## 1 BASIC EKG INTERPRETATION

## 2 Course Objectives

- ☐Describe the anatomical structures and physiologic properties of the heart including electrophysiology and conduction systems
- ☐Demonstrate correct placement of EKG monitoring leads
- ☐Accurately identify and measure EKG waveforms and segments
- ☐Employ a systematic process to evaluate and analyze EKG rhythm strips
- ☐Identify basic cardiac arrhythmias
- ☐
- ☐
- ☐

## 3 What Do I Need?

- ☐ECGs Made Easy, 4th edition, Barbara Aehlert
- ☐Calipers
- ☐Inquiring mind
- ☐Practice!!!!!

## 4 Course Outline

- 1 ☐Anatomy and Physiology
- ☐Electrophysiology
- ☐EKG Basics
- ☐Sinus Mechanisms
- ☐Atrial Rhythms
- 2 ☐Junctional Rhythms
- ☐Ventricular Rhythms
- ☐Atrioventricular Blocks
- ☐Pacemaker Rhythms
- ☐

## 5 Cardiac Anatomy
## Location

- ☐Lies in the middle of the chest in the mediastinum
- ☐About the size of its owner's fist
- ☐Base of heart is its upper portion
- ☐Lower portion of heart known as the apex

## 6 Cardiac Anatomy—Heart Surfaces

- ☐Anterior surface
  - ◘Lies behind sternum
  - ◘Formed by both right & left ventricles
- ☐Lateral surface
  - ◘Heart's left side
  - ◘Mostly left ventricle
- ☐Inferior surface
  - ◘Bottom most
  - ◘Formed by both right & left ventricles

## 7 Cardiac Anatomy—Layers of the heart

- ☐Function is to protect the heart
- ☐Double-walled sac
  - ◘Parietal pericardium
  - ◘Visceral pericardium

- ☐Pericardial space
  - ◘Contains 10-20 ml serous fluid
  - ◘Fluid acts as a lubricant

- ☐

### 8 Cardiac Anatomy—Layers of the heart

- ☐Epicardium
  - ◘Outermost layer
  - ◘Visceral pericardium
  - ◘Contains main blood vessels & fat
- ☐Myocardium
  - ◘Middle layer
  - ◘Thick & muscular
  - ◘Responsible for heart's pumping action
- ☐Endocardium
  - ◘Innermost layer
  - ◘Smooth layer of epithelium

### 9 Cardiac Anatomy--Skeleton

- ☐Thick connective tissue
- ☐Supports the heart valves
- ☐Separates the atria from the ventricles

### 10 Cardiac Anatomy—cardiac mucscle cells

- ☐Found only in heart
- ☐Short, branched, and interconnected
- ☐Fit together tightly at junctions called intercalated discs
- ☐This collective mass of cells is known as a myocardium
- ☐Electrical stimuli that originate in any cell can be transmitted to all the other cells
- ☐
- ☐

### 11 Cardiac Anatomy—Heart Chambers

- ☐Two upper chambers known as the atria
  - ◘Purpose is to *receive* blood
- ☐Two lower chambers known as the ventricles
  - ◘Purpose is to *pump* blood
- ☐Septum
  - ◘Separates right & left sides of heart
- ☐

### 12 Cardiac Anatomy

- ☐Two functional pumps
- ☐Pulmonary circulation
  - ◘Right side of heart
  - ◘Low-pressure system
- ☐Systemic circulation
  - ◘Left side of heart
  - ◘High-pressure system

### 13 Cardiac Anatomy—Heart Valves

- ☐Four valves
  - ◘Two sets atroventricular  (AV) valves
  - ◘Two sets semilunar (SL) valves

  - Function passively
  - Purpose is to direct forward flow of blood
  - Heart sounds produced by closure of these valves

### 14 Cardiac Anatomy—Heart Valves

- Atrioventricular Valves
  - Mitral valve
    - Lies between left atrium & left ventricle
    - Has 2 cusps
  - Tricuspid valve
    - Lies between right atrium & right ventricle
    - Has 3 cusps

### 15 Cardiac Anatomy—Heart Valves

- Atrioventricular Valves
  - Open with the forward pressure of blood flow
  - Close with backward pressure created by ventricular contraction

### 16 Cardiac Anatomy—Heart Valves

- Semilunar Valves
  - Pulmonic valve
  - Aortic valve
  - Prevent backflow of blood from pulmonary artery & aorta into the ventricles
  - SL valves close as pressure in the aorta & pulmonary artery exceed that of the ventricles

### 17 Cardiac Anatomy

### Blood Flow Through The Heart

### 18 Cardiac Anatomy—Cardiac Cycle

1

2
- Two Phases
  - Systole
    - Contraction
  - Diastole
    - Relaxation
  - Occurs in both the atria & ventricles

### 19 Cardiac Anatomy—Cardiac Cycle

- Diastole
  - Ventricles relax
  - Atria contract
  - SL valves closed
  - AV valves open
- Systole
  - Atria relax
  - Ventricles contract
  - SL valves open
  - AV valves closed

### 20 Cardiac Anatomy—Heart Sounds

1 ☐S$_1$ marks onset of systole (ventricular contraction)
☐S$_2$ marks end of systole
☐Silent period between S$_2$ & S$_1$ represents diastole (ventricular relaxation/filling)
2 ☐Caused by closing of valves
☐"Lub-dub"
☐First heart sound (S$_1$) occurs with closing of AV valves
☐Second heart sound (S$_2$) occurs with closure of SL valves

### 21 Cardiac Anatomy—Heart Sounds

☐1-Aortic area
  ◘2nd intercostal space, right sternal border
☐2-Pulmonic area
  ◘2nd intercostal space, left sternal border
☐3-Erb's point
  ◘3rd intercostal space, left sternal border
☐4-Tricuspid area
  ◘4th or 5th intercostal space, left sternal border
☐5-Mitral area
  ◘5th intercostal space, left midclavicular line

### 22 Cardiac Anatomy
### Coronary Circulation

☐Coronary arteries
  ◘Arise at base of aorta
  ◘Fill during diastole
  ◘Main arteries lie on the epicardial surface
  ◘Branches penetrate the heart's muscle mass and supply the subendocardium
☐Coronary veins
  ◘Follow course of coronary arteries
  ◘Join to form the coronary sinus
  ◘Drain into right atrium
  ◘

### 23 Cardiac Anatomy
### Coronary Circulation

☐Three major coronary arteries
  ◘Left anterior descending (LAD)
  ◘Circumflex (CX)
  ◘Right coronary artery (RCA)
  ◘
☐

### 24 Cardiac Anatomy
### Coronary Circulation

☐Left coronary artery
  ◘First segment called left main coronary artery
  ◘Branches into LAD and CX
  ◘LAD supplies
    ■Anterior surface left ventricle
    ■Interventricular septum
  ◘CX supplies
    ■Left atrium

    - ■Lateral surface left ventricle
    - ■Inferior surface left ventricle (15%)
    - ■Posterior surface left ventricle (15%)
    - ■Part of heart’s conduction system
    - ■
    - ■
    - ■
    - ■
- ☐

### 25 Cardiac Anatomy
### Coronary Circulation

- ☐The right coronary artery
  - ◘Branches into marginal artery and posterior descending artery
  - ◘Supplies blood to
    - ■Right atrium
    - ■Right ventricle
    - ■Inferior surface left ventricle (85%)
    - ■Posterior surface left ventricle (85%)
    - ■Part of heart’s conduction system

### 26 Acute Coronary Syndrome

- ☐Temporary or permanent blockage of coronary artery
- ☐Usual cause is rupture of atherosclerotic plaque
- ☐Includes unstable angina & myocardial infarction
- ☐Presence of collateral circulation may prevent infarction
- ☐
- ☐

### 27 Acute Coronary Syndrome

- ☐Stages
  - ◘Ischemia
    - ■Blood flow and oxygen demand out of balance
  - ◘Injury
    - ■Prolonged ischemia prolonged long enough to damage affected area of heart
  - ◘Infarction
    - ■Death of myocardial cells
- ☐

### 28 Autonomic Nervous System

- ☐Controls involuntary or visceral body functions
- ☐Two divisions
  - ◘Parasympathetic—”Rest and Digest”
  - ◘Sympathetic—”Fight or Flight”
- ☐Normally in a state of balance

### 29 Autonomic Nervous System

### 30 Parasympathetic Stimulation

- ☐Increases blood flow to skin
- ☐Increases gastric motility
- ☐Causes bronchoconstriction
- ☐Increases glycogen synthesis in the liver
- ☐Effects on the heart
  - ◘Decreases heart rate

- ◘ Decreases conduction speed
- ◘

## 31 Sympathetic Stimulation

- ☐ Pupil dilation
- ☐ Shunts blood from skin & viscera to skeletal muscle
- ☐ Causes bronchodilation
- ☐ Releases glucose stored in the liver
- ☐ Effects on the heart
  - ◘ Increases heart rate
  - ◘ Increases conduction speed
  - ◘ Increases force of contraction
  - ◘
  - ◘

## 32 Sympathetic Receptors

- 1 ☐ Alpha
  - ◘ Blood vessels
  - ◘ Vasoconstriction
- ☐ Beta$_1$
  - ◘ Heart
  - ◘ Increased HR, conductivity, & contractility
- ☐ Beta$_2$
  - ◘ Lungs
  - ◘ Bronchodilation
  - ◘
- ☐
- ☐
- 2 ☐ Dopaminergic
  - ◘ Major vessels
    - ■ Cerebral
    - ■ Coronary
    - ■ Renal
  - ◘ Vasodilation
  - ◘
- ☐

## 33 Definitions

- ☐ Chronotropic effect
  - ◘ Refers to a change in the heart rate
- ☐ Inotropic effect
  - ◘ Refers to a change in myocardial contractility
- ☐ Dromotropic effect
  - ◘ Refers to the speed of conduction through the AV junction

## 34 Cardiac Output

- ☐ Amount of blood ejected from heart each minute
- ☐ Determined by the formula of stroke volume X heart rate
- ☐ Normal values are 4-8 L/minute
  - ◘ CO at rest is ~ 5L/min

## 35 Quiz Time!

- ☐ A patient has a stroke volume of 62ml and his heart rate is 86 beats per minute. What is his cardiac output?

- ☐Is his cardiac output normal, decreased, or increased?

36 **Stroke Volume**

- ☐Stroke volume determined by
  - ☐Amount of ventricular filling during diastole (preload)
  - ☐Pressure against which ventricle must pump (afterload)
  - ☐Myocardium's contractile state

37 **Preload**

- ☐End-diastolic volume (EDV)
- ☐Influenced by venous return
  - ☐Increased blood return ↑ preload
  - ☐Decreased blood return ↓ preload

38 **Afterload**

- ☐Pressure against which ventricles must pump
- ☐Influenced by arterial blood pressure
  - ☐Increased afterload (increased resistance) ↓ SV
  - ☐Decreased afterload (decreased resistance) ↑ SV
- ☐

39 **Contractility**

- ☐Ability of muscle fibers to stretch in response to volume
- ☐Stretch of myocardial fiber is influenced by EDV (preload)
- ☐Frank-Starling law of the heart
- ☐
- ☐

40 **Break Time!!**

41 **Electrophysiology**
**Types of Cardiac Cells**

- ☐Myocardial Cells
  - ☐Contain contractile filaments
  - ☐Worker or mechanical cells
  - ☐Do not generate electrical impulses

42 **Electrophysiology**
**Types of Cardiac Cells**

- ☐Pacemaker Cells
  - ☐Specialized cells of heart's electrical system
  - ☐Spontaneously generate and conduct electrical impulses

43 **Properties of Cardiac Cells**

- ☐Automaticity
  - ☐The ability of cardiac pacemaker cells to spontaneously generate an electrical impulse
- ☐Excitability (Irritability)
  - ☐Ability of cardiac muscle cells to respond to a stimulus (depolarization)
- ☐Conductivity
  - ☐Ability to transmit an impulse
- ☐Contractility
  - ☐Ability of myocardial cells to shorten in response to a stimulus

44 **Electrophysiology**

- ☐Action Potential
  - ☐Term used to describe electrical changes in the heart that stimulate mechanical

contraction
- ◘These changes occur at the cell membrane
- ◘The difference in electrical charges (voltage) across the cell membrane is known as the *transmembrane potential*

45 **Polarization**
- ☐A cell at rest is said to be polarized
- ☐Potassium leaks out of a resting cell leaving it more negatively charged on the inside
- ☐When the inside of a cell is more negative than the outside, a resting membrane potential exists (-90mV)

46 **Depolarization**
- ☐When the cell is stimulated, depolarization occurs
- ☐Cell membrane becomes permeable to Na+
- ☐Depolarization stimulates muscular contraction
- ☐

47 **Repolarization**
- ☐Recovery phase that returns the cell to its resting state
- ☐Sodium channels close
- ☐Sodium-Potassium pump returns Na+ to the outside of the cell & K+ to the inside
- ☐

48 **Action Potential—Depolarization**
- ☐Phase 0
  - ◘Cell is stimulated resulting in depolarization
  - ◘ Occurs with the rapid influx of sodium through the sodium channels

49 **Action Potential—Repolarization**

- ☐Phase 1
  - ◘Early repolarization
  - ◘Na+ channels partially close
  - ◘K+ & Cl- leave the cell
- ☐Phase 2
  - ◘Plateau phase
  - ◘Ca+ enters through Ca+ channels & prolongs the contraction
- ☐Phase 3
  - ◘Final rapid repolarization
  - ◘Na+ & Ca+ channels close
  - ◘K+ rapidly departs cell
  - ◘

50 **Restoration of Resting Membrane Potential (RMP)**
- ☐Phase 4
  - ◘Return to resting state
  - ◘Ready to receive another stimulus

51 **Action Potential of Pacemaker Cell**

52 **Refractory Periods**
- ☐Absolute Refractory Period
  - ◘Cell cannot respond to stimulation
- ☐Relative Refractory Period
  - ◘Cell can be stimulated by a very strong stimulus
- ☐Supernormal Refractory Period

  - Weaker than normal stimulus can cause depolarization

53 **Conduction System**

- Specialized electrical (pacemaker) cells make up the conduction system of the heart
- These cells are interconnected
- They have a faster conduction velocity than all other myocardial cells
- The pacemaker site with the fasting firing rate controls the heart

54 **Conduction Pathways**

55 **Automaticity Rates**

56 **Abnormal Conduction**

- Abnormal heart rhythms are usually due to
  - Enhanced automaticity
  - Triggered activity
  - Reentry (circus movement)

57 **Abnormal Conduction—Enhanced Automaticity**

- Enhanced automaticity
  - Cells not usually associated with a pacemaker function begin to depolarize spontaneously
  - Pacemaker site other than the SA node increases its rate above what is considered normal for that site

58 **Abnormal Conduction—Reentry**

- Reentry
  - The spread of an impulse through tissue already stimulated by that same impulse
  - Caused by presence of an accessory pathway or a block or delay in the conduction circuit
  - Results in short periods of an abnormally fast heart rate
  -

59 **Abnormal Conduction—Triggered Activity**

- Triggered Activity
  - Results from abnormal electrical impulses that sometimes occur during repolarization
  - Occurs when pacemaker cells from a site other than the SA node depolarize more than once after being stimulated by a single impulse
  - Can result in atrial or ventricular beats occuring singly, in pairs, or in runs
  - *Ectopic* refers to an impulse originating from a source other than the SA node
  -

60 **Abnormal Conduction—Escape Beats**

- Lower pacemaker site takes on responsibility of pacing heart when SA node slows down or fails
- Protective mechanism to preserve cardiac output

61 **EKG Basics—Electrodes**

- Electrical currents radiate to the skin’s surface
- Electrodes sense and transmit those currents to an EKG monitor as waveforms

62 **EKG Basics—Electrodes**

63 **EKG Basics—Leads**

- Standard limb leads
  - Leads I, II, & III
  - Considered bipolar as each lead has both a negative & positive electrode

- ◘

☐

64 **EKG Basics—Leads**

- ☐Augmented Chest Leads
  - ◘Leads aVR, aVL, & aVF
  - ◘EKG machine augments the amplitude
  - ◘Unipolar leads
  - ◘Heart serves as the "negative electrode"

65 **EKG Basics—Leads**

- ☐Chest or precordial leads
  - ◘Each V electrode is considered positive
  - ◘The heart makes up the negative electrode
  - ◘Views the heart in the horizontal plane

66 **Lead Selection—Arrhythmia Monitoring**

- 1 ☐Bedside monitoring systems may have from 3-5 lead wires
- ☐Lead selector is used to select monitoring lead
- ☐Nurse or tech decides monitoring lead
- 2 ☐Lead II
  - ◘Best for atrial activity
- ☐Lead $V_1$
  - ◘Ventricular rhythms

67 **Review**

- ☐Circus movement is caused by an _________.
- ☐Escape beats serve as an ____________ mechanism.
- ☐The __________electrode serves as the "eye."
- ☐The standard limb leads and the augmented limb leads view the ___________ plane.
- ☐Current traveling away from the positive electrode creates a _________ deflection
- ☐Ventricular activity is best viewed in which monitoring lead?
- ☐
- ☐
- ☐

68 **Review**

- ☐The intrinsic rate of the AV junction is______.
- ☐Which pacemaker controls the heart?
- ☐What serves as the "negative electrode" in the precordial leads?
- ☐
- ☐

69 **EKG Basics—EKG Paper**

70 **EKG Basics—EKG Paper**

- ☐Each small box is .04 seconds
- ☐Each large box is 5 X .04 = .2 seconds
- ☐5 large boxes = 1 second
- ☐15 large boxes = 3 seconds
- ☐30 large boxes = 6 seconds

71 **EKG Basics—Monitoring problems**

- ☐Artifact

☐Wandering baseline
☐
☐
☐Electrical interference
☐

72 **EKG Basics—Monitoring problems**

73 **EKG Basics—Terminology**

☐Baseline—a straight line recorded when no electrical activity is detected
☐Waveform—movement away from the baseline in either a negative or positive fashion
☐Segment—a line between waveforms
☐Interval—a waveform and a segment
☐Complex—component containing several waveforms

74 **EKG Basics—P Waves**

☐Normal characteristics of the P wave
  ◘Precedes the QRS complex
  ◘Smooth and rounded (normally)
  ◘No more than 2.5mm high
  ◘No more than 0.11 sec long

75 **EKG Basics—QRS Complex**

☐Normally follows each P wave
☐Represents ventricular depolarization
☐Consists of Q wave, R wave, & S wave
☐May not have all of the above waveforms
☐Normal duration is .10 or less
☐
☐

76 **EKG Basics—QRS Complex**

☐Normal Q waves should measure no wider than .04 seconds and should be less 1/3 the height of the R wave
☐Deep wide Q waves may represent an MI

77 **EKG Basics—T wave**

☐T wave
  ◘Represents ventricular repolarization
  ◘Direction of T wave normally same as the QRS

78 **All together, now!**

79 **EKG Basics—PR Interval**

☐PR interval includes P wave and the PR segment
☐Tracks the atrial impulse from the atria through the AV node, bundle of His, and right & left bundle branches
☐Measured from the beginning of the P wave to the beginning of the QRS complex
☐Normal duration is .12-.20 seconds

80 **EKG Basics—PR Interval**

81 **EKG Basics—ST segment**

☐Beginning of ventricular repolarization
☐Normally isoelectric
☐Depression = ischemia
☐Elevation = injury

☐

82 **EKG Basics**
**Abnormal ST segments**
☐ST depression
  ◘ST segment depression of more than .5 mm is indicative of myocardial ischemia

83 **EKG Basics**
**Abnormal ST segments**
☐ST elevation
  ◘Considered elevated when 1mm or more above baseline
  ◘ST elevation suggests myocardial injury

84 **EKG Basics—QT interval**
☐Represents total ventricular activity
☐Measured from beginning of QRS to end of T wave
☐Normal interval is less than half of R-R interval

85 **EKG Basics—QT interval**
☐Importance of QT interval
  ◘A prolonged QT indicates a lengthened relative refractory period (vulnerable period)
  ◘Pt is at greater risk for life threatening arhythmias such as torsades de pointes

86 **Analyzing a Rhythm—Step One**
☐Assess rhythm for regularity
  ◘Use R-R interval to evaluate ventricular rhythm
  ◘Use P-P interval to evaluate atrial rhythm
  ◘R-R intervals or P-P intervals should be evaluated across an entire 6 second strip

87 **Analyzing a Rhythm—Step Two**
☐Calculate the heart rate
  ◘A tachycardia exists if rate is more than 100/min
  ◘A bradycardia is present with rate less than 60/min
☐Methods to calculate rate
  ◘Six-second method
  ◘Large Box method
  ◘Small Box method

88 **Analyzing a Rhythm**
**Calculating Rate**
☐Six second method
  ◘Number of QRS complexes in a 6 sec strip X 10
  ◘May be used for regular or irregular rhythms
  ◘Most inaccurate

89 **Analyzing a Rhythm**
**Calculating Rate**

90 **Analyzing a Rhythm**
**Calculating Rate**
☐Large Box method
  ◘Count # large boxes between R-R interval
  ◘Divide 300 by # large boxes
  ◘Variation called sequence method

91 **Analyzing a Rhythm**

### Calculating Rate

- Small Box method
  - Count # small boxes between R-R interval
  - Divide 1500 by # small boxes
  - Most accurate

### 92 Analyzing a Rhythm—Step Three

- Examine P waves
  - Normally one P wave before each QRS
  - Is P wave upright
  - Early Ps?

### 93 Analyzing a Rhythm—Step Four

- PR Interval
  - Measure PR interval, normal .12-.20 seconds
  - Is the PR interval constant or the same
  - If PR intervals different
    - Lengthening
    - variable

### 94 Analyzing a Rhythm—Step Five

- QRS Complex
  - Measure duration, normal .06-.10 seconds
  - Are all QRS complexes of the same configuration
  - QRS after every P?

95

### Analyzing a Rhythm—Extras

- QT Interval
  - Considered normal if less than ½ of R-R interval
- ST segment
  - Presence of ST elevation or depression
- T wave
  - Tall, pointed with hyperkalemia
  - Negative or flipped Ts with ischemia or evolving MI

### 96 Review

- What is a rhythm with a rate less than 60?
- An impulse firing from outside the SA node is called a ____________.
- Which waveform denotes depolarization of the atria?
- The T wave represents ___________.
- On EKG paper, the vertical axis measures _________.
- List some possible causes of "wandering baseline."

### 97 Review

- What life threatening arrhythmia can occur with a prolonged QT interval?
- How many large boxes in one second?
- What method of calculating the rate should be used with an irregular rhythm?
- What might cause a "lumpy" T wave?

### 98 Sinus Mechanisms

- Sino-atrial node (SA node) is primary pacemaker
- Most rhythms originating in the SA node are regular
  - Normal sinus rhythm (NSR)
  - Sinus bradycardia
  - Sinus tachycardia
  - Sinus arrhythmia
  - Sino-atrial (SA) block
  - Sinus arrest

99 **Normal Sinus Rhythm**

- Characteristics
  - Regular rhythm
  - Rate is 60-100 beats/min
  - P wave for every QRS, Ps look alike
  - PR interval of normal duration & constant
  - QRS usually normal

100 **Normal Sinus Rhythm**

101 **Sinus Bradycardia**

- Characteristics
  - Regular rhythm
  - Rate less than 60 beats/min
  - P wave for every QRS, Ps look alike
  - PR interval of normal duration & constant
  - QRS usually normal

102 **Sinus Bradycardia**

- Causes
  - Sleep
  - Inferior MI
  - Hyperkalemia
  - Vagal stimulation
  - SA node disease
  - Well conditioned heart
  - Medications
    - Calcium channel blockers, dig, beta-blockers, amiodarone

103 **Sinus Tachycardia**

- Characteristics
  - Regular rhythm
  - Rate 101-160
  - P wave for every QRS, Ps look alike
  - PR interval of normal duration & constant
  - QRS usually normal

104 **Sinus Tachycardia**

- Causes
  - Sympathetic stimulation

    - Myocardial infarction
    - Hypovolemia
    - Exercise
    - Fever
    - Shock
    - Drugs

### 105 Sinus Arrhythmia

- Characteristics
    - Irregular but “regularly irregular”
    - Rate varies
    - P wave for every QRS, Ps look alike
    - PR interval of normal duration & constant
    - QRS usually normal

### 106 Sinaoartrial Block—sinus exit block

- Characteristics
    - Irregular due to pause
    - Rate varies
    - P wave for every QRS, Ps look alike
    - PR interval of normal duration & constant
    - QRS usually normal

### 107 Sinus Arrest

- Characteristics
    - Irregular due to pause
    - Rate varies
    - P wave for every QRS, Ps look alike
    - PR interval of normal duration & constant
    - QRS usually normal

### 108 Atrial Rhythms

- Most common rhythm disturbance
- Originate in areas outside of the SA node
- May be associated with extremely fast ventricular rates leading to decreased ventricular filling times
- May do away with “atrial kick”

### 109 Atrial Arrhythmias—Mechanisms

- Enhanced automaticity
    - Cells not usually associated with a pacemaker function begin to depolarize spontaneously
- Reentry
    - The spread of an impulse through tissue already stimulated by that same impulse
- Triggered activity
    - Results from abnormal electrical impulses that occur during repolarization
    - These impulses, called afterdepolarizations, lead to atrial or ventricular beats occurring singly, in runs or as a sustained ectopic rhythm

### 110 Premature Atrial Contractions

- Result from an irritable focus in the atria taking over as pacemaker
- P wave of PAC may look similar to P from SA node or may be biphasic, flattened, pointed or lost in preceding T wave
- PACs are followed by a pause
- PACs may occur in bigeminy, trigeminy, or couplets
- A PAC occurring too early may not be conducted to ventricles and is called a nonconducted PAC

### 111 Premature Atrial Contractions

- Characteristics
  - Underlying rhythm regular with premature beats
  - Rate varies
  - Early Ps differing in shape from sinus P
  - PRI may be normal or prolonged

### 112 Wandering Atrial Pacemaker

- Pacemaker site shifts from SA node to another area in the atria or AV junction
- PR interval variable
- Rhythm slightly irregular
- Rate usually normal at 60-100

### 113 Mutifocal Atrial Tachycardia (MAT)

- Pacemaker site shifts from SA node to another area in the atria or AV junction
- Rate greater than 100 beats/min

### 114 Atrial Tachycardia

  - Regular rhythm
  - Rate 150-250
  - P wave for every QRS
    - Ps look alike but different than sinus Ps
    - Ps may be lost in T waves if rate very fast
  - PR interval usually normal
  - QRS usually normal

### 115 Atrial Tachycardia

### 116 Atrial Tachycardia

- Causes
  - Stimulant use
  - Cor pulmonale
  - Infection
  - Electrolyte imbalances
  - Dig toxicity
- Significance
  - Decreases filling time
  - Increases myocardial oxygen demand
  - Decreases myocardial perfusion

### 117 Atrial Flutter

- Atrial rhythm regular
- Ventricular rhythm regular or irregular
- Atrial rate 250-350
- P waves are not identifiable, instead “flutter waves” present
- PRI not measurable
- QRS usually normal

## 118 Atrial Flutter

- Causes
  - Ischemic heart disease
  - Electrolyte imbalance
  - Hypoxia
  - Pulmonary embolus
  - Cardiomyopathy
- Significance
  - Decreases filling time
  - Increases myocardial oxygen demand
  - Decreases myocardial perfusion
  - Absence of atrial kick

## 119 Atrial Fibrillation

- Irregular rhythm
- Ventricular rate varies
- No P waves
  - Wavy baseline
- PRI not measurable
- QRS usually normal

## 120 Atrial Fibrillation

- Causes
  - Hypertensive heart disease
  - Electrolyte imbalance
  - Advanced age
  - Hypoxia
  - CHF
- Significance
  - Decreases filling time
  - Increases myocardial oxygen demand
  - Decreases myocardial perfusion
  - Absence of atrial kick
  - Increased risk of stroke

## 121 Supraventricular Tachycardia

- AV Nodal Reentrant Tachycardia
  - Occurs in pts with 2 conduction pathways within the AV node
- AV Reentrant Tachycardia
  - Occurs in pts with accessory pathways
    - Wolff-Parkinson-White Syndrome (WPW)

## 122 Supraventricular Tachycardia--AVNRT

- Regular rhythm

☐Rate 150-250
☐P waves hidden in QRS
☐PRI interval not measurable
☐QRS usually normal
☐

123 **Supraventricular Tachycardia—AVRT or WPW**

☐Regular rhythm
☐Rate 60-100
☐P waves
☐PRI less than .12 sec
☐QRS .12 or more

124 **Junctional Rhythms**

☐Rhythms originating in the AV junction are called junctional arrhythmias
☐If the atria depolarize before the ventricles, retrograde depolarization of the atria results in inverted P waves with a PRI of < .12
☐If atria and ventricles depolarize together, P wave will be hidden in QRS
☐If atria depolarize after the ventricles, P wave will follow QRS

125 **Premature Junctional Contractions--PJCs**

☐Regular rhythm with premature beats
☐Rate usually within normal range, depending on underlying rhythm
☐P waves may occur before, during, or after the QRS
☐PRI of < .12 sec if P wave precedes QRS
☐QRS usually normal

126 **Junctional Escape Beats**

☐Rhythm is regular with late beats
☐Rate usually within normal range, depending on underlying rhythm
☐P waves may occur before, during, or after the QRS
☐PRI of < .12 sec if P wave precedes QRS
☐QRS usually normal
☐
☐

127 **Junctional Escape Rhythm**

☐Regular rhythm
☐Rate 40-60
☐P waves may occur before, during, or after the QRS
☐PRI of < .12 sec if P wave precedes QRS
☐QRS usually normal
☐

128 **Accelerated Junctional Rhythm**

☐Regular rhythm
☐Rate 61-100
☐P waves may occur before, during, or after the QRS
☐PRI of < .12 sec if P wave precedes QRS
☐QRS usually normal
☐

129 **Junctional Tachycardia**

☐Regular rhythm
☐Rate 101-140
☐P waves may occur before, during, or after the QRS

- ☐PRI of < .12 sec if P wave precedes QRS
- ☐QRS usually normal
- ☐

### 130 Ventricular Rhythms

- ☐Ventricles may pace the heart if
  - ◘SA node fails to discharge or is blocked
  - ◘SA rate is slower than the ventricles
  - ◘Irritable ventricular site produces early beat or rapid rhythm
- ☐Ventricular beats/rhythms have
  - ◘Abnormally shaped QRS measuring ≥ 0.12 seconds
  - ◘Abnormal depolarization results in abnormal repolarization
    - ■QRS and T wave deflect in opposite directions
- ☐

### 131 Premature Ventricular Contractions (PVCs)

- ☐Underlying rhythm regular with *premature* beats
- ☐Rate varies depending on underlying rhythm
- ☐P waves usually absent or may appear after the QRS
- ☐QRS "wide & bizzarre" ≥ 0.12 sec
- ☐QRS followed by compensatory pause

### 132 Premature Ventricular Contractions (PVCs)

### 133 Premature Ventricular Contractions (PVCs)

### 134 Premature Ventricular Contractions (PVCs)

- ☐Causes
  - ◘anxiety
  - ◘Idiopathic
  - ◘Dig toxicity
  - ◘Advanced age
  - ◘Acid-base imbalance
  - ◘Electrolyte imbalance
  - ◘Myocardial ischemia/infarction
- ☐Significance
  - ◘Can reduce cardiac output
  - ◘Can lead to more serious arrhythmias

### 135 Ventricular Escape Beats

- ☐Underlying rhythm regular with *late* beats
- ☐Rate varies depending on underlying rhythm
- ☐P waves usually absent or may appear after the QRS
- ☐QRS "wide & bizzarre" ≥ 0.12 sec
- ☐

### 136 Idioventricular Rhythm

- ☐Regular rhythm
- ☐Rate 20-40 beats/minute
- ☐P waves usually absent or may appear after the QRS
- ☐QRS ≥ 0.12 sec
- ☐

137 **Accelerated Idioventricular Rhythm**
☐Regular rhythm
☐Rate 41-100 beats/minute
☐P waves usually absent or may appear after the QRS
☐QRS $\geq$ 0.12 sec
☐

138 **Ventricular Tachycardia**
☐Essentially regular rhythm
☐Rate 101-250 beats/min
☐P waves may be present or absent
  ◘If present will be dissociated from the QRS
☐QRS $\geq$ 0.12 sec
☐

139 **Ventricular Tachycardia**

140 **Torsades de pointes**

141 **Ventricular Tachycardia**
☐Causes
  ◘Digoxin toxicity
  ◘Acid-base imbalance
  ◘Electrolyte imbalances
  ◘Invasive cardiac procedures
  ◘Myocardial ischemia/infarction
☐Significance
  ◘Reduced cardiac output
  ◘Rhythm may further deteriorate

142 **Ventricular Fibrillation**
☐Rhythm is rapid and chaotic
☐Rate cannot be determined
☐P waves not discernible
☐QRS not discernible

143 **Asystole**
☐No ventricular rate or rhythm
☐If P waves present, called ventricular standstill
☐Must be confirmed in two leads
☐CPR & ACLS

144 **Atrioventricular Blocks**
☐Interruption in conduction between atrial & ventricles
☐That interruption can result in delayed, partial, or total blockage of an impulse
☐Blockage can occur at the AV node, the bundle of His, or bundle branches
☐AV blocks are classified by their severity or "degree"
☐PR interval is key to classifying the type of AV block
☐

145 **First-Degree AV Block**
☐Regular rhythm
☐Rate usually normal
☐P waves normal
☐PRI is > 0.20 sec and constant
☐QRS usually normal

146 **Second Degree Block Type I**

**(Wenckebach)**
☐Atrial rhythm regular, ventricular rhythm irreg
☐Atrial rate greater than ventricular rate
☐More Ps than QRSs
☐PRI progressively lengthens until a P wave appears without a QRS complex
☐QRS usually normal in size but is periodically dropped

147 **Second Degree Block Type II**
☐Atrial rhythm regular, ventricular rhythm irreg
☐Atrial rate greater than ventricular rate
☐More Ps than QRSs
☐PRI normal or slightly prolonged but are constant
☐QRS normal or wide
☐

148 **Third Degree AV Block**
☐Atrial rhythm is regular as is ventricular rhythm
☐Atrial rate is greater than ventricular rate
☐No true PRI as atria and ventricles beating independently of one another
☐QRS normal or wide