Sinus Node Dysfunction and AV Block

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Electrophysiology Conference

August 26, 2015

Outline

- Bradyarrhythmias
  - Sinus bradycardia
  - Sinus arrhythmia
  - Sick sinus syndrome
- AV Block
  - First degree
  - Second Degree (I and II)
  - Third Degree
  - AV Dissociation

Bradyarrhythmias

- HR < 60bpm
- Physiologic
  - Athletes
  - Sleep: 1st degree AV block
- Pathologic

Sinus Bradycardia

- Sinus node discharges < 60bpm
- Normal P waves prior to each QRS
- Constant PR interval, > 120msec
- Often concomitant sinus arrhythmia


A
B

Sinus Bradycardia

- Excessive vagal or decreased sympathetic tone
  - Medications, anatomic changes in sinus node
- Asymptomatic
  - Young, healthy adults
  - If pause > 3 sec, pacing may be indicated
- Symptomatic
  - Reversible causes
  - Pacing

Sinus Arrhythmia

- Normal variant
- Most frequent arrhythmia
- Phasic change in P-P interval
  - Longest and shortest P-P intervals vary by > 0.16 sec or 10%.
- Marker of intact heart-rate variability
- Symptoms if long pauses between beats (rare)

Sinus Pause or sinus arrest

- Pause in sinus rhythm
- Slowing or cessation of spontaneous sinus nodal automaticity
- Absense of atrial depolariztion, ventricular asystole if escape beat is absent
- Acute MI, fibrotic changes, dig toxicity, stroke, excessive vagal tone
- Rx: reverse cause, pacing (pause > 3 sec if no sx)


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08:41
08:47

Sinoatrial Exit Block

- Impulse formed within the sinus node fails to depolarize the atria
- Results in pause on ECG where normal P wave would be
- Duration of pause is a multiple of basic P-P interval

SA Exit Block

- Type I second-degree (Wenkebach)
  - P-P interval progressively shortens before pause
  - Duration of pause is less than 2 P-P cycles
  - Cannot see on ECG
- Type II second-degree
  - Pause equals 2, 3 or 4x the normal P-P interval

A: Type I SA nodal exit block: P-P interval shortens from 1st to 2nd cycle. Duration of pause is < than 2x the shortest cycle length. Cycle after the pause is greater than cycle before the pause.

B: Type II 2:1 SA nodal exit block: 2 pauses in SA nodal activity equal 2x the basic P-P interval.

SA Exit Block

- Usually transient
- Excessive vagal stimulation, acute myocarditis, infarction, fibrosis, dig
- Rx similar to that of sinus bradycardia

Sick Sinus Syndrome

- Encompasses many sinus nodal abnormalities
  - Persistent spontaneous sinus bradycardia not caused by drugs and inappropriate for physiologic condition
  - Sinus arrest or exit block
  - Combinations of SA and AV conduction disturbances
  - Alternation of paroxysms of rapid regular or irregular atrial tachyarrhythmias and periods of slow atrial and ventricular rates (Tachy-brady)

Sick Sinus Syndrome

Top: intermittent sinus arrest, with junctional escape beats

Bottom: atrial flutter followed by off-set pause, then junctional escape rhythm

Sick Sinus Syndrome

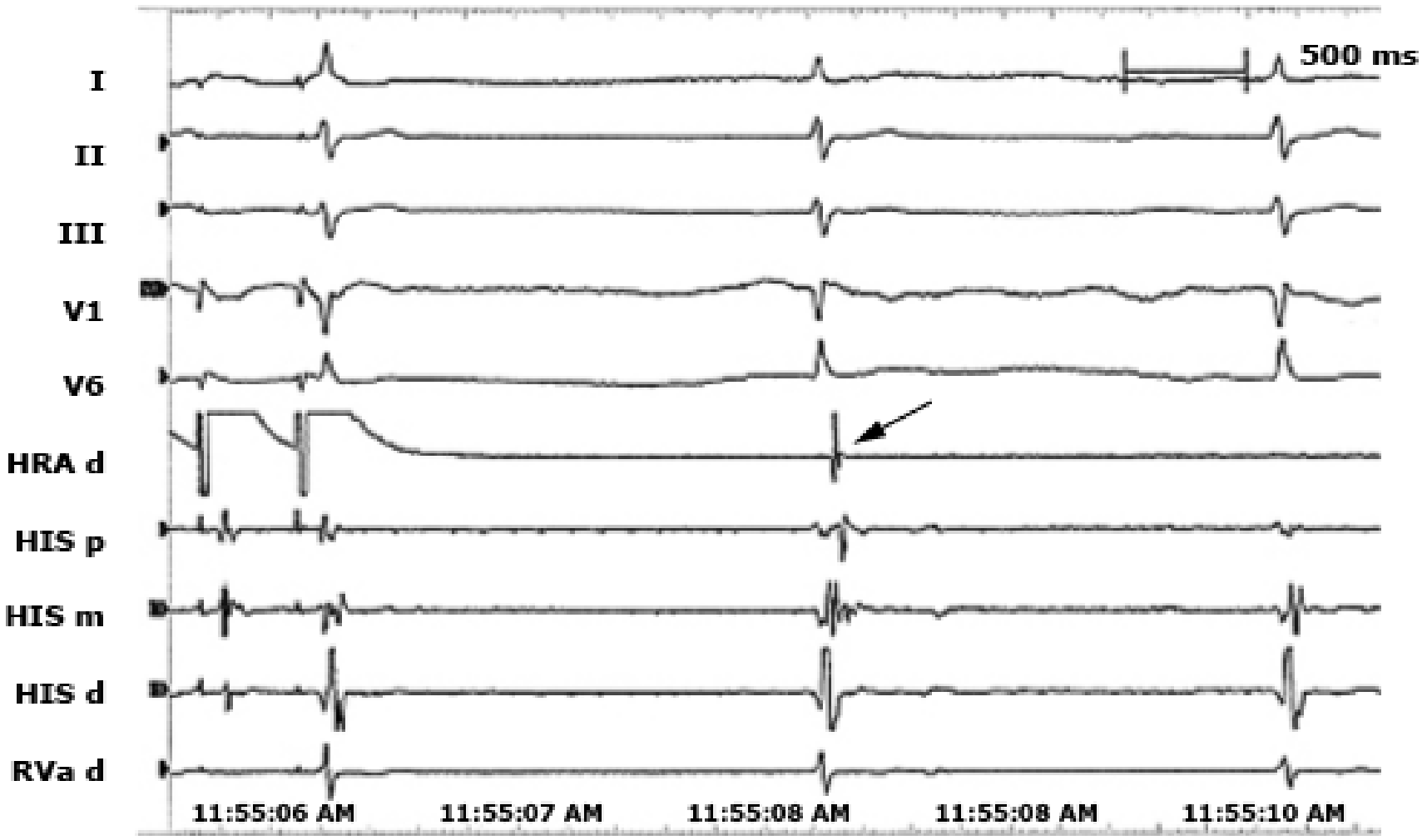
- Intrinsic sinus node disease and/or autonomic abnormalities
- Anatomy
  - total or subtotal destruction of sinus node
  - Areas of nodal-atrial discontinuity
  - Inflammatory or degenerative changes of surrounding nerves
  - Fibrofatty infiltration
  - Sclerodegenerative changes
  - Occlusion of sinus node artery

Sick sinus syndrome

- Can occur alone or in setting of congenital or acquired heart disease
- Course is intermittent and unpredictable
  - Influenced by severity of underlying heart disease
- Management
  - Pacing for bradycardia when symptomatic
  - +/- drug therapy for tachycardia

Sinus node recovery time (SNRT)

- Assess sinus node function
- Pacing near the sinus node slightly faster than intrinsic heart rate
- Await escape P wave and confirm that it is sinus
- Max SNRT: longest pause from last pacing stimulus to first spontaneously occurring sinus beat
- Sinus cycle length affects SNRT
- Corrected SNRT (CSNRT) = Return cycle length – sinus cycle length
  - Normal < 550 msec
- Total recovery time (TRT): time required to return to basal sinus rate
  - Normal is less than five seconds



After termination of pacing, SNRT of >2150msec is observed. Basal cycle length was 1200 msec, giving a CSNRT of 950msec consistent with severe SN dysfunction.

AV Block

- First-degree
- Second-degree type I (Wenkebach)
- Second-degree type II
- Third degree

AV Block

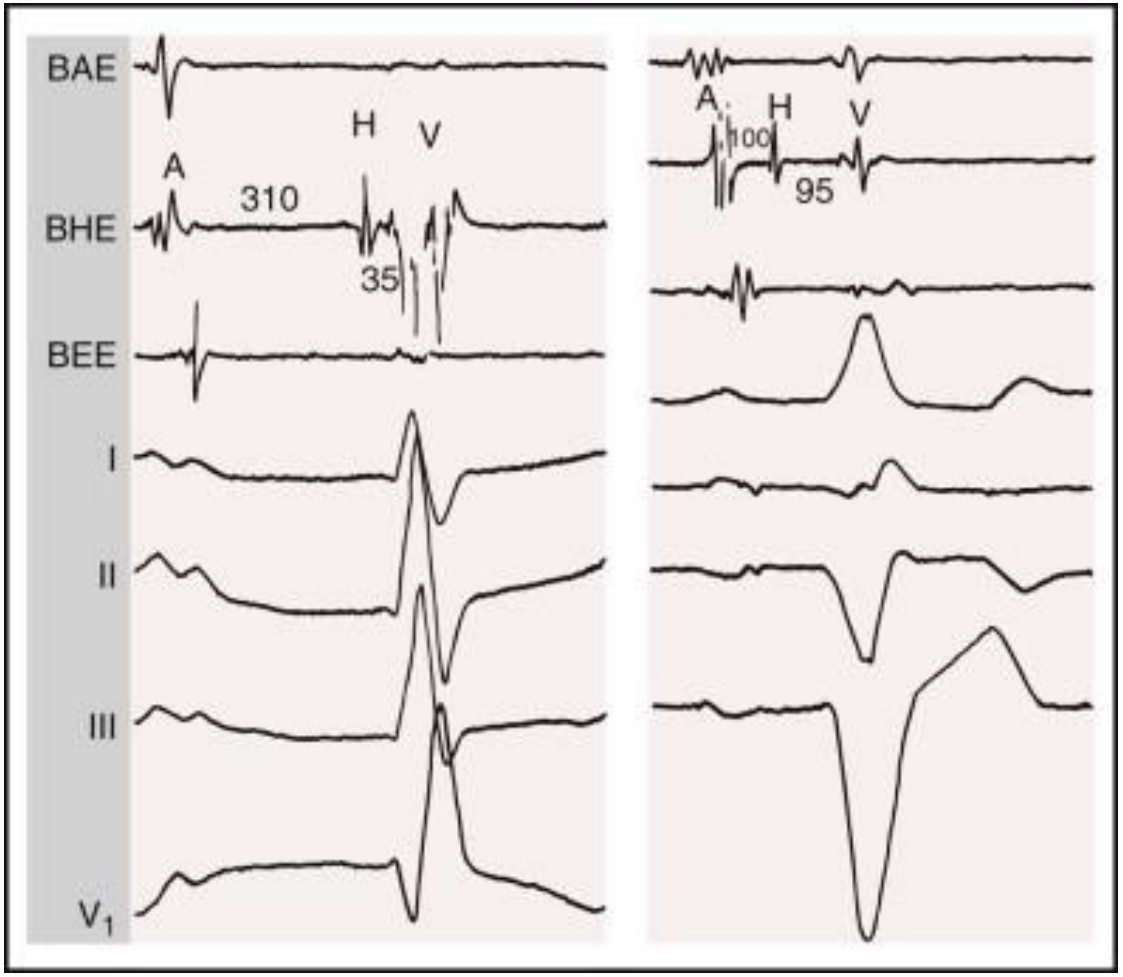
- Disturbance of impulse conduction that is either permanent or transient
- Atrial impulse is conducted with delay or is not conducted at all to the ventricle when the AV junction is physiologically refractory

First Degree AV Block

- Every atrial impulse conducted to the ventricles with a regular ventricular rate but PR interval > 0.20sec in adults
- Site of conduction delay
  - AV node: normal or widened QRS
  - His-Purkinje system: widened QRS
  - Intra-atrial
- Can progress to 2nd degree type I with increase in atrial rate or vagal tone

First degree AV Block

Delay in AV Node



Delay in His-Purkinje system

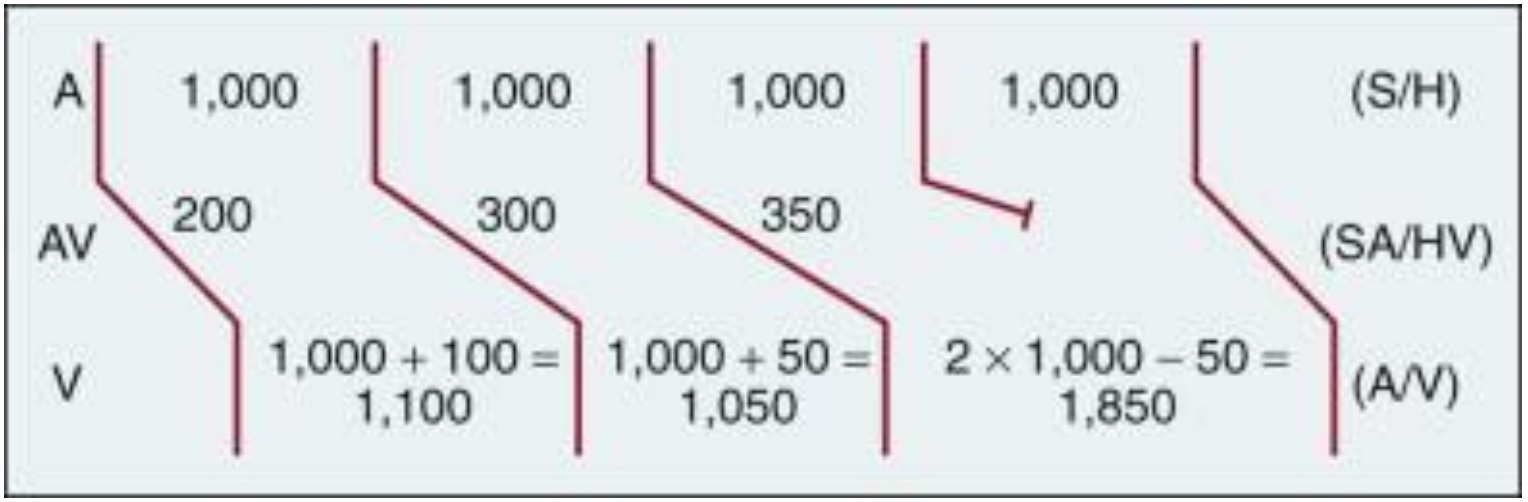
Second Degree AV Block

- Blocking of some atrial impulses to the ventricle
- Non-conducted P wave can be intermittent or frequent, at regular or irregular intervals, preceded by fixed or lengthing of PR intervals

Mobitz I Second Degree AV Block (Wenkebach)

- Progressive prolongation of the P-R interval until a P wave is not conducted
- Progressive shortening of the R-R interval
- R-R interval containing non-conducted P wave is less than two P-P intervals
- Cycle that follows non-conducted beat is longer than the cycle preceding the blocked impulse
- “grouped beating”

Typical Wenckebach cycle



Wenckebach (atypical)

A

Increment in conduction delay does not consistently decrease (last PR interval actually increases,)

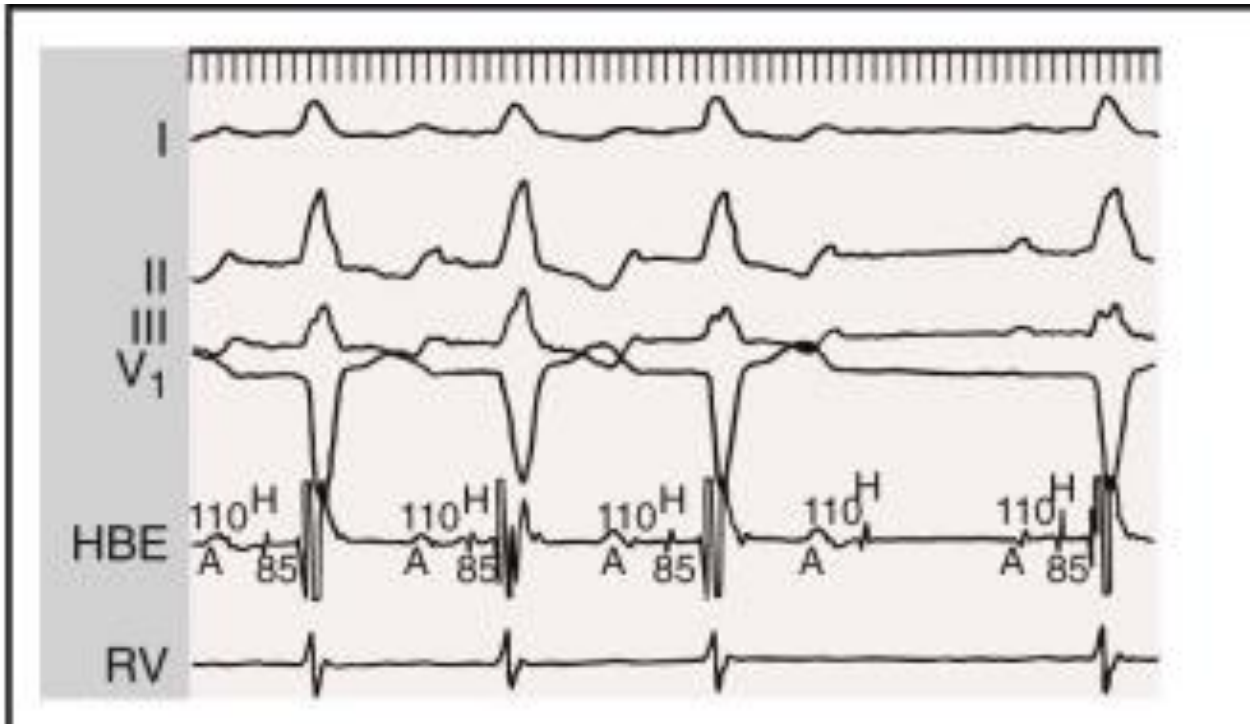
Wenckebach causes

- Normals
- Atheletes
- Drugs (digitalis, b-blockers, CCB's, clonidine, methyldopa, flecainide, sotalol, amio, propafenone, lithium)
- Myocardial infarction, esp inferior
- Myocarditis

Mobitz II Second Degree AV Block

- Regular sinus or atrial rhythm with intermittent nonconducted P waves
- Constant PR interval
- R-R interval containing non-conducted P wave is equal to two P-P intervals
- Usually occurs within or below bundle of His
  - QRS is wide in 80%
- Higher likelihood of progressing to 3rd degree AV block

Mobitz II



Sudden development of His-Purkinje block

2:1 AV block

- Regular sinus or atrial rhythm with two P waves for each QRS
- Can be Mobitz I or II

Unidirectional block. **Top,** During spontaneous sinus rhythm at a rate of 68 beats/min, 2 : 1 anterograde atrioventricular conduction occurs. **Bottom,** 1:1 retrograde conduction is seen during ventricular pacing at a rate of 70 beats/min. P waves are indicated by **arrowheads**.

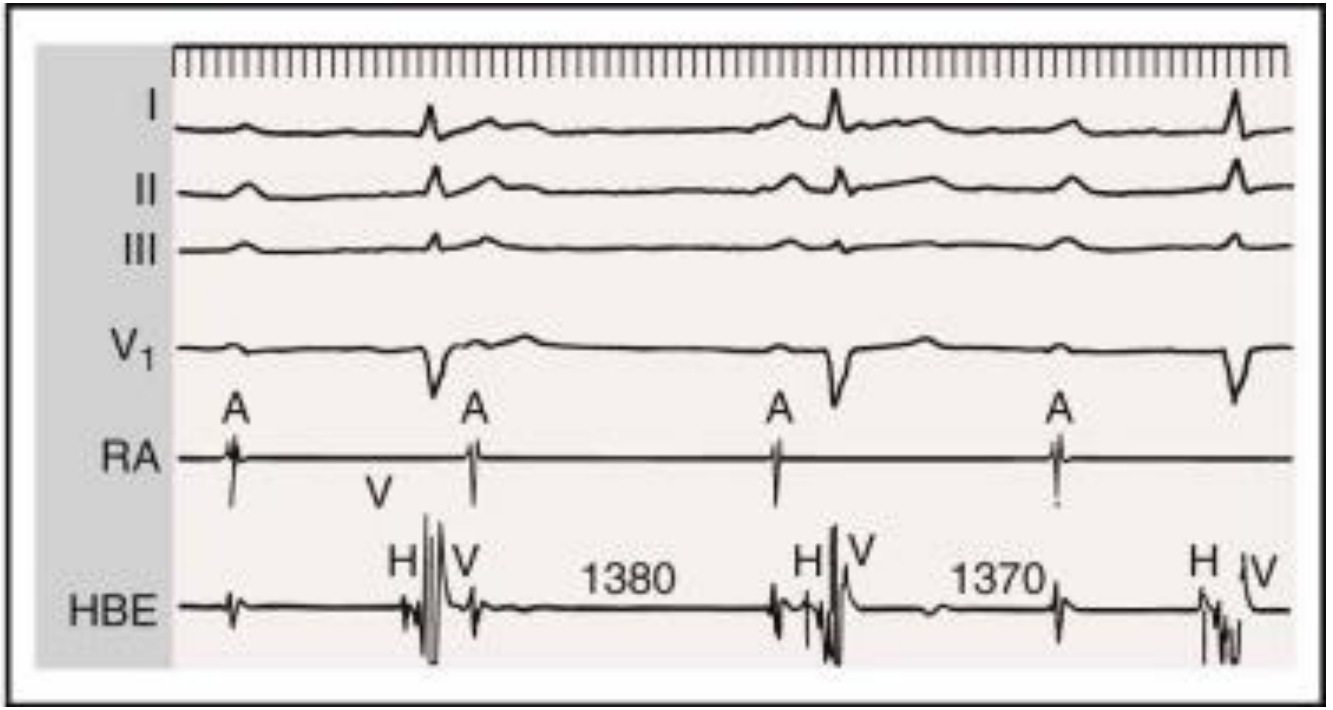
Features suggesting the Mechanism of 2:1 AV block

Feature	Mobitz I	Mobitz II
QRS duration	Narrow	Wide
Response to maneuvers that ↑ HR & AV conduction (atropine, exercise)	Block improves	Block worsens
Reponse to maneuvers that ↓ HR & AV conduction (carotid sinus massage)	Block worsens	Block improves
Develops after acute MI	Inferior MI	Anterior MI
Other	Mobitz I on another part of ECG	History of syncope

Third Degree AV Block

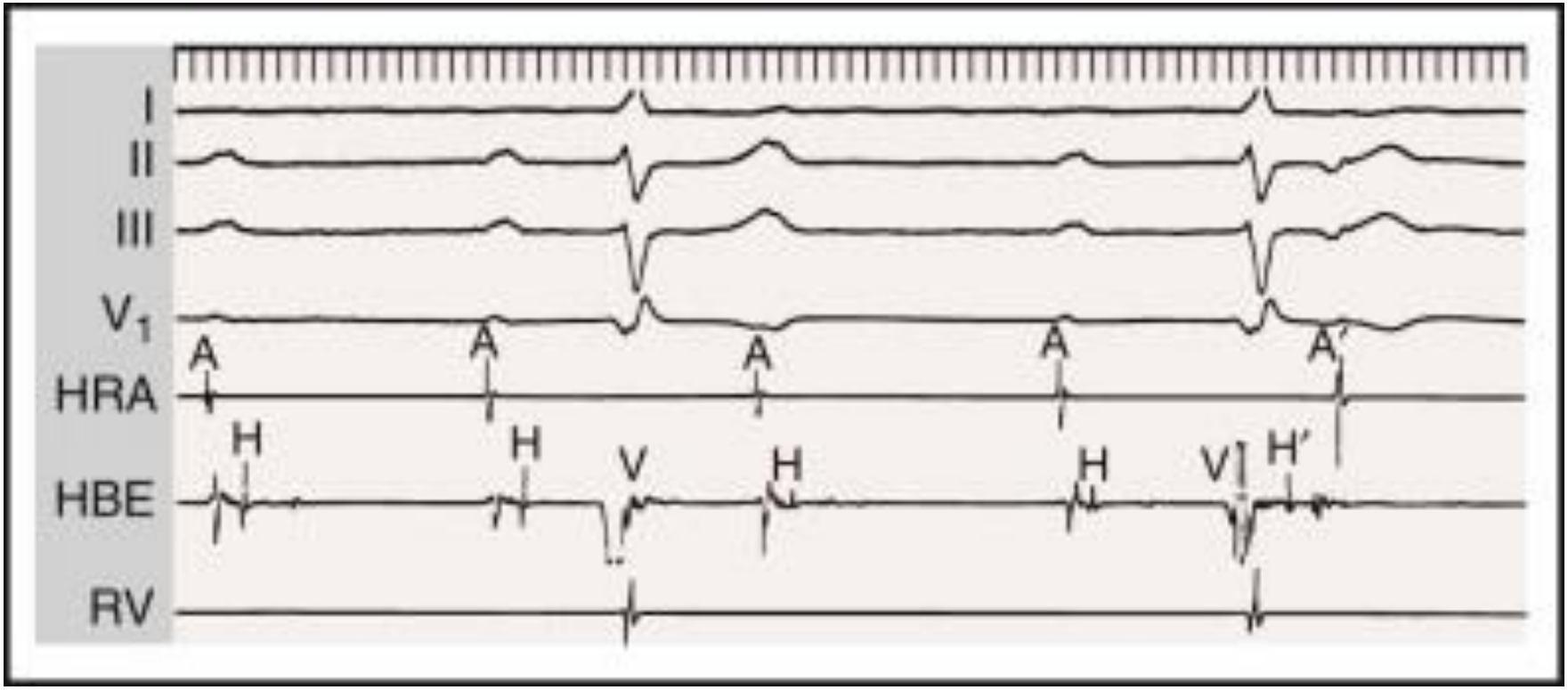
- Atrial impulses consistently fail to reach the ventricles, resulting in atrial and ventricular rhythms that are independent of each other
- PR interval varies
- P-P and R-R intervals are constant
- Atrial rate is usually faster than ventricular rate
- Ventricular rhythm maintained by junctional or idioventricular escape or ventricular PM

3rd Degree AV Block



No P wave is followed by a His Bundle potential, whereas each ventricular depolarization is preceded by a His Bundle

3rd degree AV block with retrograde VA conduction



Causes of Third degree AV block

- Myocardial Infarction
  - Occur in 5-15% of acute MI's
  - Inferior
    - 1st degree AVB or Wenkebach first
    - Stable junctional escape
    - Transient
  - Anterior
    - Mobitz II or bifascicular block
    - Up to 70% mortality (due to pump failure)
- Degenerative Diseases
- Congenital heart disease
- Infiltrative Diseases (amyloid, sarcoid)
- Digitalis toxicity: common reversible cause
- Endocarditis
- Hyperkalemia, advanced
- Lyme Disease
- Myocardial Contusion
- Acute rheumatic fever
- Aortic valve disease

Management of Third Degree Heart Block

- Monitoring if transient
- Reversible causes
- Temporary pacing
- Permanent pacing
  - Symptomatic AV block or high-grade AV block
- Atropine or isoproterenol

Questions