Unusual Aspects of Bundle Branch Blocks

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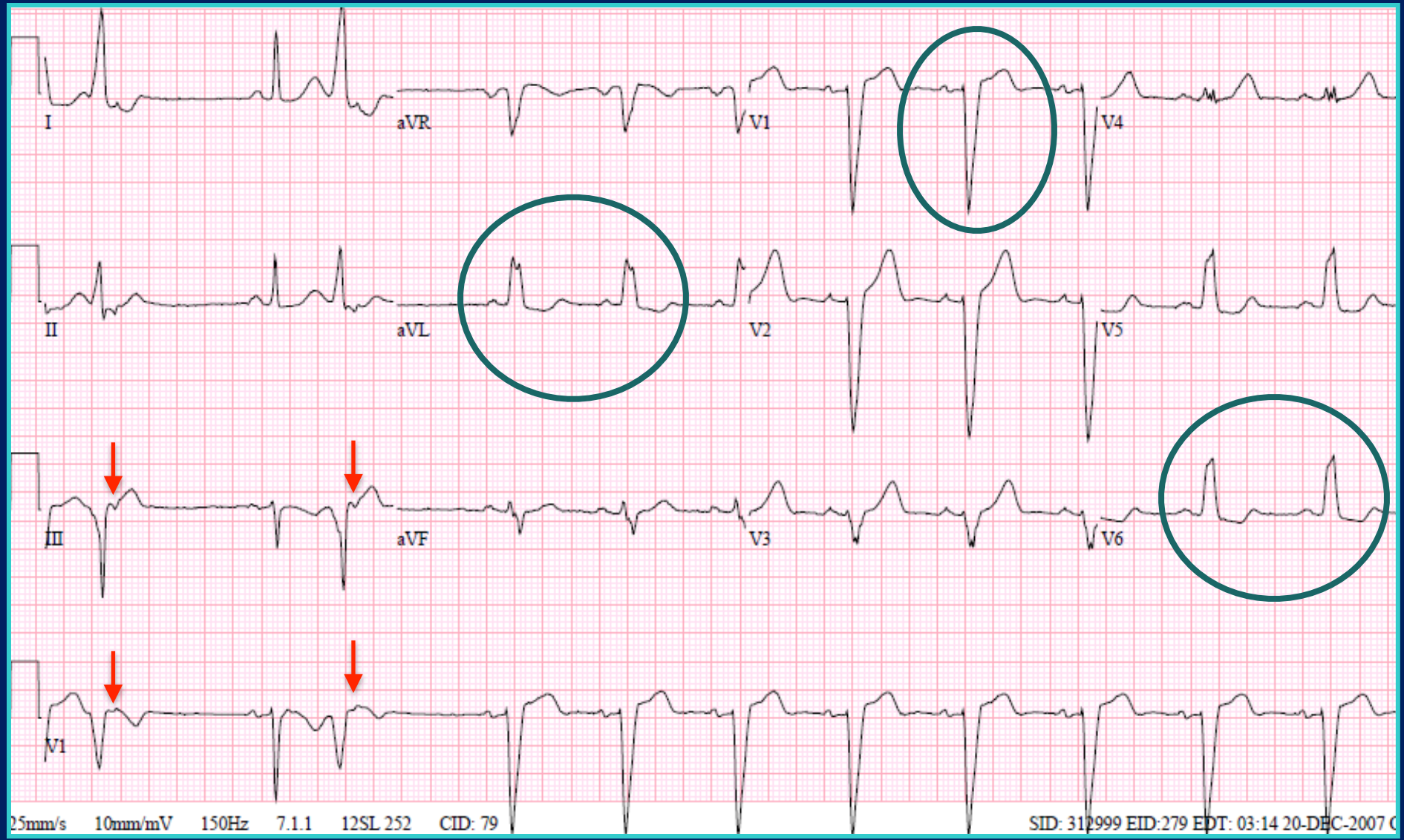
Objectives

- Brief ECG case report
- Review anatomy of ventricular conduction system
- Etiologies of BBB's
- "Functional" Bundle branch and fascicular aberrancy
  - Rate-related BBB
    - Tachycardia-dependent
    - Bradycardia-dependent



17-Dec-2007: 66 y.o. woman with long history of LBBB (routine ECG)

Note: 2 PVCs with retrograde VA conduction (arrows)

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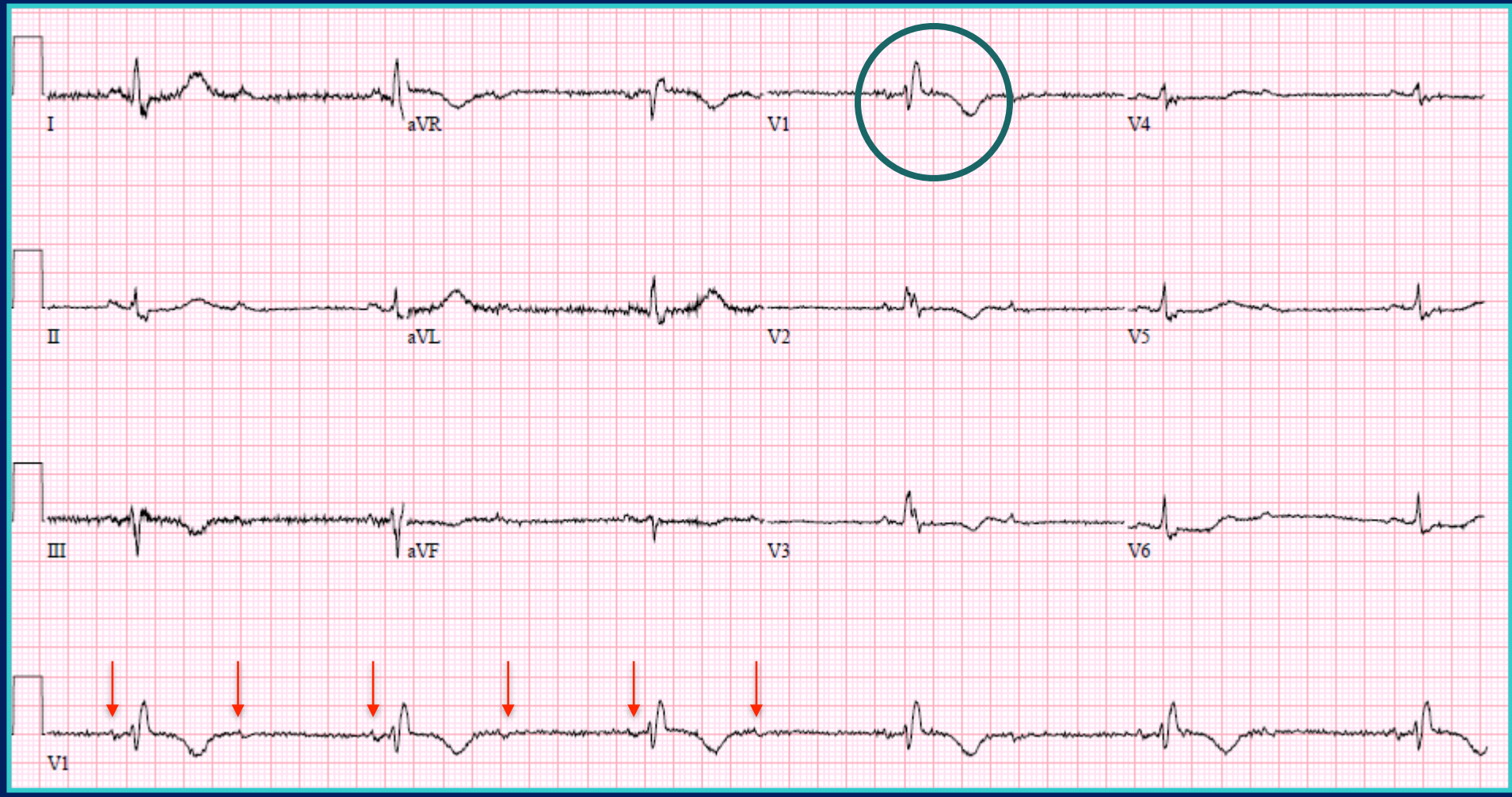

~ Six years later……19-June-2013: 71 y.o. woman (CC: fatigue; HR 35 bpm)

Note: she now has RBBB)
and
2nd degree AV block with 2:1 conduction

(left bundle must now be working!)

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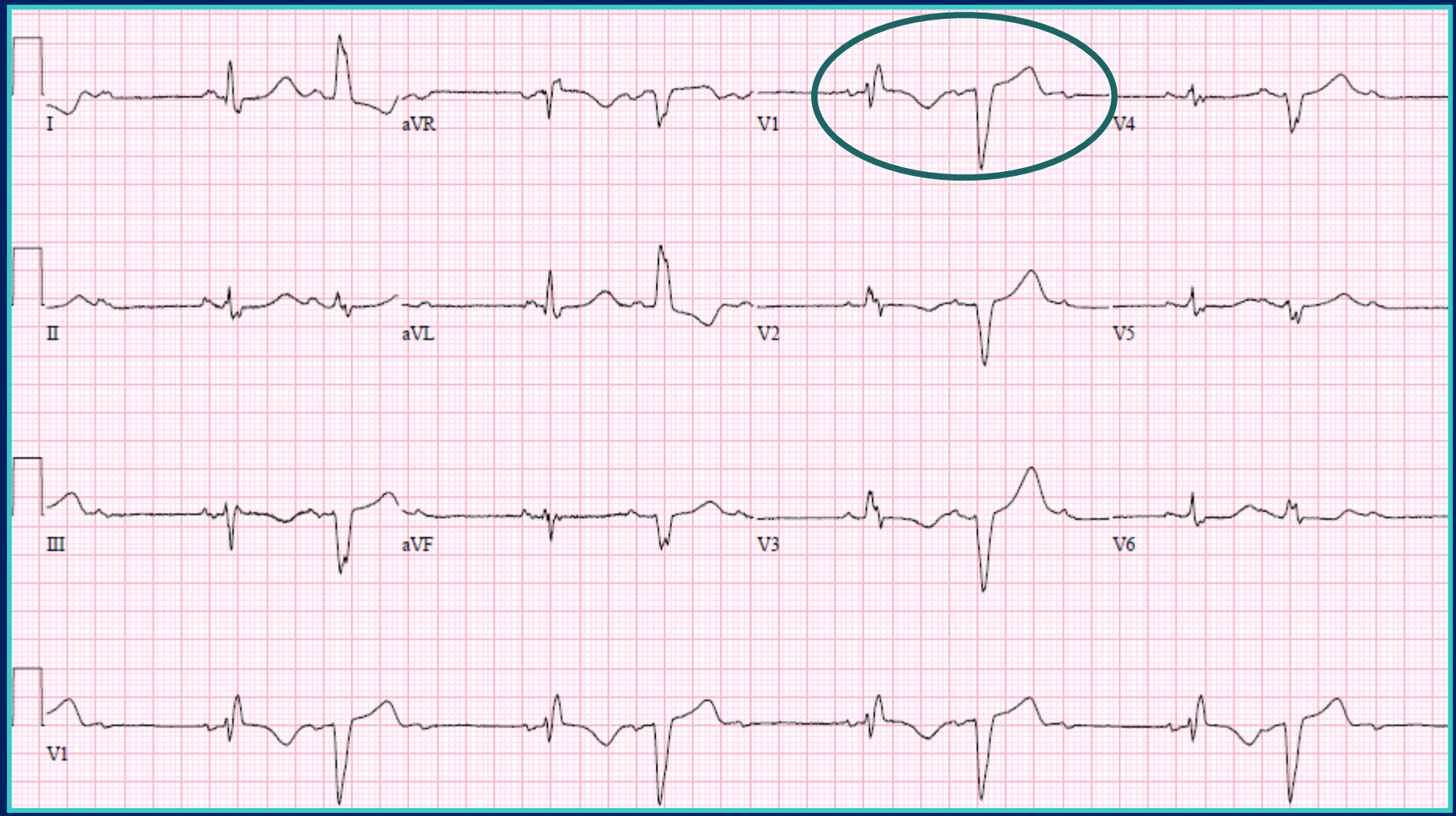

19-June-2013 (same day): 71 y.o. woman (CC: fatigue)

What do you see now?

What to do?

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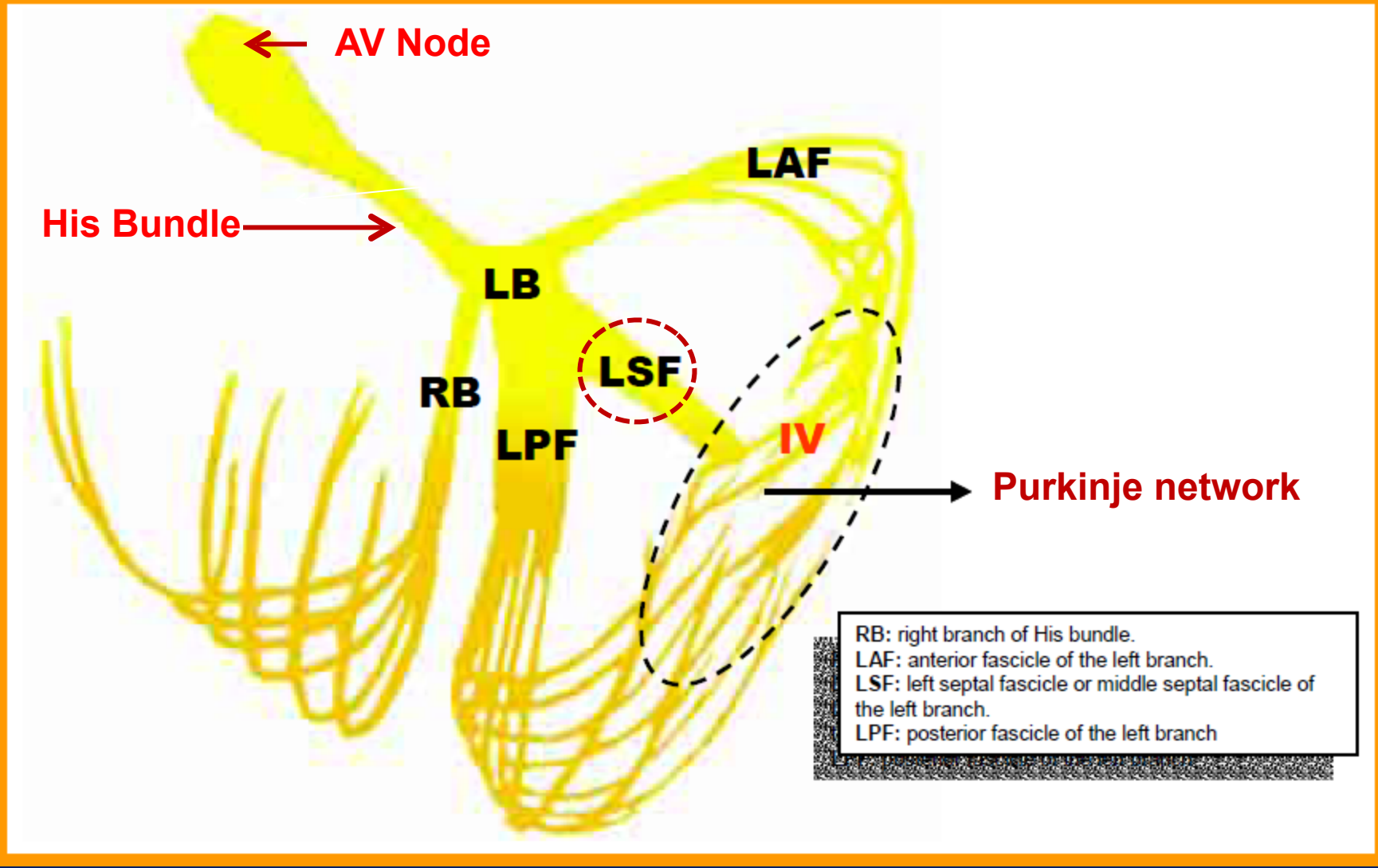
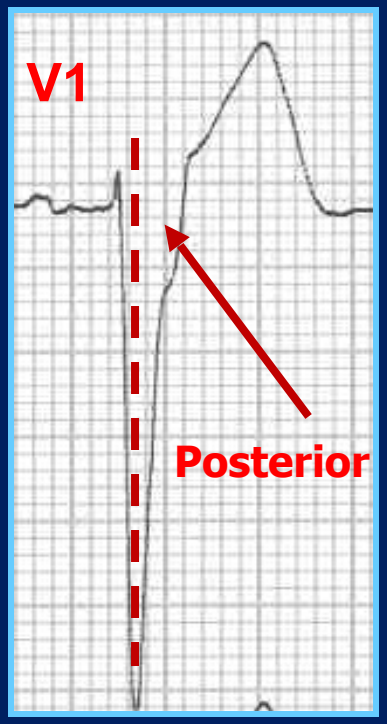
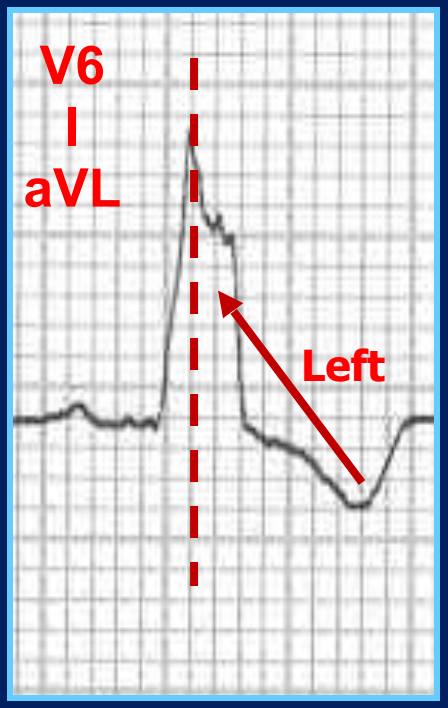
AV & IV Conduction System



Dr. ANDRÉS RICARDO PÉREZ RIERA

LBBB

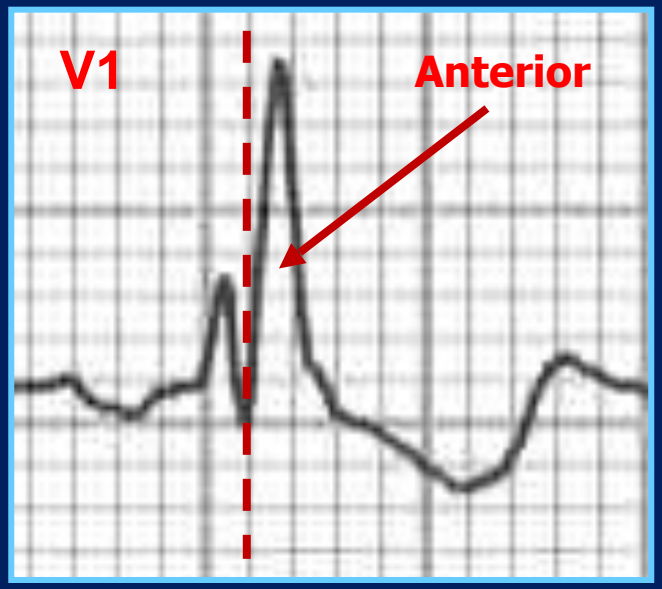


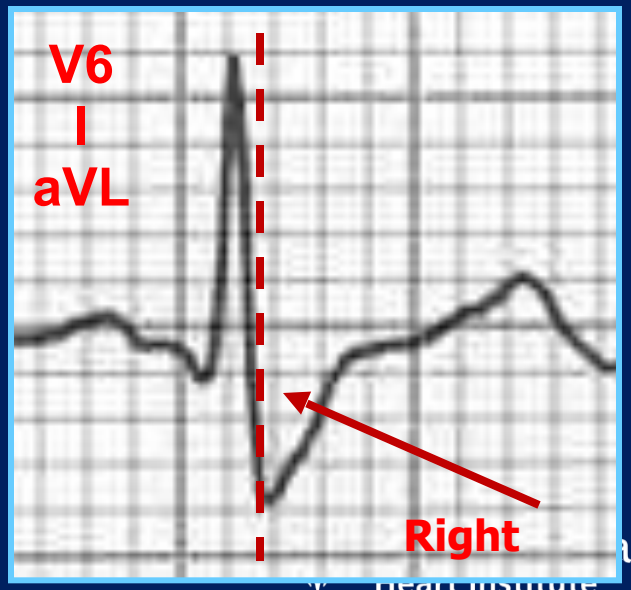


In LBBB the LV is activated last! (left & posterior)

RBBB

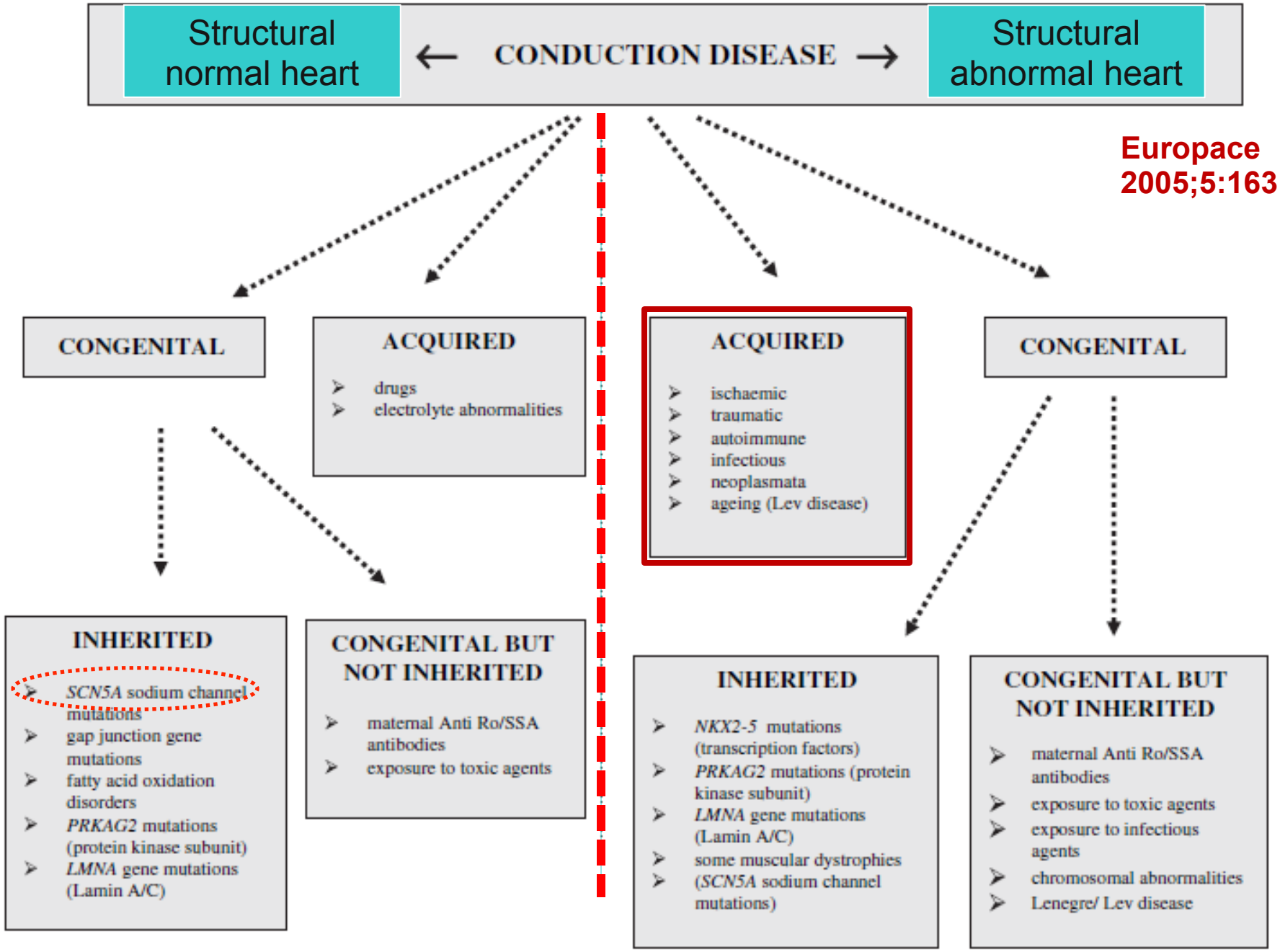
In RBBB the RV is activated last! (right & anterior)



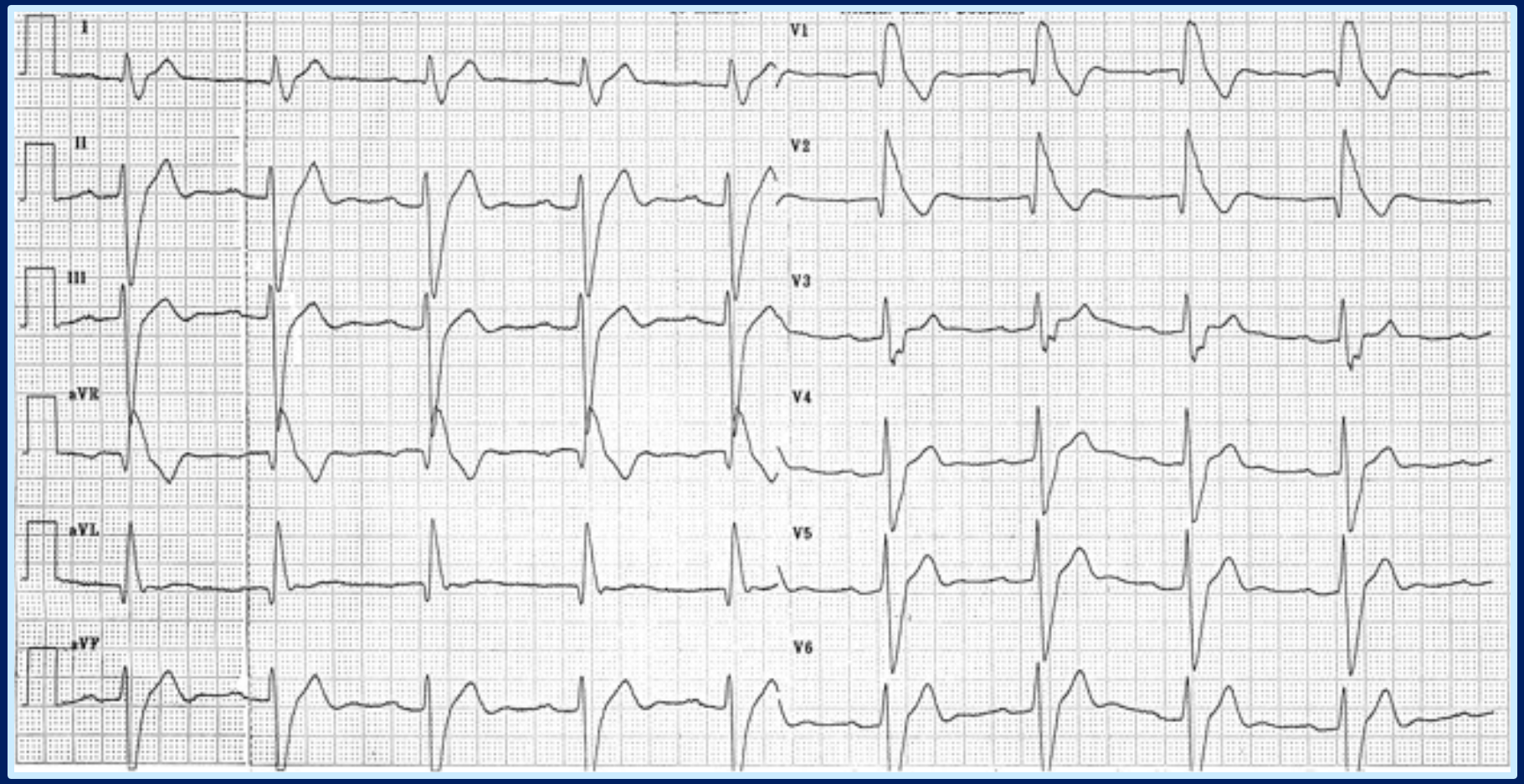


Etiologies of IV Conduction Disorders

- Familial (several variants described)
  - SCN5A mutations (Na^+ channel)
  - Connexin40 mutations
- Acquired
  - Ischemic heart disease (e.g., acute MI)
  - Idiopathic and other cardiomyopathies
  - Hypertensive heart disease
  - Valvular heart disease (e.g., aortic stenosis
  - Infiltrative cardiac diseases
  - Degenerative (aging heart – Lev's disease)


Structural normal heart
CONDUCTION DISEASE
Structural abnormal heart
Europace 2005;5:163
CONGENITAL
ACQUIRED
drugs
electrolyte abnormalities
ACQUIRED
ischaemic
traumatic
autoimmune
infectious
neoplasmata
ageing (Lev disease)
CONGENITAL
INHERITED
SCN5A sodium channel mutations
gap junction gene mutations
fatty acid oxidation disorders
PRKAG2 mutations (protein kinase subunit)
LMNA gene mutations (Lamin A/C)
CONGENITAL BUT NOT INHERITED
maternal Anti Ro/SSA antibodies
exposure to toxic agents
INHERITED
NKX2-5 mutations (transcription factors)
PRKAG2 mutations (protein kinase subunit)
LMNA gene mutations (Lamin A/C)
some muscular dystrophies
(SCN5A sodium channel mutations)
CONGENITAL BUT NOT INHERITED
maternal Anti Ro/SSA antibodies
exposure to toxic agents
exposure to infectious agents
chromosomal abnormalities
Lenegre/ Lev disease

12-lead ECG of a patient with Inherited cardiac conduction disease (ICCD) due to an SCN5A mutation.



Note: 1) atypical RBBB (qR in V1-2) and 2) LAD (-60 degrees) with S3>S2 (LAFB)

Smits J P et al. Europace 2005;7:122-137

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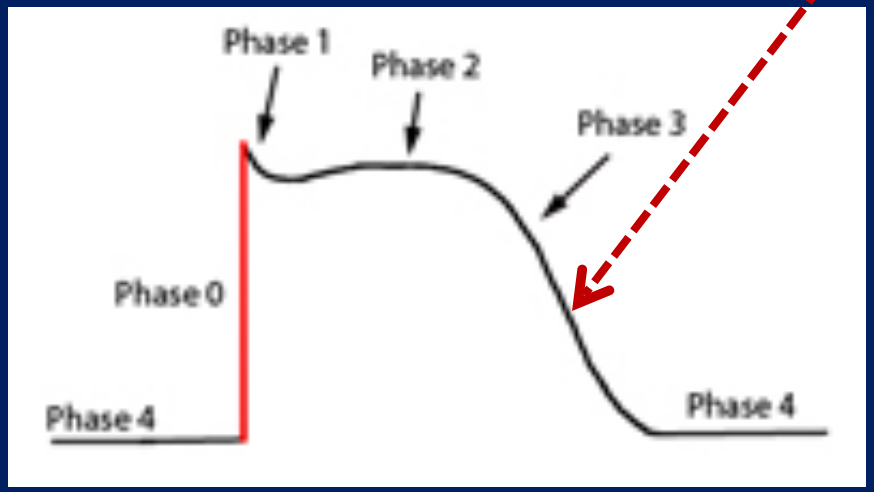
Bundle Branch Disease

- Abrupt Onset
  - e.g., Acute MI (left main or proximal LAD)
- Gradual Onset (initially rate dependent)
  - e.g., The aging conduction system (Lev's disease)

LBBB @ slightly faster HR

This is called the '*hysteresis* effect': i.e., the rate that the BBB appears during rate acceleration is higher than the rate where the BBB disappears with slowing of the heart rate.

Tachycardia-dependent BBB (Phase 3 block)



Bundle branch action potential

At faster rates the sinus impulse arrives during phase 3 of the bundle branch action potential and is blocked.

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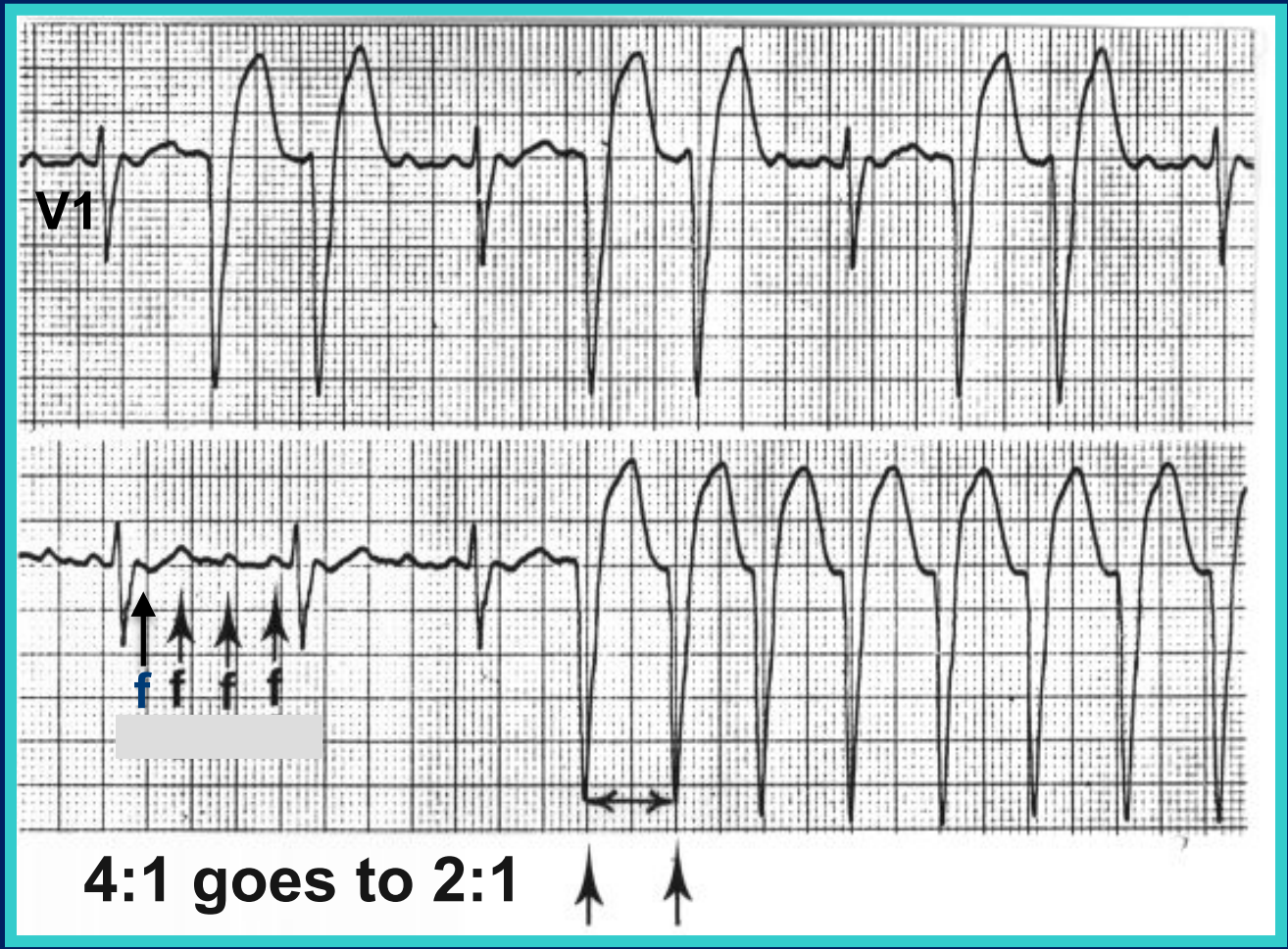
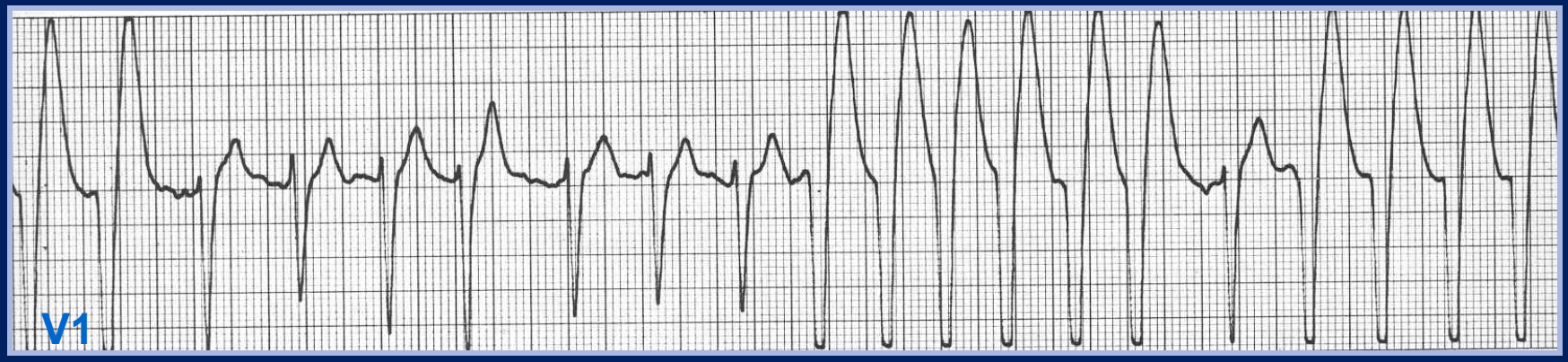
RBBB @ slightly faster HR

Tachycardia-dependent LBBB in Atrial Flutter with variable AV block

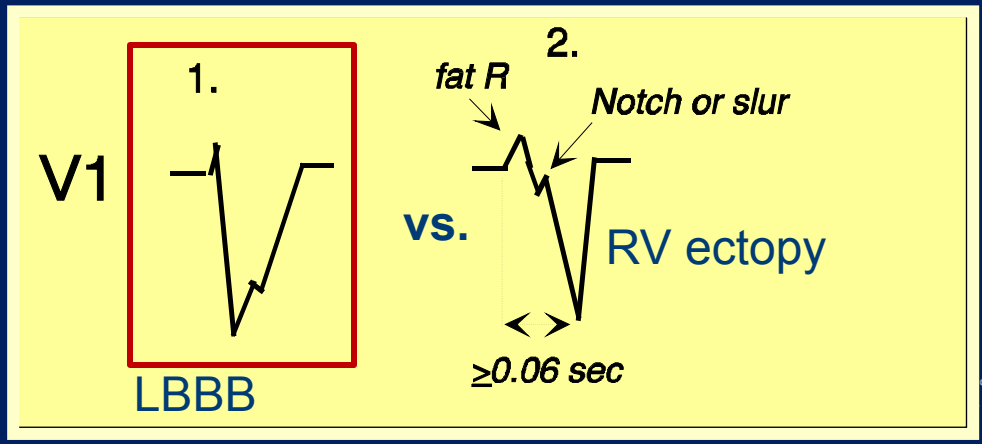


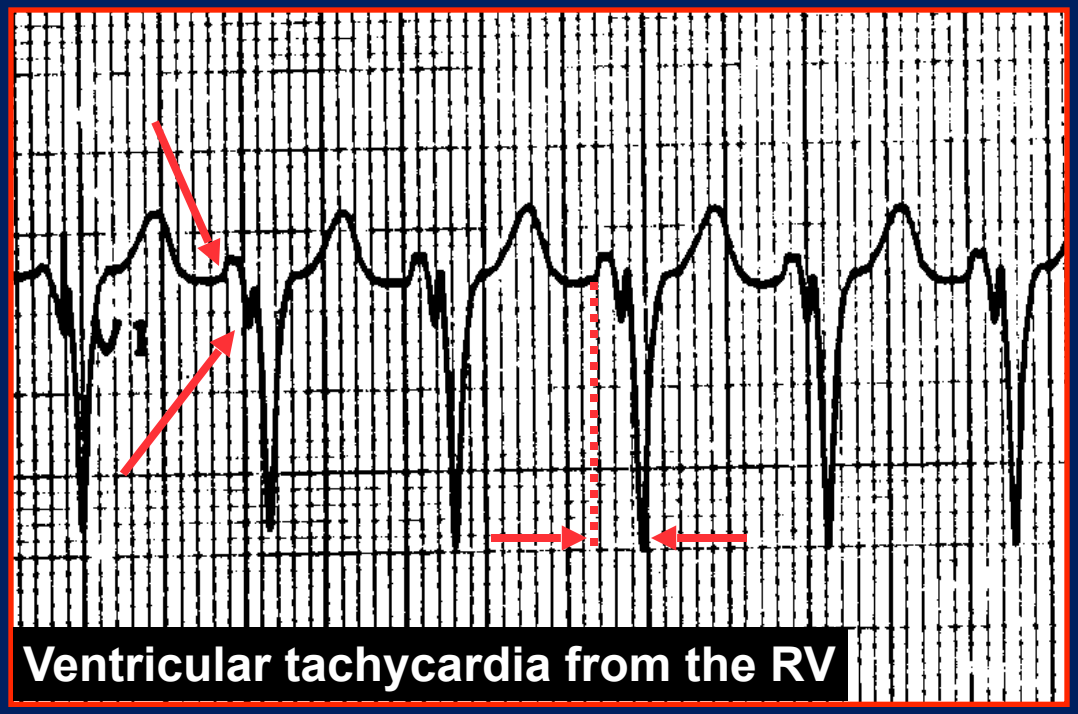
Wide QRS Tachycardia (WQRST)
(Nonsustained)

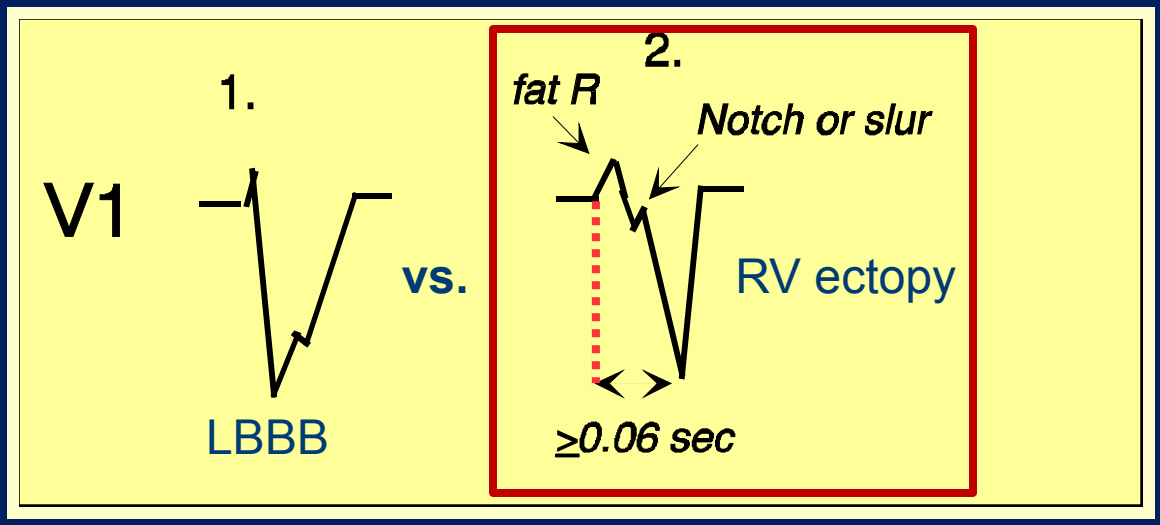
Atrial fibrillation (RVR) with intermittent tachycardia-depend LBBB



Don't confuse this WQRST for ventricular tachycardia!







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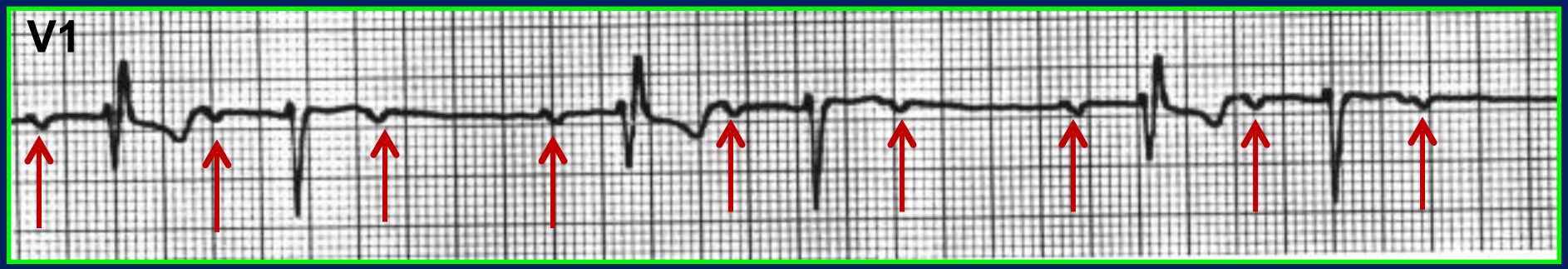
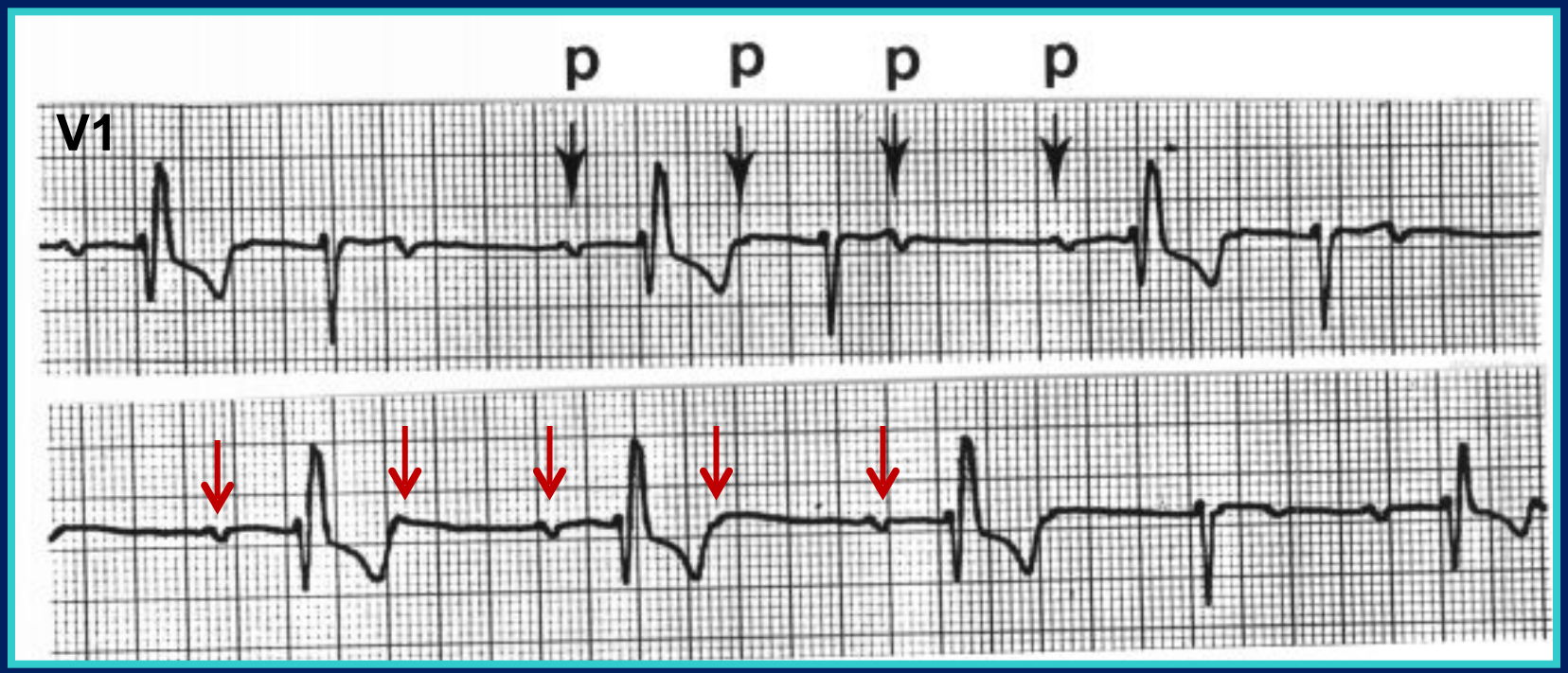
Why does the RBB fail @ longer RRs?



Normal sinus rhythm (arrows); 2nd degree (type I) 3:2 AV block

Note: Intermittent bradycardia-dependent RBBB

Bradycardia-dependent RBBB
(3:2 and 2:1 2º AV Block, type I)



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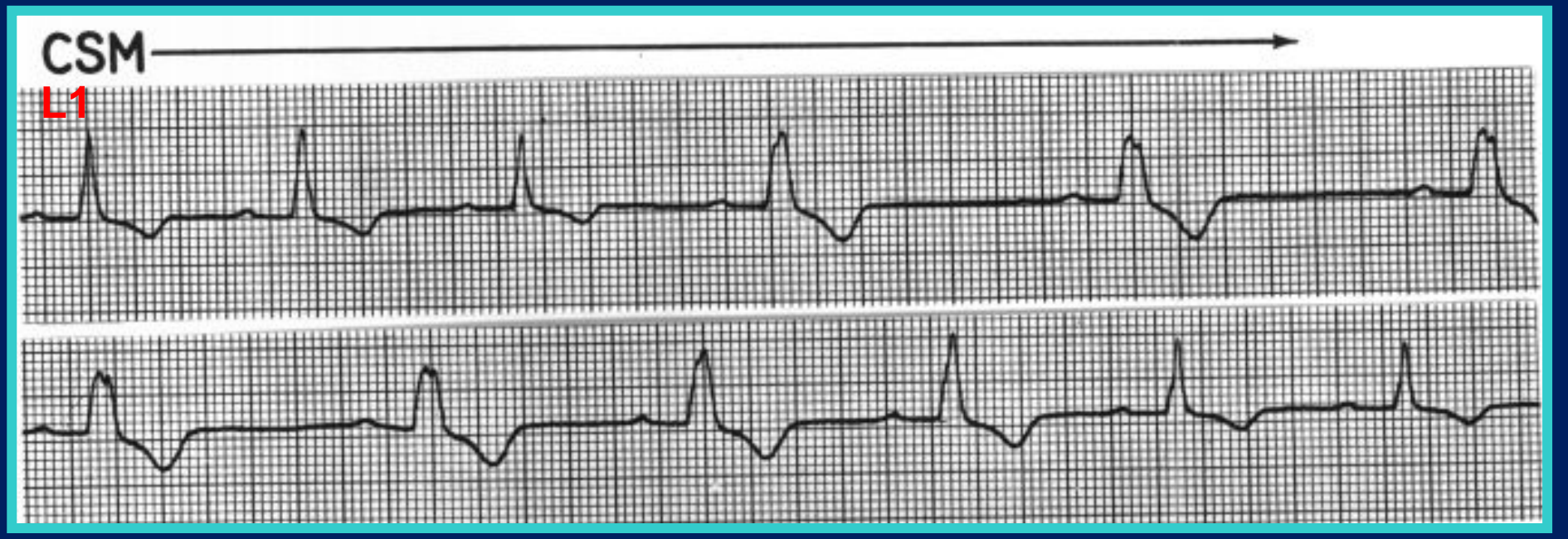
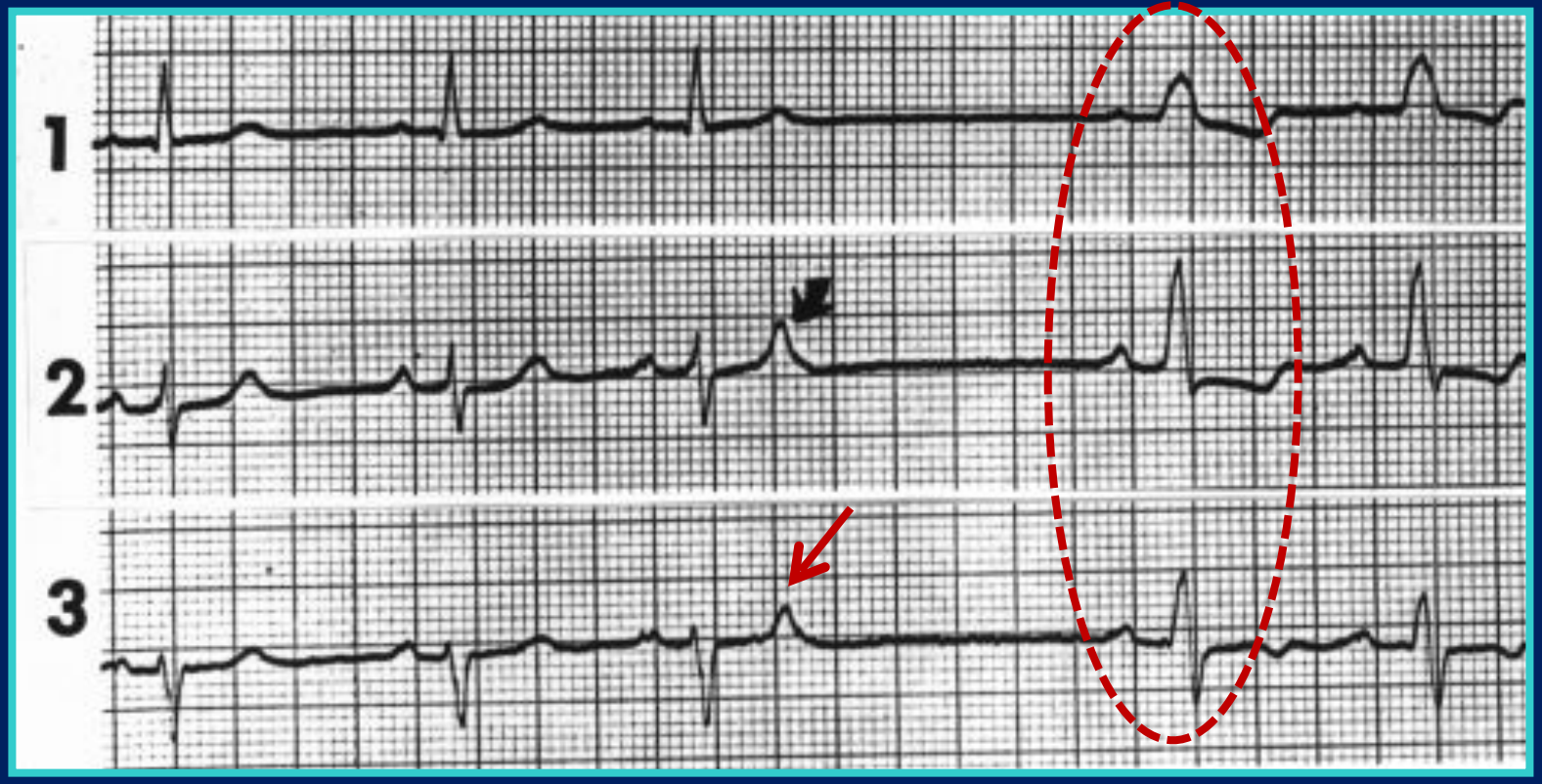
Why does the LBB fail @ slower HRs?



CSM: carotid sinus massage

An unexpected pause…….



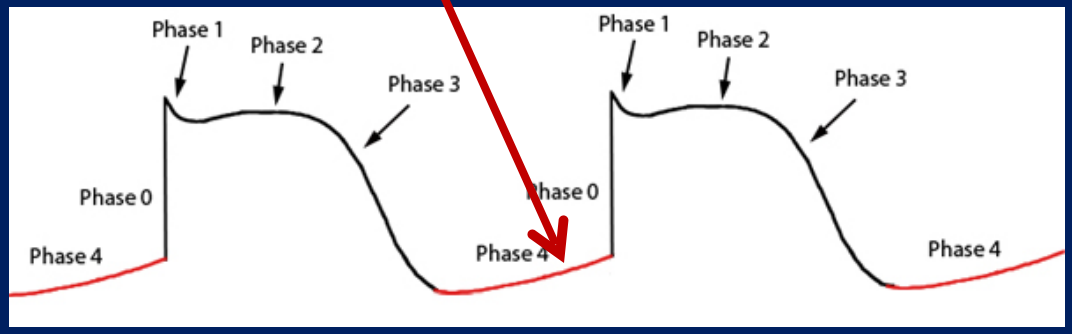
The most common cause of an unexpected pause is a nonconducted PAC

Note: the pause ends with sinus P wave conducted with **LBBB**

Proposed Mechanism: Bradycardia-dependent BBB (phase 4 block)

Bradycardia-dependent IVCD is attributed to the inherent capacity of one or the other bundle branch to "spontaneous diastolic depolarization" or "diastolic hypopolarization") during phase 4 of the action potential in an attempt to become a 'backup' pacemaker when the sinus slows too much.

If the next impulse from the atria or the atrioventricular node arrives at the bundle branch during a time period when the cells are partially depolarized, conduction may not take place in that bundle (i.e., a BBB)



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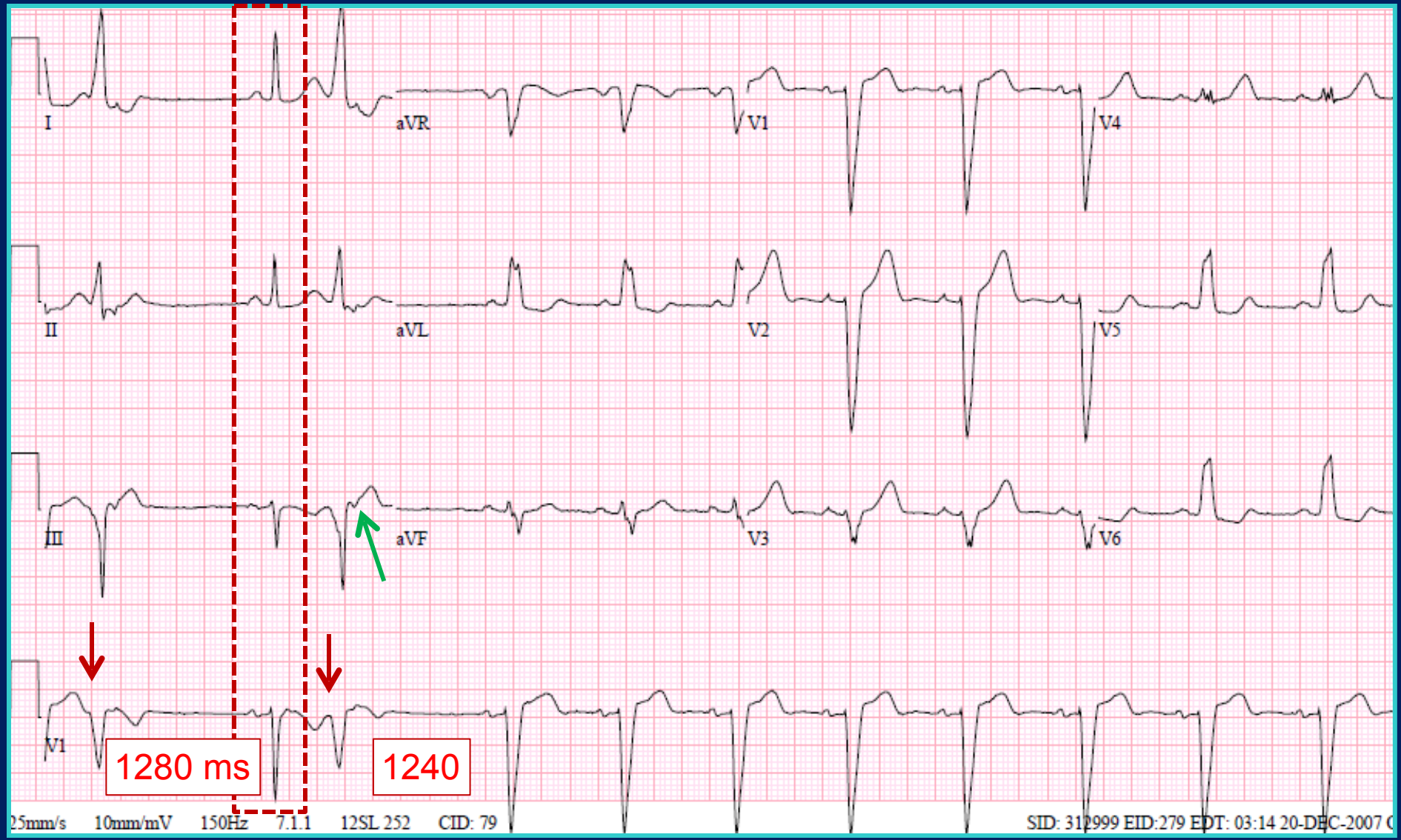

17-Dec-2007: 66 y.o. woman (routine ECG)….. back to our patient!

Note: the first **PVC** and pause allows the LBB to recover, but **LBBB** reoccurs after the 2nd **PVC** because the pause is shorter and the heart rate picks up again. This indicates the LBB can still work at slower heart rates.

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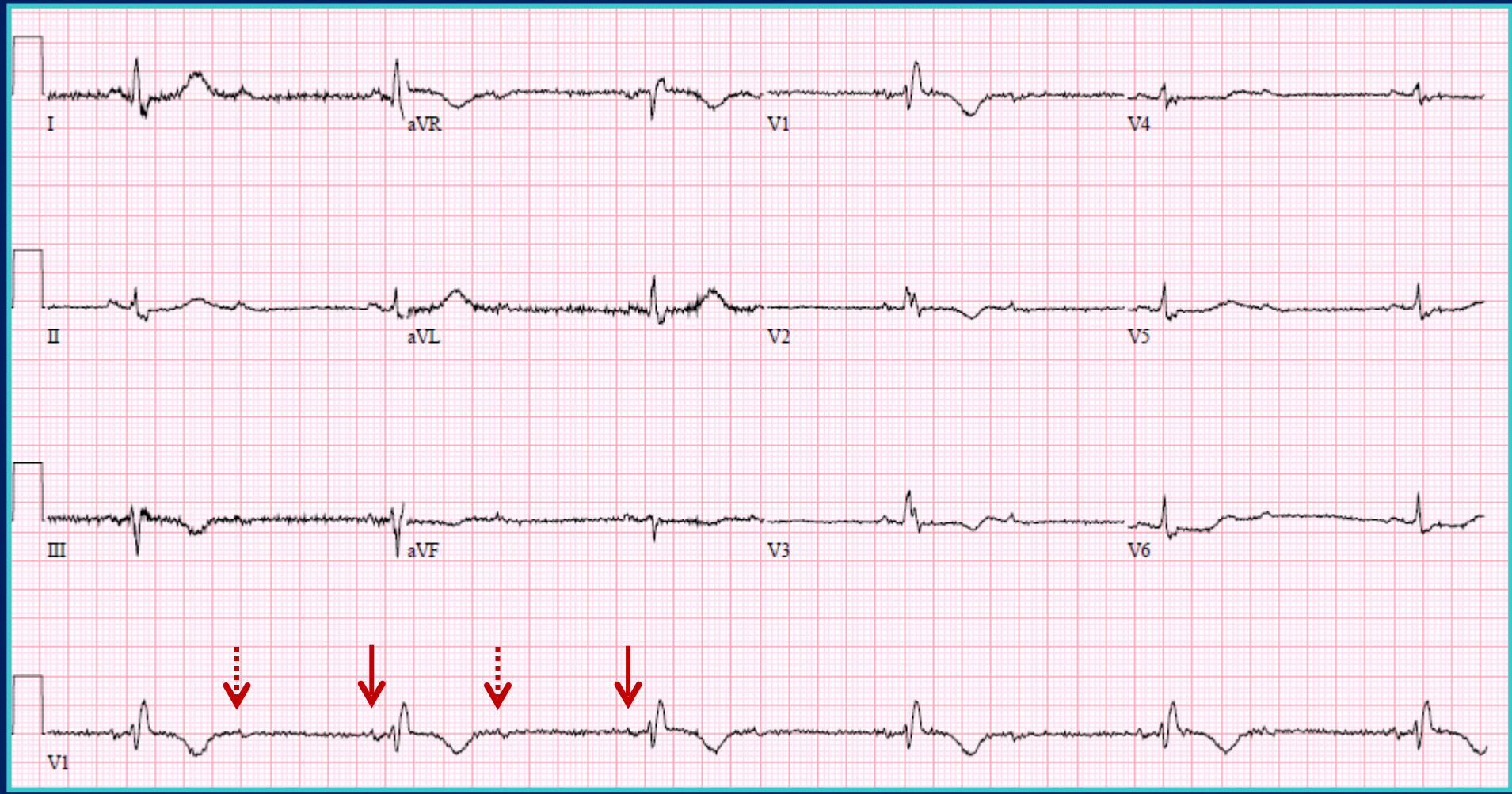

Six years later……

19-June-2013: now 71 y.o. woman (fatigue)

2:1 AV block and RBBB

Note: the conducted P waves with RBBB indicate the LBB must still be able to conduct, but the RBB is now not working!

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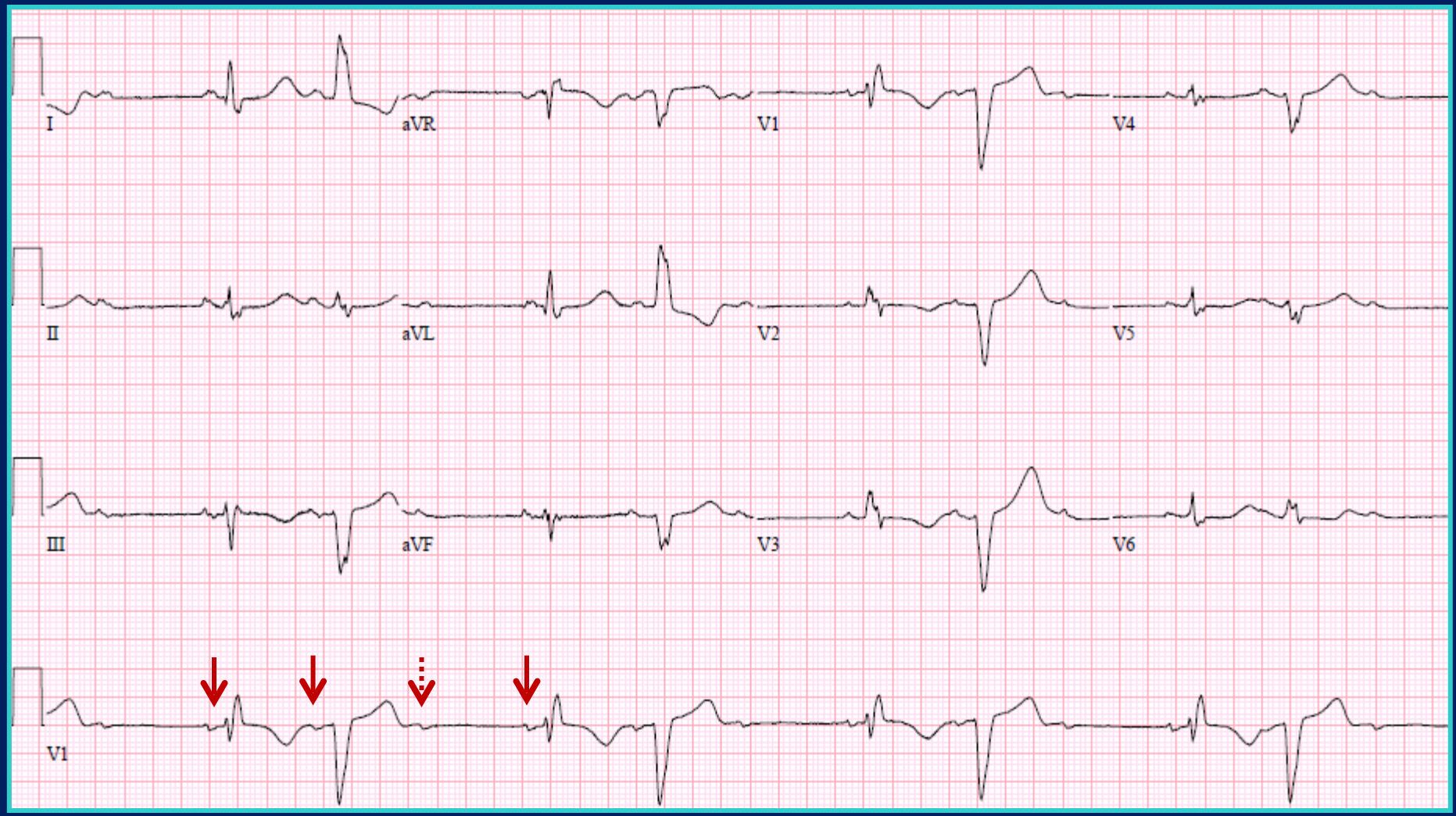

19-June-2013: 71 y.o. woman, later that same day…….

Note: the conducted beats with LBBB indicates the RBB must be working!

Summary: 2° AV block (type II) with 3:2 conduction

- RBBB is bradycardia-dependent
- LBBB is tachycardia-dependent

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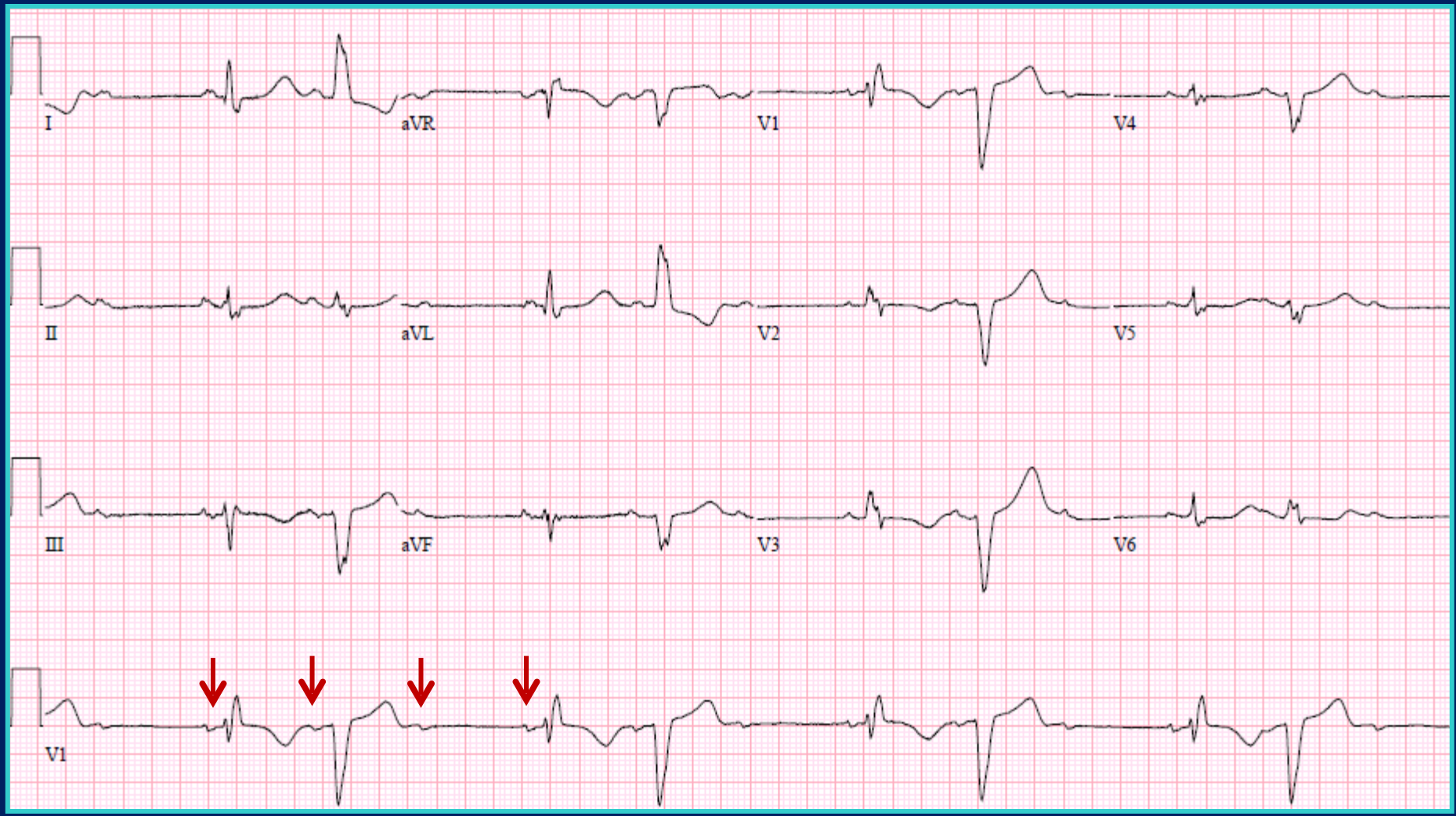

19-June-2013: PL: 71 y.o. woman (fatigue)… not only is this an amazing ECG <u>but</u>:

<u>YES!</u> She needs a PACEMAKER!

<u>Summary</u>: 2º AV block (type II) with 3:2 conduction

- RBBB is bradycardia-dependent (Phase 4 block)
- LBBB is tachycardia-dependent (Phase 3 block)

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Thank You !

Staying up to date

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