Pacing Codes and Modes Concepts

Pacing codes and modes concepts

Objectives

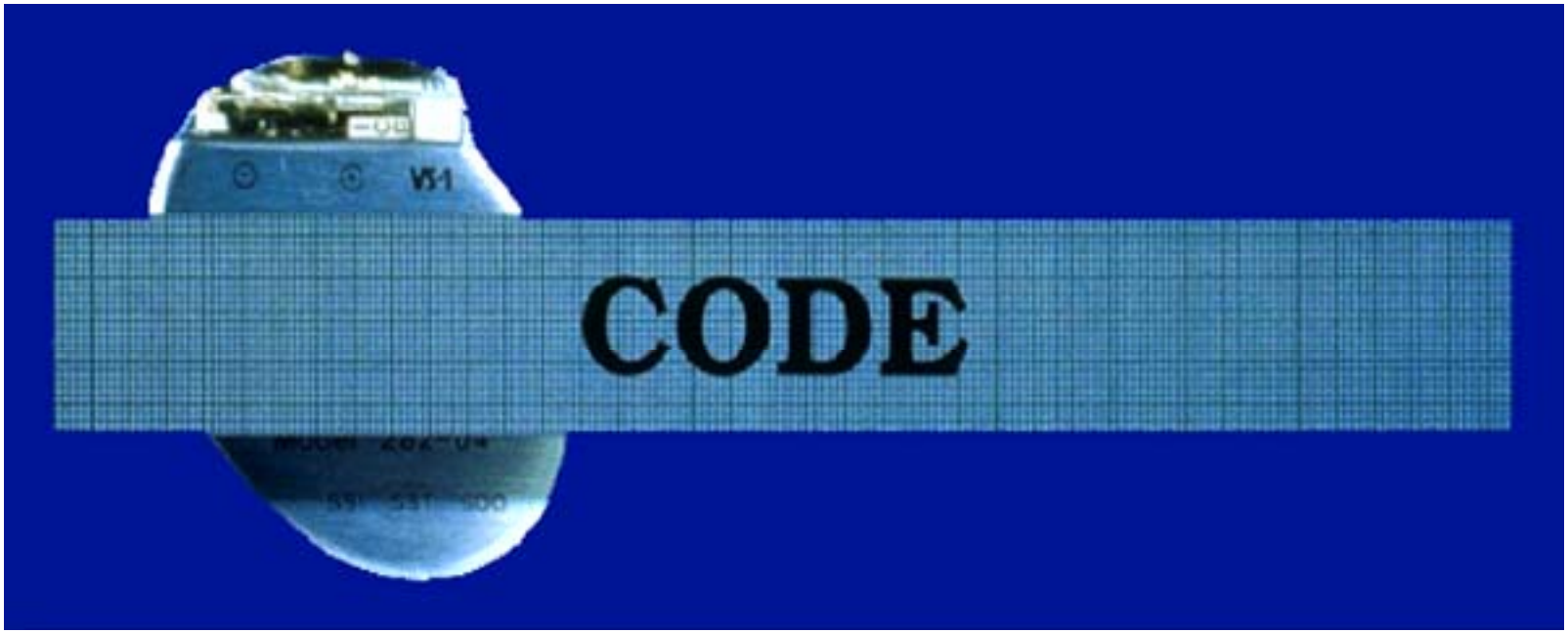
Upon completion of this program the participant will be able to:

- State what the first four positions of the NBG code represent.
- Explain the concept and benefits of AV synchrony and identify which pacing mode(s) will maintain AV synchrony.
- List two single chamber and two dual chamber pacing modalities and explain the behavior of each.
- Briefly describe “Pacemaker Syndrome” and list three possible symptoms.

Outline

- **NGB Code**
  - Single- and Dual-Chamber Modes
- **Rate Response**
- **Choosing a Pacing Mode**
- **AV Synchrony**
- **Pacemaker Syndrome**

The NASPE/BPEG Generic (I.C.H.D.)



The NASPE/BPEG generic (NBG) code

The NASPE/BPEG Generic (NBG) Code					
Position	**I**	**II**	**III**	**IV**	**V**
Category	**Chamber(s) Paced**	**Chamber(s) Sensed**	**Response to Sensing**	**Programmability, rate modulation**	**Antitachy-arrhythmia Function(s)**
Letters Used	**O-None** **A-Atrium** **V-Ventricle** **D-Dual (A+V)**	**O-None** **A-Atrium** **V-Ventricle** **D-Dual (A+V)**	**O-None** **T-Triggered** **I-Inhibited** **D-Dual (T+I)**	**O-None** **P-Simple Programmable** **M-Multi-Programmable** **C-Communicating** **R-Rate modulation**	**O-None** **P-Pacing (antitachy-arrhythmia)** **S-Shock** **D-Dual (P+S)**
Manufac-turer's Designation Only	**S- Single (A or V)**	**S- Single (A or V)**			

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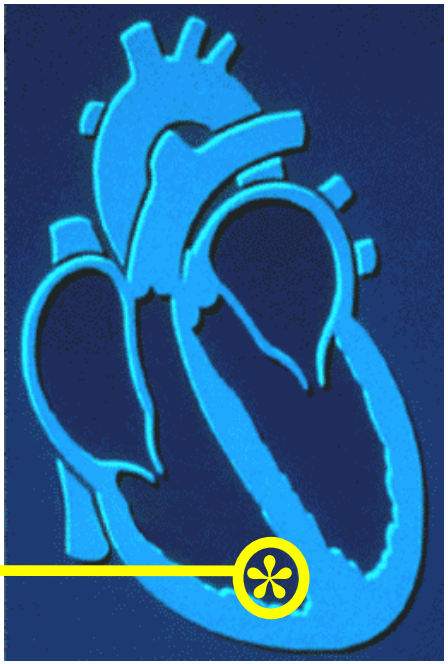
Codes are combined to describe:

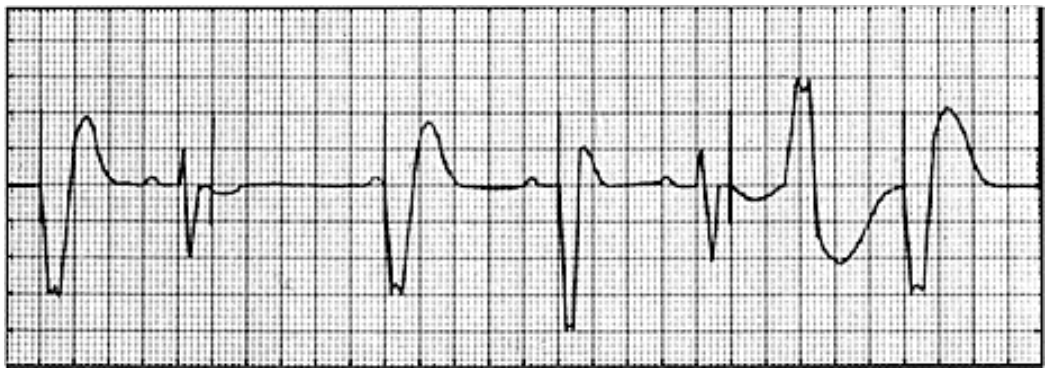
- **The mode of pacing**
- **The mode of sensing**
- **How the pacemaker will respond to the presence or absence of intrinsic beats**
  - AOO
  - AAI
  - VOO
  - VVI

VOO

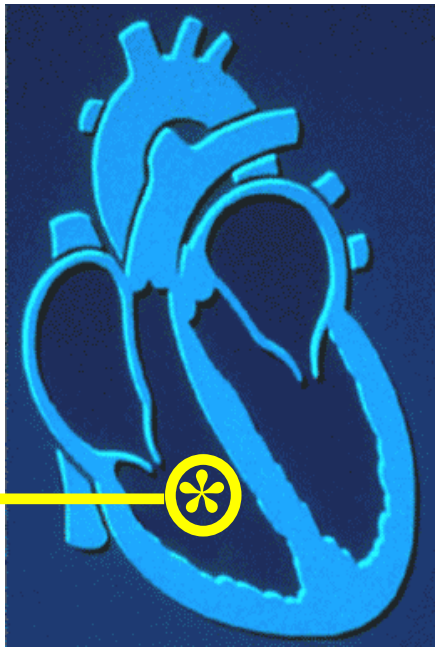


Ventricular lead

- Ventricular pacing
- No sensing
- Ventricular asynchronous pacing at lower programmed pacing rate

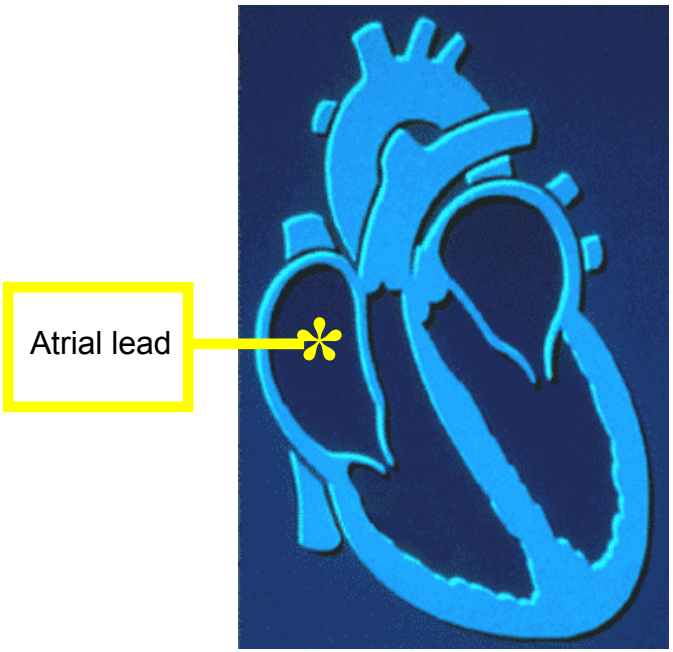


VVI

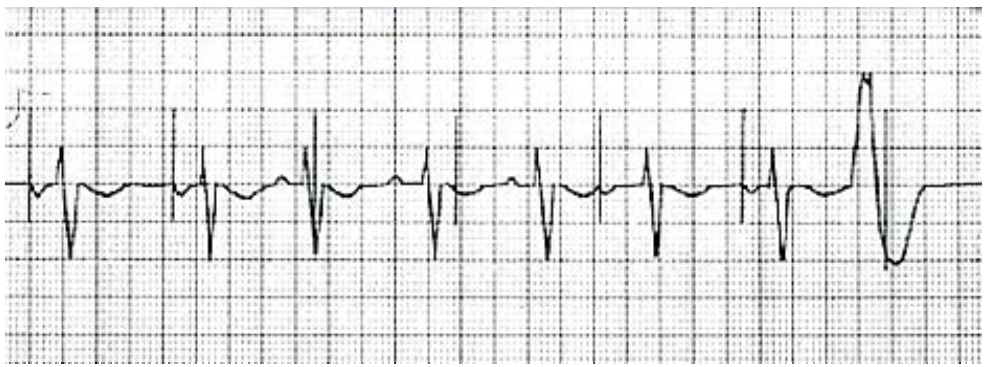


- Ventricular pacing
- Ventricular sensing
- Sensed intrinsic QRS inhibits ventricular pacing

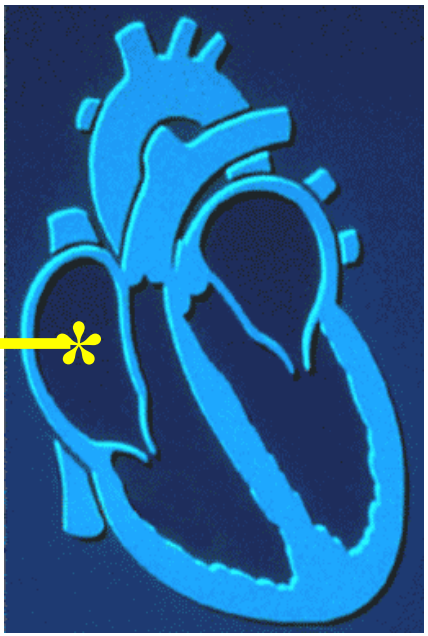
AOO



- Atrial pacing
- No sensing
- Atrial asynchronous pacing at lower programmed pacing rate



AAI

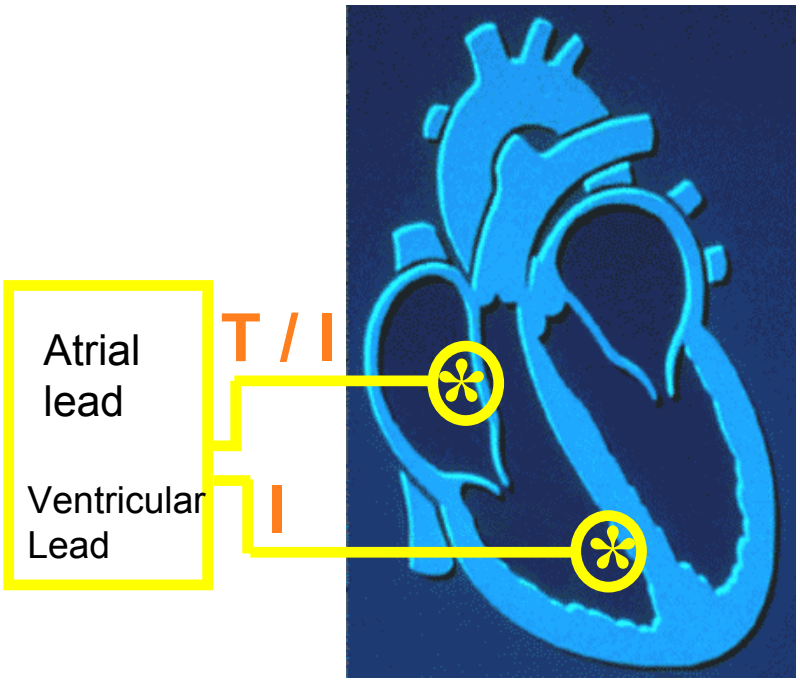


- Atrial pacing
- Atrial sensing
- Intrinsic P wave inhibits atrial pacing

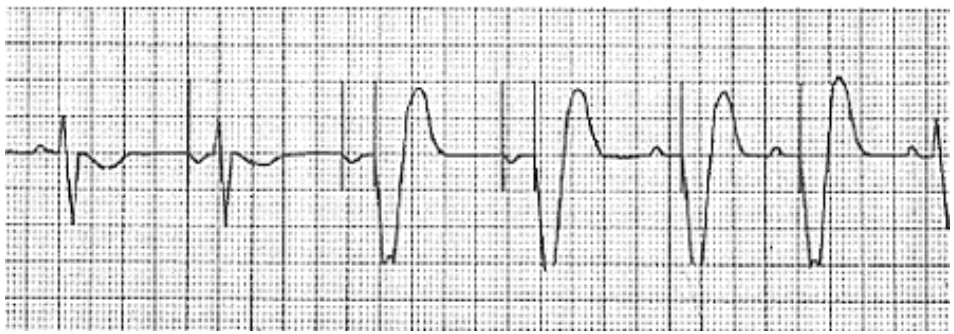
Dual Chamber Modes

Tracking modes

DDD



- Pacing in both the atrium and ventricle
- Sensing in both the atrium and ventricle
- Intrinsic P wave and intrinsic QRS can inhibit pacing
- Intrinsic P Wave can "trigger" a paced QRS

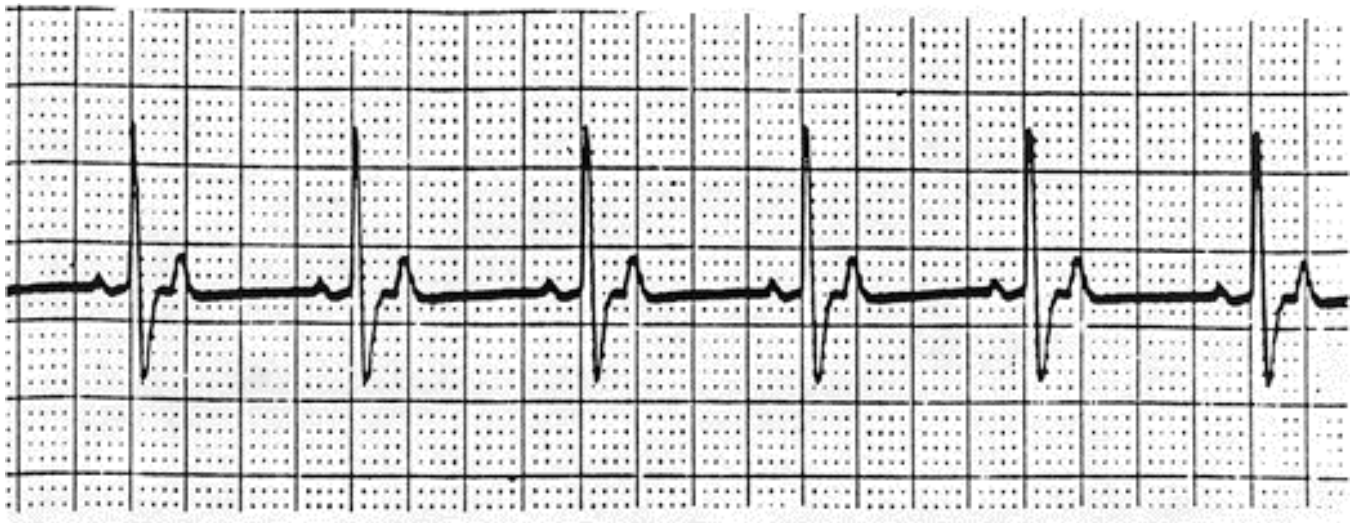


DDD pacing

- **Dual-chamber pacing capable of pacing and sensing in both the atrial and ventricular chambers of the heart**
- **4 distinct patterns can be observed with DDD pacing**
  - Sensing in the atrium and sensing in the ventricle
  - Pacing in the atrium and sensing in the ventricle
  - Sensing in the atrium and pacing in the ventricle (“P wave tracking”)
  - Pacing in the atrium and pacing in the ventricle

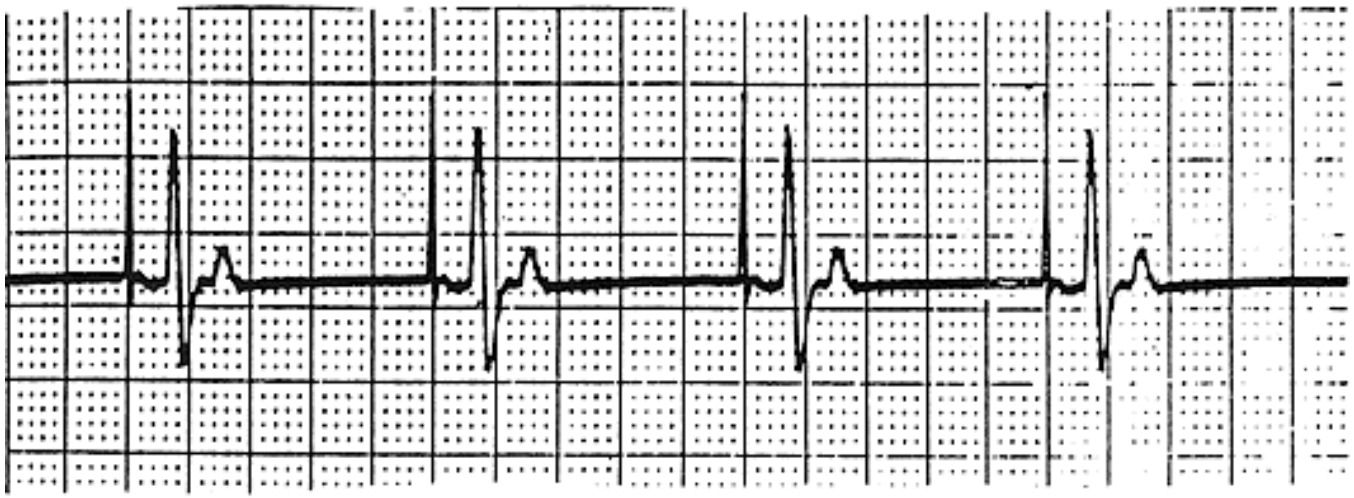
DDD pacing

Example of sensing in both the atrium and the ventricle (inhibiting in both the atrium and the ventricle)



DDD pacing

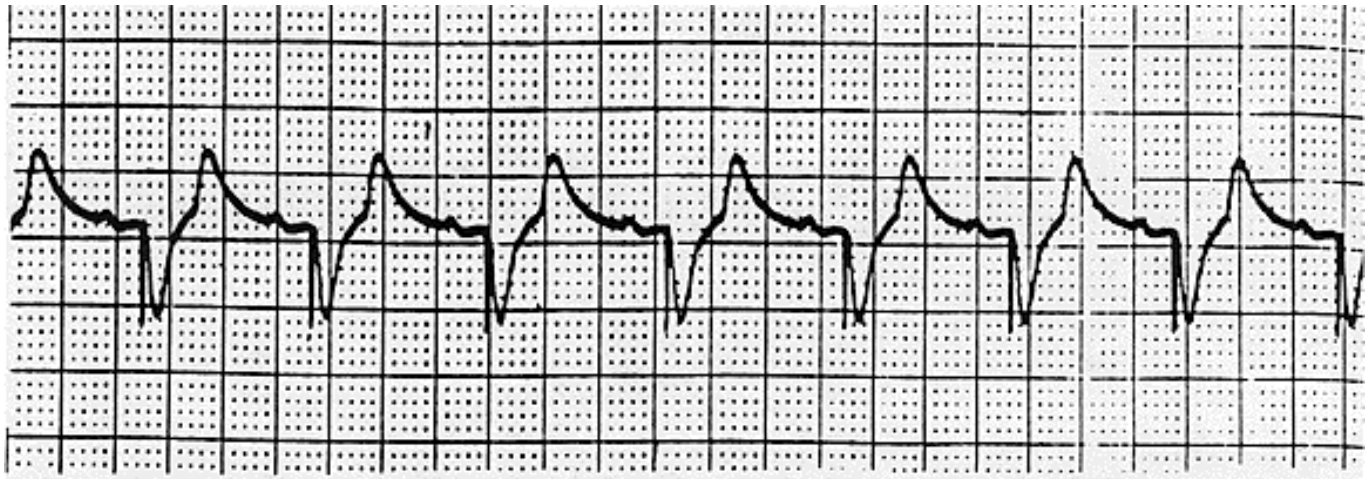
Example of pacing in the atrium with sensing (inhibition of pacing) in the ventricle



DDD pacing

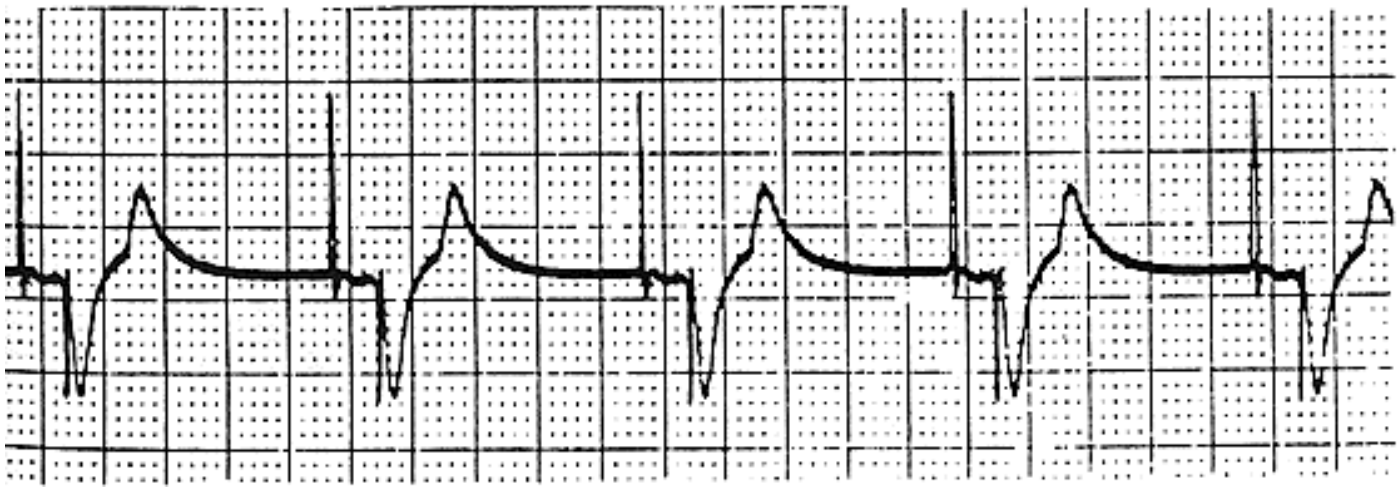
Example of sensing in the atrium (inhibition of atrial pacing) and pacing in the ventricle

- Also known as “P wave tracking”



DDD pacing

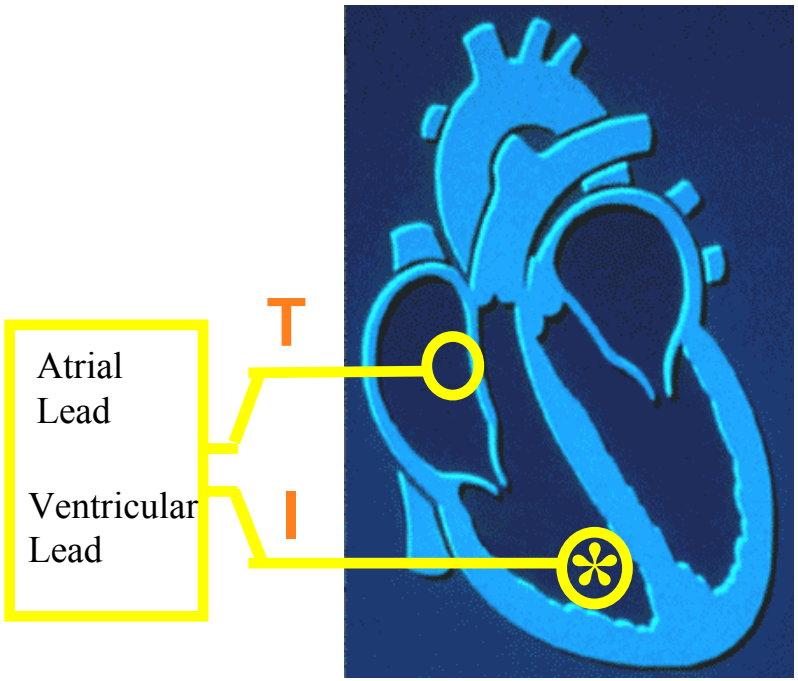
Example of atrial pacing and ventricular pacing (no inhibition of pacing)



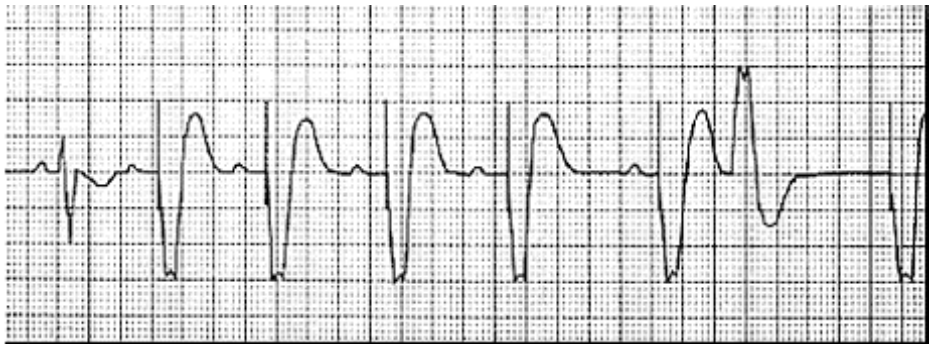
DDD mode

- **Adapts to changes post-implant**
- **May resemble AAI, VAT, VDD, DVI modes**
- **Will strive to maintain AV synchrony with variable atrial rates and AV conduction**

VDD



- Pacing in ventricle
- Sensing in both atrium and ventricle
- Intrinsic QRS inhibits ventricular pacing
- Intrinsic P wave can trigger ventricular pacing

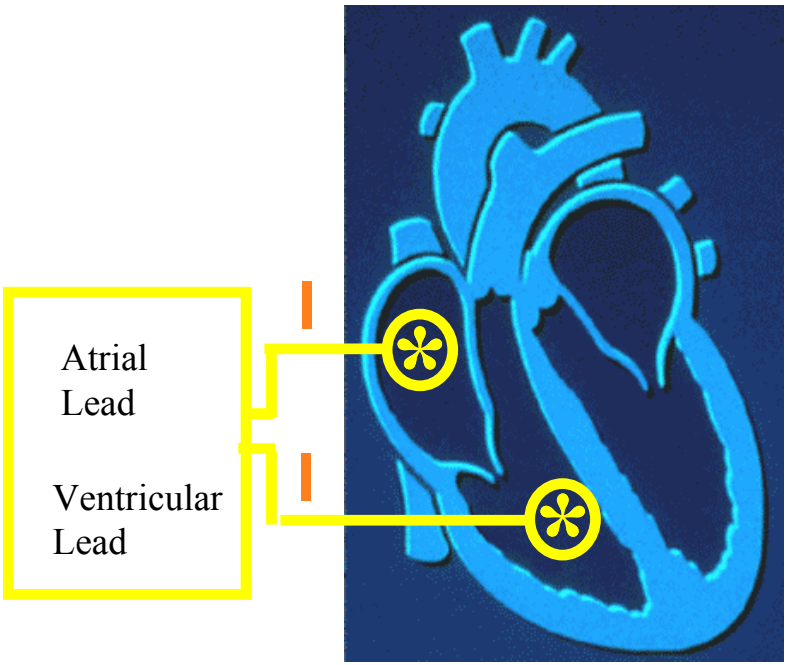


VDD pacing

- **Able to “trigger” a ventricular pacing output in response to an intrinsic P wave (“P wave tracking”)**
- **Able to “inhibit” a ventricular pacing output in response to an intrinsic QRS complex**
- **No atrial pacing. The patient must have normal sinus node function**

Non-tracking modes

DDI

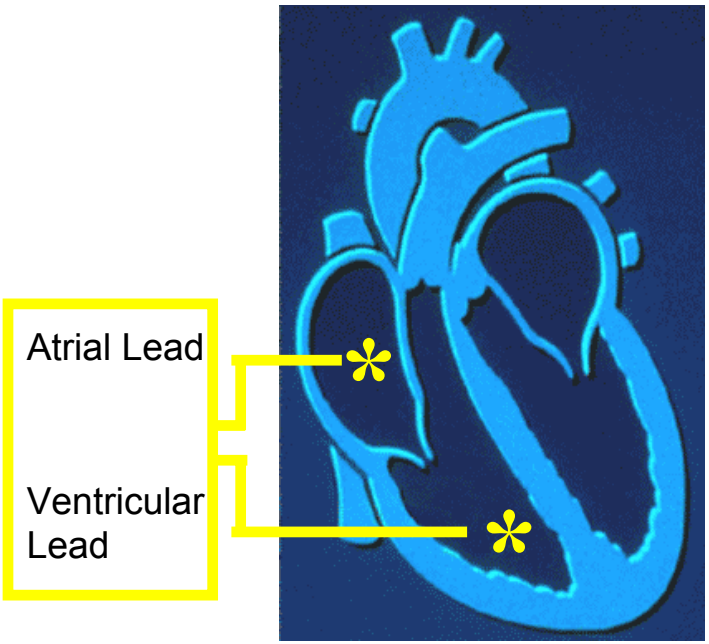


- Pacing in the atrium & ventricle
- Sensing in both atrium and ventricle
- NO tracking of P waves (no constant AV delay)

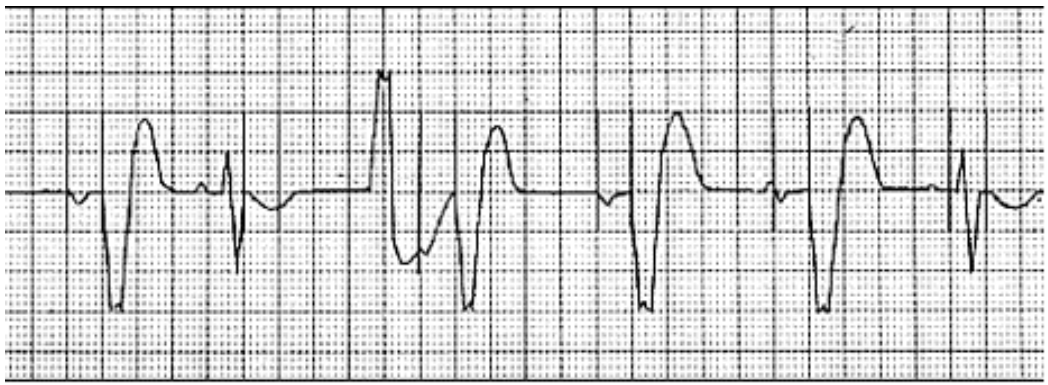
DDI pacing

- **Never trigger (start) an AV delay following an intrinsic P wave. (No P wave tracking)**
- **Similar to combining AAI and VVI modes**
- **Used primarily for atrial tachyarrhythmias and mode switching algorithms**

DOO



- Pacing in atrium and ventricle
- Intrinsic P wave and QRS do not affect pacing
- Asynchronous pacing (always pace at lower pacing rate)



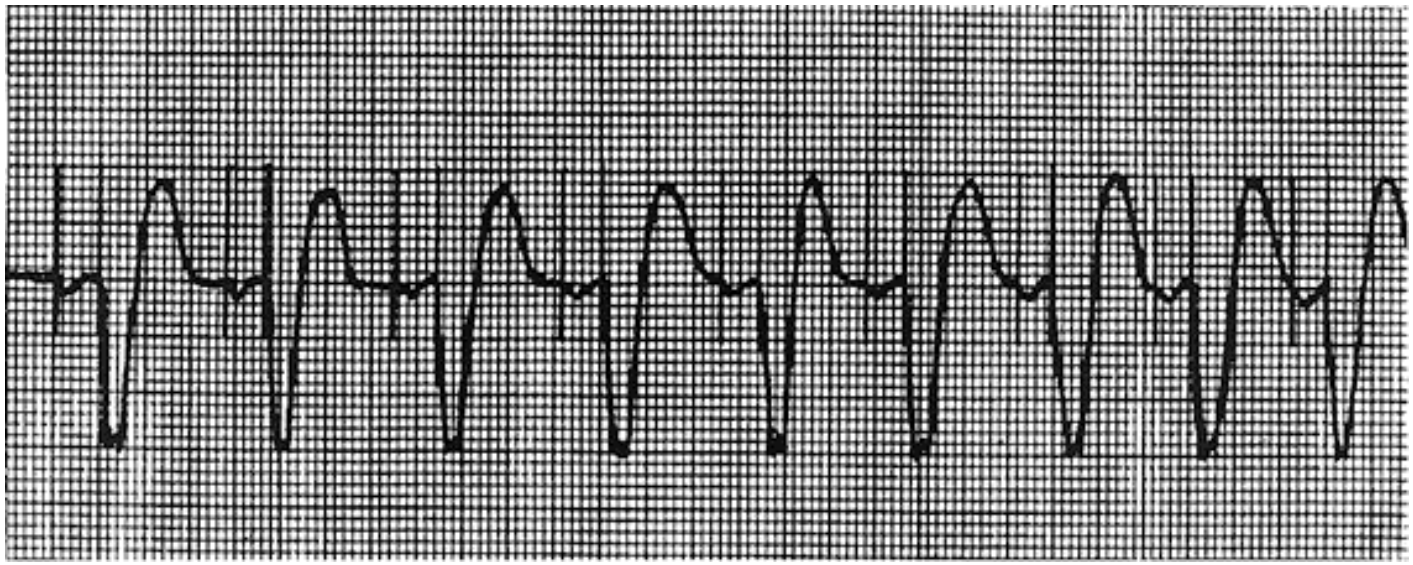
Rate modulation/rate responsive mode

Rate responsiveness/adaptive-rate pacing

- **In Rate Responsive pacing (modes ending with "R"), sensor(s) in pacemaker are used to detect changes in physiologic needs and increase the pacing rate accordingly**
- **The sensor**
  - Sensors are used to detect changes in metabolic demand
  - Sensors sense motion (piezoelectric crystal or accelerometer) or use a physiologic indicator, e.g., minute ventilation
- **The algorithm**
  - Within the software of the pacemaker
  - Uses the input from the sensor to determine the appropriate paced heart rate for the activity

DDDR pacing

Example of Dual-Chamber Rate-Responsive pacing



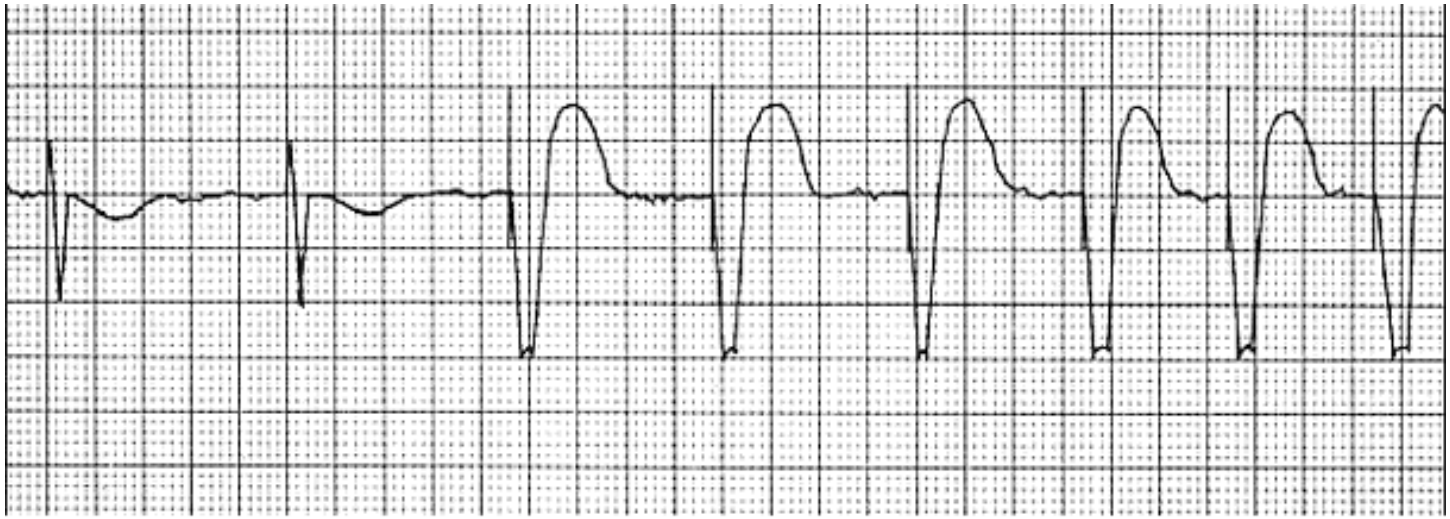
DDDR

A DDDR pacemaker has two or more indicators of a patient's metabolic need:

- Sinus node – the best indicator, as it is physiologic
- Input from the sensor(s) within the pacemaker

Atrial fibrillation with A-V block

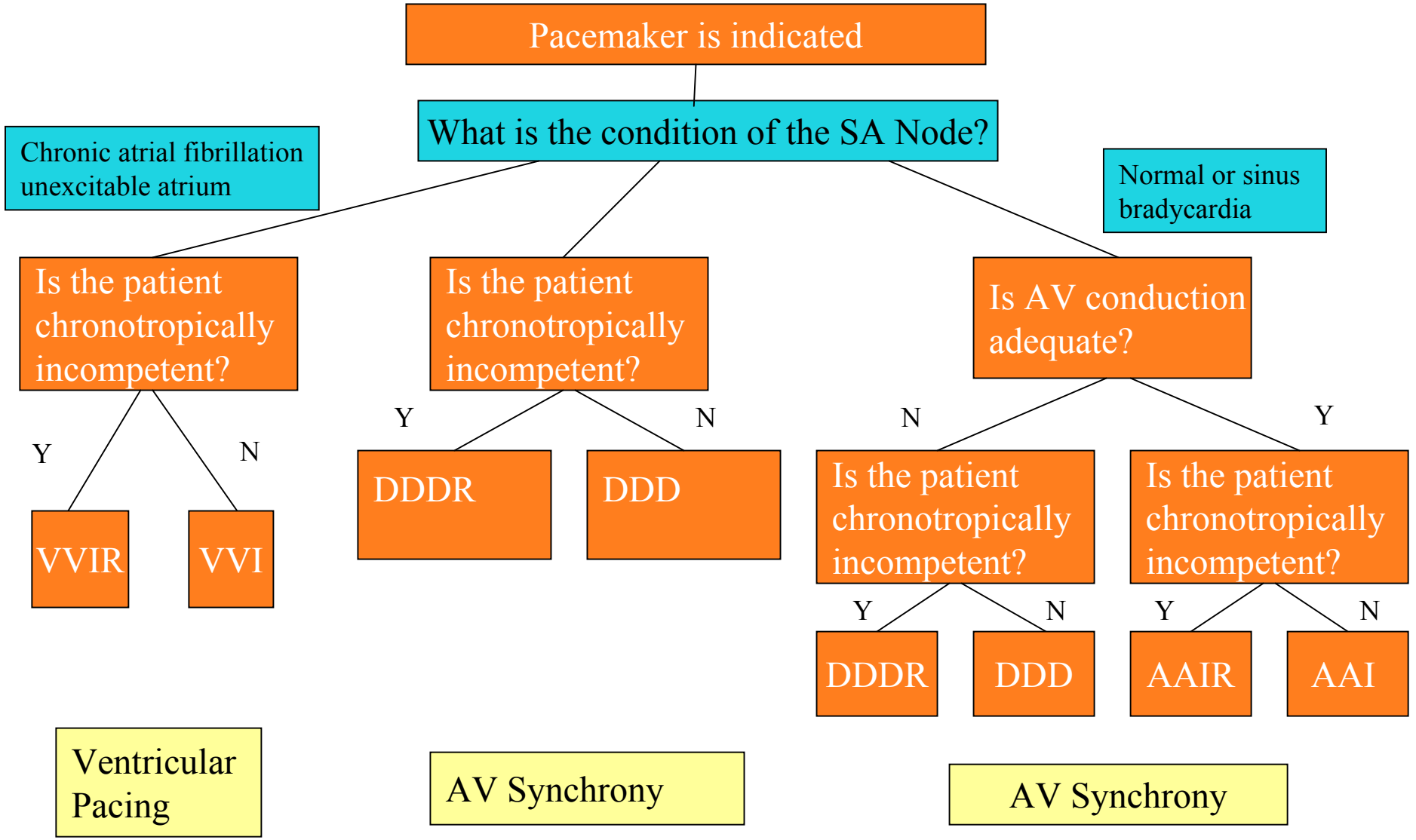
VVIR



Goals of choosing a pacing mode

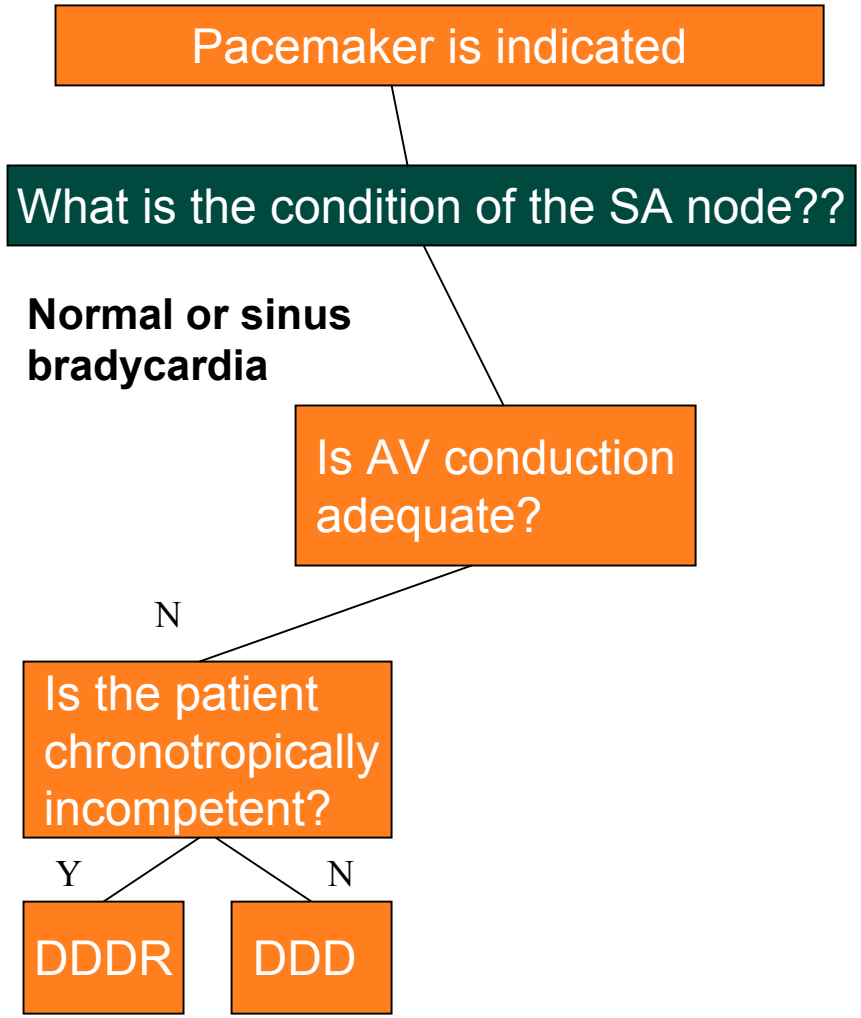
- **Desire to maintain AV synchrony**
  - DDD mode is best to provide AV synchrony
- **Preservation of AV synchrony requires:**
  - Viable atrium and
  - Patient must not have chronic/permanent atrial tachyarrhythmias

Optimal pacing mode decision tree

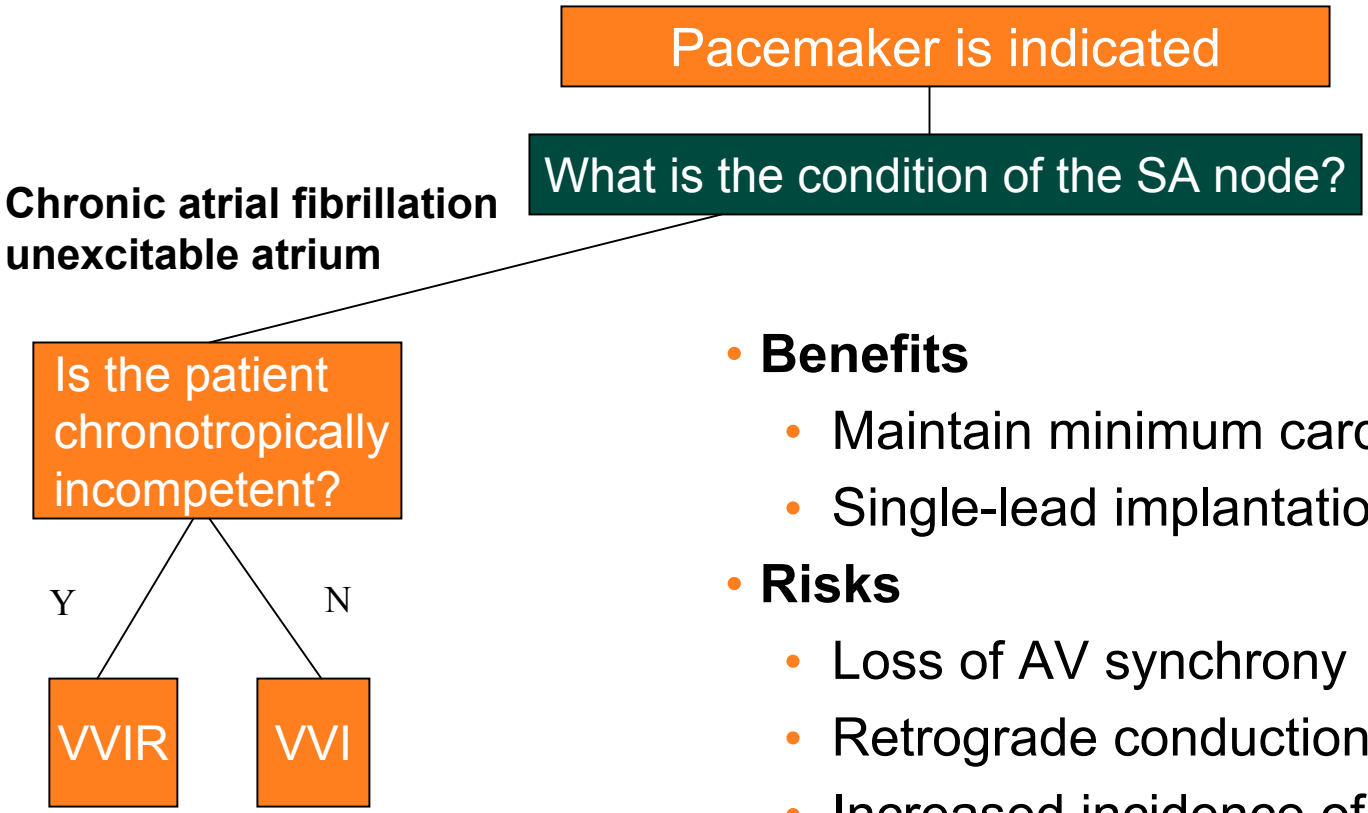


AV synchrony - DDD(R)

- **Benefits**
  - AV synchrony
  - Normal sinus response
- **Risks**
  - Loss of AV conduction



Ventricular pacing



- **Benefits**
  - Maintain minimum cardiac output
  - Single-lead implantation
- **Risks**
  - Loss of AV synchrony
  - Retrograde conduction
  - Increased incidence of atria arrhythmias

AV synchrony

Cardiac Output = Stroke Volume x Heart Rate

- Facilitates venous return
- Increases LVEDP
- Maintains appropriate opening and closing of A-V valves

Pacemaker syndrome

Loss of AV Synchrony

- Shortness of breath
- Fatigue
- Headache
- Syncope
- Vertigo
- CHF, Pulmonary Edema
- Dizziness
- Palpitations
- Pulsations in the neck
- Chest pain
- Near Syncope
- Confusion

Hemodynamic Penalties From Loss Of AV Synchrony

- Loss of atrial contribution
- Decrease in stroke volume
- Decrease in cardiac output
- Decrease in cerebral perfusion
- Decrease in coronary blood flow

Treatment of Pacemaker Syndrome

- Dual-chamber pacing
- Normal atrial sensing & capture
- Appropriate AV Delay

Summary

What was the mode of the first permanent pacemakers?

- VOO

What mode and feature are designed to most effectively mimic the normal cardiac conduction?

- DDD and rate-adaptive pacing

Name 5 symptoms of pacemaker syndrome.

- Palpitations, Canon A waves, fatigue, near syncope, lightheadedness.

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