Arrhythmias and EKGs

Part 1

Outline

1. Normal Sinus Rhythm
2. Altered Automaticity
3. Reentry
4. Conduction Block
5. Helpful hints for diagnosing arrhythmias

Normal Sinus Rhythm

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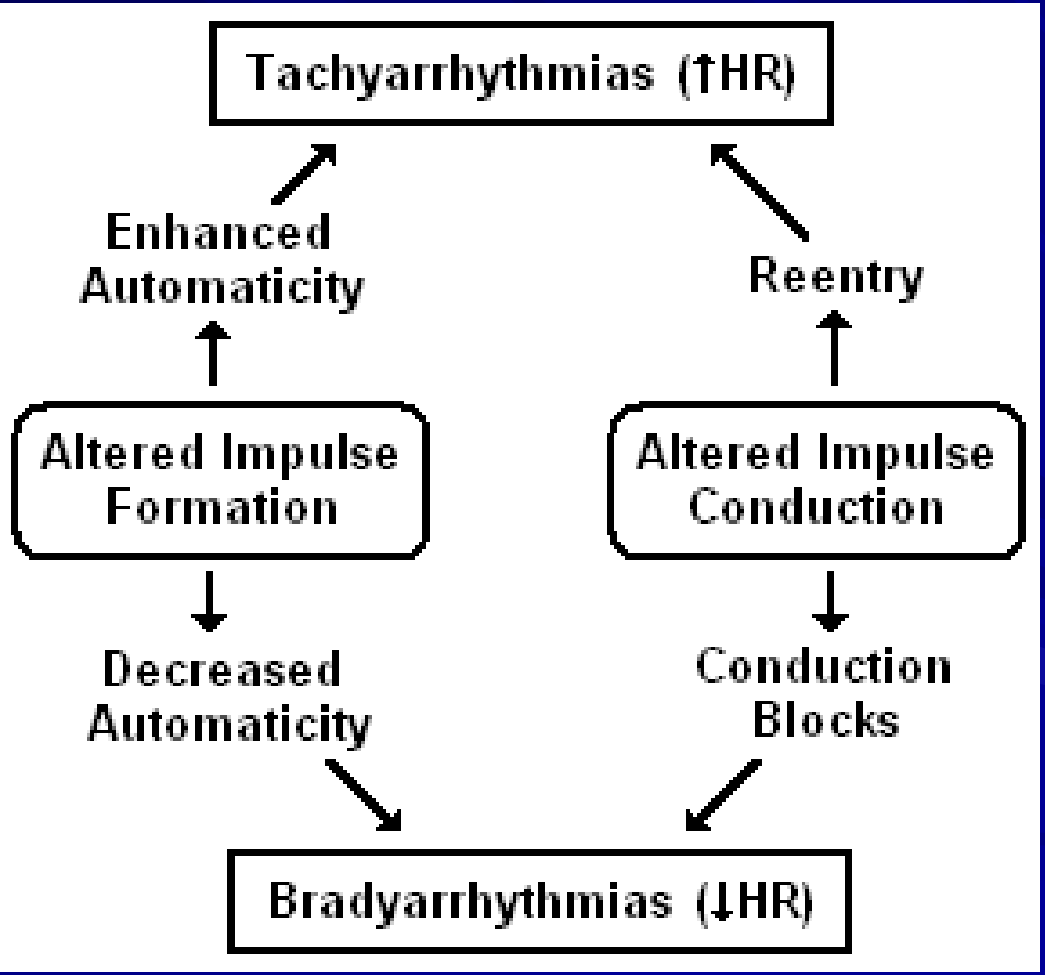
Implies normal sequence of conduction, originating in the sinus node and proceeding to the ventricles via the AV node and His-Purkinje system.

EKG Characteristics:

- Regular narrow-complex rhythm
- Rate 60-100 bpm
- Each QRS complex is proceeded by a P wave
- P wave is upright in lead II & downgoing in lead aVR

Mechanisms of Arrhythmogenesis

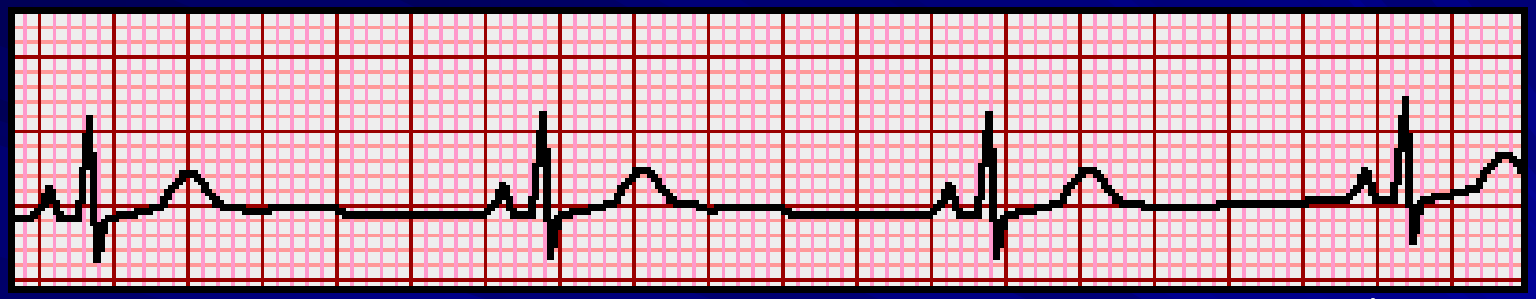


Recognizing altered automaticity on EKG

Gradual onset and termination of the arrhythmia.

The P wave of the first beat of the arrhythmia is typically the same as the remaining beats of the arrhythmia (if a P wave is present at all).

Decreased Automaticity



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Sinus Bradycardia

Increased/Abnormal Automaticity

Sinus tachycardia

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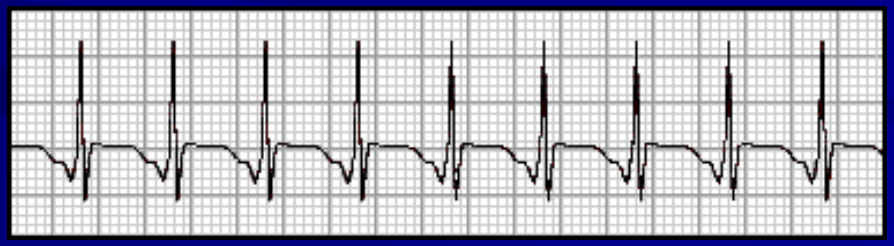
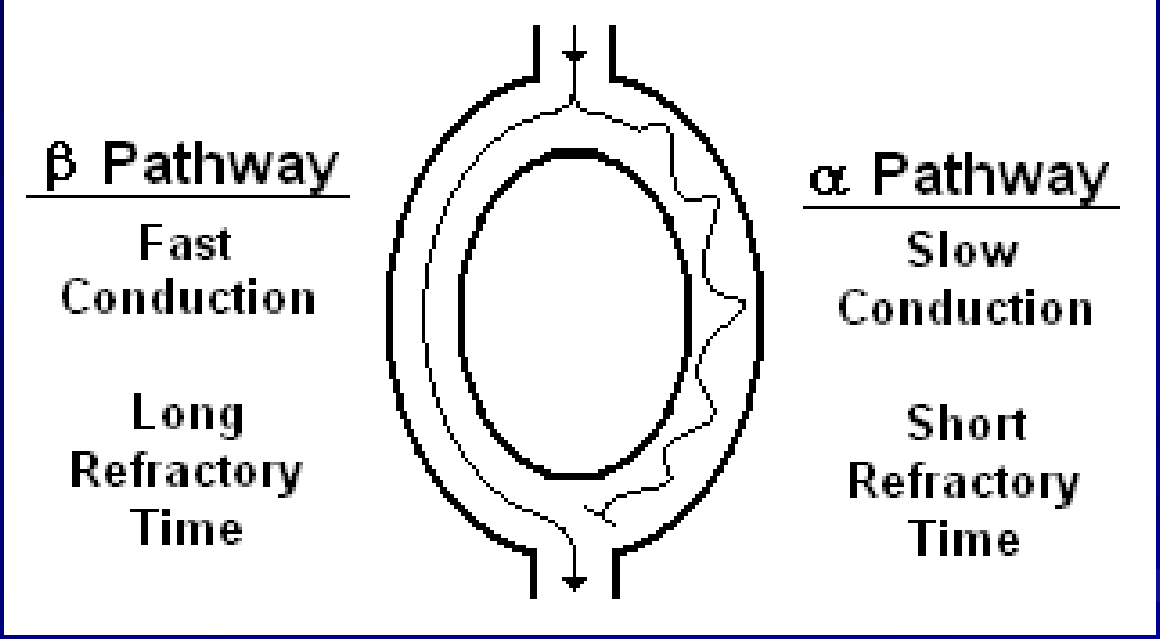
Ectopic atrial tachycardia

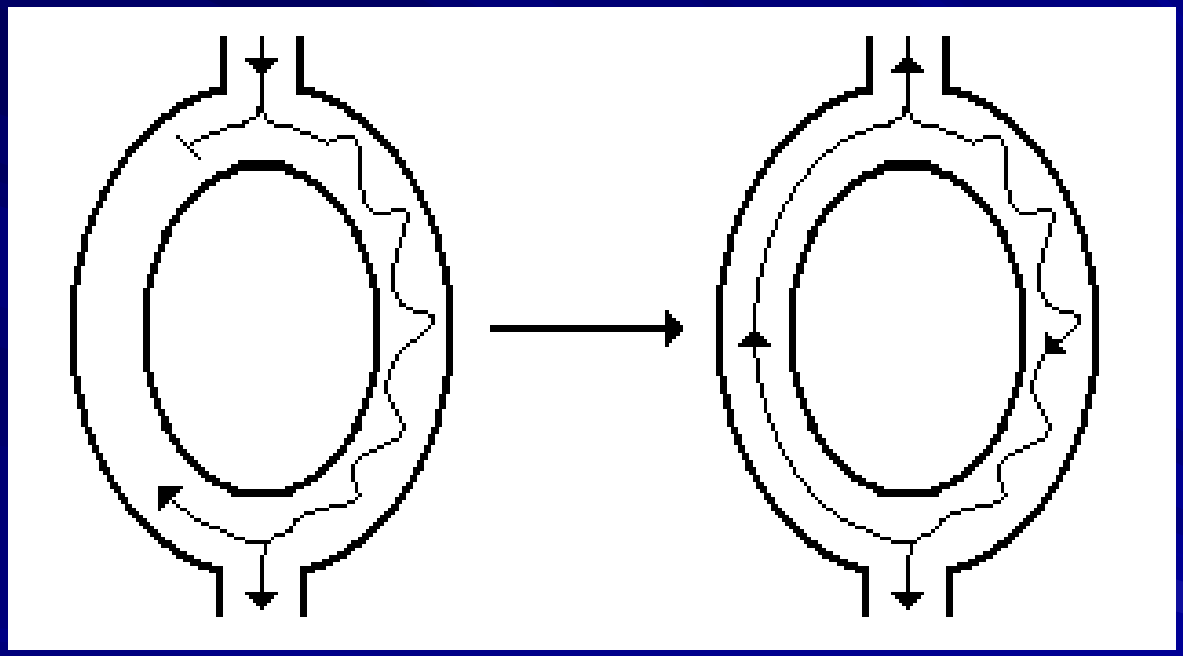


Junctional tachycardia

Mechanism of Reentry



Mechanism of Reentry



Reentrant Rhythms

- AV nodal reentrant tachycardia (AVNRT)
- AV reentrant tachycardia (AVRT)
  - Orthodromic
  - Antidromic
- Atrial flutter
- Atrial fibrillation
- Ventricular tachycardia

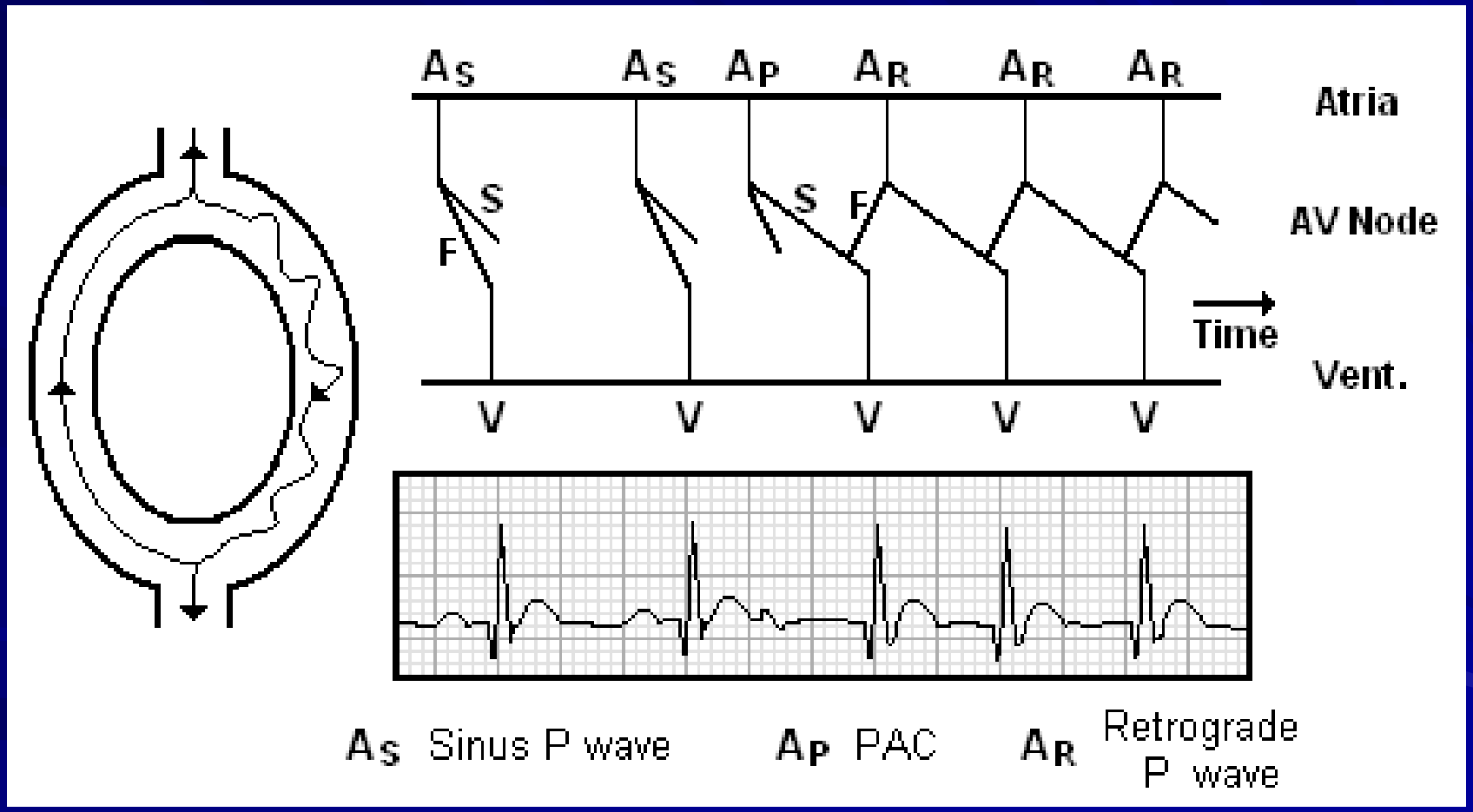
Recognizing reentry on EKG

Abrupt onset and termination of the arrhythmia.

The P wave of the first beat of the arrhythmia is different as the remaining beats of the arrhythmia (if a P wave is present at all).

Example of AVNRT

Mechanism of AVNRT



Atrial Flutter

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Most cases of atrial flutter are caused by a large reentrant circuit in the wall of the right atrium

EKG Characteristics:

- Biphasic “sawtooth” flutter waves at a rate of ~ 300 bpm
- Flutter waves have constant amplitude, duration, and morphology through the cardiac cycle
- There is usually either a 2:1 or 4:1 block at the AV node, resulting in ventricular rates of either 150 or 75 bpm

Unmasking of Flutter Waves

Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine, 7th ed., 2005.

In the presence of 2:1 AV block, the flutter waves may not be immediately apparent. These can be brought out by administration of adenosine.

Atrial Fibrillation

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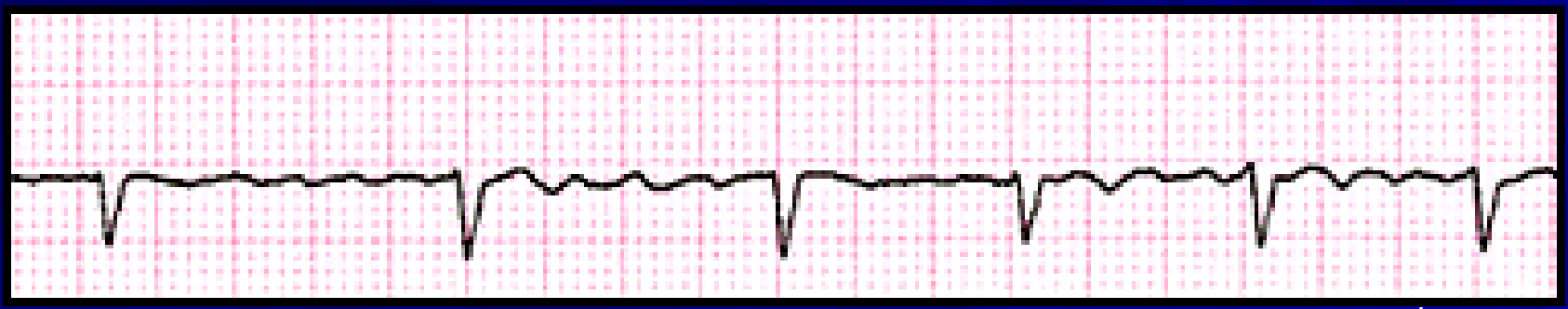
Atrial fibrillation is caused by numerous wavelets of depolarization spreading throughout the atria simultaneously, leading to an absence of coordinated atrial contraction.

Atrial fibrillation is important because it can lead to:

- Hemodynamic compromise
- Systemic embolization
- Symptoms

Atrial Fibrillation



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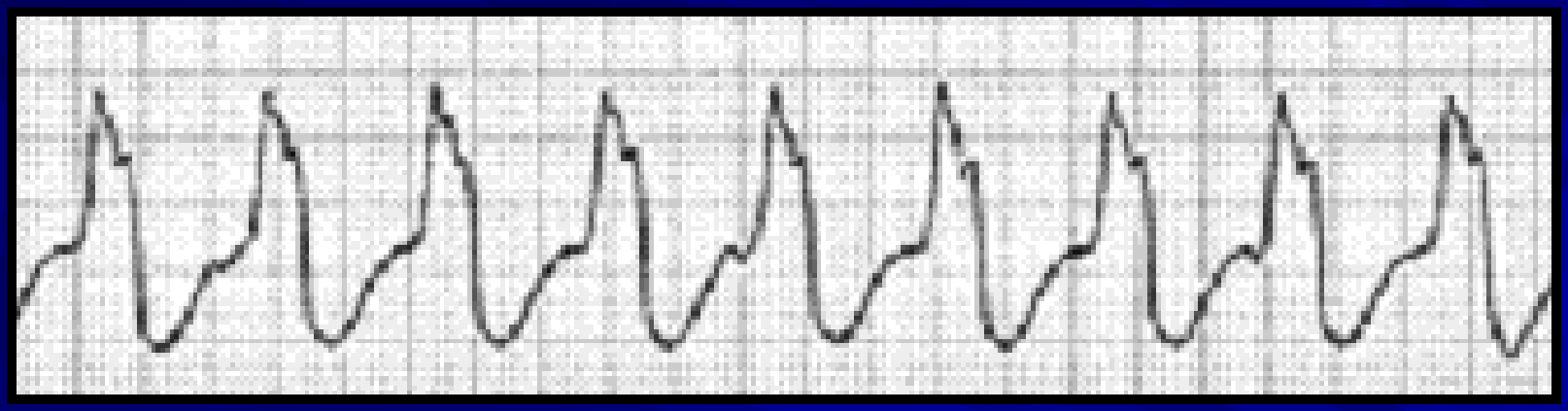
EKG Characteristics:

- Absent P waves
- Presence of fine “fibrillatory” waves which vary in amplitude and morphology
- Irregularly irregular ventricular response

What is this arrhythmia?



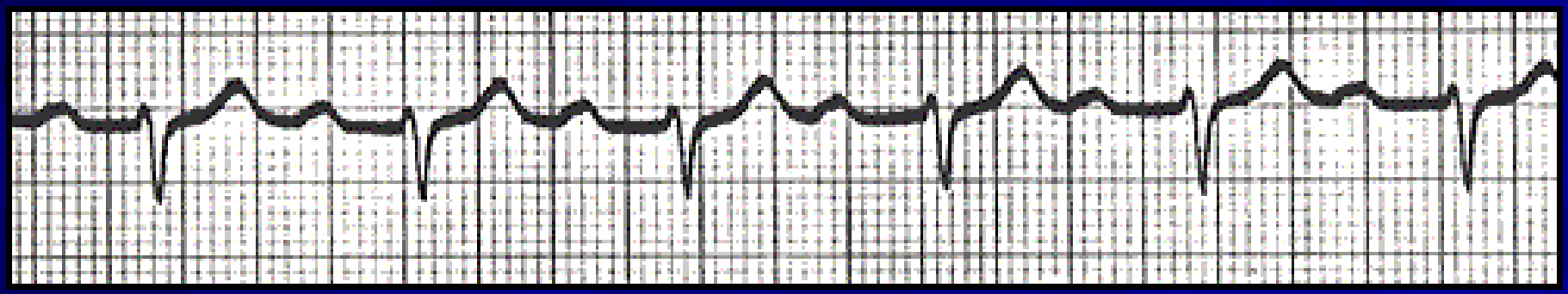
Ventricular tachycardia

Ventricular tachycardia is usually caused by reentry, and most commonly seen in patients following myocardial infarction.

Rhythms Produced by Conduction Block

- AV Block (relatively common)
  - 1st degree AV block
  - Type 1 2nd degree AV block
  - Type 2 2nd degree AV block
  - 3rd degree AV block
- SA Block (relatively rare)

1st Degree AV Block

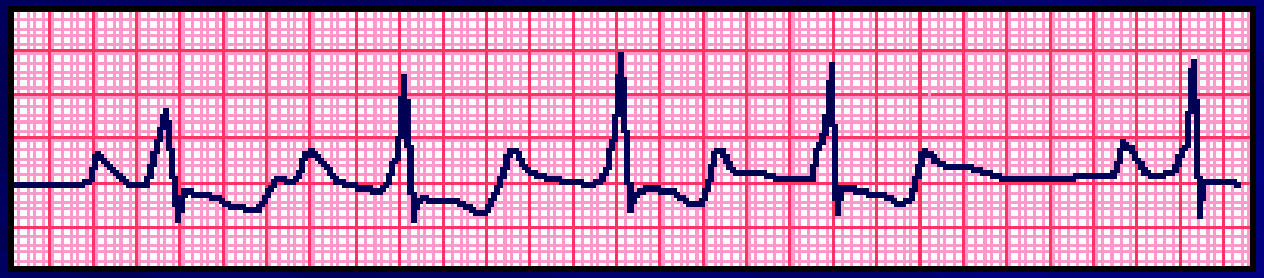


The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/

EKG Characteristics: Prolongation of the PR interval, which is constant

All P waves are conducted

2nd Degree AV Block



Type 1
(Wenckebach)

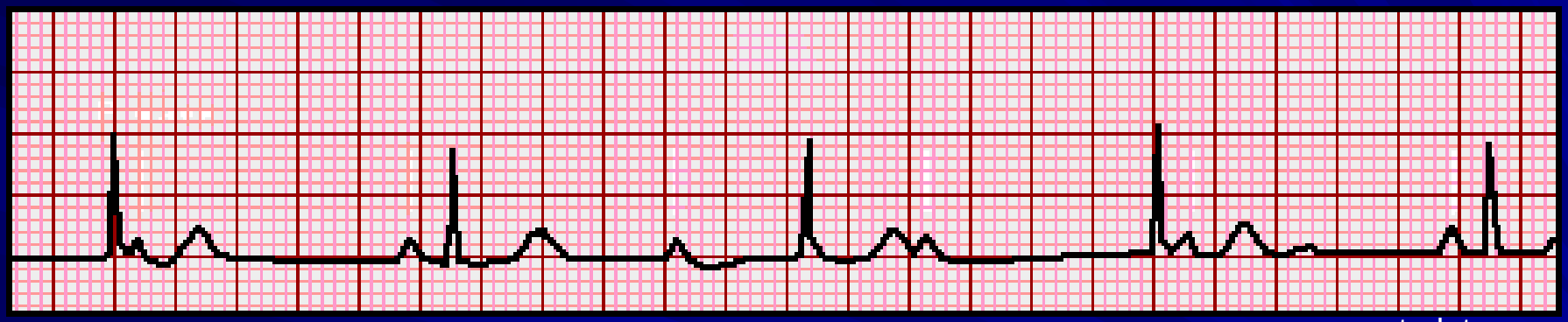
EKG Characteristics: Progressive prolongation of the PR interval until a P wave is not conducted.

As the PR interval prolongs, the RR interval actually shortens

Type 2

EKG Characteristics: Constant PR interval with intermittent failure to conduct

3rd Degree (Complete) AV Block



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EKG Characteristics:

- No relationship between P waves and QRS complexes
- Relatively constant PP intervals and RR intervals
- Greater number of P waves than QRS complexes

Questions to answer in order to identify an unknown arrhythmia:

1. Is the rate slow (<60 bpm) or fast (>100 bpm)?

   Slow → Suggests sinus bradycardia, sinus arrest, or conduction block

   Fast → Suggets increased/abnormal automaticity or reentry

2. Is the rhythm irregular?

   Irregular → Suggests atrial fibrillation, 2nd degree AV block, multifocal atrial tachycardia, or atrial flutter with variable AV block

3. Is the QRS complex narrow or wide?

   Narrow → Rhythm must originate from the AV node or above

   Wide → Rhythm may originate from anywhere

Questions to answer in order to identify an unknown arrhythmia:

4. Are there P waves?

   Absent P waves → Suggests atrial fibrillation, ventricular tachycardia, or rhythms originating from the AV node

5. What is the relationship between the P waves and QRS complexes?

   More P waves than QRS complexes → Suggests 2nd or 3rd degree AV block

   More QRS complexes than P waves → Suggests an accelerated junctional or ventricular rhythm

6. Is the onset/termination of the rhythm abrupt or gradual?

   Abrupt → Suggests reentrant rhythm

   Gradual → Suggests altered automaticity