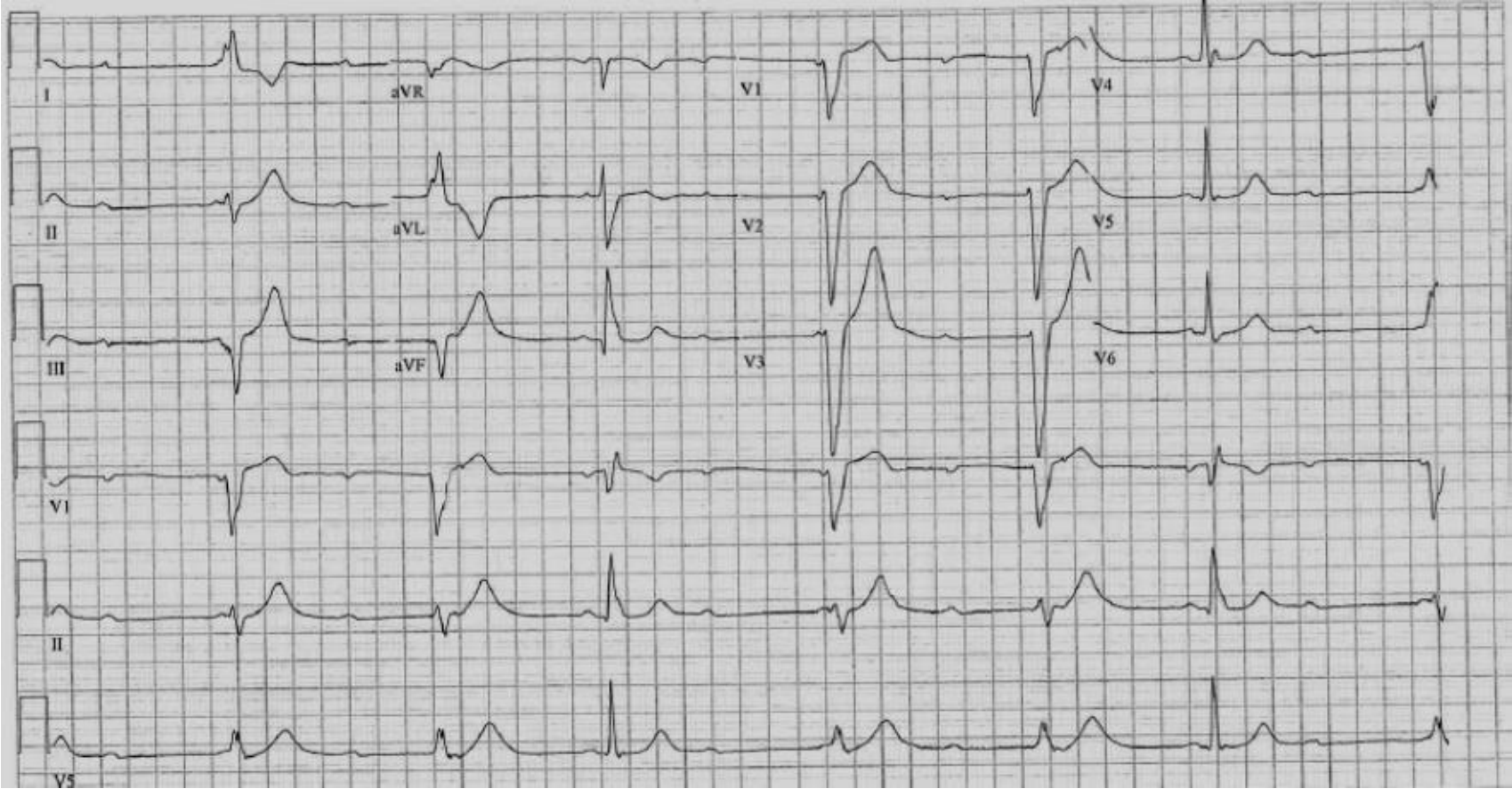


BRADYCARDIA

James D. Daniels, MD



QUESTION 2



OUTLINE

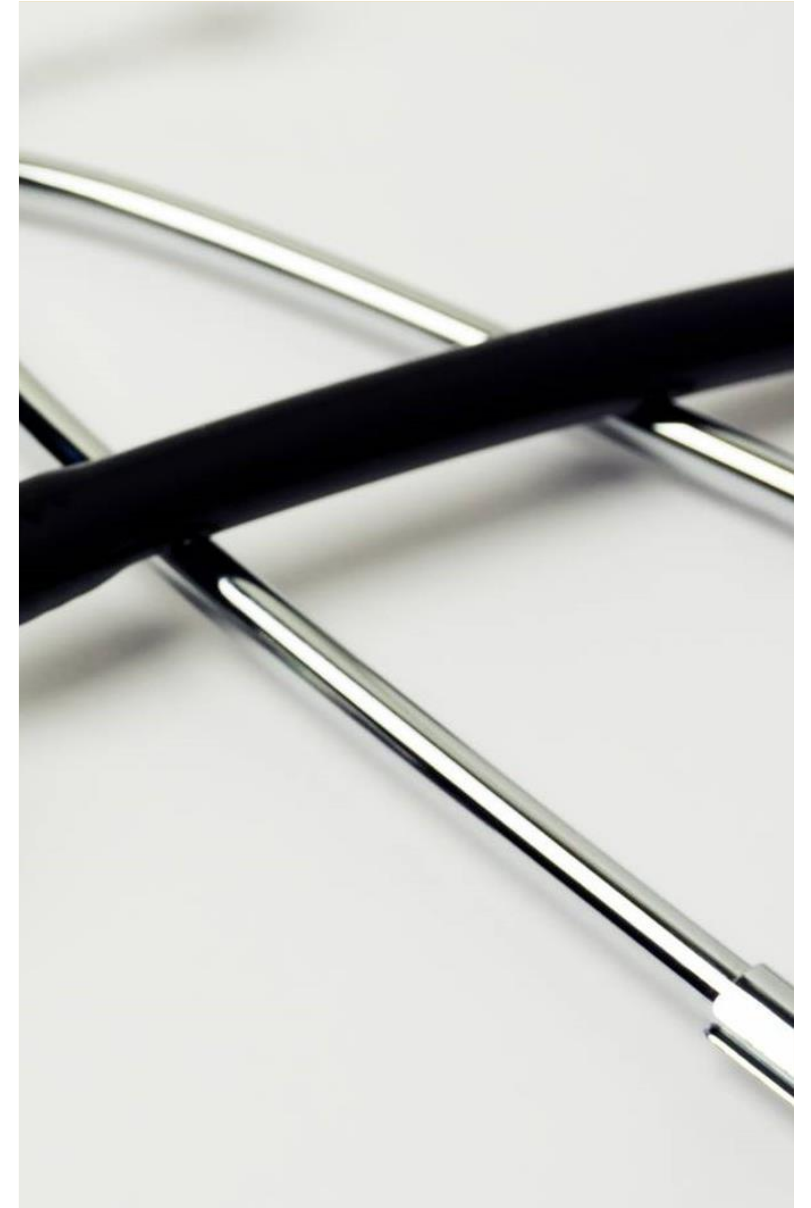
Cardiac Conduction System

Disorders of the Conduction System

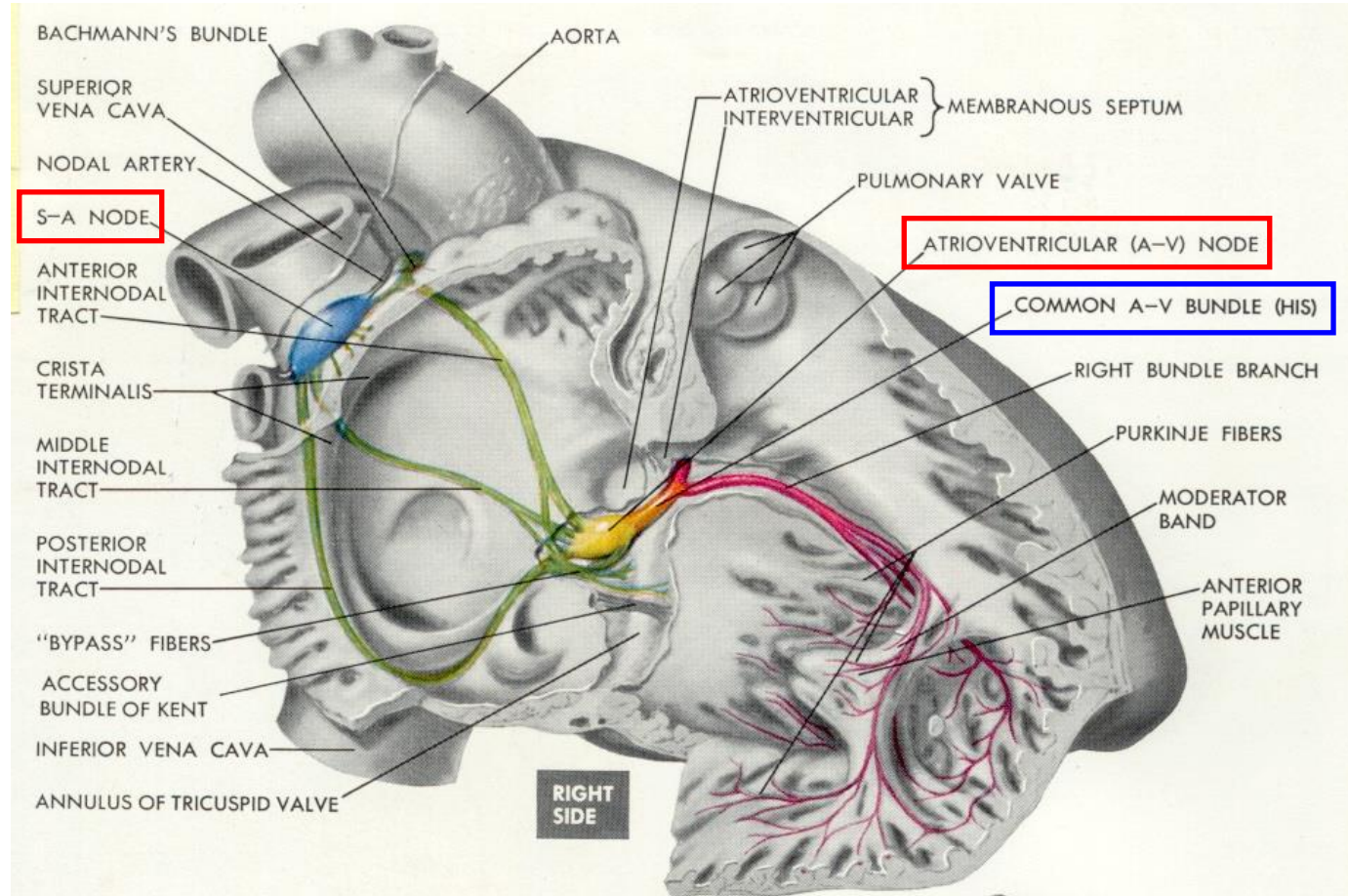
Management of Bradycardia

Pacemakers

Review Questions

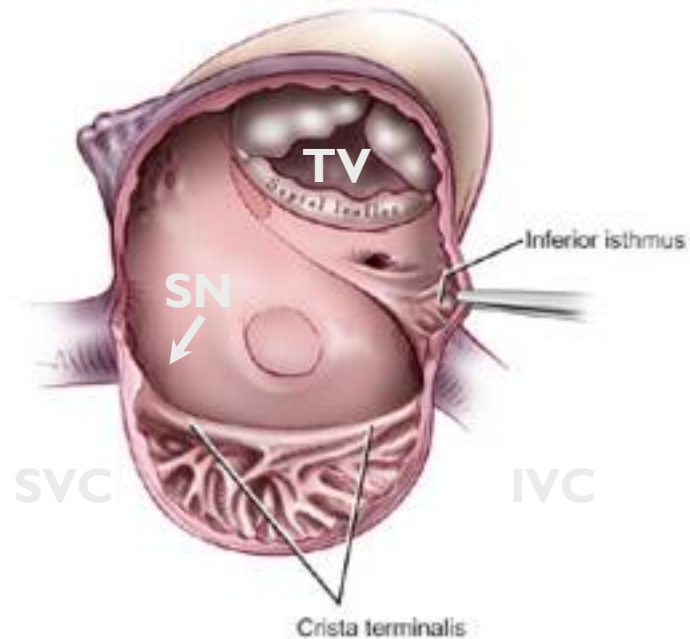


CARDIAC CONDUCTION SYSTEM



$$\text{PR interval} = \text{AH} + \text{HV}$$

SINUS NODE



- Sinoatrial (SA) node – cardiac pacemaker tissue at the junction of the posterior right atrium (RA) and superior vena cava (SVC)
 - caudal end of SA node usually medial to junction of the crista terminalis and intercaval band
 - supplied by SA nodal artery
 - Branch of RCA 55%
 - autonomic innervation



AV CONDUCTION

- AV node
 - Supplied by RCA (90%) and septal branches of LAD
- His bundle
- Bundle Branches
- Purkinje fibers

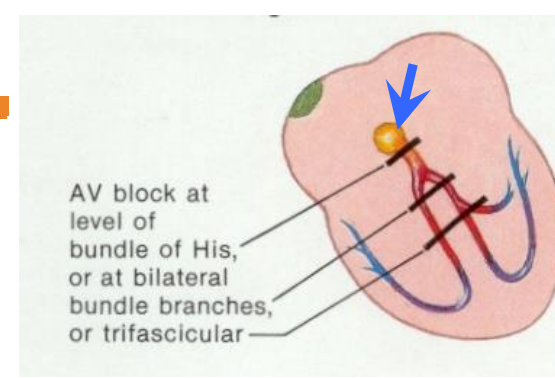
AV NODAL BLOCK

Intra-nodal block:

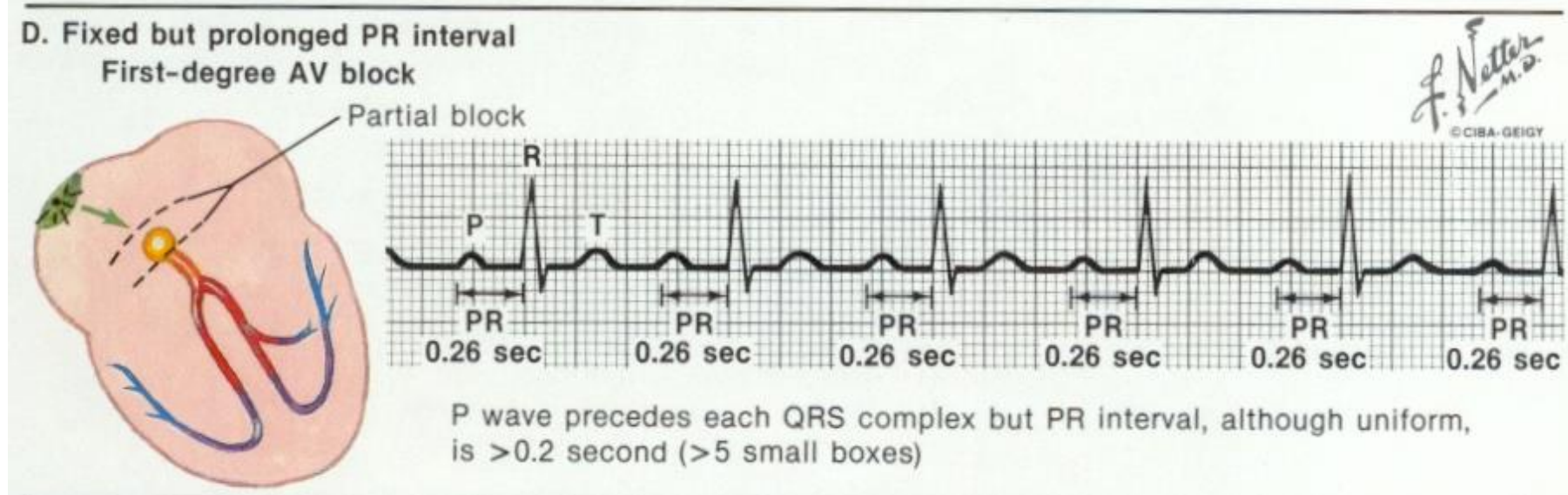
- conduction improves with catecholamines
- typically narrow-complex QRS

Infra-nodal block:

- conduction **worsens** with catecholamines
 - sinus rate increases but AV conduction does not improve
- QRS can be narrow or wide
 - Presence of wide QRS suggests infranodal



FIRST DEGREE AV BLOCK



Usually intranodal
PR (AH) prolongation
Decremental I:I conduction

MARKED 1ST DEGREE AV BLOCK WITH EXERCISE



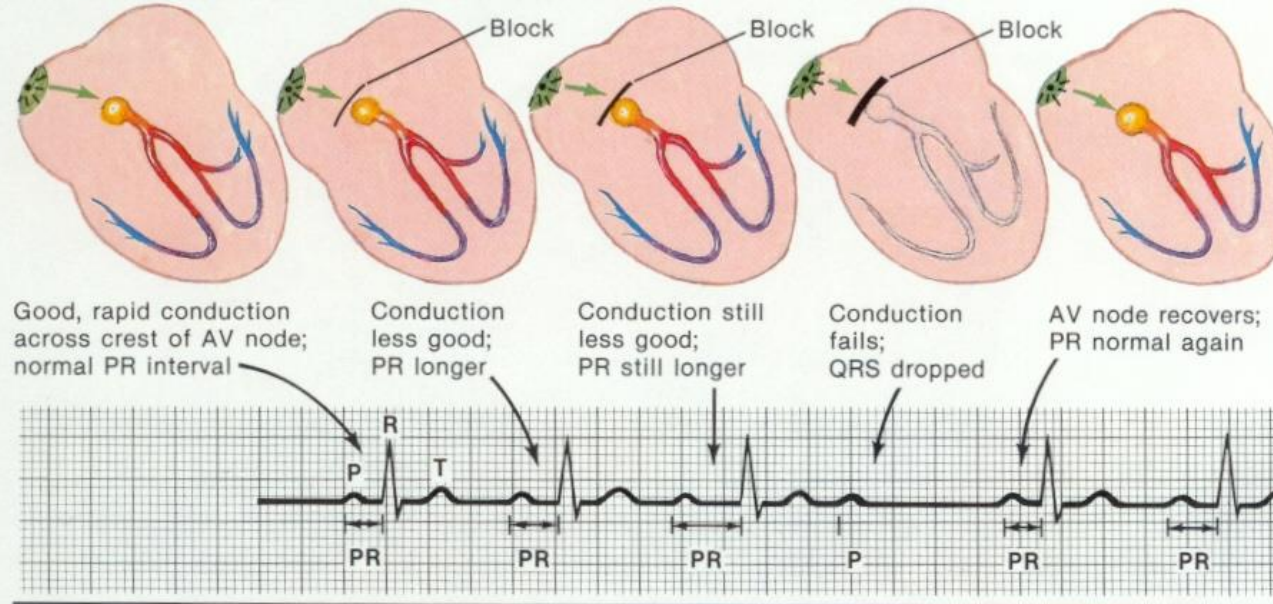
Baseline

Exercise

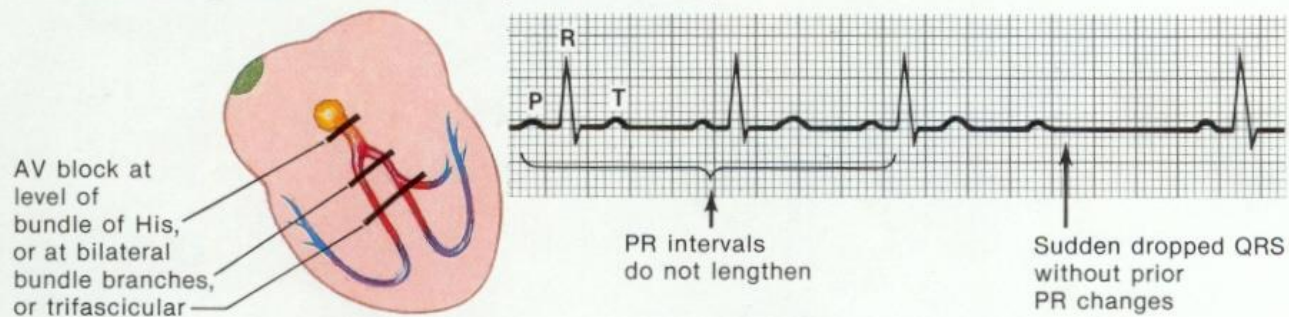
Symptomatic patient may require pacemaker

SECOND-DEGREE AV BLOCK

E. Progressive lengthening of PR interval with intermittent dropped beats
Second-degree AV block: Mobitz I (Wenckebach)



F. Sudden dropped QRS without prior PR lengthening
Second-degree AV block: Mobitz II (non-Wenckebach)





IN TYPE I (WENCKEBACH) SECOND DEGREE AV BLOCK,
PRIOR TO THE DROPPED BEAT, THE R-R INTERVAL

- A. Shortens.
- B. Remains fixed.
- C. Lengthens.
- D. None of the above



IN TYPE 2 SECOND DEGREE AV BLOCK, PRIOR TO THE DROPPED BEAT, THE R-R INTERVAL

- A. Shortens.
- B. Remains fixed.
- C. Lengthens.
- D. None of the above



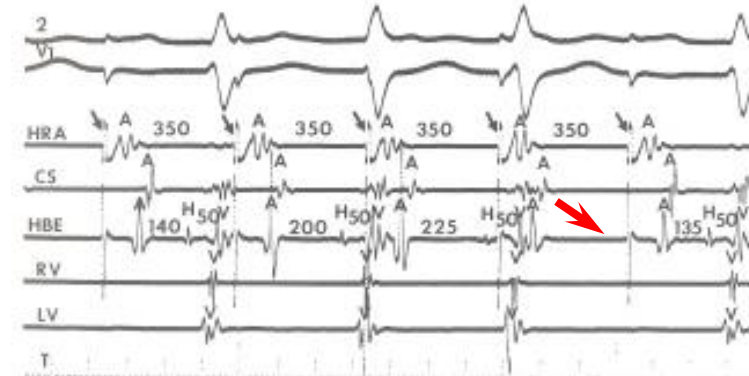


AV CONDUCTION BLOCK

Second degree Mobitz type I:

Intra-nodal

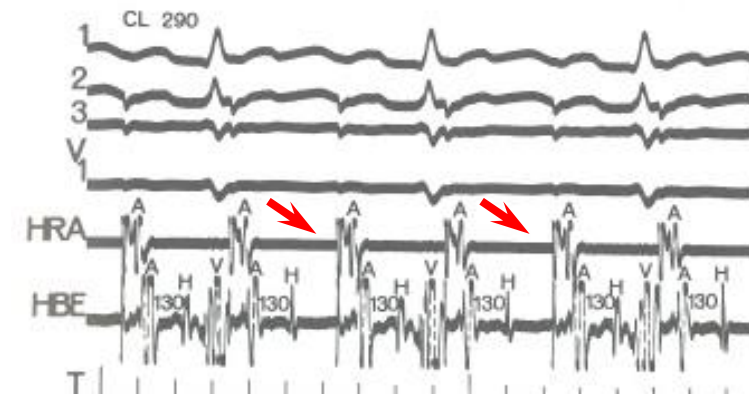
AH prolongation before block



Second degree Mobitz type II:

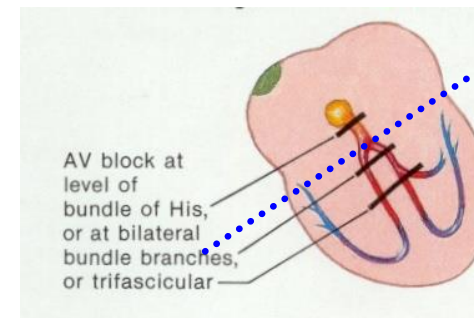
Infra-nodal

HV block

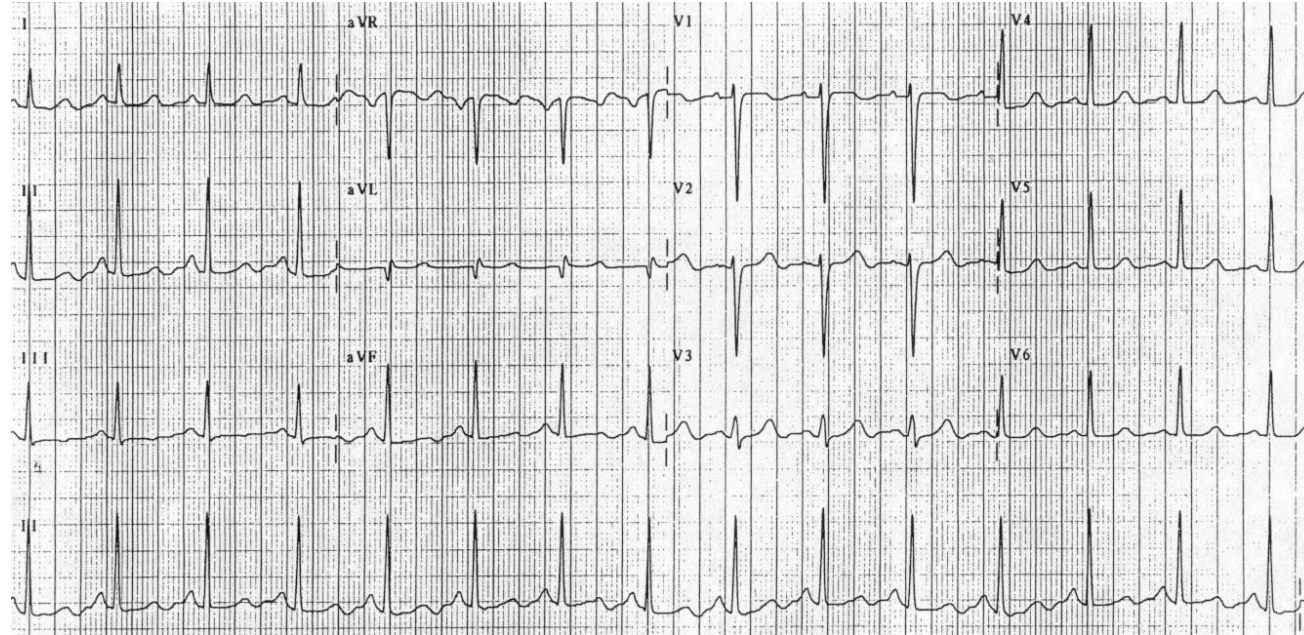


Third degree AVB:

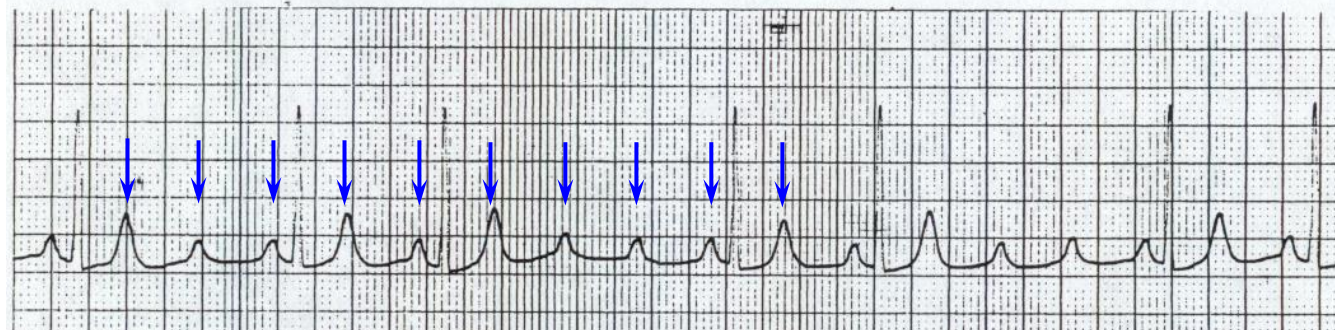
Intranodal or infranodal



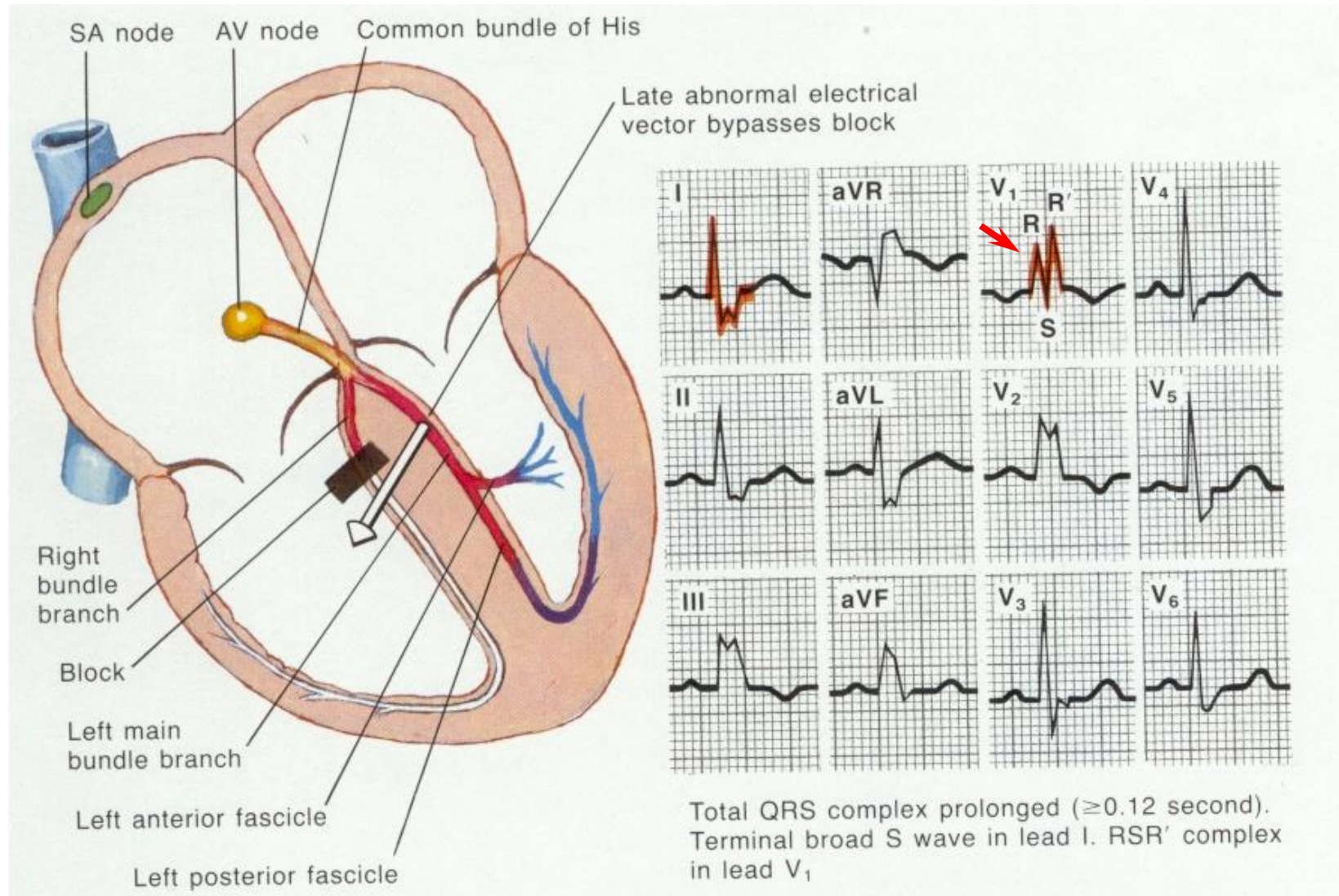
SECOND DEGREE AV BLOCK WITH EXERCISE



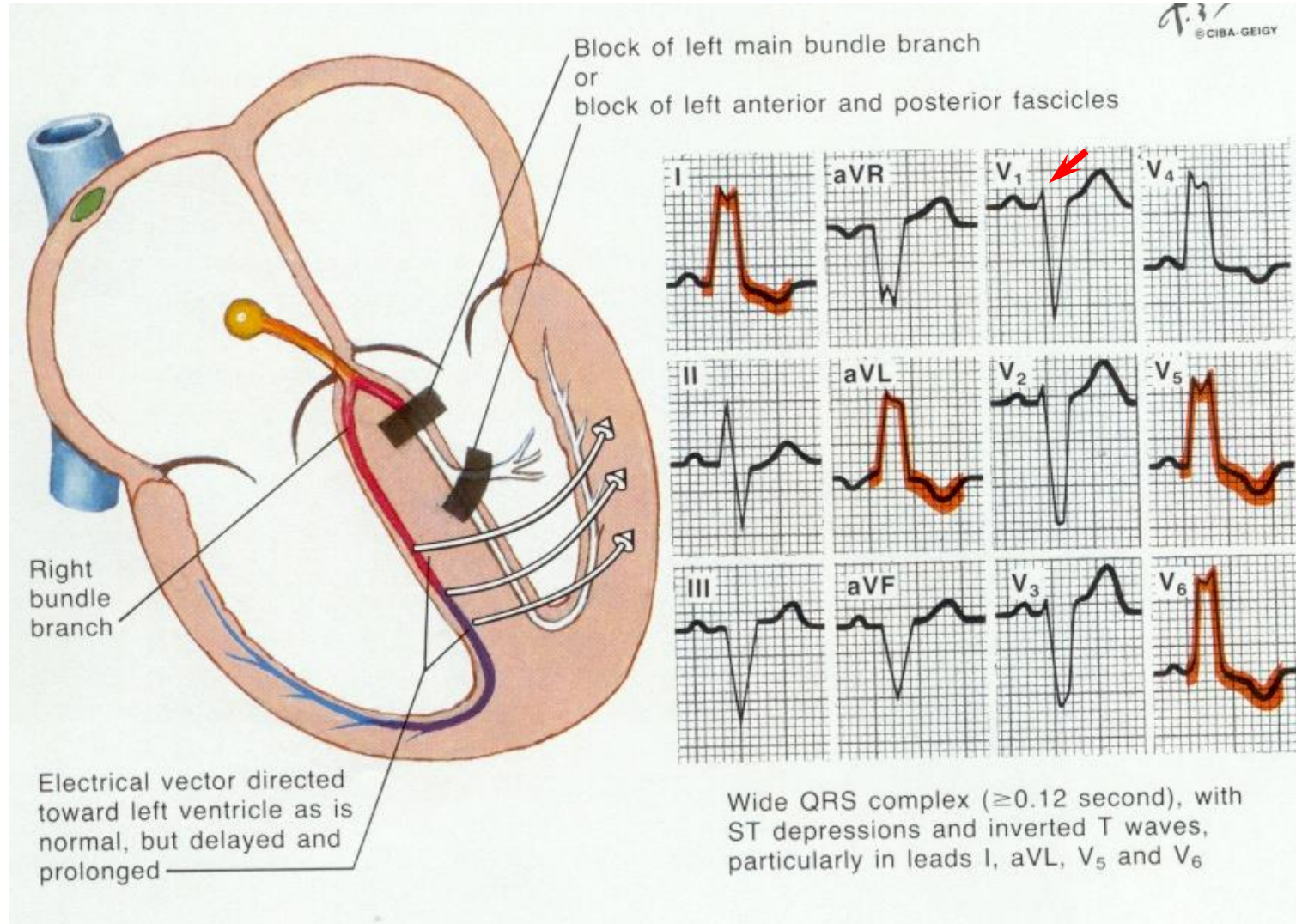
Exercise



TYPICAL RIGHT BUNDLE BRANCH BLOCK



TYPICAL LEFT BUNDLE BRANCH BLOCK



REVIEW ARTICLE

| Originally Published 6 November 2018 | 

 Check for updates

2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients With Bradycardia and Cardiac Conduction Delay: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines, and the Heart Rhythm Society

Fred M. Kusumoto, MD, FACC, FAHA, FHRS, Chair, Mark H. Schoenfeld, MD, FACC, FAHA, FHRS, Vice Chair, Coletta Barrett, RN, FAHA, James R. Edgerton, MD, FACC, FHRS, Kenneth A. Ellenbogen, MD, FACC, FAHA, FHRS, Michael R. Gold, MD, PhD, FACC, Nora F. Goldschlager, MD, FACC, FAHA, FHRS, Robert M. Hamilton, MD, José A. Joglar, MD, FACC, FAHA, FHRS, Robert J. Kim, MD, Richard Lee, MD, MBA, Joseph E. Marine, MD, MBA, FACC, FHRS, Christopher J. McLeod, MB, ChB, PhD, FACC, FAHA, FHRS, Keith R. Oken, MD, FACC, Kristen K. Patton, MD, FACC, FAHA, FHRS, Cara N. Pellegrini, MD, FHRS, Kimberly A. Selzman, MD, MPH, FACC, FHRS, Annemarie Thompson, MD, and Paul D. Varosy, MD, FACC, FAHA, FHRS [SHOW FEWER](#) | [AUTHOR INFO & AFFILIATIONS](#)

CAUSES OF BRADYCARDIA

- Sinus Bradycardia/Arrest
 - Hypoxia – pulmonary disease, sleep apnea
 - Electrolytes – Acidosis, hyperkalemia, hypermagnesemia
 - Increased vagal tone – pain, nausea, sleep apnea
 - Medication toxicity – CCB, BB
 - Trama – spinal cord injury, traumatic brain injury, cardiac contusion
- AV block
 - Medication toxicity – BB, CCB, clonidine, dig, amio
 - Increased vagal tone – pain, nausea, sleep apnea
 - Fibrosis of the conduction system
 - Acute MI – inferior > anterior
 - Infiltrative cardiomyopathy



ACUTE MANAGEMENT OF BRADYCARDIA

- Sinus bradycardia/arrest
 - Reverse cause if possible (ie, improve hypoxemia)
 - Trial of atropine 0.3-1.2 mg (1 mg vials on crash cart)
 - Consider trial of isoproterenol 1-2 mcg/min
 - Glucagon for BB overdose
 - Calcium for CCB or BB overdose
 - Temporary/permanent pacing

ACUTE MANAGEMENT OF BRADYCARDIA

- AV Block
 - Remove any offending causes if possible
 - Do not use atropine unless AV block is in the setting of an inferior MI
 - Glucagon for BB overdose
 - Calcium for CCB or BB overdose
 - Second degree block
 - Consider isoproterenol for Mobitz I
 - Acute symptoms/HD instability -> temporary pacing
 - Otherwise, conservative management
 - Complete heart block,
 - Acute symptoms/HD instability -> temporary pacing
 - Wide QRS, slow escape rhythm -> usually require pacing
 - Narrow QRS, escape >40, asx -> can usually manage conservatively until permanent pacemaker can be implanted or drug washes out

INDICATIONS FOR TEMPORARY PACING

- Important (i.e., hemodynamically significant or symptomatic) bradycardia due to conduction tissue disease or medication toxicity/overdose
- Acute Anterior MI
 - Complete AV block
 - Second degree AV block
 - Trifascicular block
 - LBBB acquired during present MI
- Acute Inferior MI – any of the above if hemodynamically significant (try atropine first)



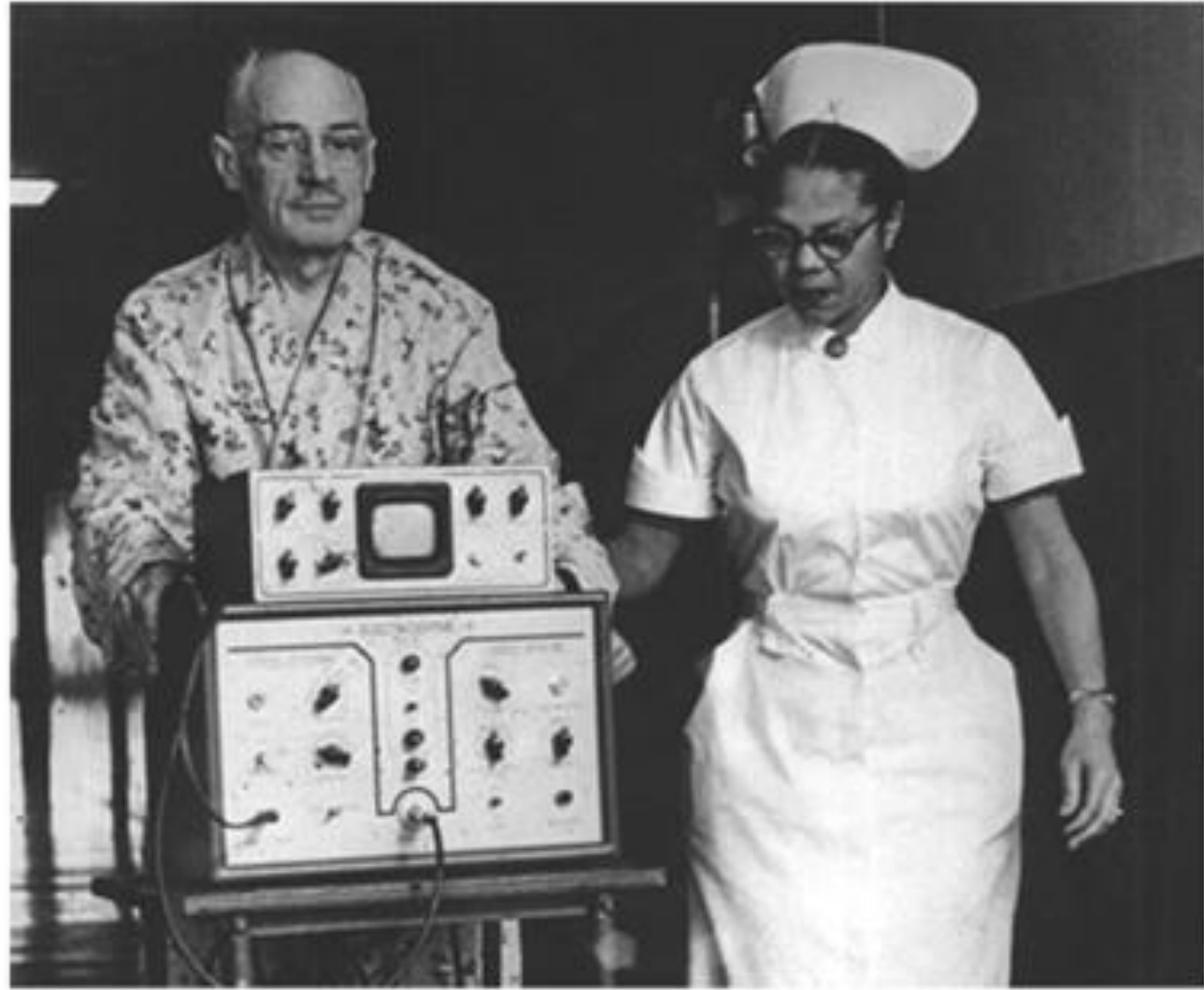
OUTPATIENT EVALUATION OF BRADYCARDIA

- Ambulatory Monitoring
 - Holter monitor
 - Event monitor
 - Implantable loop recorder
 - Smartphone based tool – AppleWatch, KardiaMobile, etc
- Echocardiogram – if symptoms or AV block
- Exercise testing
- Sleep apnea evaluation (especially for nocturnal bradycardia)
- Electrophysiology testing (rare)

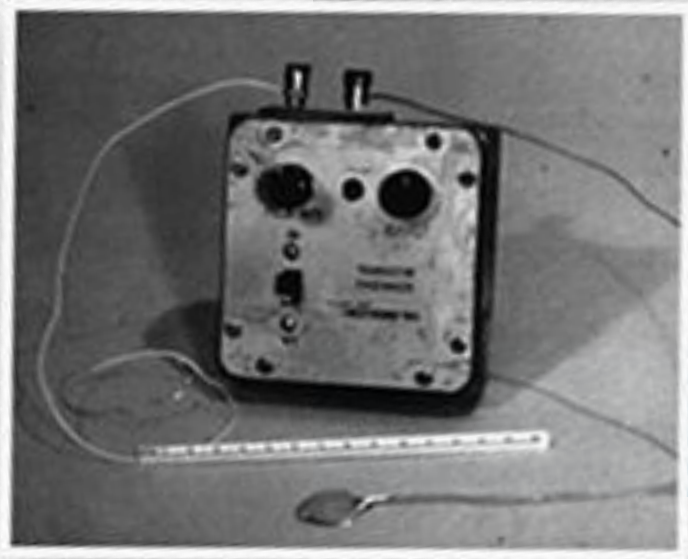


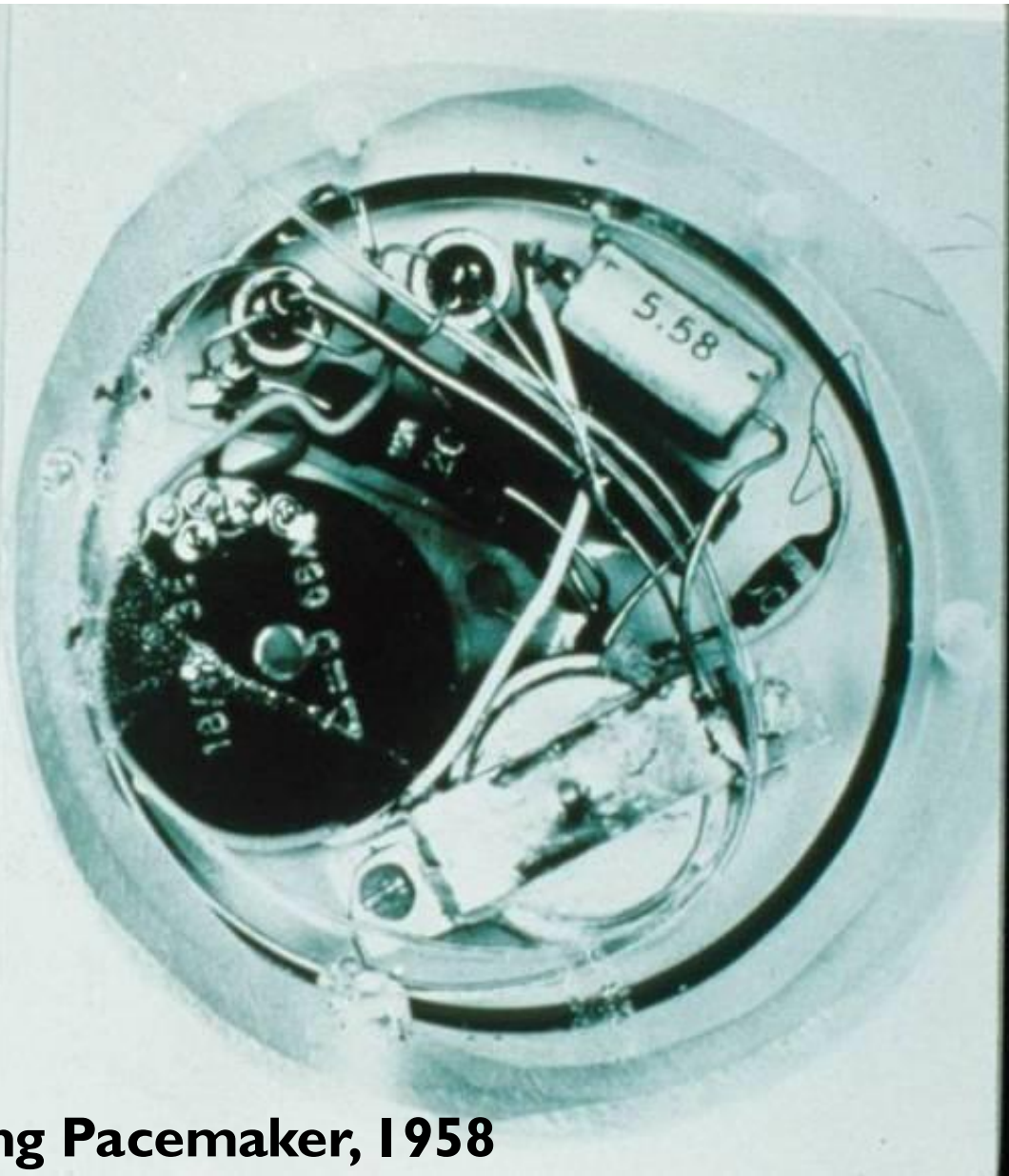
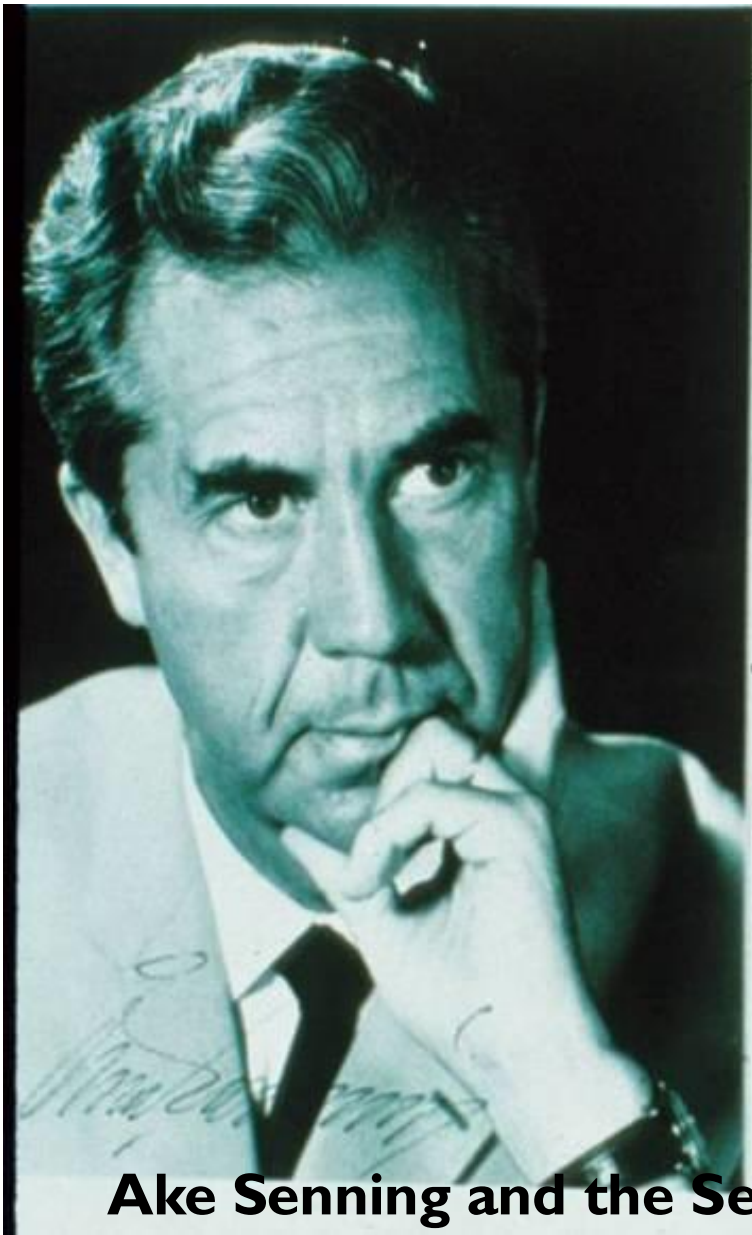
OUTPATIENT MANAGEMENT OF BRADYCARDIA

- Remove cause if possible (medications, sleep apnea, hypothyroidism, etc)
- Permanent pacing
 - Mobitz type II or third degree AV block
 - Symptomatic bradycardia
- Medical Therapy
 - Can try theophylline when pacing not available

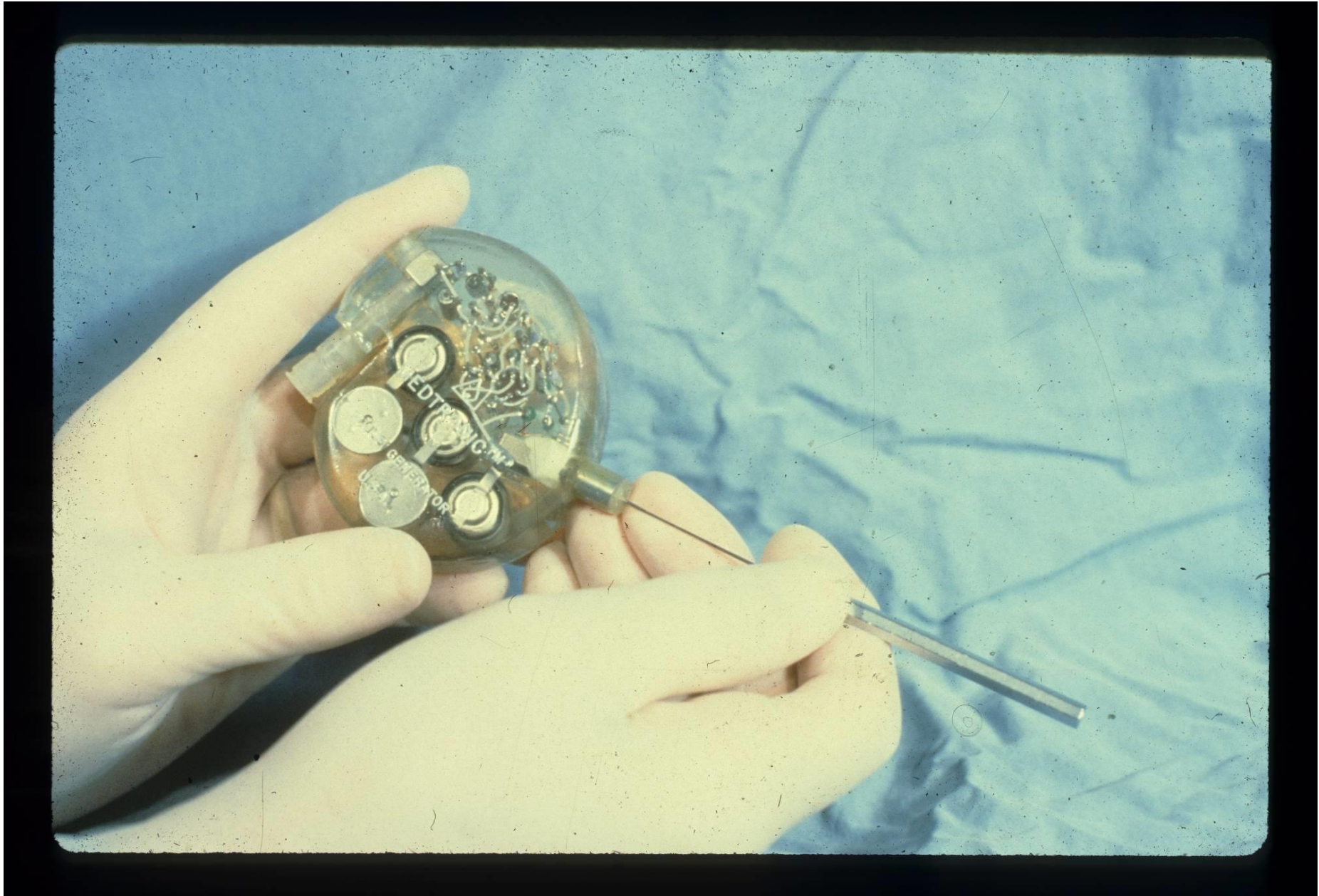


1957





Ake Senning and the Senning Pacemaker, 1958



Pacemakers (1957-2009)



5800

First External Pacemaker



5858

Pediatric Asynchronous Pulse Generator



Activitrax®

Rate response



MicroMinix®

Radically smaller size



Thera®

First Microprocessor-based, Mode switching



EnPulse®

Full automaticity



First Implantable Pacemaker

Chardack-Greatbatch



Dual chamber rate response

Byrel®



Synergist™



Rate response via activity & minute ventilation

Elite™



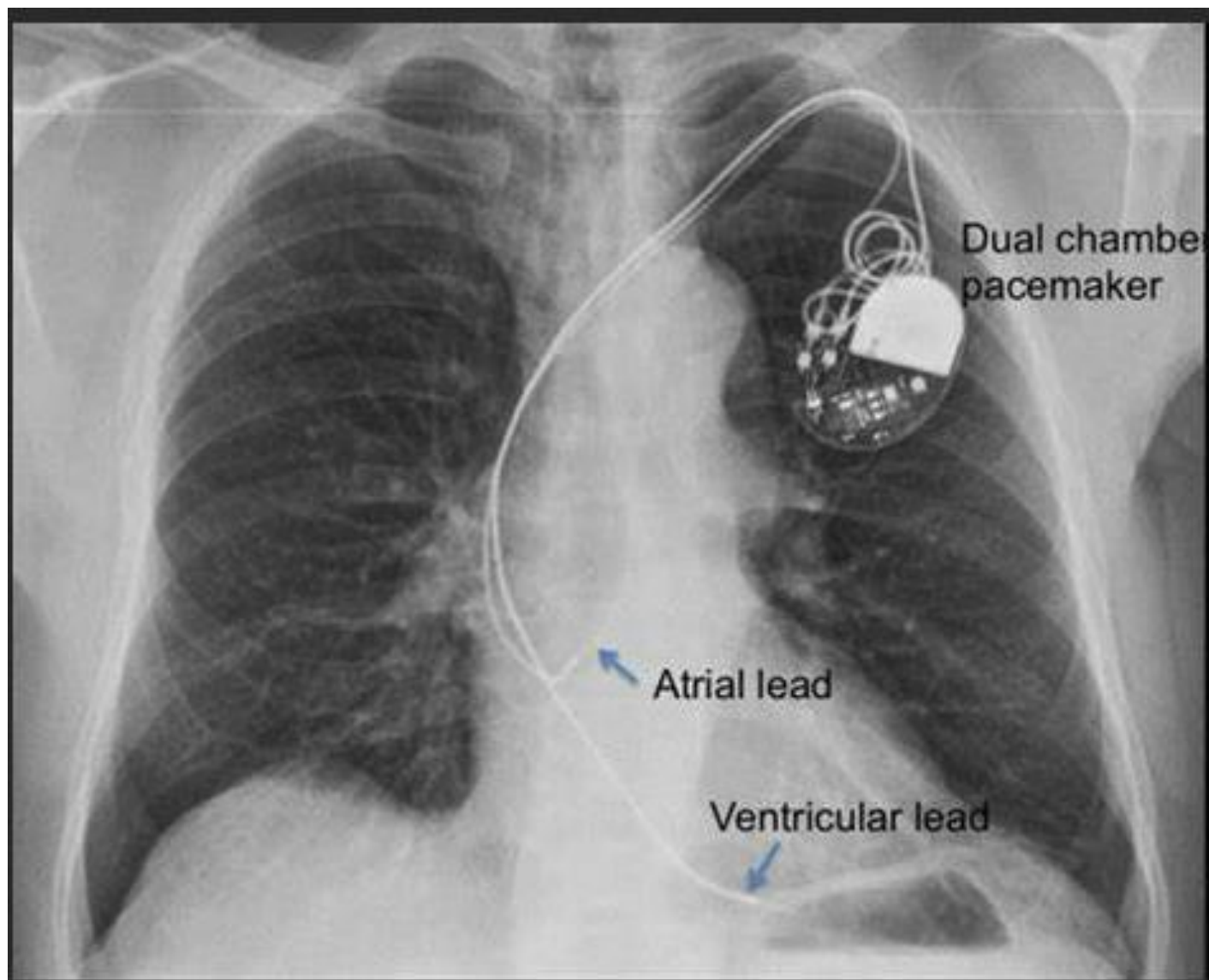
Kappa®



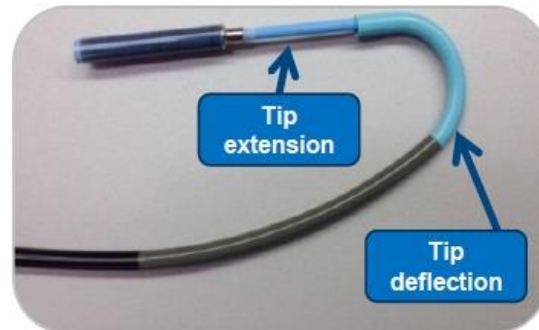
MVP, Full automaticity

Adapta™

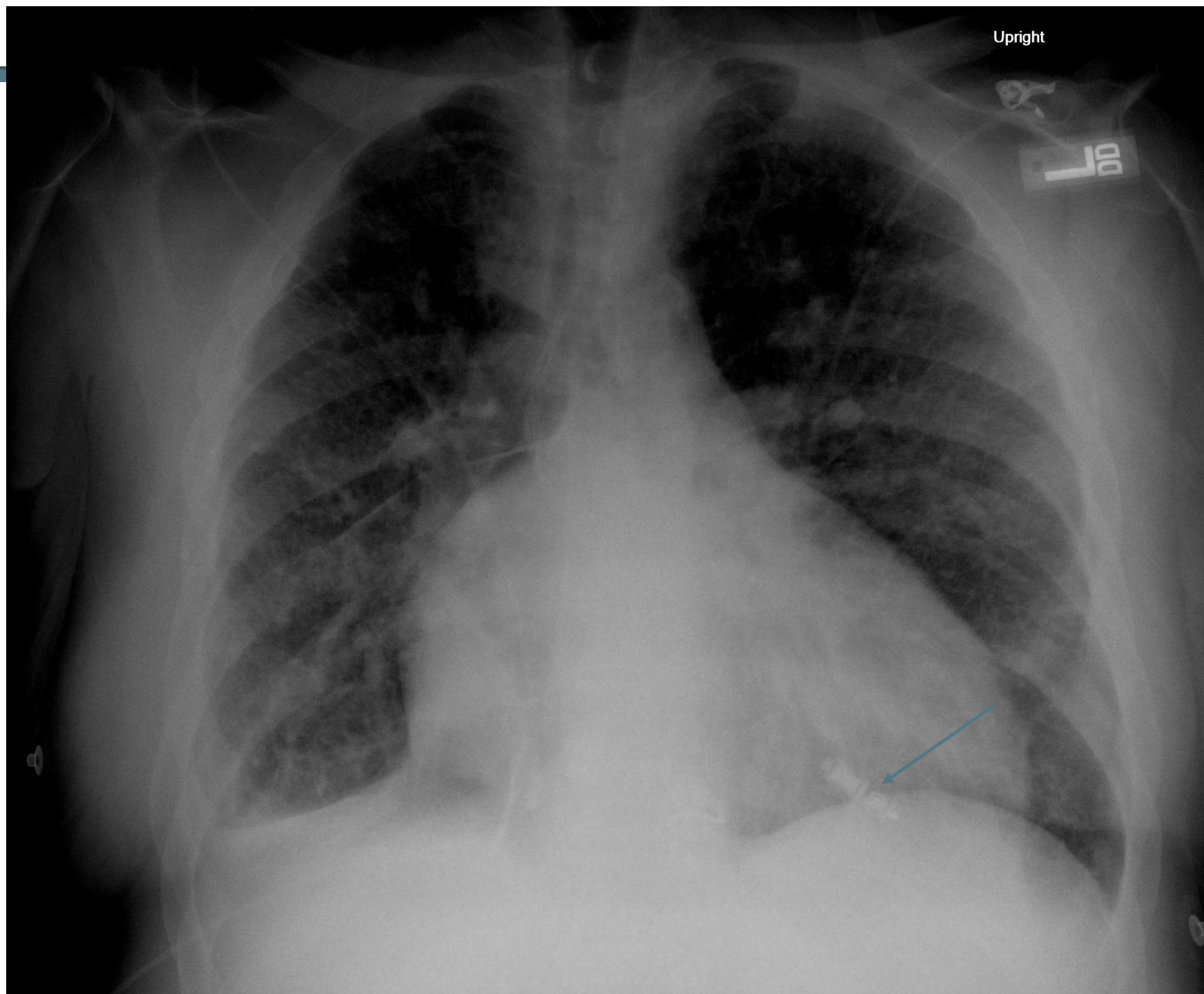




LEADLESS PACEMAKERS



Upright





SUMMARY

- Knowing the parts of the conduction system will help with diagnosis and management of abnormalities
- Treat/remove any reversible causes of bradycardia and heart block
- Acutely, medical therapy can help to reverse bradycardia
- Pacemaker implantation is indicated for
 - Non-reversible symptomatic bradycardia
 - Non-reversible Mobitz 2 second degree AV block or third degree AV block with or without symptoms

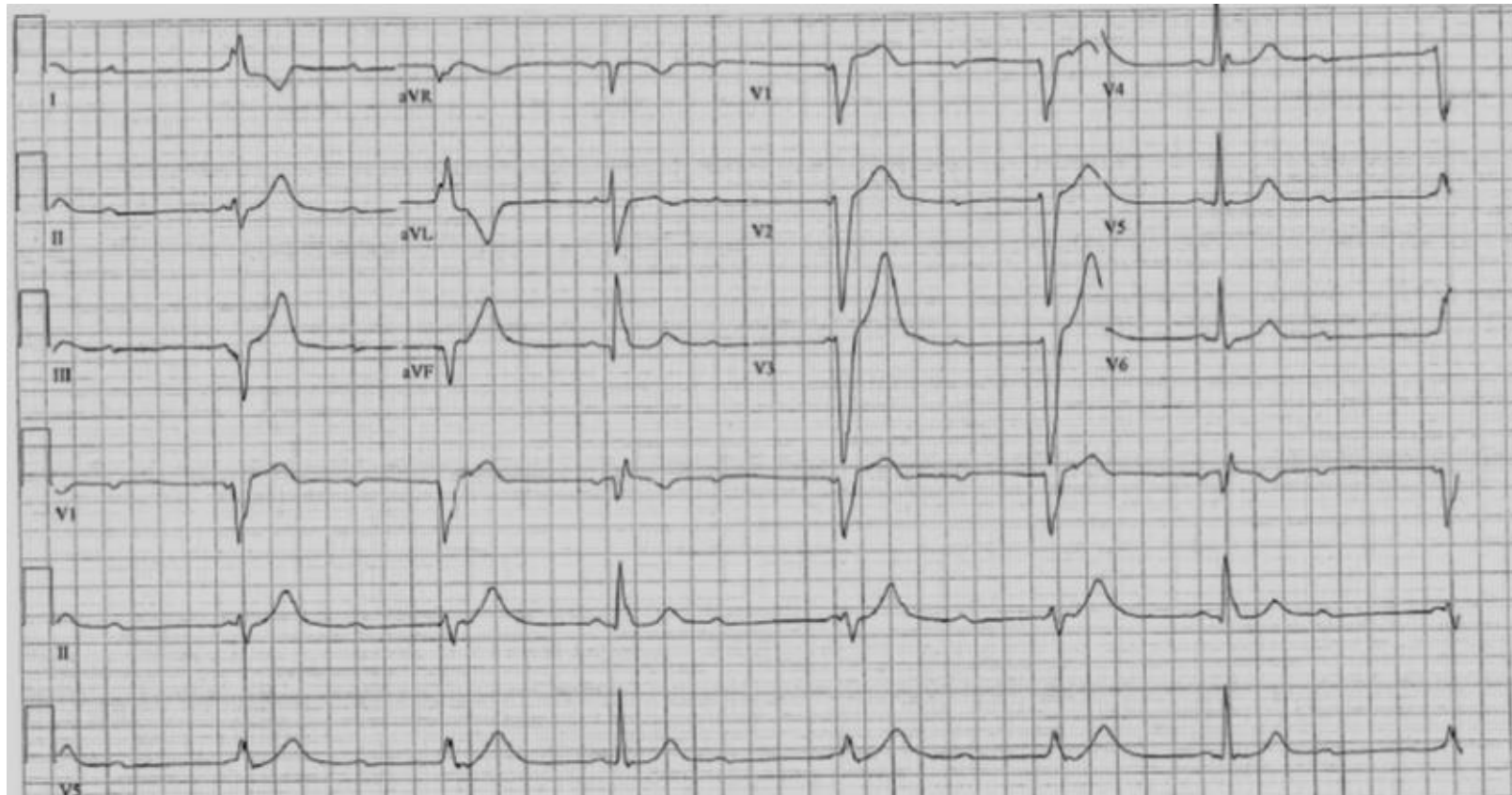
QUESTION 1

65 year old man with hypertension, diabetes, hyperlipidemia, and obesity is admitted to the hospital with typical exertional chest pain. Review of systems is positive for moderate fatigue with exertion, mild LEE, daytime somnolence, snoring, occasional dizziness with standing, constipation, and easy bruising. He denies syncope, or palpitations. Admission physical exam shows an obese male in no acute distress, but is otherwise unremarkable. ECG shows sinus bradycardia, normal PR, normal QRS, normal QT interval, no ST-T wave changes. Overnight, a rapid response is activated because of 5-6 second pauses noted on telemetry. After being awakened, the patient denies any symptoms. The most appropriate next step is:

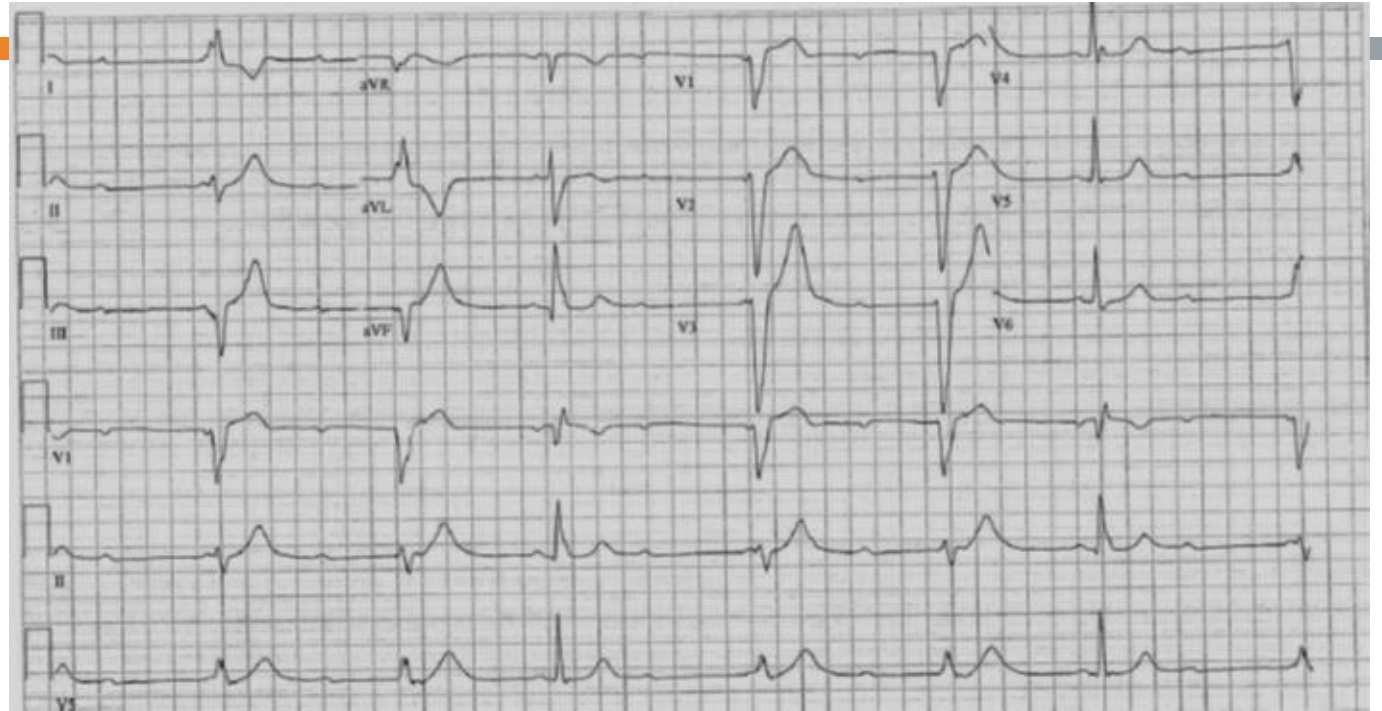
- A. Temporary pacemaker
- B. Permanent pacemaker
- C. Exercise tolerance test
- D. Cardiac cath
- E. Start metoprolol succinate 200 mg daily

CASE 5

- 78 yo woman with CAD, hypertension, who presents with multiple episodes of syncope. On exam she appears a bit lethargic but is easily arousable and has ecchymosis over her right cheek. Her heart rate is 38 beats per minute, but the rest of the physical exam is unremarkable. Her ECG is shown below:



QUESTION 2



Which of the following is the most appropriate next step?

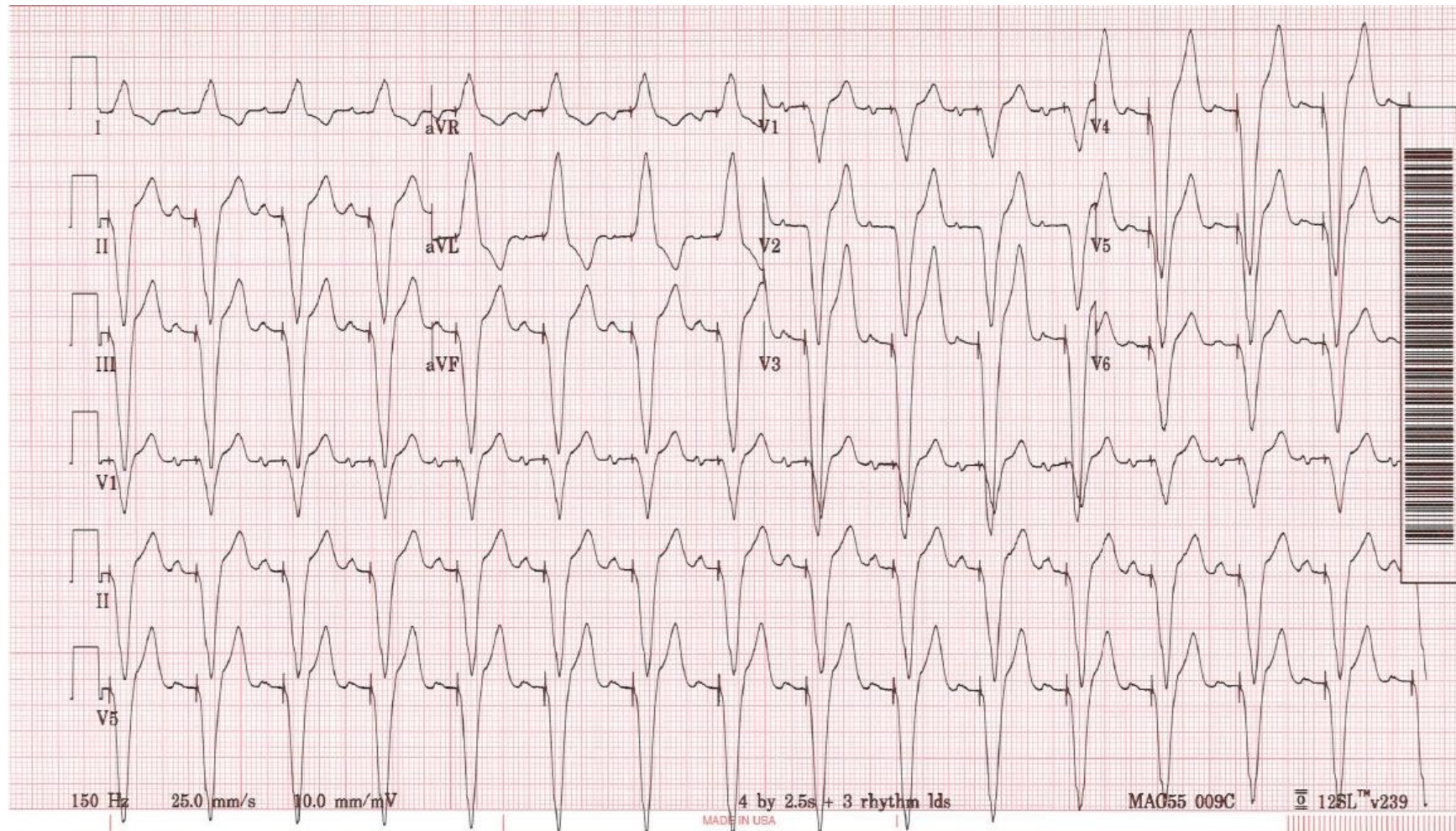
- A. Place transcutaneous pacing pads and send patient to the ICU, consider temporary pacemaker
- B. Exercise tolerance test
- C. Outpatient event monitor
- D. Refer for tilt table evaluation
- E. Cardiac catheterization



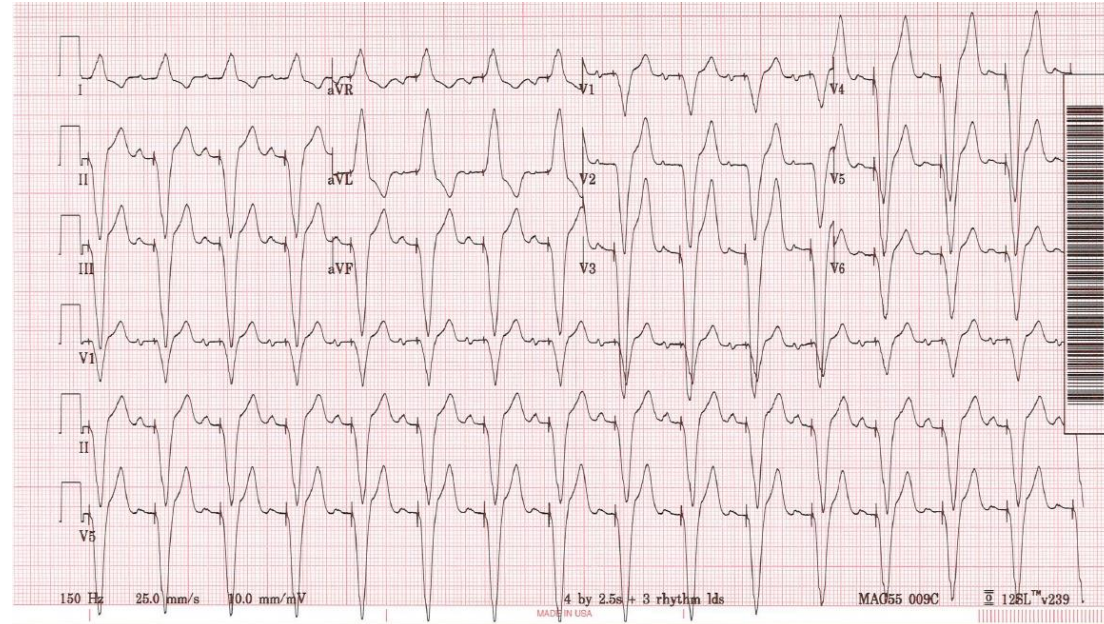
QUESTION 2

A 75 year old man s/p dual chamber pacemaker presents for routine follow up. He complains of orthostatic dizziness upon waking in the morning and actually lost consciousness on one occasion 2 months ago. He denies other syncope, exercise intolerance or chest pain. You obtain the following ECG in the office:

QUESTION 2



QUESTION 2



Which of the following is the most appropriate next step?

- A. Place transcutaneous pacing pads and send patient to the emergency department
- B. Exercise tolerance test
- C. Pacemaker interrogation
- D. Refer for tilt table evaluation
- E. Place magnet over pacemaker and send patient to the emergency department

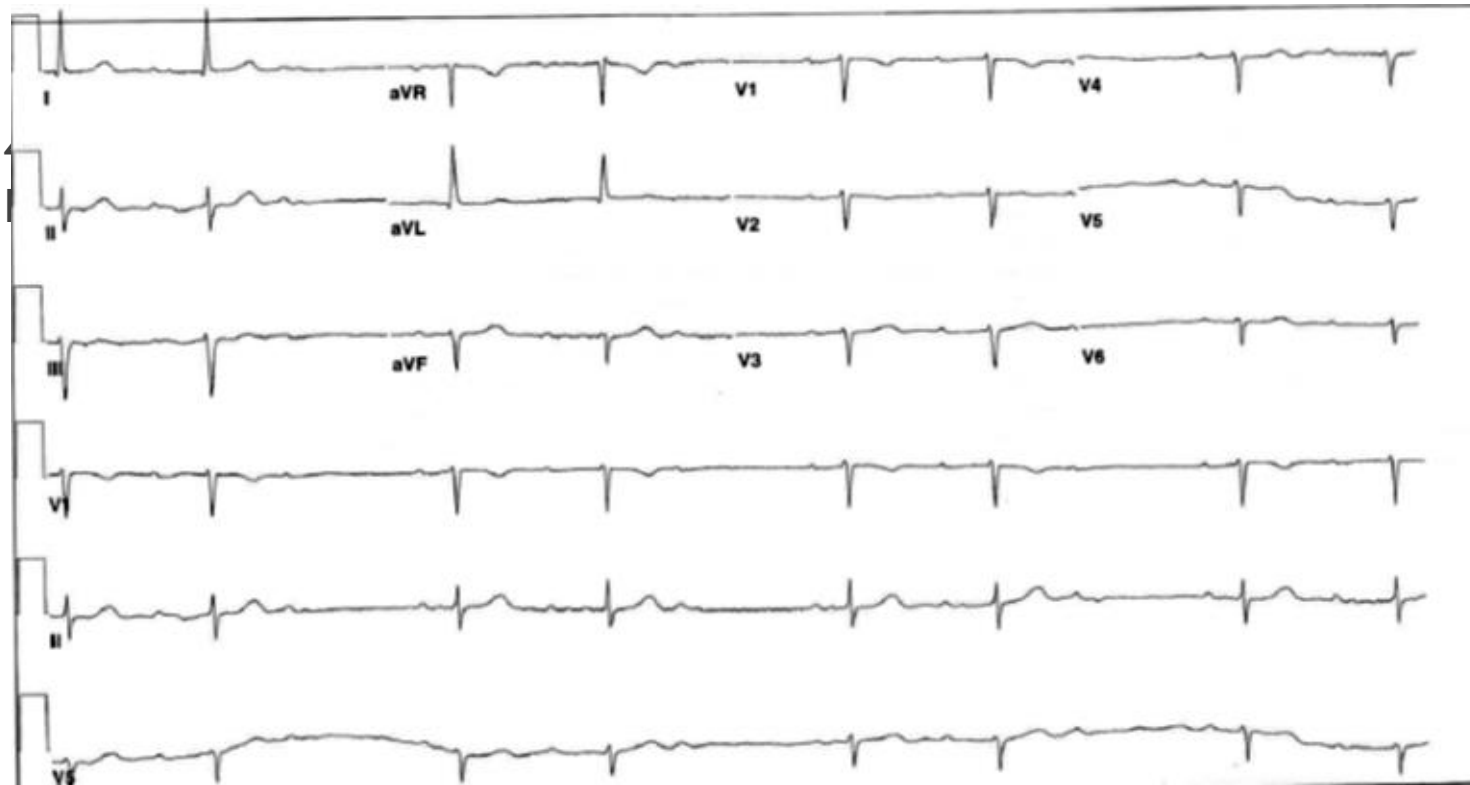


CASE 3

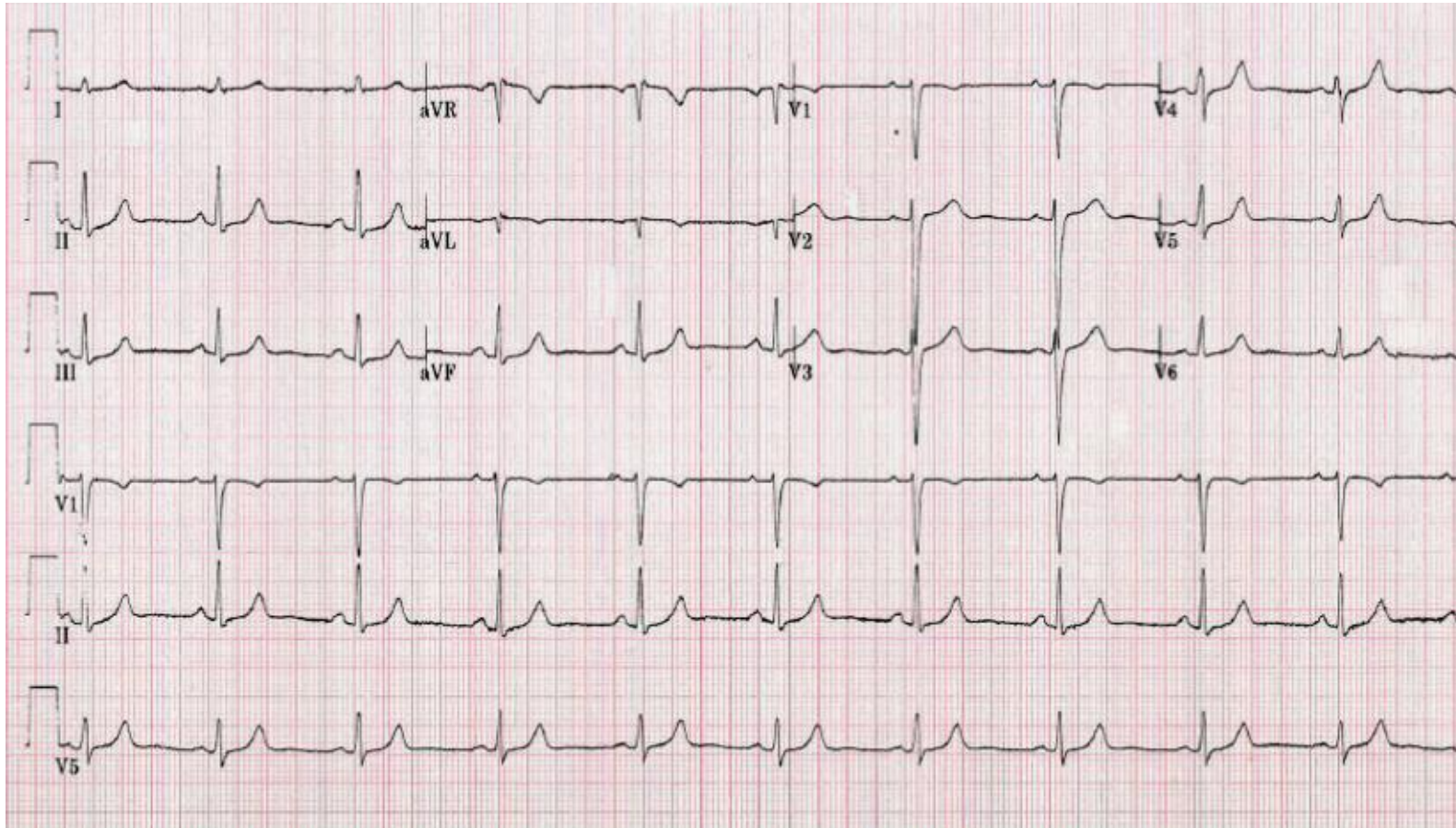
- 26yo medical student, “passes out” while watching an ophthalmology procedure in the OR. No prior h/o syncope, normal exam. No family history of cardiac disease.

CASE 4

40 yo man, avid runner, irregular heart rate noted in doctor's office, "abnormal ECG."



CASE 6 ■ 66yo man with pacemaker for “sick sinus syndrome”.
Is the pacemaker working?



CASE 7

- 55 yo woman with chronic heart failure, pacemaker in place. How is the pacemaker programmed?

