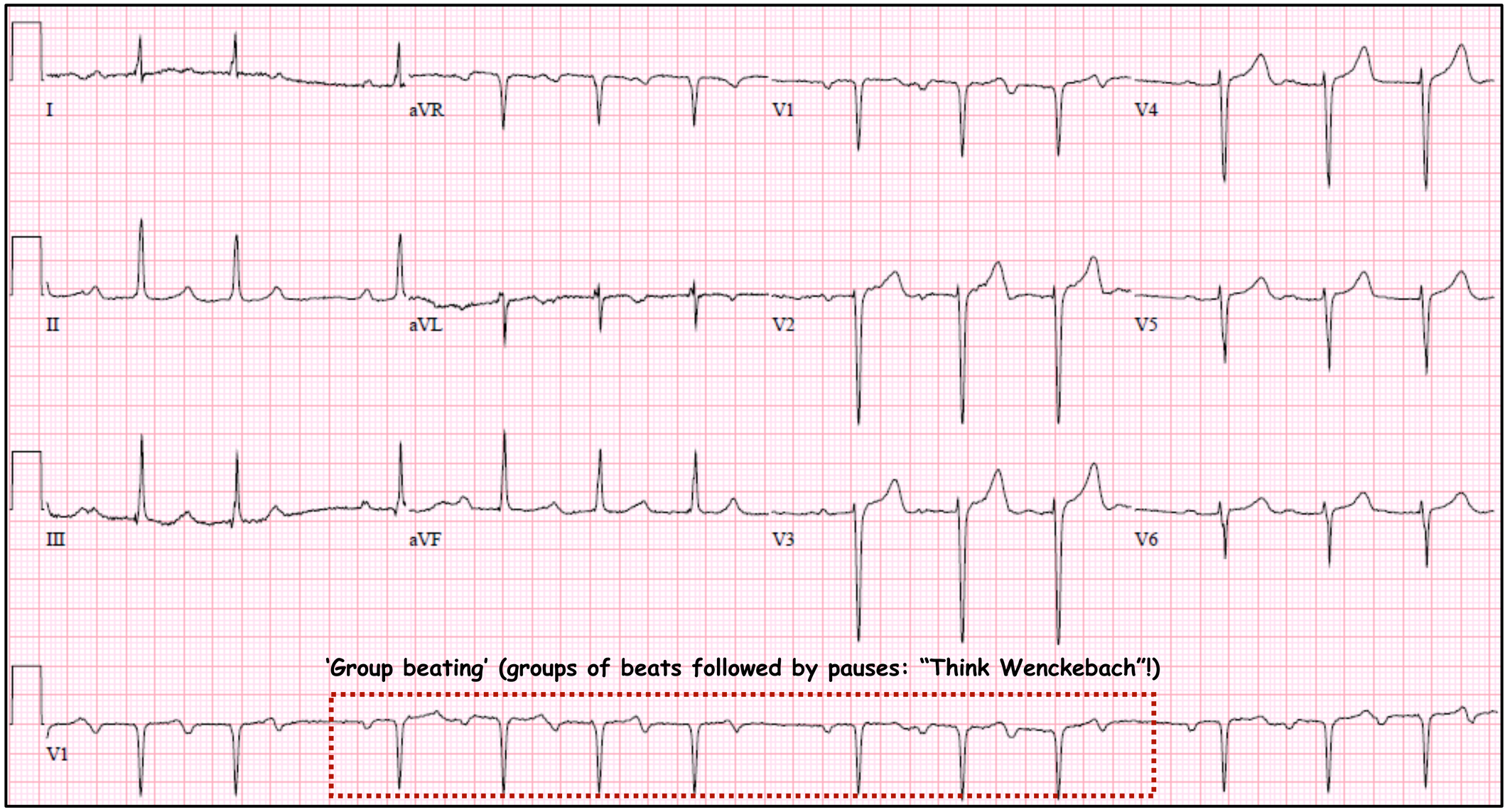
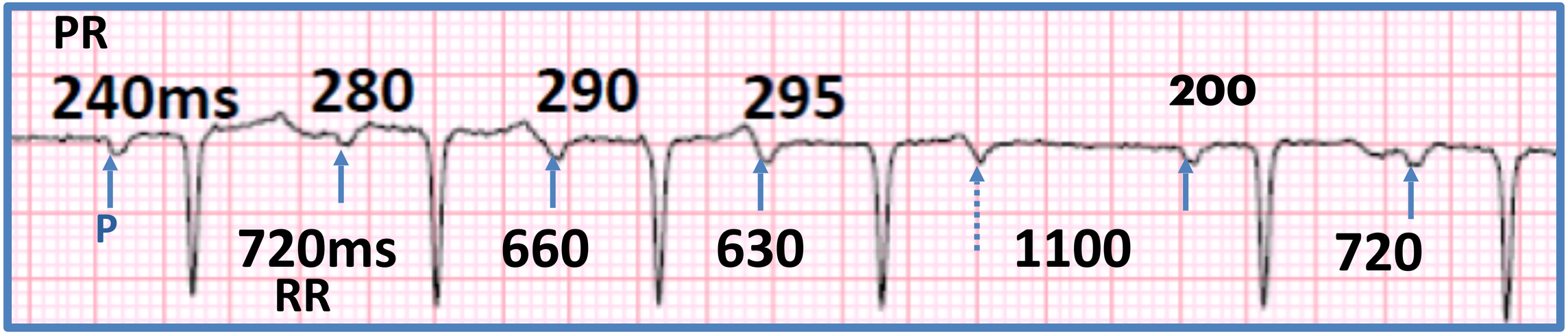


86 y woman; recent CVA; hx hypertension, diabetes, hyperlipidemia

What are the "Footprints of Wenckebach" ?

5:4 Group Beating

‘footprints’

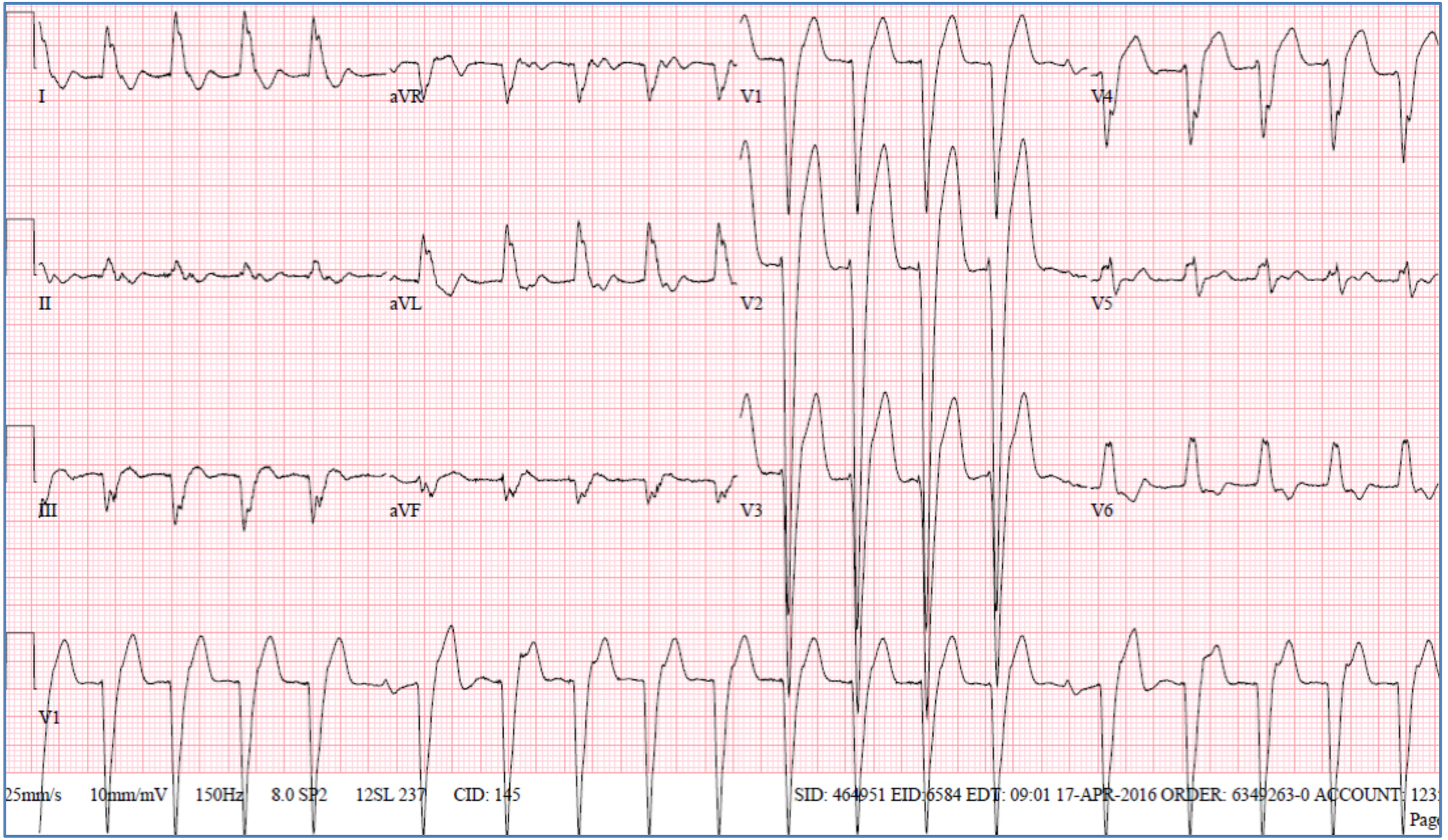


- As the PR gets longer, the RR gets shorter because:
  - The PR gets longer and longer by <u>smaller and smaller</u> increments.
  - The pause is <u>shorter</u> than the 2 preceding RR intervals.
  - The RR after the pause is <u>longer</u> than the RR before the pause; PR after pause is <u>shorter</u> than before pause
  - <u>Assumes</u> PP intervals are all the same (not always the case; e.g., sinus arrhythmia)
  - (These footprints also fail in ‘atypical’ Wenckebach when dual AV pathways are involved)

Two locations?

&

Two degrees?



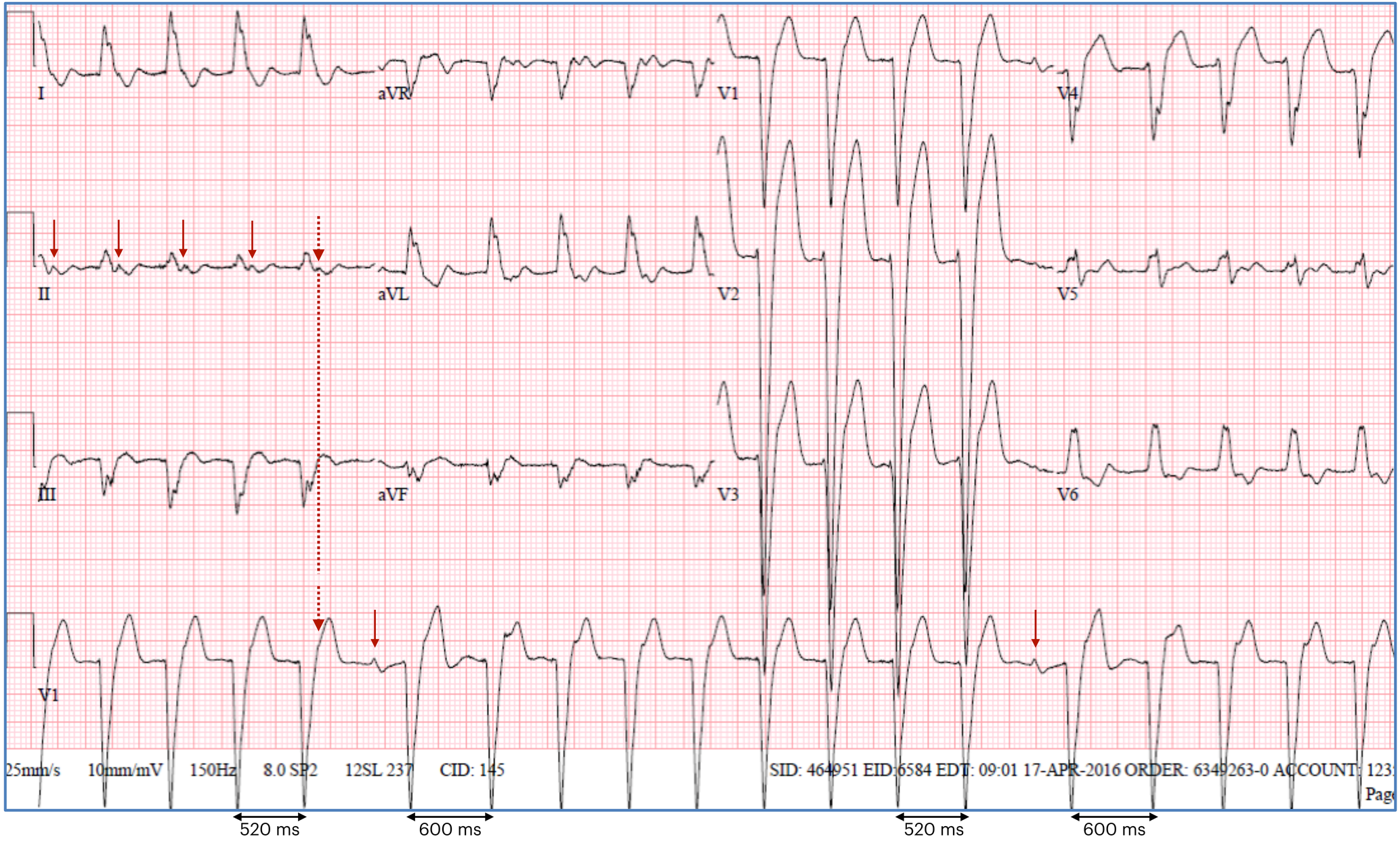
RH: 84 year old man admitted with sepsis; history of CAD, pulmonary fibrosis:

What do you think is going on?

Two locations?

&

Two degrees?



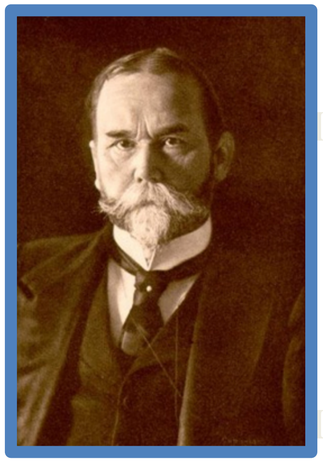
Think: ‘Footprints’ !

Two locations?

&

Two degrees?

<u>Answer</u>: Sinus tachycardia, 2nd degree AV block (type I) <u>and</u> 3rd degree (i.e., complete) LBBB



Mobitz Type II

3° LBBB + ? 2° RBBB

F, Age 89

I aVR V1 V4

II aVL V2 V5

III aVF V3 V6

V1

PR before the pause same as PR after the pause

PR PR PR PR

mV 150Hz 005C 12SL 250 CID: 16 SID: 756965 EID:Unconfirmed EDT: OR

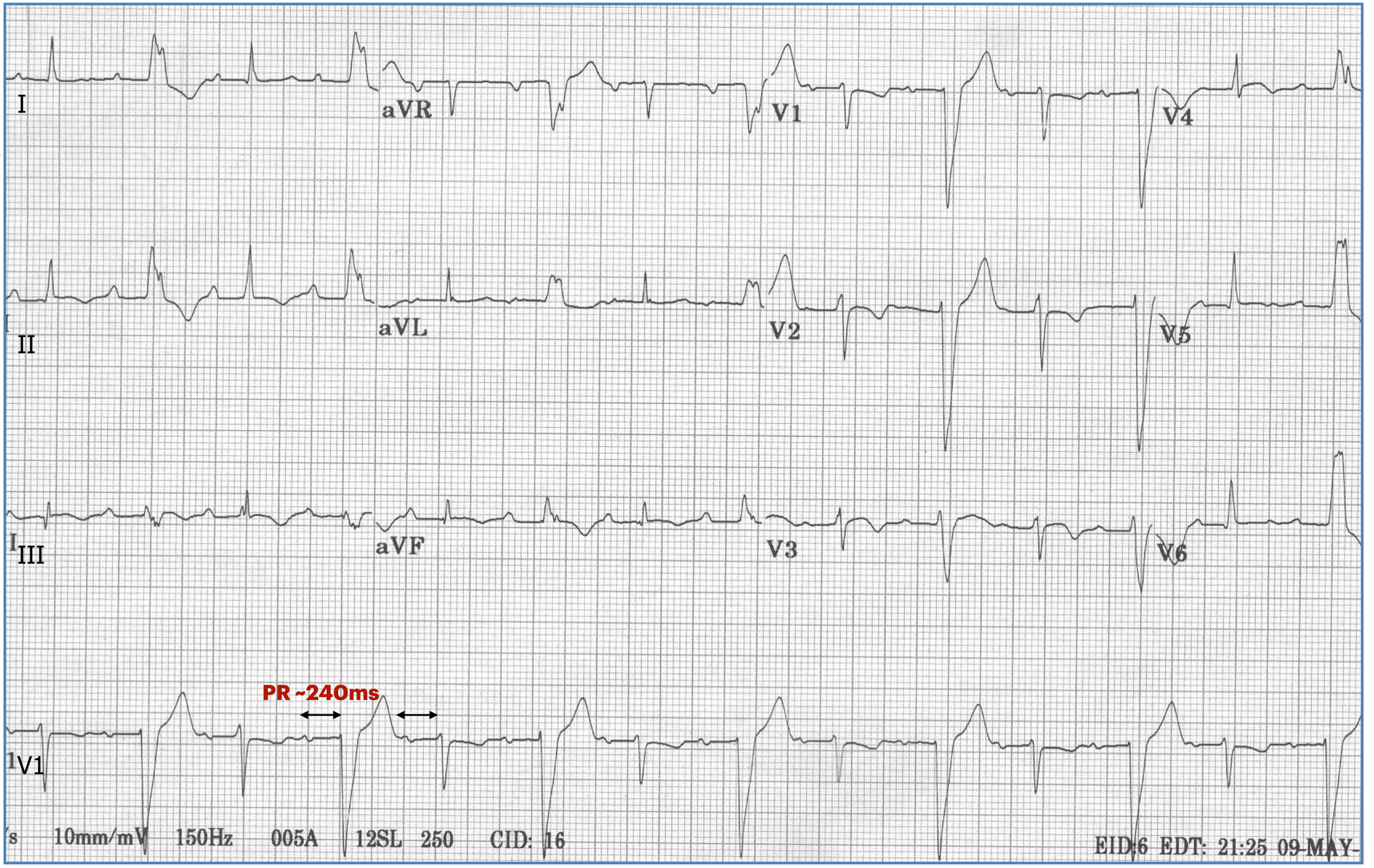
A funny thing happened on the way to the (?right) ventricle….. Where did it occur? (are both bundles sick?)

Sinus rhythm (95 bpm)
Alternating LBBB

<u>Two Locations, Two Degrees</u>

1st degree AV block
(PR ~240 ms)

2:1 LBBB
(i.e., 2nd degree LBBB)
(rate related)

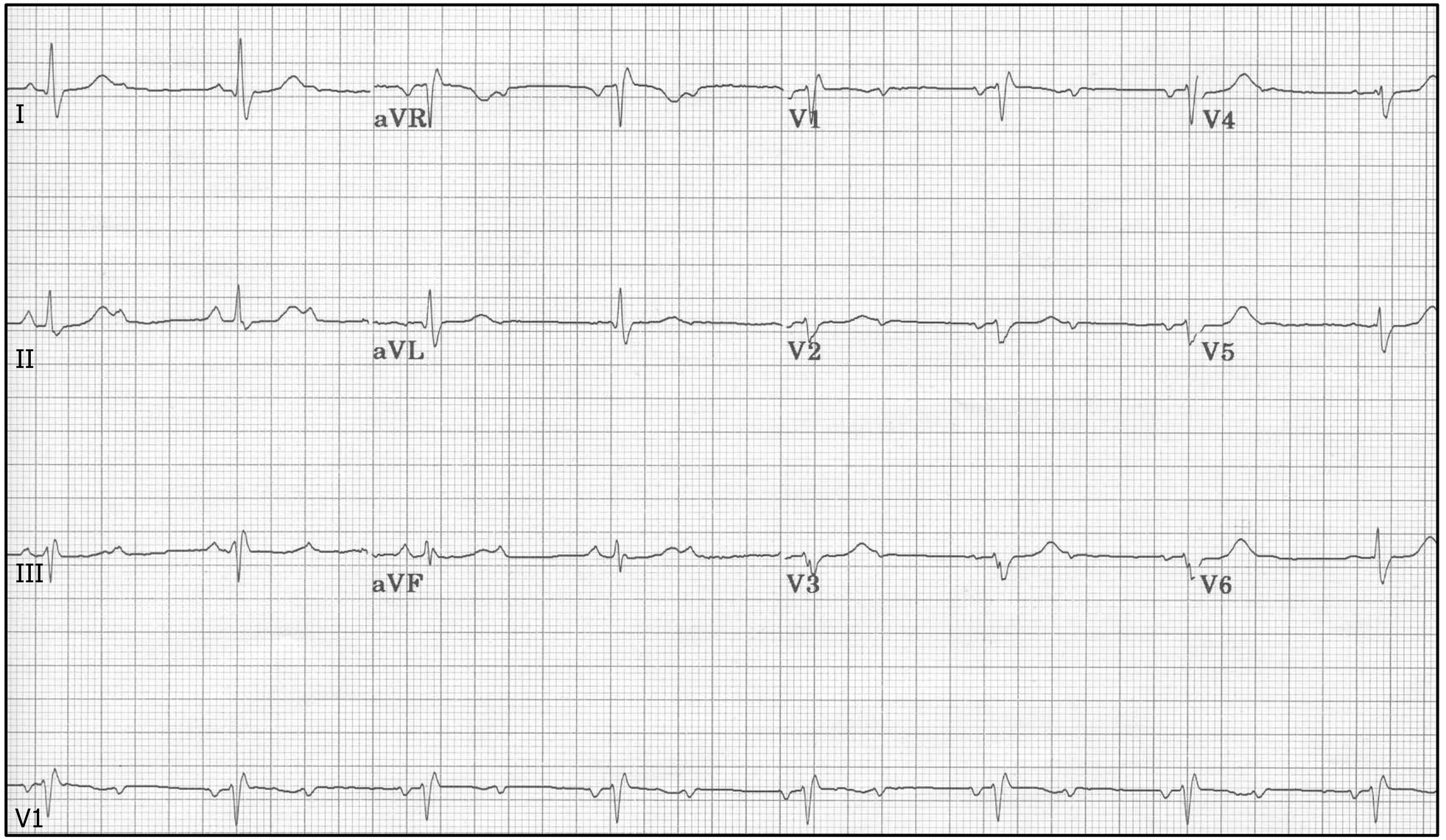


Rate-related bundle and fascicular blocks (i.e., 2nd degree) often precede, by months and years, fixed (3rd degree) IV blocks!

Two locations ?

&

Two degrees ?

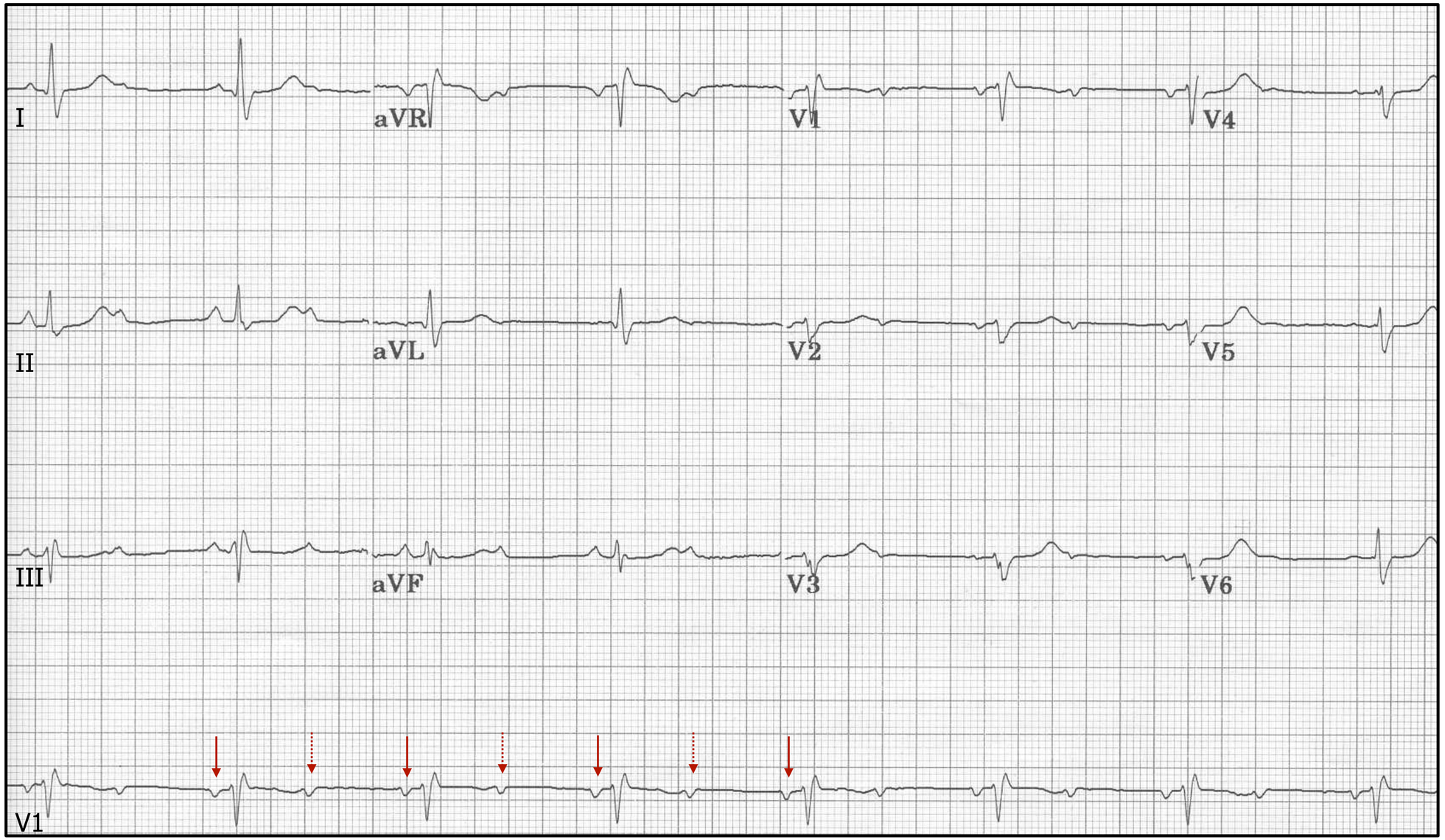


What do you think is going on?

Two locations ?

&

Two degrees ?



Sinus Tachycardia (~110 bpm)

2nd degree AV block with 2:1 conduction (type I or type II ?)… can't tell when 2:1 conduction;

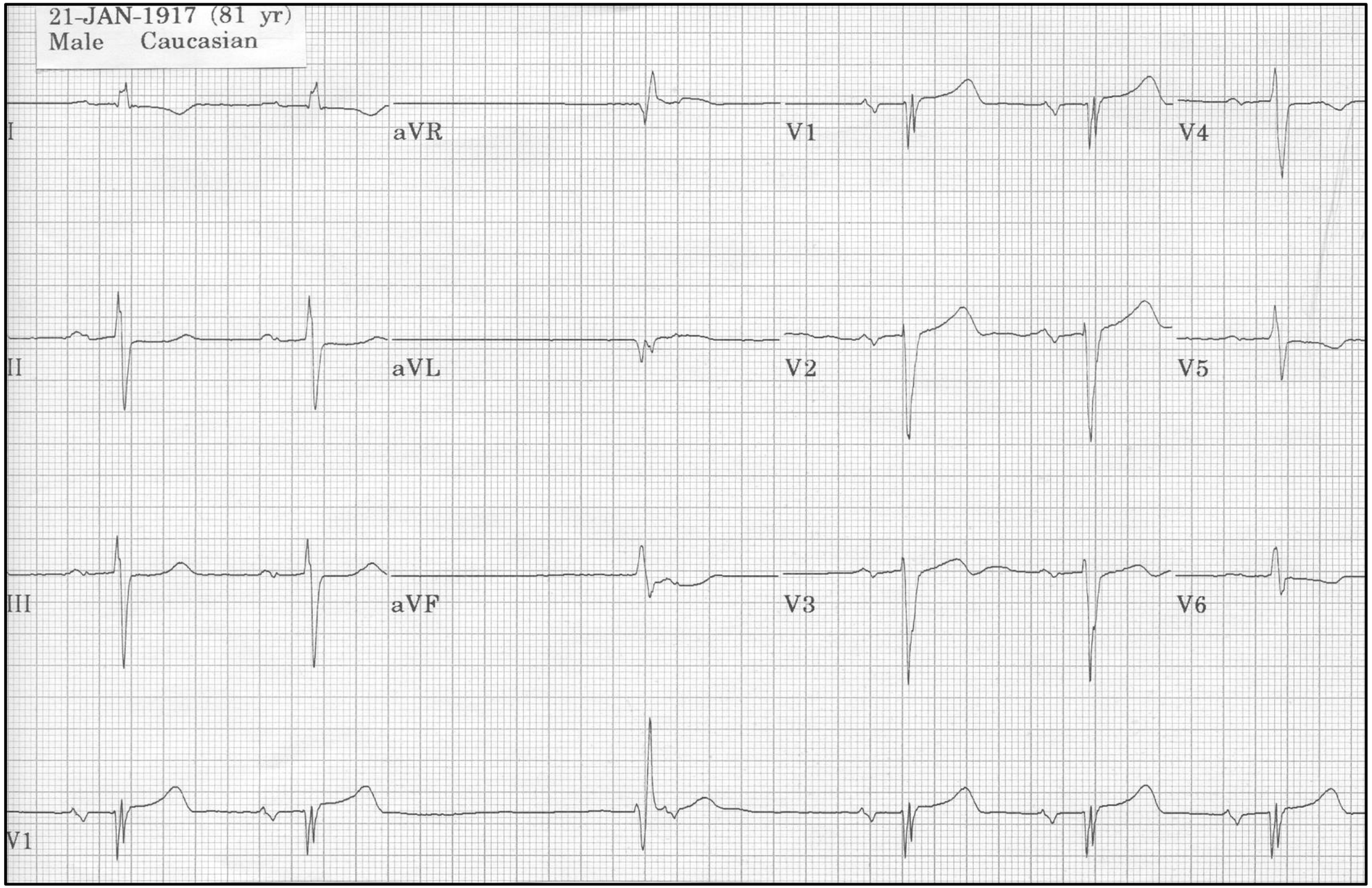
….most likely type II because: (a) normal PR and (b) wide QRS suggests type II (His bundle or LBB)

Complete RBBB (i.e., 3rd degree)

Three Locations

Three Degrees	Sino-Atrial	AV Junction: (AV Node, His Bundle)	Intraventricular
First (1°) Always conducts, but slower)	?	1° AV Block (PR >200 ms)	Incomplete RBBB Incomplete LBBB
Second (2°) Sometimes conducts, sometimes doesn't	2nd degree SA Block	Mobitz I (AV node) (aka: Wenckebach) Mobitz II (His bundle)	Type II (Mobitz), Rate related BBB's & Fascicular blocks
Third (3°) Never conducts	?	3° AV Block	RBBB LBBB LAFB LPFB LSFB Bi- & Tri-fascicular Blocks Bilateral BBB

Can you have: 3 locations and 3 degrees of heart block all expressed in the same ECG?



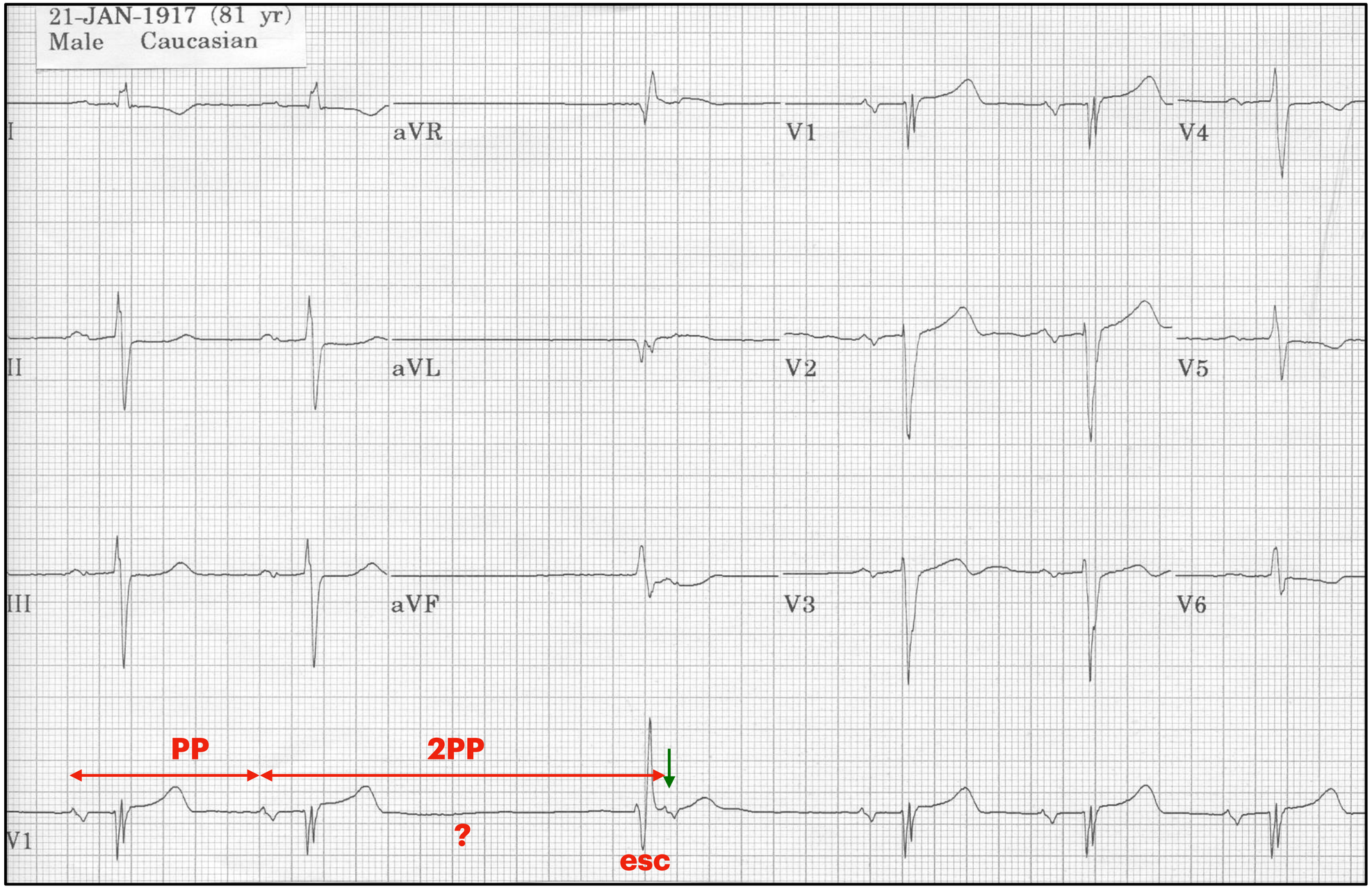
Can you find: 3 locations <u>and</u> 3 degrees of heart block in this ECG?

Location 1:

SA

Degree:

2nd degree



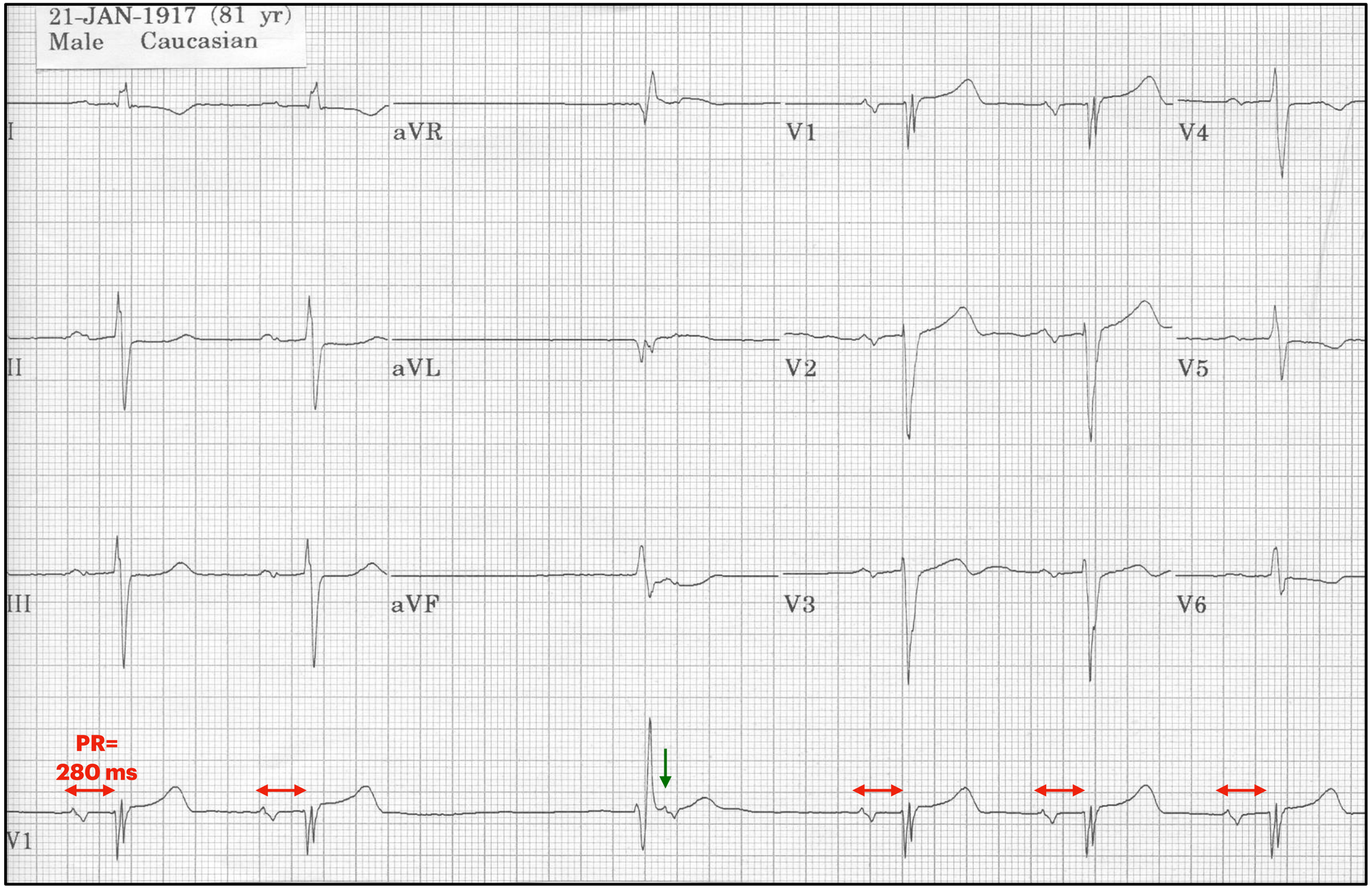
Differential diagnosis of an <u>unexpected</u> pause (without the <u>expected</u> P wave)

Location 2:

AV

Degree:

1st degree



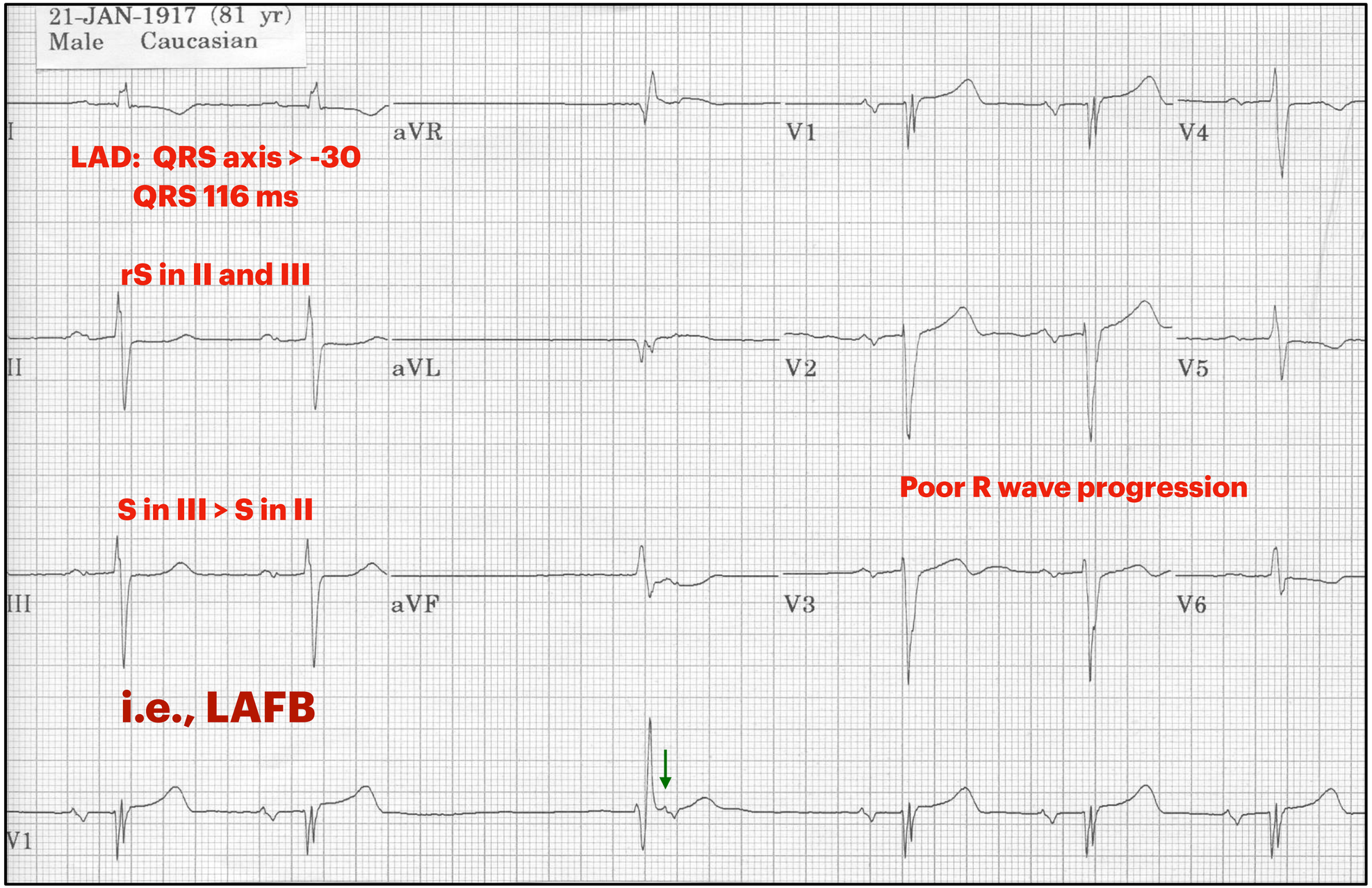
Can you find: 3 locations <u>and</u> 3 degrees of heart block in this ECG?

Location 3:

IV

Degree:

3rd degree



Can you find: 3 locations <u>and</u> 3 degrees of heart block in this ECG?

Three Locations

Three Degrees	Sino-Atrial	AV Junction: (AV Node, His Bundle)	Intraventricular
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Third (3°) Never conducts	?	3° AV Block	RBBB LBBB LAFB LPFB LSFB Bi- & Tri-fascicular Blocks Bilateral BBB

….Thank you!

Stay Up to Date

<u>and</u>

Keep reading ‘lots of ECGs

(or are they EKG’s?)

<u>References:</u>

http://ecg.utah.edu