

Bradycardia, pacing

- Bradycardia is defined as any rhythm disorder with a heart rate less than 60 beats per minute. (Typically it will be <50/min)
- Bradycardia can be a normal non-emergent rhythm. For instance, well trained athletes may have a normal heart rate that is less than 60 bpm.

Symptomatic bradycardia

Symptomatic bradycardia exists when the following 3 criteria are present:

- 1.) The heart rate is slow;
- 2.) The patient has symptoms;
- 3.) The symptoms are due to the slow heart rate.

Symptoms

- Syncope
- Dizziness
- Congestive heart failure
- Mental confusion
- Palpitations
- Shortness of breath
- Exercise intolerance

Causes of Conduction Defects

- Coronary Artery Disease
- Idiopathic Degeneration
- Calcification
- Endocarditis
- Heart Surgery
- RF Ablation



Diagnosis

- Electrocardiogram (ECG)
- Exercise ECG or stress test
- Holter monitor (24 to 72 hour ECG)
- Tilt table test
- Electrophysiology (EP) study:
 - External loop recorder
 - Insertable loop recorder



BUDOUCNOST - MONITORY



Objemově 1/9

Životnost 3 roky

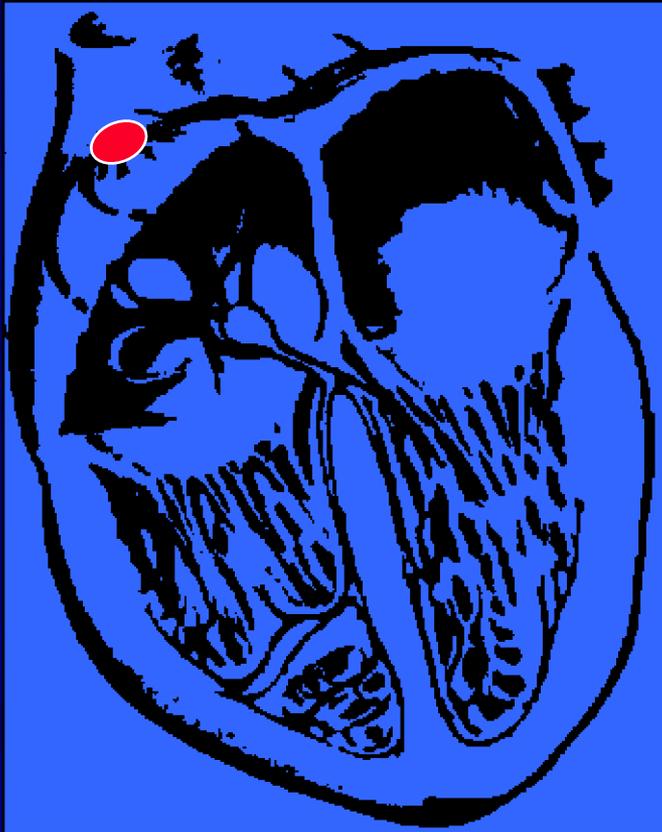
MRI kompatibilní

Insertable Reveal XT

Injectable Reveal



Sinus Node Dysfunction

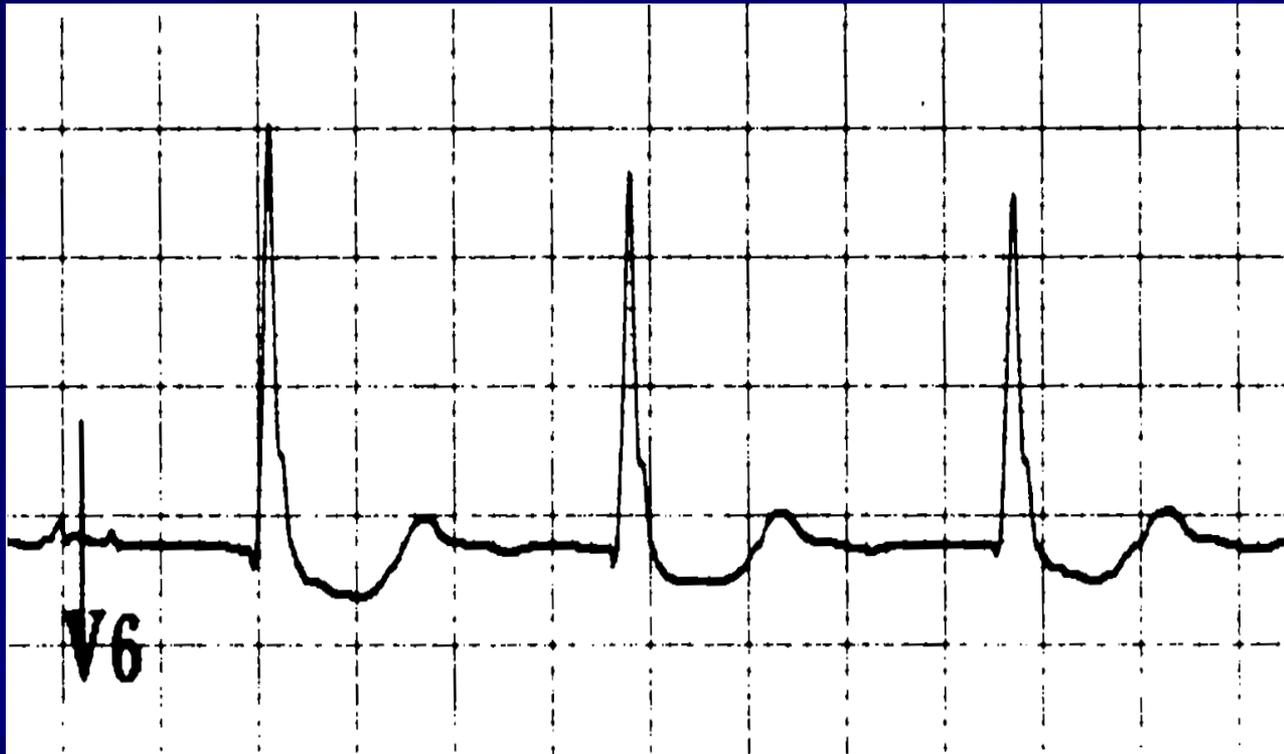


- Sinus bradycardia
- Sinus arrest
- SA block
- Brady-tachy syndrome
- Chronotropic incompetence

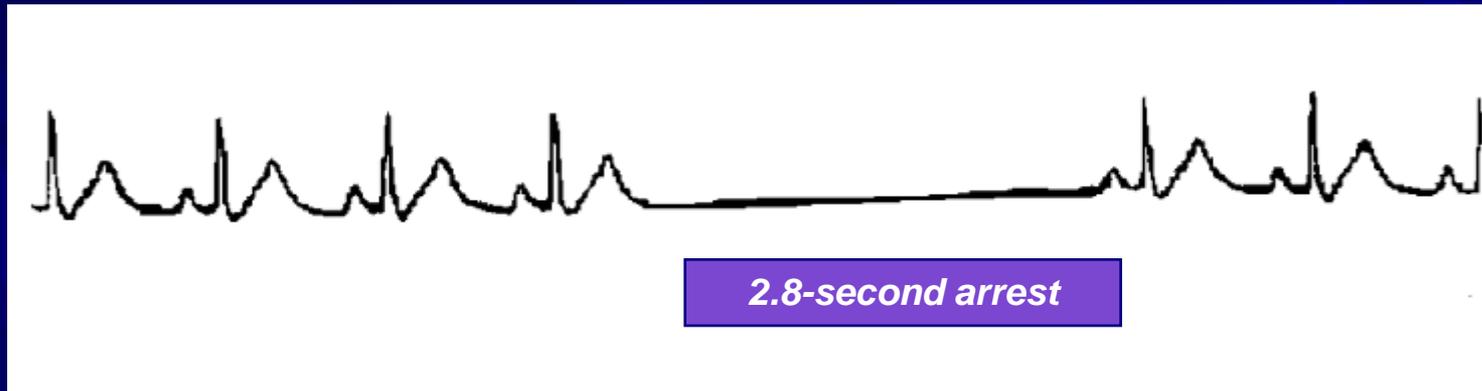
Sinus bradycardia--etiologies

- often seen as a normal variation in athletes, during sleep, or in response to a vagal maneuver. If the bradycardia becomes slower than the SA node pacemaker, a **junctional rhythm** may occur.
- 15-25% Acute MI, esp. affecting inferior wall
- Hypothyroidism, infiltrative diseases (sarcoid, amyloid, hyperkalemia)
- Drugs: beta-blockers, digitalis, calcium channel blockers, amiodarone, cimetidine, lithium

Digoxin Effect



Sinus Node Dysfunction – Sinus Arrest



- Failure of sinus node discharge resulting in the absence of atrial depolarization and periods of ventricular asystole
 - Rate = 75 bpm
 - PR interval = 180 ms (.18 seconds)
 - 2.8-second arrest

Sinus Node Dysfunction – Bradycardia-Tachycardia (Brady-Tachy) Syndrome



- Intermittent episodes of slow and fast rates from the SA node or atria
 - Rate during bradycardia = 43 bpm
 - Rate during tachycardia = 130 bpm

BED-003

-- Full Disclosure Zoom

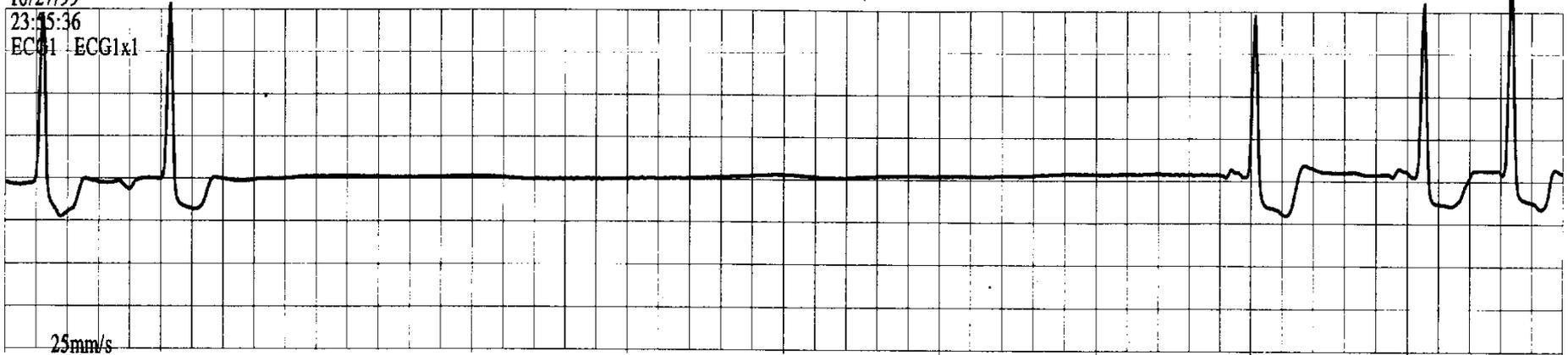
Benankova

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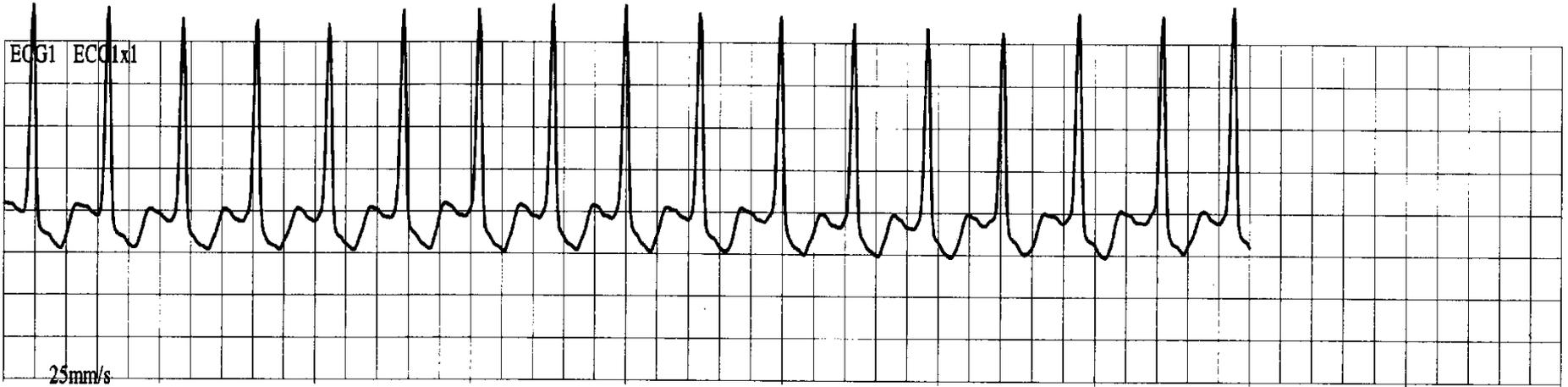
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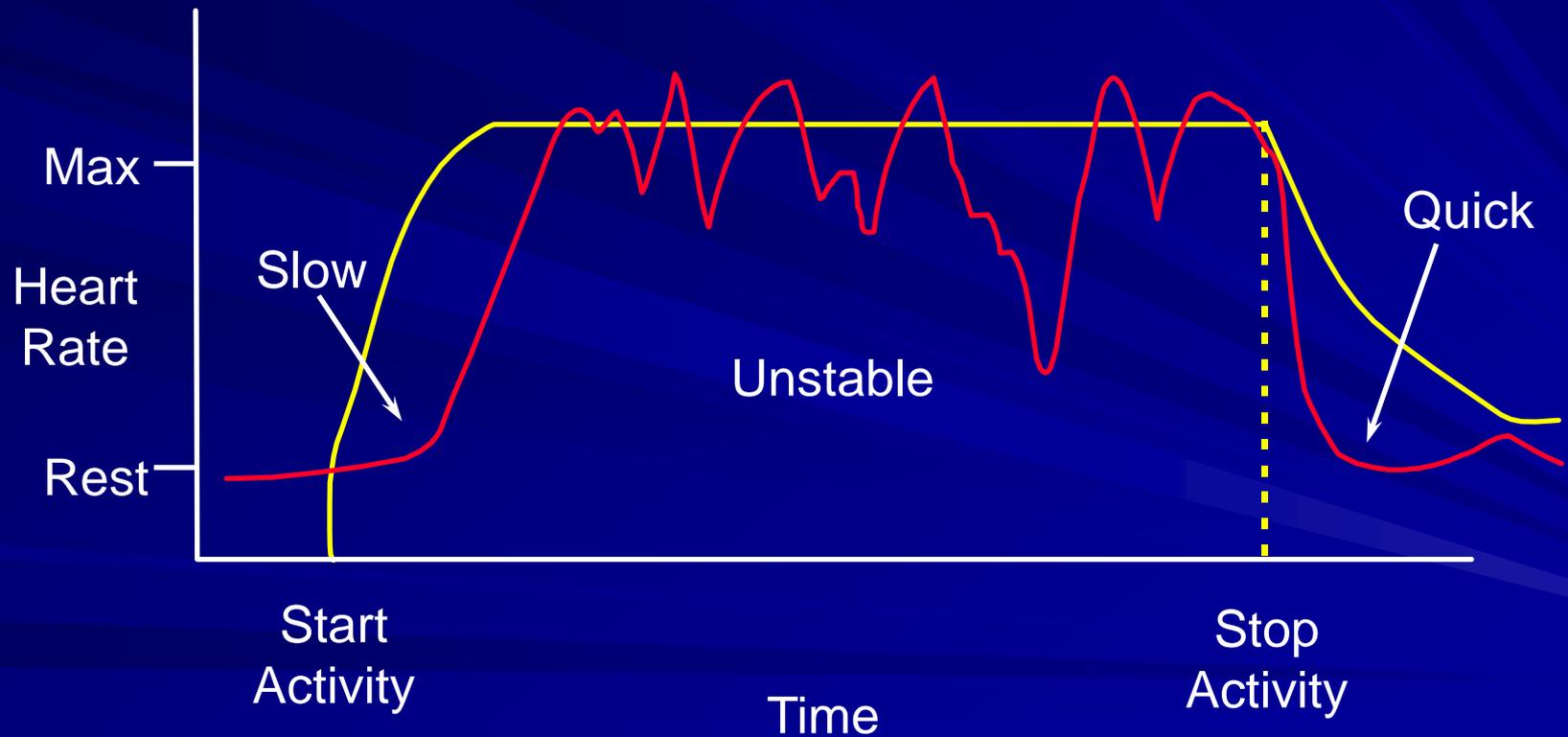
25mm/s

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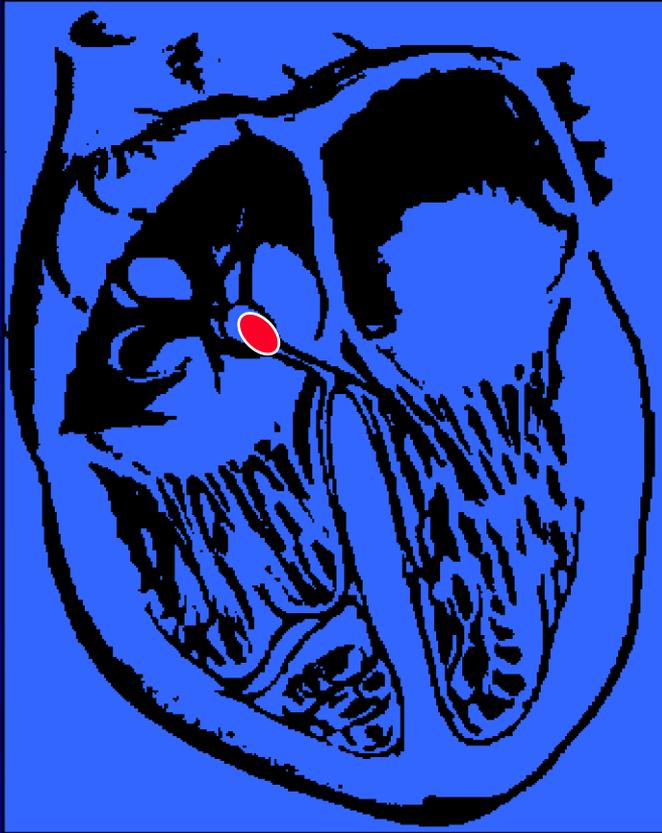
Chronotropic Incompetence



Sick Sinus Syndrome--etiology

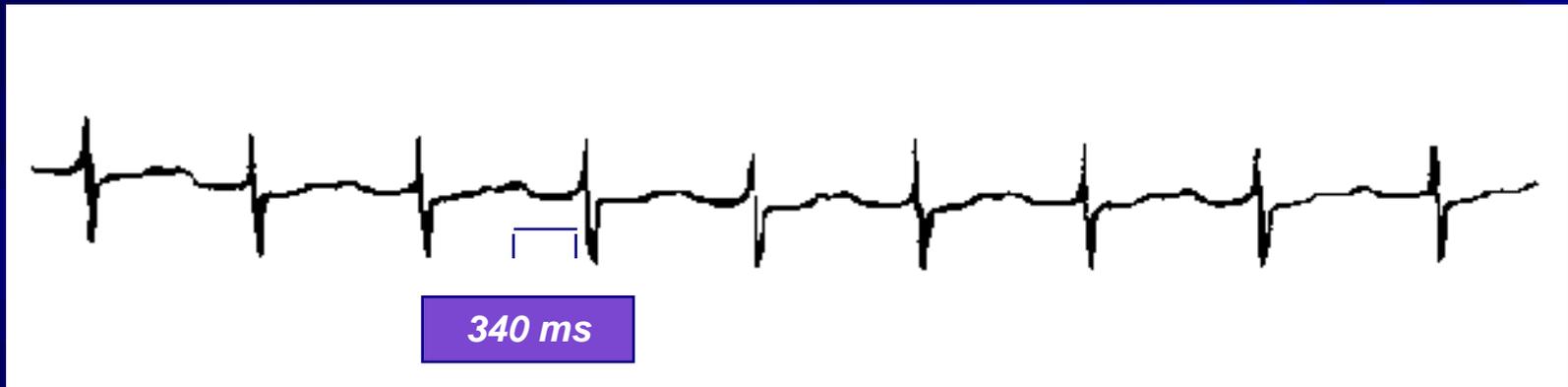
- Often due to sinus node fibrosis, SNode arterial atherosclerosis, inflammation (Rheumatic fever, amyloid, sarcoid)
- Occurs in congenital and acquired heart disease and after surgery
- Hypothyroidism, hypothermia
- Drugs: digitalis, lithium, cimetidine, methyldopa, reserpine, clonidine, amiodarone
- Most patients are elderly, may or may not have symptoms

AV Block



- First-degree AV block
- Second-degree AV block
 - Mobitz types I and II
- Third-degree AV block
- Bifascicular and trifascicular block

First-Degree AV Block



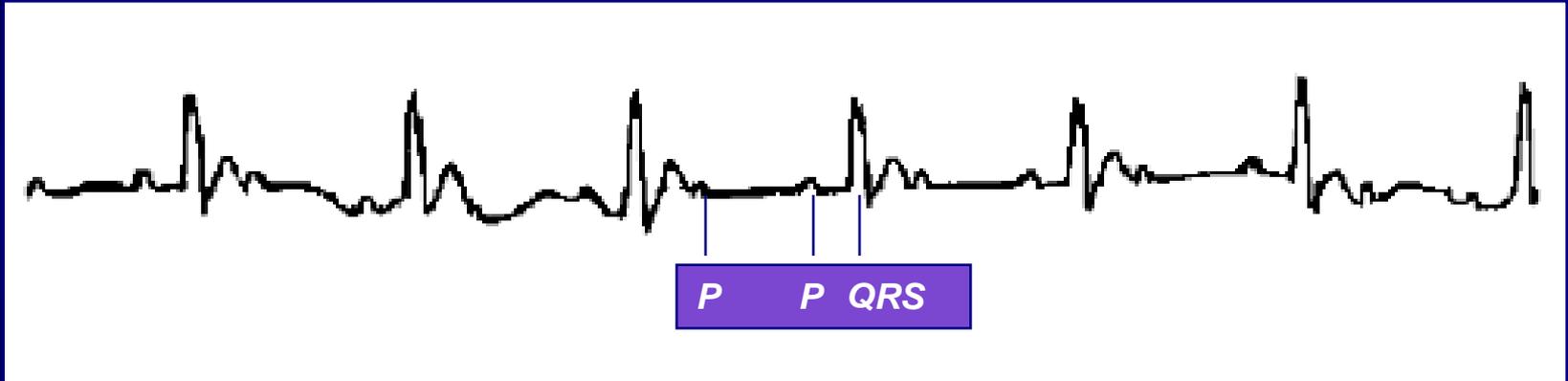
- AV conduction is delayed, and the PR interval is prolonged (> 200 ms or .2 seconds)
 - Rate = 79 bpm
 - PR interval = 340 ms (.34 seconds)

Second-Degree AV Block – Mobitz I (Wenckebach)



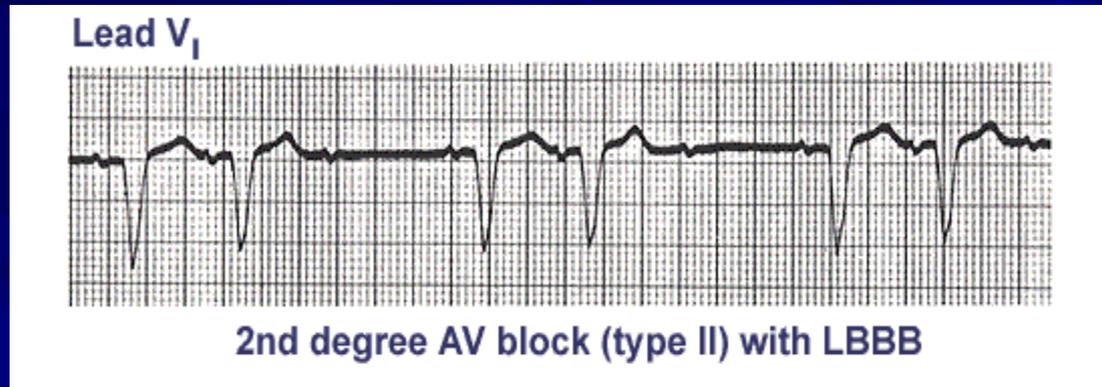
- Progressive prolongation of the PR interval until a ventricular beat is dropped
 - Ventricular rate = irregular
 - Atrial rate = 90 bpm
 - PR interval = progressively longer until a P-wave fails to conduct

Second-Degree AV Block – Mobitz II



- Regularly dropped ventricular beats
 - 2:1 block (2 P waves to 1 QRS complex)
 - Ventricular rate = 60 bpm
 - Atrial rate = 110 bpm

2nd degree block Type II (Mobitz 2)



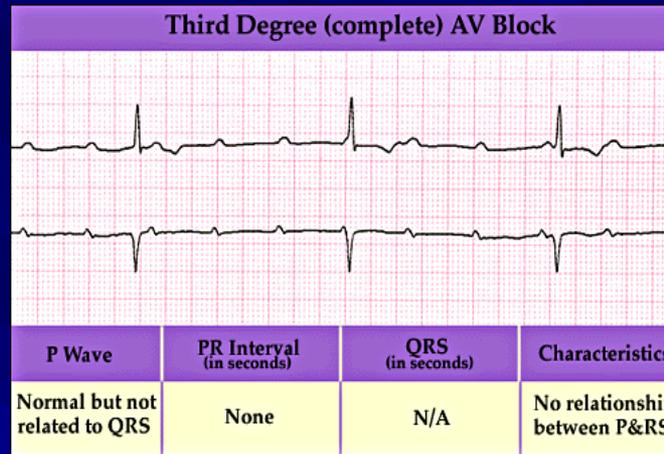
- Normal PR intervals with sudden failure of a p wave to conduct
- Usually below AV node and accompanied by BBB or fascicular block
- Often causes pre/syncope; exercise worsens sx
- Generally need pacing, possibly urgently if symptomatic

Third-Degree AV Block



- No impulse conduction from the atria to the ventricles
 - Ventricular rate = 37 bpm
 - Atrial rate = 130 bpm
 - PR interval = variable

3rd Degree AV Block



- Complete AV disassociation, HR is a ventricular rate
- Will often cause dizziness, syncope, angina, heart failure
- Can degenerate to Vtach and Vfib
- Will need pacing, urgent referral

Hypersensitive Carotid Sinus Syndrome (CSS)

- Extreme reflex response to carotid sinus stimulation
- Results in bradycardia and/or vasodilation
- Can be induced by:
 - Tight collar
 - Shaving
 - Head turning
 - Exercise

Other activities that stimulate the carotid sinus

Bradycardia Pharmacology

- **Atropine:** The first drug of choice for symptomatic bradycardia.
- **Dopamine:** Second-line drug for symptomatic bradycardia when atropine is not effective.
- **Epinephrine:** Can be used as an equal alternative to dopamine when atropine is not effective.

Pacemakers

Pacemakers are the electronic devices that can be used to initiate the heartbeat when the heart's intrinsic electrical system cannot effectively generate a rate adequate to support cardiac output

Pacemaker history

- **First pacemaker implanted in 1958**
- **First ICD implanted in 1980**
- **Greater than 500,000 patients in the US population have pacemakers**
- **115,000 implanted each year**

Types of Pacemaker

- Temporary pacemaker
- Permanent pacemaker

Indications for a temporary pacemaker

■ Acute myocardial infarction with:

- Asystole.
- Symptomatic bradycardia with hypotension not responsive to atropine).
- Bilateral bundle branch block (BBB) (alternating BBB or right bundle branch block (RBBB) with alternating left anterior hemiblock (LAHB)/left posterior hemiblock (LPHB)).

Indications for a temporary pacemaker

■ Acute myocardial infarction with:

- New or indeterminate age bifascicular block with first-degree AV block.
- Mobitz type II second-degree AV block.
- A pacemaker is only indicated in an inferior myocardial infarction if these conduction disturbances are present.

Indications for a temporary pacemaker

- Bradycardia not associated with acute myocardial infarction:
 - Asystole.
 - Second-degree or third-degree AV block with haemodynamic compromise or syncope at rest.
 - Ventricular tachyarrhythmias secondary to bradycardia.

Indications for a temporary pacemaker

- Suppression of drug-resistant ventricular tachyarrhythmia or supraventricular tachycardia.
- Drug overdose, eg digoxin, betablockers, verapamil.

Indications for Pacing

Symptomatology
+ Documented Events
Reliable Indications for
Pacing

Causes of Conduction Defects

- Coronary Artery Disease
- Idiopathic Degeneration
- Calcification
- Endocarditis
- Heart Surgery
- RF Ablation

Summary of Pacemaker Indications

- Sinus node dysfunction
- AV block
- Bifascicular and trifascicular block
- Hypersensitive Carotid Sinus Syndrome (CSS)
- Vasovagal Syncope (VVS)

Transvenous Access

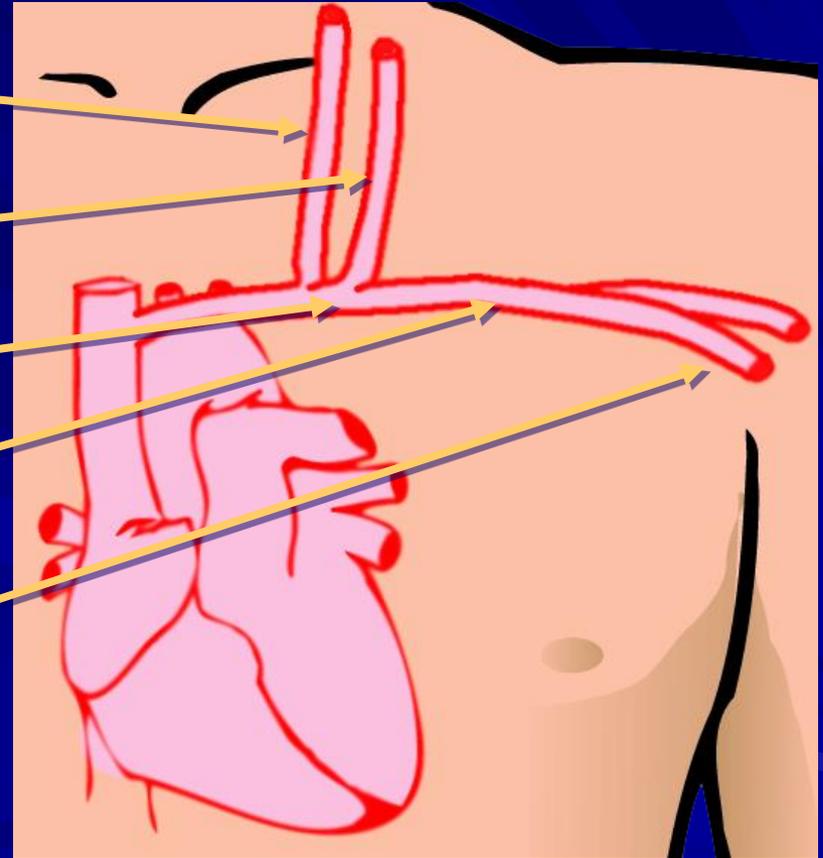
■ Internal Jugular

■ External Jugular

■ Subclavian

■ Axillary

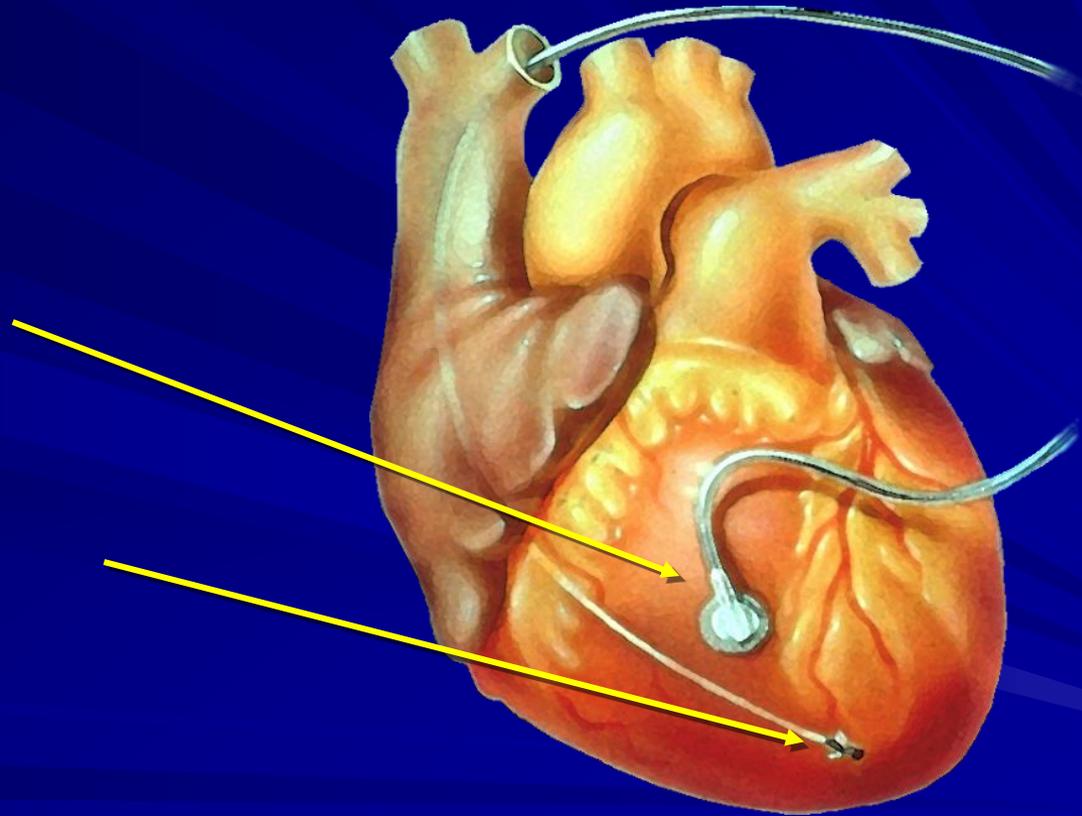
■ Cephalic



elektrody

■ Epicardiální

■ Endocardiální



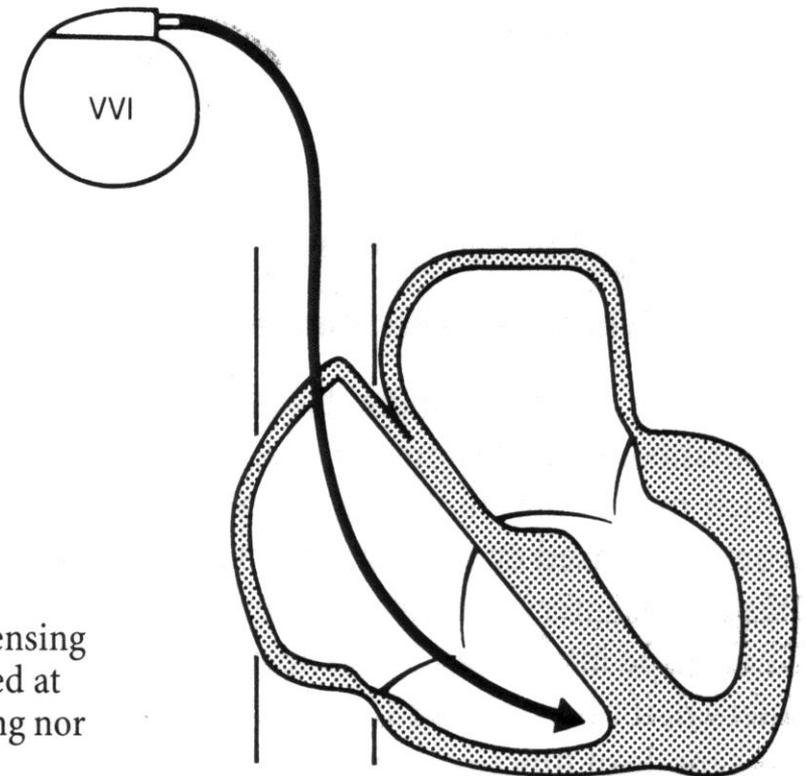
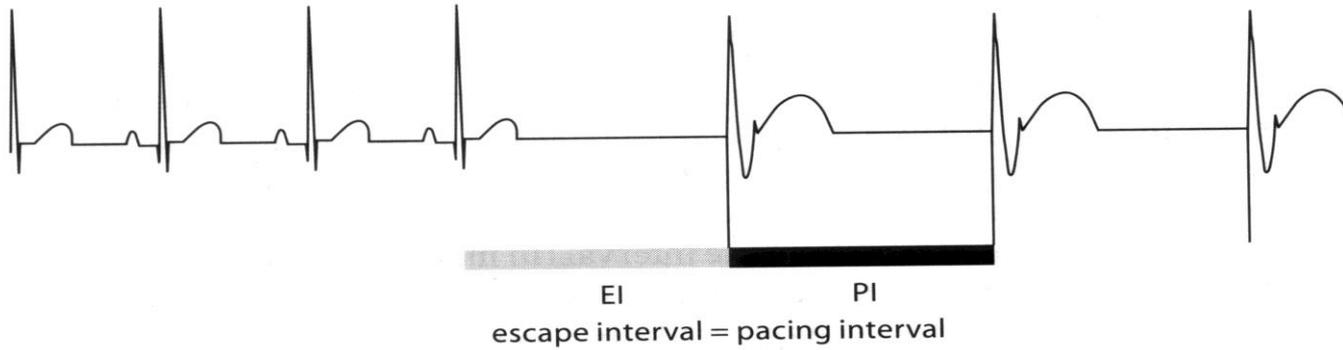


Fig. 3.5. a VVI mode. Pacing and sensing (including of extrasystoles) is limited at the ventricle. There is neither sensing nor pacing in the atrium

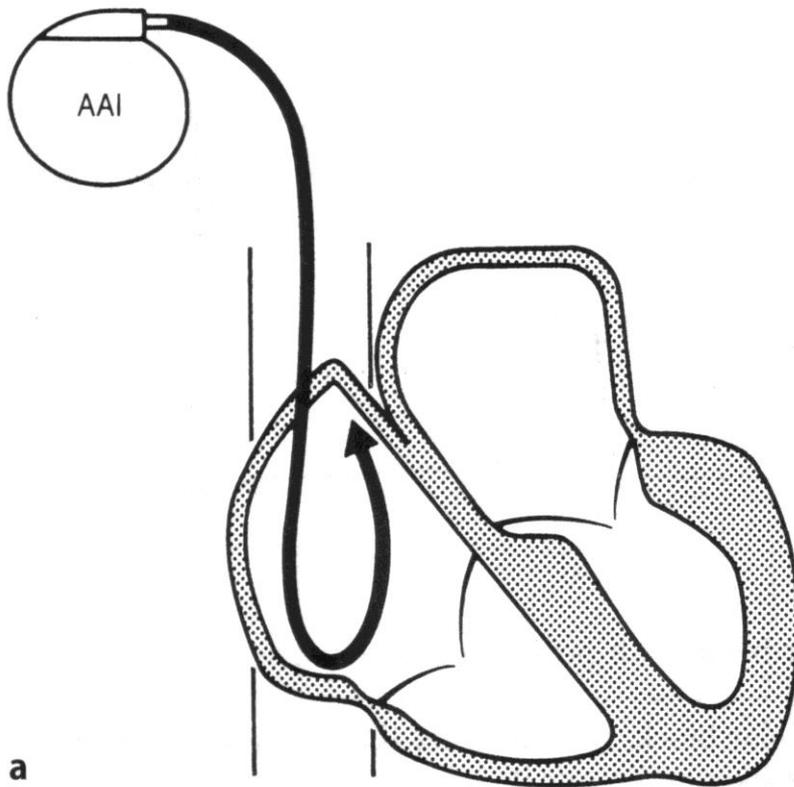


Fig. 3.7. a AAI mode. Pacing and sensing are confined to the atrium

b AAI pacemaker function diagram. When sensing an atrial event before the end of its escape interval, the pacemaker is inhibited and resets that interval. In absence of sensed event, the pacemaker delivers an atrial stimulus at the end of its escape interval. In absence of hysteresis, the escape interval (between a spontaneous event and a paced event) and the pacing interval (between two paced events) are equal

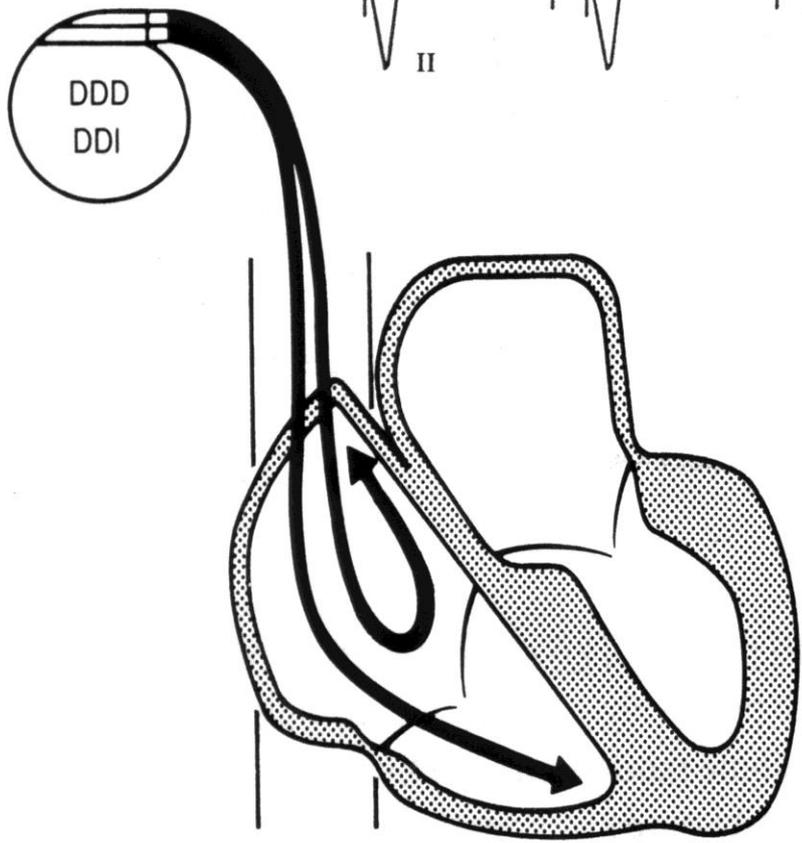
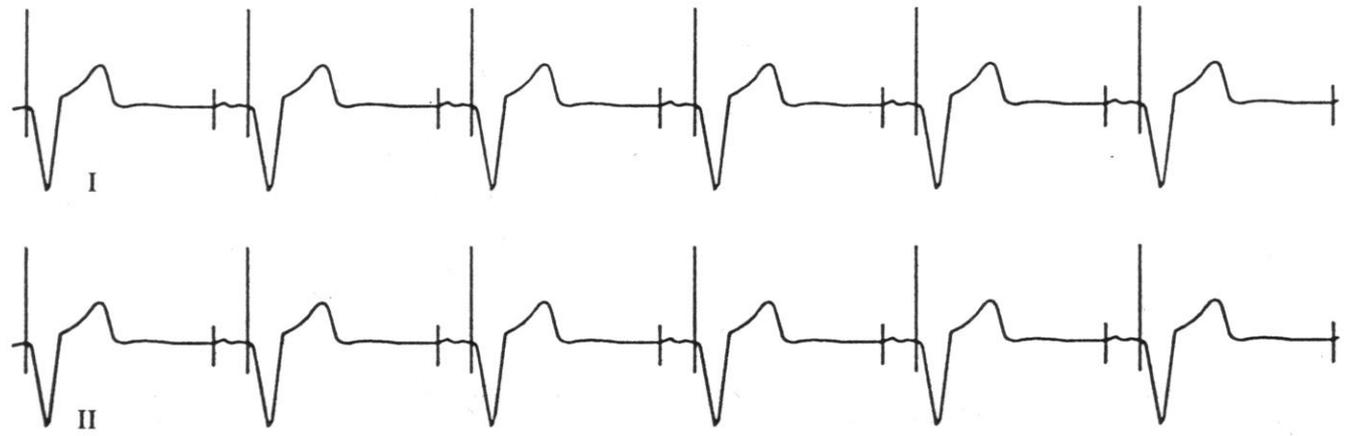
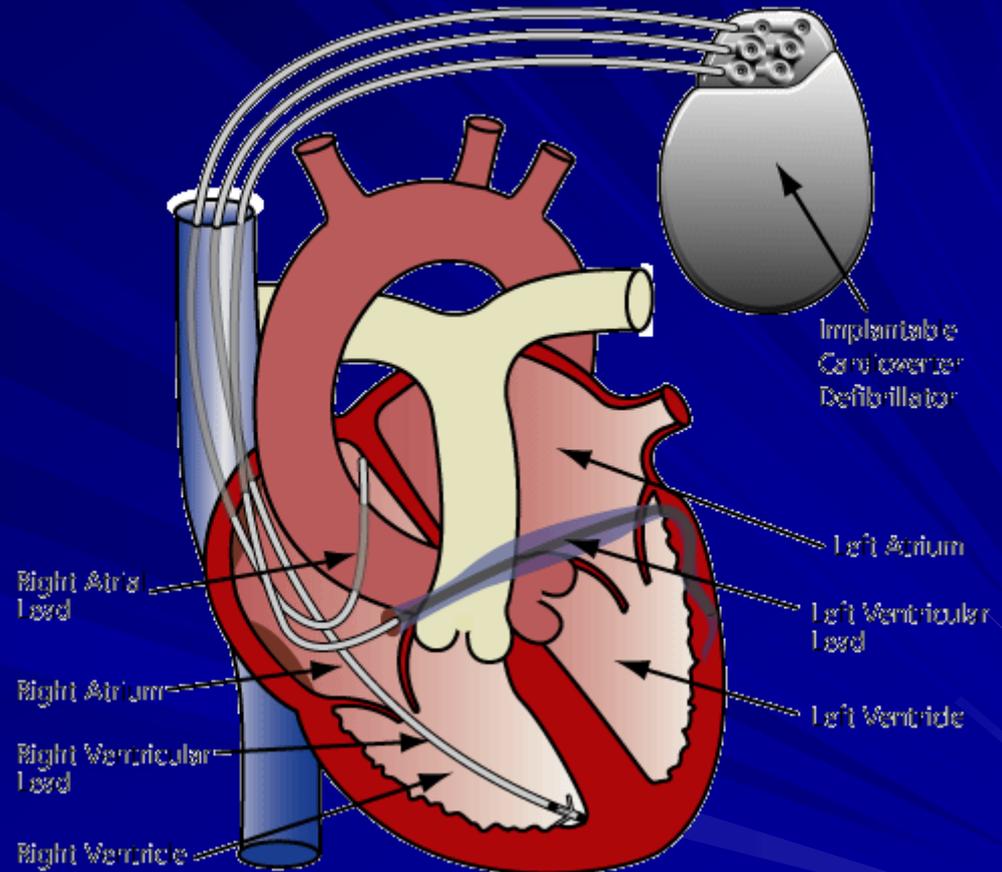
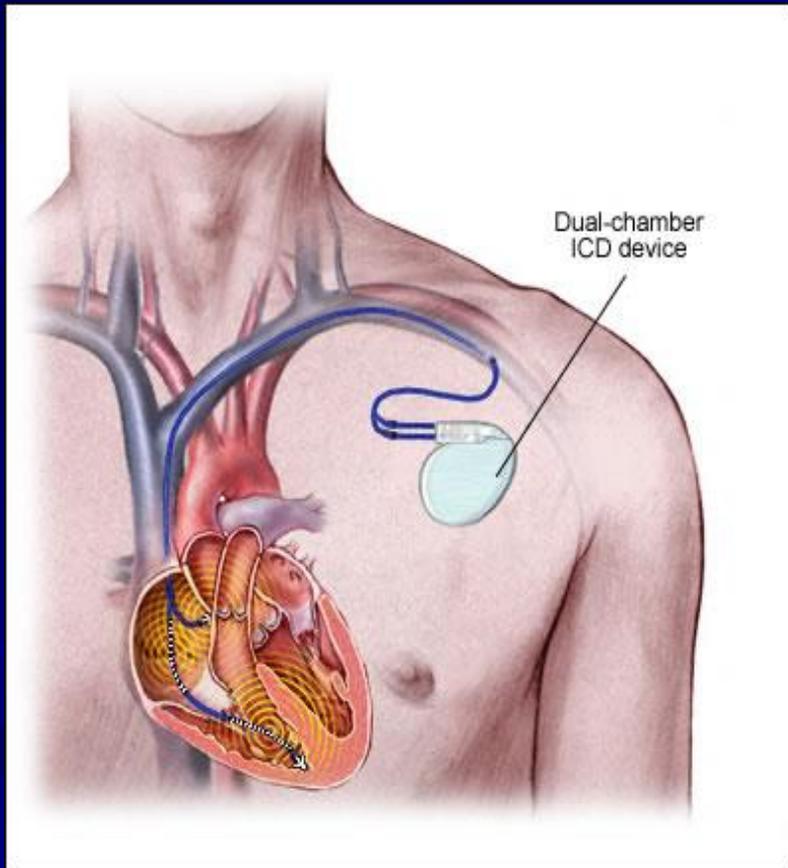
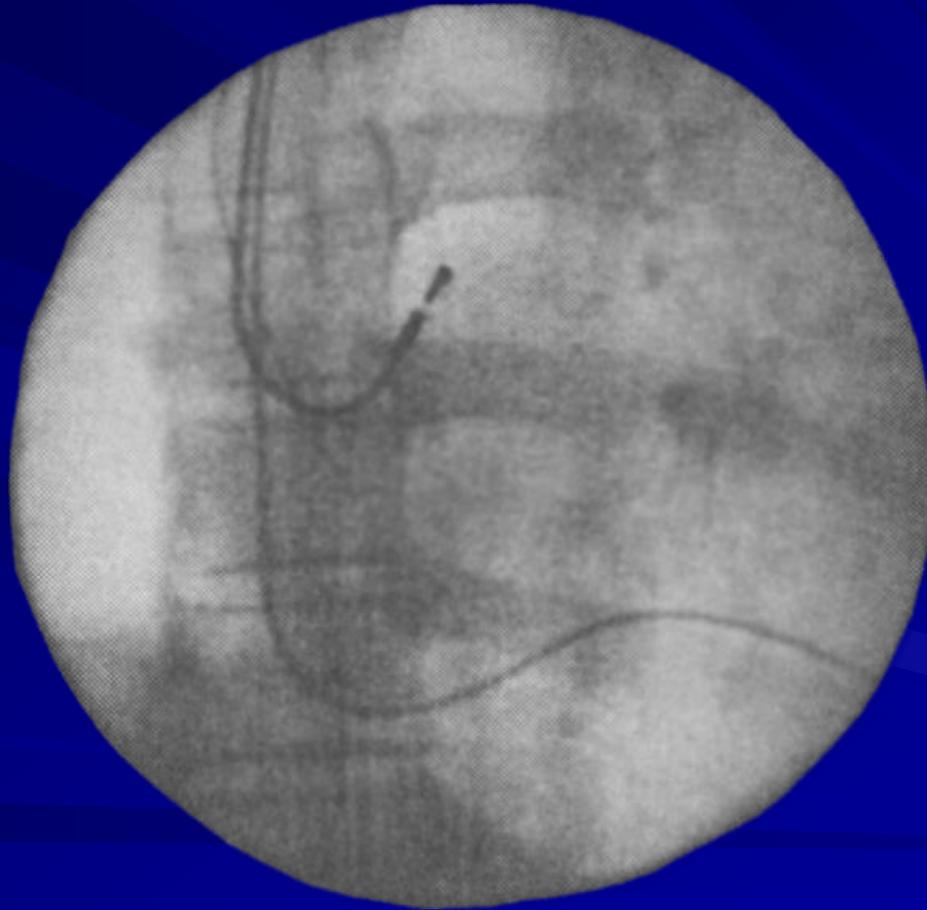


Fig. 3.20. Pacing and sensing in atrium and ventricle (DDI), and ventricular triggering by atrial sensing (DDD)

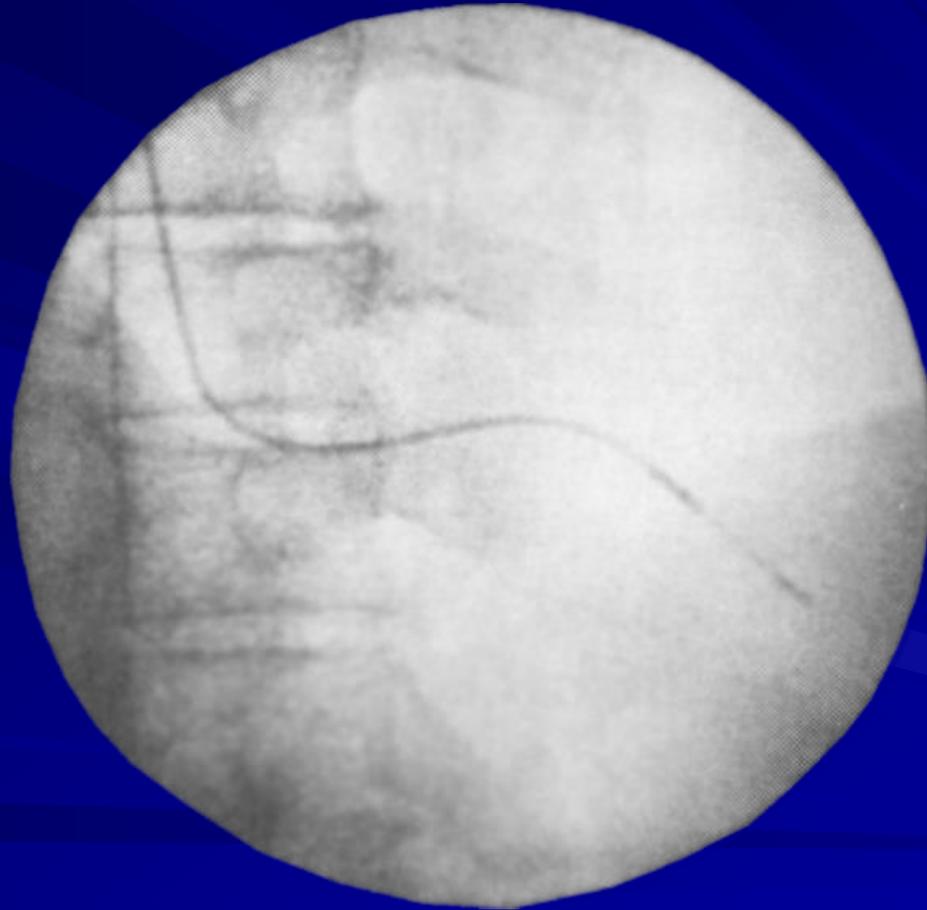
Kardiostimulátor, CRT - P



Implantace síňové elektrody



Komorová elektroda



Pacemaker Coding

■ The NASPE/BPEG code ...

- First letter indicates the chamber being paced :
 - **A** for Atrium, **V** for Ventricle, **D** for Double, **O** for none

- ... **VVI** : pacing in the ventricle
- ... **AAI** : pacing in the atrium
- ... **DDD** : pacing in both chambers

Pacemaker Coding

■ The NASPE/BPEG code ...

– Second letter indicates the chamber being sensed :

■ **A** for Atrium, **V** for Ventricle, **D** for double, **O** for none

■ ... **VVI** : sensing in the ventricle

■ ... **AAI** : sensing in the atrium

■ ... **DDD** : sensing in both chambers

Pacemaker Coding

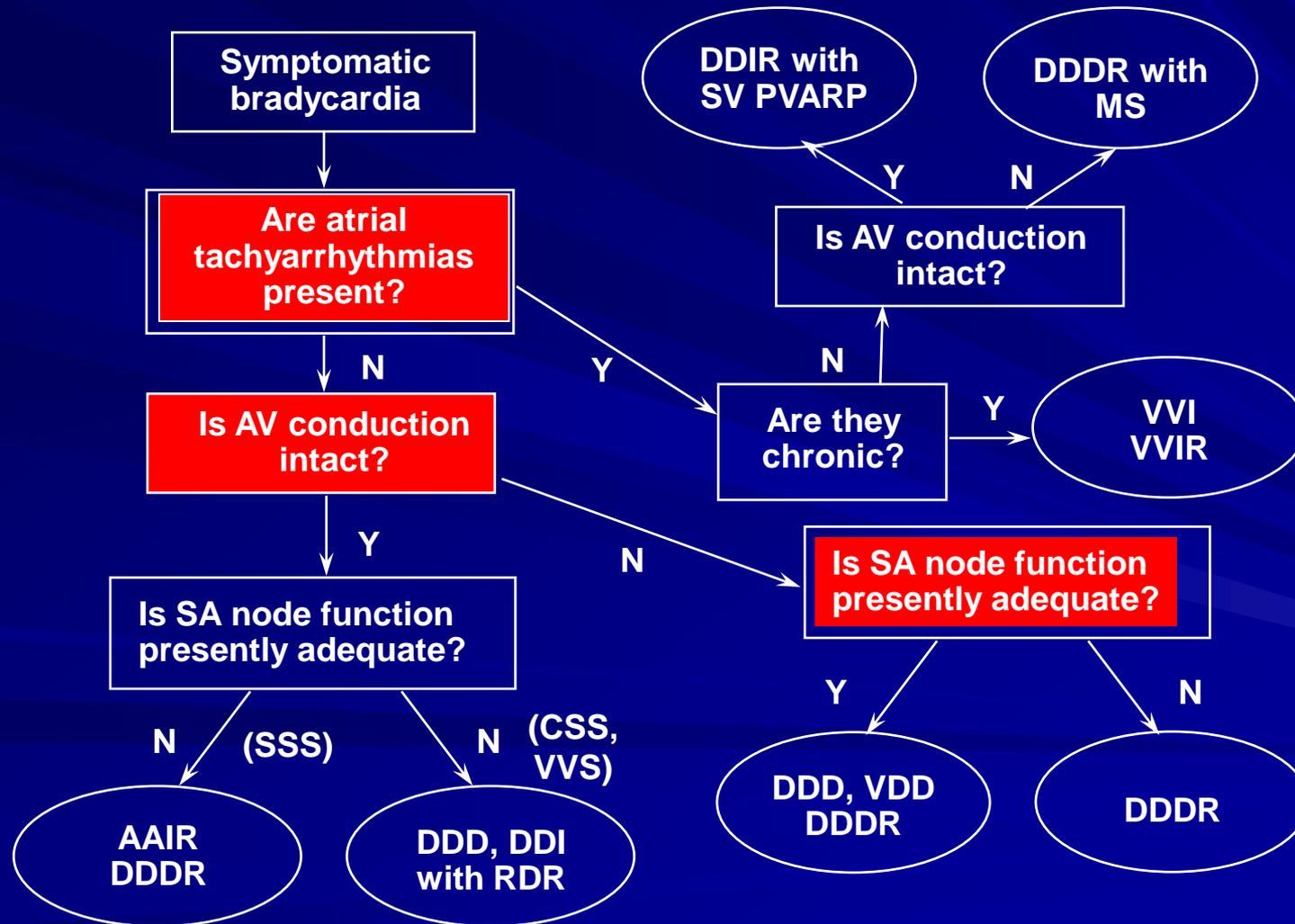
■ The NASPE/BPEG code ...

- Third letter indicates the reaction to sensing :
 - I = Inhibited, T = Triggered, D = Double, O = none
 - e.g. VVT :
 - A pacing pulse is emitted simultaneously with any detection, as in VVI pacing will also occur if no activity is detected during the lower rate interval
 - ... before : avoid 'standstill' during interference
 - today : mainly a diagnostic mode

Providing Optimal Pacing Therapy

- Heart rate increase
- Stroke volume maximization
- Atrial based pacing
- Normal ventricular activation sequence

Mode Selection Decision Tree



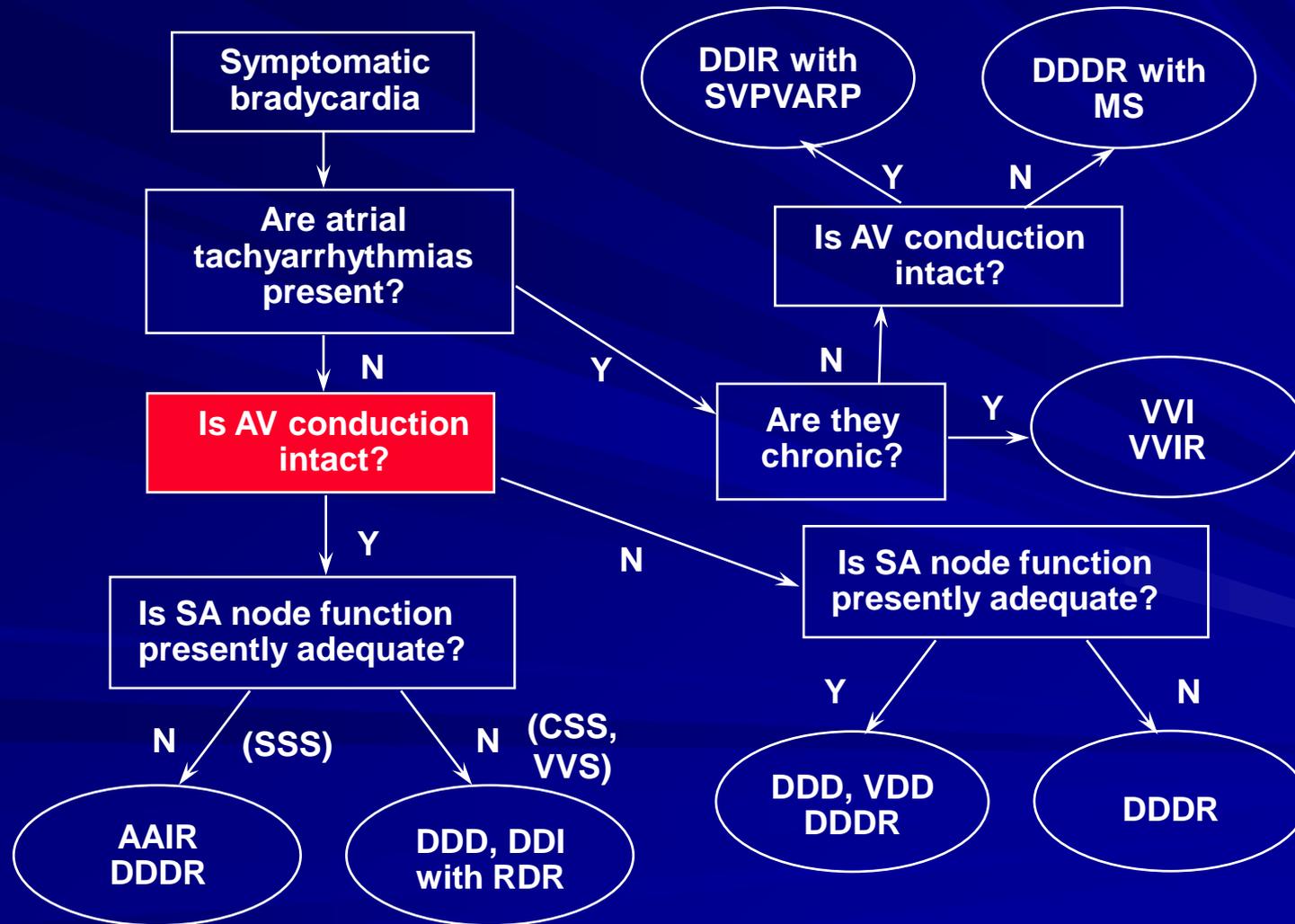
Determining the Optimal Pacing Mode: Mrs. Peacock



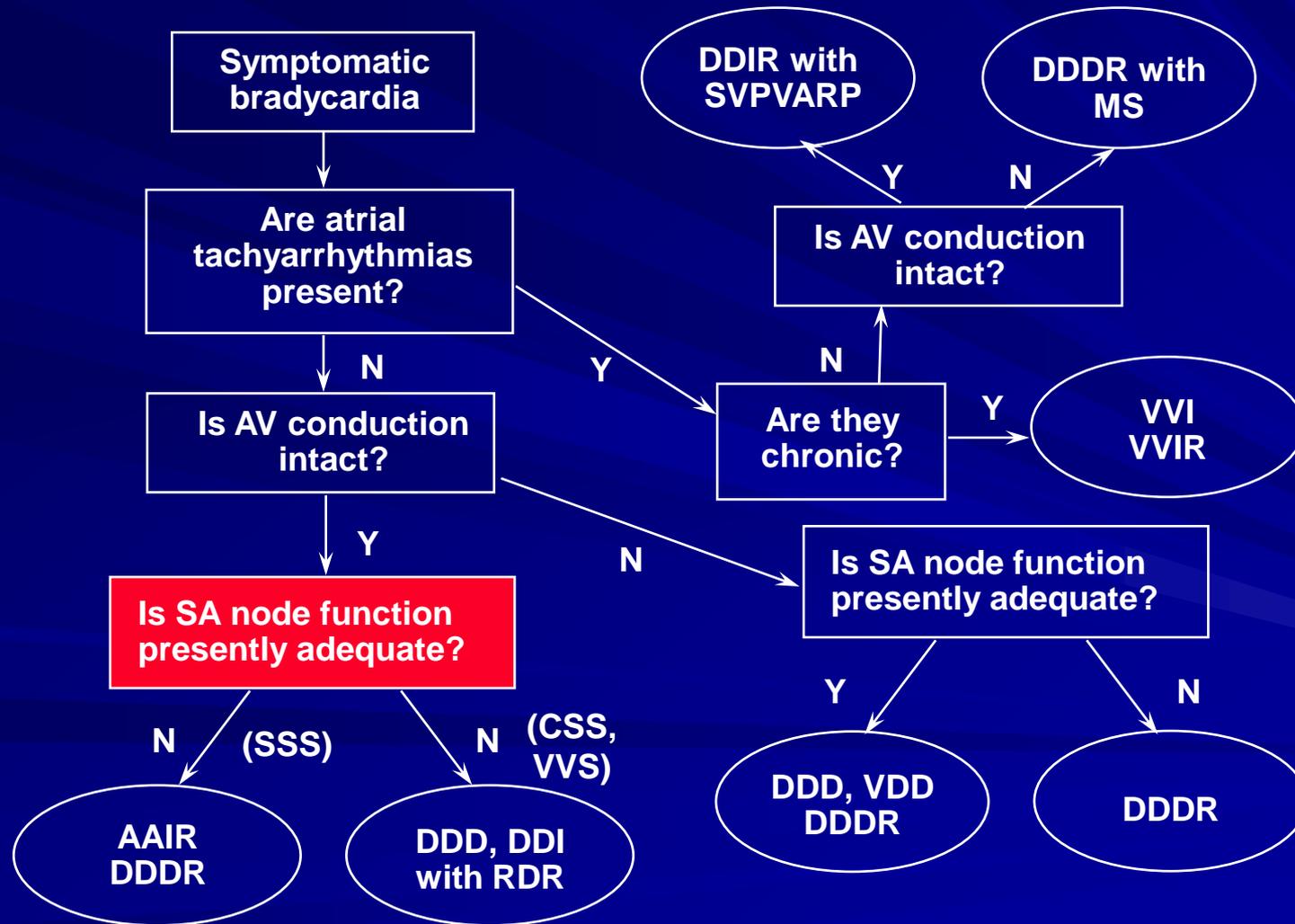
■ Patient information:

- Documented symptomatic sinus bradycardia
- When exercise tested, rate does not increase appropriately with increasing work loads
- At present, AV conduction is intact

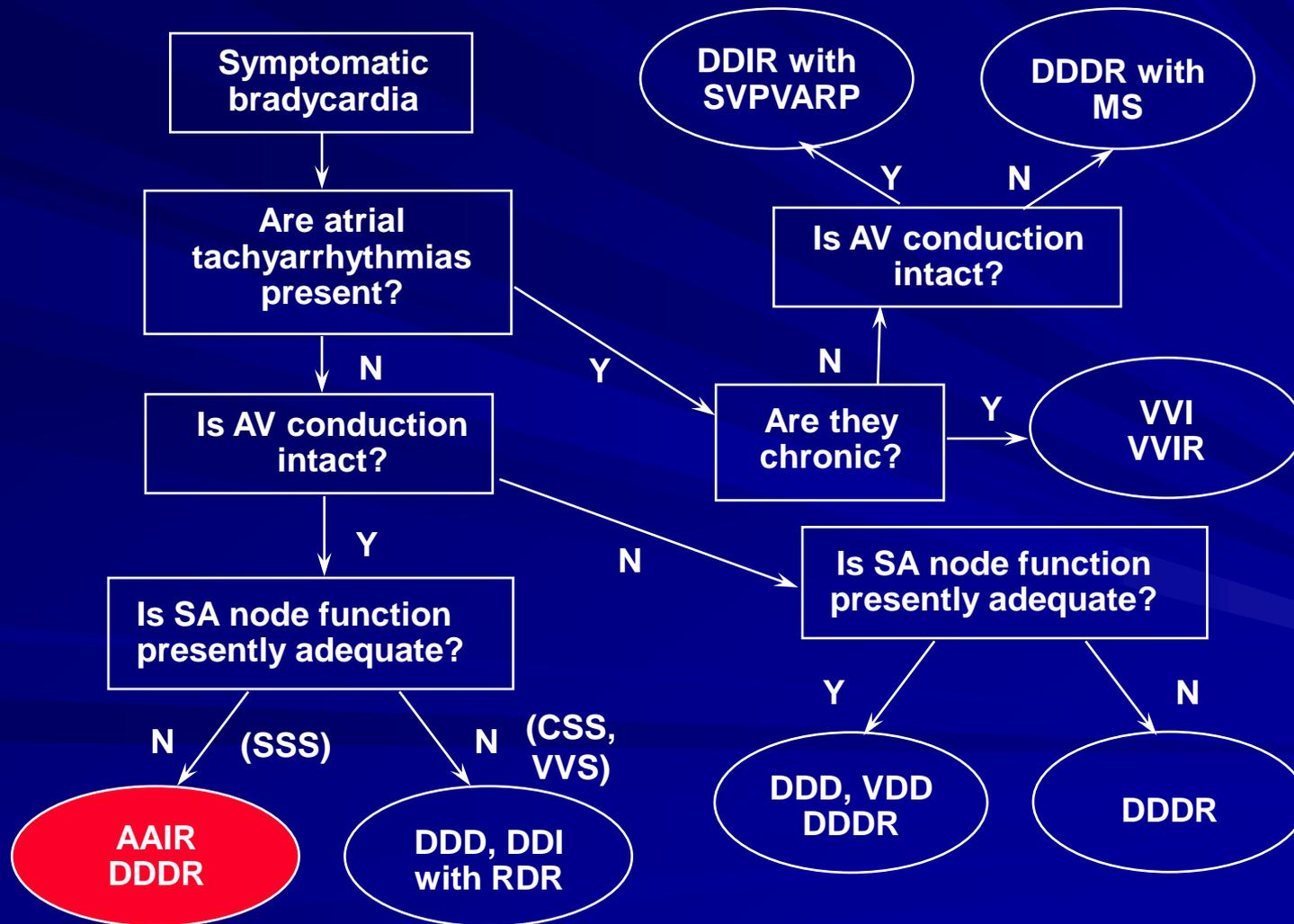
Mode Selection Decision Tree: Mrs. Peacock



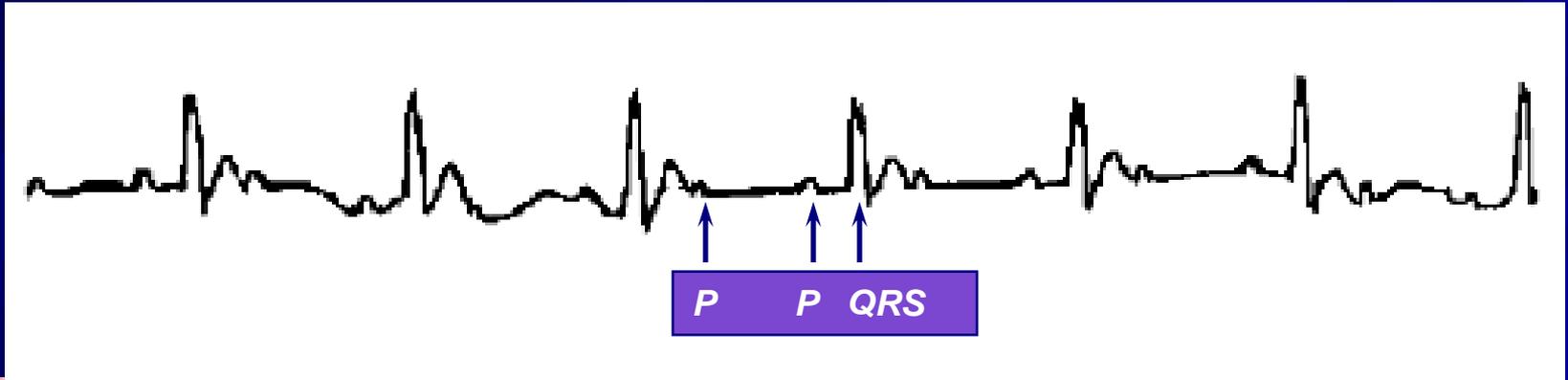
Mode Selection Decision Tree: Mrs. Peacock



Mode Selection Decision Tree: Mrs. Peacock



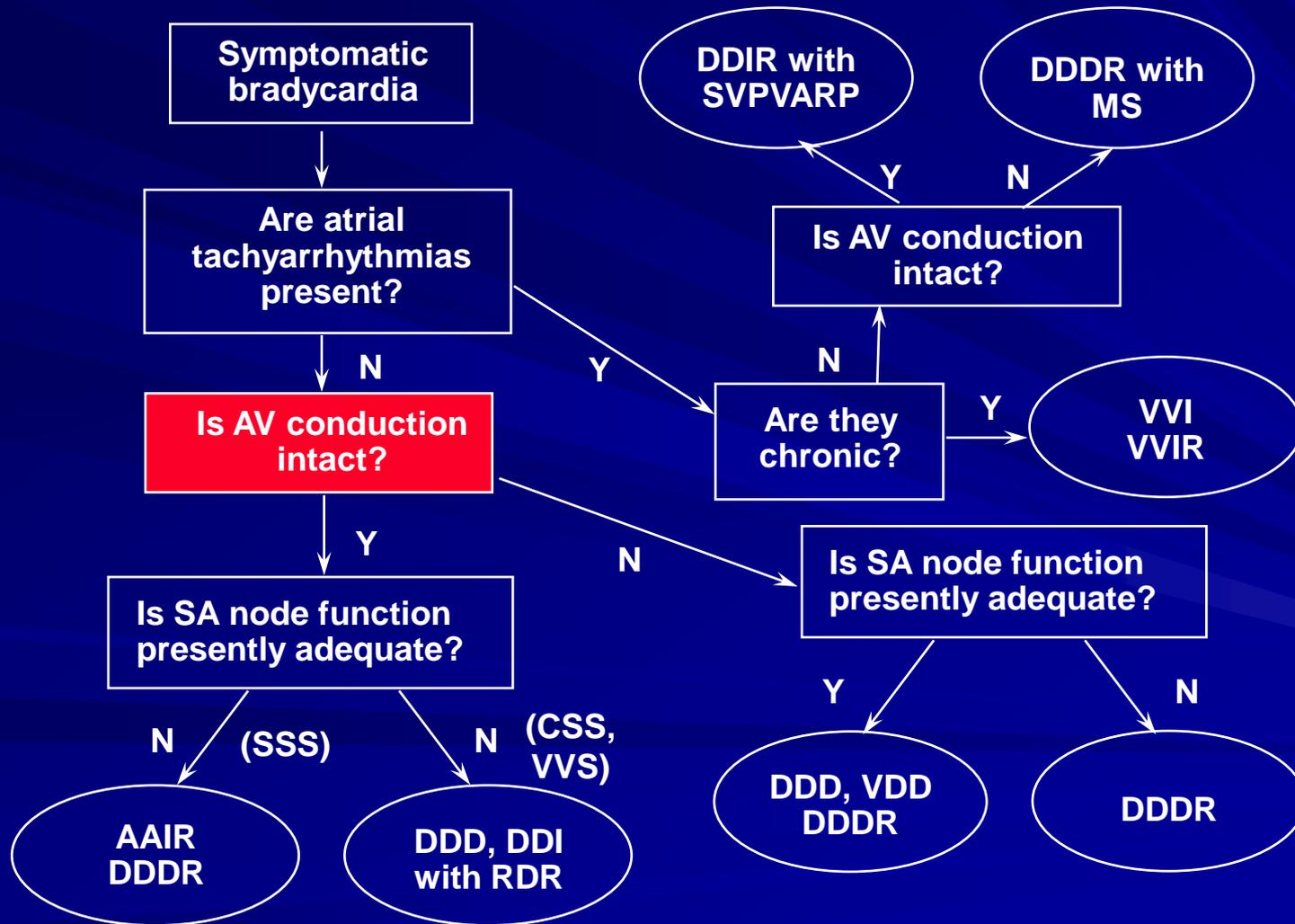
Determining the Optimal Pacing Mode: Professor Plum



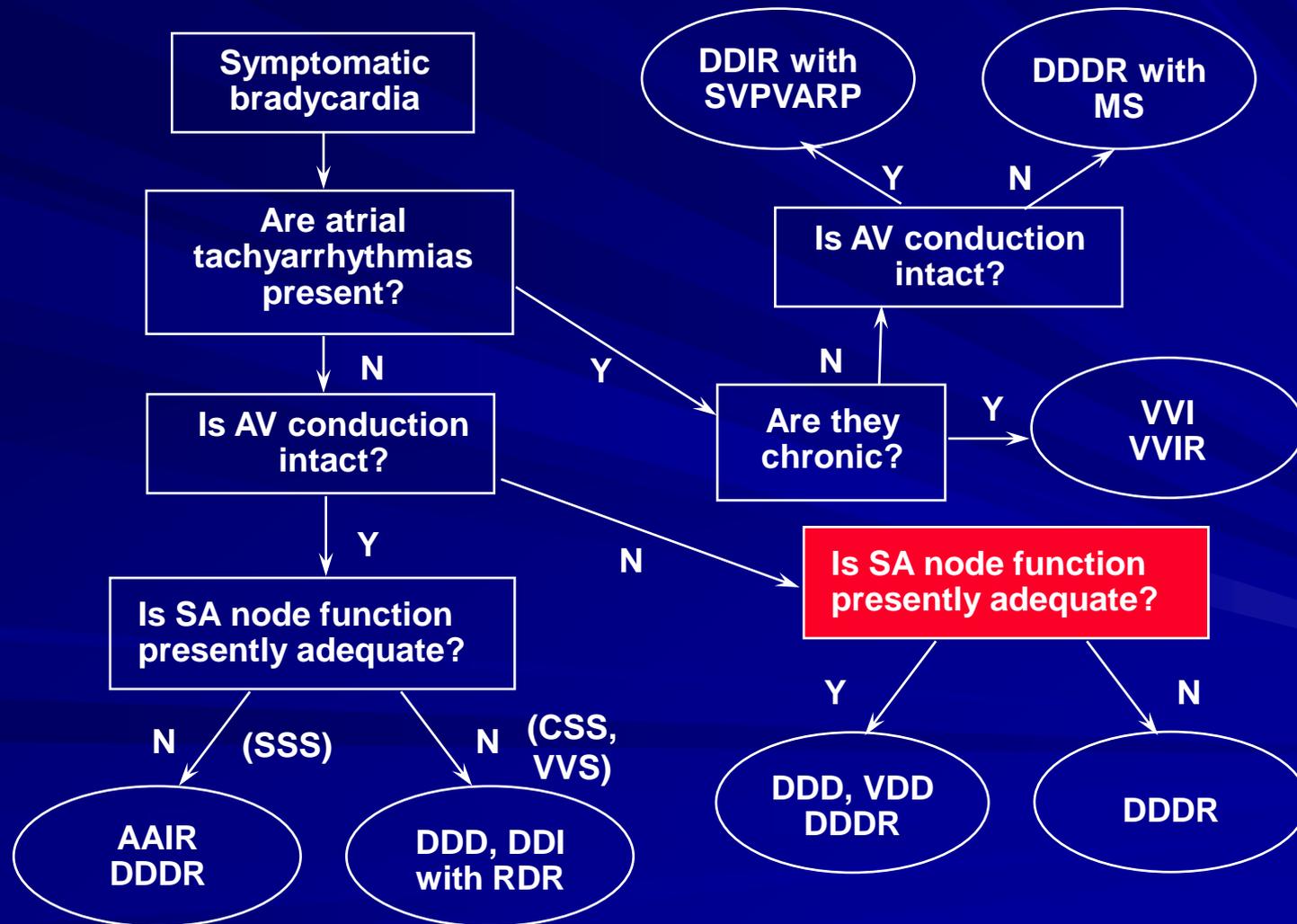
■ Patient Information:

- Professor Plum has intermittent 2nd degree Type II AV block with symptoms
- Professor Plum's atrial rate responded appropriately to an exercise test

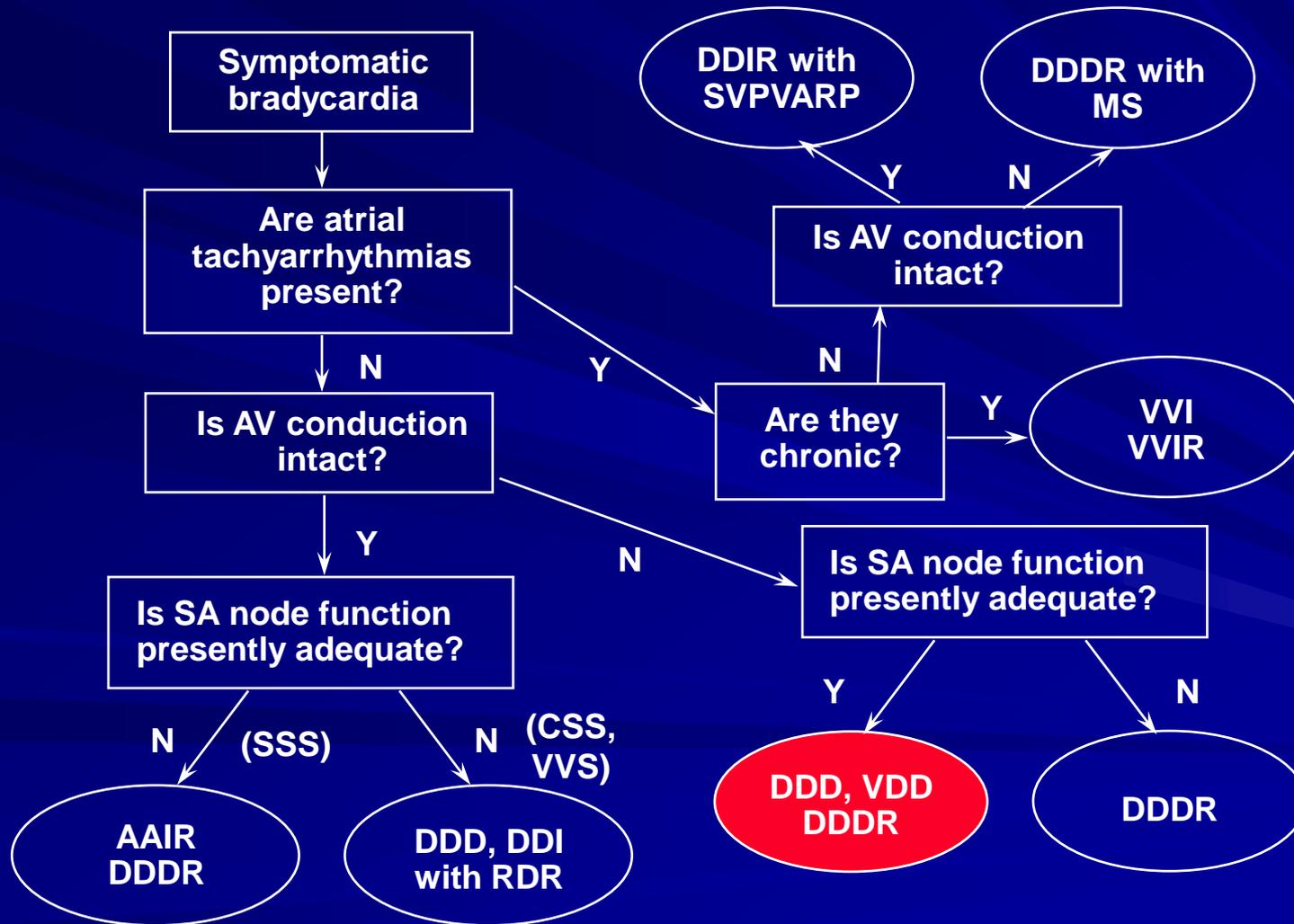
Mode Selection Decision Tree: Prof. Plum



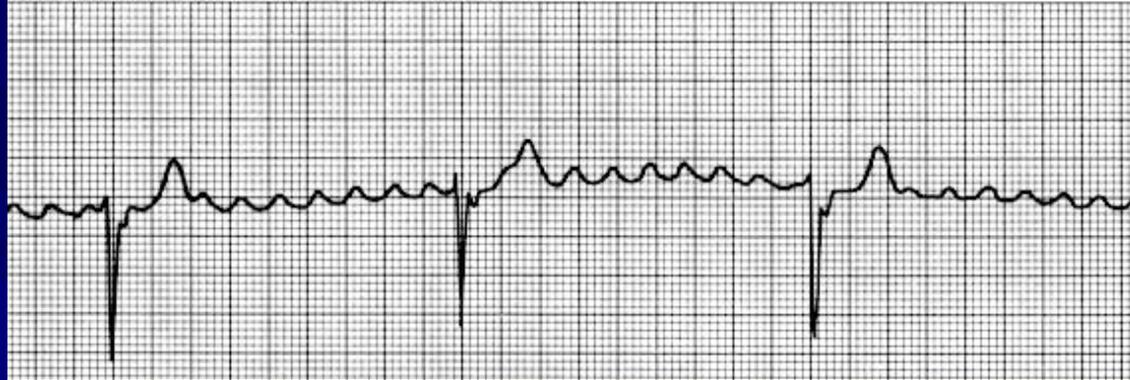
Mode Selection Decision Tree: Prof. Plum



Mode Selection Decision Tree: Prof. Plum



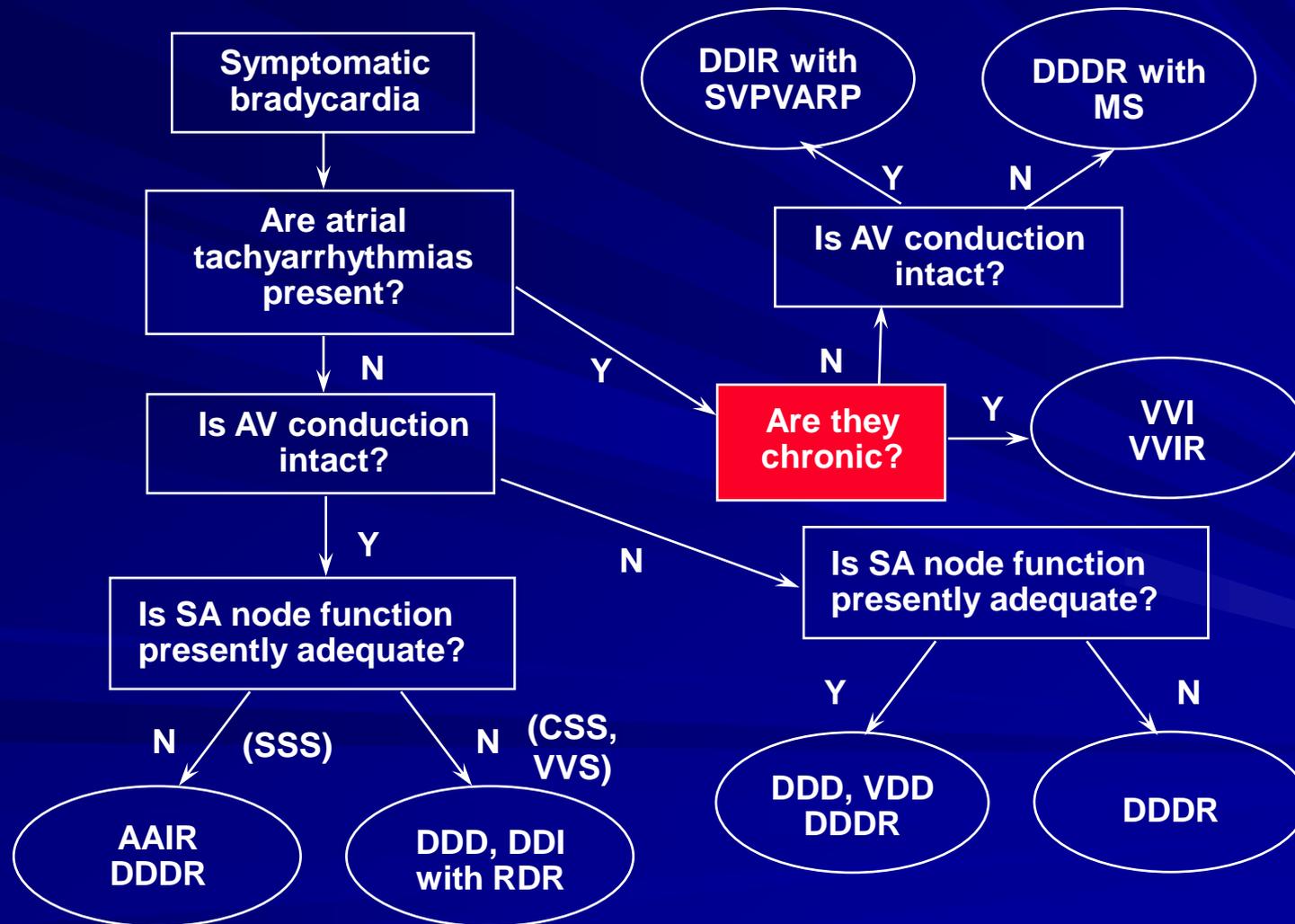
Determining the Optimal Pacing Mode: Colonel Mustard



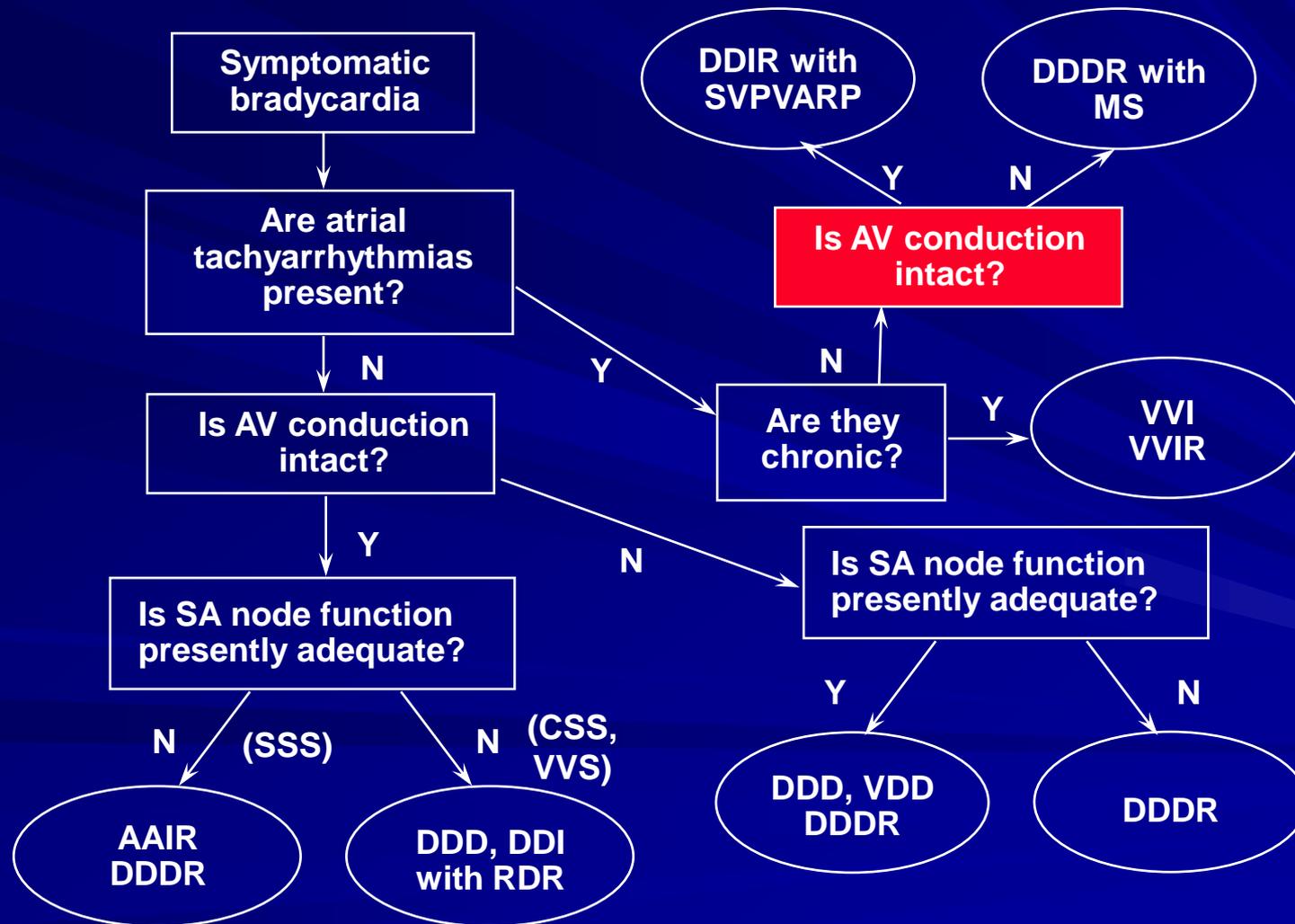
■ Patient information:

- Colonel Mustard has complete heart block and intermittent atrial flutter
- Colonel Mustard's heart rate does not reach 100 bpm in response to an exercise stress test

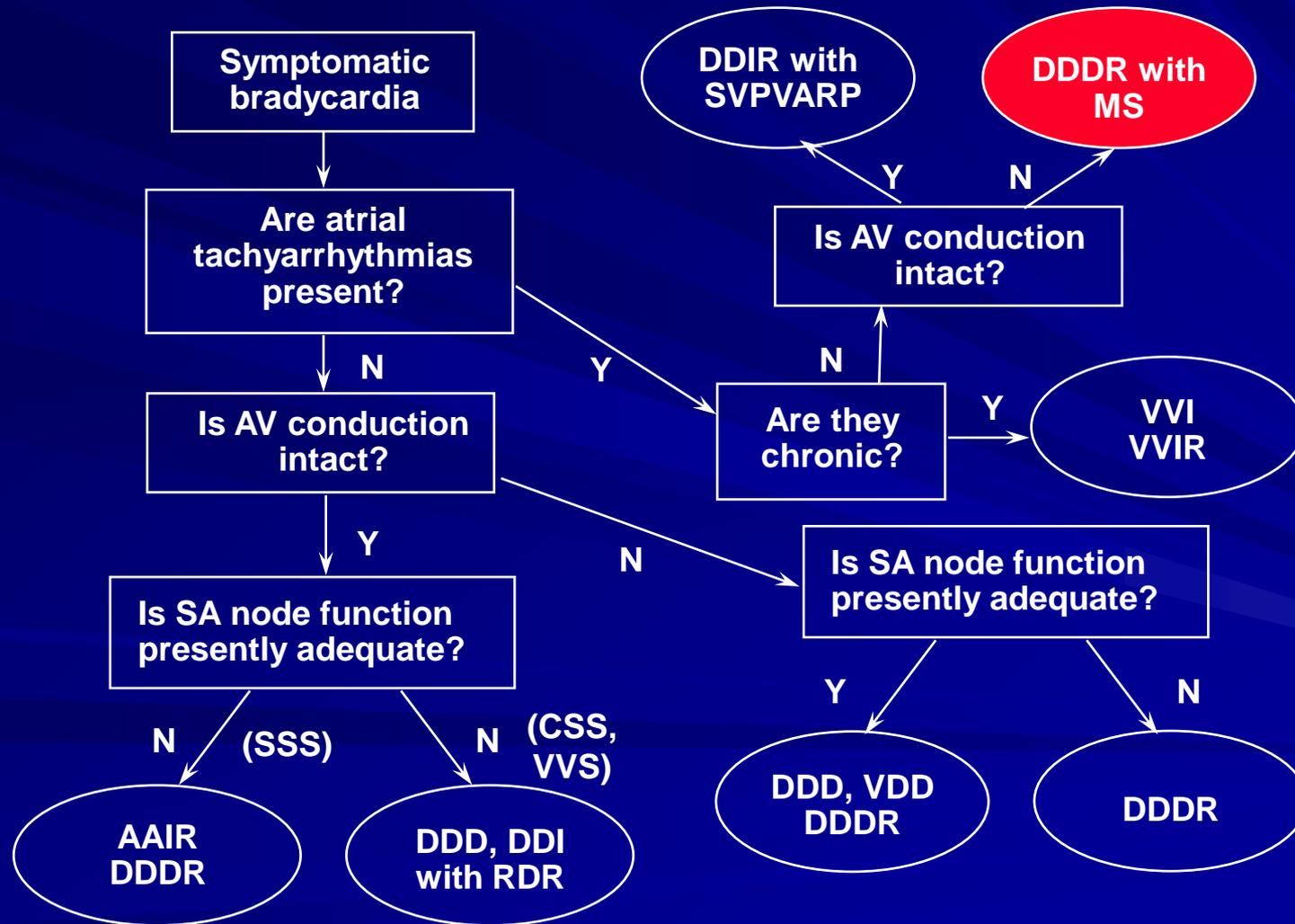
Mode Selection Decision Tree: Colonel Mustard



Mode Selection Decision Tree: Colonel Mustard



Mode Selection Decision Tree: Colonel Mustard



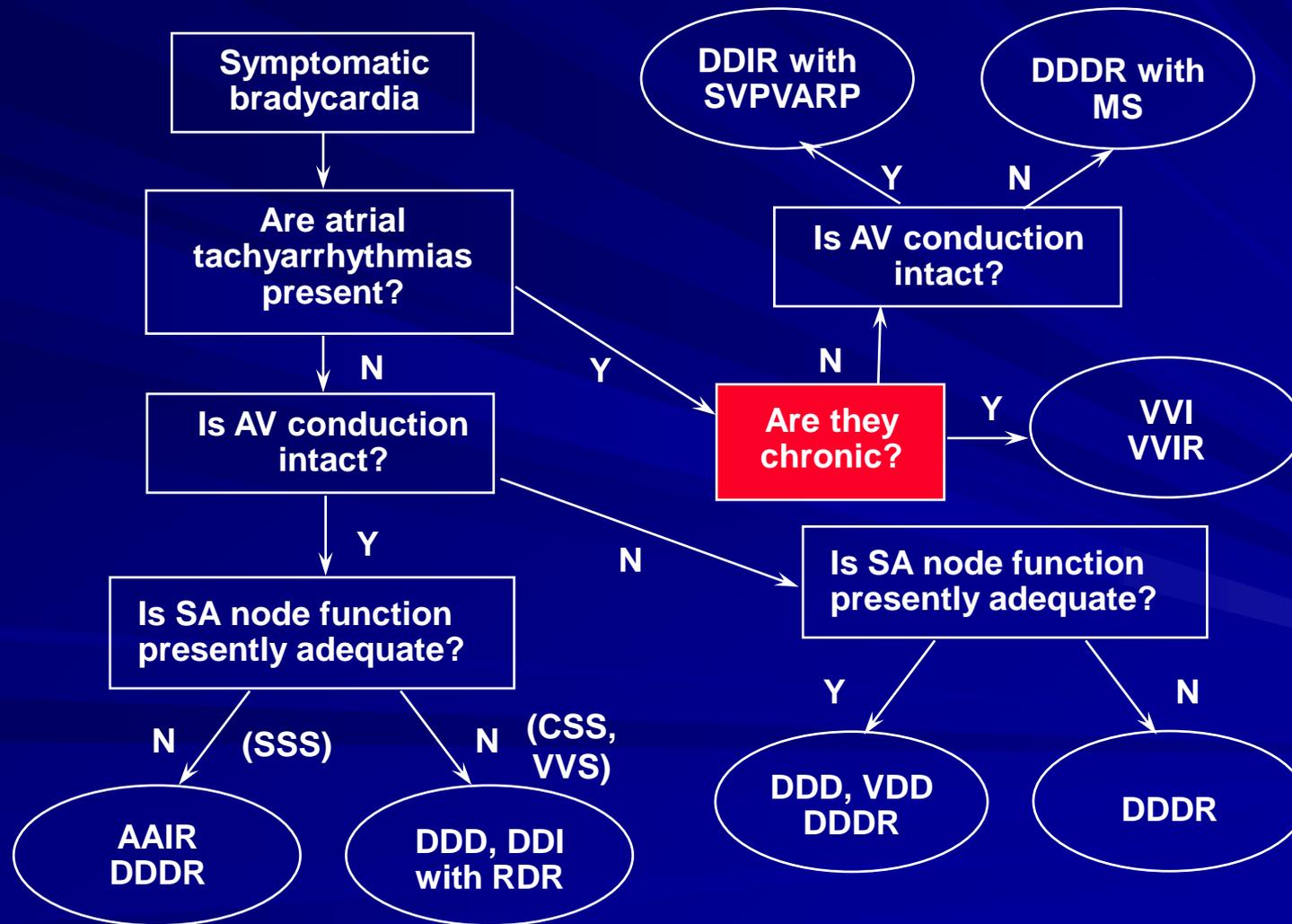
Determining the Optimal Pacing Mode: Mr. Green



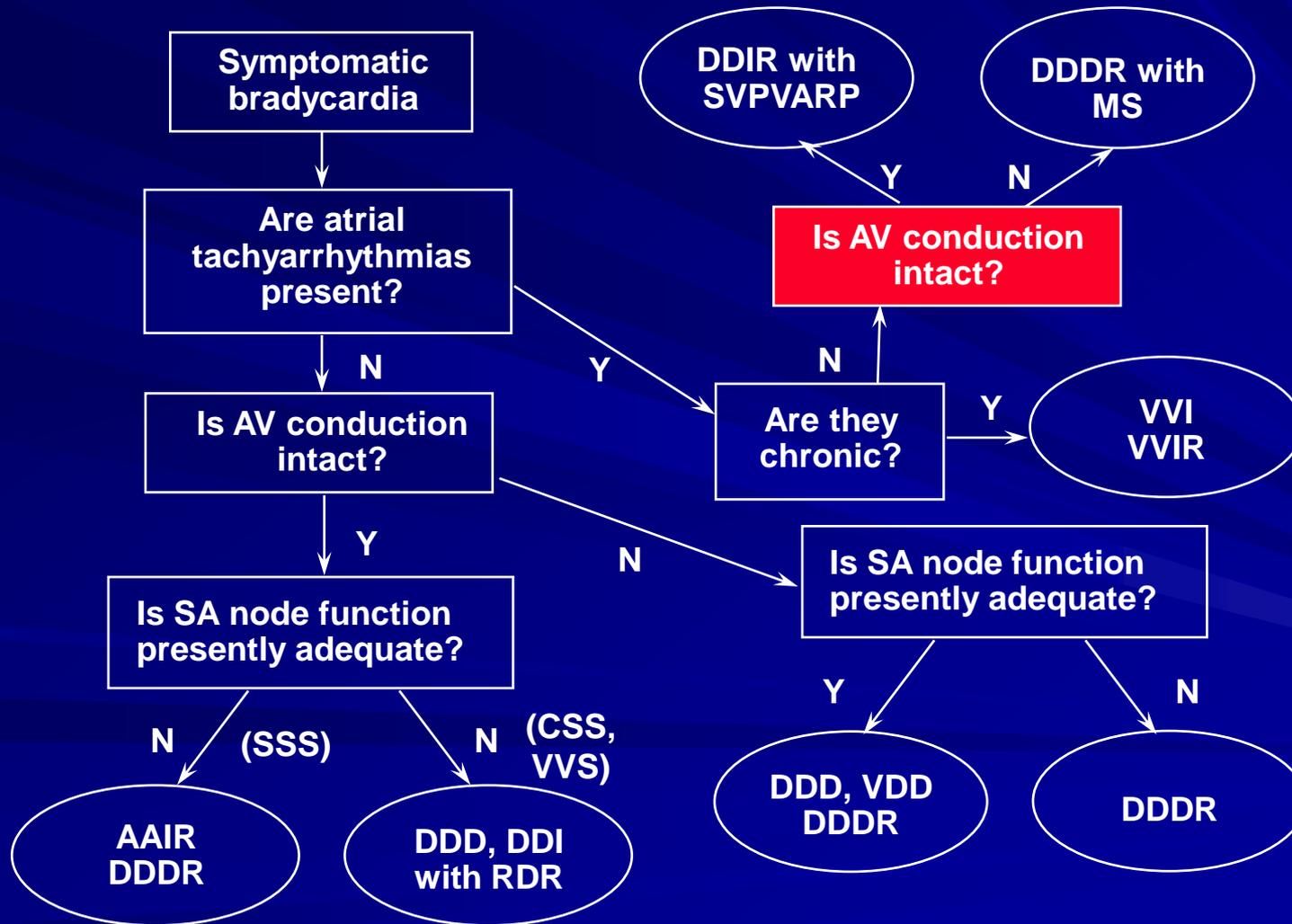
■ Patient information:

- Mr. Green has brady-tachy syndrome with intact AV conduction
- Mr. Green's heart rate does not reach 100 bpm in response to an exercise stress test

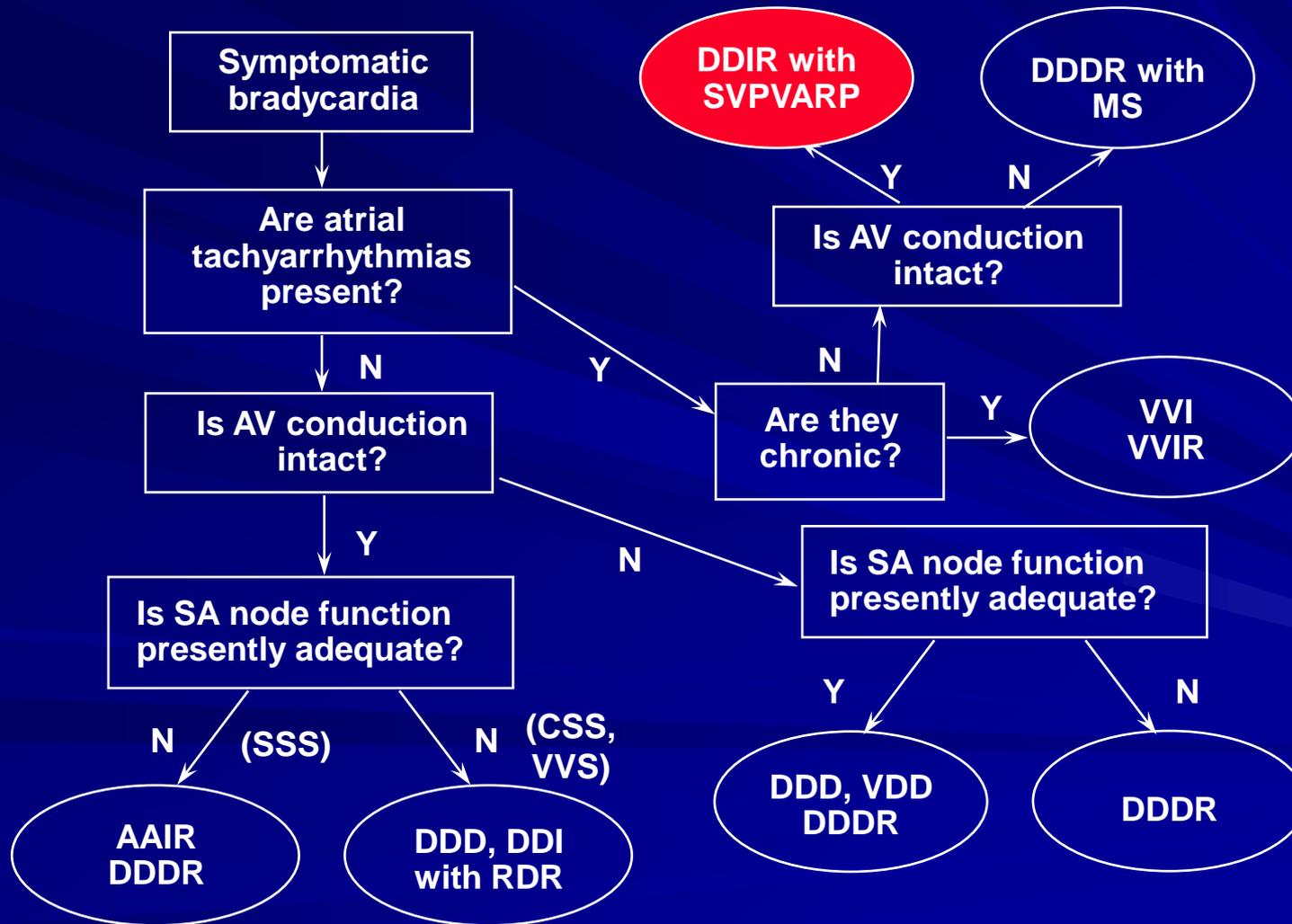
Mode Selection Decision Tree: Mr. Green



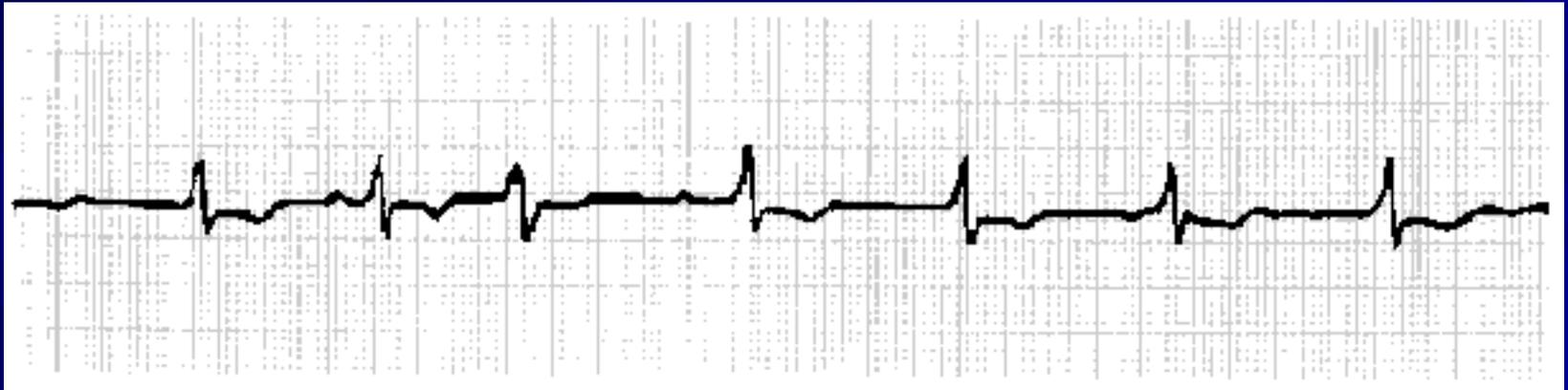
Mode Selection Decision Tree: Mr. Green



Mode Selection Decision Tree: Mr. Green



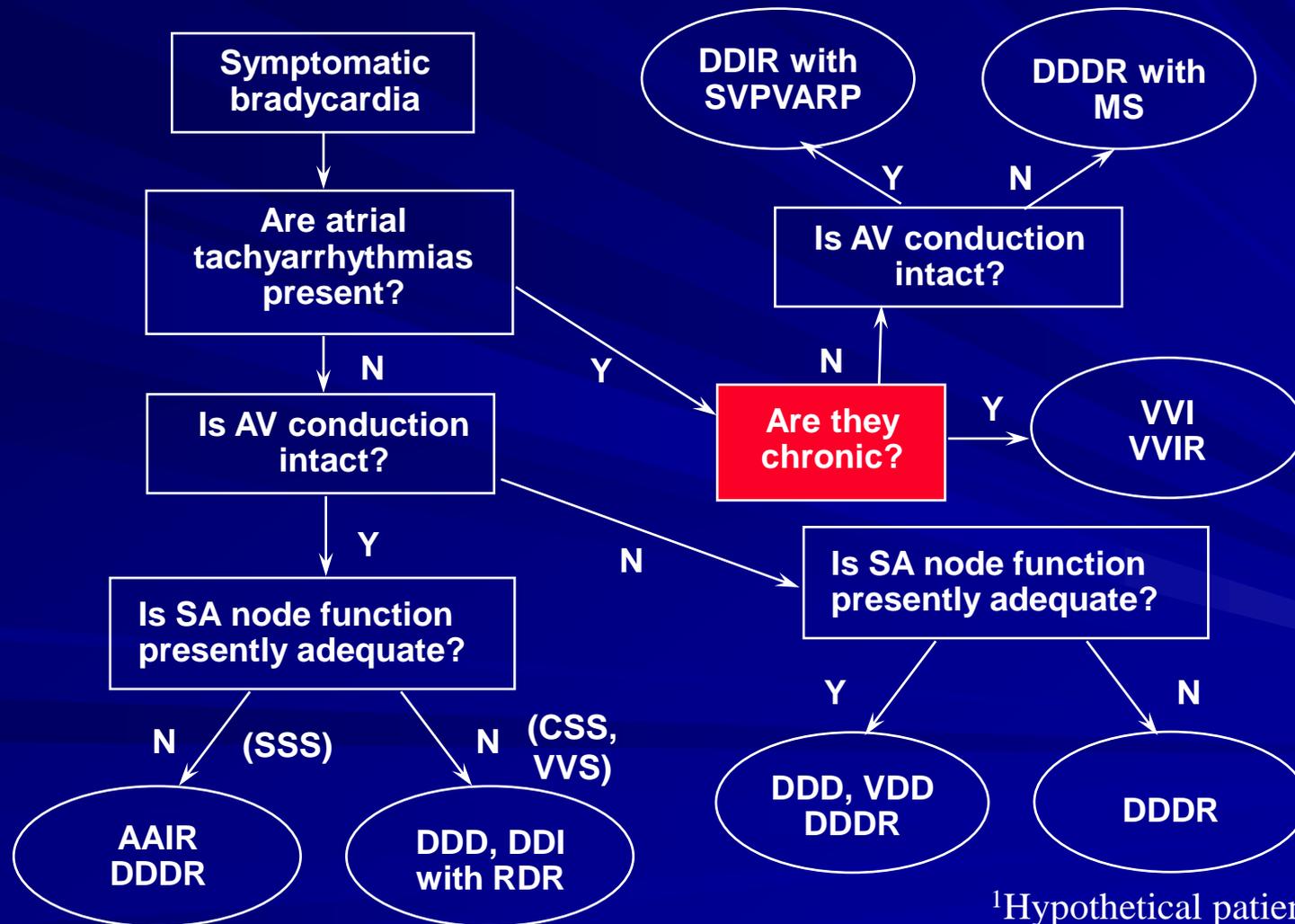
Determining the Optimal Pacing Mode: Mrs. White



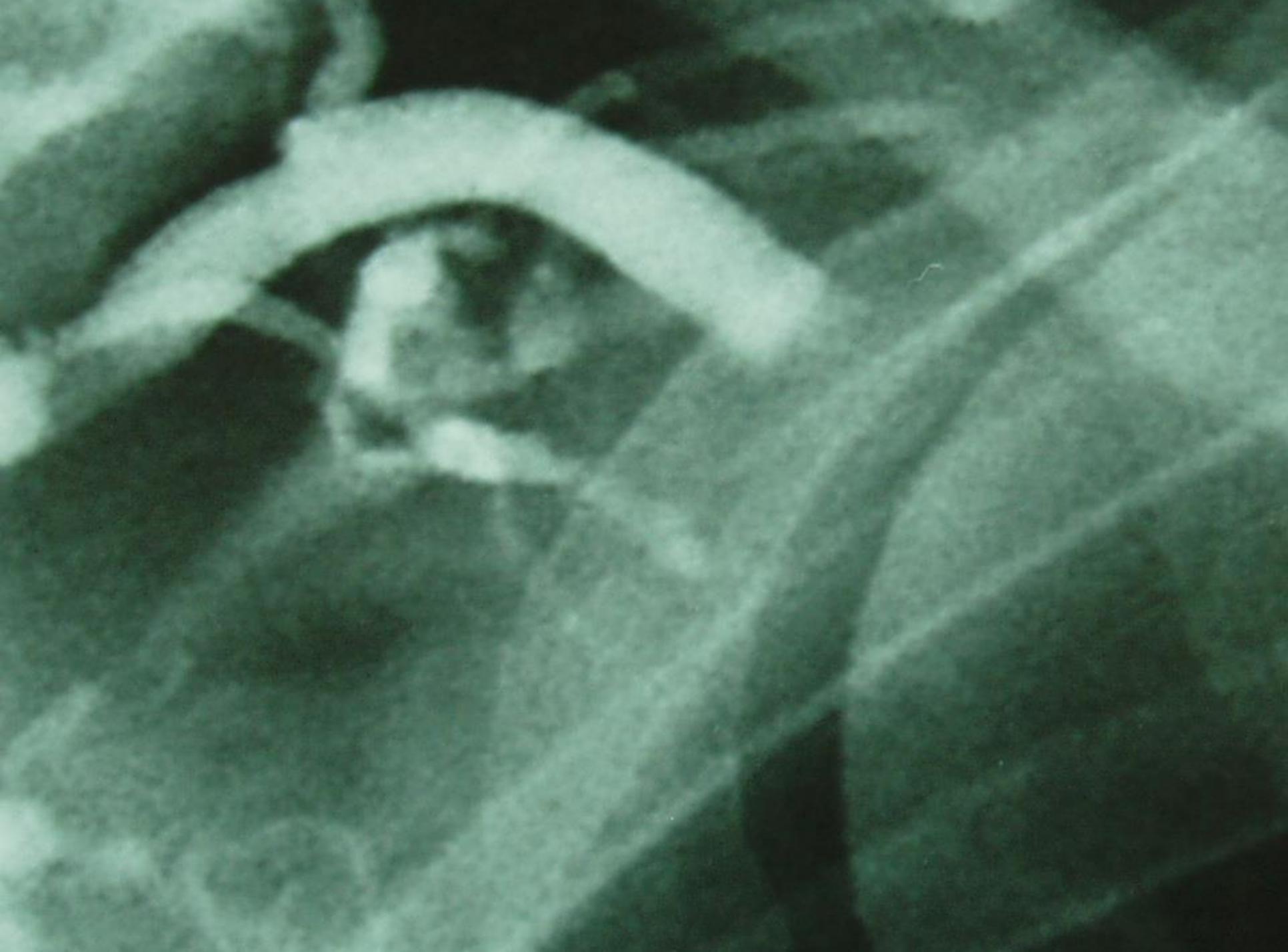
■ Patient information:

- Mrs. White has chronic atrial fibrillation with an irregular ventricular rate
- Mrs. White's heart rate does not reach 100 bpm in response to an exercise stress test

Mode Selection Decision Tree: Mrs. White¹



¹Hypothetical patient example

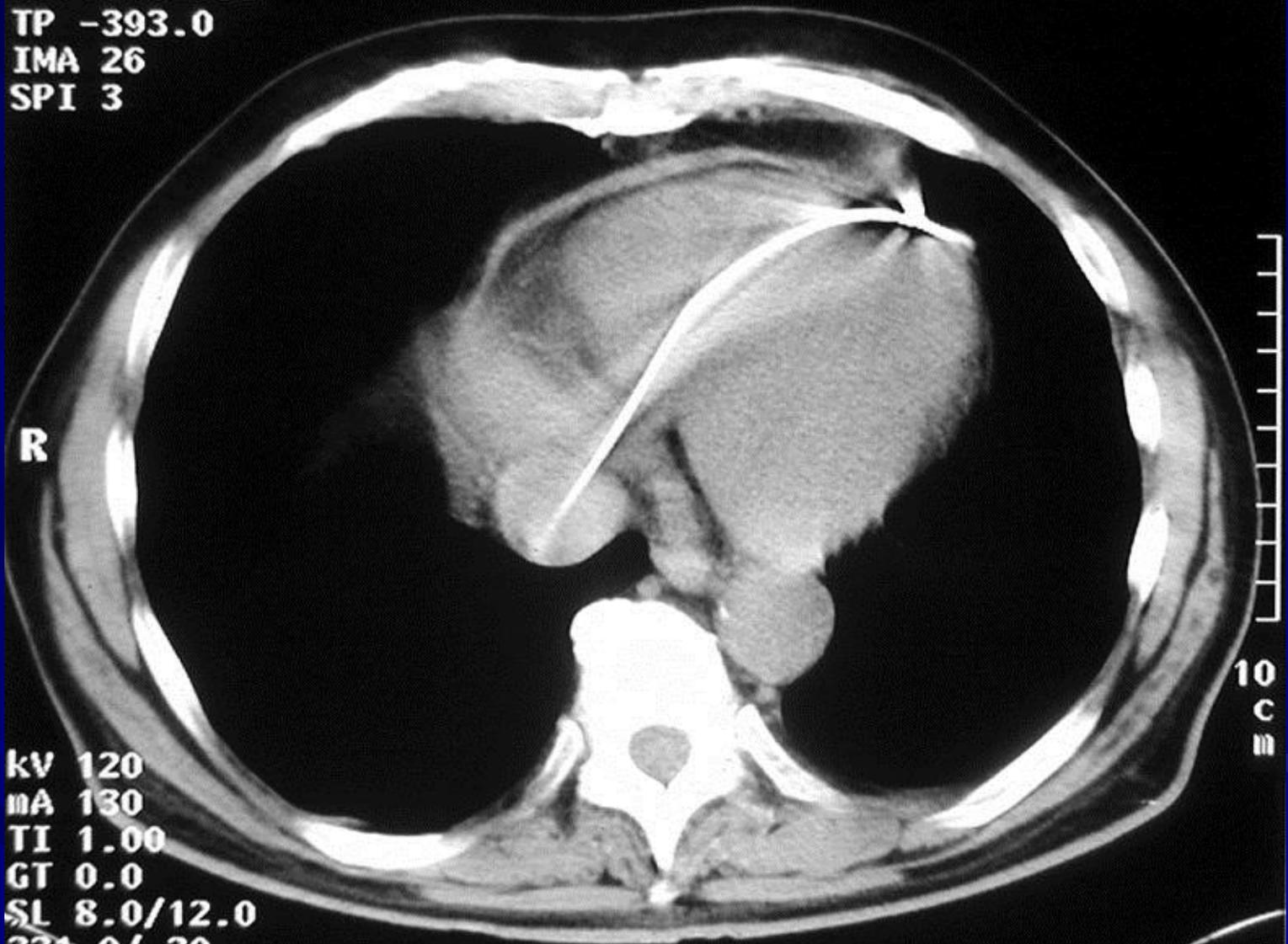


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