



American Medical Certification Association

-A division of the American School of Business-

EKG Technician Certification (ETC)
Study Guide

Dear Student,

The exam consists of 100 multiple choice questions and you will have 2 hours in which to complete the exam. When taking the test, always apply these test taking strategies:

- Look for distracters in the question such as the words, **not, always, exactly, first, next**, etc.
- Read all the answers
- Eliminate the ones that you know are incorrect
- Narrow it down to 2 possible answers
- Choose the **BEST** possible answer

ON TEST DAY

1. Please bring a picture ID with you. A **valid** driver's license, county ID, and passport are all acceptable forms of ID.
2. Please bring a #2 pencil with you.
3. Fill out all registration and test answer sheets in their entirety. Your full name as you would like it to appear on your certification card, your complete SSN and mailing address are necessary. Failure to provide this information, will delay the processing of your exam.
4. **DO NOT WRITE IN THE TEST BOOKLET!** All of your answers must be recorded on the answer sheet.
5. Cheating of any kind will not be tolerated. If someone is suspected of cheating, they will be removed from the classroom. They will forfeit their right to retake the exam.
6. In order to be successful on the exam, you must achieve a 70% or better on the exam.
7. Once the exam begins, you will not be allowed to access your cell phone or any other electronic device. Please turn them to silent prior to entering the classroom.
8. Once the exam begins, you will not be allowed to use the restroom. Please use the restroom before the exam begins.

Special Accommodations

AMCA and the American School of Business pledge to comply with the provisions of the Americans with Disabilities Act, as amended (42 USC Section 12101, et. seq.), and with Title VII of the Civil Rights Act, as amended (42 U.S.C. 2000e, et seq.), to the best of their ability.

If you need special accommodations because of a disabling condition, you may ask for special testing services. This request must be submitted in writing and included with your registration. All requests are handled on an individual basis.

If you are requesting special accommodations you must submit a letter from an appropriate healthcare professional that is licensed to evaluate the disability. The letter must be written on the healthcare professional's letterhead and include the professional's title, address and telephone number and date. The letter must also include a diagnosis of the disabling condition and explain why special testing accommodations are necessary. The letter must have an original signature from the professional and be dated no more than 2 years prior to registration of the exam

Exam Challenges

If you have a question or believe any part of the exam was unfair or misleading, you can email customer service and your concerns will be forwarded to the appropriate department. When emailing, please include "Exam Challenge" in the subject line and email to: info@americanschoolnj.com.

Good luck on your exam!

Anatomy and Electrophysiology of the Heart

The Heart consists of four chambers: Right and Left Atrium, Right and Left Ventricles. The blood flow through the heart must always go in one direction to make blood follow a certain path the heart consist of four valves: Tricuspid, Pulmonary, Mitral, and Aortic valves. The tricuspid and mitral valves are also known as the atrioventricular valves because of their position in the heart. Also assisting in the direction of blood flow through the heart are arteries and veins: arteries carry blood away from the heart and veins carry blood to the heart.

The heart receives its oxygen and nutrients from the coronary arteries that are located at the base of the aorta and it returns the blood through the coronary veins that empty into the right atrium.

The heart consists of a strong fibrous connective tissue that are considered the skeleton of the heart it protects the valves from opening during a contraction and also separates the atria from the ventricles to ensure separate contractions.

The cardiac cycle consist of two parts: diastole is the relaxation of the heart when the filling of the atria and ventricles occur. Systole is the contraction of the atria and ventricles and is when the blood that has filled the heart is pumped to the pulmonary system and the systemic system. This is when cardiac output occurs normally the heart ejects between 60-100 ml. of blood this is called stroke volume. Cardiac output is the person's heart rate \times the stroke volume over 1 minute and is expressed in liters per minute.

Blood pressure is the force that blood exerts against the walls of the arteries as it passes through them it is obtained by measuring cardiac output \times peripheral vascular resistance.

The autonomic nervous system can influence the rate and strength of contractions. The autonomic nervous system is divided into two divisions they are parasympathetic which slows the heart and is referred to as the feed or breed system; sympathetic nervous systems which speeds up the heart and is referred to as the fight or flight system.

The heart cells have four unique properties that allow them to function they are: automaticity-the ability to produce an electrical impulse; excitability-the ability to respond to an electrical stimulus; conductivity-the ability to transport an electrical stimulus; contractility-the ability to contract when stimulated.

Depolarization of the cells occurs when positive electrolytes move from outside to inside the cell causing the cell to become positively charged. The electrolytes that produce these positive and negative charges are mainly sodium, calcium, and potassium.

The electrical impulse is initiated at the sinoatrial node which has an intrinsic rate of 60-100 beats per minute. It then flows through the atria to the atrioventricular node which slows the impulse down to allow for the filling of the ventricles from the atria and has an intrinsic rate of 40-60 beats per minute.

The impulse then goes into the Purkinje fibers system which has an intrinsic rate of 20-40 beats per minute, to be distributed throughout the ventricles.

The Electrocardiogram

The electrocardiogram is the graphic record or tracing of the heart's electrical activity; the electrocardiograph is the machine with color coded or numbered lead wires that are placed on the electrodes that are attached to the patient's skin.

ECG rhythms may be shown on a display called an oscilloscope or printed on graph paper with static tracing. The graph paper used to record ECG's consists of horizontal and vertical lines that form grids. The smallest of the squares represents .04 seconds in duration horizontally or .1 millivolt vertically. The larger squares equal five small squares which read as .20 seconds horizontally or .5 mV vertically. You can use the horizontal figures to get distance and rate of the waveforms. You can use the vertical figures to measure amplitude of the waveforms.

Any abnormal rhythm is called a dysrhythmia. Artifact on a rhythm has no relationship to the electrical activity of the heart and can be caused by patient movement, shivering, muscle tremors, or loose electrodes.

Each lead provides a different view of the heart. Impulses that travel toward a positive electrode are recorded as upward deflections. Impulses that travel toward a negative electrode are recorded as a downward deflection.

Reading an ECG

The ECG technician should read an ECG in a systematic manner. Always remember to compare your ECG findings to the patient: some dysrhythmias can be life threatening and some can be no problem to the patient.

The five steps in analyzing an ECG are: heart rate, regularity, P-waves, QRS complex, and P-R interval.

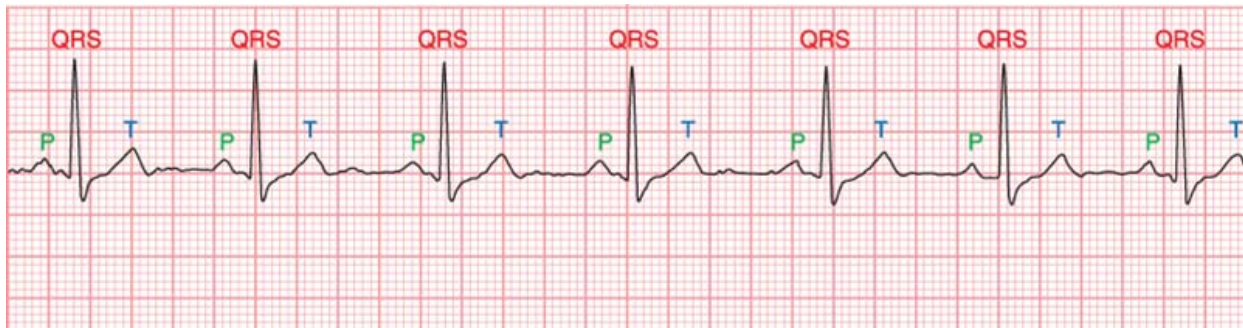
Heart rate- normal rate for an adult is between 60-100 bpm. Heart rates above 100 are called Tachycardia, heart rates below 60 are called bradycardia. There are four methods for obtaining a heart rate: 6-second interval X 10 method- involves counting the number of QRS complexes on a 6 second rhythm and multiplying that number by 10, this is the only method that can be used on an irregular rhythm. The 300,150,100,75,60,50 method- involves locating an R-wave on a bold line on the ECG paper then finding the next consecutive R wave and counting down from 300 on the subsequent bold lines to determine the rate. 1500 method- you count number of small squares between two consecutive R-waves and divide that number by 1500, it is the most accurate method of obtaining the heart rate but can only be used on regular rhythms. Rate calculators are devices that you use to measure between R-waves and it gives you the rate.

You count the QRS complexes to get the Ventricular rate and count the P-waves to determine the atrial rate.

Regularity is the second step in analyzing an ECG. To find this you measure the distance between all the R-R waves on the strip and if they are all the same the rhythm is called regular if not the rhythm is called irregular and irregular rhythms are considered abnormal. You can also measure the P-waves and this is called the P-P interval to see if they are regular.

Methods used to measure these intervals are calipers- which involves using a device called a caliper to measure the intervals, which is the quickest and easiest method. Paper and pen method- which involves using a piece of paper and marking an R-wave then marking the next R-wave and using that to judge the R-waves of the rest of the rhythm. The last method is to count the small squares between each R-R interval and see if they are all the same, this method takes longer but does not require any equipment to use.

Types of irregularities that you may find are irregularly (totally) irregular- which means there is no consistency to the rhythm such as atrial fibrillation, patterned irregularity- is where the irregularity repeats over and over such as AV-heart blocks, slightly irregular- is where there is an abnormality that does not occur very often such as one PVC in a rhythm strip, and very irregular rhythms-which means there are multiple occurrences of an abnormality such as a PVC or PAC in one rhythm strip.



- Upright, round P waves occurring at regular intervals at a rate of 60 to 100 beats per minute
- PR interval of normal duration (0.12 to 0.20 seconds) followed by a QRS complex of normal upright contour, duration (0.06 to 0.12 seconds) and configuration
- Flat ST segment followed by an upright, slightly asymmetrical T wave

P- waves

A normal P-wave is upright and rounded in Leads I,II, avf, and V2 thru V6, they should have a duration of .06 to .10 sec. and an amplitude of .5 to 2.5mm. P-waves signify the pulse initiating at the SA node and depolarizing the atria. Abnormal P-waves are called P prime waves (P') and may come from an irritated part of the atria and have a different morphology from normal P-waves.

You can separate the P-wave into two parts the first half of the P-wave is the depolarization of the right atrium and the second half is the depolarization to the left atrium. If there is a dilation of the right atrium then the P-wave will have higher amplitude and be tall and rounded, if there is a dilation of the left atrium then the P-wave will be notched or elongated.

Inverted P-waves indicate that the impulse started in or around the AV node. If you have more P-waves than QRS complexes then the impulse was blocked at the AV junction and you have a AV heart block.

QRS complexes

Normal QRS complex should be .06 to .12 sec. in duration and 5mm to 30mm in amplitude. A normal QRS complex indicates the impulse originated above the ventricles and traveled through the ventricles in a normal fashion.

The Q-wave is the first negative deflection from the base line after the P-wave. The R-wave is the first positive deflection from the base line after the P-wave. The S-wave is the first negative deflection that extends below the base line after the R-wave. These definitions are literal and if one wave is missing then you drop that wave from the complex name (i.e. no negative deflection before the R-wave then you have a RS complex).

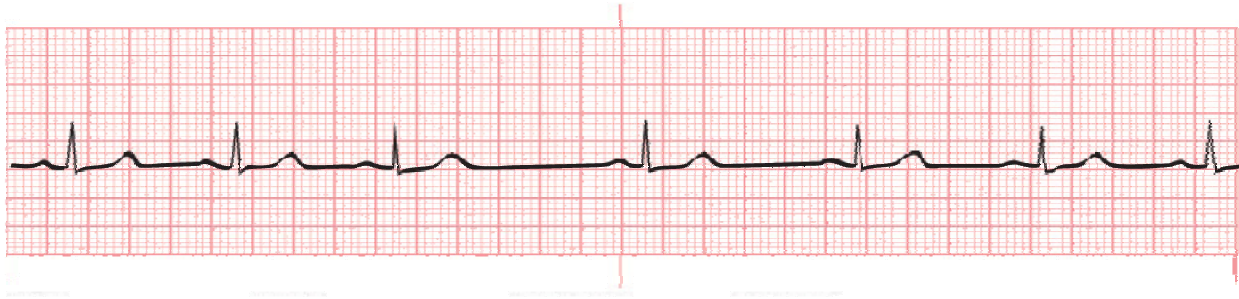
Abnormal QRS complexes are produced by abnormal depolarization of the ventricles. The duration of abnormal complexes is usually greater than .12 sec. abnormal QRS complex varies widely and can have strange, wide, and bizarre shapes. Very tall QRS complexes are usually caused by hypertrophy of one or both ventricles. Abnormally small or low-voltage complexes are seen in obese patients, hyper-thyroid patients, and pleural effusion.

P-R intervals

The P-R interval is the distance from the beginning of the P-wave to the beginning of the Q-wave or R-wave. It signifies the depolarization of the heart from the SA node through the atria and AV node. The duration of the P-R interval should be .12 to .20sec.

P-R intervals are considered abnormal if they are shorter, longer, or absent. Shorter P-R intervals indicate the impulse originated in or around the AV node. Longer P-R intervals indicate the impulse was slowed down more than it should have been usually in the AV node. Absent P-R intervals indicate that there are too many impulses in the atria to signify a P-R interval (i.e. atrial fibrillation or flutter).

Sinus Dysrhythmia



Sinus dysrhythmias originate from the SA node with that being the case there are only four dysrhythmias that are associated with the SA node: Tachycardia (heart rate over 100bpm), Bradycardia(heart rate under 60bpm), sinus arrest (the total absence of the p-wave, QRS-complex, and T-wave), sinus dysrhythmia(is the same as sinus rhythm except there is the presence of a patterned irregularity that can be described as slowing the speeding up then slowing again) this will usually happen with the inspiration and exhalation cycle(normal finding in children, athletes, and older patients)

Atrial Dysrhythmia

Atrial dysrhythmias originate outside the SA node in the atrial tissue or in the intermodal pathways.

The three mechanism responsible for atrial dysrhythmias are:

Increased automaticity-the atrial cells spontaneously depolarize and initiate impulses before the SA node can generate its pulse.

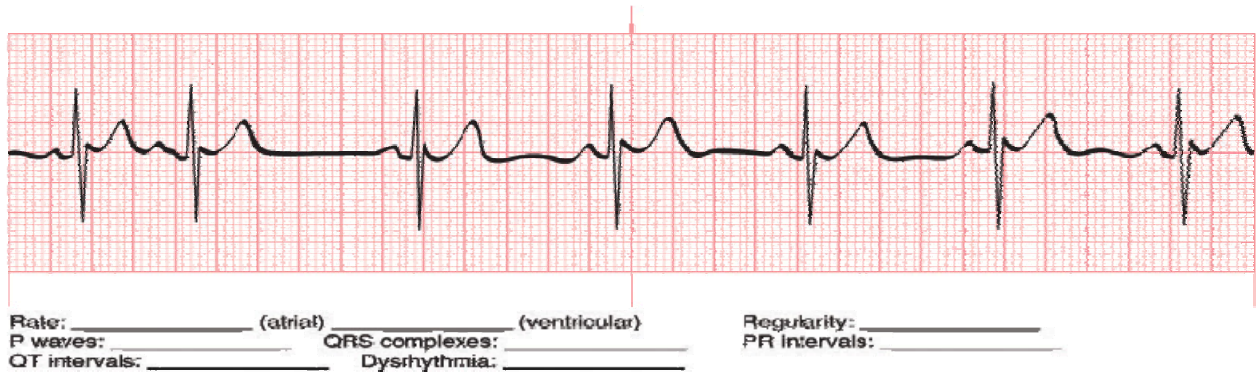
Triggered activity- injured cells sometimes only partially repolarize and this can sometimes lead to repetitive ectopic firing that may lead to atrial or ventricular tachycardia.

Reentry- occurs when an impulse is delayed along a slow conduction pathway and the impulse is able to remain active long enough to produce another impulse during myocardial repolarization.

Key characteristics of atrial dysrhythmia are shortened or prolonged P-R intervals p-waves that differ in appearance from normal p-waves, and normal QRS-complexes.

Types of atrial dysrhythmias and characteristics:

Premature Atrial Complexes



Rate: Depends on the underlying rhythm

Regularity: depends on the number of PAC's present

P-waves: may be upright or inverted, will appear different than those of the underlying rhythm

QRS complexes: Normal

PR interval: may be normal, shortened, or prolonged

Atrial tachycardia

Rate: 150-250 beats per minute

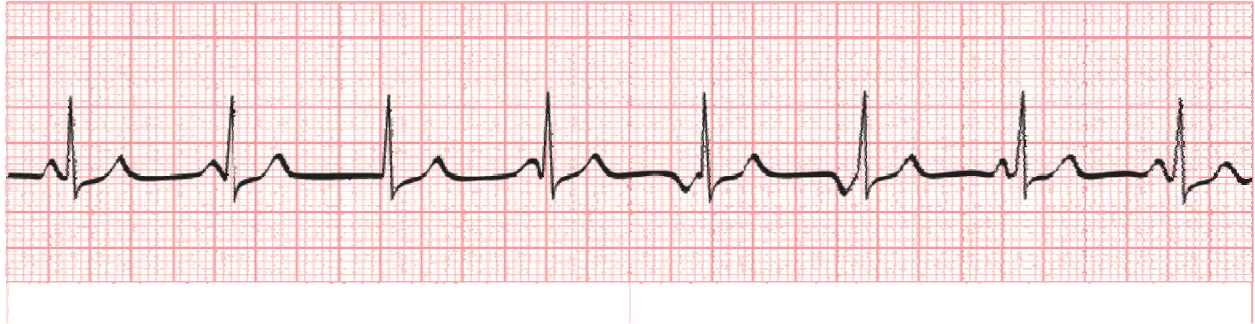
Regularity: regular

P-waves: may be upright or inverted will appear different from underlying rhythm

QRS-complex: Normal

PR interval- may be normal, shortened, or prolonged

Wandering Atrial Pacemaker



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: Usually between 60-100bpm

Regularity: Slightly irregular

P-waves: continuously change in appearance

QRS-complex: Normal

PR interval: varies

Multifocal atrial tachycardia



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: 100-150

Regularity: irregular

P-wave: constantly changing

QRS-complex: normal

PR interval: varies

Supraventricular Tachycardia



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: usually above 250bpm

Regularity: regular

P-wave: cannot be identified

QRS-complex: normal

PR-interval: absent

Atrial flutter



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: atrial between 250-350, ventricular rate can vary

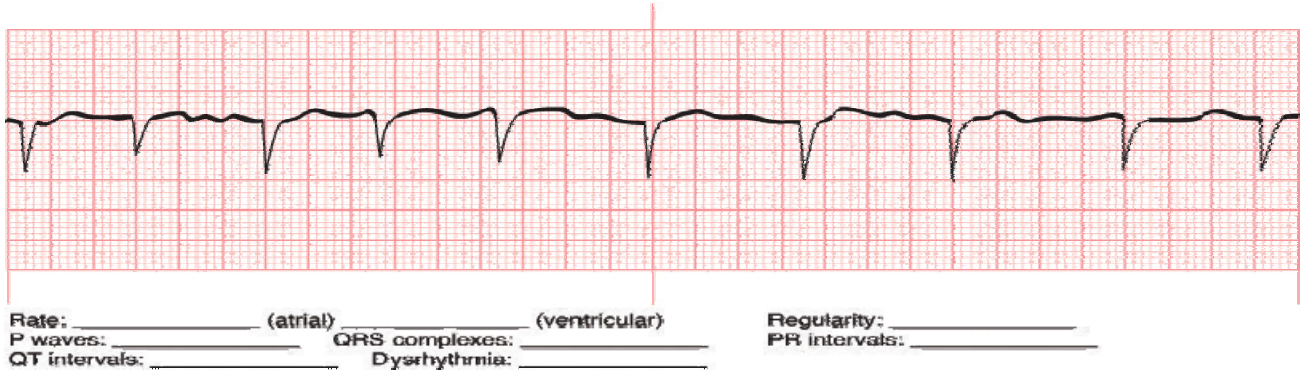
Regularity: may be regular or irregular

P-wave: absent (flutter waves)

QRS-complex: normal

PR-interval: absent

Atrial fibrillation



Rate: atrial rate over 350bpm, ventricular rate can vary

Regularity: irregularly (totally) irregular

P-wave: absent (chaotic baseline)

QRS-complex: normal

PR-interval: absent

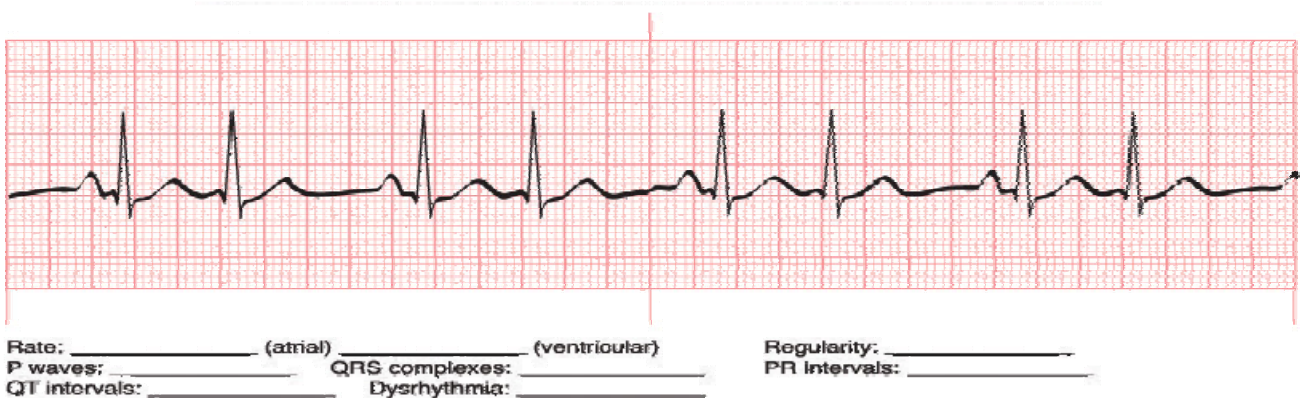
Junctional dysrhythmias

Junctional dysrhythmias originate in the AV junction around the AV node or Bundle-of-His.

Major characteristics of Junctional complex are P-waves that may be inverted, follow the QRS-complex, or absent and PR-intervals that will be shortened or absent.

Types of Junctional dysrhythmias:

Premature Junctional Complex



Rate: depends on the underlying rhythm

Regularity: occasional or frequently irregular depends on the number of PJCs

QRS-complex: Normal

PR Interval: short or absent

Junctional escape rhythm



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____ Rate: 40 to
QT intervals: _____ Dysrhythmia: _____

60bpm

Regularity: Regular

P-wave: inverted, absent, or occur after the QRS-complex

QRS-complex: normal

PR-interval: short or absent

Accelerated Junctional Rhythm



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: 60 to 100bpm

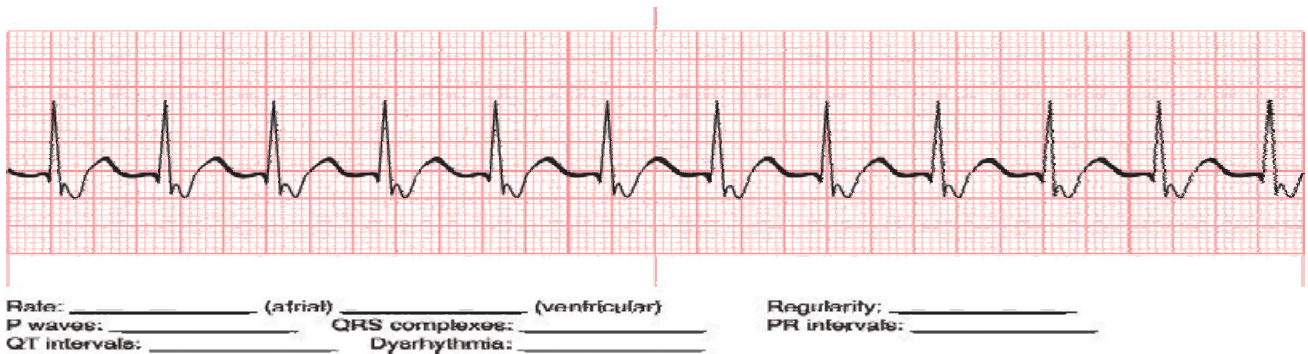
Regularity: regular

P-wave: inverted, absent, or occur after the QRS-complex

QRS-complex: normal

PR-interval: short or absent

Junctional Tachycardia



Rate: 100 to 180bpm

Regularity: regular

P-wave: inverted, absent, or occur after the QRS-complex

PR-interval: short or absent

Ventricular dysrhythmias

Ventricular dysrhythmias originate in the ventricles below the Bundle of His. Some may be benign while some may be life threatening.

Major characteristics of ventricular dysrhythmias are absent P-waves and wide bizarre QRS-complexes.

Types of ventricular dysrhythmias are:

Premature ventricular complexes



Rate: depends on the underlying rhythm

Regularity: occasionally irregular or very irregular depends on the number of PVC's

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P-wave: absent at the PVC

QRS-complex: the PVC will have a wide bizarre looking QRS

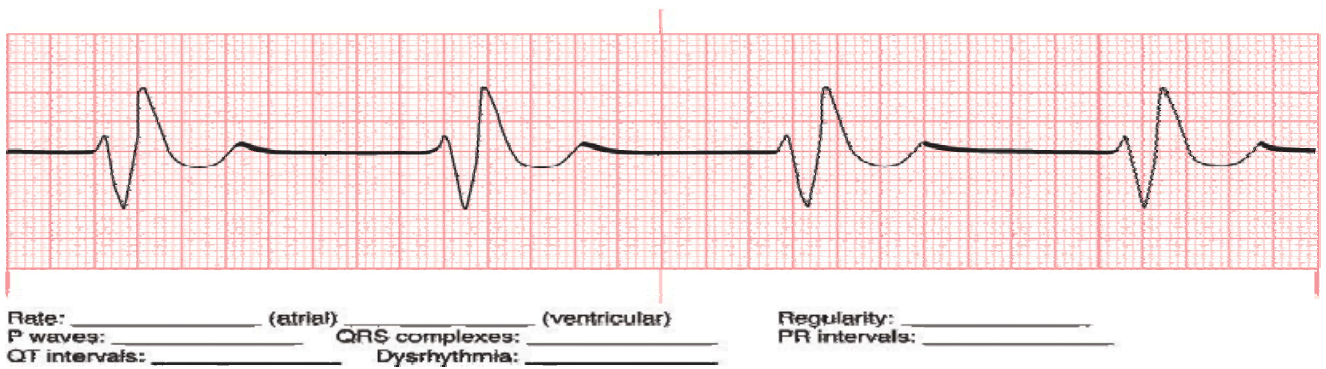
PR-interval: absent

Two PVC's in a row are called a couplet

Three PVC's in a row are called a salvo, run, or burst and are considered ventricular tachycardia.

PVC's occurring on or near the previous T wave (R on T) are likely to precipitate ventricular tachycardia or fibrillation.

Idioventricular rhythm



Rate: 20-40bpm

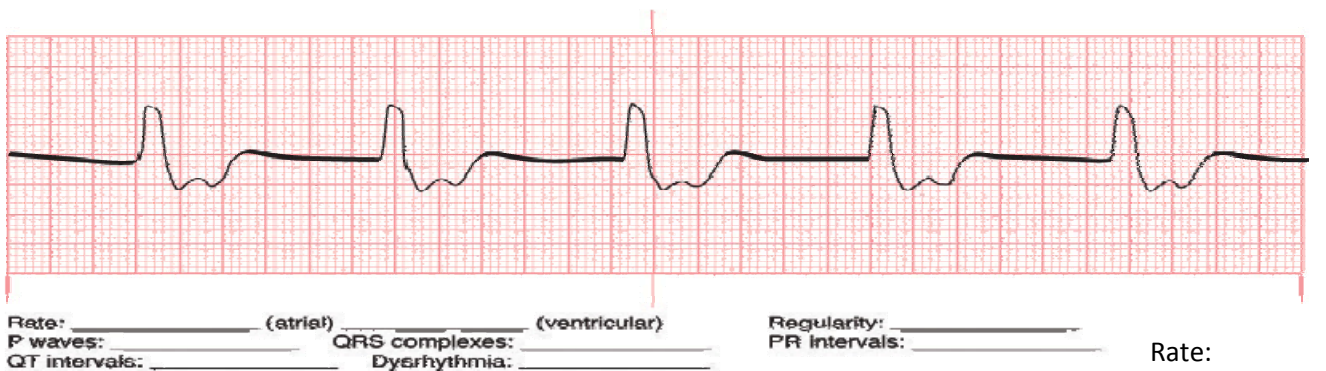
Regularity: regular

P-wave: absent

QRS-complex: wide and bizarre

PR-interval: absent

Accelerated Idioventricular rhythm



40-100bpm

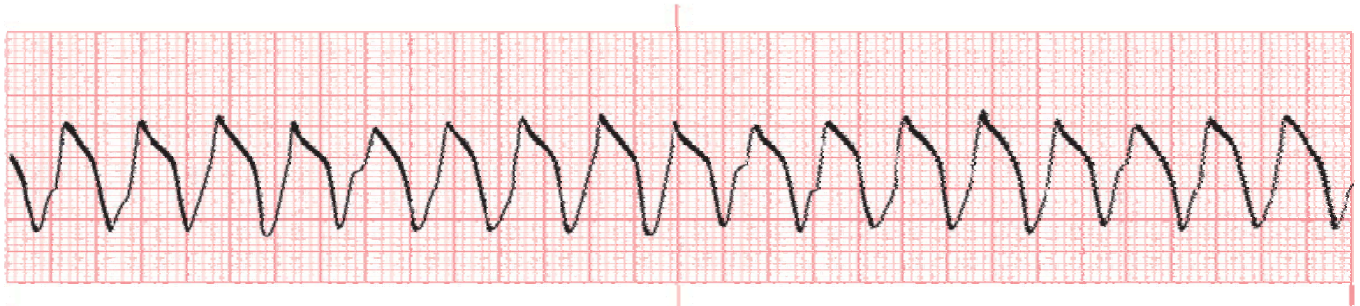
Regularity: regular

P-wave: absent

QRS-complex: wide and bizarre

PR-interval: absent

Ventricular tachycardia (may have a pulse or may not)



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
P waves: _____ QRS complexes: _____ PR intervals: _____
QT intervals: _____ Dysrhythmia: _____

Rate: 100-250bpm

Regularity: regular

P-wave: absent

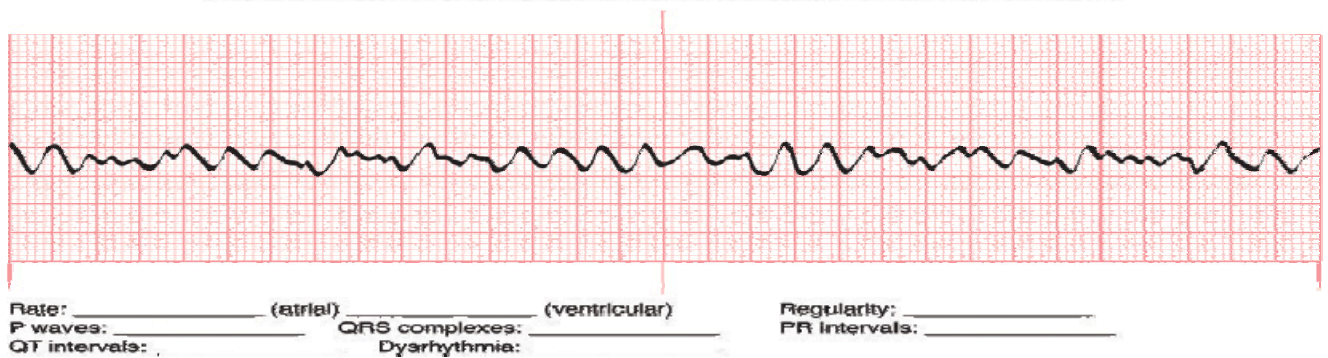
QRS-complex: wide and bizarre

PR-interval: absent

Polymorphic ventricular tachycardia (Torsades de Pointes) QRS complexes alternate between upright and downward deflections.



Ventricular fibrillation(produces no effective cardiac output)



Rate: 200-500bpm

Regularity: totally chaotic

P-wave: absent

QRS-complex: wavy line

PR-interval: absent

The only effective treatment for Ventricular fibrillation is defibrillation

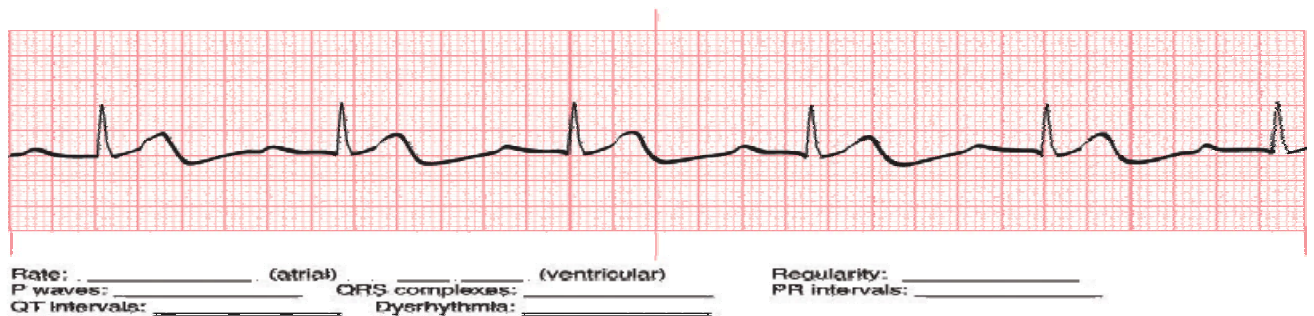
Asystole

Total absence of cardiac activity (Flat line)

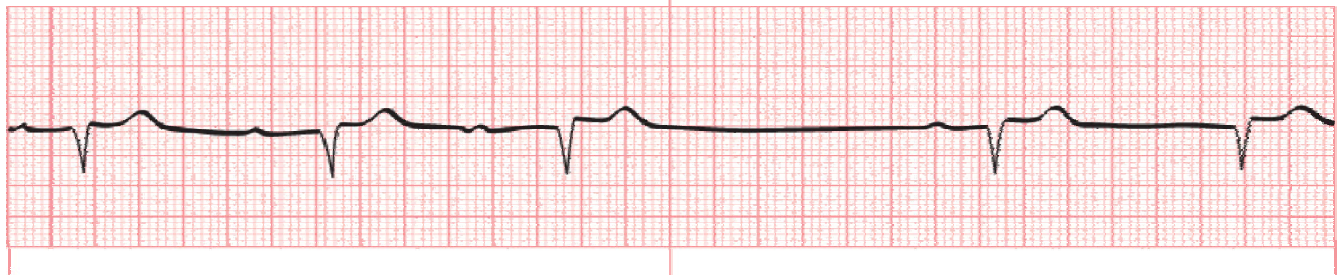
Pulseless Electrical Activity- organized electrical activity that should result in a pulse but there is no pulse.

Atrioventricular Heart Blocks

1st degree- not a true block is only significant if it occurs suddenly in a person (may precede a heart block), noticed by a PR-interval that is consistently more that .20sec. in duration.



2nd degree, Type I



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
 P waves: _____ QRS complexes: _____ PR intervals: _____
 QT intervals: _____ Dysrhythmia: _____

Rate: depends on underlying rhythm

Regularity: Patterned irregularity

P-wave: more p-waves than QRS-complexes

QRS-complex: normal

PR-interval: progressively longer until a QRS-complex is dropped then the pattern starts over

2nd Degree, Type II



Rate: _____ (atrial) _____ (ventricular) Regularity: _____
 P waves: _____ QRS complexes: _____ PR intervals: _____
 QT intervals: _____ Dysrhythmia: _____

Rate: depends on the underlying rhythm

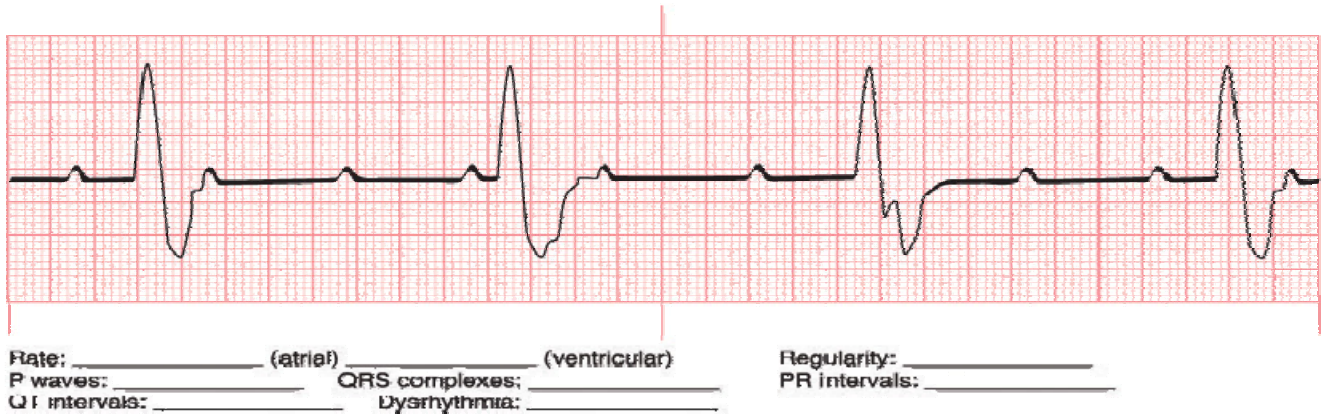
Regularity: may be patterned irregularity or irregular

P-wave: more p-waves than QRS-complexes

QRS-complex: normal

PR-interval: normal for all conducted beats

3rd Degree (total dissociation of the atria and ventricles)



Rate: normal atrial rate, slow ventricular rate

Regularity: atrial and ventricular rate are regular but not working together

P-wave: more p-waves than QRS-complexes

QRS-complex: normal or wide and bizarre depends on where the impulse is from

PR-interval: absent

Hypertrophy- condition, in which the muscular wall enlarges to increase the strength of the contraction, usually happens in the ventricles.

Dilation- condition, in which the muscular wall thins and expands to accommodate more blood, usually happens in the atria.

Preexcitation Syndromes

Wolff-Parkinson-White Syndrome (WPW)- condition in which the impulse takes a different path than the AV-node (bundle of Kent), and is characterized by the slurring of the R-wave called the Delta wave. Patients with this are prone to SVT.

Lown-Ganong-Levine Syndrome (LGL)- impulse travels through the James fibers rather than the AV-node. Only indication of this in the ECG will be a shortened PR-interval.

PRACTICE QUESTIONS

1. What is the most accurate method for acquiring heart rate?
 - A. 6X10 method
 - B. 1500 method
 - C. QRS method
 - D. 300, 150, 100, 75, 50 method
2. As an impulse moves toward a positive electrode it produces what type of deflection?
 - A. Upward
 - B. Downward
 - C. Flat
 - D. Negative
3. On ECG papers horizontal measurements are used determine what?
 - A. Electrical voltage of the waveforms
 - B. Amplitude of the waveforms
 - C. Cardiac output
 - D. Heart rate
4. The initiation of the impulse in the SA node and its movement through the atria produce?
 - A. P-wave
 - B. PR interval
 - C. QRS complex
 - D. T-wave

5. Repolarization of the ventricles is represented by the?
 - A. P-wave
 - B. ORS complex
 - C. T wave
 - D. R wave
6. Artifact is?
 - A. Produced by chaotic electrical activity found in the heart
 - B. An easier way to interpret rhythms
 - C. Usually consistent across the rhythm strip
 - D. Problematic because it can mimic life-threatening dysrhythmias
7. Two PVC's in a row are called a?
 - A. Double
 - B. Couplet
 - C. Trigeminal
 - D. Salvo
8. The heart valve that is situated between the right atrium and the right ventricle is called?
 - A. The pulmonic valve
 - B. The mitral valve
 - C. The aortic valve
 - D. The tricuspid valve

9. Automaticity means
- A. The ability of the myocardial cell to contract when stimulated by an electrical impulse
 - B. The ability of certain cells to produce an electrical impulse without the need for outside nerve stimulation
 - C. The ability to transmit an electrical stimulus from cell to cell throughout the myocardium
 - D. The ability to respond to an electrical stimulus
10. Each small square running horizontally represents?
- A. 3 seconds
 - B. .04 seconds
 - C. 5mm
 - D. 0.1mv
11. How many electrodes are used as part of a 12-lead ECG?
- A. 8
 - B. 10
 - C. 12
 - D. 5
12. The third step of analyzing an ECG rhythm is?
- A. Evaluate the QRS complex
 - B. Determine the heart rate
 - C. Determine the regularity
 - D. Evaluate the P-wave

13. The PR intervals get progressively longer in

- A. 1st degree AV heart block
- B. 2nd degree AV heart block, Type I
- C. 3rd degree AV heart block
- D. Sinus dysrhythmia

14. A heart rate below 60 is called?

- A. NSR
- B. Bradycardia
- C. Tachycardia
- D. Fast

15. atrial fibrillation has

- A. Longer PR intervals
- B. A regular rhythm
- C. No P-waves
- D. No QRS complex

Answers

1. B

2. A

3. D

4. A

5. C

6. D

7. B

8. D

9. B

10. B

11. B

12. D

13. B

14. B

15. C