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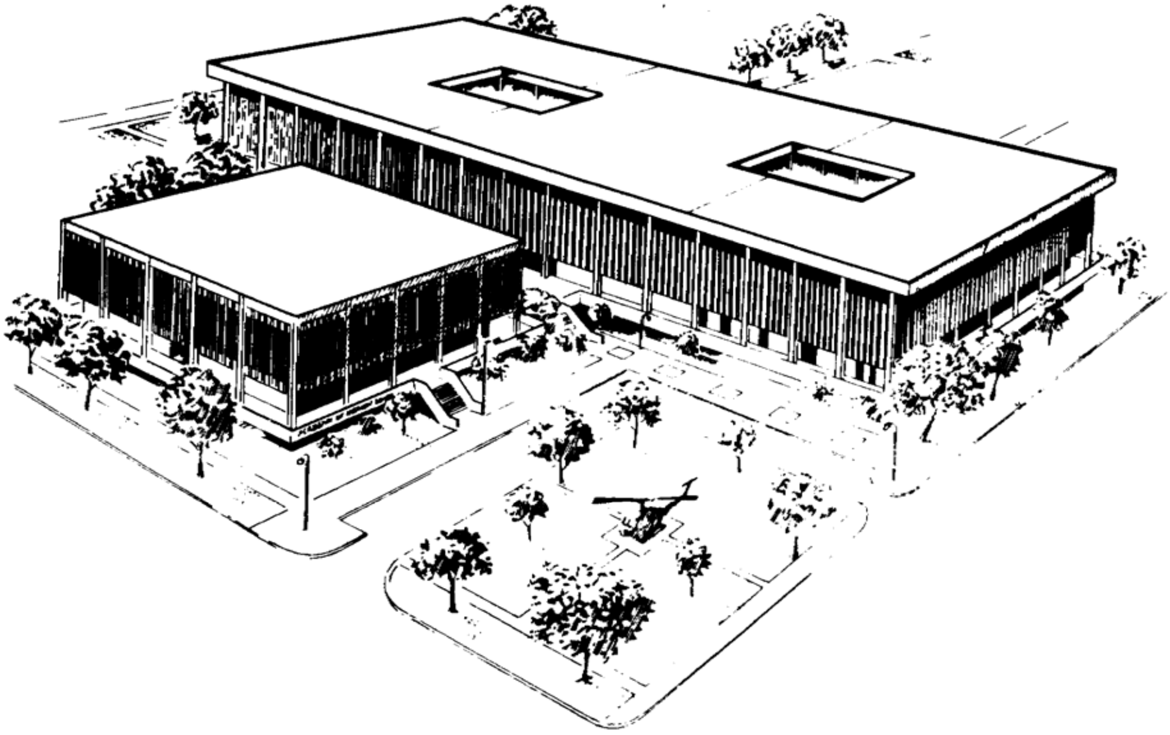

CARDIAC IMPAIRMENT

SUBCOURSE MD0571 EDITION 100

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

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Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TRAINING LITERATURE TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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CORRESPONDENCE COURSE OF
THE ACADEMY OF HEALTH SCIENCES, UNITED STATES ARMY

SUBCOURSE MD0571

CARDIAC IMPAIRMENT

INTRODUCTION

In this subcourse, you will study cardiac arrest; basic life support, to include rescue breathing; chest compressions; and recognition and treatment of cardiac dysrhythmias. This information will aid you in maintaining and improving the health of soldiers. In that pursuit, do your best to achieve the objectives of this subcourse.

Subcourse Components:

This subcourse consists of three lessons:

Lesson 1 Basic Cardiac Life Support.
Lesson 2 Dysrhythmia Recognition and Treatment.
Lesson 3 Cardiac Arrest.

Study Suggestions:

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.
--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas. Upon successful completion of the examination for this subcourse, you will be awarded 8 credit hours.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1 Basic Cardiac Life Support.

LESSON ASSIGNMENT Paragraphs 1-1 through 1-22.

LESSON OBJECTIVES After completing this lesson, you should be able to:

1-1. Identify the steps in performing one-rescuer CARDIOPULMONARY RESUSCITATION (CPR).

1-2. Identify the steps in performing two-rescuer CPR.

1-3. Identify the steps in switching from one-rescuer CPR to two-rescuer CPR.

1-4. Identify the steps in switching positions with another rescuer while you are both performing two-rescuer CPR.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

CARDIAC IMPAIRMENT

Section I. GENERAL INFORMATION

1-1. INTRODUCTION TO CARDIOPULMONARY RESUSCITATION

Blood supplies the cells of the body with oxygen. In an emergency, you must ensure that this supply of oxygen continues. The supply of oxygen to the body cells is threatened whenever the person stops breathing on his own, or when the person's heart stops pumping blood. When the oxygen supply fails, cells begin to die. The length of time required for a cell to die after the oxygen supply has stopped depends upon several factors. One of the most important factors is the type of cell involved. Brain cells are the most sensitive. Permanent brain damage usually occurs if the oxygen supply is stopped for more than 4 minutes. The following sections deal with restoring the breathing process to a person who has stopped breathing for himself and restoring the heartbeat to a person who heart has stopped beating. The combination of techniques that provides basic emergency life support by keeping oxygenated blood flowing in the brain during such occurrences is called cardiopulmonary resuscitation (CPR).

1-2. SUDDEN DEATH

Sudden death is defined as the unexpected cessation of respiration and functional circulation. There are two stages of sudden death: clinical death and biological death.

a. **Clinical Deaths.** Clinical death means that the heartbeat and breathing have stopped. This condition is reversible. Sudden death is abrupt and unexpected clinical death.

b. **Biological Death.** Biological death is permanent cellular damage due to lack of oxygen. The brain cells are the most sensitive to lack of oxygen. Irreversible brain damage occurs within 4 to 6 minutes. Biological death is a final condition.

c. **Difference Between Clinical Death and Biological Death.** Clinical death occurs as soon as the heart stops beating and the person stops breathing. Clinical death results in unconsciousness. This condition can be reversed by cardiopulmonary resuscitation. If CPR is not initiated, biological death usually occurs 4 to 6 minutes after clinical death. Biological death involves irreversible brain damage.

1-3. RECOVERY PROBABILITY RATES

If basic life support (BLS) is delayed from 1 to 4 minutes after cardiac arrest, the recovery rate is 50 percent. If BLS is delayed 7 minutes after cardiac arrest, the recovery rate is 8 percent. If BLS is delayed for 10 minutes after cardiac arrest, the recovery rate is less than one percent.

1-4. COMMON CAUSES OF SUDDEN DEATH

Listed below are the common causes of sudden death:

a. Drowning.

b. Electrical shock.

c. Poisoning.

d. Suffocation.

e. Smoke inhalation.

f. Choking on food or other objects.

g. Sensitivity reaction and anaphylactic shock.

h. Automobile accident.

i. Medical reasons.

j. Myocardial infarction.

1-5. RESCUER RESPONSIBILITIES DURING CARDIOPULMONARY RESUSCITATION

A person performing CPR has two basic responsibilities: prevent biological death of the casualty and get competent help. To prevent biological death, you must be able to recognize the nature of the emergency. You must also be able to provide artificial breathing and artificial circulation immediately. The ability to get competent help involves knowing the civilian telephone numbers for emergencies (911 in major metropolitan areas) including special numbers on a military installation including the general emergency number, the fire department number, and military police, number.

1-6. DEFINITION OF CARDIOPULMONARY RESUSCITATION

The term "cardio-" refers to the heart; the term "pulmonary-" refers to the lungs; and the term "resuscitation" means to bring a person who appears to be dead to consciousness. Thus, cardiopulmonary resuscitation means restoring lung function (breathing) and heart function (blood circulation) to a person who is clinically dead. Cardiopulmonary resuscitation is usually referred to simply as CPR. Cardiopulmonary resuscitation is composed of an assessment (evaluation) phase during which the responsiveness of the person is determined followed by the three basic maneuvers: opening the airway, rescue breathing, and chest compressions.

1-7. IMPORTANCE OF CARDIOPULMONARY RESUSCITATION

Past experience with situations requiring basic life support measures (restoring breathing and heartbeat) has demonstrated that a significant number of casualties can be successfully resuscitated if CPR is provided <u>promptly</u> and followed by more advanced cardiac life support. Prompt response is critical. The American Heart Association reports that the longer CPR is delayed, the lower the survival rate.

SECTION II. RESCUE BREATHING

1-8. INTRODUCTION

A person who is not breathing will die in a short time because the cells are not receiving a fresh supply of oxygen. Cardiopulmonary resuscitation, in this case, one-rescuer CPR, is a method by which the rescuer forces air into the casualty's lungs. The casualty's blood can then pick up oxygen from the air that has been forced into his lungs. Even though the air comes from the rescuer, it still contains plenty of oxygen. When the rescuer stops blowing air through the casualty's mouth (or nose) and breaks the seal over the casualty's mouth (or nose), the casualty's body will exhale without assistance from the rescuer. Thus, CPR acts as a substitute for the normal inhaling and exhaling process.

1-9. RESCUE BREATHING PROCEDURE

a. **Evaluation (Assessment) Phase.** If you see someone lying on the ground not moving, evaluate the situation first. Part of this evaluation is simply observing the surroundings. Does it appear that the person could have been injured in a traffic accident, by a fall, or by some other violent accident? If any of these accidents could have occurred, consider that the casualty could have a spinal fracture and take some special precautions if you must perform CPR. If you cannot see any evidence of an accident, the casualty may have suffered a heart attack without a spinal injury. Another part of the evaluation is a quick check to see if the person really is unconscious. Tap the casualty on the shoulder. Shake him gently (take care not to cause additional injury), and shout, "Are you O.K.?" (**NOTE**: Do not shake the casualty if you suspect spinal injury--just shout. Even if you do not suspect spinal damage, do not shake the person in a violent manner. Violent shaking could aggravate other injuries the casualty may have suffered.) If the casualty responds (conscious), give whatever aid is needed. If he does not respond (unconscious), conscious), continue with your rescue efforts. It will take from four to ten seconds to establish unconsciousness. Whether the casualty is conscious or unconscious, call for additional help, if such help is available.

b. **Positioning the Casualty.** You must position a casualty flat on his back before beginning CPR. If the casualty is lying in a supine position (on his back), place his arms at his side and proceed to establish an open airway (para 1-9c). If the casualty is in a prone position (on his chest), turn him onto his back using the procedures given below and shown in figure 2-1. These procedures allow the casualty's body to be turned as a unit and minimize the likelihood that injuries will be aggravated. It is especially important to use these procedures if you suspect that the casualty may have an injury to his spine. Follow this procedure:

(1) Straighten the casualty's legs (figure 1-1 A).

(2) Take the casualty's arm that is nearest to you and move it so that it is straight and above his head (figure 1-1 A). Then, move his other arm so that it is straight and above his head also.

(3) Kneel beside the casualty. Your knees should be near his chest area, but there should be enough space between you and the casualty for you to roll him onto his back (figure 1-1 A).

(4) Support the casualty's head and neck by placing your hand that is nearest his head on the back of his head and neck (figure 1-1 A).

(5) With your other hand, grasp the casualty under his far arm (figure 1-1 B).

(6) Roll the casualty towards you (figure 1-1 B). Use a steady and even pull, turning the casualty's body as a unit so that his head and neck stay in line with his back.

(7) Return the casualty's arms to his side (figure 1-1C).
If his legs are crossed, straighten them so that they are not crossed.

NOTE: Be sure that the casualty is on a hard surface. A firm surface is necessary for chest compressions to be effective. Appropriate surfaces include the ground, a backboard, and a bed board.

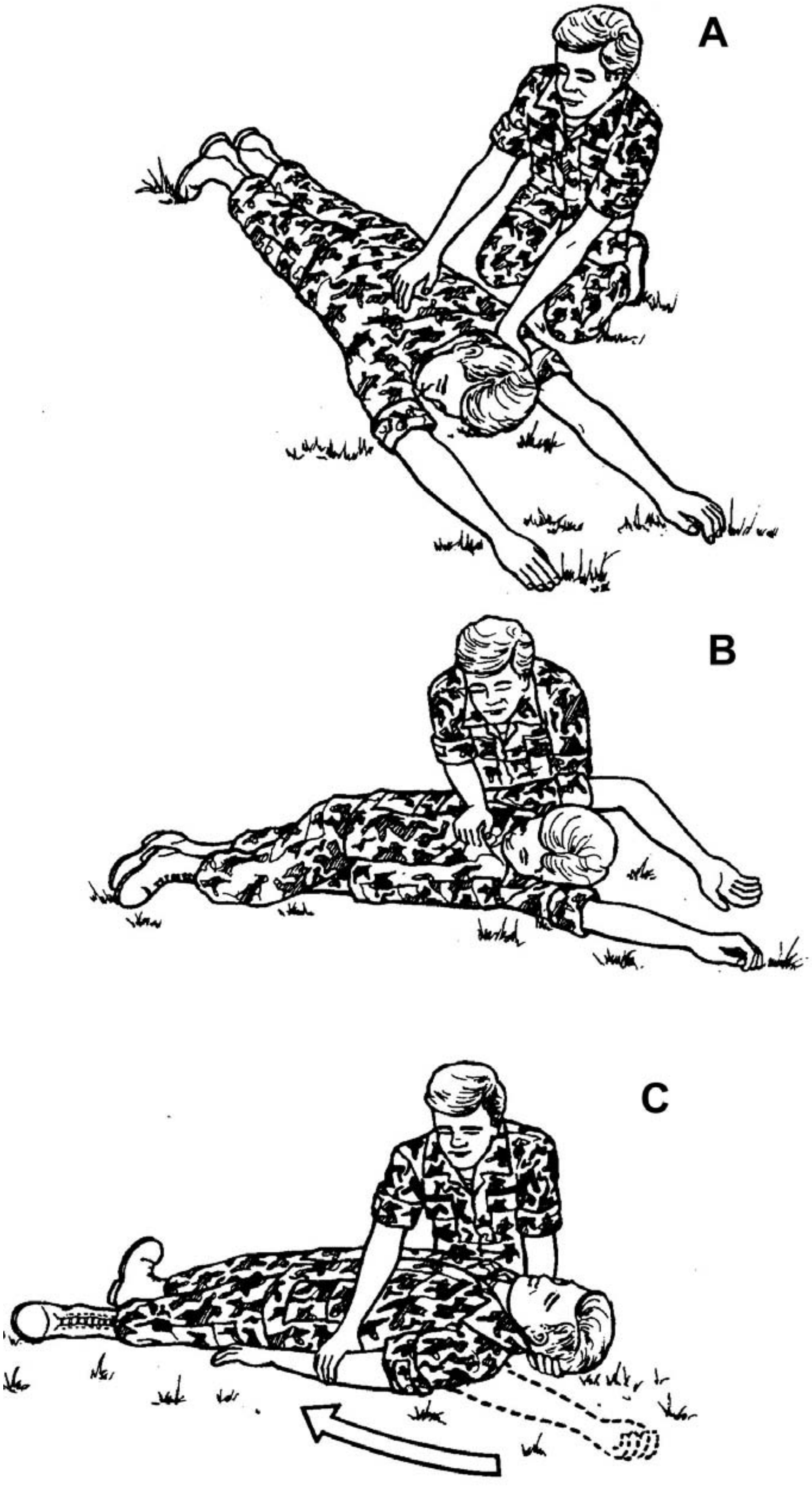


Figure 1-1. Rolling a casualty onto his back.

c. **Establishing an Airway.** Sometimes an unconscious casualty who is breathing poorly will resume normal breathing when his head is positioned so that his airway is reopened. This is especially true when the casualty's tongue has caused the airway to become blocked. Since the tongue is attached to the lower jaw, repositioning the jaw forward can lift the tongue away from the back of the throat and reopen the airway. Two commonly used methods of establishing an airway are the head-tilt/chin-lift method and the jaw-thrust method. Establishing an airway should take between 3 and 5 seconds.

(1) <u>Head-tilt/chin-lift method</u>. This is the preferred method of opening the casualty's airway if a spinal fracture in the neck region is not suspected. In addition, loose dentures can be handled easier using the head-tilt/chin-lift method than when using another method. Procedures for the head-tilt/chin-lift method of establishing an airway are given here:

(a) Kneel at the side of the casualty's head.

(b) Place the fingertips of one hand under the bony part of his chin.

(c) Place your other hand on his forehead.

(d) Press on his forehead to make the head tilt back while lifting his chin forward (figure 1-2 A). Lift until the teeth are <u>almost</u> brought together. The mouth should <u>not</u> be closed as this could prevent air from entering the casualty's airway. The thumb is usually not used in lifting the chin. In some cases, the thumb may be used to depress the casualty's lower lip slightly to keep his mouth open.

(2) <u>Jaw-thrust method</u>. The jaw-thrust method is an effective method to use in opening the airway. The procedure is as follows:

(a) Kneel beside the casualty.

(b) Rest your elbows on the same surface on which the casualty is lying.

(c) Place your hands on either side of the casualty's head. Grasp the angles of the casualty's lower jaw.

(d) Lift the casualty's lower jaw forward and tilt his head backward at the same time (figure 1-2 B).

(e) If you must perform rescue breathing, pull the casualty's lower lip open with your thumb and close the casualty's nostrils by placing your cheek tightly against his nostrils.

NOTE: This technique is very successful in opening the airway, but it is tiring to the rescuer and difficult to perform.

CAUTION: If you think the casualty has a neck injury, use the jaw-thrust method without the head-lift. If the jaw-thrust method does not open the airway, then use the head-tilt method.

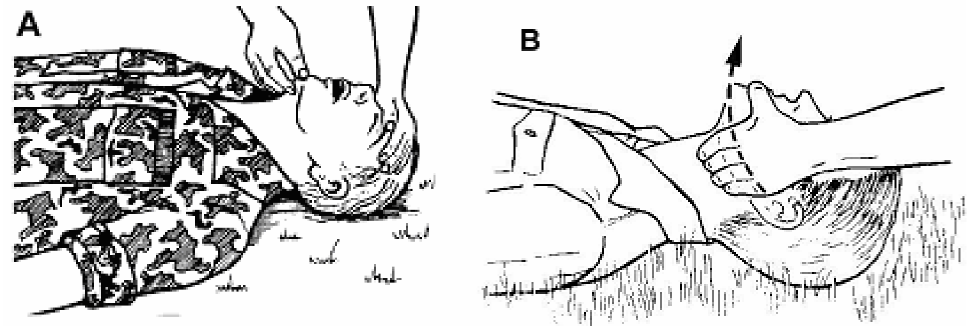


Figure 1-2. Establishing an airway A Head-tilt/chin-lift method. B Jaw-thrust method.

d. **Checking for Breathing.** Check to see if the casualty is breathing. Many times, opening the airway is all that is needed to restore breathing in an unconscious person. While you are doing the check, maintain the casualty's airway using the head-tilt/chin-lift or the jaw-thrust method.

NOTE : This is the first time you actually check to see if the casualty is breathing. Even if an unconscious casualty is breathing when you find him, his breathing could deteriorate or stop altogether while you are performing other measures. That is why you must take the precaution of positioning the casualty and establishing an airway.

(1) Place your ear over the casualty's mouth and nose and look towards the casualty's chest (figure 1-3). For the best results, your ear should be touching his nose.

Figure 1-3. Checking a casualty for breathing by the head-tilt/chin-lift method.

(2) Look at the casualty's at the casualty's chest. If the casualty is breathing, you should be able to see the chest rise and fall.

(3) Listen for the sound of breathing (air being inhaled and exhaled).

(4) Feel for the flow of air on the side of your face, the air flow being caused by the casualty exhaling.

e. **Evaluating Your Findings.**

(1) If your check shows that the casualty is breathing, take measures to maintain his airway.

(2) If your check shows that the casualty is not breathing, reposition his head and neck (para 1-7b) and check for breathing a second time. If he is still not breathing, you must perform CPR immediately.

f. **Rescue Breathing.** Forcing an unconscious casualty to inhale and exhale is the part of CPR termed "rescue breathing" or "ventilating the casualty." (Ventilation simply means that you are supplying the casualty's lungs with fresh air.) There are three methods of rescue breathing. Mouth-to-mouth is the method normally used. Mouth-to-nose, an alternate method, is used when the casualty's mouth cannot be opened or when you are unable to achieve a tight seal around the casualty's mouth. Procedures for performing mouth-to-nose rescue breathing are given in paragraph f (2) below.

NOTE: If the casualty has had his larynx removed surgically, there will be an opening in the neck for breathing purposes. This opening, called a stoma, can be used to perform mouth-to-stoma rescue breathing.

(1) Mouth-to-mouth rescue breathing. Perform mouth-to-mouth ventilations in the following manner:

(a) Gently pinch the casualty's nose closed. The casualty's nostrils must be closed so that air will not escape when you blow air into his mouth. Using the thumb and index finger of your hand on the casualty's forehead, pinch his nostrils closed gently (figure 1-4). Keep the heel of your hand on the casualty's forehead and maintain enough pressure to maintain the head-tilt. Your other hand should stay on the casualty's chin or neck so the airway remains open.

(b) Give two full breaths within 3 seconds.

NOTE: This is a change. Previously, the directions were to give "four quick breaths." It is believed those breaths put too much air in the lungs and caused complications such as gastric distention.

Figure 1-4. Administering mouth-to-mouth rescue breathing by the head-tilt/chin-lift.

1 Take a deep breath.

2 Seal your lips around the outside of the casualty's mouth thus creating an airtight seal.

3 Blow two full breaths within three seconds into the casualty's mouth.

4 If your initial attempt to ventilate the casualty is unsuccessful, reposition the casualty's head and repeat rescue breathing.

5 After the second breath, break the seal over the casualty's mouth and release his nose. The casualty's body will exhale without effort on your part.

6 Check for breathing.

(c) Evaluate the effectiveness of the two breaths.

1 If the casualty's chest did not rise and fall, then fresh air is not getting into his lungs. Try repositioning the casualty's head to open his airway more. If the head-tilt/chin-lift method or the jaw-thrust is being used, lift the chin more. If the head-tilt/neck-lift method is being used, lift the neck more. After you have done this, administer two full breaths within 3 seconds again.

2 If casualty's chest still does not rise even after you have tried to increase the airway opening, the casualty probably has an object blocking his airway. Administer manual thrusts and finger sweeps to open the airway. (Manual thrust = a thrust delivered to the abdomen or breast bone to force air out of the lungs, thus, expelling a foreign body from the airway.)

3 If the casualty begins breathing again on his own, look for injuries. **DO NOT** leave the casualty since his breathing may stop again. The casualty may still require help to keep his airway open.

4 If air goes in and out of the casualty's lungs, but he does not start breathing on his own, administer the rescue breathing procedures given in the paragraphs that follow.

(d) Feel for the carotid pulse. After you have successfully given the initial two full breaths, check the casualty's pulse. Getting fresh air into the casualty's lungs will not help if his heart is not beating and the blood is not circulating. There are two major arteries, called the carotid arteries, in the neck. On the left side of the trachea is one artery (windpipe); the other artery is on the right side of the trachea. Either artery may be used to check the casualty's carotid pulse, but normally you should use the artery on the side of the neck nearest you. The carotid pulse is used because you are already near the neck and a pulse can sometimes be felt at the carotid arteries when the pulse is too weak to be detected at arteries further from the heart. Procedures for checking the casualty's carotid pulse are given below. The procedures take about five seconds. Follow these procedures to feel for the carotid pulse:

1 Place the index and middle fingers of your hand that is not on the casualty's forehead on the side of the casualty's trachea (figure 1-5). Use the side nearest you. (**IMPORTANT:** Do not use your thumb to feel for the pulse. The pulse you find may be your thumb's pulse, not the casualty's carotid pulse.)

2 Slide your finger into the groove beside the Adam's apple (The "Adam's apple" is actually the larynx. The Adam's apple is smaller in females than in males.

3 Gently feel for the pulse. Maintain the head-tilt with your hand on the casualty's forehead.

Figure 1-5. Feeling for the casualty's carotid pulse.

4 Send someone to get help.

5 If no pulse is felt, begin CPR immediately. If a pulse can be felt, continue with rescue breathing procedures given in the next paragraph.

(e) Continue rescue breathing. If the casualty's heart is beating and he is not breathing on his own, continue to administer rescue breathing using the procedure given below. Perform ventilations at a rate of one ventilation every 5 seconds (12 ventilations per minute). Continue to keep the casualty's airway open while performing the ventilations, and follow this procedure:

1 Take a deep breath.

2 Pinch the casualty's nostrils closed; use the thumb and index finger of your hand on his forehead to do this.

3 Place your mouth over the casualty's mouth, making sure that a tight seal is formed.

4 Blow into the casualty's mouth. As you blow, observe the casualty's chest. If his chest does not rise, a sufficient amount of air is not getting into his lungs. This may be caused by these factors: inadequate positioning of the casualty's head, chin, or neck; air leaking from the casualty's nose; air leaking from around your mouth; an airway obstruction; or the breath not being delivered with sufficient force. If a problem exists, correct the problem and continue administering ventilations.

5 Remove your mouth from around the casualty's mouth and release his nose. This allows him to exhale. Remember, the casualty's airway must be kept open so that he can exhale.

6 Recheck the casualty's pulse after every 12 breaths (once per minute). If the pulse is absent, begin administering chest compressions at once.

7 Continue administering rescue breathing at the rate of one breath every 5 seconds until the casualty begins breathing on his own, until you are relieved by a qualified person, until you are ordered to stop by a doctor, or until you are too exhausted to continue.

8 If the casualty begins breathing on his own, monitor him in case his breathing stops again.

9 When possible, evacuate the casualty for further evaluation and treatment by a doctor. If the casualty is not breathing on his own, continue administering rescue breathing during the evacuation.

(2) Mouth-to-nose rescue breathing. Use this technique in the following situations: impossible to open the casualty's mouth; casualty's mouth is seriously injured; or difficult to achieve a tight seal on the casualty's mouth. Open the casualty's airway and follow this procedure for mouth-to-nose rescue breathing:

(a) Close the casualty's mouth completely. Use your hand that is not on the casualty's forehead to lift his jaw and close his mouth. It is important that no air escape through the casualty's mouth when you perform ventilations.

(b) Give two quick, full breaths. Take a deep breath, seal your lips around the casualty's nose and blow into his nose. (See figure 1-6.) Be sure the two quick breaths are given with three seconds. Observe the casualty's chest as you administer the two breaths.

Figure 1-6. Administering mouth-to-nose rescue breathing.

(c) Remove your mouth from the casualty's nose. Either open his mouth or separate his lips so that he can exhale passively.

(d) Evaluate the effectiveness of the two breaths:

1 If the casualty's chest did not rise and fall, try opening his airway more and administer two breaths again. If this does not work, check for an upper airway obstruction and remove any blockage. Then, continue administering breaths until the four quick breaths cause the chest to rise.

2 If the casualty starts to breathe on his own, begin looking for injuries and treat them. Be prepared to resume rescue breathing in case the casualty stops breathing again.

3 If the two breaths caused the casualty's chest to rise and fall but the casualty has not started breathing on-his own, feel for his carotid pulse. If there is no pulse, begin chest compressions as described in Section III of this lesson.

4 If the casualty's heart is still beating and the casualty is not breathing on his own, continue to perform-mouth-to-nose ventilations.

(e) Continue rescue breathing. If the casualty's heart is beating but he is not breathing on his own, perform mouth-to-nose ventilations at a rate of one ventilation every five seconds.

1. Take a deep breath.

2. Close the casualty's mouth.

3. Form a seal over his nose and force air into his nose.

4 Break the seal over the casualty's nose and allow him to exhale (either open his mouth or separate his lips).

5 Check the casualty's pulse after every 12 ventilations. If the pulse is absent, begin administering chest compressions.

6 Continue administering mouth-to-nose ventilations at a rate of 12 ventilations per minute until the casualty is breathing on his own, until you are relieved by a qualified person, until a doctor tells you to stop, or until you are too exhausted to continue rescue breathing.

7 If the casualty begins breathing on his own, monitor him in case his breathing stops again.

8 When possible, evacuate the casualty for further evaluation and treatment by a physician. If the casualty is not breathing on his own, continue administering rescue breathing during the evacuation.

(3) Mouth-to-stoma rescue breathing. Follow the same procedures as for mouth-to-mouth rescue breathing. The difference is that you place your mouth over the neck opening instead of over the mouth, and you hold the mouth closed.

Section III. CHEST COMPRESSIONS

1-10. INTRODUCTION

If the casualty's heart stops beating, the blood stops circulating. When blood stops circulating, cells cannot get oxygen, and they begin to die. The casualty's heart, however, may still be beating even though he has stopped breathing on his own. If his heart stops beating, he will stop breathing also. Just as the rescuer can perform rescue breathing as a substitute for the casualty's normal heartbeat, the rescuer can perform chest compressions to substitute for the casualty's normal heartbeat. In neither case, however, is the substitute measure as efficient as the body's natural process. Cardiopulmonary resuscitation is the combination of rescue breathing and chest compressions.

CARDIOPULMONARY RESUSCITATION	**=**	**RESCUE BREATHING** **(Substitute for casualty's breathing)**	**+**	**CHEST COMPRESSIONS** **(Substitute for casualty's normal heartbeat)**

Figure 1-7. Cardiopulmonary resuscitation.

1-11. EFFECTS OF CHEST COMPRESSIONS

An external chest compression is the application of pressure over the casualty's sternum. External chest compressions force blood to be circulated to the heart, lungs, brain, and other organs. Blood circulated to the lungs by this method plus rescue breathing will maintain a casualty's life until other treatment can be obtained for him. Properly performed external chest compressions alone can produce systolic blood pressure to peak at over 100 mm Hg. The compressions can bring the carotid arterial blood flow up to 35 percent of normal. The heart is located between the sternum and the spine. When the sternum is pressed down far enough into the chest cavity (1 1/2 to 2 inches in an adult), the heart is compressed between the sternum and the spine (figure 1-8 A. When pressure is removed from the sternum, it rises to its normal position. When the sternum rises, the heart resumes its normal shape (figure 1-8 B). Since blood has been forced out of the ventricles during compression, blood flows from the atria into the ventricles as the heart returns to its normal shape. Each pressure-release cycle causes blood to be pumped and is roughly equal to one heartbeat.

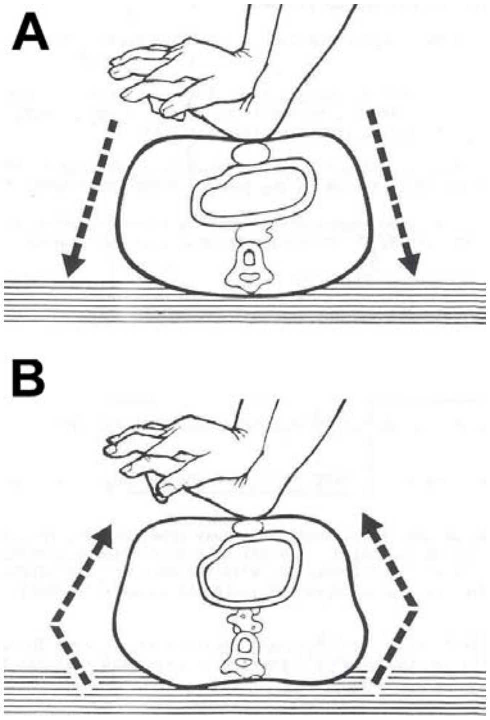


Figure 1-8. Effects of chest compression. A Compression. B Release.

1-12. PROCEDURE FOR CHEST COMPRESSIONS

Be sure the casualty is in the supine position. If the head is elevated above the heart, less or sometimes no blood gets to the brain. If necessary, a board can be placed under the patient's chest to provide a firm, flat surface for the patient to lie on.

a. **Locate the Compression Site.** Determine proper hand position in this manner:

(1) Using the middle and index finger of your hand which is nearest the casualty's legs, find the lower margin of his rib cage on the side of his body closest to you. See figure 1-9 A .

(2) Move your fingers up the casualty's rib cage to the notch where the ribs meet the sternum in the center of the lower part of the chest.

(3) Keep your middle finger on this notch and place your index finger next to the middle finger on the lower end of the sternum. See figure 1-9 B .

(4) Your other hand has been on the casualty's forehead to keep his head in position maintaining the airway. Put the heel of that hand on the lower half of the sternum, close to the index finger that is next to the middle finger in the notch. The thumb side of that hand should be against the index finger of the other hand. The heel is now on the compression site. See figure 1-9 C .

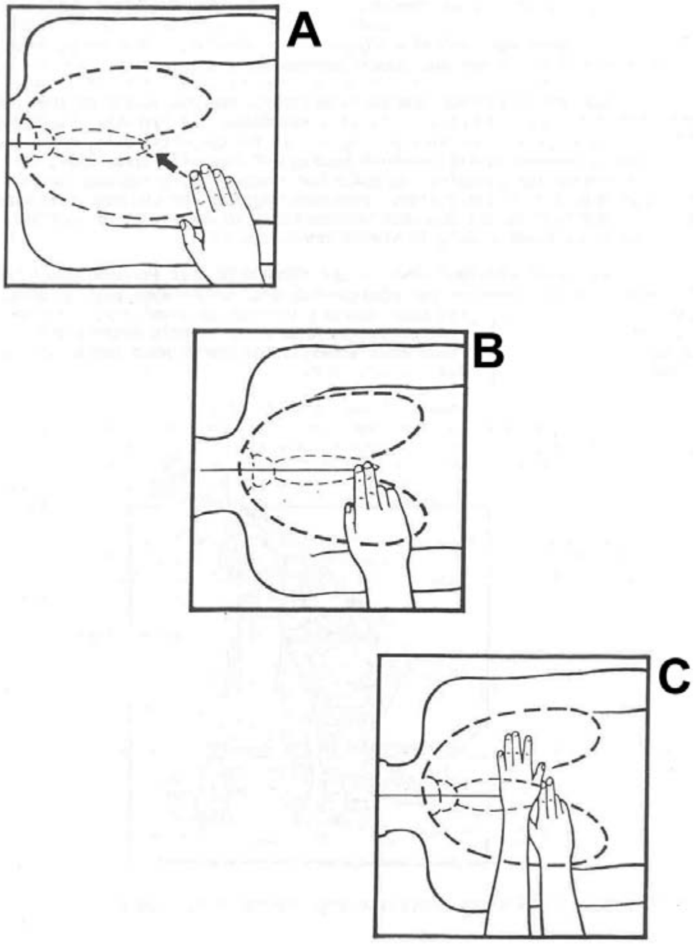


Figure 1-9. Locating the compression site for chest compression.

b. **Position Hands for Giving Chest Compressions.** Follow these steps:

(1) Remove your hand from the notch and put it on top of the hand on the sternum.

(2) Be sure both hands point away from the rescuer (toward the opposite side of the casualty). You may hold your fingers straight or interlocked. You will exert pressure with the HEEL of your hands; therefore, be sure your fingers and palms DO NOT touch the casualty's chest. (See figure 1-10.)

NOTE: An alternate method to this hand position is to grasp the wrist of your hand on the casualty's chest with your hand that had located the lower end of the sternum.

c. **Administer External Chest Compressions.** Proceed in this way:

(1) Lock your elbows with your arms straight. This makes chest compressions more efficient and saves the rescuer's energy.

(2) Position your shoulders directly over your hands so that the thrust for each chest compression is straight down. The casualty's torso may roll if you push other than straight down. If the casualty rolls, the thrust of the chest compression will be much weaker and less effective. Also, the rolling motion of the casualty can make the rescuer very tired and cause additional injury to the casualty. Possible injuries include fractured ribs, fractured xyphoid process, and lacerations (rips or punctures) of internal organs caused by sharp pieces of broken bone.

(3) Push straight down on the sternum so that it goes down 1 1/2 to 2 inches for the normal sized adult. Use your weight when pushing down. Instead of pushing down using your arm and shoulder muscles only, let the weight of your body move forward and use that force to help depress the sternum. Remember to keep your arms straight and your elbows locked during the push. (See figure 1-10.)

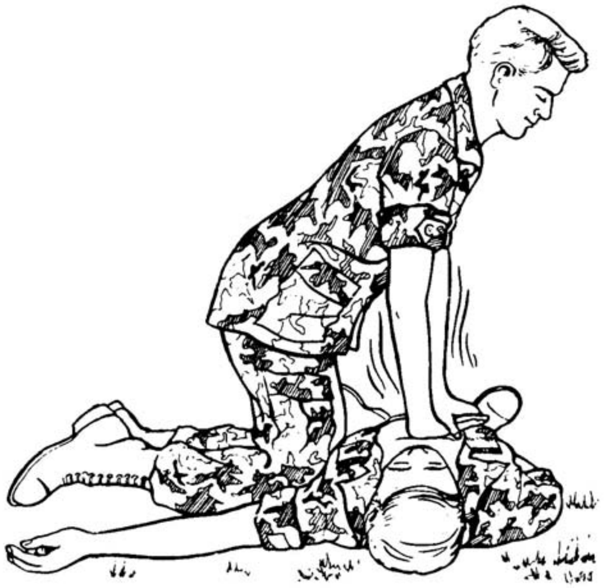


Figure 1-10. Rescuer administering external chest compressions.

(4) Give 15 compressions (10-12 seconds). A compression cycle consists of a thrust which compresses the heart and a release which allows the heart to refill with blood. These compressions are delivered at a rate of 80 cycles per minute (about 11 seconds for each 15 compressions). Delivering chest compressions at this rate will allow the rescuer to administer a total of 60 compressions per minute since some time will be required to administer two breaths after every 15 compressions.

d. **Relax and Allow the Chest to Rise Completely.** Releasing the pressure allows the heart to refill with blood. Release the pressure completely so that the sternum resumes its normal position, but do not remove the heel of your hand from the compression site. If you do lose the compression site, repeat the procedures for finding the site.

e. **Repeat Until 15 Push-Relax Cycles Have Been Completed.** (If One--Rescuer CPR is Being Performed) or five Push-Relax Cycles Have Been Completed (If Two-Rescuer CPR is Being Performed). Establish a definite rhythm and compress at the rate of 80 cycles per minute (15 compressions in 10-12 seconds). Spend half the time for each compression pushing down and half the time letting the chest rise. Keep the compression cycles regular, smooth, and uninterrupted.

f. **Give Two Quick Breaths (3-5 seconds).** Immediately after giving the fifteenth chest compression, release the pressure, move your hands to the casualty's head, and open his airway. Close the nose (or mouth) and seal the casualty's mouth (or nose or stoma). Blow air in until the chest rises. Look out of the corner of your eye to be sure the chest rises. Break the seal, take a breath, and administer a second breath.

g. **Administer Three More Cardiopulmonary Resuscitation Cycles (15 Chest Compressions and Two Breaths Per Cycle).** Before you do this, relocate the compression site over the casualty's sternum. Use the procedure given in paragraph 2-13 i (l). DO NOT GUESS where the site is.

h. **Check the Pulse (3-5 seconds).**

(1) Check the pulse after the first 4 CPR cycles. If the pulse is absent, give two breaths and resume one-rescuer CPR. If the pulse is present, perform rescue breathing.

(2) Recheck the pulse every few (3-5) minutes after the initial pulse check.

Section IV. ONE-RESCUER METHOD CARDIOPULMONARY RESUSCITATION

1-13. INTRODUCTION

There are two basic methods of administering CPR. The one-rescuer method is used when you have no one available to help you perform CPR. The two-rescuer method is used when you have assistance available. The one-rescuer method is presented in this section, and the two-rescuer method is presented in Section V.

1-14. ONE-RESCUER CARDIOPULMONARY RESUSCITATION METHOD

This method should be taught to a lay person. Teaching two-rescuer CPR to a nonprofessional may only confuse him. One person alone can maintain sufficient circulation and ventilation, but doing this procedure alone is very tiring.

a. **Airway.**

(1) Determine that the casualty is unresponsive. Tap him on the shoulder, the shoulder nearest you. Gently shake him, taking care not to cause more injury. Shout, "Are you O.K.?" If the casualty does not respond, consider that he is unconscious. See figure 1-11.

(2) Call for help.

(3) Position the casualty, if necessary. Place the casualty on his back and on a flat, firm surface. Turn the casualty's body as a unit being careful not to injure his head or neck as you move him. When the casualty is on his back, put his arms by the side of his body.

(4) Kneel at the casualty's shoulders so that rescue breathing and chest compressions can be performed without the rescuer moving his own knees.

(5) Open the airway using the head-lilt/chin-lift method (figure 1-12).

b. **Breathing.** Begin assessment by determining whether the casualty is breathing.

(1) If the casualty is breathing, follow this procedure:

(a) Monitor the casualty's breathing.

(b) Keep the casualty's airway open.

(c) Yell for help.

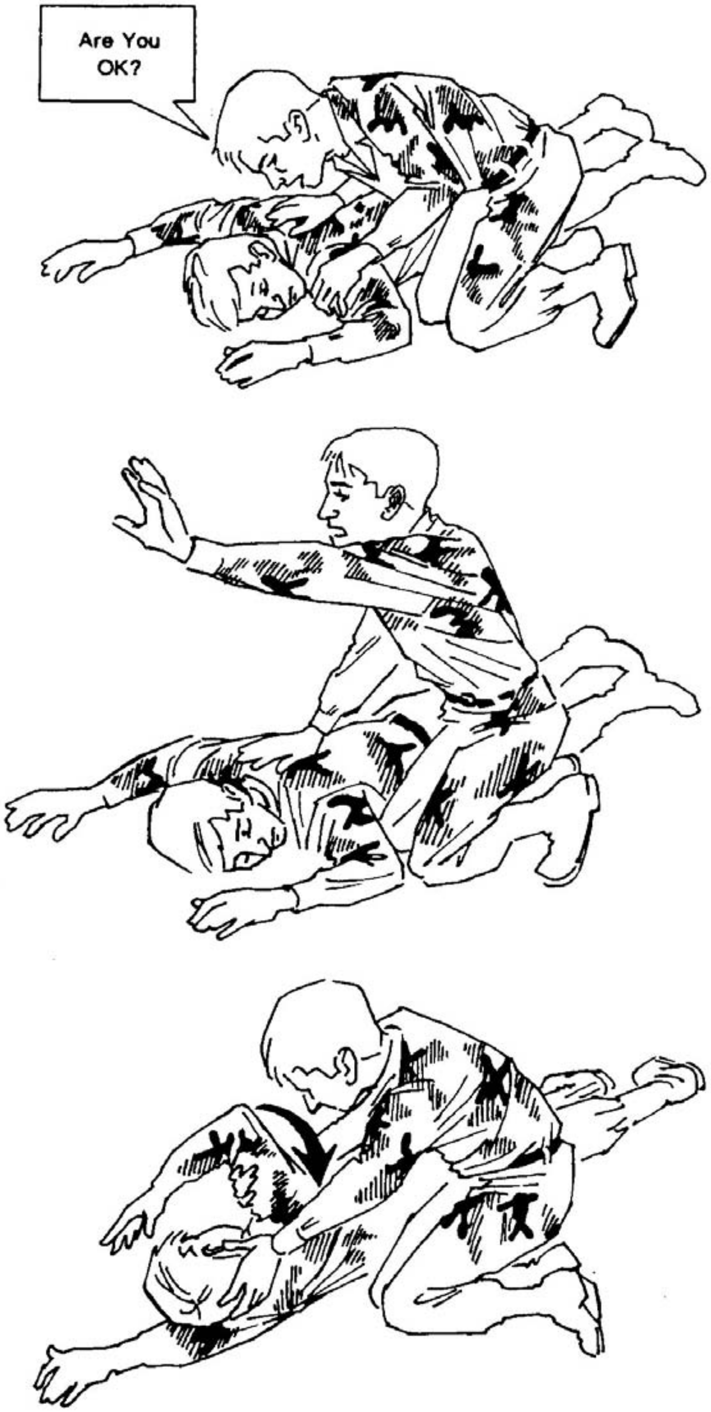


Figure 1-11. Initial steps of one-rescuer CPR.

Figure 1-12. Head-tilt/chin-lift method.

(2) If the casualty is NOT breathing, follow this procedure:

(a) Begin rescue breathing by giving two full breaths.

(b) If you cannot give two full breaths, reposition the casualty's head. Try giving two full breaths again.

(c) If the attempt at ventilation is still unsuccessful, assume there is a foreign body in the airway. Clear the airway as you would if there were a foreign body in the airway. Then, ventilate with two full breaths. If this is successful, continue to the next step.

c. **Circulation.** Begin with assessment and determine whether the casualty has a pulse.

(1) Continue rescue breathing at the rate of 12 times per minute if there is a pulse.

(2) If there is no pulse, start external chest compressions using this procedure:

(a) Determine the correct hand position.

(b) Do 15 external chest compressions. The rate should be 80 to 100 chest compressions per minute. To get the proper rhythm and be sure you are performing the correct number of chest compressions, count one-and, two-and, three-and, four-and, five-and, six-and, seven-and, eight-and, nine-and, ten-and, eleven-and, twelve-and, thirteen-and, fourteen-and, fifteen."

(c) Open the casualty's airway. Give him two rescue breaths (full, slow breaths).

(d) Determine the proper hand position. Start 15 more external chest compressions at a rate of 80 to 100 chest compressions per minute.

(e) Do four complete cycles of 15 compressions and two ventilations.

d. **Reassessment.** Reassess the casualty after four cycles of compressions and ventilations.

(1) Check to see if the casualty's carotid pulse has returned. (It should take about 5 seconds to check.) If the casualty still has no pulse, begin CPR again by giving two ventilations then 15 compressions. If the casualty's pulse has resumed, go to the next step.

(2) Check to see if the casualty is breathing. (This check should take from 3 to 5 seconds.) If the casualty is breathing, check his breathing and pulse closely. If the casualty is NOT breathing, start rescue breathing at 12 times per minute. Also, monitor the pulse closely.

(3) If it is necessary to continue CPR, stop and check every few minutes to see if the casualty's pulse has started and if he has begun breathing again. Be careful not to stop CPR for more than 7 seconds at a time unless something very unusual is happening.

NOTE: One-rescuer CPR is summarized in figure 1-13.

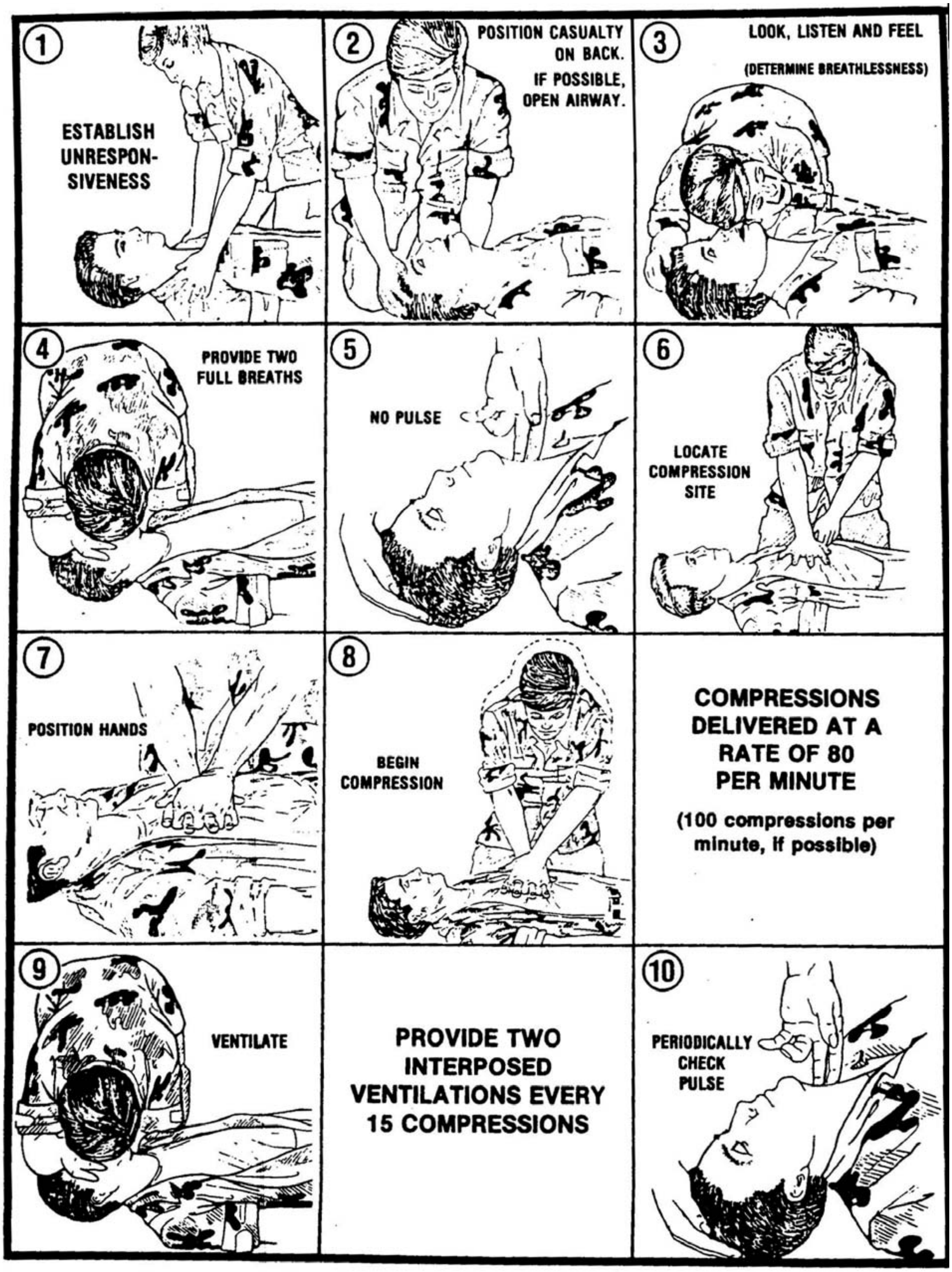


Figure 1-13. One-rescuer CPR.

Section V. TWO-RESCUER METHOD CARDIOPULMONARY RESUSCITATION

1-15. INTRODUCTION

If two rescuers are available, one rescuer can perform chest compressions while the other rescuer performs rescue breathing. One rescuer should position himself on one side of the casualty near his head while the other rescuer positions himself on the other side of the casualty near the casualty's chest.

1-16. TWO-RESCUER CARDIOPULMONARY RESUSCITATION: GENERAL METHOD

These general procedures are followed:

a. One rescuer positions himself at the casualty's side. He performs external chest compressions and may be called the compressor.

b. The other rescuer positions himself at the casualty's head. He may be called the ventilator. His responsibilities include:

(1) Maintaining an open airway.

(2) Monitoring the carotid pulse.

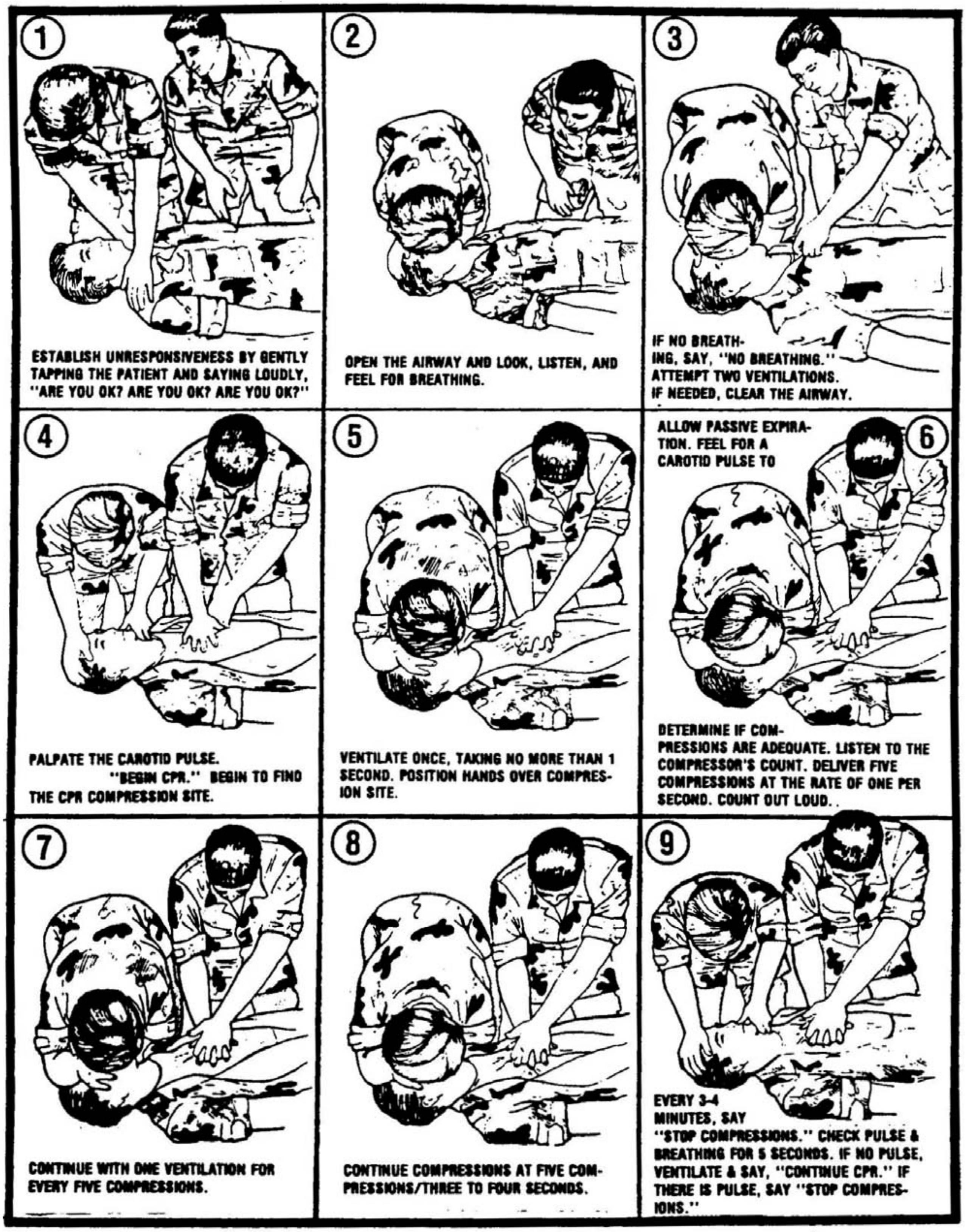
(3) Performing rescue breathing.

c. The compression rate for two-person CPR is 80 to 100 chest compressions per minute.

d. Five external chest compressions are given by one rescuer (the compressor), then two full breaths are given by the other rescuer (the ventilator). After the fifth compression, the compressor should pause 1 to 1 1/2 seconds for the ventilator to give the two full breaths. Five external chest compressions to one ventilation (two full breaths) is the ratio.

e. The two rescuers should change places when the compressor becomes tired.

NOTE: Two-rescuer CPR is summarized in figure 1-14.



ESTABLISH UNRESPONSIVENESS BY GENTLY TAPPING THE PATIENT AND SAYING LOUDLY, "ARE YOU OK? ARE YOU OK? ARE YOU OK?"

OPEN THE AIRWAY AND LOOK, LISTEN, AND FEEL FOR BREATHING.

IF NO BREATHING, SAY, "NO BREATHING." ATTEMPT TWO VENTILATIONS. IF NEEDED, CLEAR THE AIRWAY.

PALPATE THE CAROTID PULSE. "BEGIN CPR." BEGIN TO FIND THE CPR COMPRESSION SITE.

VENTILATE ONCE, TAKING NO MORE THAN 1 SECOND. POSITION HANDS OVER COMPRESSION SITE.

ALLOW PASSIVE EXPIRATION. FEEL FOR A CAROTID PULSE TO DETERMINE IF COMPRESSIONS ARE ADEQUATE. LISTEN TO THE COMPRESSOR'S COUNT. DELIVER FIVE COMPRESSIONS AT THE RATE OF ONE PER SECOND. COUNT OUT LOUD.

CONTINUE WITH ONE VENTILATION FOR EVERY FIVE COMPRESSIONS.

CONTINUE COMPRESSIONS AT FIVE COMPRESSIONS/THREE TO FOUR SECONDS.

EVERY 3-4 MINUTES, SAY "STOP COMPRESSIONS." CHECK PULSE & BREATHING FOR 5 SECONDS. IF NO PULSE, VENTILATE & SAY, "CONTINUE CPR." IF THERE IS PULSE, SAY "STOP COMPRESSIONS."

Figure 1-14. Two-rescuer CPR.

1-17. TWO-RESCUER CARDIOPULMONARY RESUSCITATION: ONE-RESCUER CARDIOPULMONARY RESUSCITATION IN PROGRESS

Cardiopulmonary resuscitation is being performed by one lay person, and two professional rescuers arrive at the same time. The rescuers enter the process just after the one rescuer has completed a cycle of 15 compressions and two breaths. (REMEMBER: One person doing CPR will perform fifteen external chest compressions then two full breaths. Two persons doing CPR will perform five external chest compressions then two full breaths.) Two rescuers follow this sequence of steps:

a. One rescuer (the ventilator) positions himself at the casualty's head. That rescuer (1) opens the airway and (2) checks for a pulse.

b. At the same time, the other rescuer (the compressor) positions himself at the casualty's side. This rescuer (1) locates the site for external chest compressions and (2) finds the proper hand position. Both the ventilator and the compressor's actions should take about 5 seconds.

c. If the ventilator finds no pulse, the compressor should begin external chest compressions at the rate of 80 to 100 per minute. The ventilator counts "one-and, two-and, three-and, four-and, five."

d. The compressor pauses at the end of five. The ventilator gives two full breaths.

NOTE: The pause for two full breaths may be shorter if a tube has been inserted to open the casualty's airway.

1-18. TWO-RESCUER CARDIOPULMONARY RESUSCITATION: NO CARDIOPULMONARY RESUSCITATION IN PROGRESS

When both rescuers arrive at the same time and no CPR is in progress, some decisions must be made. Both rescuers must decide what to do and start right away. They should follow this procedure:

a. Determine that the casualty is unresponsive.

b. Position the casualty.

c. One rescuer (the ventilator) should:

    (1) Position himself at the casualty's head.

    (2) Open the air-way.

    (3) Check for breathing.

(4) If the casualty still is not breathing, say "No breathing" and give two full breaths.

(5) Check for carotid pulse. If there is no pulse, say "No pulse."

d. At the same time, the second rescuer (the compressor) should position himself by the casualty's side and:

(1) Find the site for external chest compressions.

(2) Place his hands in the correct position for external chest compressions.

(3) After the first rescuer says "No pulse", the compressor should begin external chest compressions.

e. The rescuers continue to administer CPR cycles (5 compressions and 2 breaths per cycle).

1-19. RESCUERS CHANGE POSITIONS IN TWO-RESCUER CARDIOPULMONARY RESUSCITATION

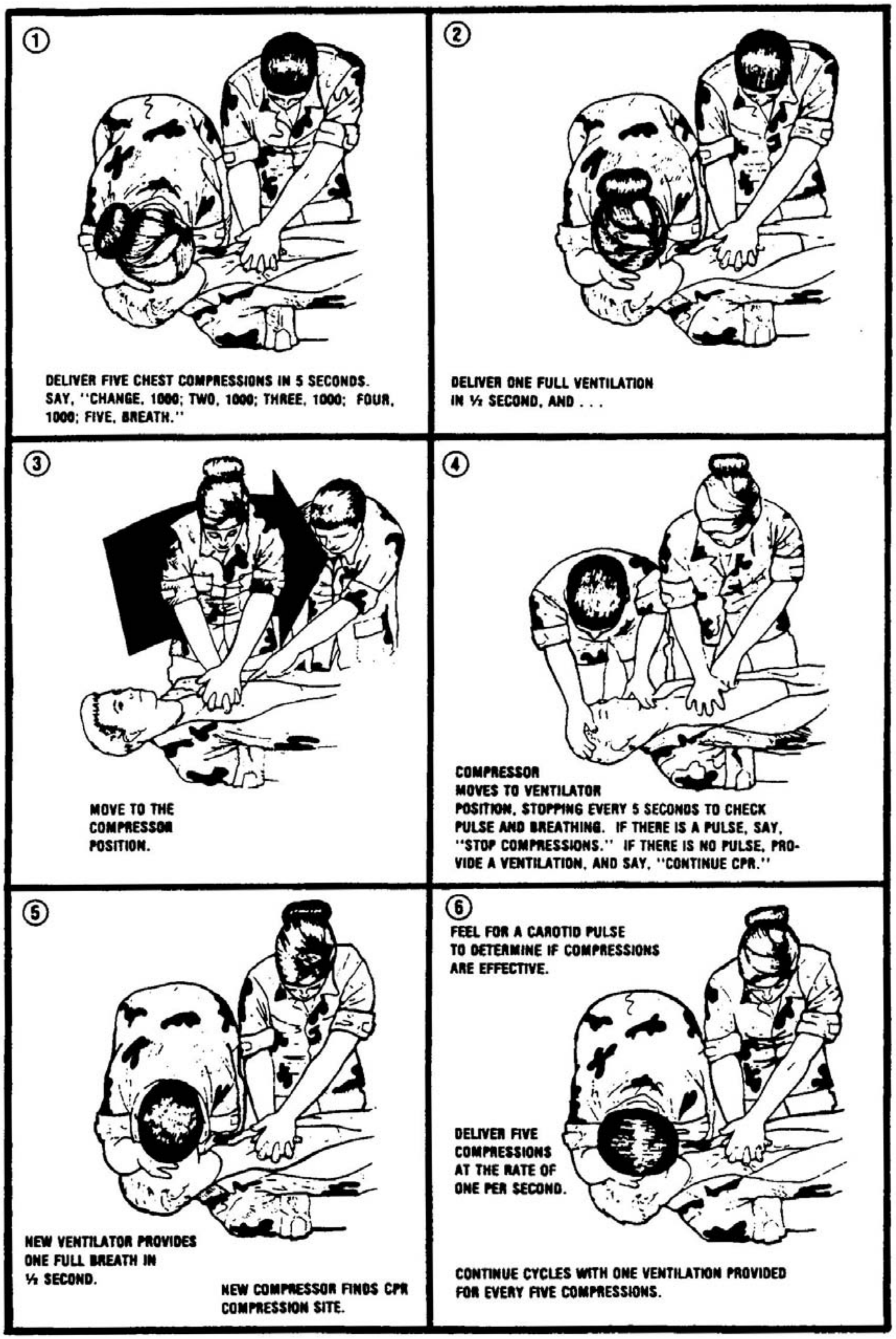
a. A position exchange (figure 1-15) is used to give tie rescuer at the chest a rest. If there are other CPR qualified persons in the area, a switch can be used to bring a new person in and take a tired rescuer out.

b. Follow this procedure to make a switch in rescuers:

(1) The first rescuer (person at the chest) initiates the exchange by counting, "Change-one thousand, two-one thousand, three-one thousand, four-one thousand, five-one thousand."

(2) Then, the second rescuer gives a breath and moves to the position for chest compressions while the first rescuer moves to the position for rescue breathing. <u>The rescuers do not change sides</u>.

(3) The first rescuer (now at the casualty's head) checks the casualty's pulse (takes about 5 seconds). If no pulse is felt, he tells the rescuer at the chest. The first rescuer continues to administer rescue breathing, and the second rescuer examines the casualty for injuries. If there is still no pulse during a second check, the rescuer at the chest is told. The other rescuer gives the casualty a breath, and both rescuers continue to administer CPR.



① DELIVER FIVE CHEST COMPRESSIONS IN 5 SECONDS. SAY, "CHANGE, 1000; TWO, 1000; THREE, 1000; FOUR, 1000; FIVE, BREATH."

② DELIVER ONE FULL VENTILATION IN ½ SECOND, AND . . .

③ MOVE TO THE COMPRESSOR POSITION.

④ COMPRESSOR MOVES TO VENTILATOR POSITION, STOPPING EVERY 5 SECONDS TO CHECK PULSE AND BREATHING. IF THERE IS A PULSE, SAY, "STOP COMPRESSIONS." IF THERE IS NO PULSE, PROVIDE A VENTILATION, AND SAY, "CONTINUE CPR."

⑤ NEW VENTILATOR PROVIDES ONE FULL BREATH IN ½ SECOND.

NEW COMPRESSOR FINDS CPR COMPRESSION SITE.

⑥ FEEL FOR A CAROTID PULSE TO DETERMINE IF COMPRESSIONS ARE EFFECTIVE.

DELIVER FIVE COMPRESSIONS AT THE RATE OF ONE PER SECOND.

CONTINUE CYCLES WITH ONE VENTILATION PROVIDED FOR EVERY FIVE COMPRESSIONS.

Figure 1-15. Rescuers change positions.

1-20. MONITOR THE CASUALTY

a. To be sure the CPR effort is effective, the casualty's condition must be monitored. The ventilator monitors the pulse and breathing to determine whether the chest compressions are effective and whether the casualty's circulation and breathing have begun gain.

b. The ventilator also checks the carotid pulse during chest compressions to determine if the chest compressions are effective.

c. At the end of the first minute and every few minutes after that, stop chest compressions for about 5 seconds to see if the casualty is breathing on his own and if his circulation has improved.

d. Rescuers should change places when the compressor is tired.

Section VI. CARDIOPULMONARY RESUSCITATION COMPLICATIONS/ CARDIOPULMONARY RESUSCITATION TERMINATION

1-21. CARDIOPULMONARY RESUSCITATION COMPLICATIONS

External chest compression and rescue breathing must be performed properly in order to support life. Sometimes even correctly performed CPR may cause complications.

a. **Neck and Spine Complications.** If the head is not positioned properly, you may not be able to get air into the casualty's lungs. You may, in fact, even cause neck and spine complications if the head is not in the proper position.

b. **Gastric Complications.** Too much air pushed too fast into the casualty can result in gastric distention (the air enters the casualty's stomach and pushes the stomach out). Gastric distention can be caused by the rescuer delivering the breaths with too much force, or the condition can be caused by an obstruction in the casualty's airway which prevents his lungs from filling quickly. Gastric distention can cause vomiting and may decrease the lung volume by pushing up on the diaphragm. The treatment for gastric distention is to recheck and reposition the casualty's head to be sure the airway is open. Ventilate and watch for the rise and fall of the casualty's chest. If ventilations are still inadequate, roll the casualty onto one side, press into his epigastrium (pit of the stomach), wipe out his mouth, and continue cardiopulmonary resuscitation.

CAUTION: Do not push on the casualty's abdomen.

c. **Fractures.** Fractures of the ribs or sternum may occur even if CPR is performed correctly. Care should be taking, however, to be sure there is proper hand placement and technique because fractures of the ribs or sternum (including the xyphoid process) can lead to punctured lungs; lacerated liver, aorta, stomach, or spleen; or cardiac tamponade (blood in the pericardial sac) caused by a lacerated pericardium.

d. **Vomiting (Regurgitation).** If the casualty vomits, turn his entire body onto one side and wipe out his mouth. Then, return him to the supine (flat on his back) position and continue administering CPR.

e. **Dentures.** Do not remove dentures from the casualty's mouth unless they are loose or broken. If it is necessary to remove dentures, send them with the casualty when he is evacuated (put them in his pocket, and so forth).

1-22. CARDIOPULMONARY RESUSCITATION TERMINATION

Generally, these are the only reasons to stop CPR: the rescuer is physically unable to continue, the rescuer is relieved by a doctor or other medical personnel, a doctor pronounces the casualty dead, or the casualty revives.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS: The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. Sudden death may be defined as ____

   ____

2. List two characteristics of clinical death.

   a. ____.

   b. ____.

3. What is biological death? ____

   ____.

4. List three common causes of sudden death.

   a. ____.

   b. ____.

   c. ____.

5. List the two basic responsibilities of a rescuer during cardiopulmonary resuscitation.

   a. ____.

   b. ____.

6. Cardiopulmonary resuscitation means restoring ______________function and

   ______________________________ function to a person who is clinical dead.

7. A person who is not breathing will die in a short time because _______________

____.

8. Cardiopulmonary resuscitation is made up of rescue breathing

and ____
.

9. The head-tilt/chin-lift method and the jaw thrust methods are both methods of

____ during rescue breathing.

10. When you are checking for breathing during rescue breathing, you should <u>look</u> at

the casualty's is chest to see if _________________________________, <u>listen</u>

for __________________________, and <u>feel</u> for __________________________.

11. Mouth-to-stoma rescue breathing is used when the casualty ________________

____.

12. Rescue breathing is part of CPR in which an unconscious casualty is forced to

____.

13. List four reasons cardiopulmonary resuscitation may be stopped.

a. ____.

b. ____.

c. ____.

d. ____.

14. When you are giving chest compressions, a compression cycle consists of

_________________________________ which compresses the heart and

___________________________ which allows the heart to refill with blood.

15. When two people have knowledge of CPR, one rescuer can perform

_____________________________ and the other rescuer can perform the

____.

16. When checking for the casualty's pulse during CPR, check the carotid pulse

because ________________________ and you are already near the neck.

17. You cannot feel the casualty's pulse and you are preparing to administer chest

compressions. The first thing you do is _______________________________.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. The unexpected cessation of respiration and functional circulation. (para 1-2)

2. Heartbeat has stopped.
   Breathing has stopped. (para 1-2a)

3. Biological death is permanent cellular damage due to lack of oxygen. (para 1-2b)

4. You are correct if you listed any three of the following:

   Drowning
   Choking on food or other objects
   Electrical shock
   Poisoning
   Sensitivity reaction and anaphylactic shock
   Suffocation
   Smoke inhalation.
   Automobile accident.
   Myocardial infarction
   Medical reasons. (para 1-4a through j)

5. Prevent biological death.
   Get competent help. (para 1-5)

6. Lung.
   Heart. (para 1-6)

7. The cells are not receiving a fresh supply of oxygen. (para 1-8)

8. Chest compressions. (para 1-10)

9. Establishing an airway. (paras 1-9c(l) and (2))

10. The chest rises and falls.
    The sound of breathing.
    The flow of air on the side of your face. (paras 1-9d(l) through (4))

11. Has had his larynx surgically removed leaving an opening in the neck for breathing. (para 1-9f, NOTE)

12. Inhale and exhale. (para 1-9f)

13. The rescuer is physically exhausted and can't continue.
The rescuer is relieved by a doctor or another rescuer.
The doctor pronounces the casualty dead.
The casualty revives. (para 1-22)

14. A thrust.
A release. (para 1-12c(4))

15. Chest compressions.
Rescue breathing. (para 1-15)

16. A carotid pulse can sometimes be felt when other pulses are too weak to be detected. (para 1-9f(1)(d))

17. Locate the compression site. (para 1-12a)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2 Dysrhythmia Recognition and Treatment.

LESSON ASSIGNMENT Paragraphs 2-1 through 2-12.

LESSON OBJECTIVES After completing this lesson, you should be able to:

2-1. Identify electrocardiogram rhythms.

2-2. Identify normal sinus rhythm.

2-3. Identify and treat these cardiac dysrhythmias:

Sinus bradycardia.
Sinus tachycardia.
Wandering pacemaker.
Premature atrial contractions.
Atrial tachycardia.
Atrial flutter.
Atrial fibrillation.
Premature junctional contraction.
First-degree heart block.
Wenckebach heart block.
Classical second-degree heart block.
Complete heart block.
Premature ventricular contractions.
Ventricular tachycardia.
Ventricular fibrillation.
Idioventricular rhythm.
Asystole.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

DYSRHYTHMIA RECOGNITION AND TREATMENT

Section I. DYSRHYTHMIA

2-1. INTRODUCTION

a. Dysrhythmia is a disturbance in cardiac rhythm. Ninety percent of patients with acute myocardial infarction (heart attack) will experience a form of cardiac dysrhythmia during the first couple of weeks after their attack. Half of these will be life threatening and will lead to cardiac arrest (sudden stoppage of adequate cardiac output) unless properly treated. In order to analyze and treat a dysrhythmia correctly, you must have a systematic approach to the electrocardiogram (EKG). Only after this process has been completed can you make sound judgments as to which cardiac drug to administer and when to defibrillate or use cardioversion.

b. When monitoring a patient's EKG, remember that you are monitoring electrical activity of a heart, not mechanical activity. So, a pulse is always taken to assure you of the heart's pumping action. Information learned from the EKG will be used to help determine the treatment of the dysrhythmia. Dysrhythmia treatment could be defibrillation, cardioversion, intravenous cardiac drugs, and/or CPR.

DYSRHYTHMIA = a disturbance in cardiac rhythm.
ELECTROCARDIOGRAM = monitors electrical activity of the heart.

2-2. DYSRHYTHMIA CAUSES/SIGNIFICANCE

a. **Causes of Dysrhythmia.** Dysrhythmias develop for various reasons including acute myocardial infarction (heart attack), trauma, and drug reactions. Drowning, near drowning, asphyxiation, and the patient's underlying medical conditions can also cause dysrhythmias.

b. **Significance of Dysrhythmia.** There are several reasons why cardiac dysrhythmias may be clinically significant. Heart rates below 40 to 50 beats per minute lead to inadequate cardiac output and often precede electric instability of the heart. If the sinus rate falls below 60 beats per minute, another conduction system may take over. The Atrial Ventricular Junction (AV Junction) has an inherent rate of 40 to 60 beats a minute. The Ventricle has an inherent rate of 20 to 40 beats a minute. This may lead to premature ventricular contractions and ventricular dysrhythmias. If a heart rate is over 120 to 140 beats per minute, the heart must work harder. This causes further myocardial ischemia (diminished blood flow). Tachycardias may be linked with a drop in cardiac output which is secondary to decreased stroke volume, this lowered volume being caused by the ventricles having less time to fill between heartbeats. And, finally, ectopic beats (beats located away from the normal position) could be a sign of electric instability of the ventricles. Such heartbeats are an important sign since they may indicate that more serious dysrhythmias such as ventricular tachycardia or ventricular fibrillation may develop.

Section II. ELECTROPHYSIOLOGY

2-3. GENERAL

a. **Heart Cells.** Two types of cells are found in the heart: <u>electrical cells</u> and <u>mechanical cells</u>. The heart's conduction system is mare-up of electrical cells. These cells have the ability to begin and transmit electrical activity in the heart. Myocardial cells (the mechanical cells) make up the bulk musculature of the heart. When an electrical stimuli reaches these cells, the cells contract. An electrical impulse stimulates the mechanical action of the heart causing the heart to pump effectively. If the electrical system of the heart does not function properly, <u>arrhythmias</u> (a mechanical activity) may occur.

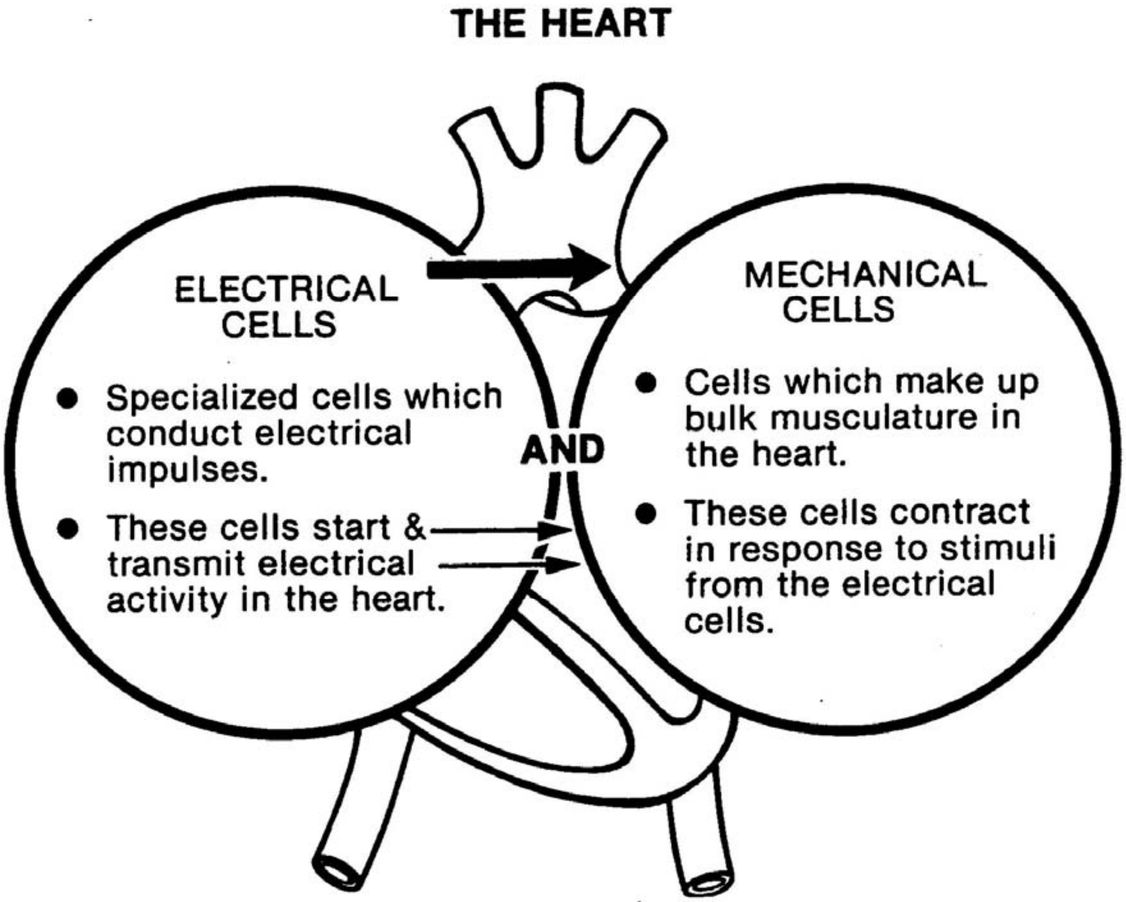


Figure 2-1. Electrical cells and mechanical cells.

b. **Electrical Activity In The Heart.** The heart's electrical activity begins in the sinoatrial (SA) node and flows toward the ventricles. See figure 3-2. All the areas of this conduction system can do the following: initiate impulses; become irritable; respond to an impulse. Impulses are initiated in each area of the conduction system as shown here:

SA node ....60-100 per minute
AV Junction......40-60 per minute
Ventricle...........20-40 per minute

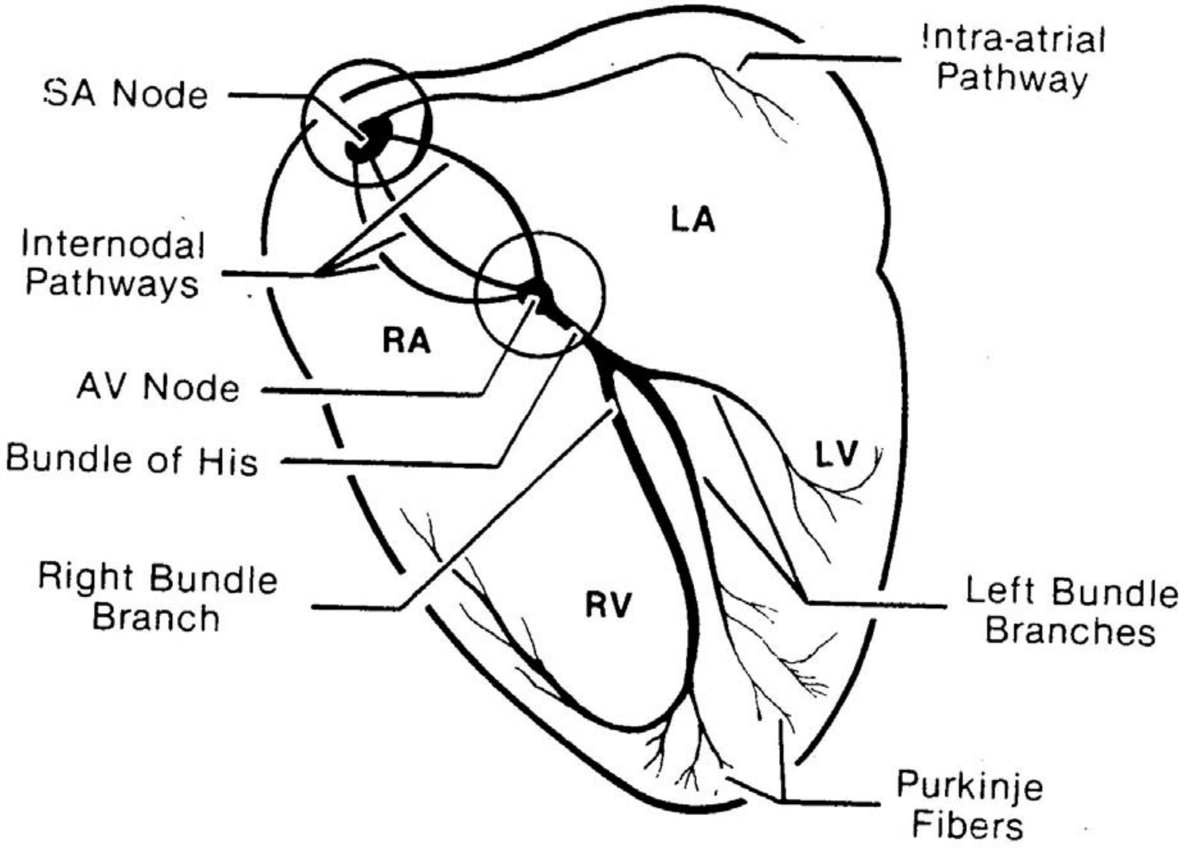
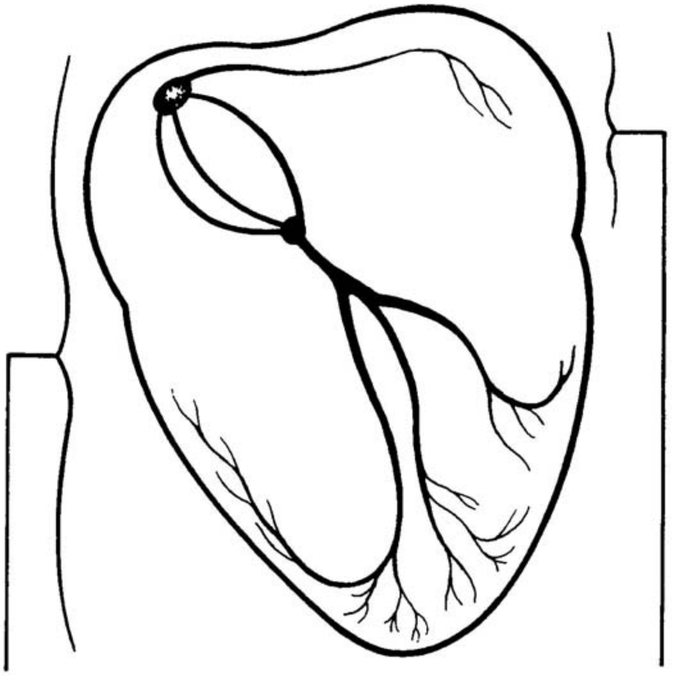


Figure 2-2. Electrical conduction system of the heart.

c. **The Pacemaker Site.** The common pacemaker site is the SA node because it initiates electrical impulses at a faster rate than the junction or ventricle. An impulse from the AV junction can take over if the SA node should fail. If the AV junction also fails, the ventricle can take over. This is a protective backup system, a system which helps the heart maintain electrical efficiency. Sometimes the junction or the ventricle becomes irritable and starts impulses at a faster than normal rate which overrides the SA node. When this happens, the pacemaker site that is the fastest dominates and takes over control of the heart.

2-4. INNERVATION

The autonomic nervous system (ANS) regulates internal organ activities, usually involuntarily and automatically. This system regulates sweating, alters the size of the pupils, and directs many other body adjustments. The ANS influences the heart rate and myocardial contractility (the ability of cardiac muscle cells or tissues to shorten when stimulated) by sympathetic and/or parasympathetic stimulation. Sympathetic impulses increase heart activity; parasympathetic impulses decrease heart activity. Both of these systems must be in balance for the heart to function properly. If one or the other system is stimulated abnormally or blocked, the result will be heart arrhythmias. See figure 2-3 for autonomic nervous system control of the heart.



SYMPATHETIC

- Innervates both atria and ventricles
- Increases
  Heart Rate
  AV Conduction
  Irritability

PARASYMPATHETIC

- Innervates the atria via vagus nerve
- Little or no effect on junction or ventricles
- Decreases
  Heart Rate
  AV Conduction
  Irritability

Figure 2-3. Innervation of the heart.

2-5. GRAPHIC DISPLAY OF ELECTROCARDIOGRAM

a. **Heart Electrical Forces.** During the cardiac cycle (one contraction of the heart plus the relaxation period that follows), electrical changes take place in the heart. These changes can be visualized and recorded.

(1) Detection of electrical forces in the heart. Electrical forces in the heart can be detected on the body's surface. Therefore, electrodes attached to the patient's skin can detect electrical forces in the heart.

(2) Recording of electrical forces in the heart. The recording of the electrical changes during the cardiac cycle is called an electrocardiogram (ECG or EKG). The instrument used to record these changes is an electrocardiograph.

b. **Electrocardiogram Graph Paper and Machines.** Electrocardiogram graph paper and the speed of the EKG machines are standard and uniform. Lines on the graph paper are horizontal and vertical with four light lines between two heavy lines. The horizontal lines indicate voltage. The electrical voltage of the heart impulse is measured in millivolts and determined by the magnitude of deflection (the power of a wave).

(1) Determination of electrical impulse strength. Compare the height of a wave spike to the horizontal lines to determine the strength of the electrical impulse.

(2) Vertical lines. Vertical lines indicate the speed of the electrical current traveling within the heart. The distance in time between two heavy vertical lines is 0.20 seconds and between two light vertical lines or across one small square is 0.04 seconds.

(3) Heavy lines. Heavy lines are necessary to determine rates, rules, and normal values. Light lines are composed of five small columns between two heavy vertical lines.

(4) Squares. There are 25 squares in each large square.

(5) Standard rate of EKG paper. The standard rate of EKG paper travels past the stylus at a rate of millimeters per second.

(6) Graph paper markings. The markings on the graph paper can be examined and compared to normal markings to give the reader an idea of the electrical activity of the patient's heart. See figure 2-4 for an example of standard EKG graph paper measurements.

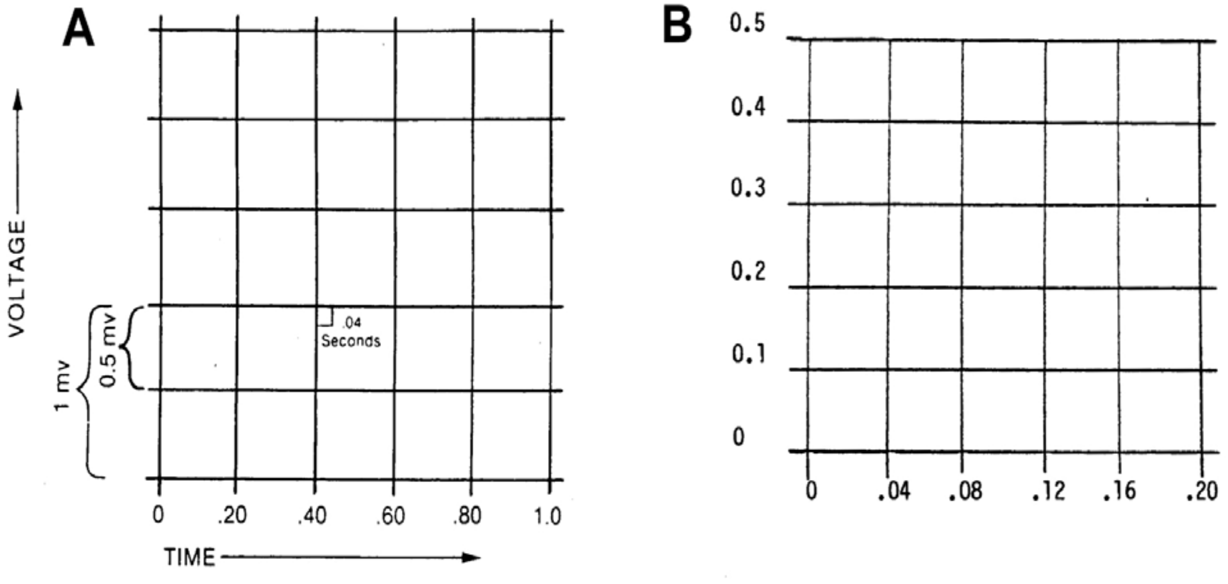


Figure 2-4. Standard graph paper measurements. A Graph paper. B Enlargemen of one square of graph paper.

c. **Electrical Impulses of Electrocardiogram Waves.** Each part of the cardiac cycle produces a different electrical impulse. The electrical flow of the heart starts with the SA node (right atrium) and continues to the Purkinje fibers (ventricles). Electrodes transmit impulses to a recording pen which graphs the impulses in a series of up and down waves called deflection waves. The cardiac cycle includes all of the wave patterns produced by electrical activity beginning with the pacemaker impulses and including ventricular repolarization. An isoelectric line occurs when there is no current strong enough to produce either a positive or negative deflection. The positive and negative forces are equal with the result that a flat line is shown (usually following the "T" wave). An electrical force (from the heart) toward the positive electrode will draw the stylus in an upright wave while an electrical force toward the negative electrode will draw the stylus in a downward wave. A single cardiac cycle is expected to produce one heartbeat. Deflections above or below the isoelectric line are called waves. Each wave is labeled with a letter. The waves are called the P wave, QRS complex, and the T wave. The letters were arbitrarily selected and do not stand for any words. Here are the waves:

(1) P wave. A small upward (positive) wave that indicates atrial polarization (the spread of an impulse from the SA node through the muscle of the two atria). The atria contract a fraction of a second after the P wave begins.

(2) QRS wave (complex). This second wave begins as a downward deflection and continues as a large, upright, triangular wave which finally ends as a downward wave at its base. This wave complex shows the spread of the electrical impulse through the ventricles.

(3) T wave. The third wave showing ventricular repolarization.

NOTE: There is no deflection to show atrial repolarization because the stronger QRS wave masks this event.

NOTE: Figure 2-5 shows EKG wave patterns produced by the electrical activity of the heart.

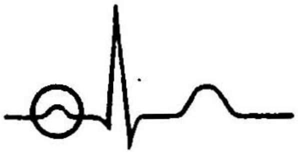
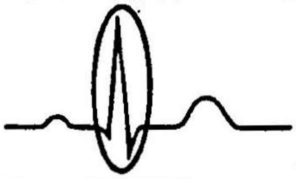
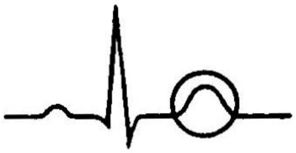
Electrical Activity	Graphic Depiction	Associated Pattern
Atrial Depolarization		P Wave
Delay at AV Node		PR Segment
Ventricular Depolarization		QRS Complex
Ventricular Repolarization		T Wave
No electrical activity		Isoelectric Line

Figure 2-5. Electrocardiogram wave patterns produced by electrical activity in the heart.

d. **Size and Time Intervals of EKG Waves.** The size of the deflection waves and particular time intervals are important when you are reading an electrocardiogram. For example, the duration of a normal "P" wave is between 0.06 and 0.1 seconds, the time it takes for depolarization current to pass through the atrial musculature. An increased width of "P" wave may indicate left atrial abnormality or right atrial hypertrophy (enlargement). The deflection of a normal "P" wave is small due to the thin walled structure of the atria. A "P" wave is usually no more than 3 mm high. A taller "P" wave may indicate that atrial enlargement has occurred due to hypertension, coronary pulmonade, or congenital heart disease.

(1) P-R interval. Measured from the beginning of the P wave to the beginning of the R wave, this wave pattern represents the conduction time from the beginning of atrial excitation to the beginning of ventricular excitation. This is the time it takes for an electrical impulse to travel through the atria and atrioventricular node to the remaining conducting tissues. A medical condition that disrupts this electrical impulse will display itself as a P-R interval that is longer than 0.2 seconds, due to the increased time it takes to travel the conducting tissues. The normal P-R interval is between 0.12 and 0.20 seconds.

(2) Q wave. The Q wave is defined as the first down (negative) deflection following the P wave but coming before the R wave.

(3) QRS complex. This complex is made up of three waves: the Q, the R, and the S waves. The QRS complex represents ventricular depolarization. A normal QRS measurement is less than 0.12 seconds. The QRS complex is larger than the P wave on an EKG because ventricular depolarization involves a greater muscle mass than atrial depolarization.

(4) R wave. The R wave is the first upward (positive) deflection that follows the wave.

(5) S-T segment. Beginning at the end of the S wave ending at the beginning of the T wave, this wave represents the time between the end of the spread of the heart's electrical impulse through the ventricles and repolarization of the ventricles. When a patient has acute myocardial infarction, the S-T segment is elevated. When the heart muscle does not receive enough oxygen, the S-T segment is depressed.

(6) T wave. Representing repolarization of the ventricular cells, the T wave is flat when the heart muscle does not receive enough oxygen; for example, in atherosclerotic heart disease. When the body's potassium level is increased, the T wave may be elevated. This wave occurs after the QRS complex.

NOTE: Refer to figure 2-6 to see these waves.

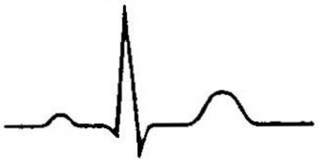
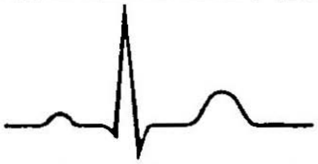
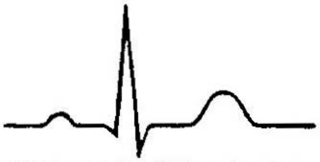
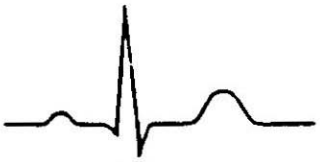
EKG Component	Graphic Depiction	Definition
PR Segment		From the end of the P wave to the beginning of the QRS complex
PRI		From the beginning of the P wave to the beginning of the QRS complex (normally .12 – .20 seconds)
Q Wave		First negative deflection of the QRS complex
R Wave		First positive deflection of the QRS complex
S Wave		First negative deflection following the R wave
QRS Complex		From the beginning of the Q wave to the end of the S wave (normally less than .12 seconds)
ST Segment		From the end of the S wave to the beginning of the T wave

Figure 2-6. EKG wave, segment, and internal definitions.

(7) The refractory period. During this period, cell charges are depolarized and have not returned to their polarized state. A cell that is electrically "refractory" cannot receive another impulse until it is repolarized. The refractory period on an EKG includes the QRS complex and the T wave. The absolute refractory period includes the QRS and the upslope of the T wave and is NOT a dangerous period. The relative refractory period may allow depolarization of ventricles. This period occurs on the downslope of the T wave; it is dangerous if an impulse occurs at this time.

e. **Electrocardiogram Uses.** The EKG has a variety of uses; for example, abnormal cardiac rhythms and conduction patterns and following the course of recovery from a heart attack. Some people carry a Holter monitor to monitor heart electrical activity. This machine can be carried around by the patient while he goes about his everyday routines. The Holter monitor is especially useful in detecting rhythm disorders in the conduction system. It is also useful in correlating rhythm disorders and symptoms and then following the effectiveness of drugs in dealing with these disorders.

Section III. RHYTHMS/HEART BLOCKS

2-6. ANALYSIS OF EKG RHYTHM STRIPS

a. **Regularity.**

(1) Determine regularity (also called rhythm) by looking at the R to R interval (RRI). This interval can be regular or irregular.

(2) The R-R interval is constant for regular rhythm, which means the distance between the beats, is the same.

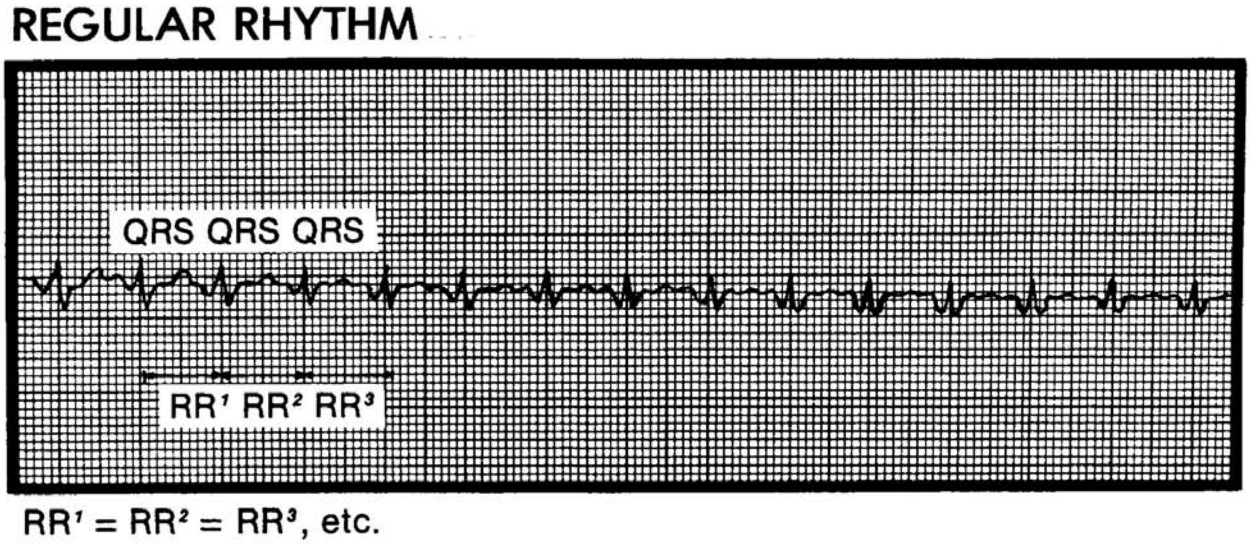


Figure 2-7. Regular rhythm.

(3) If the R to R interval (RRI) is inconsistent and the rhythm is irregular, the heartbeats are premature. A basically regular rhythm occurs when a heartbeat or two interrupt a regular rhythm; for example, ectopic (heartbeats originating from an abnormal place; that is, from somewhere other than the S-A node) or grouped heartbeats. A regularly irregular rhythm is a pattern of irregularity. A totally irregular rhythm has no pattern at all.

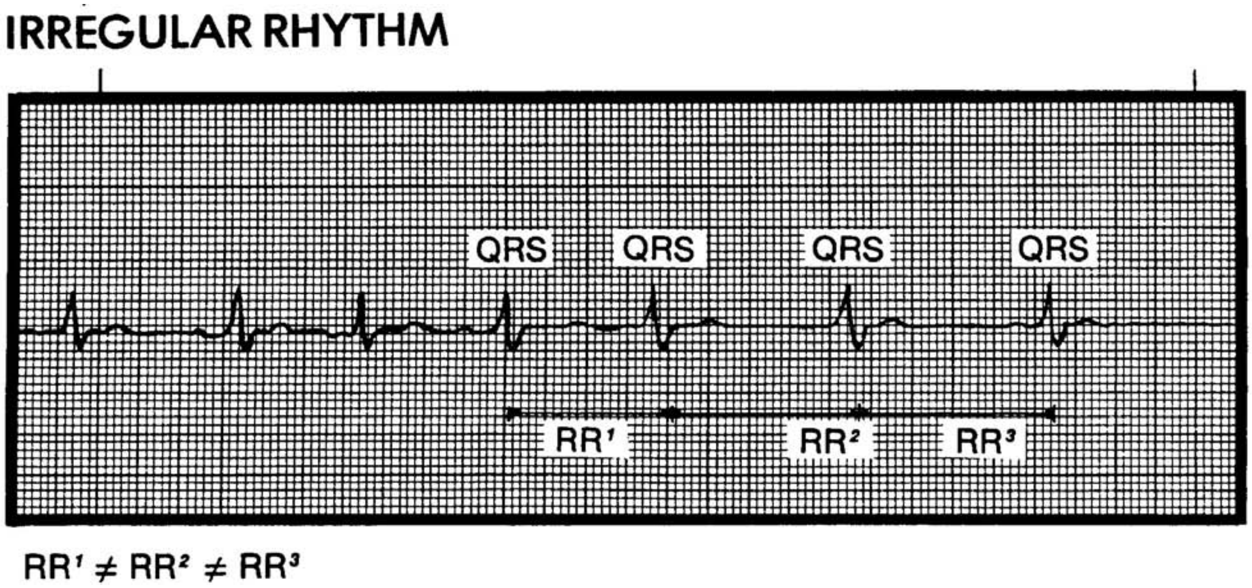


Figure 2-8. Irregular rhythm. (file: 5712-8.pcx)

b. **Rate.**

(1) Rate for regular heartbeat rhythms can be calculated in two ways.

(a) Method I. The most accurate method is to count the number of small squares between the two R waves and divide that number into 1500.

(b) Method II. The faster method is to count the number of large squares between R waves and divide that number into 300. This method is useful during an emergency. This method does not require a 6-second strip. Also, it allows rapid rate calculation using simple memorization of rate for large boxes. See figure 2-9.

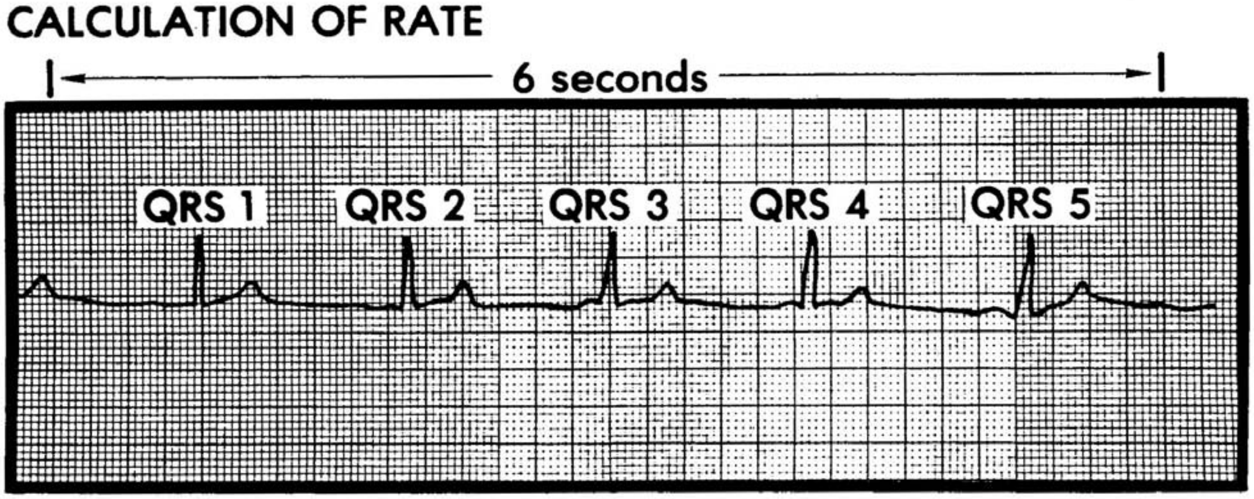


Figure 2-9. Calculation of heartbeat rate.

(2) The heartbeat rate for irregular heartbeat rhythm is based on the 6-second strip method. The minimum amount of time needed to determine cardiac rhythm is 6 seconds. The method described here is the quickest and easiest method although it is not as accurate as the "box" method. The vertical notches in the upper margin of the paper are 3 seconds apart.

(a) Count the number of QRS complexes in a 6-second strip.

(b) Multiply by 10 to get the heart rate for one minute.

c. **P Waves.** P waves are small positive deflections that occur on the oscilloscope. These waves represent atrial depolarization. Normally, the P waves are rounded, uniform, and upright and come before the QRS complex. These waves are either regular or irregular. Measured distances between all P waves should be constant. Determine whether there is a P wave for every QRS complex. Determine whether the P wave is in front of the QRS complex and see if there are more P waves than QRS complexes. Check to see if all the P waves look alike. See if there are irregular P waves associated with ectopic or irregular beats.

d. **P-R Intervals.** All P-R intervals should be constant. Measure the P-R intervals to determine if the intervals are normal or abnormal. A normal P-R interval is from 0.12 to 0.20 seconds. If the P-R interval varies, notice if there is a pattern to the changing measurements.

e. **QRS Complexes.** These complexes represent ventricular depolarization. The QRS complexes should be of equal duration.

(1) Here is an analysis of the parts of the QRS complex.

(a) Q waves are a negative deflection on the oscilloscope. They follow the P waves.

(b) R waves are a positive deflection on the oscilloscope, and they follow the Q waves.

(c) S waves are a negative deflection on the oscilloscope following the R waves.

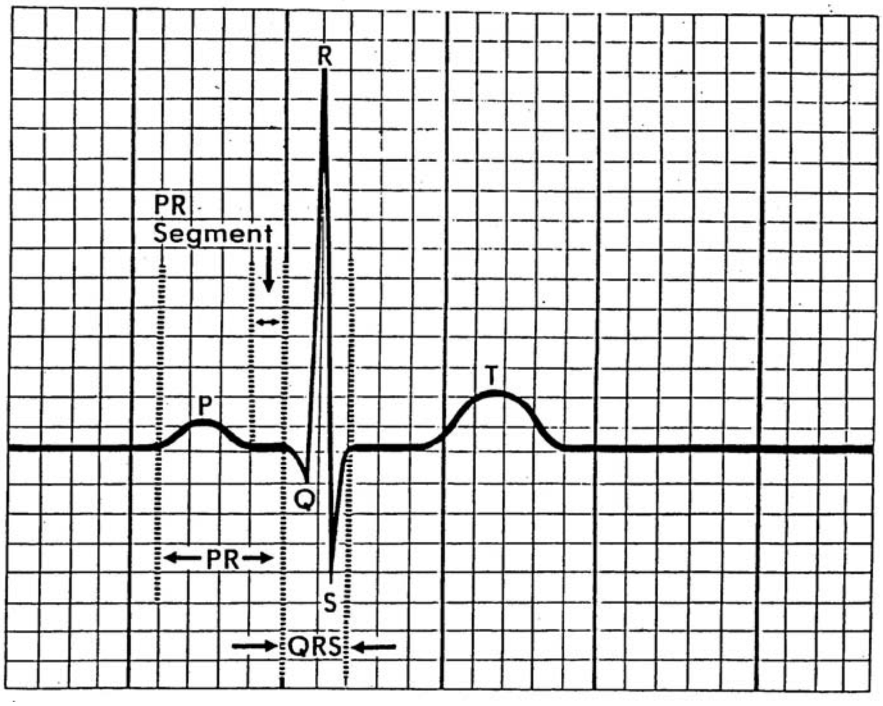


Figure 2-10. Electrocardiograph waves, segments, and intervals.

(2) Check the measurement of the QRS complex. The complex should be less than 0.12 seconds. See if the measurement is within normal limits. See if all the QRS complexes look alike. If there are any unusual QRS complexes, determine if they are associated with ectopic beats (abnormal heartbeats).

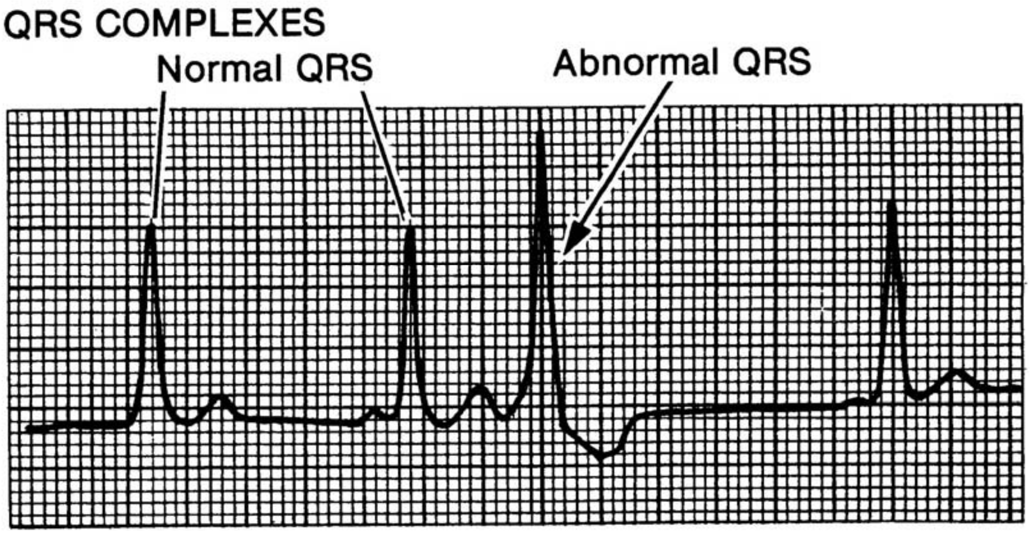


Figure 2-11. QRS complexes.

NOTE: For instructional purposes, the lines on the figures showing heartbeats are sometimes heavier than normal.

2-7. CARDIAC RHYTHMS

a. **Normal Sinus Rhythm (NSR).**

(1) Normal sinus rhythm originates in the SA node (pacemaker) and travels through the normal conduction pathways. It is not an arrhythmia (abnormality in the normal cardiac rhythm) or dysrhythmia (a disturbance in cardiac rhythm) because it is a normal pattern.

(2) Normal sinus rhythm is analyzed in this manner:

(a) When the R-R intervals and the P-P intervals are constant, the rhythm is considered regular.

(b) The atrial and ventricular rates equal 60 to 100 heartbeats per minute with no added or lost P, QRS, or T waves.

(c) The P wave has a uniform configuration with one P wave in front of every QRS.

(d) The P-R interval is constant between 0.12 and 0.20 seconds.

(e) The QRS complex measures less than 0.12 seconds.

(3) There is no treatment for normal sinus rhythm.

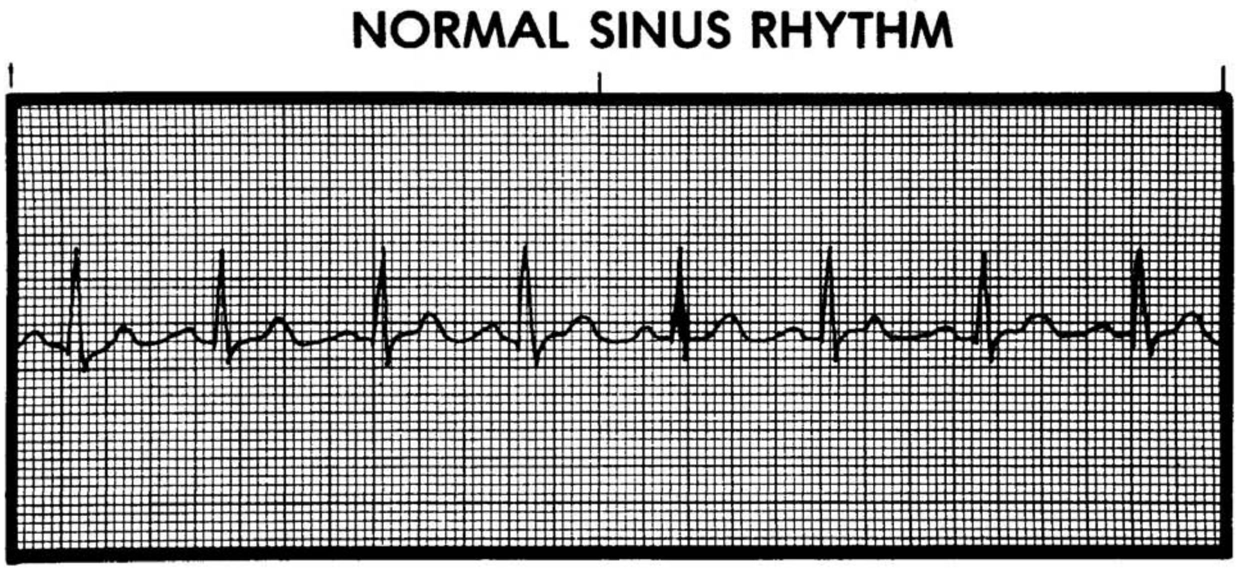


Figure 2-12. Normal sinus rhythm.

b. **Sinus Bradycardia.**

(1) Analysis.

(a) The rhythm is regular with the R-R intervals constant and the P-P intervals constant.

(b) The atrial and ventricular rates are less than 60 beats per minute.

(c) The P wave is normal and upright with one P wave in front of every QRS complex.

(d) The P-R interval is constant between 0.12 and 0.20 seconds.

(e) The QRS complex measures less than 0.12 seconds.

(f) A heart rate of less than 60 beats per minute may indicate good physical conditioning if the individual is young and healthy.

(g) If the person is suffering from acute myocardial infarction (AMI), this heartbeat rate may indicate any one of the following: conduction system damage, increased parasympathetic tone, or possible toxic levels of certain cardiac drugs (digitalis, quinidine). If the heartbeat rate decreases to less than 50 beats per minute, the heart may not be able to pump enough fluid through the body's vital organs. Additionally, bradycardia leads to electrical instability in the ventricles possibly resulting in ventricular arrhythmias.

NOTE: Males normally have a slower heart rate than females. Cardiovascularly healthy people may normally have a slow (less than 60 beats per minute) heart rate which also normally slows during sleep and rest. A slow heart rate is significant only if it is associated with MI or cardiovascular compromise.

(2) Treatment.

(a) There is no treatment if the casualty's blood pressure is normal, he is alert, and there are no ventricular, abnormal beats.

(b) If the casualty is experiencing premature ventricular contractions (PVCs), hypotension, or there are MI symptoms (chest pain or dyspnea), administer atropine. The dosage for a patient NOT in cardiac arrest is 0.5 mg intravenously at 5 minute intervals until the heart rate increases to 60 beats per minute or greater and until the signs and symptoms lessen. The dosage of atropine should not exceed 2 mg.

(c) Treat premature ventricular contractions (PVCs) with a bradycardiac rhythm) with atropine, NOT lidocaine. The reason is that atropine may restore the normal AV conduction system, but lidocaine may block this response.

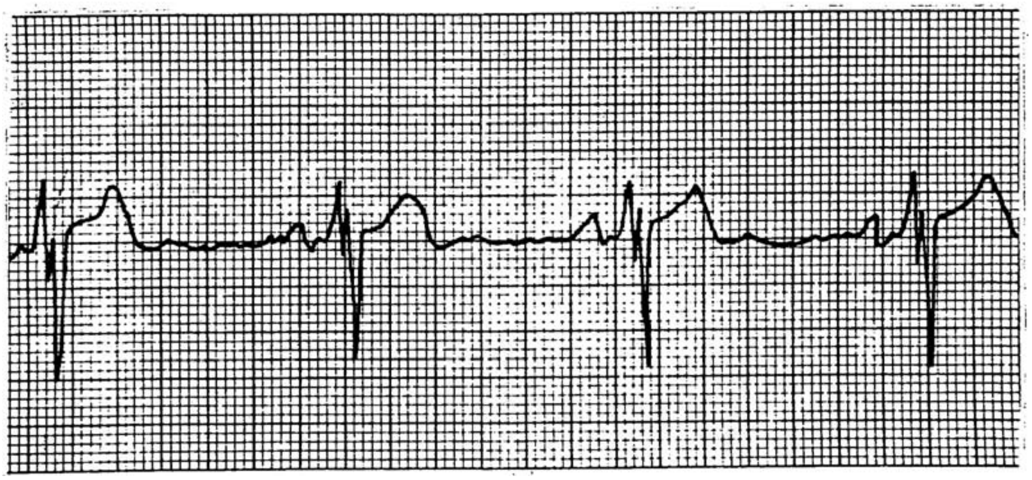


Figure 2-13. Sinus bradycardia.

c. **Sinus Tachycardia.**

(1) Analysis. In sinus tachycardia, the rhythm is regular, the R-R and P-P intervals are constant. Atrial and ventricular rates are equal to or greater than 100 beats per minute. The P wave is normal and upright with one P wave in front of every QRS complex. The P-R interval is constant between 0.12 and 0.20 seconds, and the QRS complex measures less than 0.12 seconds. A variety of circumstances can cause sinus tachycardia: pain, fever, hypoxia, shock, congestive heart failure, and drugs such as epinephrine, atropine, isoproterenol. The more rapid the heart rate, the harder the heart works which can lead to further heart damage in AMI. Also, because there is insufficient time between contractions for the ventricles to fill completely with blood, the heart may not be able to pump fluid effectively when the heart rate is more than 120 to 140 beats per minute. Strenuous exercise such as jogging may cause this condition.

(2) Treatment. Treatment for sinus tachycardia is to treat the cause of this irregularity (fever, fear, blood loss, and so forth.).

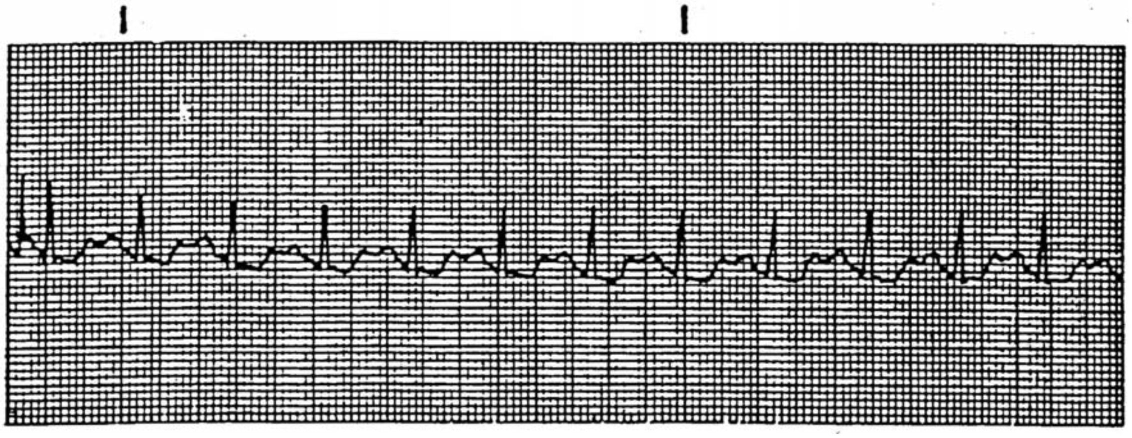


Figure 2-14. Sinus tachycardia. (file: 571f2-14.pcx)

2-8. ATRIAL RHYTHMS

a. **Identification.** The sinus node loses its pacemaking role, and the site with the fastest rate becomes the pacemaker. In this case, the atria is the fastest pacemaker and takes over the pacemaking role. The P wave configuration of atrial rhythms may be flattened, notched, peaked, sawtoothed, diphasic, or upright. The QRS complexes are narrow. Atrial arrhythmia may be caused by irritability of the heart or escape mechanisms of the heart.

NOTE: An escape mechanism is defined as an impulse from somewhere along the conduction pathway that "escapes" to emit an electrical impulse of its own. This electrical impulse stimulates an otherwise electrically quiet heart.

b. **Wandering Pacemaker.**

(1) Analysis. The rhythm is slightly irregular with a normal heartbeat rate of from sixty to one hundred beats per minute. The P wave may change from heartbeat to heartbeat. The PR interval is less than 0.20 of a second and may vary. The QRS is less than 0.12 of a second. If the cardiac output falls, sympathomimetic or parasympatholytic drugs can be given.

(2) Treatment. There is no treatment. The pacemaker shifts between the SA node and the atria. This shift causes each P wave to differ slightly from the P waves around it.

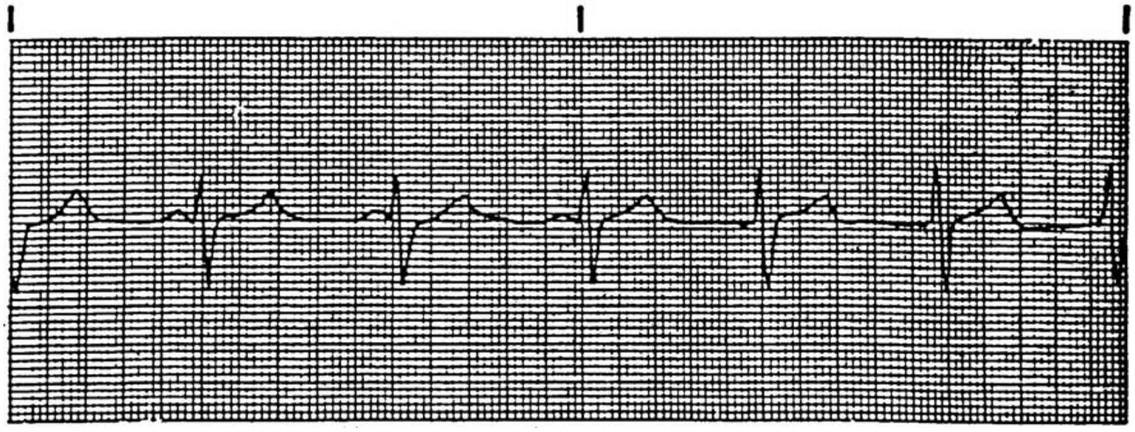


Figure 2-15. Wandering pacemaker.

c. **Premature Atrial Contractions.**

(1) Analysis. Premature Atrial Contractions **(**PACs) are single heartbeats that originate in the atria and come early in the cardiac cycle. The rhythm depends on the underlying rhythm that will usually be regular except for the premature atrial contraction. The heartbeat rate is usually normal depending on the underlying rhythm. The P waves of the early beat differ from sinus P waves. These P waves can be flattened or notched and thus lost in the preceding T wave. The P-R interval is 0.12 to 0.20 of a second but can be greater than 0.20 of a second. The QRS is less than 0.12 of a second. Isolated PACs may occur in "normal' cardiovascularly healthy people. Frequent PACs may indicate organic heart disease and possibly initiate atrial tachyarrhythmias.

(2) Treatment. The patient should be sedated. Stimulants such as alcohol, caffeine, and tobacco should be eliminated.

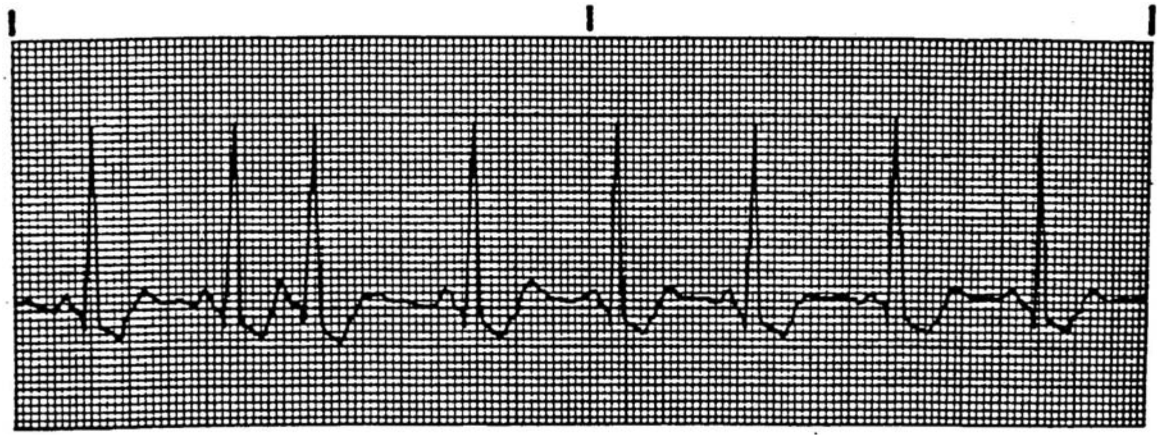


Figure 2-16. Premature atrial contraction (PAC).

d. **Atrial Tachycardia.**

(1) Analysis. Atrial tachycardia (AT) is caused when a single focus in the atria fires very rapidly and overrides the SA node. The rhythm is regular and the heartbeat rate is 150 to 250 beats per minute. The atrial P wave differs from the sinus P wave and can be lost in the preceding T wave. The PR interval is 0.12 to 0.20 of a second with the QRS less than 0.12 of a second. There are two forms of clinical atrial tachycardia: paroxysmal AT/supraventricular tachycardia (PAT/PSVT) and nonparoxysmal AT. Paroxysmal AT/supraventricular tachycardia is characterized by repeated episodes of atrial tachycardia. The episodes may begin abruptly and last from a few seconds to many hours. Nonparoxysmal atrial tachycardia is an abnormal heart problem that is secondary to some other problem.

(2) Treatment. Treatment for nonparoxysmal AT is the same as for sinus tachycardia. See paragraph 2-7c. Treatment for PAT/PSVT is as follows:

(a) Unstable patient (blood pressure less than 90 mm Hg, systolic):

1 Administer synchronized cardioversion of 75 to 100 joules.

2 If there is no response, repeat at 200 joules.

3 If there is still no response, repeat synchronized cardioversion at 360 joules.

4 Correct any underlying abnormalities.

5 Give pharmacological therapy; perform cardioversion.

(b) Stable patient (blood pressure more than 90 mm Hg, systolic):

1 Perform vagal maneuvers.

2 If there is no response, administer verapamil in the dosage of 0.075 to 0.15 mg/kg body weight (maximum 10 mg) as IV bolus over a 1-minute period.

3 If the initial response is not satisfactory and a repeat dose is required, administer at 0.15 mg/kg body weight (maximum 10 mg) 30 minutes after the first dose.

4 If there is still no response, perform cardioversion or use other drug therapy according to a doctor's order.

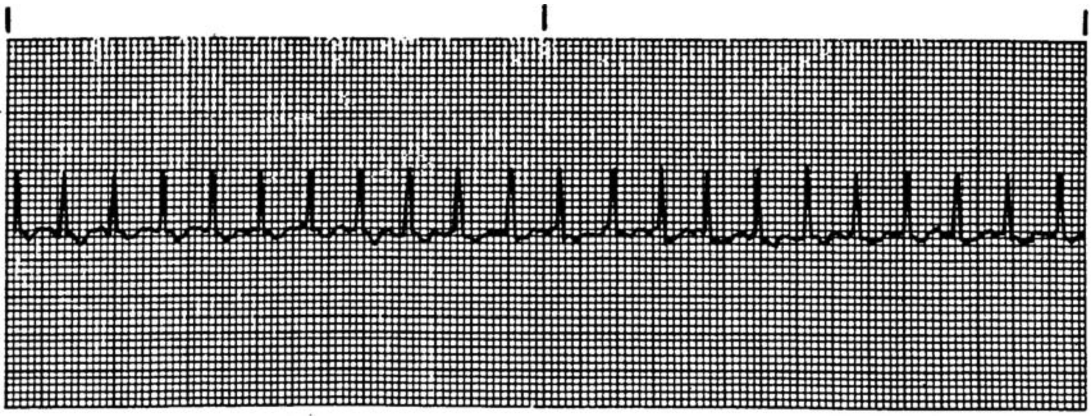


Figure 2-17. Atrial tachycardia.

e. **Atrial Flutter.**

(1) Analysis. Atrial rhythm is regular if the PP intervals are constant. The ventricular rhythm is regular if the AV node conducts impulses in a constant pattern. The ventricular rhythm is irregular if the AV node varies the pattern. In regard to the heartbeat rate, the atrial rate is 250 to 350 heartbeats per minute. The ventricular heartbeat rate depends on the ratio of impulses conducted to the ventricles. The P waves have well defined "flutter" waves and a sawtooth appearance. The P-R interval is not measured (impossible to determine). The QRS complex is less than 0.12 seconds.

(2) Treatment.

(a) There is no treatment if the casualty is hemodynamically (having to do with the movements of the circulation of blood) stable.

(b) If the patient is experiencing a falling blood pressure, cool and clammy skin, confusion, or unconsciousness, treatment is directed at slowing the ventricular rate. In the field, transport the casualty to a medical treatment facility where he can be monitored. DO NOT use cardioversion for a casualty who has been taking digitalis or a person who has a ventricular rate of more than 120 to 140 beats per minute. Cardioversion would not be used if the casualty were experiencing inadequate cardiac output resulting in hypotension, cold and clammy skin, confusion, or coma. Cardioversion would be indicated only when it would be a long time before the casualty could be transported to a medical treatment facility.

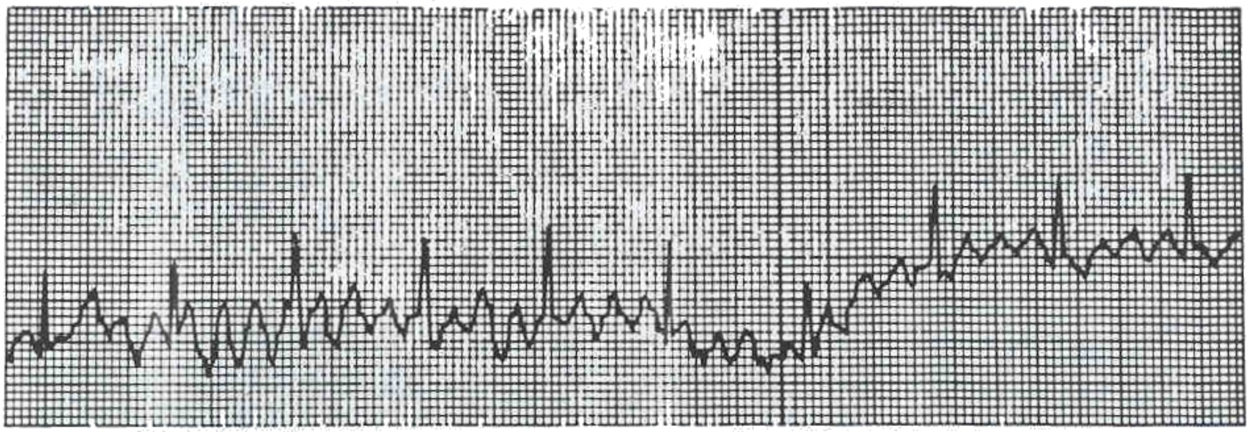


Figure 2-18. Atrial flutter.

f. **Atrial Fibrillation.**

(1) Analysis. In atrial fibrillation, the rhythm is irregularly irregular. The atrial rhythm is unmeasurable, and the R-R interval is irregularly irregular (ventricular). In regard to the heartbeat rate, the atrial rate is unmeasurable. If the ventricular rate is less than 100 beats per minute, it is controlled. If the ventricular rate is greater than 100 beats per minute, it has a rapid ventricular response that is uncontrolled. The atrial heartbeat rate is unmeasurable. The ventricular heartbeat rate, if controlled, is less than 100 beats per minute. If the ventricular heartbeat rate is uncontrolled, the rate is greater than 100 beats per minute. There is either no P wave or there are fibrillatory P waves in which case there is no depolarization of atria, and the waves at the baseline have chaotic undulations. The P-R interval cannot be measured. The QRS complex is less than 0.12 seconds. Atrial fibrillation is usually the result of underlying heart disease. Occasionally, this problem may occur in a normal patient or in patients with MI, especially if SA node infarction occurs. Rapid ventricular response reduces ventricular filling decreasing the stroke volume.

(2) Treatment. Treatment is directed toward eliminating the cause of the problem and decreasing the rate of ventricular response. In the field, transport the casualty to a medical treatment facility and monitor him.

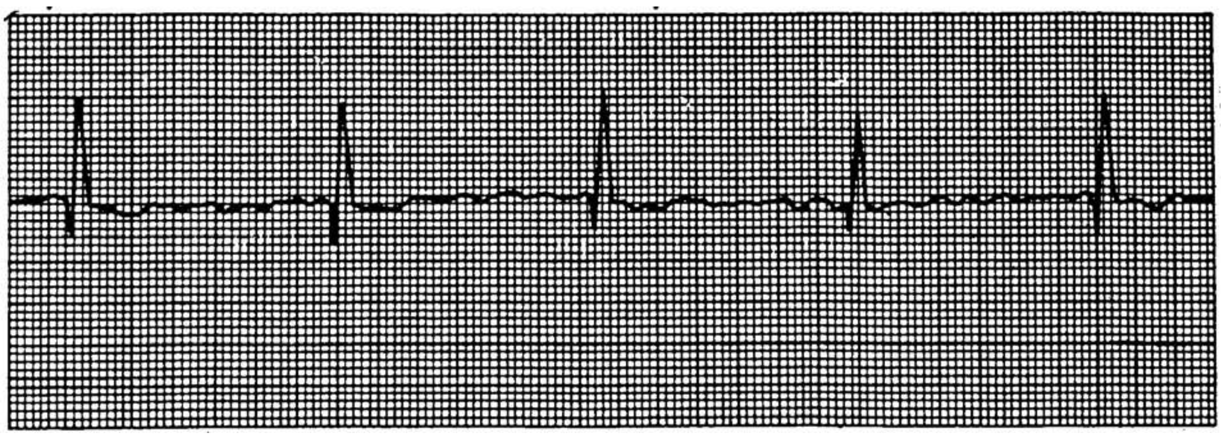


Figure 2-19. Atrial fibrillation (slow).

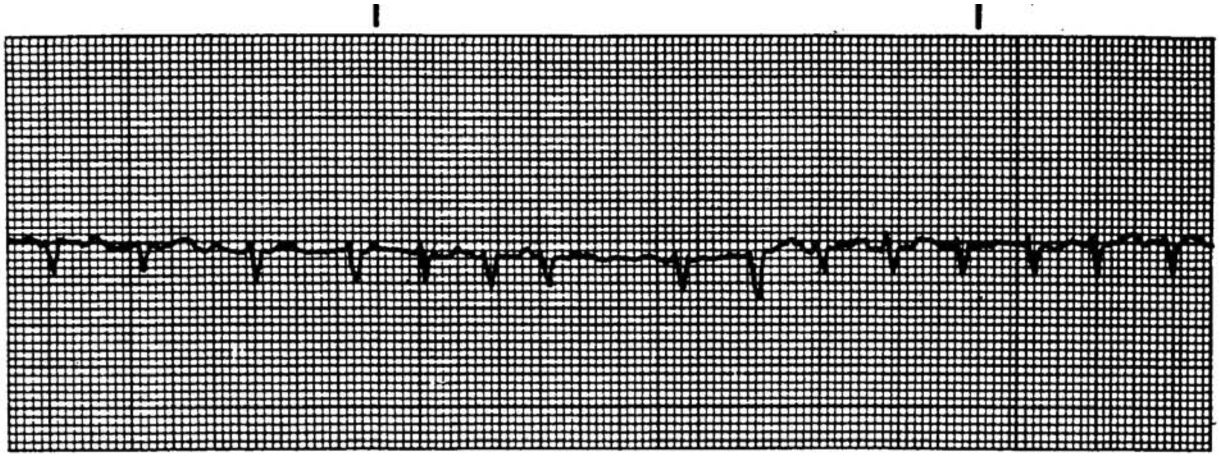


Figure 2-20. Atrial fibrillation (rapid).

2-9. JUNCTIONAL RHYTHMS

a. **General Information.** Junctional arrhythmias create an inverted P wave because the atria are depolarized by the retrograde conduction. These abnormal conditions will depolarize the ventricles in the normal manner (normal QRS). An inverted P wave can occur before, during, or after the QRS complex. All junctional rhythms will create an inverted P wave, but some low atrial impulses can also cause inverted P waves.

b. **Premature Junctional Contraction.**

(1) Analysis. Premature junctional contraction (PJC) is another form of heart abnormality. This condition occurs when a small region of the heart becomes more excitable than normal. This causes an occasional abnormal impulse to be generated between the normal impulses. The abnormal impulse is generated from the region of the heart called the ectopic focus. A wave of depolarization spreads out from the ectopic focus and causes a premature contraction. The regularity depends on the regularity of the underlying rhythm, and the rate depends on the rate of the underlying rhythm. P waves will be inverted and can fall before, during, or after the QRS complex. The PR interval can only be measured if the P wave precedes the QRS Complex. The QRS complex lasts less than 0.12 of a second. What happens is that the AV node takes over the pacemaking function.

(2) Treatment. Treatment is the same as for premature atrial contractions (PACs). See paragraph 2-8c.

NOTE: The normal inherent rate of atrial ventricular junction is 40 to 60 beats per minute. If higher pacemaker sites fail, a junctional escape pacemaker might take control of the heart. The rhythm would then be called a junctional escape rhythm. Inherent rates are as follows: atria--75 beats/minute; A-V node - 60 beats/minute; ventricles--40 to 60 beats per minute; and normal heart rate - 60 to 100 beats per minute.

Figure 2-21. Premature junctional contractions (PJC).

2-10. **HEART BLOCKS**

a. **General Information.** Heart blocks are arrhythmias caused by conduction disturbances at the AV node.

b. First-Degree (Incomplete) Heart Block.

(1) Analysis. The first-degree heart block takes place where there is an incomplete block. The regularity and rate depend on the underlying rhythm of the heart. The P waves are upright and uniform and followed by the QRS complex. The PR interval is constant and greater than 0.20 seconds. The QRS complex is less than 0.12 seconds.

(2) Treatment. There is no treatment.

Figure 2-22. First degree (incomplete) heart block.

c. Wenckebach (Second-Degree Heart Block/Mobitz Type 1).

(1) Analysis. The rhythm is irregular, and the R-R interval gets progressively shorter as the P-R intervals get longer. Grouped beating is characteristic. The heartbeat rate is usually slightly slower than normal. P waves are upright and uniform, but some P waves are not followed by QRS complexes. The P-R interval progressively lengthens until one P wave is not conducted. The QRS complex lasts less than 0.12 of a second. This condition is a less serious type of second-degree heart block. It is, however, still quite common in patients with acute myocardial infarction. The condition may be produced by digitalis.

(2) Treatment. The casualty should be transported to a medical treatment facility and monitored. If the heart rate is very slow, give atropine in the dosage 0.5 mg every five minutes to a total dose of 2.0 mg intravenously or until the heartbeat rate is up to 60 beats per minute.

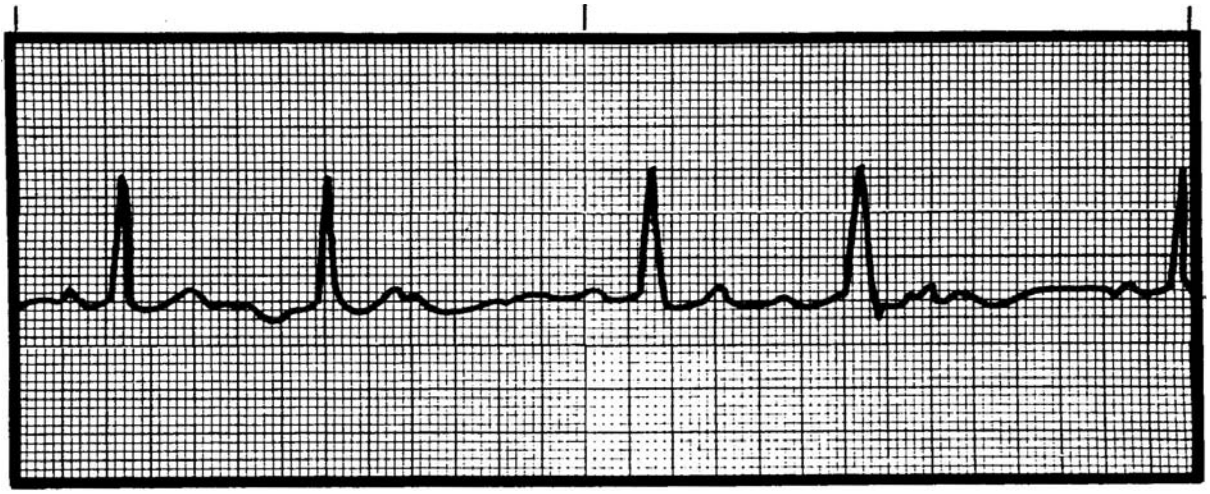


Figure 2-23. Wenckebach (second-degree heart block/Mobitz Type I).

d. **Classical Second-Degree Heart Block (Mobitz Type II).**

(1) Analysis. The rhythm is regular if the conduction ratio is constant; however, the rhythm is irregular if the conduction ratio varies. The rate for atrial is usually normal, and the ventricular rate is usually bradycardia. P waves are upright and uniform with more P waves than QRS complexes (usually a ratio of 2:1, 3:1, and so forth.). The P-R interval is constant on conducted beats, but it may be longer than normal.

(2) Treatment. If the cardiac output is adequate, there is no treatment. If there are signs of an inadequate cardiac output, treat with 0.5 mg atropine sulfate IV bolus. This dose may be repeated until the pulse reaches 60 or more beats per minute or until a maximum dose of 2.0 mg has been given. If atropine sulfate is ineffective, administer 2 mg of isoproteronal in 500 cc D5W IV piggyback until the blood pressure is 80 or the heart rate is greater than 60. Radio the medical treatment facility to have a pacemaker ready.

Figure 2-24. Classical second-degree heart block (Mobitz Type II).

e. **Complete Heart Block (Third-Degree).**

(1) Analysis. The rhythm is regular with PP and RR intervals constant. The atrial rate is normal, but the ventrical response rate varies in this way. The junction focus has a rate of 40 to 60 beats per minute. The ventrical focus has a rate of 20 to 40 beats per minute. P waves are upright and uniform with more P waves than QRS complexes. There are no PR intervals because the P waves have no relationship to QRS complexes. Occasionally, a P wave is superimposed on a QRS complex. The QRS complex is less than 0.12 seconds at the junctional focus and greater than 0.12 seconds at the ventricular focus. Cardiac output may be greatly diminished if the heart rate is below 35 to 50 beats per minute. Additionally, in third-degree heart block, the atria and ventricles are no longer synchronized; therefore, the ventricles do not fill completely before each contraction, causing cardiac output to be even further reduced. The ventricular rate may be so slow that circulation cannot be maintained and syncope (congestive heart failure) or angina may occur.

(2) Treatment. Administer atropine sulfate 0.5 mg IV bolus and repeat at 5-minute intervals to try to maintain a heart rate greater than 60 or until the maximum dose of 2.0 mg is given. If this treatment is ineffective, administer isoproteronal 2 mg in 500 cc D5W IV piggyback until the blood pressure is 80 or the heart rate is greater than 60. NEVER give lidocaine to a casualty with complete heart block. Lidocaine may increase the threshold of the conduction system and block part of the conduction pathways. (You must be able to tell the difference between PVCs and complete heart block.) And, finally, radio a doctor to have a pacemaker ready.

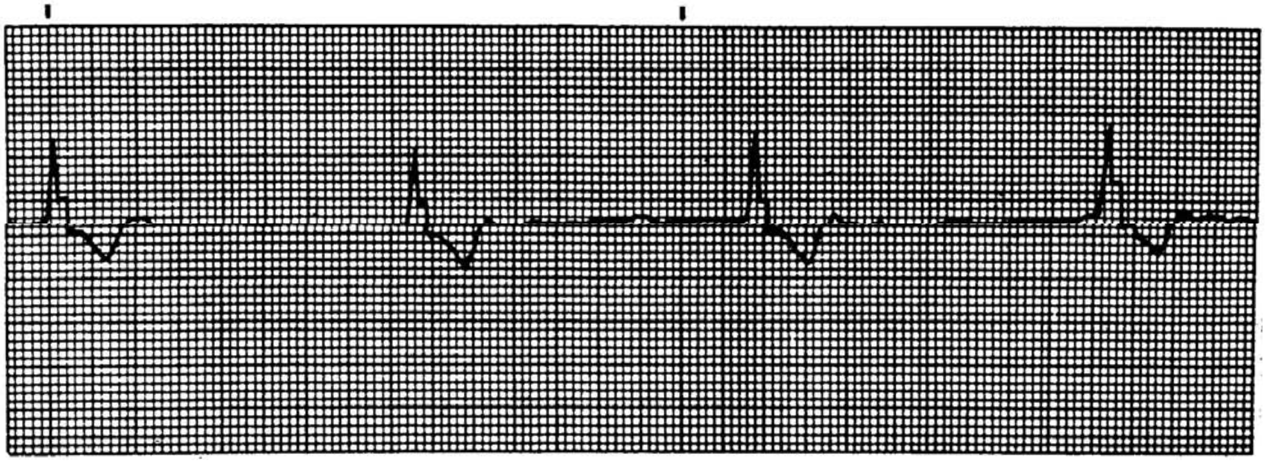


Figure 2-25. Complete heart block.

2-11. **VENTRICULAR ARRHYTHMIAS.**

a. **General.** Ventricular arrhythmias are the most serious arrhythmias. The definition of arrhythmia is an abnormality in the rate, rhythm, or conduction of the heartbeat. A heartbeat irregularity may be an indication of some disease or a normal response to the body's activity. Arrhythmias are classified on the basis of the site of origin of the arrhythmia: SA node, atria, AV node, or ventricle. As with some heart blocks, the QRS complex measurement is equal to or greater than 0.12 seconds. A QRS of less than 0.12 of a second indicates a supraventricular pacemaker. If the QRS is 0.12 of a second or greater, the problem could be ventricular or supraventricular with ventricular conduction defect. All ventricular arrhythmias will have a QRS complex of 0.12 of a second or greater. The reason ventricular rhythms are the most serious arrhythmias is that the heart is less effective than usual and is functioning on its last level of backup support. Four types of ventricular arrhythmias will be covered here: premature ventricular contractions, ventricular tachycardia, ventricular fibrillation, and idioventricular rhythm.

b. **Premature Ventricular Contractions.**

(1) Analysis. A premature ventricular contractions (PVCs) is a single ectopic (heartbeat arising from a place other than the SA node) caused by irritable focus in the ventricles. The heartbeat comes earlier than expected and interrupts the regularity of the underlying rhythm of the heart. The heartbeat rate is determined by the underlying heartbeat rhythm, PVCs not being included in the rate. P waves will not come before an ectopic heartbeat; however, P waves may be seen near a premature ventricular contraction. Since the heartbeat comes from a lower focus, there will be no P-R interval. The QRS complex will be wide and bizarre (at least 0.12 or more of a second). The T wave is usually in the opposite direction from the R wave. Premature ventricular contractions may be quite serious, particularly in certain combinations and in the wake of acute myocardial infarction. Dangerous signs include frequent PVCs, runs of PVCs, multifocal PVCs, and the R-on-T phenomenon. In a perfectly healthy person, PVCs may not always be considered an abnormality; however, if the casualty is experiencing acute myocardial infarction, PVCs must be treated instantly.

(2) Characteristics. The following are characteristic of premature ventricular contractions:

(a) A compensatory pause usually follows a PVC. The distance between the R wave of complex preceding the PVC and the R wave of complex following the PVC is exactly twice the R-R interval of underlying rhythm.

(b) The PVC does not have to have a compensatory pause. The beat can be "interpolated" between two sinus beats without interrupting the underlying rhythm.

(c) Premature ventricular contractions indicate myocardial irritability. The frequency of PVCs suggests the degree of myocardial irritability.

(d) Premature ventricular contractions are considered unifocal if they all originate from a single ventricular focus and have similar configurations.

(e) Premature ventricular contractions are considered multifocal if they original from many different points and have different configurations.

(f) If a PVC occurs during a vulnerable (relative refractory) phase of the cardiac cycle, the PVC can produce lethal, repetitive arrhythmias. A PVC that falls on the downslope of a T wave is referred to as "R-on-T" phenomenon and is considered very dangerous.

(g) With increasing irritability, PVCs can occur in pairs called couplets or in runs of three or more consecutive ectopics (ectopic heartbeat originating from a place other than the SA node).

(h) Premature ventricular contractions frequently occur in patterns such as the following:

1 Bigeminy--a PVC every other heartbeat.

2 Trigeminy--a PVC every third beat.

3 Quadrigeminy--a PVC every fourth beat.

NOTE: Bigeminy, trigeminy, and quadrigeminy can also describe patterns of premature atrial contractions (PACS) and premature junctional contractions (PJCs).

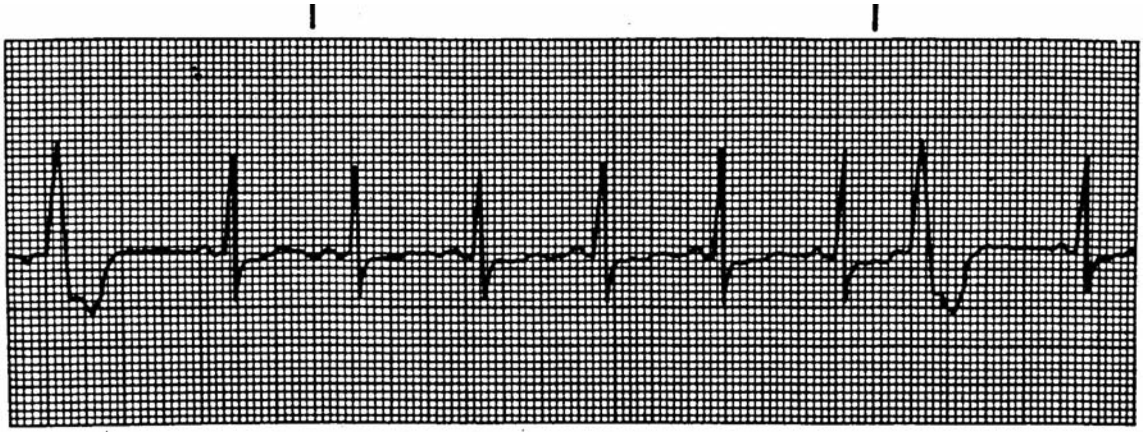


Figure 2-26. Frequent premature ventricular contractions.

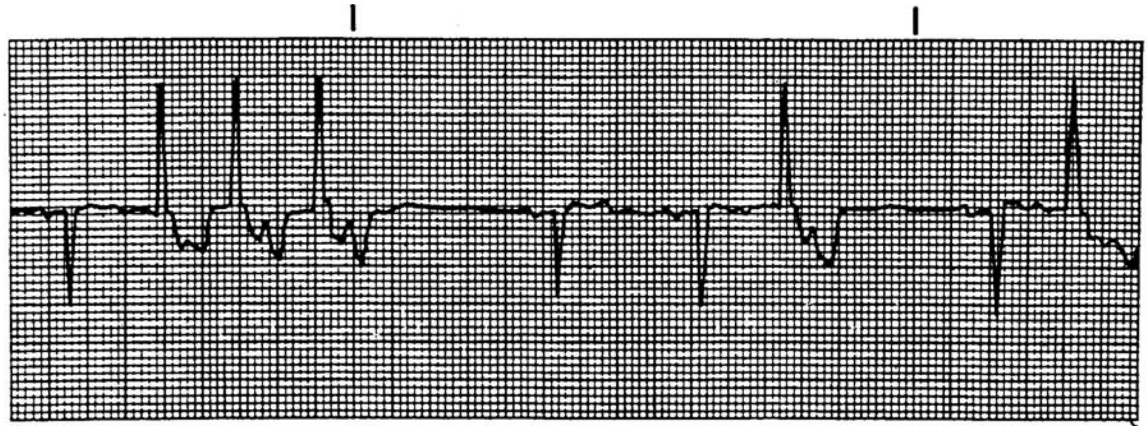


Figure 2-27. Runs of premature ventricular contractions.

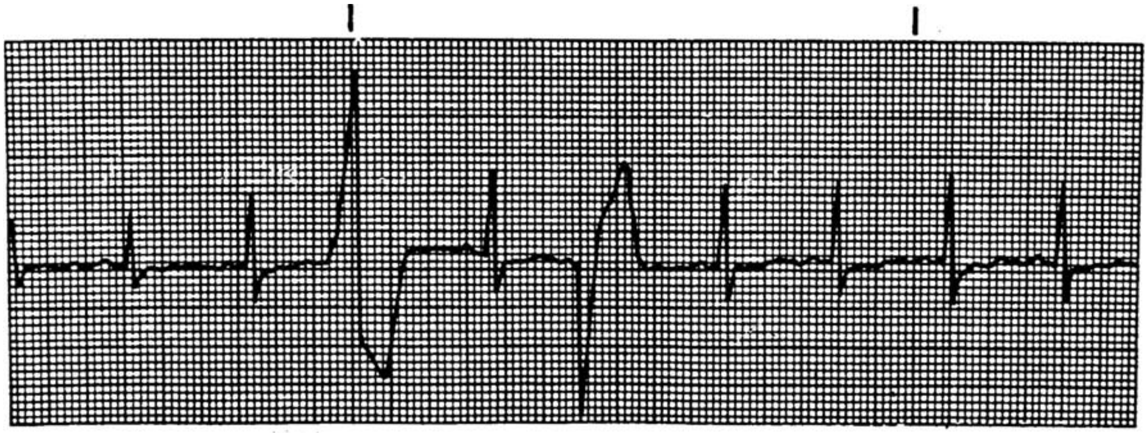


Figure 2-28. Multifocal premature ventricular contractions.

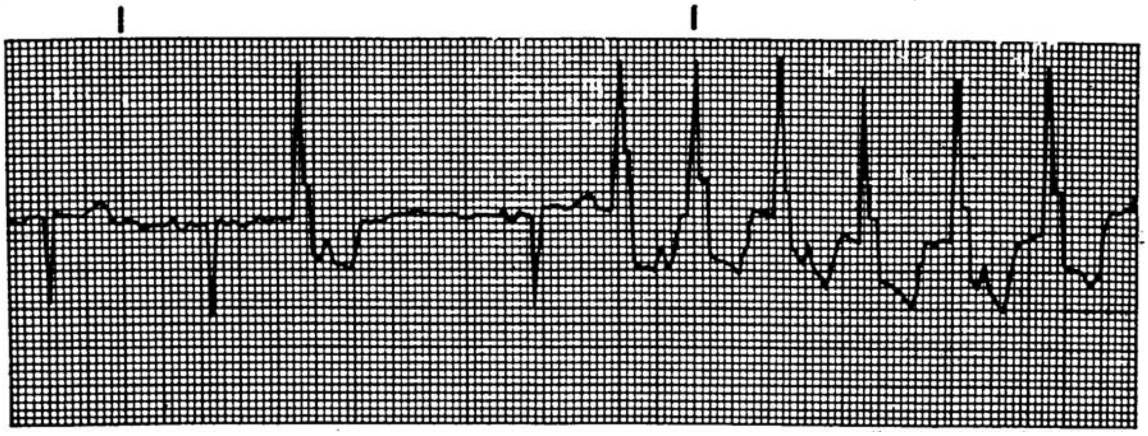


Figure 2-29. Runs of premature ventricular contractions with short run of ventricular tachycardia.

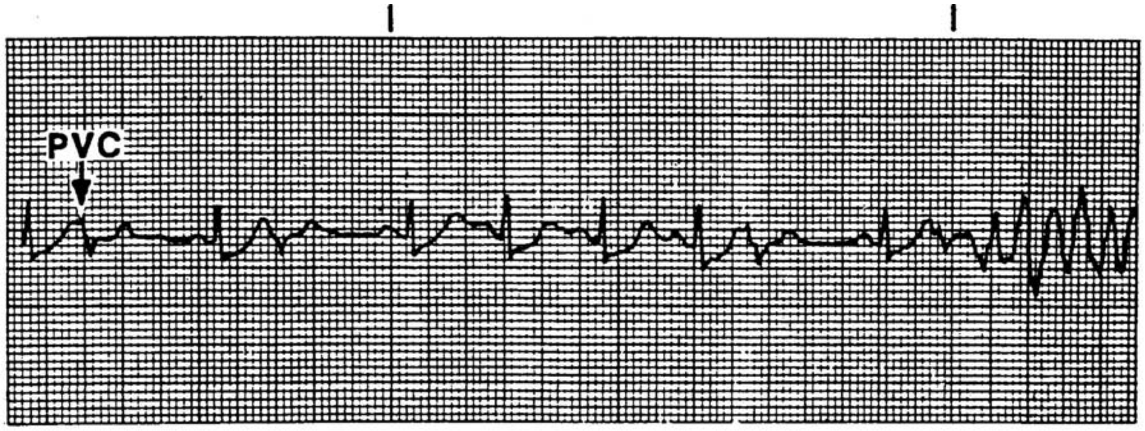


Figure 2-30. R-on-T phenomenon ending in ventricular fibrillation.

(3) Treatment. Administer lidocaine.

(a) Administer lidocaine if any or all of the following are present:

1 Frequent PVCs (more than 6 per minute).

2 Premature ventricular contractions frequently coupled.

3 Multifocal PVCs (Premature ventricular contractions which are different shapes and sizes).

4 Bursts of two or more PVCs in succession.

(b) Give this dosage:

1 Initially, give 1.0 mg per kilogram of weight of lidocaine IV bolus.

2 Additionally, 0.5 mg/kg IV boluses can be given every 2 to 10 minutes, if necessary to a total of 3 mg/kg intravenously.

(c) If transport time is excessive, consider continuous infusion at 1 to 4 mg/minute.

(d) If PVCs occur and the casualty is also experiencing bradycardia, treat the bradycardia first.

c. **Ventricular Tachycardia.**

(1) Analysis. The rhythm of the heart is usually regular, but the rhythm can be slightly irregular. The heartbeat rate is from 150 to 250 beats per minute. The rate can exceed 250 beats per minute of the heart rhythm progressing to ventricular flutter. Occasionally, the rate may be slower than 150 beats per minute; the condition is then termed slow ventricular tachycardia (VT). P waves are not normally seen; however, dissociated waves may be seen. The focus is in the ventricles, and there will be no PR interval. The QRS complex is wide and bizarre. The complex may be 0.12 of a second or greater. The T wave is usually in the opposite direction from the R wave. Ventricular tachycardia is serious and dangerous. It may be the precursor of ventricular fibrillation. If VT persists, there may be a marked reduction in cardiac output.

(2) Treatment. Begin with lidocaine intravenously unless the situation is critical, then give a DC countershock.

NOTE: If the casualty has no pulse, treat as you would for ventricular fibrillation. Treatment for a stable and unstable casualty is not the same.

(a) Stable casualty. Follow this procedure for the casualty who has no symptoms (no chest pain or dyspnea, adequate blood pressure, and a pulse):

1 Administer lidocaine 1 mg/kg intravenously bolus. This may be followed by 0.5 mg/kg intravenously every 8 minutes until the ventricular tachycardia resolves or up to 3 mg/kg intravenously.

2 Give procainamide 2 mg/minute intra-venously until the ventricular tachycardia resolves or up to 1,000 mg intravenously. (Use procainamide if lidocaine doesn't work.)

3 If drug therapy is not successful, perform low energy cardioversion of 50 joules.

4 If a defibrillator is available, use a mechanical means of conversions ("chest thump" or "cough.")

NOTE: Mechanical conversion may cause ventricular fibrillation.

(b) Unstable casualty. Follow this procedure for the casualty who has chest pain, a systolic blood pressure less than 90 mm Hg, and a pulse.

1 Perform nonsynchronized cardioversion in the following sequence:

a Give 50 joules.

b If there is no change, give 100 joules.

c If there is still no change, give 200 joules.

d If there is still no change, give 360 joules.

2 Administer lidocaine 1 mg/kg intra-venously bolus. This may be followed by 0.5 mg/kg intravenously every 8 minutes up to a total of 3 mg/kg intravenously.

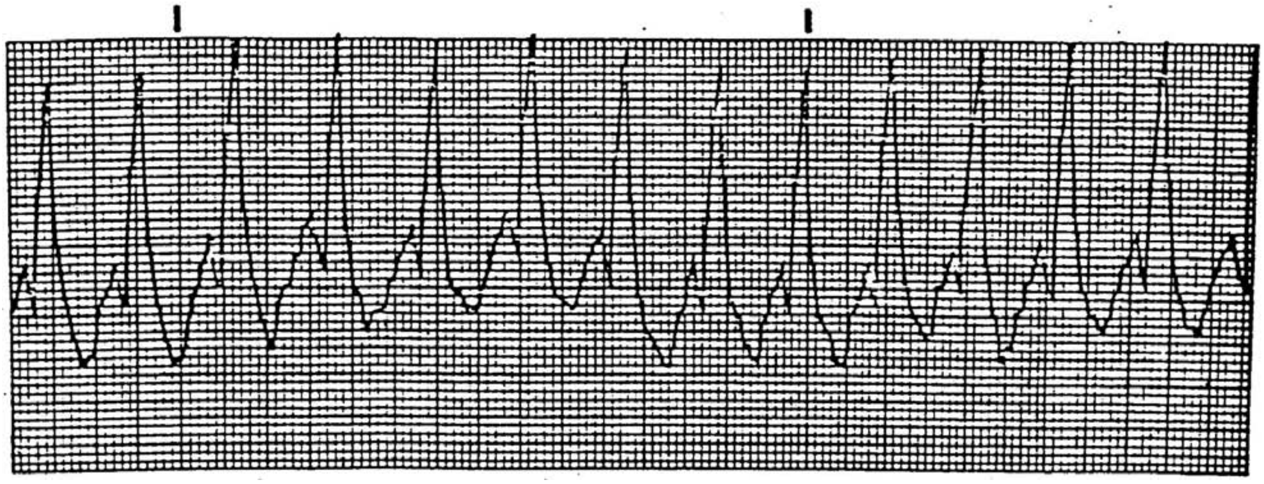


Figure 2-31. Ventricular tachycardia.

d. **Ventricular Fibrillation).**

(1) Analysis. The rhythm, rate, P waves, P-R interval, and QRS complex are totally chaotic with no discernible waves or complete complexes in this abnormality. The ventricles fire in a totally disorganized fashion, and, instead of beating, the ventricular muscle quivers. Consequently, there is no cardiac output, and the ventricular fibrillation is the same as death. The casualty is clinically dead. Normal heart rhythm must be restored within a few minutes or biologic death follows. When you see a rhythm on the monitor that resembles ventricular fibrillation, check quickly to be sure this pattern is not caused by muscle tremor, loose leads, or patient movement artifact.

(2) Treatment. For a witnessed arrest, first check the patient for a pulse. I there is no pulse, perform a precordial thump. Again check for a pulse; if there is no pulse, perform CPR until a defibrillator is available. For an unwitnessed arrest, check for a pulse. If there is no pulse, perform CPR until a defibrillator is available. Follow this procedure for either a witnessed arrest or an unwitnessed arrest once a monitor is available:

(a) Check the monitor for rhythm.

(b) Defibrillate at 200 joules. Check the pulse and rhythm.

(c) If this is unsuccessful, defibrillate at 200 to 300 joules. (Again, if VF recurs, use the energy level previously successful.)

(d) If still unsuccessful, defibrillate up to 360 joules.

(e) If there is no pulse, perform CPR.

(f) Establish IV access.

(g) Administer epinephrine, 1:10,000, 0.5 - 1.0 mg IV Push. (Repeat epinephrine every 5 minutes.)

(h) Intubate, if possible.

(i) Administer lidocaine, 1 mg/kg IV Push.

(j) Defibrillate with up to 360 joules. (Again, if VF occurs, defibrillate with the energy level previously successful.)

(k) Administer bretylium, 5 mg/kg IV Push.

(l) Consider bicarbonate.

(m) Defibrillate with up to 360 joules. (If VP recurs, defibrillate with the energy level previously successful.)

(n) Administer bretylium, 10 mg/kg IV Push.

(o) Defibrillate with up to 360 joules. (If VF recurs, defibrillate with the energy level previously successful.)

(p) Administer either lidocaine or bretylium.

(q) Defibrillate with up to 360 joules. (If VF recurs, defibrillate with the energy level previously successful.)

NOTE: This sequence of treatment is appropriate for a broad range of patients. It may be necessary to make some changes in treatment in individual cases.

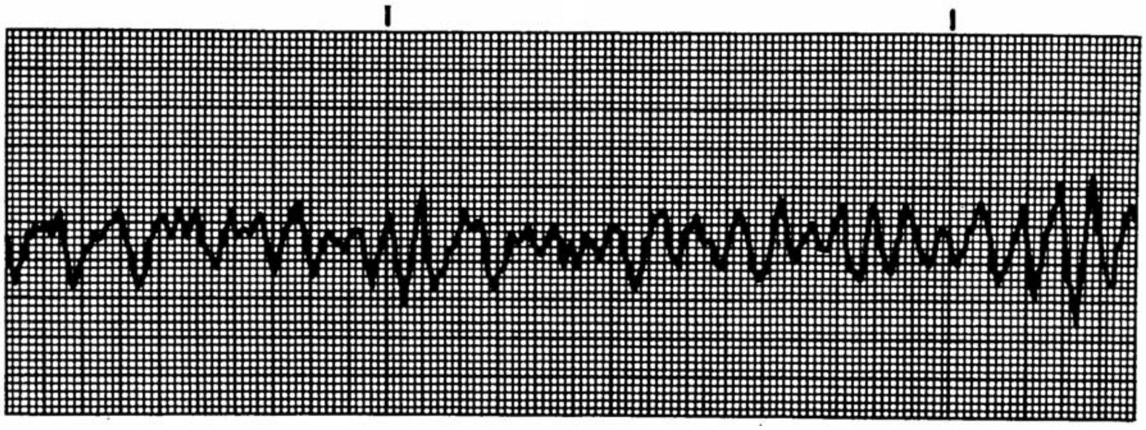


Figure 2-32. Ventricular fibrillation (fine).

Figure 2-33. Ventricular fibrillation (coarse).

e. **Idioventricular Rhythm.**

(1) Analysis. The rhythm is usually regular, but can be unreliable, since the rhythm of the heart is at such a low site. There is no P wave nor P-R interval. The QRS complex is wide and bizarre and 0.12 second or greater. The escape rhythm has taken over the pacemaking responsibility.

(2) Treatment. Treat as follows:

(a) First administer atropine.

(b) If atropine is unsuccessful, administer isoprel.

(c) If there is no improvement, perform a fluid challenge. Administer 500 cc IV fluid quickly until the patient has received two liters of fluid.

(d) In a hospital setting, if the patient's condition has not improved, an internal or external pacemaker is considered.

(e) If there is still no improvement, the next step is chest massage.

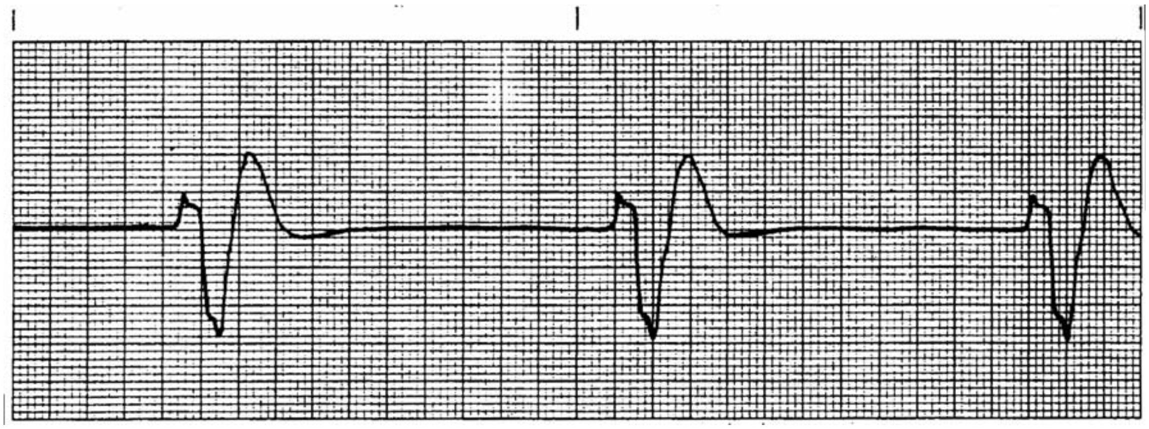


Figure 2-34. Idioventricular rhythm.

2-12. **ASYSTOLE (CARDIAC STANDSTILL)**

a. **Analysis.** A straight line on the electrocardiogram indicates an absence of electrical activity by the heart: no regularity, rate, P waves, P-R interval, or QRS complex. The casualty is clinically dead. He has no effective cardiac output. Normal rhythm must be restored within a few minutes by appropriate treatment.

b. **Treatment.** It is sometimes difficult to distinguish between asystole and ventricular fibrillation. If there is any doubt, treat the patient for ventricular fibrillation. When the rhythm is unclear and the possibility of VT exists, defibrillate as for ventricular fibrillation. If asystole is present, follow this procedure:

(1) Continue CPR.

(2) Establish IV access.

(3) Administer epinephrine, 1:10,000, 0.5 - 1.0 mg IV push.

(4) Intubate when possible.

(5) Administer atropine, 1.0 mg IV push, repeated in 5 minutes.

(6) Consider bicarbonate.

(7) Consider pacing (the use of an internal or external pacemaker).

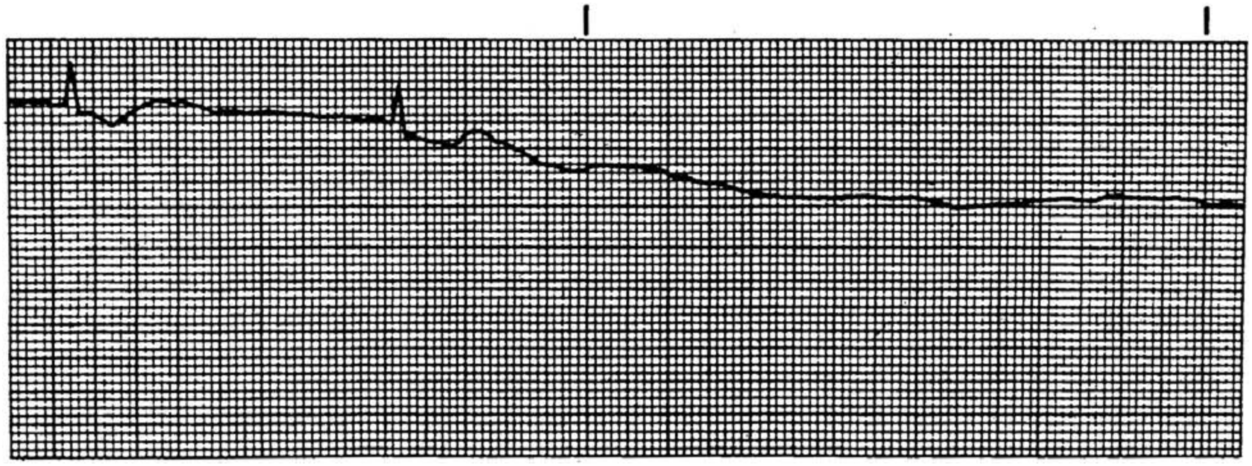


Figure 2-35. Asystole (cardiac standstill).

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS: The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. When you are calculating regular rhythms, the most accurate method is to count the number of small squares between ____________________ and divide that number into 1500.

2. The rate for irregular rhythm is based on the ______________ strip method.

3. In atrial polarization, the P waves seen on the oscilloscope indicate

   ___________________________________ deflections.
   (small or large) (positive or negative)

4. Q waves occurring on the oscilloscope are ____________________ deflections.

5. The rhythm for sinus bradycardia is __________________with the PR intervals __________________ and the PP intervals _________________________.

6. Administer ______________ when you treat sinus bradycardia with hypotension.

7. The casualty's heartbeat rhythm is regular (RRI and PPI are constant). The atrial and ventricular waves are equal to or greater than 100 beats per minute. The P wave is uniform with one P wave appearing in front of every QRS complex. The P-R interval is constant between 0.12 and 0.20 seconds. The QRS measures less than 0.12 seconds. Which cardiac dysrhythmia is the casualty suffering from?

   ____

8. A soldier in the field is experiencing atrial fibrillation. His pulse is rapid.

   Treatment is to ______________________________________and monitor him.

9. In the dysrhythmia, ____________________________the rhythm is regular, the RR and PP intervals are constant, and the atrial and ventricular rates are equal to or greater than 100 beats per minute.

10. In the case of atrial rhythms, the sinus node loses its pacemaking role, and the site with the ____________________________________ becomes the pacemaker.

11. What is the treatment for wandering pacemaker atrial rhythm?

    ____.

12. A single focus in the atria fires very rapidly and overrides the SA node. The name of this atrial rhythm is _____________________________________.

13. Premature junctional contraction (PJC) occurs when a small region of the heart becomes ____.

14. What is the general cause of heart blocks? _________________________________

15. A premature ventricular contraction (PVC) is a single ectopic heartbeat which comes earlier than expected ____________________________and the regularity of the underlying rhythm of the heart.

16. A characteristic of ventricular fibrillation (VF) is that the ventricles of the heart fire in a ________________instead of beating, the ventricular muscle ______________.

17. Another name for cardiac standstill is ___________________________________.

18. List five atrial rhythms dealt with in this lesson.

a. ____.

b. ____.

c. ____.

d. ____.

e. ____.

19. List four ventricular arrhythmias written about in this lesson.

a. ____.

b. ____.

c. ____.

d. ____.

20. The one junctional rhythm listed in this lesson is __________________________.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. Two R waves. (para 2-6b(l)(a))

2. Six second. (para 2-6b(2))

3. Small.   Positive. (para 2-5c(l))

4. Negative. (para 2-5d(2))

5. Regular. Constant. Constant. (para 2-7b(l)(a))

6. Atropine. (para 2-7b(2)(b))

7. Sinus tachycardia. (para 2-7c(l))

8. Transport him to a medical treatment facility. (para 2-8f(2))

9. Sinus tachycardia. (para 2-7c(l))

10. Fastest rate. (para 2-8a)

11. There is no treatment. (para 2-8b(2))

12. Atrial tachycardia (AT). (para 2-8d(l))

13. More excitable than nominal. (para 2-9b(l))

14. Conduction disturbances at the AV node are a general cause of heart blocks. (para 2-10a)

15. Interrupts. (para 2-11b(1)

16. Totally disorganized. Quivers. (para 2-11d(1))

17. Asystole. (para 2-12)

18. Wandering pacemaker.
    Premature atrial contractions (PACs).
    Atrial tachycardia.
    Atrial flutter.
    Atrial fibrillation. (paras 2-8b through f)

19. Premature ventricular contractions (PVCs).
Ventricular tachycardia (VT).
Ventricular fibrillation (VF).
Idioventricular rhythm. (paras 2-11b through e)

20. Premature junctional contraction (PJC). (para 2-9(b)

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Cardiac Arrest (Defibrillation)
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-15.
LESSON OBJECTIVE	After completing this lesson, you should be able to: 3-1. Identify the causes, signs, risk factors, and major management techniques of cardiac arrest.
SUGGESTION	After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

CARDIAC ARREST (DEFIBRILLATION)

Section I. REVIEW OF THE CARDIOVASCULAR SYSTEM AND THE RESPIRATORY SYSTEM

3-1. DEFINITIONS

Some of the terms used in this and following lessons are defined below.

a. **Casualty.** The casualty is the person with the medical problem, such as a person who is not breathing.

b. **Rescuer.** The rescuer is the person who is assisting the casualty; for example, the person who is giving mouth-to- mouth resuscitation to the casualty.

c. **Airway.** The airway consists of the body structures through which air from the atmosphere passes while going to the lungs. The airway includes the oral and nasal cavities (mouth and nose), pharynx (throat), larynx (voice box), trachea (windpipe), and bronchi (two tubes leading from the trachea to the lungs).

d. **Sign.** A sign is anything that the rescuer can tell about the casualty's condition by using his own senses. For example, a rescuer can <u>see</u> a wound, <u>hear</u> breathing difficulty, <u>feel</u> that the casualty has a fever by touching the casualty's skin, and <u>smell</u> an unusual odor on the casualty's Is breath, a possible sign of poisoning.

e. **Symptom.** A symptom is any change from the norm which is felt by the casualty but which cannot be directly or objectively sensed by the rescuer. Examples of symptoms felt by the victim are chest pains, nausea, a headache, and mental confusion. An injury can produce both signs and symptoms; for example, pain which only the victim can feel and a bump or bruise which can be viewed by others.

f. **Aggravate.** To aggravate a wound means to make it worse. For example, moving a person with a fractured leg before the leg is splinted can cause the sharp ends of the broken bone to cut nerves and blood vessels that were not damaged before the person was moved.

3-2. IMPORTANCE OF FOOD, OXYGEN, AND THE CARDIOVASCULAR SYSTEM

The human body is composed of cells. The average adult's body is made up of around eighty trillion (80,000,000,000,000) living cells. Each living cell needs energy to survive. Cells obtain energy through oxidation. That is, they combine a source of potential energy with oxygen to liberate energy. The sources of potential energy come from the food (carbohydrates, fats, and proteins) that is processed into usable units by the body's digestive system (stomach, small intestines, liver, pancreas, etc.). Oxygen comes from the air that is breathed in and absorbed by the lungs. Oxygen in the lungs and food in the intestines, however, cannot help muscles and other cells unless the oxygen and food can be delivered to those cells. Delivering food and oxygen to the cells is the function of blood and of the body's cardiovascular system.

3-3. THE CARDIOVASCULAR SYSTEM

The cardiovascular system consists of the heart and the blood vessels. The cardiovascular system keeps all parts of the body supplied with blood. Blood brings oxygen and nutrients to the cells and carries away waste products.

a. **Heart.** The heart (figure 3-1) is the pump that keeps the blood circulating. Actually, the heart could be described as two pumps, both of which are under the control of a natural pacemaker called the sinoatrial node. Each side (right half and left half) of the heart has a receiving chamber for the blood called the atrium and a pumping chamber called the ventricle. The two halves of the heart are separated by a wall-like structure called the interventricular septum. The sinoatrial node (SA node), located at the junction of the superior vena cava and the right atrium, is a small bundle of nerve tissue that produces an electrical stimulus. This electrical stimulus causes the muscles of the ventricles to contract.

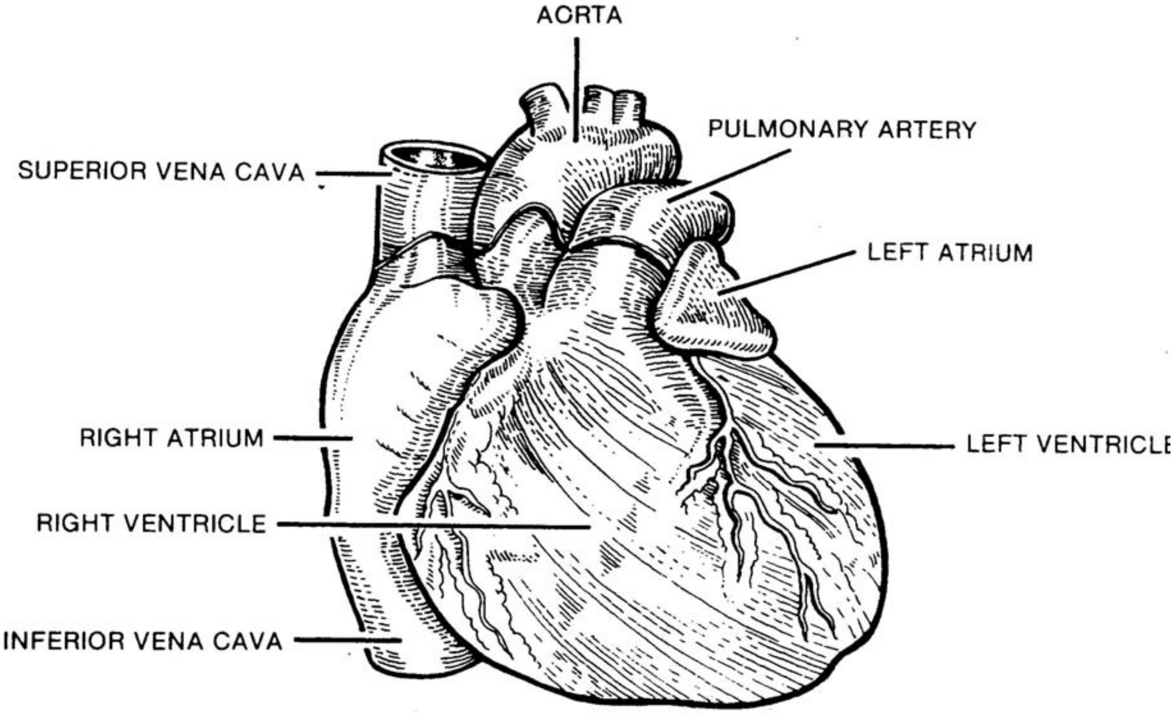


Figure 3-1. The human heart (front view).

b. **Blood Vessels.** The blood vessels of the cardiovascular system carry the blood away from the heart and back to the heart again.

(1) Blood circulation systems. Since the heart is divided into two parts (the right half consisting of the right atrium and the right ventricle and the left half consisting of the left atrium and the left ventricle), it is not surprising to find that there are actually two blood circulatory systems--the systemic and the pulmonary.

(a) Systemic. The systemic (general) circulatory system is the larger of the two systems. It takes the blood pumped by the left ventricle to all parts of the body and returns the blood to the right atrium. The blood is rich in oxygen when it leaves the heart through the left ventricle and is low in oxygen content when it returns to the right atrium.

(b) Pulmonary. The pulmonary circulatory system takes the blood pumped by the right ventricle to the lungs and returns the blood to the left atrium. The blood is oxygen-poor when it leaves the right ventricle and oxygen-rich when it returns to the left atrium.

(2) Types of blood vessels. Both the systemic and the pulmonary circulatory systems are composed of three major types of blood vessels: arteries, capillaries, and veins.

(a) Arteries. Arteries carry blood pumped by the ventricles away from the heart. The arteries of the systemic circulatory system carry oxygenated (oxygen-rich) blood to body tissues. Pulmonary arteries carry deoxygenated (oxygen-poor) blood to the lungs. Arteries have the capacity to constrict and dilate. This constricting and dilating helps regulate blood pressure.

(b) Capillaries. The arteries are large blood vessels that divide into smaller branches. These branches then divide again and again. Each time, the blood vessels become smaller and smaller. Finally, the blood vessels are so small that only one red blood cell can pass through at a time. When they reach this size, the blood vessels are called capillaries. When a blood cell enters the capillaries, it is free to perform its primary functions. In the pulmonary system, the red blood cells give up carbon dioxide to the lungs and pick up oxygen. In the systemic system, blood gives oxygen, nutrients, and fluids to the cells and picks up carbon dioxide and other waste materials.

(c) Veins. Capillaries join together to form larger blood vessels. These blood vessels combine to form even larger blood vessels. This process continues until large blood vessels called veins are formed. Veins carry blood back to the heart. The veins of the systemic system carry oxygen-poor blood to the right atrium. The veins of the pulmonary system carry oxygen-rich blood to the left atrium.

3-4. THE RESPIRATORY SYSTEM

The respiratory system consists of two lungs and the respiratory tract that carries air to and from the lungs (figure 3-2). When a person inhales, air enters the nose or mouth, travels down the trachea, and into one of the two bronchi. These air tubes divide into smaller and smaller tubes. Finally, the air reaches the tiny alveoli. These alveoli are like tiny sacs. When air enters an alveolus, the capillaries surrounding the alveolus absorb oxygen and give off carbon dioxide. When a person exhales, the air carrying the carbon dioxide travels from the alveoli through the air tubes, up the trachea, and out of the nose or mouth. Of course, not all of the air inhaled reaches the alveoli nor is all of the oxygen removed from the air in the alveoli. The average adult takes in about 500 milliliters of air each time he inhales, and he exhales the same amount. Even after the person exhales, the lungs still contain about 2300 milliliters of air.

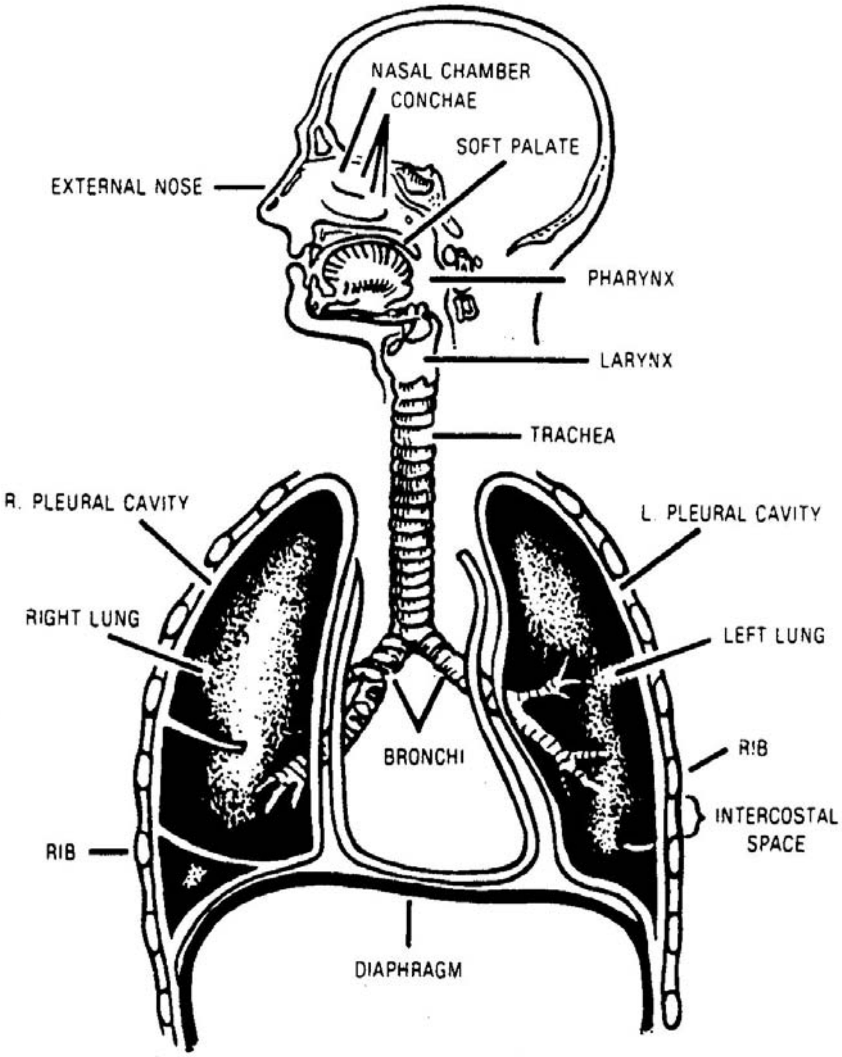
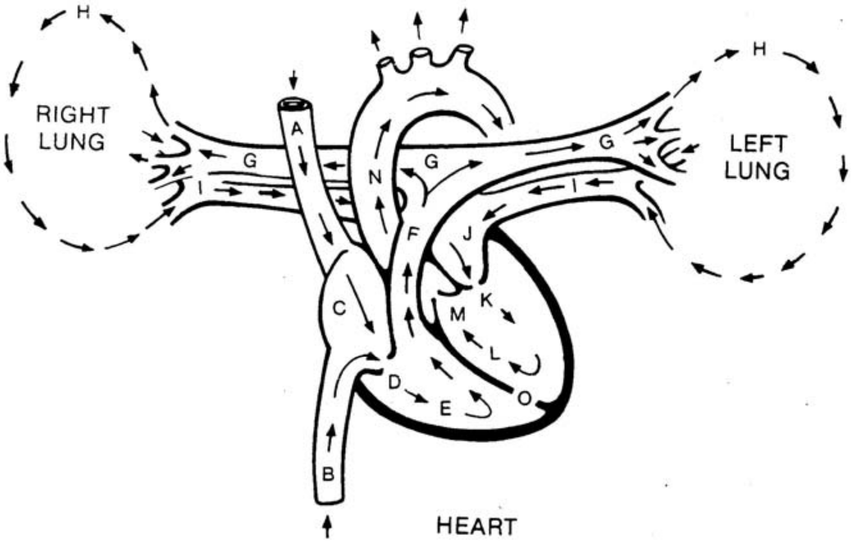


Figure 3-2. The respiratory system.

3-5. **BLOOD FLOW**

In order to summarize how blood flows in the body, let's take a trip through the body's circulatory system (see figure 3-3). We will enter the system at the inferior vena cava.



Direction of blood flow

A. Superior vena cava
B. Inferior vena cava
C. Right atrium
D. Tricuspid valve
E. Right ventricle
F. Pulmonary valve
G. Pulmonary arteries
H. Lungs
I. Pulmonary veins
J. Left ventricle
K. Mitral valve
L. Left ventricle
N. Aorta
O Interventricular septum

Figure 3-3. Blood flow to and from the heart. (Not drawn to scale; front view).

a. **Vena Cava.** There are two major blood veins that empty into the right atrium. The inferior vena cava carries oxygen-poor blood from the lower trunk and legs. The superior vena cava drains blood from the head and upper chest.

b. **Right Atrium.** The right atrium, the upper chamber of the right side of the heart, receives blood from the superior vena cava (blood from the upper body) and from the inferior vena cava (blood from the lower body). As the right atrium contracts, the rig ventricle relaxes. Contraction of the right atrium forces blood through the triscupid valve into the relaxed right ventricle. The triscupid valve is so formed that blood cannot flow back into the right atrium.

c. **Right Ventricle.** When the right ventricle is filled with blood, it receives an impulse from the sinoatrial (SA) node. This impulse causes the muscles of the right ventricle to contract. The contraction causes the inside of the ventricle (the space where the blood is) to become smaller. Increased pressure forces blood out of the ventricle and into the pulmonary artery. The pulmonary valve located at the beginning of the pulmonary artery keeps blood from flowing back into the right ventricle when the ventricle relaxes and returns to its normal size.

d. **Lungs (Pulmonary System).** The pulmonary artery divides into two arteries. One artery travels to the right lung while the other artery travels to the left lung. The arteries divide until they reach the capillary stage; the capillaries surround the alveoli (air sacs) of the lungs. There the oxygen-poor blood gets rid of its carbon dioxide and picks up oxygen from the air in the alveolus. The blood, now rich in oxygen, returns to the left atrium through the pulmonary veins.

e. **Left Atrium.** The left atrium receives blood from the lungs though two pulmonary veins. When the left ventricle relaxes after having contracted, blood flows from the left atrium into the left ventricle through the mitral valve. The mitral valve keeps blood from flowing back into the left atrium when the left ventricle contracts.

f. **Left Ventricle.** After the left ventricle is filled with oxygen-rich blood, it receives an impulse which causes it to contract and pump blood into the large artery called the aorta. When blood enters the aorta, it passes through the aortic valve. This valve keeps the blood from flowing back into the heart once the left ventricle relaxes.

g. **Body (Systemic System).** Arteries going to the head and upper body branch off the aorta. Two of these arteries (the right and left coronary arteries) supply the heart muscles with blood. After the aorta turns down, it divides into smaller arteries which go to the lower parts of the body. Arteries go to all parts of the body and divide into smaller blood vessels that eventually become capillaries. Blood in the capillaries give nutrients and oxygen to the cells and remove wastes. Capillaries then group to form veins that return blood to the right atrium. Before we leave the systemic circulatory system, though, let us take a brief look at the blood that flows to the intestines and to the kidneys.

(1) Intestines. Capillaries surrounding the intestines absorb fluids and nutrients from the intestines. Before returning to the heart, blood travels to the liver through the hepatic portal vein. In the liver, some of the nutrients are removed and stored for future use. The liver also removes bacteria and other types of unwanted substances from the blood. After passing through the liver, blood returns to the inferior vena cava through the hepatic vein.

(2) Kidneys. Some of the blood flows through the kidneys. The kidneys act as filters and remove most of the waste products contained in the blood. The major waste product removed is urea. The kidneys expel urea and other waste products in the form of urine.

Section II. GENERAL CONSIDERATIONS REGARDING CARDIAC ARREST

3-6. CARDIAC ARREST AND HEART ATTACK

It is important to understand the difference between cardiac arrest and a heart attack. Cardiac arrest (sudden death) is a result of the sudden and unexpected cessation of respiration and circulation. That is, the casualty stops breathing, and his heart stops beating. A heart attack is caused by a blockage of one or more of the coronary arteries (arteries which provide the heart muscles with oxygen-rich blood).

3-7. PRIMARY CAUSES OF CARDIAC ARREST

Cardiac arrest (cessation of the heartbeat) may occur for a number of reasons. Sixty percent of cardiac arrest cases occur as a result of cardiovascular diseases which include progression of myocardial infarction (death of myocardial cells due to an interrupted blood supply) and progression of heart rhythm disorders. Respiratory disease accounts for fifteen percent of cardiac arrest cases, and digestive and urogenital disease account for another seven percent of cardiac arrest cases. These miscellaneous cases make up the remaining three percent: hyperkalemia (abnormally high potassium concentration in the blood); electrical burns; metabolic disorders such as acidosis (disease resulting from accumulation of acid or depletion of alkaline in the blood and body tissues); trauma to the chest; pulmonary embolism (pulmonary artery or a branch being closed); intracerebral hemorrhage (bleeding in the cerebrum); and coronary artery spasm. When cardiac arrest occurs, oxygen is not circulated, and the body uses the oxygen stored in the vital organs in seconds.

3-8. MAJOR RISK FACTORS OF CARDIAC ARREST

a. **Statistics.** Statistics indicate that cardiac arrest is more likely to occur in these groups of individuals:

(1) Older persons.

(2) Individuals with a family history of arteriosclerosis (hardening of the arteries).

(3) Persons with hypertension (high blood pressure).

(4) Diabetes mellitus sufferers (body produces too little insulin, person very thirsty, and eats too much).

(5) Cigarette smokers.

(6) Those with elevated blood cholesterol.

(7) Persons with preexisting heart disease.

(8) Individuals who have premature ventricular complexes.

b. **Changing the Risk Factor.** Some risk factors cannot be changed: age, sex, race, and heredity. Other major risk factors, however, can be changed: cigarette smoking, hypertension, diabetes, and elevated cholesterol levels. The most important single cause of preventable death in the United States (US) is cigarette smoking. This habit begins and contributes to arteriosclerosis, myocardial infarction, and sudden death. Those who stop smoking return to the level of nonsmokers very rapidly. Hypertension (high arterial blood pressure) contributes to coronary artery disease, stroke, and heart failure. Control of hypertension makes a difference on whether or not a person survives cardiovascular problems. Research indicates that high total cholesterol levels increase the risk of coronary artery disease. Diet modification can lower the total cholesterol level thus decreasing the incidence of heart disease. A change to positive health behaviors can decrease the risk factors of cardiovascular problems.

3-9. MAJOR SIGNS OF CARDIAC ARREST

Cardiac arrest, the cessation of heartbeat, can occur for a variety of reasons. The major signs that the heart has stopped beating include sudden loss of consciousness, absence of pulse and respirations, cyanosis, and dilated pupils. Additionally, the dysrhythmias of cardiac arrest seen on a monitor include the following:

a. Ventricular fibrillation--an irregular and chaotic ventricular arrhythmia with a rapid rate and disorganized spread of impulses throughout the ventricular myocardium.

b. Ventricular tachycardia--abnormally rapid ventricular rate with broad QRS complexes and a rate between 100 and 200 beats per minute.

c. Asystole--absence of heartbeat.

d. Severe brady dysrhythmia--abnormally slow heartbeat with atrial and ventricular beats less than 60 beats per minute.

3-10. COMPONENTS OF THE DEFIBRILLATOR (LIFEPAK 5)

The defibrillator (Lifepack 5) is made up of these parts:

a. The electrocardiography monitor module (module and recorder).

b. A direct current (DC) defibrillator module with synchronizer. This piece of equipment has a charge time of 400 joules in 12.5 seconds and can deliver an electrical charge of 20, 30, 50, 100, 200 or 360 joules.

c. Patient cables.

d. A battery pack charger to recharge two batteries in 4 1/2 hours.

e. A nickel cadmium battery (the power source) which provides a minimum of twelve 360-joule discharges and 30 minutes of recorder use.

Section III. MAJOR MANAGEMENT TECHNIQUES OF CARDIAC ARREST

3-11. MONITORED CARDIAC ARREST

Monitored cardiac arrest is cardiac arrest (the cessation of heartbeats) that occurs when an electrocardiogram (EKG or ECG) is monitoring the casualty. Someone checking the monitor sees that the rhythm of the casualty's heart has changed to ventricular fibrillation. Ventricular fibrillation is a serious type of electrical failure in the heart. A ventricle receives extremely rapid, uncoordinated electrical signals that keep the heart from relaxing fully. When this happens in a ventricle, the affected part of the heart is unable to pump blood. An electric shock, if given in time, may cause the heart to beat again in normal rhythm. Follow this procedure to treat monitored cardiac arrest:

a. **Verify That There Is No Pulse.** Physically check for carotid pulse. Check the electrocardiogram equipment quickly to make sure that the problem is not just interference on the monitor due to cable or patient movement. If there is no pulse, do the next step.

b. **Perform Precardial Thump.** Using the fleshy part of your closed fist, deliver a thump eight to twelve inches above the sternum. This thump decreases the unreliability of the heart muscle and makes it less likely that the heart will start fibrillating. If this maneuver results in sinus rhythm (normal heart rhythm) with a pulse, proceed with lidocaine therapy. The dosage of lidocaine depends on the patient's condition. Usually, the dosage is I mg/kg with additional bolus injection of 0.5 mg/kg every 2 to 10 minutes, if needed, to a total dose of 3 mg/kg. The maintenance dosage is 2 to 4 mg.

c. **Defibrillate If Ventricular Fibrillation Persists.** Use an electrical charge of 200 joules. Give a nonsynchronized DC countershock. If 200 joules is unsuccessful, try 200 to 300 joules, then 360 joules, then CPR.

d. **Initiate Cardiopulmonary Resuscitation And Drug Therapy.** See Section IV and Section V of Lesson 1, Basic Cardiac Life Support.

e. **Procedure.** Proceed as you would for an unmonitored cardiac arrest. Refer to paragraph 3-12, UNMONITORED CARDIAC ARREST.

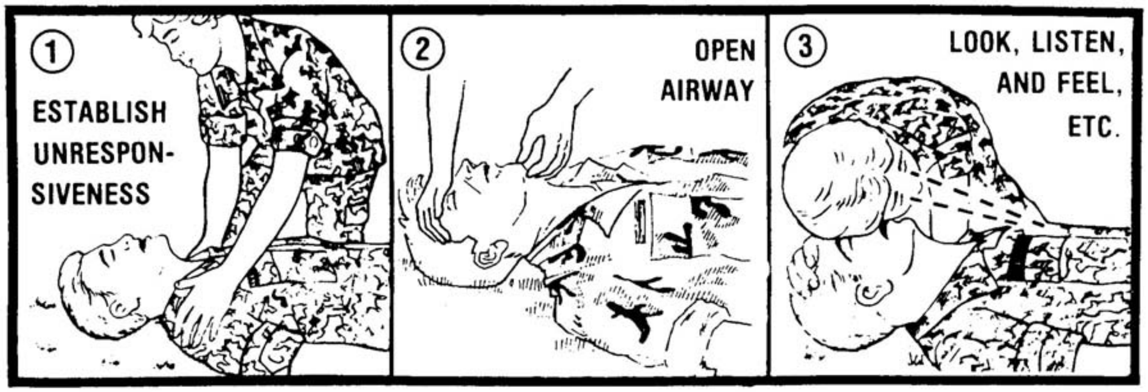


Figure 3-4. Cardiopulmonary resuscitation.

Figure 3-5. Basic cardiac life support.

3-12. **UNMONITORED CARDIAC ARREST**

Unmonitored cardiac arrest is cardiac arrest that occurs when the patient is not being monitored. Additionally, a defibrillator is not immediately available. Follow this procedure:

a. Initiate basic cardiac life support while a monitor defibrillator is being brought to the scene.

b. Take a "Quick-look" at the cardiac rhythm.

(1) Check to ensure that power is on and the oscilloscope (the instrument which shows electrical variations of the heartbeat on a screen) is functional (showing a line).

(2) Apply conductive media to paddles.

(3) Stop compressions.

(4) Use standard paddle placement to determine cardiac rhythm.

c. Defibrillate if <u>ventricular fibrillation</u> occurs.

(1) Set the electric charge 200 joules or according to panel instructions.

(2) Ensure that the paddles are firmly placed on the patient's chest with about 25 pounds of pressure.

(a) Place the negative paddle to the right of the upper sternum and below the right clavicle.

(b) Place the positive paddle below and to the left of the patient's left nipple.

(c) Apply downward pressure to each paddle.

(d) Remember that poor contact with the patient's skin will cause him to get burned when the machine is fired.

(e) Yell "Stand clear!" making sure that no one is directly or indirectly in contact with the patient.

(3) Administer a nonsynchronized countershock by pressing the discharge buttons on each paddle simultaneously.

(4) Release the thumb pressure from the discharge buttons.

(5) Check the cardiac rhythm.

(6) Check for a pulse.

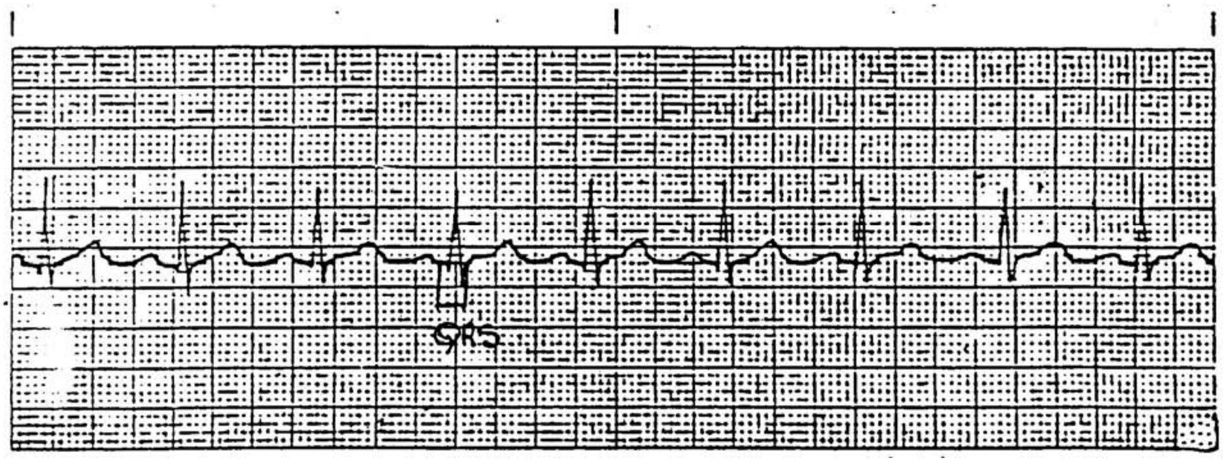


Figure 3-6. Normal cardiac rhythm.

(7) If the rhythm is adequate, check the carotid pulse to see if the pulse is associated with the rhythm shown on the oscilloscope. Also, check the vital signs and remain with the patient until he is evacuated.

d. If ventricular fibrillation continues, give a third countershock at 360 joules immediately.

e. If there is no pulse, this countershock has not been successful. Resume CPR.

f. Establish an effective airway. (Endotracheal intubation is preferable.)

g. Establish an intravenous (IV) line. (Two lines are preferable.)

h. Administer drug therapy as clinically indicated. Epinephrine (adrenalin) in a 1:10,000 solution in the dosage 0.5 to 1 mg may be injected intravenously and repeated at five minute intervals, if necessary. Give endotracheally if an IV line cannot be established quickly.

i. If ventricular fibrillation still continues, administer the third countershock. Use an energy load of not more than 360 joules. Stop CPR before the countershock and resume CPR after the countershock, if necessary.

j. Administer other drug therapy as clinically indicated. Include lidocaine (Xylocaine) 50 to 100 mg IV push.

CAUTION: Do not exceed 225 mgs of lidocaine.) Also, include bretylium tosylate (Bretylol) in the dosage 5 mg/kg IV bolus if lidocaine is ineffective.

k. If ventricular tachycardia (ventricles beating together but very fast) is seen with "Quick-look" paddles, follow this procedure:

(1) Administer lidocaine in the dosage 50 to 100 mg IV bolus.

(2) If the patient is coping with the rhythm, perform synchronized cardioversion with an electrical charge of 50 joules, a low energy charge. The object is to try to shock the ventricles into normal rhythm.

NOTE: Sedate the casualty who is awake if there is time.

(3) If synchronized cardioversion is ineffective, repeat cardioversion.

NOTE: These definitions are important to remember. Synchronized cardioversion is a timed electro shock delivered to a patient, the shock triggered by the R wave of the patient's electrocardiogram. Defibrillation is a non-timed electro shock delivered to a patient.

(4) Continue treatment as for unmonitored ventricular fibrillation, but cardiovert rather than defibrillate.

l. If asystole (absence of heartbeat) is seen with "Quick-look" paddles, follow this procedure:

(1) Begin/continue cardiopulmonary resuscitation.

(2) Insert an endotracheal tube or an esophageal airway for optimal ventilation.

(3) Start an IV infusion.

NOTE: Defibrillation is NOT used with asystole because there is no electrical activity in the heart to correct.

(4) Give 0.5 mg to 1 mg intravenously of epinephrine.

(5) Administer 1.0 mg of atropine intravenously. Repeat one time in 5 minutes.

(6) Repeat epinephrine at five minute intervals.

(7) In rare instances, a temporary pacemaker can be used to restore the paced rhythm of the heart.

m. If there is electromechanical dissociation (organized electrical activity without myocardial contraction) when the patient's cardiac rhythm is NOT correlated with his pulse, use these procedures:

(1) Administer CPR with optimal ventilation. Open the airway and blow into the patient's mouth to begin the process of restoring breathing and heartbeat.

(2) Administer epinephrine. The recommended dosage is 0.5 mg to 1.0 mg (5 to 10 ml of a 1:10,000 solution) given intravenously. Repeat every five minutes during resuscitative efforts. DO NOT administer epinephrine in the same intravenous line as alkaline solutions such as sodium bicarbonate.

n. If electromechanical dissociation persists, give additional doses of epinephrine at time intervals and as clinical judgment dictates.

NOTE: Previously, sodium bicarbonate was recommended in the treatment of cardiac arrest. Currently, there is controversy over this drug's benefit. Therefore, use sodium bicarbonate only after you have tried therapies such as defibrillation, cardiac compression, intubation, epinephrine, and antiarrhythmics have been tried without success.

o. The causes of electromechanical dissociation must be considered. Correctable causes include hypovolemia, cardiac tamponade, tension pneumothorax, hypoxemia, and acidosis. Less correctable cause of EMD include massive myocardial damage from miocardial infarction, prolonged ischemia during resuscitation, and pulmonary embolism.

SECTION IV. CARDIOVERSION

3-13. ATTACH THE PATIENT TO THE CARDIAC MONITOR

Follow this procedure:

a. Rub the electrode site with an alcohol pad to remove oil and dead tissue from the surface. (Shave hair if necessary.)

b. Apply conductive paste or gel to the electrodes and attach the electrodes to the chest.

CAUTION: Never use alcohol on electrodes. Alcohol could ignite and burn the patient.

Figure 3-7. Electrode placement.

c. Use "Lead II" placement for the electrodes to measure the electrical output of the heart.

(1) Place the positive electrode below the left pectoral muscle.

(2) Place the negative electrode below the right clavicle.

(3) Place the ground electrode below the right pectoral muscle or below the left clavicle.

d. Attach the electrodes to the patient's monitoring cable.

3-14. PERFORM CARDIOVERSION PROCEDURE

Synchronized cardioversion is the use of the DC defibrillator to stop abnormal cardiac rhythms other than ventricular fibrillation. The procedure to follow is the same as for defibrillation with these exceptions:

a. The doctor may order diazepam (Valium) for a conscious patient.

b. The QRS complex on the monitor must be upright with maximum R-wave.

(1) P is a small positive deflection seen on the oscilloscope occurring right before Q. P represents the atria depolarization.

(2) Q is a negative (downward) deflection.

(3) R is the positive (upward) deflection and the highest point seen on the oscilloscope.

(4) S is a negative (downward) deflection seen on the oscilloscope.

(5) T is the positive deflection seen on the oscilloscope occurring after QRS complex. T represents the repolarization of the heart.

c. Switch on the synchronizer.

d. Yell, "Clear." before beginning.

e. Administer the initial shock of 200 joules. Some abnormal rhythms may be converted with shocks as low as 10 joules.

f. Press and hold the discharge buttons on the paddles until the defibrillator delivers the countershock.

g. If the initial countershock is not successful, use higher levels of energy on the next countershock.

h. If ventricular fibrillation occurs, follow this procedure:

(1) Turn off the synchronizer.

(2) Charge to between 200 to 300 joules.

(3) Defibrillate.

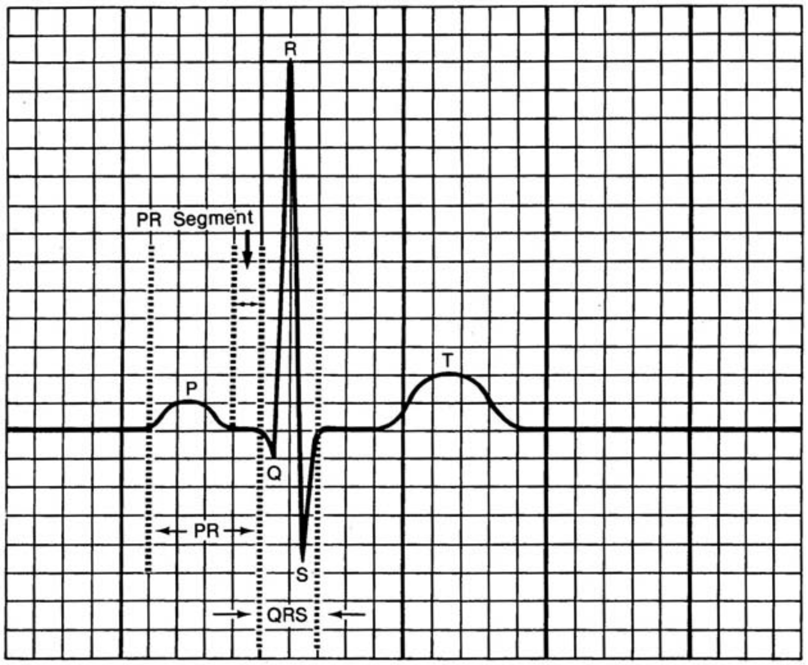


Figure 3-8. Electrocardiogram.

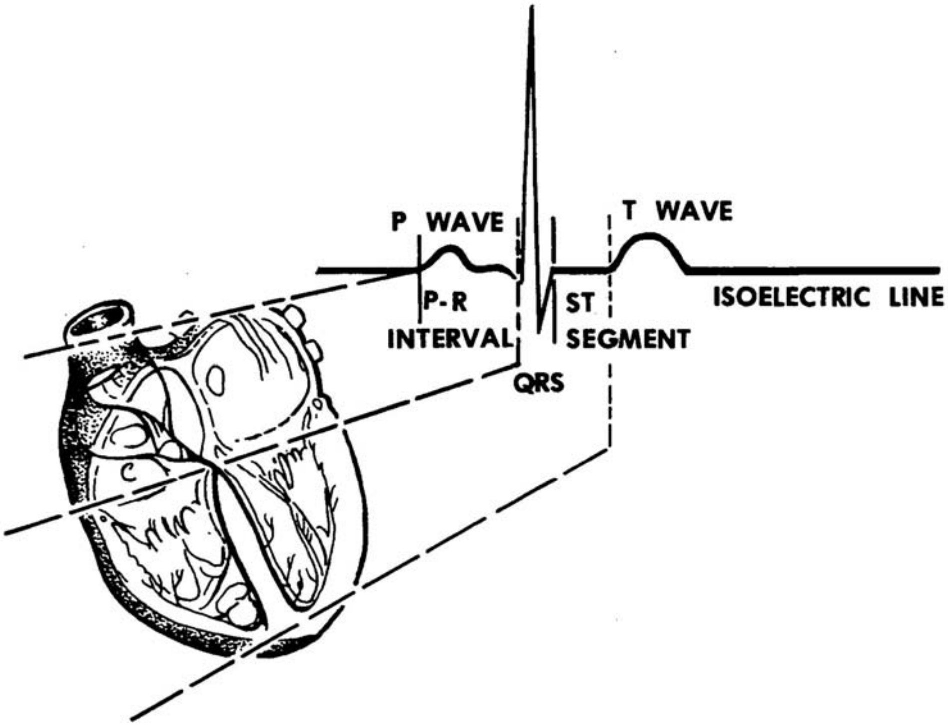


Figure 3-9. Electrocardiogram waves.

3-15. **CONCLUSION**

To prevent or treat a cardiac arrest effectively, you must first be able to recognize the problem and then apply the skills necessary for safe and effective management. Each situation presents a life or death series of decisions that must be varied to suit the patient. The guidelines you have learned in this lesson will be of valuable assistance to you in treating cardiac arrest.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS: The following exercises are to be answered by completing the incomplete statement or by writing the answer in the space provided at the end of the question. After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. List the three primary causes of cardiac arrest.

   a. ____.

   b. ____.

   c. ____.

2. List four groups of persons who are likely to have cardiac arrest.

   a. ____.

   b. ____.

   c. ____.

   d. ____.

3. Sudden loss of consciousness, absence of pulse and respirations, cyanosis, and dilated pupils are major signs that ______________________________________.

4. The ECG monitoring has been started, but now the patient's heartbeat rhythm has deteriorated to ventricular fibrillation (monitored) or asystole. This is called ____ cardiac arrest.

5. The patient is not being monitored and suffers cardiac arrest. This is called _____________________________________ cardiac arrest.

6. You witness a cardiac arrest. The patient is being monitored on an ECG. Why should you verify pulseness?

____

____

7. These are the steps in managing monitored cardiac arrest. The steps are NOT in the order in which they would be performed. Choose the response which lists the steps in the order of performance.

   1. Initiate CPR.

   2. Perform precardial thump.

   3. Defibrillate if ventricular fibrillation persists.

   4. Verify pulselessness.

   5. Proceed as for unmonitored cardiac arrest.

   a 1,2,4,3,5.

   b. 4,2,3,1,5.

   c. 1,3,2,4,5.

   d. 4,1,5,3,2

8. The following statements are steps in managing unmonitored cardiac arrest. Fill in the blanks.

   a. Begin the procedure by initiating basic cardiac life support while __________ is being brought to the scene.

   b. Take a "Quick-look" at the _____________________________.

   c. If ventricular fibrillation occurs, ___________________________.

   d. If ventricular fibrillation continues, _________________________.

   e. If this is not successful, _________________________________.

   f. Next, set up _______________________________.

9. These are steps in getting ready to defibrillate a patient who is having ventricular fibrillation.

   a. Where do you place the negative paddle? ______________________________

   ____

   b. Where do you place the positive paddle? ______________________________

   ____

   c. If the paddles have poor contact with the patient's skin, what will happen when the machine fires?

   ____

   d. Before administering the countershock by pressing the discharge buttons on the machine, what should you do?

   ____

10. List one drug to be administered initially if drug therapy is indicated in

    unmonitored cardiac arrest. ____

11. List two drugs to be administered if the patient is having ventricular tachycardia after the third countershock in unmonitored cardiac arrest.

    a. ____.

    b. ____.

12. The "Quick-look" paddles indicate that the patient is suffering from ventricular tachycardia. You will follow these steps:

    a. Administer________________________________. (Name the drug.)

    b. Perform ____________________________________ cardioversion.

    c. Repeat cardioversion if __________________________ is ineffective.

    d. Continue as for unmonitored ventricular fibrillation, but ___________________ rather than defibrillate.

13. Why isn't defibrillation used on the patient with asystole?

____

14. What is electromechanical dissociation?

____

15. How is electromechanical dissociation determined?

____.

16. What is cardioversion? ____

____.

17. You are performing cardioversion on a patient with cardiac arrest and ventricular fibrillation occurs. List three things you must do immediately.

a. ____.

b. ____.

c. ____.

18. The figure below shows an electrocardiogram representation of one heartbeat. Components of the electrocardiogram are marked with the letters A, B, C, D, E, F, G, and H. Opposite each letter write the letter name of the component as shown in the first blank line.

* A = P wave

* B = ______

* C = ______

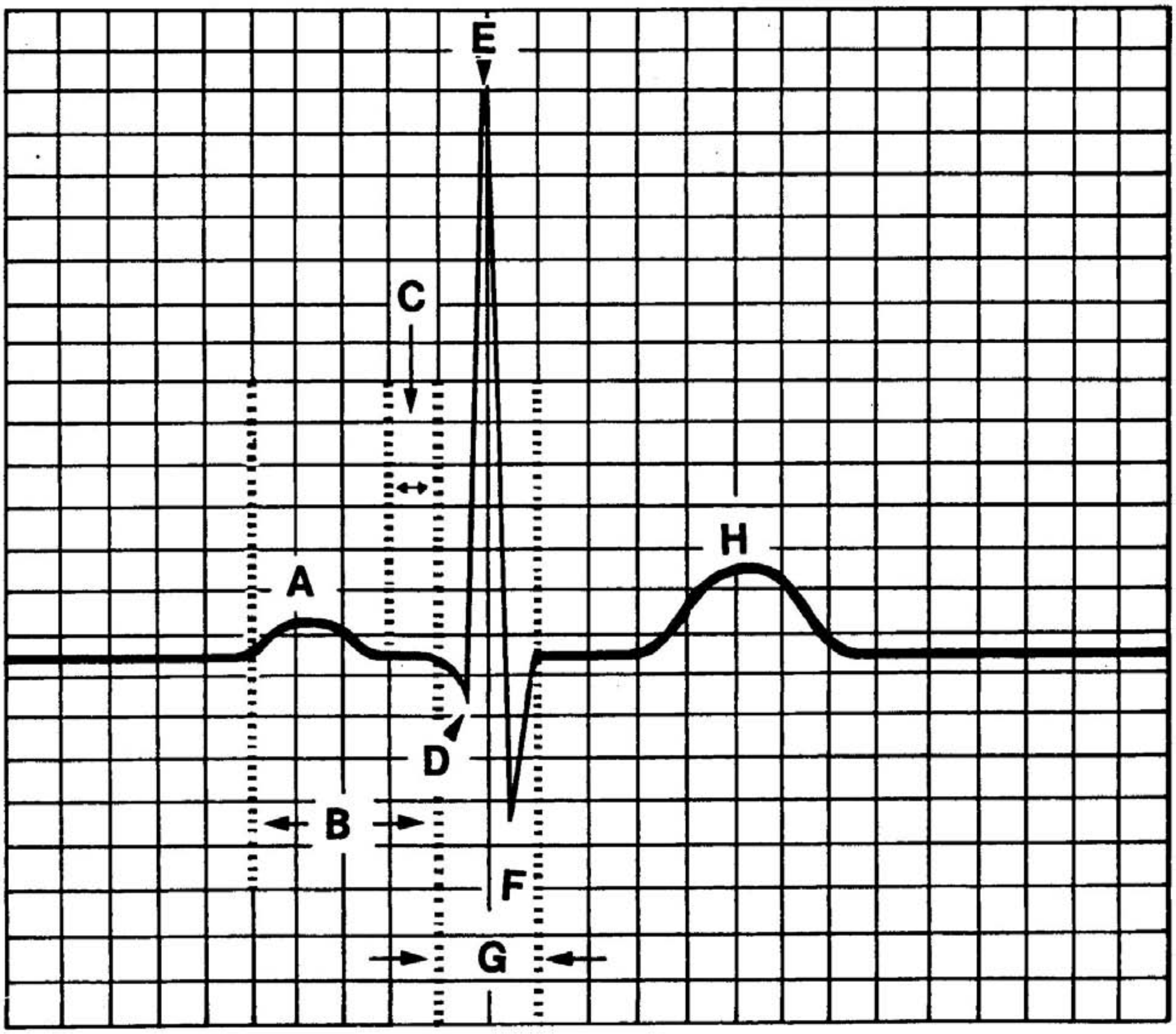
* D = ______

* E = ______

* F = ______

* G = ______

* H = ______



Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. You are correct if you listed any three of the following:

   - Results of cardiovascular diseases.
   - Respiratory diseases.
   - Central nervous system disease.
   - Digestive disease.
   - Urogenital disease.
   - Hyperkalemia.
   - Electrical burns.
   - Metabolic disorders.
   - Trauma to chest.
   - Pulmonary embolism.
   - Intracerebral hemorrhage.
   - Coronary artery spasm.

   (para 3-7)

2. You are correct if you listed any four of the following:

   - Older people.
   - People with family history of arteriosclerosis.
   - People with elevated blood cholesterol.
   - Patients with hypertension.
   - Diabetes mellitus sufferers.
   - Cigarette smokers.
   - Patients with preexisting heart disease.
   - People with premature ventricular complexes.

   (paras 3-8a and b)

3. The heart has stopped beating. (para 3-9)

4. Monitored. (para 3-11)

5. Unmonitored. (para 3-12)

6. Verify pulselessness to be sure there really is no pulse rather than just monitor interference because of cable or patient movement. para 3-11a)

7. b (paras 3-11a through e)

8. a. A monitor defibrillator.
   b. Cardiac rhythm.
   c. Defibrillate.
   d. Give a second countershock.
   e. Resume CPR.
   f. An effective airway. (para 3-12a through f)

9. a. Place the negative paddle to the right of the upper sternum and below the right clavicle.
   b. Place the positive paddle below and to the left of the patient's left nipple.
   c. The patient's skin will be burned.
   d. Yell "Stand clear!" and make sure no one has direct or indirect contact with the patient. (paras 3-12c(2)(a) through (e))

10. Epinephrine. (para 3-12h)

11. Lidocaine.
    Bretylium tosylate. (para 3-12j)

12. a. Lidocaine.
    b. Synchronized.
    c. Synchronized cardioversion.
    d. Cardiovert. (paras 3-12k(1) through (4))

13. Defibrillation is used when there is electrical activity in the heart. In asystole, there is no electrical activity in the heart; therefore, defibrillation is not used. (para 3-12l(3) NOTE)

14. Electromechanical dissociation is organized electrical activity without myocardial contraction. (para 3-12m)

15. Electromechanical dissociation is determined by correlating the cardiac rhythm to the patient's pulse. (para 3-12m)

16. Cardioversion is the use of the defibrillator to end abnormal cardiac rhythms, other than ventricular fibrillation. (para 3-14)

17. Turn off the synchronizer.
    Charge to between 200 to 300 joules.
.   Begin defibrillation procedures. (paras 3-14h(1) through (3))

18. A = P wave

    B = P-R

    C = PR segment

    D = Q wave

    E = R wave

    F = S wave

    G = QRS complex

    H = T wave

    (paras 3-14b(1) through (5) and figure 3-9)

End of Lesson 3