CHAPTER 21

EMERGENCY MEDICAL CARE PROCEDURES

INTRODUCTION

For a Navy Corpsman, the terms "first aid" and "emergency medical procedures" relate to the professional care of the sick and injured before in-depth medical attention can be obtained. Appropriate care procedures may range from providing an encouraging word to performing a surgical cricothyroidotomy to open a patient’s airway. Always remember, however, that first aid measures are temporary expedients to save life, to prevent further injury, and to preserve resistance and vitality. These measures are not meant to replace proper medical diagnosis and treatment procedures. Hospital Corpsmen (HMs) will be able to provide the competent care that makes the difference between life or death, temporary or permanent injury, and rapid recovery or long-term disability if they:

- Understand the relationship between first aid and proper medical diagnosis and treatment
- Know the limits of professional care that HMs can offer
- Keep current on emergency medicine procedures to include:
  - Conducting routine practical scenarios
  - Attending emergency medical and trauma courses of instruction
  - Keeping abreast of new emergency medical equipment

The intent of this chapter is to provide the user a reference to use in the training and performance of certain emergency situations. It was written to provide a quick overview and step by step assessment guidelines to follow in the most emergent situations HMs routinely encounter. The information is based on current practices, as of the date of publishing, as well as lessons learned from combat operations in Iraq and Afghanistan.

There may be operational limitations and local protocols dictated by the General Medical Officer / Medical Director that may require the HM to alter medications or certain procedures. Remember, the Hospital Corpsman Pledge is always in effect.

LAW OF ARMED CONFLICT

The law of armed conflict encompasses all international law regulating the conduct of nations and individuals engaged in armed conflict. As world tension increases, so does the potential for armed conflict. As members of a force dedicated to prevent such a conflict, HMs as medical personnel must face the reality of becoming involved. A basic understanding of the principles and applications of the law of armed conflict will help enhance efforts in providing the best medical care possible while maintaining our moral and ethical obligation.

A combatant is anyone participating in military operations or activities. Generally, this means members of a military force with certain exceptions, and civilian personnel who are actually engaged in hostilities. Noncombatants include all others including civilians not engaged in hostilities, medical personnel, chaplains, other persons captured or detained, and people who surrender, are captured, shipwrecked, sick, or wounded.

GENERAL FIRST AID RULES

LEARNING OBJECTIVE:

Explain general first aid rules.

There are a few general first aid rules that HMs should follow in any emergency:

- Maintain breathing
- Stop bleeding/maintain circulation
- Prevent or treat for shock
Mental preparation is an often overlooked aspect of emergency care. While it is possible to provide life-like training and scenarios to HMs, there is no substitute for being able to handle a real emergency. The HM can take steps in order to prepare for the stressors encountered as a result of a severe trauma or medical scene.

1. Regular exercise and a healthy lifestyle will allow the HM’s body to better handle the physical symptoms it will experience resulting from stress.

2. Keeping abreast of current medical procedures and emergency medicine procedures will keep the HM mentally prepared.

3. Keeping current with the latest and greatest medical equipment and how to operate the equipment at the command is vitally important. As emergency responders, HMs have a large dependence on medical equipment. It is essential that the HM knows the location, function and application of the medical gear to be used. On the way to the scene IS NOT THE TIME to get familiar with the gear.

4. Know the surroundings and the resources available. It is important to think and plan at least three steps ahead. For example: All injured patients are going to be moved to a certain location. What resources will be needed to move the patients; will extra people be needed to help carry the patients or extra gear? These are just a couple of questions to ask before an operation begins or an injury occurs.

These are a few guidelines to keep in mind while reading this chapter. More detail will be provided in the following sections.

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**TRIAGE**

**LEARNING OBJECTIVE:**

Explain the procedures for tactical and non-tactical triage.

_Triage_, a French word meaning "to sort", is the process of quickly assessing patients in a multiple-casualty incident and assigning patients a priority (or classification) for receiving treatment according to the severity of the illness or injury. In the military, there are two types of triage, **tactical** and **non-tactical**, and each type uses a different set of prioritizing criteria.

The person in charge is responsible for balancing the human lives at stake against the realities of the tactical situation, the level of medical consumable resources on hand, and the realistic capabilities of medical personnel on the scene. Triage is a dynamic process, and a patient’s priority is subject to change as the situation progresses.

**SORTING FOR TREATMENT**

In civilian or non-tactical situations, sorting of casualties from a multiple casualty incident is slightly different from combat situations. There are four basic classes (priorities) of injuries, and the order of treatment of each is different.

**Priority I - Immediate.**

Casualties whose injuries are critical but who will require only minimal time or equipment to manage and who have a good prognosis for survival. An example is the casualty with a compromised airway or massive external hemorrhage.
Priority II - Delayed

Casualties whose injuries are debilitating but who do not require immediate management to salvage life or limb. An example is the casualty with a long bone fracture.

Priority III - Minor

Casualties, often called the “walking wounded” who have minor injuries that can wait for treatment or who may even assist in the interim by comforting other casualties or helping as litter bearers.

Priority IV - Expectant

Casualties whose injuries are so severe that they have only minimal chance of survival. An example is the casualty with a 90% full-thickness burn and thermal pulmonary injury.

Priority V - Dead

Casualties who are unresponsive, pulseless and breathless. In a disaster, resources rarely allow for attempted resuscitation of cardiac arrest casualties.

Next follows a simple non-tactical triage algorithm to assist HMs in non-tactical situations to make objective determinations about a patient’s triage category and subsequent treatment and transportation requirements (Fig 21-1).

Figure 21-1.—START Triage Algorithm (Courtesy Newport Beach Fire Department, Newport Beach, CA)

Triage in the tactical environment is very different due to the environmental and human hazards, i.e. bullets and ordnance.

Please note the differences as noted in the Tactical Combat Casualty Care (TCCC) Triage categories table below (Table 21-1). Review the TCCC Triage Algorithm as well (Fig. 21-2).

<table>
<thead>
<tr>
<th>Triage Category</th>
<th>Category Description</th>
<th>Examples</th>
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| Immediate       | This group includes those that require lifesaving surgery. The surgical procedures in this category should not be time-consuming and should concern only patients with high chances of survival. | Upper airway obstruction  
Severe respiratory distress  
Life-threatening bleeding  
Tension pneumothorax  
Extensive 2nd or 3rd degree burns  
Untreated poisoning(chemical agent) with severe symptoms  
Heat stroke  
Decompensated Shock  
Rapidly deteriorating level of consciousness  
Any other rapidly deteriorating life-threatening condition |
| Delayed         | This group includes those wounded who are badly in need of time-consuming surgery, but whose general condition permits delay in surgical treatment without unduly endangering life. Sustaining treatment will be required. | Compensated shock  
Fracture, dislocation, or injury causing circulatory compromise  
Severe bleeding, controlled by a tourniquet or other means  
Penetrating head, neck, chest, back, or abdominal injuries without airway or breathing compromise or decompensated shock  
Severe combat stress symptoms or psychosis |
| Minimal         | These casualties have relatively minor injuries and can effectively care for themselves or can be helped by non-medical personnel. | Uncomplicated closed fractures and dislocations or minor lacerations  
Frostbite  
Strains and sprains  
Minor head injury (loss of consciousness of less than 5 minutes with normal mental status and equal pupils) |
| Expectant       | Casualties in this category have wounds that are so extensive that even if they were the sole casualty and had the benefit of optimal medical resource application, their survival would be unlikely. Using a minimal but competent staff, provide comfort measures for these casualties. | Traumatic cardiac arrest  
Massive Brain Injury  
2nd or 3rd degree burns over 70% of the body surface area (BSA)  
Gunshot wound to the head with Glasgow Coma Scale of 3 |

Table 21-1.—TCCC Triage Categories
Figure 21-2.—Triage Algorithm for Tactical Combat Casualty Care
**AIRWAY MANAGEMENT**

**LEARNING OBJECTIVE:**
*Perform airway management using simple and advanced airway adjuncts.*

**OPEN THE AIRWAY**

**Scenario**

The HM is evaluating a casualty who is not breathing.

**Objective**

Complete all of the steps required to open the casualty's airway without causing unnecessary injury.

**Performance Steps**

Take *Body Substance Isolation (BSI)* precautions.

*Recovery Position* for patients who are unconscious or who have an altered level of consciousness (LOC), i.e. return of spontaneous breathing after rescue breathing:

1. Roll the casualty onto his or her back if necessary.
   a. Kneel beside the casualty.
   b. Raise the near arm and straighten it out above the head.
   c. Adjust the legs so that they are together and straight or nearly straight.
   d. Place one hand on the back of the casualty's head and neck.
   e. Grasp the casualty under the arm with the free hand.
   f. Pull steadily and evenly toward yourself, keeping the casualty's head and neck in line with the torso.
   g. Roll the casualty as a single unit.
   h. Place the casualty's arms at his or her side.

**NOTE:**
The following steps are employed when the HM must secure a patent (open) airway and either establish or maintain breathing.

2. Establish the airway using the head-tilt/chin-lift or jaw thrust method.
   a. **Head-tilt/chin-lift maneuver.**

   **CAUTION:**
   Do not use this method if a spinal injury is suspected.

   **NOTE:**
   Remove any foreign material or vomit seen in the mouth as quickly as possible.

   i. With the casualty in a supine position, the HM positions beside the casualty's head along one side of the body.
   ii. Place one hand on the casualty's forehead and apply firm, backward pressure with the palm of the hand to tilt the head back.
   iii. Place the tips of the fingers of the other hand under the lower jaw near the bony part of the casualty's chin.
   iv. Lift the chin upward, bringing the entire lower jaw with it, helping to tilt the head back.

   **CAUTION:**
   Do not use the thumb to lift the lower jaw.

   Do not press deeply into the soft tissue under the chin with the fingers.

   Do not completely close the casualty's mouth.

**CAUTION:**
Use this method if a spinal injury is suspected.

**WARNING:**
Do NOT place suspected spinal injury patients in the recovery position.

i. Kneel above the supine casualty's head. Rest elbows on the surface on which the casualty is lying.

ii. Carefully reach forward and gently place one hand on each side of the casualty's lower jaw, at the angles of the jaw below the ears.

iii. Stabilize the casualty's head with the forearms.

iv. Using the index fingers, push the angles of the casualty's lower jaw forward.

v. Use the thumbs to help position the lower jaw to allow breathing through the mouth as well as the nose.

vi. The completed maneuver should open the airway with the mouth slightly open and the jaw jutting forward.

**CAUTION:**
Do not tilt or rotate the casualty's head.

3. Check for breathing within 3 to 5 seconds. While maintaining the open airway position, place an ear over the casualty's mouth and assess the breathing using the "look, listen, and feel" technique.
   a. Look for the chest to rise and fall.
   b. Listen for air escaping during exhalation.
   c. Feel for the flow of air on the side of the face.

4. Take appropriate action.
   a. If the casualty resumes breathing on his or her own, maintain the airway and (if no spinal injury is assessed or suspected) place the casualty in the recovery position.
      i. Roll the casualty as a single unit onto his or her side.
      ii. Place the hand of the upper arm under the chin.
      iii. Flex the upper leg.

   **NOTE:**
   Continue the initial assessment to check the casualty for other injuries.

   b. If the casualty does not resume breathing, perform rescue breathing.

**PERFORM ORAL AND NASOPHARYNGEAL SUCTIONING OF A PATIENT**

**Scenario**

The HM is managing a patient that requires suctioning.

**Objective**

Perform oral or nasopharyngeal suctioning to clear the airway without causing injury to the patient.
Performance Steps

**CAUTION:**
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Position the patient in a semi-Fowler's (semi-sitting) position or, in the case of severe trauma, roll the patient onto his side to allow gravity to assist in clearing the airway.

**NOTE:**
In some cases, such as spinal injuries, the patient must remain in whatever position they are initially found or must be managed while they are immobilized on a long spine board.

2. Check the suction unit for proper assembly of all its parts.

3. Turn on the assembled unit and check to see if it is operational.

**NOTE:**
Inspect the suction unit regularly to ensure it is in working condition. Switch on the suction, clamp the tubing, and make certain the unit generates a vacuum of more than 300 mm Hg. Check that a battery-charged unit has charged batteries.

4. Select the appropriate catheter and attach it to the suction tubing.

   a. Tonsil-tip (Yankauer) catheters are best for suctioning in the field, as they have wide diameter tips and are somewhat rigid.

   b. Flexible (French, or whistle-tip) catheters are used in situations where rigid catheters cannot be used, such as a patient with clenched teeth or for use in nasopharyngeal suctioning.

5. Prepare equipment.
   a. Open the basin package.
   b. Pour the saline solution into the basin.
   c. Open the suction catheter package.

6. Explain to the patient the reason for suctioning.

7. Pre-oxygenate the patient with 100% oxygen.
   a. If the patient is receiving oxygen therapy, increase the oxygen to 100% for 1 minute.
   b. Monitor the patient's pulse oximeter reading during the entire procedure.
   c. If the patient is not receiving oxygen therapy, have him take a minimum of five deep breaths or administer the breaths with a bag-valve-mask (BVM) system.

**NOTE:**
After each suctioning attempt or suctioning period, re-oxygenate the patient.

8. Remove the catheter from the package using the dominant hand.

9. Test the patency of the catheter.
   a. Turn the suction unit on with the non-dominant hand.
   b. Insert the catheter tip into the saline solution using the dominant hand.
   c. Occlude the suction control port with the non-dominant thumb and observe the saline entering the drainage bottle.

**NOTE:**
If no saline enters the bottle, check the suction unit and or replace the catheter and retest for patency.
10. Suction the patient.
   a. **Oral route.**
      i. **Rigid catheter.**
         1. Instruct a conscious patient to cough to help bring secretions up to the back of the throat.
         2. If the patient is unconscious, use the cross finger method of opening the airway.
         3. Place the convex (outward curving) side of the rigid tip against the roof of the mouth and insert to the base of the tongue.

         **NOTE:**
         A rigid tip does not need to be measured. Only insert the tip as far as YOU can see it. Be aware that advancing the catheter too far may stimulate the patient's gag reflex and cause vomiting.

         4. Apply suction by placing the thumb of the non-dominant hand over the suction control port.

         **WARNING:**
         Never suction for more than 15 seconds at one time for adults, 10 seconds for children, and 5 seconds for infants. Longer periods of continuous suctioning may cause oxygen deprivation and subsequent hypoxic injury to the brain.

         5. Clear the secretions from the catheter between each suctioning interval by inserting the tip into the saline solution and suction the solution through the catheter until the catheter is clear of secretions.

         6. Repeat steps 10-a-i-1 through 10-a-i-5 until all secretions have been removed or until the patient's breathing becomes easier. Noisy, rattling or gurgling sounds should no longer be heard.

   ii. **Flexible catheter.**
      1. Measure the catheter from the patient's earlobe to the corner of the mouth or the center of the mouth to the angle of the jaw.
      2. Insert the catheter into the patient's mouth to the correct depth, without the suction applied.

         **NOTE:**
         If an oropharyngeal airway (OPA) is in place, insert the catheter alongside the airway and then back into the pharynx.

         3. Place the thumb of the non-dominant hand over the suction control port on the catheter, applying intermittent suction by moving the thumb up and down over the suction control port.

         4. Apply suction in a circular motion while withdrawing the catheter.

         5. Suction for no longer than 15 seconds removing secretions from the back of the throat, along outer gums, cheeks, and base of tongue.

         **WARNING:**
         Advancing the catheter too far into the back of the patient's throat may stimulate the gag reflex. This could cause vomiting and the aspiration of stomach contents.

         6. Clear the secretions from the catheter between suctioning by inserting the tip into the saline solution and suction the solution through the catheter until the catheter is clear of secretions.

         7. Repeat steps 10-a-ii-1 through 10-a-ii-6 until all secretions have been removed or until the patient's breathing becomes easier. Noisy, rattling or gurgling sounds should no longer be heard.
If the patient is uncooperative or oral entry is not possible due to facial trauma, nasopharyngeal suctioning may be required.

b. Nasopharyngeal route.
   i. Measure the flexible catheter from the tip of the earlobe to the nose.
   ii. Lubricate the catheter by dipping the tip into the saline solution.
   iii. Insert the catheter into one nostril without suction applied. If an obstruction is met, try the other nostril.
   iv. Quickly and gently advance the catheter 3 to 5 inches.
   v. Perform steps 10-a-ii-3 through 10-a-ii-5 to suction secretions.

11. Re-oxygenate the patient and or ventilate for at least five assisted ventilations.

12. Observe the patient for hypoxemia.
   a. Color change.
   b. Increased or decreased pulse rate.

NOTE: If the measurement from the ear lobe to the corner of the casualty's mouth is equivalent to the depth of insertion in the airway.

CAUTION:
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

WARNING:
Use an OPA for an unconscious casualty only. Do not use an OPA on a conscious or semiconscious casualty because there may still be an active gag reflex. In such cases, a nasopharyngeal airway (NPA) would be more appropriate. An OPA should not be used in children who may have ingested a caustic or petroleum-based product, as it may induce vomiting.

1. Select the appropriate size of OPA, have three from which to choose.
   a. Place the airway beside the outside of the casualty's jaw.
   b. Measure from the casualty's ear lobe to the corner of the mouth.

NOTE:
The measurement from the ear lobe to the corner of the casualty's mouth is equivalent to the depth of insertion in the airway.

2. Perform the head-tilt/chin-lift or jaw thrust maneuver to open the airway.

WARNING:
If a neck or spinal injury is suspected, use the jaw thrust maneuver to open the airway.
3. Open the casualty's mouth.
   a. Place the crossed thumb and index finger of one hand on the casualty's upper and lower teeth at the corner of the mouth.
   b. Use a scissors motion to pry the casualty's teeth apart.

   **NOTE:**
   If the teeth are clenched, wedge the index finger behind the casualty's back molars to open the mouth.

4. **Insert the OPA.**
   a. Insert the airway with the tip facing the roof of the mouth.
   b. Slide the OPA along the roof of the mouth. Follow the natural contour of the tongue past the soft palate.
   c. Rotate the airway 180° as the tip reaches the back of the tongue.

   **NOTE:**
   The airway may be difficult to insert. If so, use a gauze pad to pull the tongue forward or a tongue depressor to depress the tongue.

   d. Gently advance the airway and adjust it so the flange rests against the casualty's lips or teeth.

   **NOTES:**
   The tip of the airway should rest just above the epiglottis.

   If the flange of the airway did not seat correctly on the lips or if the casualty gags, the airway may be the wrong size. Repeat the procedure using a different size of airway.

   **WARNING:**
   If the casualty starts to regain consciousness and gags or vomits, remove the airway immediately.

5. **Insert the OPA using a tongue depressor.**
   a. Use the tongue depressor to depress the tongue, ensuring the tongue remains forward.
   b. Insert the OPA sideways from the corner of the mouth until the flange reaches the teeth.
   c. Rotate the OPA at a 90° angle, removing the tongue depressor while exerting gentle backward pressure on the OPA until it rests securely in place against the lips or teeth.

6. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

7. Evacuate the casualty.

   **NOTE:**
   The airway may need to be taped or tied in place to avoid dislodgement during evacuation. If so, the casualty must be constantly monitored for the return of consciousness.

**INSERT A NASOPHARYNGEAL AIRWAY**

**Scenario**

The HM is assessing a patient with a reduced level of consciousness who is unable to maintain his airway.

**Objective**

Insert the appropriate size of NPA, without causing further injury to the patient.
Performance Steps

**CAUTION:**
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Place the patient supine with the head in a neutral position.

   **CAUTION:**
   Do not use a NPA if the patient has maxillofacial or head trauma.

2. Select the appropriate size NPA by measuring from the tip of the patient's nose to earlobe.
3. Coat the distal tip (non-flanged end) of the NPA with a water-soluble lubricant.

   **CAUTION:**
   Do not use a petroleum-based or non-water-based lubricant. These substances can cause damage to the tissues lining the nasal cavity and pharynx thus increasing the risk for infection.

4. **Insert the NPA.**
   
   a. Push the tip of the nose upward gently.
   
   b. Position the tube so that the bevel of the airway faces toward the septum.

   **NOTE:**
   Most NPAs are designed to be placed in the right nostril.

   c. Gently advance the lubricated NPA into the nostril with the curvature of the device following the curve of the floor of the nose. Advance it until the flange rests against the nostril.

   **CAUTION:**
   Never force the NPA into the patient's nostril. If resistance is met, pull the tube out and attempt to insert it in the other nostril. If the patient becomes intolerant of the airway, gently withdraw it from the nasal passage.

   5. Place the patient in the recovery (lateral recumbent, coma) position to prevent aspiration of blood, mucus, or vomitus.

   6. Monitor the casualty's respirations on a regular basis.
      
      a. Reassess air exchange and placement every time the casualty is moved.
      
      b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

   7. Record the procedure.
   8. Evacuate the patient.

**NOTE:**
NPA insertion may cause nasal bleeding.

**INSERT A COMBITUBE®**

**Scenario**
An unconscious casualty requires the insertion of an esophageal tracheal Combitube®. An assistant is performing resuscitative measures. No cervical spine injury is present.

**Objective**
Insert the Combitube® and successfully ventilate the casualty without causing further injury.

**Performance Steps**

1. Take **Body Substance Isolation (BSI)** precautions.
2. Inspect upper airway for visible obstruction.
3. Inspect and test equipment.
4. Lubricate distal end of tube.
5. Perform a tongue-jaw lift.
6. Insert device until casualty's teeth sit between printed black rings, within 3 attempts.
7. Inflate #1 (blue) cuff with appropriate amount of air based on size of tube.
8. Inflate #2 (white) cuff with appropriate amount of air based on size of tube.
9. Direct assistant to ventilate casualty with a BVM through primary tube.
10. Perform steps 5-9 in less than 30 seconds.
11. Watch for rise and fall of the chest, auscultate for breath sounds and over the epigastrium to confirm tube placement.
13. Attach pulse oximeter to casualty, if available.
14. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.
15. Secure device to the casualty around casualty's neck.

**Performance Steps**

1. Take body substance isolation (BSI) precautions.
2. Inspect the upper airway for visible obstruction.
3. Direct the assistant to pre-oxygenate the casualty for a minimum of 30 seconds.
4. Inspect and test equipment.
5. Lubricate the distal end of the tube with water soluble lubricant.
6. Perform a tongue-jaw lift.
7. Insert the device until the base connector is aligned with the casualty's teeth.
8. Inflate the cuffs with the appropriate amount of air based on the size of the tube.
   a. Use size 3 if the casualty is less than 61 inches in height. Inflate with 60 ml of air.
   b. Use size 4 if the casualty is 61 inches to 71 inches in height. Inflate with 80 ml of air.
   c. Use size 5 if the casualty is taller than 71 inches in height. Inflate with 80 ml of air.
9. Direct the assistant to ventilate the casualty with a BVM.
10. Auscultate the lung fields and epigastrium, and watch for rise and fall of the chest to confirm tube placement.
11. Assess casualty for spontaneous respirations for 10 seconds.
12. Attach pulse oximeter to casualty.
13. Ventilate casualty when respirations are <8 or > 30 or a pulse oximeter reading <90%.
14. Secure the device to the casualty.

**INSERT A KING LT® AIRWAY**

**Scenario**

An unconscious casualty requires the insertion of an esophageal airway. An assistant is performing resuscitative measures. No cervical spine injury is present.

**Objective**

Insert the King LT® without causing further injury.
15. Monitor the casualty’s respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

16. Evacuate the casualty.

PERFORM A SURGICAL CRICOThYROIDOTOMY

Scenario

The HM has a casualty requiring a surgical cricothyroidotomy.

Objective

Perform a surgical cricothyroidotomy without causing unnecessary injury to the casualty.

Performance Steps

1. Gather cricothyroidotomy kit or minimum essential equipment.

   NOTE:
   Because of the need for speed, every HM should have an easily accessible cricothyroidotomy kit that contains all required items.

   a. Cutting instrument: number 10 or 15 scalpel or knife blade.

   b. Airway tube: ET tube, tracheotomy tube, or any non-collapsible tube that will allow enough airflow to maintain oxygen saturation.

   NOTE:
   In a field setting, an ET tube is preferred because it is easy to secure. Use a size 6.0 to 7.0 ET tube, and ensure the cuff will hold air.

2. Hyperextend the casualty's neck.

   WARNING:
   Do not hyperextend the casualty's neck if a cervical injury is suspected.

   a. Place the casualty in the supine position.
   b. Place a blanket or poncho rolled up under the casualty's neck or between the shoulders blades to hyperextend the neck.

3. Put on gloves.

4. Locate the cricothyroid membrane.

   a. Place a finger of the non-dominant hand on the thyroid cartilage (Adam's apple), and slide the finger down to the cricoid cartilage.
   b. Palpate for the soft cricothyroid membrane below the thyroid cartilage and just above the cricoid cartilage.
   c. Slide the index finger down into the depression between the thyroid and cricoid cartilage.
   d. Prepare the skin over the membrane with an alcohol swab.

5. Stabilize the larynx with the non-dominant hand.
6. With the cutting instrument in the dominant hand, make a 1-1/2 inch vertical incision through the skin over the cricothyroid membrane.

**NOTE:**
A vertical incision will allow visualization of the cricothyroid membrane, but keep the scalpel blade away from the lateral aspect of the neck. This is important because of the large blood vessels located there, i.e. carotid artery and jugular vein.

**CAUTION**
Do not cut the cricothyroid membrane with this incision.

7. Maintain the opening of the skin incision by pulling the skin taut with the fingers of the non-dominant hand.

8. Stabilize the larynx with one hand and cut horizontally through the cricothyroid membrane.

9. Insert a commercially designed cricothyroidotomy hook or improvise with the tip of an 18-gauge needle formed into a hook through the opening; hook the cricoid cartilage, and lift to stabilize the opening.

10. Insert the end of the ET tube or tracheotomy tube through the opening and towards the lungs. The tube should be in the trachea and directed toward the lungs. Inflate the cuff with 10 cubic centimeters (cc) of air.

11. Assess the casualty for spontaneous respirations (10 seconds).

12. Attach a pulse oximeter to the casualty, if available.

13. Assist with ventilations when respirations are <8 or >30 or a pulse oximeter reading <90% Direct an assistant to ventilate the casualty with a BVM, if necessary.

14. Auscultate lung fields and watch for rise and fall of the chest to confirm tube placement.

15. Secure the tube, using tape, cloth ties, or other measures, and apply a dressing to further protect the tube and incision.

16. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

17. Evacuate casualty.

**PERFORM A NEEDLE CHEST DECOMPRESSION**

**Scenario**

The HM has a breathing casualty with chest trauma who requires needle chest decompression.

**Objective**

Complete all the steps necessary to perform a needle chest decompression without causing unnecessary injury to the casualty.
Performance Steps

NOTE:
Pneumothorax is defined as the presence of air within the chest cavity. Air enters either from the lungs through a rupture, laceration, or from the outside through a sucking chest wound. Trapped air in the chest cavity under pressure, called a tension pneumothorax, compresses the lung beneath it.

NOTE:
Unrelieved pressure will push and compress the contents of the chest in the opposite direction, away from the side of the tension pneumothorax. This, in turn, will prevent the heart from filling with blood and beating correctly and the good lung from providing adequate respirations.

CAUTION:
This procedure should ONLY be performed if the casualty has a chest trauma and progressive respiratory distress.

1. Locate the insertion site. Locate the second intercostal space approximately two finger widths below the clavicle (between the second and third ribs) at the mid-clavicular line (approximately in line with the nipple) on the same side of the casualty's chest as the injury.

2. Insert a large bore (3.25 inch, 14 gauge) needle and catheter unit.
   a. Firmly insert the needle into the skin over the top of the third rib into the second intercostal space, until the chest cavity has been penetrated, as evidenced by feeling a "pop" as the needle enters the chest cavity.
   b. A hiss of escaping air may be heard.

3. Withdraw the needle while holding the catheter still.

NOTE:
The casualty's respiration should improve.

4. Secure the catheter to the chest wall using tape.

5. Monitor the casualty until medical care arrives or the casualty is evacuated.

ADMINISTER OXYGEN

Scenario

The HM has a patient requiring oxygen administration.

Objective

Administer oxygen therapy using a non-rebreather (NRB) mask or nasal cannula to assist the patient's breathing without causing further harm to the patient. Calculate the duration of flow of the oxygen.

Performance Steps

CAUTION:
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Explain the procedure to the patient.
2. Assemble and prepare the equipment.
   a. Inspect the oxygen cylinder and its markings.

   **NOTE:**
   Ensure the cylinder is labeled for medical oxygen; the bottles may be completely green, silver, or chrome with a green area around the valve stem on top.

   b. Attach the regulator/flow meter.
   c. Open the oxygen cylinder.
   d. Check for leaks.
   e. Check oxygen cylinder pressure.

   **NOTE:**
   The safe residual level of the oxygen at which the tank should be replaced has been established to be 200 pounds per square inch (psi).

3. Position the patient in the position of comfort to facilitate breathing unless contraindicated by the mechanism of injury (MOI).

4. Determine the delivery device to use.

   **NOTE:**
   Humidifiers can be connected to flow meters to provide moisture to dry oxygen; oxygen can dry out mucous membranes with prolonged use.

   Humidified oxygen is usually more comfortable to the patient and is particularly helpful for children and for chronic obstructive pulmonary disease (COPD) patients.

   a. A bag-valve-mask (BVM) system is the delivery device of choice for patients with signs of inadequate breathing, i.e. respirations <8 or >30 per minute.
   b. A NRB mask is the delivery device of choice in the pre-hospital setting for patients with signs of inadequate breathing, or who are cyanotic, having chest pain, severe trauma, signs of shock, or an altered mental status.
   c. A nasal cannula is appropriate for patients unable to tolerate the NRB.

5. **Apply the NRB mask.**
   a. Select the correct size of mask.

   **NOTE:**
   The apex of the mask should fit over the bridge of the patient's nose and extend to rest on the chin, covering the mouth and nose completely. NRB masks come in different sizes for adults, children, and infants.

   b. Attach the extension tubing to the regulator/flow meter.
   c. Initiate the oxygen flow and adjust it to the prescribed rate of 10-15 liters/minute (LPM) to deliver up to 90% oxygen.
   d. Pre-fill the reservoir bag using gloved fingers to cover the connection between the mask and the reservoir, if applicable.
   e. Place the mask on the patient and adjust the straps.
   f. Instruct the patient to breathe normally.

6. **Apply the nasal cannula.**
   a. Attach the cannula tubing to the regulator/flow meter.
   b. Adjust the oxygen flow to the prescribed rate of 1-4 LPM to deliver 24-44% oxygen.
   c. Position the cannula so the two small, tube-like prongs fit in the patient's nostrils curving naturally along the base of the nostrils.
   d. Adjust the nasal cannula to hold in place.

7. Continue to monitor the patient for signs of confusion, restlessness, level of consciousness, skin color, increased capillary refill, or changes in vital signs.
8. Check the equipment for security of tubing connections and administration device, oxygen flow, and humidified water level as indicated.

**NOTE:**
Change the delivery device and tubing IAW local protocols.

9. **Calculate the duration of flow of the oxygen cylinder.**
   a. Determine the remaining pressure in the tank by reading the regulator gauge.
   b. Determine the safe residual level of the oxygen tank.

**NOTE:**
The safe residual level of the oxygen at which the tank should be replaced has been established to be **200 psi**.

c. Determine the available cylinder pressure by subtracting the safe residual level from the remaining pressure. Example: 2000 psi remaining pressure minus 200 psi safe residual level = 1800 psi available pressure.

d. Determine the conversion factor for the oxygen cylinder in use.

**NOTE:**
Each type of oxygen cylinder, depending on its size, employs a specific conversion factor.

i. D size oxygen cylinder--0.16.
ii. E size oxygen cylinder--0.28.
iii. G size oxygen cylinder--2.41.
vi. M size oxygen cylinder--1.56.

e. Determine the available liters by multiplying the conversion factor by the amount of available pressure. Example: A "D" size cylinder is being used. A 0.16 conversion factor x 1800 psi available pressure = 288 liters of oxygen available for use.

f. Determine the flow rate as prescribed by medical direction.

g. Determine the duration of the oxygen by dividing the available liters by the flow rate. Example: 288 available liters divided by the prescribed flow rate of 10 LPM = 28.8 (29) minutes duration of oxygen flow.

10. Follow safety precautions.
   a. Ensure "OXYGEN" and "NO SMOKING" signs are posted wherever oxygen is used or stored.
   b. Inform the patient and visitors about the restrictions.

**WARNING:**
The principle danger in using oxygen is fire.

The presence of oxygen in increased concentrations makes all materials more combustible.

Materials that burn slowly in ordinary air, burn violently and even explosively in the presence of oxygen.

c. Use only non-sparking wrenches on oxygen cylinders.

d. Ensure all electrical equipment is properly grounded.

e. Position oxygen cylinders away from doors and high traffic areas.

f. Do not use oil or grease around oxygen fittings.

g. Secure and store oxygen cylinders in an upright position.
LEARNING OBJECTIVES:

Explain the signs and symptoms of shock.

Determine treatment by the type of shock presented.

Shock is a state of inadequate tissue perfusion resulting in a decreased amount of oxygen to vital tissues and organs. There are three major types of shock (Table 21-2):

1. **Hypovolemic** shock is a loss of intravascular volume, which may occur from blood, plasma, or fluid loss. Also known as hemorrhagic shock.

2. **Distributive** (Vasogenic) shock - occurs when the vascular container (blood vessels) dilate (enlarge) without a proportional increase in fluid volume. As a result, the heart’s preload decreases (blood available for pumping out to the body to provide oxygen and nutrients), and thus cardiac output falls leaving the tissues hypoxic and starved for energy.
   a. **Neurogenic** shock is caused by the failure of the nervous system to control the diameter of blood vessels.
   b. **Septic shock** is caused by the presence of severe infection which leads to vasodilation.
   a. **Psychogenic (vasovagal)** shock is typically mediated through the para-sympathetic nervous system. Stimulation of the vagus nerve produces bradycardia which can lead to fainting.

3. **Cardiogenic** shock is caused by the heart failing to pump blood adequately to all vital parts of the body.

<table>
<thead>
<tr>
<th>Vital Sign</th>
<th>Hypovolemic</th>
<th>Distributive</th>
<th>Cardiogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Neurogenic</td>
<td>Septic</td>
</tr>
<tr>
<td>Skin Temp</td>
<td>Cool, Clammy</td>
<td>Warm, Dry</td>
<td>Cool, Clammy</td>
</tr>
<tr>
<td>Skin Color</td>
<td>Pale, cyanotic</td>
<td>Pink</td>
<td>Pale, Mottled</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>Drops</td>
<td>Drops</td>
<td>Drops</td>
</tr>
<tr>
<td>LOC</td>
<td>Altered</td>
<td>Lucid</td>
<td>Altered</td>
</tr>
<tr>
<td>Cap Refill</td>
<td>Slowed</td>
<td>Normal</td>
<td>Slowed</td>
</tr>
</tbody>
</table>

Table 21-2.—Differentiating Types of Shock
STAGES OF SHOCK

Shock occurs in three successive stages. The HM's goal is to recognize the signs of the early stages of shock and begin immediate treatment before the permanent damage occurs. The three stages of shock are compensated, decompensated and irreversible.

- Compensated (Non-progressive) Shock: At this stage, the blood pressure is maintained; however, there is a narrowing of the pulse pressure, which is the difference between the systolic and diastolic pressures. Treatment at this stage will typically result in recovery.

- Decompensated (Progressive) Shock: At this stage, the blood pressure is falling because the blood volume has dropped 15 to 25%. The compensatory mechanisms are beginning to fail, and signs and symptoms are much more obvious. At this point, vasoconstriction can have a disastrous effect if allowed to continue. Treatment at this stage will sometimes result in recovery.

- Irreversible Shock: Shock has progressed to a terminal stage. Arterial blood pressure is abnormally low. There are life-threatening reductions in cardiac output, blood pressure, and tissue perfusion. Even aggressive treatment at this stage does not normally result in recovery.

Hypovolemic Shock - a state of shock caused by any loss of fluid volume either by blood loss, dehydration, burns, etc. The container has retained its normal size but the fluid volume has decreased, creating an imbalance. The most common cause of hypovolemic shock on the battlefield is due to massive hemorrhage which causes hemorrhagic shock.

The amount of blood that can be lost before death occurs will vary from individual to individual. The average adult blood volume is 5 to 6 liters. Normally, a loss of approximately 1 liter or 25-40% of the person's total blood volume will create a life-threatening condition. Massive hemorrhage may be fatal within 60-120 seconds. In a tactical environment, treatment should not be delayed. Controlling major hemorrhage should be the first priority over securing an airway.

Signs and symptoms seen with hemorrhagic shock are normally linked with the amount of blood lost and the casualty’s internal reaction to this blood loss. DO NOT rely on BP as the main indicator of shock! More attention should be paid to the casualty’s mental status, quality of distal pulses, and tachycardia. Hemorrhagic shock, which is hypovolemic shock resulting from blood loss, can be categorized into four classes, depending on the severity of hemorrhage. Remember these parameters are only guidelines and should not be taken as absolute amounts of associated blood loss (Table 21-3).

What happened to ABC’s?

The brain can go four to six minutes without oxygen before permanent damage or death. Death from massive hemorrhage may occur within two minutes.
**Class I Shock**

This stage has few clinical manifestations. The casualty's body is able to compensate to maintain homeostasis. “A tactically relevant definition of shock in a combat trauma casualty is an abnormal radial pulse (weak or absent) and an abnormal mentation (LOC) not attributed to drug therapy or brain injuries.”

**Class II Shock**

Although the circulating blood volume is reduced, compensatory mechanisms such as the sympathetic nervous system are able to maintain blood pressure and tissue perfusion at a level sufficient to prevent cellular damage.

**Class III Shock**

At this point, unfavorable signs begin to appear. The body’s compensatory systems can no longer maintain adequate perfusion. The classic signs of shock (tachycardia, tachypnea, and confusion) become obvious. HMs must see the importance of catching the casualty in the early stages of shock because by the time the casualty gets to this stage, he or she is in significant trouble.

**Class IV Shock**

This is a severe stage of shock! These casualties truly have only minutes to live. Survival depends on immediate control of hemorrhage (surgery for internal hemorrhage) and aggressive resuscitation.

**Signs and Symptoms**

See Table 21-3.

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**Table 21-3.—Classes of Hemorrhagic Shock**

<table>
<thead>
<tr>
<th>Classification of Hemorrhagic Shock</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of Blood Loss (% total blood volume)</td>
<td>&lt;750ml (&lt;15%)</td>
<td>750-1500ml (15%-30%)</td>
<td>1500-2000ml (30%-40%)</td>
<td>&gt;2000ml (&gt;40%)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal or minimally increased</td>
<td>&gt;100</td>
<td>&gt;120</td>
<td>&gt;140</td>
</tr>
<tr>
<td>Pulse (quality)</td>
<td>Normal</td>
<td>Thready</td>
<td>Thready/very weak</td>
<td>No Radial/thready Carotid</td>
</tr>
<tr>
<td>Capillary Refill</td>
<td>Normal</td>
<td>Delayed (3-5 seconds)</td>
<td>Delayed (&gt;5 seconds)</td>
<td>Delayed (&gt;5 seconds)</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>Normal</td>
<td>20-30</td>
<td>30-40</td>
<td>&gt;35</td>
</tr>
<tr>
<td>SBP</td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased (&lt;80 mmHg)</td>
<td>Greatly Decreased (approx. 60 mmHg)</td>
</tr>
<tr>
<td>Skin Color</td>
<td>Pink</td>
<td>Pale</td>
<td>White extremities/Ashen Gray</td>
<td>White extremities/Ashen Gray/Cyanotic</td>
</tr>
<tr>
<td>Skin Temperature</td>
<td>Cool</td>
<td>Cool, Moist</td>
<td>Cool Extremities</td>
<td>Cold Extremities</td>
</tr>
<tr>
<td>Mental Status</td>
<td>Normal</td>
<td>Anxiety</td>
<td>Severe Anxiety</td>
<td>Lethargic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fright</td>
<td>Confused</td>
<td>Unconscious</td>
</tr>
</tbody>
</table>

---
Treatment

See soft tissue injury section for Hemorrhage control procedures.

The field care phase will determine the HM’s actions; Care Under Fire phase use a tourniquet for life-threatening extremity hemorrhage and Tactical Field Care phase use direct pressure and or a hemostatic dressing. Once the bleeding is stopped obtain vascular access, give resuscitative fluids, and coordinate Casualty Evacuation (CASEVAC).

**Three Types of Distributive Shock**

<table>
<thead>
<tr>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic</td>
</tr>
<tr>
<td>Neurogenic</td>
</tr>
<tr>
<td>Psychogenic</td>
</tr>
</tbody>
</table>

**SEPTIC SHOCK**

Shock caused by a systemic infection. In these cases the bacteria multiply rapidly throughout the body releasing toxins into the blood stream. The toxins cause the blood vessels in the periphery (arms and legs) to dilate maldistributing the blood away from critical areas (i.e. brain, heart, and lungs).

**Signs and Symptoms**

See Table 21-3.

**Treatment**

It typically takes between 5-7 days for septic shock to develop. However, HMs may be called on to care for a casualty who sustained an injury and did not promptly seek medical attention. If so, a HM’s primary focus should be to CASEVAC the casualty to a higher echelon of care. Additionally, the casualty will require IV antibiotic therapy with a broad spectrum antibiotic.

**NEUROGENIC SHOCK**

Shock caused by an injury that interrupts the spinal cord's sympathetic nervous system pathway, resulting in significant dilation of peripheral arteries. Because of the loss of sympathetic control of the vascular system which controls the smooth muscle in the walls of the blood vessels, the peripheral vessels dilate below the level of injury.

**Signs and Symptoms**

See Table 21-3 and below.

1. Injuries consistent with spinal injury.
2. Bradycardia with hypotension (low heart rate with low blood pressure should be a red flag, start suspecting neurogenic shock).
3. The casualty with neurogenic shock, in the absence of traumatic brain injury, is alert, orientated, and lucid (clear in the mind) when in the supine (laying down on back) position.

**Treatment**

1. Maintain ABC’s.
2. Spinal Immobilization (if mechanism of injury causes a high suspicion of spinal injury).
3. Oxygen therapy to keep oxygen saturation >92% (if available).
4. Obtain IV access and give fluids, if necessary.
5. Trendelenburg position (head down, feet elevated).
6. Keep patient warm.
7. CASEVAC.
PSYCHOGENIC (VASOVAGAL) SHOCK

Also known as vasovagal _syncope_ or fainting, this occurs when there is stimulation of the tenth cranial nerve (vagus nerve) which produces bradycardia and hypotension. If the bradycardia and hypotension are severe enough, cardiac output falls, resulting in insufficient blood flow to the brain and the casualty loses consciousness. Typically, normal blood pressure is quickly restored before systemic impairment of perfusion occurs. Common causes are fear, receiving unexpected bad news, or the sight of blood.

**Signs and Symptoms**

See Table 21-3 and below.

- The periods of bradycardia and vasodilation are generally limited to minutes.

**Treatment**

Because it is a self-limited condition, a vasovagal episode is unlikely to result in true “shock” and normal blood pressure is quickly restored when the casualty is placed in a horizontal position.

CARDIOGENIC SHOCK

Failure of the heart to adequately pump blood throughout the body, resulting from causes that can be categorized as either intrinsic (a result of direct damage to the heart itself, a heart attack, for instance) or extrinsic (related to a problem outside the heart, a tension pneumothorax, for example). In this scenario, the container is the correct size and is filled with the right amount of fluid; it is the pump that is not functioning properly.

**Intrinsic Causes**

Any injury that weakens the cardiac muscle will affect its output. The damage may result from a myocardial infarction or from a direct bruise to the heart muscle from a blunt cardiac injury that prevents the heart from pumping properly.

**Extrinsic Causes**

External factors that cause the heart not to work properly (i.e., tension pneumothorax and cardiac tamponade)

---

**Why do WE learn something that WE can’t treat?**

_Answer_: Use these signs and symptoms of cardiac tamponade as a way for ruling out tension pneumothorax.

**Signs and Symptoms**

- Tension Pneumothorax:
  - Chest trauma
  - Shortness of breath/dyspnea
  - Tachycardia
  - Cyanosis
  - Decreased/absent lung sounds on affected side
  - Jugular vein distention and tracheal deviation (away from the side of injury or affected side)
Cardiac Tamponade:
- Chest Trauma
- Shortness of breath/dyspnea
- Tachycardia
- Cyanosis
- Distant (muffled) heart tones/sounds
- Narrowing pulse pressure

**Treatment**
- Maintain ABC’s
- Oxygen therapy to keep oxygen saturation >92% (if available)
- CASEVAC

Specific treatment for a tension pneumothorax is needle decompression, which will be discussed in a future lesson.

**VOLUME RESUSCITATION**

Although volume resuscitation of a trauma casualty in shock makes sense, no research has demonstrated improved survival of critically injured trauma casualties when IV fluid therapy has been administered in the field.

In fact, one researcher found that IV fluids administered in the field were beneficial only when three conditions existed:
- Casualty is bleeding at a rate of 25 to 100 mL/min
- IV fluid administration rate is equal to the bleeding rate
- Scene time and transport time exceed 30 minutes

Therefore, transport of the trauma casualty should never be delayed to start an IV.

HMs will receive training on the type of vascular access (PO, IV, or IO) to start and the type of fluids to give in the lesson on Combat Fluid Resuscitation.

In order to understand the best method for assessing a traumatic injury in the field, it is important to realize some key differences in the environments HMs operate. The scene size up provides critical information pertaining to the surroundings. These are general guidelines which are adaptable to both the non-tactical and tactical environments.

<table>
<thead>
<tr>
<th>CASUALTY ASSESSMENT AND SHOCK CASUALTIES&lt;sup&gt;28&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Care Under Fire Phase:</strong></td>
</tr>
<tr>
<td>There are many things that cause shock; the most common is uncontrolled hemorrhage. If the casualty has life-threatening extremity hemorrhage, use a tourniquet. For non-extremity hemorrhage, use direct pressure with a Committee on Tactical Combat Casualty Care (CoTCCC) approved hemostatic dressing.</td>
</tr>
<tr>
<td><strong>Tactical Field Care Phase:</strong></td>
</tr>
<tr>
<td>Shock is very difficult to treat in a hospital setting let alone in a field or combat environment. Reassess treatment started during Care Under Fire Phase to control the hemorrhage. Assess airway and intervene if necessary. Complete a head to toe assessment using DCAP-BTLS* noting and treating additional injuries. Determine if vascular access is required (see Combat Fluid Resuscitation lesson) and give fluids if necessary. If the casualty is able to drink fluids, they should be encouraged to do so. Consider pain medications and give antibiotics if warranted. Reassess all care provided. Document care given, prevent hypothermia, and CASEVAC.</td>
</tr>
</tbody>
</table>

*DCAP-BTLS: deformities, contusions, abrasions, punctures or penetrations, burns, tenderness, lacerations, and swelling.
Scene Assessment / Scene Size Up

The Scene Assessment is broken down into two stages with the first being Scene Assessment and the second being the Scene Size Up. The Scene Assessment process begins from the moment HMs are notified of the incident. Think of it as a mental exercise or checklist. HMs should “Arm Chair Quarterback” the information received once notified and start brainstorming what could potentially be seen once he/she arrives on the actual scene. The size up occurs once HMs can visualize the scene for themselves. The reason for the two step process is simple; as with the communication exercise “Telephone,” what is assessed upon arriving at the scene may be totally different than what was reported through the notification process. The three priorities of the Scene Assessment / Size Up are:

1. Safety.
2. Identification of Patients.

Once on scene, the first priority is always safety. Safety is a relative term when considering a tactical environment. The HM’s responsibility is to place the patient, bystanders, and ultimately him/herself in the safest position relative to the situation.

In the Scene Size Up, consideration should also be paid to the environmental and geographic area that the incident has occurred. For example, a casualty who has been injured in a desert environment may require interventions to treat an environmental injury as well as the physical injuries identified during the patient assessment. An additional example would be arriving on the scene of a patient that has received a gunshot wound and was bleeding onto an absorbent material such as house carpet. This patient may require additional treatment for shock due to the blood loss not readily visible due to the carpet.

The second priority once arriving on scene is identifying the total number of patients. Some of this information may be provided to the HM during the initial notification of incident, but once on the scene it is imperative that the HM visualize each patient and begin a triage process. The third priority in the Scene Assessment / Size Up process is to identify and consider the mechanism of injury (MOI). The MOI will lead to the HM to the index of suspicion (IOS).

The MOI is simply defined as the basic manner in which the casualty was injured. For example, a casualty that was involved in a collision is subject to multiple forces resulting from the collision. Regardless of injury pattern, the MOI is generally described as deceleration trauma (abrupt stopping from being in motion). As an additional example, a casualty that receives a gunshot or stab wound has a MOI of penetrating trauma and conversely a member struck with a bat has a MOI of blunt trauma.

The IOS is derived directly from the MOI and is defined as the injury patterns the casualty will display based on the MOI. Using the examples above, deceleration trauma can result in cervical spine injury, solid organ shear, or musculoskeletal injury. Penetrating trauma can result in hollow organ rupture, sucking chest wounds, and abdominal evisceration. Blunt trauma can result in hollow organ or solid organ rupture. These examples are meant to simply identify potential injury patterns specific to this text. The responder must fully assess and evaluate each patient to positively identify life threatening conditions and treat them accordingly.

Once the Scene Assessment and Size Up are complete the HM will have a better idea of the number of patients and their severity of injury. After completing the patient assessment, he/she will then be able to compose a comprehensive treatment and evacuation plan to deliver the patients to definitive medical care.
PATIENT ASSESSMENT

LEARNING OBJECTIVE:

Assess emergency medical conditions in both tactical and non-tactical environments.

GENERAL IMPRESSION

A simultaneous or global overview of the status of the patient’s respiratory, circulatory, and neurologic systems to identify obvious significant external problems with oxygenation, circulation, hemorrhage or gross deformities. Within 15-30 seconds, the pre-hospital care provider has gained a general impression of the patient’s overall condition. This establishes whether the patient is presently or imminently in a critical condition and rapidly evaluates the patient’s overall systemic condition. This is when the decision regarding ground vs. air transport should be made. Early decision making will ultimately shorten scene time.

SYNCOPE

Uncomplicated syncope (fainting) is the result of blood pooling in dilated veins, which reduces the amount of blood being pumped to the brain. Causes of syncope include getting up too quickly, standing for long periods with little movement, and stressful situations. Signs and symptoms that may be present are dizziness; nausea; visual disturbance from pupillary dilation; sweating; pallor; and a weak, rapid pulse. As the body collapses, blood returns to the head, and consciousness is quickly regained. Revival can be promoted by carefully placing the casualty in the shock position or in a sitting position with the head between the knees. Placing a cool, wet cloth on the patient’s face and loosening his or her clothing can also help. Syncope may also result from an underlying medical problem such as diabetes, cerebrovascular accident (stroke), heart condition, or epilepsy.

CEREBROVASCULAR ACCIDENT

A cerebrovascular accident, also known as stroke or apoplexy, is caused by an interruption of the arterial blood supply to a portion of the brain. This interruption may be caused by arteriosclerosis, by a clot forming in the brain, or by a hemorrhage in the brain. Tissue damage and loss of function result.

Onset of a cerebrovascular accident is sudden, with little or no warning. The first signs include weakness or paralysis on the side of the body opposite the side of the brain that has been injured. Muscles of the face on the affected side may be involved. The patient’s level of consciousness varies from alert to unresponsive. Additionally, motor functions including vision and speech on the affected side are disturbed, and the throat may be paralyzed.

Emergency treatment for a cerebrovascular accident is mainly supportive. Special attention must be paid to the casualty’s airway, since he or she may not be able to keep it clear. Place the casualty in a semi-reclining position or on the paralyzed side.

- Be prepared to use suction if the casualty vomits
- Act in a calm, reassuring manner, and keep any onlookers quiet since the casualty may be able to hear what is going on
- Administer oxygen to combat cerebral hypoxia
- Carefully monitor the casualty’s vital signs and keep a log. Pay special attention to respirations, pulse strength and rate, and the presence or absence of the bilateral carotid pulse
- Transport the casualty to a medical treatment facility as soon as possible
CONVULSIONS

Convulsions, or seizures, are a startling and often frightening phenomenon. Convulsions are characterized by severe and uncontrolled muscle spasms or muscle rigidity. Convulsive episodes occur in one to two percent of the general population.

Although epilepsy is the most widely known form of seizure activity, there are numerous forms of convulsions that are classified as either central nervous system (CNS) or non-CNS in origin. It is especially important to determine the cause in patients who have no previous seizure history. This determination may require an extensive medical workup in the hospital. Since epilepsy is the most widely known form of seizure activity, this section will highlight epileptic seizure disorders.

Epilepsy, also known as seizures or fits, is a condition characterized by an abnormal focus of activity in the brain that produces severe motor responses or changes in consciousness. Epilepsy may result from head trauma, scarred brain tissue, brain tumors, cerebral arterial occlusion, fever, or a number of other factors. Fortunately, epilepsy can often be controlled by medications.

Grand mal seizure is the more serious type of epilepsy. Grand mal seizure may be but is not always preceded by an aura. The casualty soon comes to recognize these auras, which allows him or her time to lie down and prepare for the seizure's onset. A burst of nerve impulses from the brain causes unconsciousness and generalized muscular contractions, often with loss of bladder and bowel control. The primary dangers in a grand mal seizure are tongue biting and injuries resulting from falls. A period of sleep or mental confusion follows this type of seizure. When full consciousness returns, the casualty will have little or no recollection of the attack.

Petit mal seizure is of short duration and is characterized by an altered state of awareness or partial loss of consciousness, and localized muscular contractions. The patient has no warning of the seizure's onset and little or no memory of the attack after it is over.

First aid treatment for both types of epileptic seizure consists of protecting the casualty from self-injury. Additional methods of seizure control may be employed under a medical officer's supervision. In all cases, be prepared to provide suction to the casualty since the risk of aspiration is significant. Transport the patient to a medical treatment facility once the seizure has ended.

DROWNING

Drowning is a suffocating condition in a water environment. Water seldom enters the lungs in appreciable quantities because, upon contact with fluid, laryngeal spasms occur, and these spasms seal the airway from the mouth and nose passages. To avoid serious damage from the resulting hypoxia, quickly bring the casualty to the surface and immediately, even before the casualty is pulled to shore, start artificial ventilation. Do not interrupt artificial ventilation until the rescuer and the casualty are ashore. Once on dry ground, quickly administer an abdominal thrust (Heimlich maneuver) to empty the lungs, and then immediately restart the ventilation until spontaneous breathing returns. Oxygen enrichment is desirable if a mask is available. Remember that an apparently lifeless person who has been immersed in cold water for a long period of time may be revived if artificial ventilation is started immediately.

PSYCHIATRIC EMERGENCIES

A psychiatric emergency is defined as a sudden onset of behavioral or emotional responses that, if not responded to, will result in a life-threatening situation. Probably the most common psychiatric emergency is the suicide attempt. A suicide attempt may range from verbal threats and suicidal gestures to a successful suicide.
Always assume that a suicide threat is real; do not leave the patient alone. In all cases, the prime consideration for the HM is to keep patients from inflicting harm to themselves and to get them under the care of a trained psychiatric professional. When dealing with suicidal gestures or attempts, treat any self-inflicted wounds appropriately.

In the case of ingested substances, do not induce vomiting in a patient who is not awake and alert. For specific treatment of ingested substances, refer to Chapter 22, “Poisoning and Drug Abuse.”

There are numerous other psychiatric conditions that would require volumes to expound upon. In almost all cases, appropriate first aid treatment consists of a calm, professional, understanding demeanor that does not aggravate or agitate the patient. With an aggressive or hostile patient, a show of force may be all that is required. A show of force involves at least 4 and preferably 5 personnel who approach the patient with one person designated to maintain communication with him or her. The intent is to let the patient know that he or she must control his or her behavior or there is a team who will help the patient control the behavior. Almost all cases of psychiatric emergencies will present with a third party often the family or friend of the patient who has recognized a distinct change in the behavior pattern of the patient and who is seeking help for them.

DERMATOLOGIC EMERGENCIES

Most dermatologic cases that present as emergencies are not real emergencies. The patient perceives them as such because of the sudden presentation and or repulsive appearance or excessive discomfort. Treat most dermatologic conditions symptomatically. The major exception to symptomatic treatment is toxic epidermal necrolysis (TEN).

Toxic epidermal necrolysis is a condition characterized by sudden onset, excessive skin irritation, painful erythema (redness of skin produced by congestion of the capillaries), bullae (large blisters), and exfoliation of the skin in sheets. TEN is also known as the scalded skin syndrome because of its appearance. TEN is thought to be caused by a staphylococcal infection in children and by a toxic reaction to medications in adults.

Since skin is the largest single organ of the body and serves as a barrier to infection, prevention of secondary skin infection is very important. Treatment of skin infections consists of isolation techniques, silver nitrate compresses, aggressive skin care, intravenous antibiotic therapy, and in drug-induced cases, systemic steroids.

NOTE:
In the following assessment and treatment sections assume the following is true for the scenarios presented:

(1) All required equipment is available.
(2) None of the situations takes place in a CBRNE environment.
MEDICAL PATIENT ASSESSMENT

Scenario
The HM has a patient with a complaint that is medical in nature and no significant mechanism of injury.

Objective
Perform a medical patient assessment without causing further injury.

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Perform scene size-up.
   a. Determine the safest route to access the patient.
   b. Determine the mechanism of injury/nature of illness.
   c. Determine the number of patients.
   d. Request additional help if necessary.
   e. Consider stabilization of the spine.
2. Perform an Initial Assessment.
   a. Form a general impression of the patient and the patient's environment.
   b. Assess the patient's mental status using the Alert, Verbal, Pain, Unresponsive (AVPU) scale.
      i. A - Alert and oriented.
      ii. V - Responsive to verbal stimuli.
      iii. P - Responsive to painful stimuli.
      iv. U - Unresponsive.
   c. Determine the chief complaint/apparent life-threatening condition.
   d. Assess the airway.
      i. Perform an appropriate maneuver to open and maintain the airway if necessary.
      ii. Insert an appropriate airway adjunct, if necessary.
   e. Assess breathing.
      i. Determine the rate, rhythm, and quality of breathing.
      ii. Administer oxygen if necessary using the appropriate delivery device.
   f. Assess circulation.
      i. Check skin color and temperature.
      ii. Assess the pulse for rhythm and force.
         1. Check the radial pulse in adults.
         2. Check the radial pulse and capillary refill in children under 6 years old.
         3. Check the brachial pulse and capillary refill in infants.
      iii. Check for major bleeding.
      iv. Control major bleeding.
      v. Treat for shock.
   g. Identify priority patients and make a transport decision (load and go or stay and play).

NOTE:
High priority conditions that require immediate transport include poor general impression, unresponsive, responsive but not following commands, difficulty breathing, shock, complicated childbirth, chest pain with systolic blood pressure less than 100, uncontrolled bleeding, and severe pain.
3. Conduct a rapid physical exam if the patient is unconscious. Inspect each of the following areas for deformities, contusions, abrasions, punctures or penetration, burns, tenderness, lacerations, swelling (DCAP-BTLS).
   a. Assess the head.
   b. Assess the neck.
   c. Assess the chest.
   d. Assess the abdomen.
   e. Assess the pelvis.
   f. Assess the extremities.
   g. Assess the posterior.
4. Gather a SAMPLE history from the patient: signs and symptoms, allergies, medications, past/pertinent medical history, last oral intake, and events preceding illness or injury.
   NOTE: If the patient is unable to provide this information, gather as much information about the SAMPLE history as possible from the patient's family and or bystanders.
   a. Signs and symptoms. Gather history of the present illness (OPQRST) from the patient.
      i. Respiratory.
         1. Onset - When did it begin?
         2. Provocation - What was the patient doing when this came on?
         3. Quality - Can the patient describe the feeling he or she has?
         4. Radiation - Does the feeling seem to spread to any other part of the body? Does the patient have pain or discomfort anywhere else in the body?
         5. Severity - On a scale of 1 to 10, how bad is the breathing trouble (10 is worst, 1 is best)?
         6. Time - How long has the patient had this feeling?
         7. Interventions - Has the patient taken any medication to help him or her breathe? Did it help?
      ii. Cardiac.
         1. Onset - When did it begin?
         2. Provocation - What was the patient doing when this came on?
         3. Quality - Can the patient describe the feeling he or she has?
         4. Radiation - Does the feeling seem to spread to any other part of the body? Does the patient have pain or discomfort anywhere else in the body?
         5. Severity - On a scale of 1 to 10, how bad is the breathing trouble (10 is worst, 1 is best)?
         6. Time - How long has the patient had this feeling?
         7. Interventions - Has the patient taken any medication to help? Did it help?
      iii. Altered mental status.
         1. Description of the episode - Can the patient describe what happened? How did the episode occur?
         2. Onset - How long ago did it occur?
         3. Duration - How long did it last?
         4. Associated symptoms - Was the patient sick or complaining of not feeling well before this happened?
         5. Evidence of trauma - Was the patient involved in falls or accidents recently?
         6. Interventions - Has the patient taken anything to help with this problem? Did it help?
         7. Seizures - Did the patient have a seizure?
8. Fever - Did the patient have a fever? What was the patient's temperature?

iv. Allergic reaction.
1. History of allergies - Does the patient have any allergies?
2. What the patient exposed to - Is there any chance that he or she was exposed to something to which he or she is allergic?
3. How was the patient exposed - How did he or she come into contact with _______ (whatever the patient is allergic to)?
4. Effects - What kind of symptoms is the patient having? How long after he or she was exposed did the symptoms start?
5. Progression - How long after exposure did the symptoms start? Are they worse now than they were before?
6. Interventions - Has the patient taken anything to help? Did it help?

v. Poisoning/overdose.
1. Substance - What substance was involved?
2. When did the patient ingest/become exposed - When did the exposure/ingestion occur?
3. How much did the patient ingest - How much did the patient ingest?
4. Over what time period - Over how long a period did the ingestion occur?
5. Interventions - What interventions did the family or bystanders take?
6. Estimated weight - What is the patient's estimated weight?

vi. Environmental emergency.
1. Source - What caused the injury?
2. Environment - Where did the injury occur?
3. Duration - How long was the patient exposed?
4. Loss of consciousness - Did the patient lose consciousness at any time?
5. Effects (general or local) - What signs and symptoms is the patient having? What effect did being exposed have on the patient?

vii. Obstetrics.
1. Is the patient pregnant?
2. How long has she been pregnant (weeks or months)?
3. Is the patient having pain or contractions?
4. Is the patient bleeding? Is the patient having any discharge?
5. Does she feel the need to push?
6. When was her last menstrual period?

viii. Behavioral.
1. How does the patient feel?
2. Determine suicidal tendencies - Does the patient have a plan to hurt himself or herself or anyone else?
3. Is the patient a threat to self or others?
4. Is there a medical problem?
5. Interventions?

b. Allergies?
c. Medications?
d. Past pertinent history?
e. Last oral intake?
f. Event(s) leading to present illness?
5. Perform a focused physical examination on the affected body part/system.
6. Obtain baseline vital signs.
7. Provide medication, interventions, and treatment as needed.
8. Re-evaluate the transport decision.
9. Consider completing a detailed physical examination.
   a. Repeat the initial assessment.
   b. Repeat vital signs.
   c. Repeat the focused assessment regarding the patient's complaint or injuries.

RESPIRATORY EMERGENCY ASSESSMENT

Scenario

The HM has a conscious patient with a respiratory emergency.

Objective

Correctly identify and treat a respiratory emergency without causing further harm to the patient.

Performance Steps

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Examine the patient.
   a. Assess the airway and open it, if necessary.

CAUTION:
A patient experiencing respiratory distress can rapidly progress to full arrest. Always be prepared to utilize advanced airway procedures.

   i. Ask the patient a question requiring more than a yes or no answer.
   ii. Note whether or not the patient can speak in full sentences.
   iii. Look for the presence of drooling that may indicate a partial or complete airway obstruction.

   b. Assist with artificial ventilations if respiratory effort and rate are inadequate.
      i. Look for the rise and fall of the chest during inspiration and expiration.
      ii. Listen for the presence of noisy respirations (e.g., stridor, wheezing).

   c. Apply supplemental oxygen by mask or nasal cannula.

   d. Place the patient in the position of comfort.

   NOTE:
Any casualty complaining of difficulty breathing should receive supplemental oxygen.

   e. Obtain a complete set of vital signs to include pulse oximetry, if available.

2. Perform a focused physical examination.
   a. Listen to the anterior and posterior lung fields with the stethoscope.
   b. Look at the chest and abdomen and note the presence of any retractions.
   c. Check the skin for the presence of cyanosis.
   d. Check the lower extremities for the presence of edema.
3. Obtain a focused history.
   a. Ask the patient if there is an existing condition such as asthma.
   b. Ask the patient if he is taking any medications.
   c. Question the patient about allergies to medications.
   d. Ask the patient if difficulty breathing was of sudden or gradual onset.
4. Assist the patient in using a metered dose inhaler.

   **NOTE:**
   This step may only be performed if the casualty has an inhaler prescribed to him.
   a. Perform the five rights of medication dosage.
   b. Have the patient exhale deeply.
   c. Have the patient place his lips around the opening and press the inhaler to activate the spray as he inhales deeply.
   d. Instruct the patient to hold his breath as long as possible before exhaling.
   e. Repeat steps 4b through 4d.

   **NOTE:**
   This step may only be performed with a medical officer's order for a nebulizer treatment.
   a. Set up the nebulizer per manufacturer's guidelines.
   b. Instill the appropriate medicine IAW local SOP.
   c. Connect the nebulizer to an oxygen source.

   **NOTE:**
   Compressed air can be used but it does not supply the casualty with supplemental oxygen.
   d. Turn on the flow of oxygen and check for the formation of mist (smoke).
   e. Have the patient place his lips on the mouth piece and slowly inhale and exhale the mist.
   f. Monitor the patient's vital signs every 5 minutes. If available, attach the casualty to a pulse oximeter.
7. Evacuate the patient.

**CARDIAC EMERGENCIES**

A number of heart conditions are commonly referred to as heart attacks. These conditions include angina pectoris, acute myocardial infarction, and congestive heart failure. Together these heart conditions are the cause of at least half a million deaths per year in the United States. Heart conditions occur more commonly in men in the 50-to-60-year age group. Predisposing factors are the lack of physical conditioning, high blood pressure and blood cholesterol levels, smoking, diabetes, and a family history of heart disease.

**Angina Pectoris**

Angina pectoris, also known simply as angina, is caused by insufficient oxygen being circulated to the heart muscle. This condition results from a spasm of the coronary artery, which allows the heart to function adequately at rest but does not allow enough oxygen-enriched blood to pass through the heart to support sustained exercise. When the body exerts itself, the heart muscle becomes starved for oxygen. The result of this condition is a squeezing, substernal pain that may radiate to the left arm and to the jaw.

Angina is differentiated from other forms of heart problems because the pain results from exertion and subsides with rest. Many people who suffer from angina pectoris carry nitroglycerin tablets. If the casualty of a suspected angina attack is carrying a bottle of these pills, place one pill under the tongue. Relief will be almost instantaneous.
Other first aid procedures include providing supplemental oxygen, reassurance, comfort, monitoring vital signs, and transporting the casualty to a medical treatment facility.

**Acute Myocardial Infarction**

Acute myocardial infarction results when a coronary artery is severely occluded by arteriosclerosis or completely blocked by a clot. The pain associated with myocardial infarction is similar to that of angina pectoris but is longer in duration, not related to exertion or relieved by nitroglycerin, and leads to death of heart-muscle tissue. Other symptoms are sweating, weakness, and nausea. Additionally, although the patient’s respirations are usually normal, his pulse rate increases and may be irregular, and his blood pressure falls. The casualty may have an overwhelming feeling of doom. Death may result.

**Congestive Heart Failure**

A heart suffering from prolonged hypertension, valve disease, or heart disease will try to compensate for decreased function by increasing the size of the left ventricular pumping chamber and increasing the heart rate. This condition is known as congestive heart failure. As blood pressure increases, fluid is forced out of the blood vessels and into the lungs, causing pulmonary edema. Pulmonary edema leads to rapid shallow respirations, the appearance of pink frothy bubbles at the nose and mouth and distinctive rattling sounds (known as *rales*) in the chest. Increased blood pressure may also cause body fluids to pool in the extremities resulting in peripheral edema. Emergency treatment for congestive heart failure is essentially the same as that for acute myocardial infarction. Do not start CPR unless the patient’s heart function ceases. If an intravenous line is started, it should be maintained at the slowest rate possible to keep the vein open since an increase in the circulatory volume will make the condition worse. Immediately transport the patient to a medical treatment facility.

**CARDIAC EMERGENCY ASSESSMENT**

**Scenario**

The HM has a conscious patient who is complaining of chest pain. The HM has already taken the appropriate body substance isolation (BSI) precautions. The HM has already done the initial patient assessment, focused history, and physical.

**Objective**

Complete all necessary steps to manage a patient with a cardiac emergency, without causing any further injury.

1. Identify the signs and symptoms of cardiac emergency or compromise.
   a. Pain, pressure, or discomfort in the chest or upper abdomen (epigastrium).
   b. Dyspnea.
   c. Palpitations.
   d. Sudden onset of sweating with nausea or vomiting.
   e. Anxiety (feeling of impending doom or irritability).
   f. Abnormal pulse.
      i. Bradycardia (less than 60 beats per minute).
      ii. Tachycardia (greater than 100 beats per minute).
   g. Abnormal blood pressure.
      i. Hypotensive (systolic pressure less than 90).
      ii. Hypertensive (systolic pressure greater than 140).
h. Pulmonary edema.
   i. Shortness of breath.
   ii. Dyspnea.
   iii. Rales upon auscultation.
   i. Pedal edema.

2. Administer the appropriate treatment.
   a. Place the patient in a position of comfort.

   **NOTE:**
   This is normally in the Fowler's position.

   b. Apply a high concentration of oxygen via a non-rebreather mask.

   c. Assist the patient in taking nitroglycerin, if available.

   **NOTE:**
   Administer the nitroglycerin only if ALL of the following conditions are met:
   - Patient complains of chest pain.
   - Patient has a history of cardiac problems.
   - Patient has a current prescription for nitroglycerin.
   - Patient has the nitroglycerin.
   - Patient's systolic blood pressure is greater than 100.

   i. Check the five rights.
   ii. Remove the oxygen mask.
   iii. Ask the patient to open his or her mouth and to lift the tongue.
   iv. Place the tablet or spray (if using mist) under the tongue with a gloved hand.

   **CAUTION:**
   Avoid contacting the nitroglycerin tablet or mist with bare skin. The vasodilation affects could cause unconsciousness.

   v. Have the patient close his or her mouth and hold the tablet under the tongue.
   vi. Replace the oxygen mask.
   vii. Recheck the blood pressure within two minutes.

   **NOTE:**
   If the blood pressure falls below 100, treat the patient for shock and transport immediately.

   d. If the patient experiences no relief, repeat step 2c every 5 minutes until the patient has taken a total of three tablets.
   e. If the patient experiences no relief after three nitroglycerin tablets or his condition worsens, initiate an IV at to keep vein open (KVO/TKO) rate.

3. Transport promptly to the nearest medical treatment facility.
4. Perform an ongoing assessment while en route.
5. Document all interventions.

**ALLERGIC REACTION ASSESSMENT**

**Scenario**

The HM has a patient demonstrating signs and symptoms of an allergic reaction.

**Objective**

Treat a patient with an allergic reaction without causing further harm.

**Performance Steps**

1. Recognize the causes of allergic reactions.
   a. Drugs (penicillin).
   b. Insect bites (bee stings).
   c. Pollen.
   d. Food (peanuts).
2. Recognize the early manifestations of an allergic or anaphylactic reaction.
   a. Skin.
      i. Flushing.
      ii. Urticaria (hives).
      iii. Swelling of face (especially eyes and lips), hands, feet, neck.
      iv. Swelling of mouth, tongue, airway (angioedema).
   b. Respiratory.
      i. Tightness in throat and chest.
      ii. Cough.
      iii. Rapid, labored noisy breathing.
      iv. Stridor (harsh, high pitched sound during inspiration).
      v. Wheezing (may be audible without a stethoscope).
   c. Cardiac.
      i. Increased heart rate.
      ii. Decreased blood pressure.
   d. Generalized feelings.
      i. Itchy, watery eyes.
      ii. Headache.
      iii. Runny nose.
      iv. Sense of impending doom.
3. Recognize the signs of anaphylactic shock.
   a. May have any of the above, but must have signs of respiratory distress or shock.
   b. Altered mental status.
   c. Signs of respiratory distress.
   d. Signs of shock.
4. Treat allergic reactions.

   NOTE:
   Take Body Substance Isolation (BSI) precautions.

   a. Perform initial assessment ABCs (treat any life-threatening conditions).
   b. Perform a focused history and physical exam.
   c. Assess baseline vital signs and SAMPLE history.
   d. Manage the patient's airway and breathing. If the patient has an epinephrine autoinjector and has symptoms of anaphylaxis, assist in the epinephrine administration.
5. Evacuate the patient to the nearest medical treatment facility (MTF).

**ANAPHYLACTIC EMERGENCY**

This condition, also called anaphylaxis or anaphylactic shock, is a severe allergic reaction to foreign material. The most frequent causes are probably penicillin and the toxin from bee stings, although foods, inhalants, and contact substances can also cause a reaction. Anaphylaxis can happen at any time, even to people who have taken penicillin many times before without experiencing any problems. This condition produces severe shock and cardiopulmonary failure of a very rapid onset. Because of the rapidity and severity of the onset of symptoms, immediate intervention is necessary. The general treatment for severe anaphylaxis is the subcutaneous injection of 0.3 cc of epinephrine and supportive care.

The most characteristic and serious symptoms of an anaphylactic reaction are loss of voice and difficulty breathing. Other typical signs are giant hives, coughing, and wheezing. As the condition progresses, signs and symptoms of shock develop, followed by respiratory failure. Emergency management consists of maintaining vital life functions. Summon the medical officer immediately.
ANAPHYLACTIC SHOCK ASSESSMENT

Scenario

The HM needs to treat a casualty for an anaphylactic shock.

Objective

Initiate treatment for anaphylactic shock, stabilize the casualty, and minimize the effects of anaphylaxis without causing further injury to the casualty.

Performance Steps

1. Check the casualty for signs and symptoms of anaphylactic shock.
   a. Skin.
      i. Flushed or ashen.
      ii. Burning or itching.
      iii. Edema (swelling), especially in the face, tongue, or airway.
      iv. Urticaria (hives) spreading over the body.
      v. Marked swelling of the lips and cyanosis about the lips.
   b. Respiratory.
      i. Tightness or pain in the chest.
      ii. Sneezing and coughing.
      iii. Wheezing, stridor, or difficulty in breathing (dyspnea).
      iv. Sputum (may be blood tinged).
   c. Circulatory.
      i. Weak, rapid pulse.
      ii. Falling blood pressure.
      iii. Hypotension.
      iv. Dizziness or fainting.
      v. Coma.

2. Open the airway, if necessary.

   **NOTE:**
   Anaphylactic reactions occur within minutes or even seconds after contact with the substance to which the patient is allergic. Reactions occur in the skin, respiratory system, and circulatory system.

   **NOTE:**
   Take Body Substance Isolation (BSI) precautions.

3. Administer high concentration oxygen.

4. Administer epinephrine.
   a. Administer 0.3 - 0.5 ml of epinephrine, 1:1000 solution, subcutaneously (SQ) or intramuscularly (IM).
      **NOTE:** Annotate the time of injection.
   b. Additional epinephrine may be required if anaphylaxis progresses. Additional doses may be administered every 5 to 10 minutes if needed.

5. Initiate an intravenous (IV) infusion.

6. Provide supportive measures for the treatment of shock, respiratory failure, circulatory collapse or cardiac arrest.
   a. Infuse additional IV fluid if blood pressure continues to drop.
   b. Position the casualty in the supine position with legs elevated if injuries permit.
   c. Perform rescue breathing, if necessary.
   d. Administer external chest compressions, if necessary.

7. Check the casualty's vital signs every 3 to 5 minutes until the casualty is stable.

8. Record the treatment given.

**NOTE:**
In cases of airway obstruction from severe glottic edema, a cricothyroidotomy may be necessary.

3. Administer high concentration oxygen.

4. Administer epinephrine.
   a. Administer 0.3 - 0.5 ml of epinephrine, 1:1000 solution, subcutaneously (SQ) or intramuscularly (IM).
      **NOTE:** Annotate the time of injection.
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   b. Position the casualty in the supine position with legs elevated if injuries permit.
   c. Perform rescue breathing, if necessary.
   d. Administer external chest compressions, if necessary.

7. Check the casualty's vital signs every 3 to 5 minutes until the casualty is stable.

8. Record the treatment given.
9. Evacuate the casualty, providing supportive measures en route.

POISONS/DRUG ABUSE/HAZARDOUS MATERIALS EMERGENCIES

HMs can encounter special situations that include poisoning, suspected drug abuse, or exposure to hazardous materials. Knowledge of these conditions along with the ability to assess and treat them is essential. These situations are discussed in detail in Chapter 22, "Poisoning and Drug Abuse."

POISONED CASUALTY ASSESSMENT

Scenario

The HM has a casualty that has been poisoned. All other more serious injuries have been assessed and treated. The HM has taken body substance isolation (BSI) precautions and has performed an initial assessment.

Objective

Determine the type of poisoning and provide treatment, minimizing the effects of the poisoning, without causing further injury to the casualty.

1. Determine the type of poisoning.

CAUTION:

If determination cannot be made to the type of poisoning, the casualty should be treated by the symptoms presented.

a. Ingested poisons.
   i. Altered mental status.
   ii. Nausea/vomiting.
   iii. Abdominal pain.
   iv. Diarrhea.
   v. Chemical burns around the mouth.
   vi. Unusual breath odors.

b. Inhaled poisons.
   i. Carbon monoxide.
      1. Headache.
      2. Dizziness.
      3. Dyspnea.
      4. Nausea/vomiting.
      5. Cyanosis.
      6. Coughing.
   ii. Smoke Inhalation.
      1. Dyspnea.
      2. Coughing.
      3. Breath that has a smoky smell or the odor of chemicals involved at the scene.
      4. Black residue in any sputum coughed up by the casualty.
      5. Nose-hairs singed from superheated air.

c. Injected poisons.
   i. Sympathomimetics
      (Uppers- example: cocaine).
         1. Excitement.
         2. Tachycardia.
         3. Tachypnea.
         4. Dilated pupils.
         5. Sweating.
   ii. Sedative-Hypnotics
      (Downers - examples; Valium®, Xanax XR®).
         1. Sluggish.
         2. Sleepy typical coordination of body and speech.
         3. Pulse and breathing rates are low, often to the point of a true emergency.
iii. Hallucinogens (LSD).
   1. Tachycardia.
   2. Dilated pupils.
   3. Flushed face.
   4. Often sees or hears things, has very little concept of time.

iv. Narcotics (Morphine, heroin).
   1. Reduced rate of breathing.
   2. Dyspnea.
   3. Low skin temperature.
   5. Pinpoint pupils.
   6. Very sleepy.

iv. Absorbed poisons.
   1. Liquid or powder on the casualty's skin.
   2. Burns.
   3. Itching.
   4. Irritation.
   5. Redness.

2. Administer emergency care.
   a. Ingested poisons.
      1. Maintain the airway.
      2. Gather all information about the type of ingested poisoning.
      3. Initiate IV therapy.

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<td>Mix with soda for easier consumption.</td>
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<th>CAUTION:</th>
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<td>Activated charcoal is contraindicated for patients that have an altered mental status that are suspected of swallowing acids or alkalis, or have an inability to swallow.</td>
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<td>Be prepared to provide oral suctioning if the casualty starts to vomit. All vomitus must be saved.</td>
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1. Adults and children: 1 gram of activated charcoal/kg of body weight.
3. Usual pediatric dose: 12.5 - 25 grams.

v. Give supplemental oxygen.
vi. Record the name, dose, and time of administration of medication.

vii. Transport to the nearest medical treatment facility.

b. Inhaled poisons.
   1. Remove the casualty from the unsafe environment.
   2. Maintain the airway.
   3. Administer high concentrations of oxygen.

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<td>Oxygen therapy is the most important treatment for inhalation poisoning.</td>
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iv. Transport to the nearest medical treatment facility.
c. Absorbed poisons.
   1. Remove the casualty from the source.
   2. Remove contaminated clothing.
   3. Brush off any powders from the casualty's skin.
   4. Flush the skin with large amounts of water for at least 20 minutes.
d. Injected poisons.
   i. Maintain the airway and be prepared to provide assisted ventilations.
   ii. Give supplemental oxygen.
   iii. Initiate IV therapy.
   iv. Look for gross soft tissue damage ("tracks").
   v. Protect the casualty from harming self and others.

   NOTE:
   Be prepared to use restraints.

   vi. Transport to the nearest medical treatment facility.

3. Document procedures.

DIABETIC EMERGENCIES

Diabetes mellitus is an inherited condition in which the pancreas secretes an insufficient amount of the protein hormone insulin. Insulin regulates carbohydrate metabolism by enabling glucose to enter cells for use as an energy source.

Diabetic Ketoacidosis

Diabetic ketoacidosis most often results either from forgetting to take insulin or from taking too little insulin to maintain a balanced condition. Diabetics may suffer from rising levels of glucose in the blood stream (hyperglycemia). The rising levels of glucose result in osmotic diuresis, an increased renal excretion of urine. Serious dehydration (hypovolemia) may result.

Concurrently, the lack of glucose in the cells leads to an increase in metabolic acids in the blood (acidosis) as other substances, such as fats, are metabolized as energy sources. The result is gradual central nervous system depression, starting with symptoms of confusion and disorientation, and leading to stupor and coma. Blood pressure falls, and the pulse rate becomes rapid and weak.

Respirations are deep, and a sickly sweet acetone odor is present on the breath. The skin is warm and dry.

NOTE:
Diabetic casualties are often mistakenly treated as if intoxicated since the signs and symptoms presented are similar to those of alcohol intoxication.

The diabetic under treatment tries to balance the use of insulin against glucose intake to avoid the above problems. The casualty or the casualty’s family may be able to answer two key questions:

1. Has the casualty eaten today?
2. Has he taken the prescribed insulin?

If the answer is yes to the first and no to the second question, the casualty is probably in a diabetic coma.

Emergency first aid centers on ABC support, administration of oral or intravenous fluids to counter shock, and rapid evacuation to medical officer's supervision.

Insulin Shock

Insulin shock results from too little sugar in the blood (hypoglycemia). This type of shock develops when a diabetic exercises too much or eats too little after taking insulin. Insulin shock is a very serious condition because glucose is driven into the cells to be metabolized, leaving too little glucose in circulation to support the brain. Brain damage develops quickly. Signs and symptoms of insulin shock include:

- Pale, moist skin
- Dizziness and headache
- Strong, rapid pulse
- Fainting, seizures, and coma

Treatment is centered on getting glucose into the system quickly to prevent brain damage. Placing sugar cubes under the tongue or administering oral liquid glucose are the most beneficial treatments.
Hard candies are a good interim treatment as well. Transport the casualty to a medical treatment facility as soon as possible.

**NOTE:**
If the HM is in doubt as to whether the casualty is in insulin shock or a ketoacidotic state, give them sugar.

Brain damage develops very quickly in insulin shock and must be reversed immediately.

If the casualty turns out to be ketoacidotic, a condition that progresses slowly, the extra sugar will do no appreciable harm.

### DIABETIC EMERGENCY ASSESSMENT

#### Scenario

The HM has a patient with a diabetic emergency.

#### Objective

Initiate treatment for hypoglycemia or hyperglycemia, stabilize the patient, and minimize the effects without causing further injury to the patient.

**NOTE:**
Take Body Substance Isolation (BSI) precautions.

1. Identify the signs and symptoms of a diabetic emergency.
   a. **Hypoglycemia.** (Low blood sugar)

   **NOTE:**
   Hypoglycemia is the most common of all diabetic emergencies.
   
   i. Rapid onset of altered mental status.

   **NOTE:**
   This is especially so after missing a meal, vomiting, or an unusual amount of physical exertion.

   ii. Intoxicated appearance, staggering, slurred speech, or unconsciousness.

   iii. Elevated heart rate.

   iv. Cold, clammy skin.

   v. Hunger.

   vi. Seizures.

   vii. Uncharacteristic behavior.

   viii. Anxiety.

   ix. Combativeness.

   b. **Hyperglycemia.** (High blood sugar)

      i. Slow onset.

      ii. Warm, red, dry skin.

      iii. Sweet, fruity breath odor (acetone).

      iv. Deep, rapid breathing.

      v. Dry mouth.

      vi. Intense thirst.

      vii. Abdominal pain.

      viii. Nausea and vomiting.

2. Administer the appropriate treatment.

   **NOTE:**
   If unsure whether the patient has hyperglycemia or hypoglycemia, it is safer to treat the patient for hypoglycemia.

   a. **Hypoglycemia.**

      i. If conscious, administer oral glucose IAW local protocol.

      **NOTE:**
      Give it only if the patient has a history of diabetes, the patient has an altered mental status and the patient is awake enough to swallow.

      1. Apply glucose to a tongue depressor and place it in the patient's mouth between the cheek and gum.

      2. Or if the patient is able, let the patient squeeze the glucose from the tube directly into his mouth.
ii. Monitor the patient for complications.
iii. Assess vital signs.
iv. If unconscious:
   1. Secure the airway and administer oxygen.
   2. Assess vital signs.
   3. Start an intravenous IV at to keep vein open (TKO) rate.
   4. Place the patient in the recovery position.

   NOTE:
   May be directed by the medical officer to give D50 (dextrose solution) intravenously to determine hyper- vs. hypoglycemia.

5. Transport to the nearest medical treatment facility.

b. Hyperglycemia.
   i. Maintain an open airway and administer oxygen.
   ii. Assess vital signs.
   iii. Start an IV at TKO rate.
   iv. Place the patient on a cardiac monitor, if available.
   v. Transport to the nearest medical treatment facility.

3. Document all treatment given.

   NOTE:
   Document the patient's mental status using the alert, verbal, painful, and unresponsive (AVPU) scale and vital signs every 5 minutes.

   A change in mental status may indicate an alteration in the patient's blood sugar level.

HEAD INJURIES

Head wounds must be treated with particular care, since there is always the possibility of brain damage. The general treatment for head wounds is the same as that for other fresh wounds. However, certain special precautions must be observed if the HM is giving first aid to a person who has suffered a head wound.

HEAD INJURY ASSESSMENT

Scenario

The HM needs to treat a casualty with an open or closed head injury. All other more serious injuries have been assessed and treated.

Objective

Treat the head injury and stabilize the casualty without causing additional injury.

Performance Steps

WARNING:
Treat casualties with any type of traumatic head injury or loss of consciousness as if they have a spinal injury.

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Check for the signs and symptoms of head injuries.
   a. Closed head injury is caused by a direct blow to the head.

   WARNING:
   Brain injury, leading to a loss of function or death, often occurs without evidence of a skull fracture or scalp injury.

   Because the skull cannot expand, swelling of the brain or a collection of fluid pressing on the brain can cause pressure.

   This can compress and destroy the brain tissue.
i. Deformity of the head.
ii. Clear fluid or blood escaping from the nose and or ear(s).
iii. Periorbital discoloration (raccoon eyes).
iv. Bruising behind the ears, over the mastoid process (battle sign).
v. Lowered pulse rate if the casualty has not lost a significant amount of blood.
vi. Signs of increased intracranial pressure.
   1. Headache, nausea, and or vomiting.
   2. Possible unconsciousness.
   3. Change in pupil size or symmetry.
   4. Lateral loss of motor nerve function--one side of the body becomes paralyzed.

   NOTE:
   Lateral loss may not happen immediately but may occur later.

   5. Change in the casualty's respiratory rate or pattern.
   6. A steady rise in the systolic blood pressure if the casualty hasn't lost significant amounts of blood.
   7. A rise in the pulse pressure (systolic pressure minus diastolic pressure).
   8. Elevated body temperature.
   9. Restlessness--indicates insufficient oxygenation of the brain.

b. Concussion--caused by a violent jar or shock.

   NOTE:
   A direct blow to the skull may bruise the brain.

   i. Temporary unconsciousness followed by confusion.
   ii. Temporary, usually short term, loss of some or all brain functions.

iii. The casualty has a headache or is seeing double.
iv. The casualty may or may not have a skull fracture.

c. Contusion--an internal bruise or injury. It is more serious than a concussion. The injured tissue may bleed or swell. Swelling may cause increased intracranial pressure that may result in a decreased level of consciousness and even death.

d. Open head injury.
   i. Penetrating wound--an entry wound with no exit wound.
   ii. Perforating wound--the wound has both entry and exit wounds.
   iii. Visibly deformed skull.
   iv. Exposed brain tissue.
   v. Possible unconsciousness.
   vi. Paralysis or disability on one side of the body.
   vii. Change in pupil size.
   viii. Lacerated scalp tissue--may have extensive bleeding.

2. Direct manual stabilization of the casualty's head.
3. Check the casualty's vital signs.
4. Assess the casualty's level of consciousness using the AVPU scale.
   a. A--alert. The casualty responds spontaneously to stimuli and is able to answer questions in a clear manner.
   b. V--verbal. The casualty does not respond spontaneously but is responsive to verbal stimuli.
   c. P--pain. The casualty does not respond spontaneously or to verbal stimuli but is responsive to painful stimuli.
   d. U--unresponsive. The casualty is unresponsive to any stimuli.
5. Assess the casualty's pupil size.
   a. Observe the size of each pupil.

   **NOTE:**
   A variation of pupil size may indicate a brain injury.
   In a very small percentage of people, unequal pupil size is normal.

   b. Shine a light into each eye to observe the pupillary reaction to light.

   **NOTE:**
   The pupils should constrict promptly when exposed to bright light.
   Failure of the pupils to constrict may indicate brain injury.

6. Assess the casualty's motor function.
   a. Evaluate the casualty's strength, mobility, coordination, and sensation.
   b. Document any complaints, weakness, or numbness.

   **NOTE:**
   Progressive loss of strength or sensation is an important indicator of brain injury.

7. Treat the head injury.
   a. Treat a superficial head injury.
      i. Apply a dressing.
      ii. Observe for abnormal behavior or evidence of complications.
   b. Treat a head injury involving trauma.
      i. Maintain a patent airway using the jaw thrust maneuver.
      ii. If the casualty is unconscious, insert an oropharyngeal airway without hyper-extending the neck.
      iii. Administer high concentration oxygen by non-rebreather mask (NRB) and evaluate the need for artificial ventilations with supplemental oxygen.
      iv. Apply a cervical collar.
      v. Dress the head wound(s).
   vi. Control bleeding.

   **WARNING:**
   Do not apply pressure to or replace exposed brain tissue.

   vii. Treat for shock.
   viii. Monitor the casualty for convulsions or seizures.
   ix. Position the casualty with the head elevated 6 inches to assist with the drainage of blood from the brain.

   **CAUTION:**
   Do not give the casualty anything by mouth.

8. Continue to monitor the casualty and check and record the following at 5 minute intervals.
   a. Level of consciousness.
   b. Pupillary responsiveness and equality.
   c. Vital signs.
   d. Motor functions.
10. Evacuate the casualty.

**CHEST INJURIES**

Since chest injuries may cause severe breathing and bleeding problems, all chest injuries must be considered as serious conditions. Any casualty showing signs of difficulty in breathing without signs of airway obstruction must be inspected for chest injuries. The most serious chest injury that requires immediate first aid treatment is the sucking chest wound. This is a penetrating injury to the chest that produces a hole in the chest cavity. The chest hole causes the lung to collapse, preventing normal breathing functions. This is an extremely serious condition that will result in death if not treated quickly.
Casualties with open chest wounds gasp for breath, have difficulty breathing out, and may have a bluish skin color to their face. Frothy-looking blood may bubble from the wound during breathing. The proper treatment for a sucking chest wound is as follows:

TREAT A CASUALTY WITH A CHEST INJURY

Scenario

The HM has a casualty with a chest injury. All other more serious injuries have been assessed and treated.

Objective

Treat a chest wound without causing additional injury to the casualty.

Performance Steps

NOTE: Take Body Substance Isolation (BSI) precautions.

1. Perform an initial assessment of the casualty.
2. Check the casualty for signs and symptoms of chest injuries.
   a. Deformities, contusions, abrasions, punctures/penetrations (DCAP), bleeding, tenderness, lacerations, swelling (BTLS).
   b. Pleuritic pain that is increased by or occurs with respirations and is localized around the injury site.
   c. Labored or difficult breathing.
   d. Diminished or absent breath sounds.
   e. Cyanotic lips, fingertips, or fingernails.
   f. Rapid, weak pulse and low blood pressure.
   g. Coughing up blood or bloody sputum.
   h. Failure of one or both sides of the chest to expand normally upon inhalation.
   i. Paradoxical breathing - the motion of the injured segment of a flail chest, opposite to the normal motion of the chest wall.
   j. Enlarged neck veins.
   k. Coughing up blood or bloody sputum.
   l. Tracheal deviation - shift of the trachea from the midline toward the unaffected side due to pressure buildup on the injured side. THIS IS A LATE SIGN.
3. Check for an exit wound or injury.
4. Determine the type of injury.
   a. Open pneumothorax - air entering pleural space through defect in pleural wall.
      i. Signs and symptoms.
         1. Respiratory distress.
         2. Anxiousness.
         3. Tachypnea.
      ii. Treatment.
         1. Seal the wound(s), covering the larger wound first.
            NOTE: All penetrating chest wounds should be treated as if they were sucking chest wounds.
         2. Cut the dressing wrapper on one long and two short sides and remove the dressing.
            NOTE: In an emergency, any airtight material can be used. It must be large enough so it is not sucked into the chest cavity.
         3. Apply the inner surface of the wrapper to the wound when the casualty exhales.
         4. Ensure that the covering extends at least two inches beyond the edges of the wound.
5. If the HM does not have the ability to perform a needle chest decompression, seal by applying overlapping strips of tape to three sides of the plastic covering to provide a flutter-type valve.

6. If the HM has the ability to perform a needle chest decompression (NCD), ensure all four sides of the occlusive dressing are secured. (NCD procedures outlined later.)

7. Cover the exit wound in the same way, if applicable.

**NOTE:**
Assess the effectiveness of the flutter valve when the casualty breathes.

When the casualty inhales, the plastic should be sucked against the wound, preventing the entry of air.

When the casualty exhales, trapped air should be able to escape from the wound and out the untaped side of the dressing.

8. Supplement with oxygen if available.

**WARNING:**
Complication - if tension pneumothorax is suspected, perform a needle chest decompression (NCD).

b. **Rib fracture** - generally caused by a direct blow to the chest or compression of the chest. Severe coughing can also cause rib fracture.

i. Signs and symptoms.
   1. Pain is aggravated by respirations and coughing.
   2. Crepitus is present.
   3. The casualty will guard to protect the injury.

ii. Complications.
   1. Internal bleeding (hemothorax).
   2. Shock.

iii. Treatment.
   1. Use a sling and swathe to immobilize the affected side, i.e. immobilizing the arm as a means to support the rib cage.
   2. Administer oxygen as necessary.

**NOTE:**
The broken rib may puncture the lung or the skin.

**WARNING:**
Do not tape, strap, or bind the chest, these interventions increase the development of pneumonia.

c. **Flail chest** - two or more ribs fractured in two or more places or a fractured sternum.

i. Signs and symptoms.
   1. Severe pain at the site.
   2. Rapid shallow breathing.
   3. Paradoxical respirations.

ii. Complications.
   1. Respiratory insufficiency.
   2. Pneumothorax with hemothorax.

iii. Treatment.
   1. Establish and maintain an airway.
   2. Administer oxygen, if available.
   3. Assist the casualty's respirations, if necessary.
   4. Monitor the casualty for signs of hemothorax or tension pneumothorax, as necessary.
d. **Hemothorax** - bleeding from lacerated blood vessels in the chest cavity and or lungs. It results in the accumulation of blood in the chest cavity not outside the lungs.

i. Signs and symptoms.
   1. Hypotension due to blood loss.
   2. Shock.
   3. Cyanosis.
   4. Tightness in the chest.
   5. Mediastinal shift may produce deviated trachea away from the affected side. LATE SIGN
   6. Coughing up frothy red blood.

ii. Complications.
   1. Possibility of hypovolemic shock.
   2. Frequently accompanies a pneumothorax.

iii. Treatment.
   1. Establish and maintain an airway.
   2. Administer oxygen.
   3. Assist the casualty's breathing, as necessary.


ii. Treatment.
   1. Establish and maintain an airway.
   2. Perform NCD if indicated.
   3. Administer oxygen.
   4. Assist the casualty's respirations, as necessary.
   5. Monitor the casualty for progression of symptoms.

5. Treat the injury.

6. Treat the casualty for shock.

7. Record the care provided.

8. Evacuate the casualty.

**NOTE:**
Continue to assess the casualty. The casualty should be evacuated by the most expedient means.

**ABDOMINAL INJURIES**

A deep wound in the abdomen is likely to constitute a major emergency since there are many vital organs in this area. Abdominal wounds typically cause intense pain, nausea and vomiting, spasm of the abdominal muscles, and severe shock. Immediate surgical treatment is almost always required; therefore, the casualty must receive medical attention at once, or the chances of survival will be poor. The HM should give only the most essential first aid treatment, and concentrate efforts on getting the casualty to a medical treatment facility. The following first aid procedures may be of help to a person suffering from an abdominal wound.
ABDOMINAL INJURY ASSESSMENT

Scenario
The HM has a casualty with an open abdominal wound. All other more serious injuries have been assessed and treated.

Objective
Treat an open abdominal wound, minimize the effects of the injury, and stabilize the casualty without causing additional injury.

Performance Steps

1. Position the casualty.
   a. Place the casualty on his back (face up).
   b. Ensure the casualty has a patent airway.
   c. Flex the casualty's knees.
   d. Turn the casualty's head to the side and keep the airway clear if vomiting occurs.

2. Treat for shock. Initiate one large bore (18 gauge) IV if the casualty is exhibiting signs and symptoms of shock.

   WARNING:
The most important concern in the initial management of abdominal injuries is shock.

   Shock may be present initially or develop later.

   Neither the presence nor absence of a wound, nor the size of the external wound are safe guidelines for judging the severity of the wound.

3. Expose the wound. Inspect for distention, contusions, penetration, eviscerations or obvious bleeding.

   CAUTION:
   Do not attempt to replace protruding internal organs or remove any protruding foreign objects.

4. Stabilize any protruding objects.

5. Apply a sterile abdominal dressing.

   NOTE:
   Protruding abdominal organs should be kept moist to prevent the tissue from drying out.

   A moist, sterile dressing should be applied if available.

   a. Using the sterile side of the dressing, or other clean material, place any protruding organs near the wound.
   b. Ensure that the dressing is large enough to cover the entire mass of protruding organs or area of the wound.
   c. If large enough to cover the affected area, place the sterile side of the plastic wrapper directly over the wound to provide an additional barrier layer to protect the organs from rupture and contamination. Open abdominal wounds can become infected quickly and lead to systemic infection, or sepsis.
   d. Place the dressing directly on top of the wound or plastic wrapper, if used.
   e. Tie the dressing tails loosely at the casualty's side.

   CAUTION:
   Do not apply pressure on the wound or expose internal parts.

   f. If two dressings are needed to cover a large wound, repeat steps 5a through 5e. Ensure that the ties of additional dressings are not tied over each other.
   g. If necessary, loosely cover the dressings with cravats. Tie them on the side of the casualty opposite that of the dressing ties.

6. Do not cause further injury to the casualty.
   a. Do not touch any exposed organs with bare hands.
   b. Do not try to push any exposed organs back into the body.
c. Do not tie the dressing tails tightly or directly over the dressing.
d. Do not give the casualty anything by mouth (NPO).

**NOTE:**
Continue to assess the casualty.

7. Prepare the casualty for evacuation.
   a. Place the casualty on his back (face up) with the knees flexed.
   b. If evacuation is delayed, check the casualty for signs of shock every 5 minutes.
   c. Consider pain management as necessary.
8. Record the treatment given.
9. Evacuate the patient.

**CHILDBIRTH EMERGENCIES**

Every HM must be prepared to handle the unexpected arrival of a new life into the world. If the HM is fortunate, a prepackaged sterile delivery pack will be available; unfortunately this is usually not the case. This pack will contain all the equipment needed for the normal delivery of a healthy baby. If the pack is not available the HM will require imaginative improvisation of clean alternatives.

When faced with an imminent childbirth, first determine whether there will be time to transport the expectant mother to a hospital. To help make this determination, the HM should try to find out:

- Which delivery will this be the woman (first vaginal deliveries normally take much longer than subsequent deliveries)
- Have there been any complications with this pregnancy (or previous pregnancies)
- Has her water broken or is there blood
- The time between contractions (if less than 3 minutes, delivery is approaching)
- If the mother senses that she has to move her bowels (if so, then the baby’s head is well advanced down the birth canal)
- If there is crowning of the baby’s head at the vaginal opening (crowning indicates that the baby is ready to present itself)
- How long will it take to get to the hospital

The HM must weigh the answers to these questions and decide if it will be safe to transport the patient to the hospital.

**Preparation**

Prior to childbirth, The HM must quickly "set the stage."

- Do not allow the mother to go to the bathroom since straining may precipitate delivery. However, do not try to inhibit the natural process of childbirth
- The mother should lie back on a sturdy table, bed, or stretcher with a folded sheet or blanket placed under her buttocks for absorption and comfort
- Ensure one side of the pelvis is elevated (place hip roll under right or left side; left side is more common) to ensure blood flow in the pelvic region and thus ensuring oxygenation of the fetus: the weight of the fetus and uterus can compress the abdominal aorta resulting in insufficient blood flow
- Remove all of the patient’s clothing below the waist, bend the knees, move the thighs apart (i.e. lithotomy position), and drape her lower extremities with clean towels or sheets
- Don sterile gloves, or, if these are not available, the HM must rewash his or her hands
Normal Vaginal Delivery (NVD)

In a normal delivery, the HM’s calm professional manner and sincere reassurance to the mother will reduce her anxiety and make the delivery easier for everyone. Help the woman rest and relax as much as possible between contractions.

During a contraction, deep, open-mouth breathing will relieve some pain and straining. As the child’s head reaches the area of the rectum, the mother will feel an urgent need to defecate. Reassurance that this is a natural feeling and a sign that the baby will be born soon will help alleviate her apprehension.

**DELIVERY STEPS.—**Watch for the presentation of the top of the baby’s head.

1. Once the head appears, the HM takes up station at the foot of the bed and gently supports the head (with the palms of the hand) to keep it from emerging too quickly. Allow the head to come out slowly.

2. Once the head presents, direct the mother to breathe and not to push while checking for the umbilical cord. As more of the head appears, visually check to be sure that the umbilical cord is not wrapped around the neck.

3. Cord around the baby’s neck: If it is, either gently try to untangle the cord or move one section over the baby’s shoulder. If neither of these actions is possible, clamp the cord in two places, 2 inches apart, and cut it between the clamps.

4. Once the baby’s chin emerges, direct the mother to breathe and not to push.

5. Support the baby’s head with one hand and use the bulb syringe from the pack to suction the mouth and then the nostrils. Before placing the bulb in the baby’s mouth or nose, compress it; otherwise, a forceful aspiration into the lungs will result.

6. The baby will now start a natural rotation to the left or right, away from the face-down position.

7. As this rotation occurs, keep the baby’s head in alignment with his or her body.

8. The shoulders appear next, usually one at a time. Deliver the top shoulder first using the flexibility of the posterior pelvic floor to move the shoulder under and out from the symphysis pubic bone. The bottom shoulder will typically deliver itself with a bit of force. Remember, the baby is VERY slippery.

9. Keep one hand beneath the baby’s head, and use the other hand to support its emerging body.
Infant Care Post-Delivery

Care immediately after delivery is critical for successful transition of the baby from intranatal circulation and oxygenation (all provided by the mother) to extranatal circulation and oxygenation (all required of the baby). The following are steps to successfully transition the baby:

1. Airway and Breathing.
   a. Once the baby has been born, suction the nose and mouth again if breathing has not started.
   b. Wipe the baby’s face, nose, and mouth clean with sterile gauze.
   c. Vigorously rub the baby’s back and flick its feet to get the baby to cry and or to sustain a good healthy cry (if the cry is depressed). The reward is the baby’s hearty cry.

2. Circulation.
   a. Keep the baby level with the mother’s uterus until the cord is cut.
   b. Clamp the umbilical cord as the pulsations cease.
   c. Use two clamps from the prepackaged sterile delivery pack, 2 inches apart, with the first clamp 6 to 8 inches from the navel.
   d. Cut the cord between the clamps.
   e. For safety, use gauze tape to tie the cord 1 inch from the clamp toward the navel. Secure the tie with a square knot.

3. Warmth.
   a. Wrap the baby in a warm, sterile blanket, and log its time of arrival.
   b. If the baby has a low body temperature, place chest to chest with the mother (who must be stable) and place a blanket over the two of them to allow for heat transfer from the mother.

Mother Care Post-Delivery

This is a relatively dangerous period for the mother, as hemorrhage and shock may occur. Steps must be taken to ensure all infection control procedures are followed. Additionally, close hemodynamic monitoring is needed as the mother transitions from pregnancy to post-partum physiologic status. The following are steps to ensure a successful and safe transition:

1. The placenta (afterbirth) will deliver itself in 10 to 20 minutes. Massaging the mother’s lower abdomen can aid this delivery. Do not pull on the umbilical cord to hasten its delivery. Log the time of the placenta’s delivery, and wrap it up for hospital analysis.

   **NOTE:**
   If there are any concerns regarding delivery of the placenta or its presentation upon delivery, immediately contact a medical officer for guidance.

2. Place a small strip of tape (½ -inch wide), folded and inscribed with the date, time of delivery, and mother’s name, around the baby’s wrist.

3. Place the same identification tape around the mother’s wrist so that the mother and baby can be matched later at the medical treatment facility.

4. Monitor vital signs every 5 minutes for the first 15 minutes, every 15 minutes for three recordings, every 30 minutes for 2 recordings, and every hour for 4 hours. Then resort to vital signs every 4 hours. If the patient is bleeding heavily or shock signs and symptoms are present, continue every 5 minute vital signs until the mother is stabilized.

5. Monitor for uterine hemorrhage.
   a. The uterus should be gently massaged to keep it hard.
   b. For first time mothers, the uterus will be at or slightly above the navel.
c. For experienced mothers, the uterus will be at or slightly below the navel.

**NOTE:**
If the uterus appears too high or is offset to the right or left the mother has a full bladder that must be emptied (either on her own or via urinary catheterization).

A full bladder will prevent the uterus from contracting and closing the vessels that are bleeding.

d. Have mother put infant to breast to aid with contractions which clamps down the uterine arteries and veins and decreases the bleeding.

6. Nutrition and restoration of resources.
   a. The mother will need nourishment and will wish to rest and watch her baby.

7. Care of the vaginal opening and canal.
   a. The mother should keep her hands away from the area surrounding the birth outlet.
   b. If uncontaminated water is available, she may wish to wash off her thighs. She may get up and go to the bathroom or seek better shelter.
   c. All care should be taken to avoid introducing infection into the birth canal.
   d. Educate the mother about the amount and color of vaginal discharge.
      i. She can expect some vaginal discharge for several days.
      ii. This is reddish for the first day or so but lightens and becomes less profuse within a few days.
      iii. May bleed longer than a typical period.
      iv. If bleeding increases, immediately assess the location and firmness of the uterus and ensure the mother has voided recently.

Final Notes

Stay with the mother until relieved by competent personnel. Almost all emergency births are normal. The babies typically thrive and the mothers recover quickly. It is very important when assisting with an emergency delivery that the HM continually reassures the mother and attempts to keep her calm.

**COMPLICATIONS IN CHILDBIRTH**

Unfortunately, not all deliveries go smoothly. The following sections cover various complications in childbirth.

**Breech Delivery**

A breech delivery occurs when the baby’s legs and or buttocks emerge first. Follow the steps for a normal delivery, and support the lower extremities with one hand. If the head does not emerge within 3 minutes, try to maintain an airway by gently pushing fingers into the vagina. Push the vagina away from the baby’s face and open his or her mouth with one finger. Get medical assistance immediately.

**Prolapsed Cord**

If the cord precedes the baby, protect it with moist, sterile wraps. If a physician cannot be reached quickly, place the mother in an extreme shock position. Give the mother oxygen, if available, and gently move a sterile gloved hand into the vagina to keep its walls and the baby from compressing the cord. The HM will provide support until the baby is delivered. The HM cannot remove his or her hand until told to do so by a medical officer. Get medical assistance immediately.

**Excessive Bleeding**

If the mother experiences severe bleeding, treat her for shock and give her oxygen, if available. Place sanitary napkins over the vaginal entrance and rush her to a hospital.
If hemorrhaging does occur, do the following:

1. The uterus should be gently massaged to keep it hard.
2. The woman should lie flat, and the bottom of the bed should be elevated.
3. Put a cold pack (such as a small towel dipped in cold water and wrung out) on the lower abdomen to irritate the uterus to contract.
4. Put pressure on the perineum with several sanitary napkins and the pressure of a hand.

**Limb Presentation**

If a single limb presents itself first, immediately get the mother to a hospital.

**NON-TACTICAL TRAUMA ASSESSMENT**

If there is no immediate danger to the HM or the surroundings are non-threatening, then the HM’s only limitations are the resources available and the nature of the injury. During these types of scenarios, it is quite reasonable to use the following patient assessment algorithm while assessing a trauma patient (Fig. 21-3).
Basic Trauma Life Support Assessment:

Scene Survey
- Is scene safe?
- Mechanism of injury (MOI)
- Number of patient’s?
- Any HAZMAT?

Primary Assessment (Expose As You Go)
- Treat life threatening injuries as found.
- Control C-Spine
- Assess level of consciousness (AVPU) 
  A: Open and maintainable?
  B: Control C-Spine
  C: Assess rate and quality
     Access for deviated trachea and jugular vein distention
     Exposure and look and feel the chest
     Is there equal rise and fall?
     Dicap-BTLS, flail segments?
  C: Evaluate skin color and temperature
     Feel carotid and radial pulse
     Evaluate pulse rate, strength, and quality

Head / Face - Dicap-BTLS
Neck - Dicap-BTLS
- Step Off?
- Apply C-collar

Shoulders - Dicap-BTLS
Abdomen - Dicap-BTLS
- Tenderness, Rigidity, Distention (TRD)

Pelvis - Dicap-BTLS
- Tenderness, Instability, Crepitus (TIC)
- Firearm (Ejection)?

Legs - Dicap-BTLS
- PMS (Pulse Motor Sensory)
Arms - Dicap-BTLS
- PMS (Pulse Motor Sensory)

Back - Log roll survivor if appropriate, if not, check for
- Dicap-BTLS, Step-Offs

Secure to Liter

Enroute:
- Re-assess ABC’s and Interventions
- Detailed exam head, ears, ears, nose
- Additional procedures and splinting as appropriate
- Give abbreviated report

Physical Exam Acronyms:

- A: Alert
- V: Verbal
- P: Painful
- U: Unresponsive

- B: Deformities
- C: Contusions
- A: Abrasions
- P: Punctures / Penetrations
- B: Burns
- T: Tenderness
- L: Lacerations
- S: Swelling

CPR: 30:2 x 5
Re-Assess

Continue Assessment
TCCC GUIDELINES FOR CARE

Basic Management Plan for Care Under Fire

1. Return fire/take cover.
2. Direct/expect casualty to remain engaged as a combatant, if appropriate.
3. Direct casualty to move to cover/apply self-aid if able.
4. Try to keep the casualty from sustaining additional wounds.
5. Airway management is best deferred until the Tactical Field Care Phase.
6. Stop LIFE-THREATENING external hemorrhage if tactically Feasible.
   a. Direct casualty to control hemorrhage by self-aid if able.
   b. Use a tourniquet for hemorrhage that is anatomically amendable to tourniquet application.
   c. For hemorrhage that cannot be controlled with a tourniquet, apply currently approved hemostatic dressing with pressure.

Basic Management Plan for Tactical Field Care

1. Casualties with an altered mental status should be disarmed immediately.
2. Airway Management.
   a. Unconscious casualty without airway obstruction.
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Place casualty in the recovery position.
   b. Casualty with airway obstruction or impending airway obstruction.
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Allow casualty to assume a position that best protects the airway, to include sitting up.
      iv. Place unconscious casualty in the recovery position.
      v. If previous measures unsuccessful: Surgical cricothyroidotomy (with lidocaine if conscious)
   a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space at the mid-clavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.
   b. All open and or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.
4. Bleeding.
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.
b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no traumatic brain injury (TBI)).

c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.

d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

5. Intravenous (IV) access:
   a. Start an 18-gauge IV or saline lock if indicated.
   b. If resuscitation is required and IV access is not obtainable, use the intraosseous (IO) route.

6. Fluid resuscitation:
   a. Assess for hemorrhagic shock; altered mental status (in the absence of head injury) and weak or absent peripheral pulses are the best field indicators of shock.
   b. If not in shock:
      i. No IV fluids necessary.
      ii. PO fluids permissible if conscious and can swallow.
   c. If in shock:
      i. Hextend®, 500-mL IV bolus.
      ii. Repeat once after 30 minutes if still in shock.
      iii. No more than 1000 mL of Hextend®.
   d. Continued efforts to resuscitate must be weighed against logistical and tactical considerations and the risk of incurring further casualties.
   e. If a casualty with TBI is unconscious and has no peripheral pulse, resuscitate to restore the radial pulse.

   a. Minimize casualty’s exposure to the elements. Keep protective gear on or with the casualty if feasible.
   b. Replace wet clothing with dry if possible.
   c. Apply Ready-Heat Blanket to torso.
   d. Wrap in Blizzard Rescue Blanket.
   e. Put Thermo-Lite Hypothermia Prevention System Cap on the casualty’s head, under the helmet.
   f. Apply additional interventions as needed and available.
   g. If mentioned gear is not available, use dry blankets, poncho liners, sleeping bags, body bags, or anything that will retain heat and keep the casualty dry.
8. Penetrating Eye Trauma.
   a. If a penetrating eye injury is noted or suspected.
      i. Perform a rapid field test of visual acuity.
   b. Cover the eye with a rigid eye shield (NOT a pressure patch).
   c. Ensure that the 400 mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

9. Monitoring:
   a. Pulse oximetry should be available as an adjunct to clinical monitoring.
   b. Readings may be misleading in the settings of shock or marked hypothermia.

10. Inspect and dress known wounds.
11. Check for additional wounds.
12. Provide analgesia as necessary.
   a. Able to fight:
      i. These medications should be carried by the combatant and self-administered as soon as possible after the wound is sustained.
         1. Mobic®, 15 mg PO once a day.
         2. Tylenol®, 650-mg bilayer caplet, 2 PO every 8 hours.
   b. Unable to fight:
      NOTE:
      Have naloxone readily available whenever administering opiates.
      i. Does not otherwise require IV/IO access.
      ii. Oral transmucosal fentanyl citrate (OTFC), 800 ug transbuccally.
      iii. Recommend taping lozenge-on-a-stick to casualty’s finger as an added safety measure.
      iv. Reassess in 15 minutes.
      v. Add second lozenge, in other cheek, as necessary to control severe pain.
      vi. Monitor for respiratory depression.
      vii. IV or IO access obtained:
         1. Morphine sulfate, 5 mg IV/IO.
         2. Reassess in 10 minutes.
         3. Repeat dose every 10 minutes as necessary to control severe pain.
         4. Monitor for respiratory depression.
      viii. Promethazine, 25 mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect.

13. Splint fractures and recheck pulse.
   a. If able to take PO:
      i. Moxifloxacin, 400 mg PO one a day.
   b. If unable to take PO (shock, unconsciousness):
      i. Cefotetan, 2 g IV (slow push over 3-5 minutes) or IM every 12 hours OR
      ii. Ertapenem, 1 g IV/IM once a day.
15. Communicate with the casualty if possible.
   a. Encourage; reassure.
   b. Explain care.
   c. Cardiopulmonary resuscitation (CPR) - Resuscitation on the battlefield for casualties of blast or penetrating trauma who have no pulse, no ventilations, and no other signs of life will not be successful and should not be attempted.
   d. Documentation of Care - Document clinical assessments, treatments rendered, and changes in the casualty’s status. Forward this information with the casualty to the next level of care.
Basic Management Plan for Tactical Evacuation Care

The new term “Tactical Evacuation” includes both Casualty Evacuation (CASEVAC) and Medical Evacuation (MEDEVAC) as defined in Joint Publication 4-02.

1. Airway Management.
   a. Unconscious casualty without airway obstruction:
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Place casualty in the recovery position.
   b. Casualty with airway obstruction or impending airway obstruction:
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Allow casualty to assume any position that best protects the airway, to include sitting up.
      iv. Place unconscious casualty in the recovery position.
      v. If above measures are unsuccessful:
         vi. Laryngeal Mask Airway (LMA)/incubating LMA OR
         vii. Combitube® OR
         viii. Endotracheal intubation OR
         ix. Surgical cricothyroidotomy (with lidocaine if conscious).
   c. Spinal immobilization is not necessary for casualties with penetrating trauma.

2. Breathing:
   a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space (over the top of the 3rd rib) at the mid-clavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.
   b. Consider chest tube insertion if no improvement and or long transport is anticipated.
   c. Most combat casualties do not require supplemental oxygen, but administration of oxygen may be of benefit for the following types of casualties:
      i. Low oxygen saturation by pulse oximetry.
      ii. Injuries associated with impaired oxygenation.
      iii. Unconscious casualty.
      iv. Casualty with TBI (maintain oxygen saturation > 90%).
      v. Casualty in shock.
      vi. Casualty at altitude.
   d. All open and or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.
3. Bleeding:
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a Council of TCCC (CoTCCC)-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.
   b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no TBI).
   c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.
   d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse.
   e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

4. Intravenous (IV) access:
   a. Reassess need for IV access.
      i. If indicated, start an 18-gauge IV or saline lock.
      ii. If resuscitation is required and IV access is not obtainable, use intraosseous (IO) route.

5. Fluid resuscitation:
   a. Reassess for hemorrhagic shock: altered mental status in the absence of brain injury and or change in pulse character.
   b. If not in shock:
      i. No IV fluids necessary.
      ii. PO fluids permissible if conscious and can swallow.
   c. If in shock:
      i. Hextend® 500-mL IV bolus.
      ii. Repeat once after 30 minutes if still in shock.
      iii. No more than 1000 mL of Hextend®.
   d. Continue resuscitation with packed red blood cells (PRBCs), Hextend® (not to exceed 1000 ml), or Lactated Ringer’s solution (LR) as indicated.
   e. If a casualty with TBI is unconscious and has a weak or absent peripheral pulse, resuscitate as necessary to maintain a systolic blood pressure of 90 mmHg or above.

   a. Minimize casualty’s exposure to the elements. Keep protective gear on or with the casualty if feasible.
   c. Apply additional interventions as needed.
   d. Use the Thermal Angel or other portable fluid warmer on all IV sites, if possible.
   e. Protect the casualty from wind if doors must be kept open.
7. Penetrating Eye Trauma:
   a. If a penetrating eye injury is noted or suspected:
      i. Perform a rapid field test of visual acuity.
      ii. Cover the eye with a rigid eye shield (NOT a pressure patch).
      iii. Ensure that the 400 mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

8. Monitoring.
   a. Institute pulse oximetry and other electronic monitoring of vital signs, if indicated.

9. Inspect and dress known wounds if not already done.

10. Check for additional wounds.

11. Provide analgesia as necessary.
   a. Able to fight:
      i. Mobic®, 15 mg PO once a day.
      ii. Tylenol®, 650-mg bilayered caplet, 2 PO every 8 hours.
   
   b. Unable to fight:

   CONSIDERATION:
   Have naloxone readily available whenever administering opiates.

   i. Does not otherwise require IV/IO access:
      1. Oral transmucosal fentanyl citrate (OTFC) 800 micrograms transbuccally.
      2. Recommend taping lozenge-on-a-stick to casualty’s finger as an added safety measure.
      3. Reassess in 15 minutes.
      4. Add second lozenge, in other cheek, as necessary to control severe pain.

   ii. IV or IO access obtained:
      1. Morphine sulfate, 5 mg IV/IO.
      2. Reassess in 10 minutes.
      3. Repeat dose every 10 minutes as necessary to control severe pain.
      4. Monitor for respiratory depression.
   
   iii. Promethazine, 25 mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect.

12. Reassess fractures and recheck pulses.

13. Antibiotics: recommended for all open combat wounds.
   a. If able to take PO:
      i. Moxifloxacin, 400 mg PO once a day.
   
   b. If unable to take PO (shock, unconsciousness):
      i. Cefotetan, 2 g IV (slow push over 3-5 minutes) or IM every 12 hours OR
      ii. Ertapenem, 1 g IV/IM once a day.

14. The Pneumatic Anti-shock Garment (PASG) may be useful for stabilizing pelvic fractures and controlling pelvic and abdominal bleeding. Application and extended use must be carefully monitored. The PASG is contraindicated for casualties with thoracic or brain injuries.

15. Documentation of Care:
   a. Document clinical assessments, treatments rendered, and changes in casualty’s status on a TCCC Casualty Card.
   
   b. Forward this information with the casualty to the next level of care.
MORPHINE USE FOR PAIN RELIEF

LEARNING OBJECTIVE:

Explain morphine dosage, administration routes, indications, contraindications, and casualty marking procedures.

A HM may be issued morphine for the control of shock through the relief of severe pain. This controlled drug is issued under very strict accountability procedures. Possession of this drug is a medical responsibility that must not be taken lightly. Policies pertaining to morphine administration are outlined in BUMEDINST 6570.2 series, Morphia Dosage and Casualty Marking.

MORPHINE ADMINISTRATION

Morphine is the most effective of all pain-relieving drugs. It is most commonly available in pre-measured doses in syrettes or tubexes. Proper administration in selected patients relieves distressing pain and assists in preventing shock. The adult dose of morphine is 10 to 20 mg, which may be repeated, if necessary, in no less than 4 hours.

Morphine has several undesirable effects, however, and the HM must thoroughly understand these effects. Morphine:

- Is a severe respiratory depressant and must not be given to patients in moderate or severe shock or in respiratory distress
- Increases intracranial pressure and may induce vomiting. These effects may be disastrous in head injury cases
- Causes constriction of the pupils (pinpoint pupils). This effect prevents the use of the pupillary reactions for diagnosis in head injuries
- Is cardiotoxic and a peripheral vasodilator. Small doses of morphine may cause profound hypotension in a patient in shock
- Poisoning is always a danger. There is a narrow safety margin between the amounts of morphine that may be given therapeutically and the amounts that produce death
- Causes considerable mental confusion and interferes with the proper exercise of judgment. Therefore, morphine should not be given to ambulatory patients
- Is a highly addictive drug. Morphine should not be given trivially and must be rigidly accounted for. Only under emergency circumstances should morphine be administered

Rigidly control morphine administration to patients in shock or with extensive burns. Because of the reduced peripheral circulation, morphine administration by subcutaneous or intramuscular routes may not be absorbed into the bloodstream, and pain may persist. When pain persists, the uninformed often give additional doses, hoping to bring about relief. When resuscitation occurs and the peripheral circulation improves, the stored quantities of morphine are released into the system, and an extremely serious condition (morphine poisoning) results. When other pain-relieving drugs are not available and the patient in shock or with burns is in severe pain, 20 mg of morphine may be given intramuscularly (followed by massage of the injection site). Resist the temptation to give more, however. Unless otherwise ordered by a medical officer, doses should not be repeated more than twice and then at least 4 hours apart.

If the pain from a wound is severe, morphine may be given when examination of the patient reveals no:

- Head injury
- Chest injury, including sucking and nonsucking wounds
- Wounds of the throat, nasal passages, oral cavity, or jaws wherein blood might obstruct the airway
- Massive hemorrhage

21-61
• Respiratory impairment, including chemical burns of the respiratory tract (any casualty having fewer than 16 respirations per minute should not be given morphine)
• Evidence of severe or deepening shock
• Loss of consciousness

CASUALTY MARKING

Morphine overdose is always a danger. For this reason, plainly identify every casualty who has received morphine. Write the letter "M" and the hour of injection on the patient’s forehead (e.g., M0830) with a skin pencil or semi-permanent marking substitute. Attach the empty morphine syrette or tubex to the patient’s shirt collar or another conspicuous area of the clothing with a safety pin or by some other means. This action will alert others that the drug has been administered.

SOFT TISSUE INJURIES

LEARNING OBJECTIVES:

Describe the different types of wounds.

Determine management and treatment procedures for open and internal soft-tissue injuries.

The most common injuries seen by HMs in a first aid setting are soft tissue injuries with the accompanying hemorrhage, shock, and danger of infection. Any injury that causes a break in the skin, underlying soft tissue structures, or body membranes is known as a wound. This section will discuss the classification of wounds, the general and specific treatment of soft tissue injuries, the use of dressings and bandages in treating wounds, and the special problems that arise because of the location of wounds.

CLASSIFICATION OF WOUNDS

Wounds may be classified according to their general condition, size, location, the manner in which the skin or tissue is broken, and the agent that caused the wound. It is necessary to consider these factors to determine what first aid treatment is appropriate for the wound.

General Condition of the Wound

If the wound is fresh, first aid treatment consists mainly of stopping the flow of blood, treating for shock, and reducing the risk of infection. If the wound is already infected, first aid consists of keeping the casualty quiet, elevating the injured part, and applying a warm wet dressing. If the wound contains foreign objects, first aid treatment may consist of removing the objects if they are not deeply embedded. DO NOT remove objects embedded in the eyes or the skull, and do not remove impaled objects. Stabilize the impaled object to prevent further injury and minimize bleeding. Impaled objects should be surgically removed.

LACERATIONS—These wounds are torn, rather than cut. They have ragged, irregular edges and masses of torn tissue underneath. These wounds are typically made by blunt (as opposed to sharp) objects. A wound made by a dull knife, for instance, is more likely to be a laceration than an incision. Bomb fragments often cause lacerations. Many of the wounds caused by accidents with machinery are lacerations; they are often complicated by crushing of the tissues as well. Lacerations are frequently contaminated with dirt, grease, or other material that is ground into the tissue. They are therefore very likely to become infected.

PUNCTURES—Punctures are caused by objects that penetrate into the tissues while leaving a small surface opening. Wounds made by nails, needles, wire, and bullets are typically punctures. As a rule, small puncture wounds do not bleed freely; however, large puncture wounds may cause severe internal bleeding.
The possibility of infection is great in all puncture wounds, especially if the penetrating object has tetanus bacteria on it.

**AVULSIONS**—An avulsion is the tearing away of tissue from a body part. Bleeding is normally heavy. In certain situations, the torn tissue may be surgically reattached. It can be saved for medical evaluation by wrapping it in a sterile dressing and placing it in a cool container, and rushing it along with the casualty to a medical facility. Do not allow the avulsed portion to freeze, and do not immerse it in water or saline.

**AMPUTATIONS**—A traumatic amputation is the non-surgical removal of the limb from the body. Bleeding is heavy and requires a tourniquet (which will be discussed later) to stop the flow. Shock is certain to develop in these cases. As with avulsed tissue, wrap the limb in a sterile dressing, place it in a cool container, and transport it to the hospital with the casualty. Do not allow the amputated limb to be in direct contact with ice, and do not immerse it in water or saline. The limb can often be successfully reattached.

**Causes of Wounds (Kinematics of Trauma)**

Although it is not always necessary to know what agent or object has caused the wound, it is helpful. Knowing what has caused the wound may give the HM some idea of the probable size of the wound, its general nature, the extent to which it is likely to become contaminated with foreign matter, and what special dangers must be guarded against. Of special concern in wartime setting is the velocity of wound-causing missiles (bullets or shrapnel). A low-velocity missile damages only the tissues with which it comes into contact. On the other hand, a high-velocity missile can do enormous damage by forcing the tissues and body parts away from the track of the missile with a velocity only slightly less than that of the missile itself. These tissues, especially bone, may become damage-causing missiles themselves, thus accentuating the destructive effects of the missile.

Having classified the wound into one or more of the general categories listed, the HM will have a good idea of the nature and extent of the injury, along with any special complications that may exist. This information will aid in the treatment of the casualty.

**MANAGEMENT OF OPEN SOFT-TISSUE INJURIES**

There are three basic rules to be followed in the treatment of practically all open soft tissue injuries: to control hemorrhage, to treat the casualty for shock, and to prevent infection. These will be discussed, along with the proper application of first aid materials and other specific first aid techniques.

**Hemorrhage**

Hemorrhage is the escape of significant amounts of blood from the vessels of the circulatory system. The average adult body contains about 5-6 liters of blood. Five hundred milliliters of blood, the amount given by blood donors, can normally be lost without any harmful effect. The loss of 1 liter of blood usually causes shock, but shock may develop if small amounts of blood are lost rapidly, since the circulatory system does not have enough time to compensate adequately. The degree of shock progressively increases as greater amounts of blood escape. Young children, sick people, or the elderly may be especially susceptible to the loss of even small amounts of blood since their internal systems are in such delicate balance. Capillary blood is normally dark brick red in color. If capillaries are cut, the blood oozes out slowly. Blood from the veins is dark red. Venous bleeding is characterized by a steady, even flow. If an artery near the surface is cut, the blood, which is bright red in color, will gush out in spurts that are synchronized with the heartbeats. If the severed artery is deeply buried, however, the bleeding will appear to be a steady stream.
In actual practice, it can be difficult to decide whether bleeding is venous or arterial, but the distinction is not important. The important thing to know is that all bleeding must be controlled as quickly as possible.

External hemorrhage is of greatest importance because it is the most frequently encountered and the easiest to control. It is characterized by a break in the skin and visible bleeding. Internal hemorrhage (which will be discussed later) is far more difficult to recognize and to control.

Control of Hemorrhage and the use of Tourniquets

In the past, emphasis has been placed on elevation of an extremity and compression on a pressure point (proximal to the bleeding site) as intermediate steps in hemorrhage control. No research has been published on whether or not elevation of an extremity slows hemorrhage. If the extremity is fractured, this maneuver could potentially result in converting a closed fracture to an open one or in causing increased internal hemorrhage. Similarly, the use of pressure points for hemorrhage control has not been studied. Thus, in the absence of compelling data, these interventions can no longer be recommended for situations where direct pressure or a pressure dressing has failed to control hemorrhage.

If external bleeding from an extremity cannot be controlled by pressure, application of a tourniquet is the reasonable next step in hemorrhage control.

APPLY A TOURNIQUET TO CONTROL BLEEDING

Scenario

The HM has encountered a casualty who is bleeding profusely from an extremity and needs a tourniquet to control the bleeding. All other more serious injuries have been assessed and treated.

Objective

Control the bleeding from the extremity without causing further harm to the casualty.

Performance Steps

<table>
<thead>
<tr>
<th>NOTE: Take Body Substance Isolation (BSI) precautions.</th>
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<tbody>
<tr>
<td>1. Determine if the bleeding is life-threatening.</td>
</tr>
<tr>
<td>2. Apply a tourniquet if direct pressure and the emergency bandage fail to control the bleeding.</td>
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</tbody>
</table>

CAUTION: Under combat conditions, while under effective enemy fire, a temporary tourniquet may often be the primary means to control bleeding.

A properly applied tourniquet will quickly control life-threatening hemorrhage until the casualty can be moved away from the effective fire.

a. Improvised tourniquet.
   i. Don BSI
   ii. Apply pressure to pressure point above the wound.
   iii. Prepare equipment.
   iv. Expose the wound.
   v. Place the prepared cravat and windlass 2-3 inches above the wound (not over a joint) and secure the cravat tightly against the extremity with a full non-slip knot.
   vi. Twist the windlass until the bleeding stops.
   vii. While holding tension on the windlass, place the windlass inside the half knot of the second cravat proximal to the tourniquet (if possible).
viii. Tighten the second cravat around windlass and secure the second cravat to the extremity with a full non-slip knot.

ix. Assess for the absence of a distal pulse (not indicated for amputations).

x. Place a "T" and the time of application on the casualty.

xi. Secure the tourniquet in place with tape.

b. C-A-T®:

i. Don BSI.

ii. Apply pressure to pressure point above the wound.

iii. Expose the wound enough to ensure the tourniquet is placed above the injury.

iv. Place C-A-T® between the heart and the wound on the injured extremity, 2-3 inches above the wound.

v. Pull the free end of the self adhering band through the buckle and route through the friction adapter buckle (it is not necessary to route through friction adapter on an arm wound).

vi. Pull the self adhering band tight around the extremity and fasten it back on itself.

vii. Twist the windlass until the bleeding stops.

viii. Lock the windlass in place within the windlass clip.

ix. Secure the windlass with the windlass strap.

x. Assess for the absence of a distal pulse (not indicated for amputations).

xi. Place a "T" and the time of application on the casualty.

xii. Secure the C-A-T® in place with tape.

3. Record the treatment.

4. Reassess the injury to ensure bleeding has been controlled.

5. If the source of bleeding was due to a traumatic amputation.

a. Wrap the amputated part in a clean cloth or sterile dressing (if available).

b. Wrap or bag the amputated part in plastic.

c. Label the plastic bag with the casualty's information.

d. Transport the amputated part in a cool container (if available) with the casualty.

CAUTION:

Do not place the amputated part directly in contact with ice.

Do not submerge the part directly in water.

Do not allow the part to freeze.

6. Evacuate the casualty.

MANAGEMENT OF INTERNAL SOFT-TISSUE INJURIES

Internal soft-tissue injuries may result from deep wounds, blunt trauma, blast exposure, crushing accidents, bone fracture, poison, or sickness. They may range in seriousness from a simple contusion to life-threatening hemorrhage and shock.

Visible Indications

Visible indications of internal soft-tissue injury include the following:

- Hematemesis (vomiting bright red blood)
- Hemoptyisis (coughing up bright red blood)
- Melena (excretion of tarry black stools)
- Hematochezia (excretion of bright red blood from the rectum)
- Hematuria (passing of blood in the urine)
• Nonmenstrual (vaginal bleeding)
• Epistaxis (nosebleed)
• Ecchymosis (pooling of the blood near the skin surface)

Other Signs and Symptoms

More often than not, however, there will be no visible signs of injury, and the HM will have to infer the probability of internal soft-tissue injury from other symptoms such as the following:

- Pale, moist, clammy skin
- Subnormal temperature
- Rapid, feeble pulse
- Falling blood pressure
- Dilated, slowly reacting pupils with impaired vision
- Tinnitus
- Syncope
- Dehydration and thirst
- Yawning and air hunger
- Anxiety, with a feeling of impending doom

Immediate Treatment

There is little that the HM can do to correct internal soft-tissue injuries since they are almost always surgical problems. The goal must be to obtain the greatest benefit from the casualty’s remaining blood supply.

INITIATE TREATMENT FOR HYPOVOLEMIC SHOCK\(^\text{23}\)

Scenario

The HM in the field is assessing a casualty who is suffering from significant blood loss.

Objective

Initiate treatment for hypovolemic shock, stabilize the casualty, minimize the effect of shock, and prepare for immediate evacuation without further injury to the casualty.

Performance Steps

1. Control bleeding.
2. Maintain the airway.

3. Reassure the casualty to reduce anxiety.

4. Initiate one large bore (18 gauge) IV.
5. Maintain the IV flow with Hextend®.

- Continue the flow until the systolic blood pressure stabilizes at greater than 80mm Hg.
- The usual amount is 500 ml; repeat the dose of 500 ml one time. A total of 1000 ml maximum amount of Hextend® can be used for hypovolemia.
- A palpable radial pulse typically indicates that the casualty has a systolic blood pressure of 80 mm Hg.
6. Elevate the casualty’s legs.
   a. Elevate the casualty's legs above chest level, without lowering the head below chest level.

   **NOTE:**
   Splint leg or ankle fractures before elevating the legs, if necessary.

   b. If the casualty is on a litter, elevate the foot of the litter.

7. Maintain normal body temperature.
   Aggressively treat for hypothermia in a trauma patient.

8. Monitor the casualty.

   **NOTE:**
   Give nothing by mouth. Moisten the casualty's lips with a wet cloth.

   a. Check vital signs every 5 minutes until they return to normal, and then check every 15 minutes.
   b. Check the casualty's level of consciousness.

   **NOTE:**
   If the blood pressure is unstable or drops, the pneumatic anti-shock garment (PASG) should be applied by qualified personnel.

9. Record the procedure.

10. Evacuate the casualty.

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**WOUND CLOSURE**

**LEARNING OBJECTIVES:**

Discuss the different types of suture material and their uses.

Explain topical, local infiltration and nerve-block anesthetic administration procedures.

Explain the steps in wound suturing and suture removal.

The care of the wound is largely controlled by the tactical situation, facilities available, and the length of time before proper medical care may be available. Normally, the advice to HMs regarding the suturing of wounds is DO NOT ATTEMPT IT. However, if days are expected to elapse before the patient can be seen by a surgeon, he or she should know how to use the various suture procedures and materials, and how to select the most appropriate of both.

Before discussing the methods of coaptation (bringing together), some of the contraindications to wound closing should be described.

- If there is reddening and edema of the wound margins, infection manifested by the discharge of pus, and persistent fever or toxemia, DO NOT CLOSE THE WOUND
  - If these signs are minimal, the wound should be allowed to "clean up"
  - The process may be hastened by warm, moist dressings, and irrigations with sterile saline
  - This aids in the liquefaction of necrotic wound materials and the removal of thick exudates and dead tissues
• If the wound is a puncture wound, a large gaping wound of the soft tissue, or an animal bite, leave it un-sutured. Even under the care of a surgeon, it is the rule not to close wounds of this nature until after the fourth day
  o This is called "delayed primary closure" and is performed upon the indication of a healthy appearance of the wound
  o Healthy muscle tissue that is viable is evident by its color, consistency, blood supply, and contractibility
  o Muscle that is dead or dying is comparatively dark and mushy; it does not contract when pinched, nor does it bleed when cut. If this type of tissue is evident, do not close the wound
• If the wound is deep, consider the support of the surrounding tissue; if there is not enough support to bring the deep fascia together, do not suture because dead (hollow) spaces will be created
  o In this generally gaping type of wound, muscles, tendons, and nerves are typically involved
  o Only a surgeon should attempt to close this type of wound

If the wound is small, clean, and free from foreign bodies and signs of infection, steps should be taken to close it. All instruments should be checked, cleaned, and thoroughly sterilized. Use a good light and position the patient on the table so that access to the wound will be unhindered.

The area around the wound should be cleansed and then prepared with an antiseptic. The wound area should be draped, whenever possible, to maintain a sterile field in which the HM will work. The HM should wear a cap and mask, scrub hands and forearms, and wear sterile gloves.

SUTURE MATERIALS

In modern surgery, many kinds of ligature and suture materials are used. All can be grouped into two classes: non-absorbable sutures and absorbable sutures.

Non-Absorbable Sutures

These are sutures that cannot be absorbed by the body cells and fluids in which they are embedded during the healing process. When used as buried sutures, these sutures become surrounded or encapsulated in fibrous tissue and remain as innocuous foreign bodies. When used as skin sutures, they are removed after the skin has healed. The most commonly used sutures of this type and the characteristics associated with each are listed below.

• Silk frequently reacts with tissue and can be "spit" from the wound
• Cotton loses tensile strength with each autoclaving
• Linen is better than silk or cotton but is more expensive and not as readily available
• Synthetic materials (e.g., nylon, dermalon) are excellent, particularly for surface use. They cause very little tissue reaction; however, there is a tendency for the knots to come untied. Because of this tendency, most surgeons tie 3 to 4 square knots in each such suture. Nylon is preferred over silk for face and lip areas because silk too often causes tissue reactions
• Rust-proof metal (usually stainless steel wire) has the least tissue reaction of all suture materials and is by far the strongest. The primary problems associated with it are that it is more difficult to use because it kinks and that it must be cut with wire cutters
Absorbable Sutures

These are sutures that are absorbed or digested during and after the healing processes by the body cells and tissue fluids in which they are embedded. It is this characteristic that enhances their use beneath the skin surfaces and on mucous membranes.

Surgical gut fulfills the requirements for the perfect suture ease of manufacture, tensile strength, and variety available more often than any other material.

- Manufacture of catgut: Though it is referred to as "catgut," surgical gut is derived from the submucosal connective tissue of the first one-third (about 8 yards) of the small intestine of healthy government-inspected sheep. The intestine of the sheep has certain characteristics that make it especially adaptable for surgical use. Among these characteristics are its uniformly fine-grained tissue structure and its great tensile strength and elasticity.

- Tensile strength of catgut: This suture material is available in sizes of 6-0 to 0 and 1 to 4, with 6-0 being the smallest diameter and 4 being the largest. The tensile strength increases with the diameter of the suture.

- Varieties of catgut: Surgical gut varies from plain catgut (the raw gut that has been gauzed, polished, sterilized, and packaged) to chromic catgut (that has undergone various intensities of tanning with one of the salts of chromic acid to delay tissue absorption time). Some examples of these variations and their absorption times follow in Table 21-4.

<table>
<thead>
<tr>
<th>Type Gut</th>
<th>Absorption Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Plain</td>
<td>10 days</td>
</tr>
<tr>
<td>B: Mild</td>
<td>20 days</td>
</tr>
<tr>
<td>C: Medium</td>
<td>30 days</td>
</tr>
<tr>
<td>D: Extra</td>
<td>40 days</td>
</tr>
</tbody>
</table>

Table 21-4.—Absorption Times of Various Types of Surgical Gut

SUTURE NEEDLES

Suture needles may be straight or curved, and they may have either a tapered round point or a cutting edge point. They vary in length, curvature, and diameter for various types of suturing. Specific characteristics of suture needles are listed below.

- **Size:** Suture needles are sized by diameter and are available in many sizes.
- **Taper point:** Most often used in deep tissues, this type needle causes minimal amounts of tissue damage.
- **Cutting edge point:** This type needle is preferred for suturing the skin because of the needle's ability to penetrate the skin's toughness.
- **Atraumatic (atraloc, wedged):** These needles may either have a cutting edge or a taper point. Additionally, the suture may be fixed on the end of the needle by the manufacturer to cause the least tissue trauma.

PREPARATION OF CASUALTY

Before suturing the wound(s) of any casualty, the following steps should be taken to prepare the casualty.

1. Examine the casualty carefully to determine what materials are needed to properly close the wound.
   a. Select and prepare sterile instruments, needles, and suture materials.
   b. Position the patient securely so that access to the wound and suture tray is optimal. It is normally not necessary to restrain patients for suturing.
   c. Make sure a good light is available.

2. Strictly observe **aseptic** wound preparation. Use mask, cap, and gloves. Thorough cleaning and proper draping are essential.
3. Select an anesthetic with care. Consider the patient’s tolerance to pain, time of injury, medications the patient is taking or has been given, and the possible distortion of the tissue when the anesthetic are infiltrated.

Selection of Anesthesia

The most common local anesthetic used is Xylocaine, which comes in various strengths (0.5%, 1%, and 2%) and with or without epinephrine. Injectables containing epinephrine must never be used on the fingers, toes, ears, nose, or any other appendage with small vessels because of the vasoconstricting effect of the epinephrine which would eliminate blood flow causing tissue death in these areas. Epinephrine is also contraindicated in patients with hypertension, diabetes, or heart disease.

The three methods of anesthesia administration are topical, local infiltration, and nerve block. Topical anesthetics are generally reserved for ophthalmic or plastic surgery and nerve blocks are generally accomplished by an anesthesiologist or nurse anesthetist for the surgical patient. For HMs, topical anesthesia is limited to the instillation of eye drops for mild corneal abrasions after all foreign bodies have been removed. DO NOT attempt to remove embedded foreign bodies. Nerve blocks are limited to digital blocks wherein the nerve trunks that enervate the fingers or toes are anesthetized.

Performing a digital block is a fairly simple procedure, but it should not be attempted except under the supervision of a medical officer or after a great deal of practice. The first step is cleansing the injection site with an antiseptic solution. The anesthetizing agent is then infiltrated into the lateral and medial aspects at the base of the digit with a small bore needle (25- or 26-gauge), taking care not to inject into the veins or arteries. Proper placement of the anesthesia should result in a loss of sensitivity in a few minutes. This is tested by asking if the patient can distinguish a sharp sensation or pain when a sharp object is gently applied to the skin.

Administering local anesthesia is similar except the HM is anesthetizing nerves immediately adjacent to where the work will be done instead of nerve trunks. There are two generally accepted methods of infiltrating the anesthesia. One is through the skin surrounding the margin of the wound and the other is through the wound into the surrounding tissue. In either case, sufficient quantities must be infiltrated to effect anesthesia approximately ½ inch around the wound, taking care not to inject into a vein or artery.

CAUTION:
The maximum recommended amount of Xylocaine to be used is 50 ml for a 1% solution or the equivalent.

GENERAL PRINCIPLES OF WOUND SUTURING

Wounds are closed either primarily or secondarily. A primary closure takes place within a short time of when the wound occurs, and it requires minimal cleaning and preparation. A secondary closure, on the other hand, occurs when there is a delay of the closure for up to several days after the wound's occurrence. A secondary closure requires a more complex procedure. Wounds 6 to 14 hours old may be closed primarily if they are not grossly contaminated and are meticulously cleaned. Wounds 14 to 24 hours old should not be closed primarily. When reddening and edema of the wound margins, discharge of pus, persistent fever, or toxemia are present, do not close the wound.
Do not use a primary closure for a large, gaping, soft-tissue wound. This type of wound will require warm dressings and irrigations, along with aseptic care for 3 to 7 days to clear up the wound. Then a secondary wound closure may be performed.

The steps to perform a delayed wound closure are outlined below:

1. Debride the wound area and convert circular wounds to elliptical ones before suturing. Circular wounds cannot be closed with satisfactory cosmetic results.

2. Try to convert a jagged laceration to one with smooth edges before suturing it. Make sure that not too much skin is trimmed off; that would make the wound difficult to approximate.

3. Use the correct technique for placing sutures. The needle holder is applied at approximately one-quarter of the distance from the blunt end of the needle. Suturing with a curved needle is done toward the person doing the suturing. Insert the needle into the skin at a 90° angle, and sweep it through in an arc like motion, following the general arc of the needle.

4. Carefully avoid bruising the skin edges being sutured. Use Adson forceps and very lightly grasp the skin edges. It is unsafe to use dressing forceps while suturing. Since there are no teeth on the grasping edges of the dressing forceps, the force required to hold the skin firmly may be enough to cause necrosis.

5. Do not put sutures in too tightly. Gentle approximation of the skin is all that is necessary. Remember that postoperative edema will occur in and about the wound, making sutures tighter. Figure 21-4 illustrates proper wound-closure techniques.

6. If there is a significant chance that the sutured wound may become infected (e.g., bites, delayed closure, gross contamination), place an iodoform (anti-infective) wick in the wound. Or place a small rubber drain in the wound, and remove the drain in 48 hours.

7. When suturing, the best cosmetic effect is obtained by using numerous interrupted simple sutures placed 1/8 inch apart. Where cosmetic result is not a consideration, sutures may be slightly farther apart. Generally, the distance of the needle bite from the wound edges should be equal to the distance between sutures.

8. When subcutaneous sutures are needed, it is proper to use 4-0 chromic catgut.

9. When deciding the type of material to use on skin, use the finest diameter that will satisfactorily hold the tissues. Table 21-5 provides guidance as to the best suture to use in selected circumstances.
When cutting sutures, subcutaneous catgut should have a 1/16-inch tail. Silk skin sutures should be cut as short as is practical for removal on the face and lip. Elsewhere, skin sutures may have longer tails for convenience. A tail over ¼-inch is unnecessary, however, and tends to collect exudate.

The following general rules can be used in deciding when to remove sutures:

a. Face: As a general rule, 4 or 5 days. Better cosmetic results are obtained by removing every other suture and any suture with redness around it on the third day and the remainder on the fifth day.

b. Body and scalp: 7 days.

c. Soles, palms, back, or over joints: 10 days, unless excess tissue reaction is apparent around the suture, in which case they should come out sooner.

d. Any suture with pus or infection around it should be removed immediately, since the suture's presence will make the infection worse.

e. When wire is used, it may be left in safely for 10 to 14 days.

**Table 21-5.—Suture Size by Location**

<table>
<thead>
<tr>
<th>Suture Size</th>
<th>Suture Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-0</td>
<td>Can be used to suture in G-Tube or Chest Tube</td>
</tr>
<tr>
<td>3-0</td>
<td>Skin: Foot</td>
</tr>
<tr>
<td></td>
<td>Deep: Chest, Abdomen, Back</td>
</tr>
<tr>
<td>4-0</td>
<td>Skin: Scalp, Chest, Abdomen, Foot, Extremity</td>
</tr>
<tr>
<td></td>
<td>Deep: Scalp, Extremity, Foot</td>
</tr>
<tr>
<td>5-0</td>
<td>Skin: Scalp, Brow, Oral, Chest, Abdomen, Hand, Penis</td>
</tr>
<tr>
<td>6-0</td>
<td>Skin: Ear, Lid, Brow, Nose, Lip, Face, Penis</td>
</tr>
<tr>
<td>7-0</td>
<td>Skin: Eyelid, Lip, Face</td>
</tr>
</tbody>
</table>

MANAGEMENT OF MUSCULOSKELETAL INJURIES

**LEARNING OBJECTIVE:**

Select the appropriate stabilization and treatment procedure for the management of bone injuries.

**BONE INJURIES**

A break in the bone is known as a fracture. There are two main kinds of fractures. A closed fracture is one in which the injury is entirely internal; the bone is broken but there is no break in the skin. An open fracture is one in which there is an open wound in the tissues and the skin. Sometimes the open wound is made when a sharp end of the broken bone pushes out through the flesh; sometimes it is made by an object such as a bullet that penetrates from the outside.

Open fractures are more serious than closed fractures. They typically involve extensive damage to the tissues and are quite likely to become infected. Closed fractures are sometimes turned into open fractures by rough or careless handling of the casualty.

It is not always easy to recognize a fracture. All fractures, whether closed or open, are likely to cause severe pain and shock; but the other symptoms may vary considerably. A broken bone sometimes causes the injured part to be deformed or to assume an unnatural position. Pain, discoloration, and swelling may be localized at the fracture site, and there may be wobbly movements if the bone is broken clear through.

It may be difficult or impossible for the casualty to move the injured part; if able to move it, there may be a grating sensation (crepitis) as the ends of the broken bone rub against each other. However, if a bone is cracked rather than broken through, the casualty may be able to move the injured part without much difficulty.
An open fracture is easy to recognize if an end of the broken bone protrudes through the flesh. If the bone does not protrude, however, the HM might see the external wound but fail to recognize the broken bone.

General Guidelines

If required to give first aid to a person who has suffered a fracture, follow these general guidelines:

- If there is any possibility that a fracture has been sustained, treat the injury as a fracture until an X-ray can be made.
- Get the casualty to a definitive care facility at the first possible opportunity. All fractures require medical treatment.
- Do not move the casualty until the injured part has been immobilized by splinting (unless the move is necessary to save life or to prevent further injury).
- Treat for shock.
- Do not attempt to locate a fracture by grating the ends of the bone together.
- Do not attempt to set a broken bone unless a medical officer will not be available for many days.
- When a long bone in the arm or leg is fractured, the limb should be carefully straightened so that splints can be applied, unless it appears that further damage will be caused by such a maneuver.
  - Never attempt to straighten the limb by applying force or traction with any improvised device.
  - Pulling gently along the long axis of the limb is permissible and may be all that is necessary to get the limb back into position.
- Apply splints.
  - If the casualty is to be transported only a short distance, or if treatment by a medical officer will not be delayed, it is best to leave the clothing on and place emergency splinting over it.
  - If the casualty must be transported for some distance, or if a considerable period of time will elapse before treatment by a medical officer, it may be better to remove enough clothing to apply well padded splints directly to the injured part.
  - To remove clothing over the injured part, cut the clothing or rip it along the seams.
  - In any case, be careful! Rough handling of the casualty may convert a closed fracture into an open fracture, increase the severity of shock, or cause extensive damage to the blood vessels, nerves, muscles, and other tissues around the broken bone.
- If the fracture is open.
  - Take care of the wound before dealing with the fracture.
  - Bleeding from the wound may be profuse, but most bleeding can be stopped by direct pressure on the wound.
  - Other supplemental methods of hemorrhage control were discussed in the section on wounds of this chapter. Use a tourniquet as a last resort.
  - After the bleeding has been stopped, treat the fracture.

Now that the general rules for treating fractures have been reviewed, please read on regarding the symptoms and emergency treatment of specific fracture sites.

Forearm Fracture

There are two long bones in the forearm, the radius and the ulna. When both are broken, the arm may appear to be deformed. When only one is broken, the other acts as a splint and the arm retains a more or less natural appearance. Any fracture of the forearm is likely to result in pain, tenderness, inability to use the forearm, and a kind of wobbly motion at the point of injury. If the fracture is open, a bone will show through.
If the fracture is open, stop the bleeding and treat the wound. Apply a sterile dressing over the wound. Carefully straighten the forearm. Remember that rough handling of a closed fracture may turn it into an open fracture. Apply a pneumatic splint if available; if not, apply two well-padded splints to the forearm, one on the top and one on the bottom. Be sure that the splints are long enough to extend from the elbow to the wrist. Use bandages to hold the splints in place. Put the forearm across the chest. The palm of the hand should be turned in, with the thumb pointing upward. Support the forearm in this position by means of a wide sling and a cravat bandage, as shown in Figure 21-5. The hand should be raised about 4 inches above the level of the elbow. Treat the casualty for shock and evacuate as soon as possible.

NOTE:
Treatment of the fracture depends partly upon the location of the break.

If the fracture is in the upper part of the arm near the shoulder, place a pad or folded towel in the armpit, bandage the arm securely to the body, and support the forearm in a narrow sling (Fig. 21-6).

Upper Arm Fracture

The signs of fracture of the upper arm include pain, tenderness, swelling, and a wobbly motion at the point of fracture. If the fracture is near the elbow, the arm is likely to be straight with no bend at the elbow.

If the fracture is in the middle of the upper arm, use one well-padded splint on the outside of the arm. The splint should extend from the shoulder to the elbow. Fasten the splinted arm firmly to the body and support the forearm in a narrow sling.

Another way of treating a fracture in the middle of the upper arm is to fasten two wide splints (or four narrow ones) about the arm and then support the forearm in a narrow sling. If using a splint between the arm and the body, be very careful that it does not extend too far up into the armpit; a splint in this position can cause a dangerous compression of the blood vessels and nerves and may be extremely painful to the casualty.
If the fracture is at or near the elbow, the arm may be either bent or straight. No matter in what position the arm is found, **DO NOT ATTEMPT TO STRAIGHTEN IT OR MOVE IT IN ANY WAY.** Splint the arm as carefully as possible in the position in which found. This will prevent further nerve and blood vessel damage. The only exception to this is if there is no pulse distal to the fracture, in which case gentle traction is applied and then the arm is splinted. Treat the casualty for shock and get him under the care of a medical officer as soon as possible.

**Femur Fracture**

The femur is the long bone of the upper part of the leg between the kneecap and the pelvis. When the femur is fractured through, any attempt to move the limb results in a spasm of the muscles and causes excruciating pain. The leg has a wobbly motion, and there is complete loss of control below the fracture. The limb may assume an unnatural position, with the toes pointing outward. By actual measurement, the fractured leg is shorter than the uninjured one because of contraction of the powerful thigh muscles. Serious damage to blood vessels and nerves often results from a fracture of the femur, and shock is likely to be severe.

If the fracture is open, stop the bleeding and treat the wound before attempting to treat the fracture itself. Serious bleeding is a special danger in this type of injury, since the broken bone may tear or cut the large femoral artery in the thigh.

Carefully straighten the leg. Apply two splints, one on the outside of the injured leg and one on the inside. The outside splint should reach from the armpit to the foot. The inside splint should reach from the crotch to the foot. The splints should be fastened in five places: (1) around the ankle; (2) over the knee; (3) just below the hip; (4) around the pelvis; and (5) just below the armpit. The legs can then be tied together to support the injured leg as firmly as possible.

It is essential that a fractured thigh be splinted before the casualty is moved. Manufactured splints, such as the Hare or the Thomas half-ring traction splints are best, but improvised splints may be used. Remember, **DO NOT MOVE THE CASUALTY UNTIL THE INJURED LEG HAS BEEN IMMOBILIZED.** Treat the casualty for shock, and evacuate at the earliest possible opportunity.

**Lower Leg Fracture**

When both bones of the lower leg are broken, the usual signs of fracture are likely to be present. When only one bone is broken, the other one acts as a splint and, to some extent, prevents deformity of the leg. However, tenderness, swelling, and pain at the point fracture are almost always present. A fracture just above the ankle is often mistaken for a sprain. If both bones of the lower leg are broken, an open fracture is very likely to result.

If the fracture is open, stop the bleeding and treat the wound. Carefully straighten the injured leg. Apply a pneumatic splint if available; if not, apply three splints, one on each side of the leg and one underneath (Fig. 21-7). Be sure that the splints are well padded, particularly under the knee and at the bones on each side of the ankle.

Carefully straighten the leg. Apply two splints, one on the outside of the injured leg and one on the inside. The outside splint should reach from the armpit to the foot. The inside splint should reach from the crotch to the foot. The splints should be fastened in five places: (1) around the ankle; (2) over the knee; (3) just below the hip; (4) around the pelvis; and (5) just below the armpit. The legs can then be tied together to support the injured leg as firmly as possible.

**Figure 21-7.—Splinting a Leg**

*Photograph provided by HM1 Stephen J. Oreski, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.*
A pillow and two side splints work very well for treatment of a fractured lower leg. Place the pillow beside the injured leg, then carefully lift the leg and place it in the middle of the pillow. Bring the edges of the pillow around to the front of the leg and pin them together. Then place one splint on each side of the leg (over the pillow), and fasten them in place with strips of bandage or adhesive tape. Treat the casualty for shock and evacuate as soon as possible. When available, use the Hare or Thomas half-ring traction splints.

**Kneecap Fracture**

Carefully straighten the injured limb. Immobilize the fracture by placing a padded board under the injured limb. The board should be at least 4 inches wide and should reach from the buttock to the heel. Place extra padding under the knee and just above the heel. Use strips of bandage to fasten the leg to the board in four places: (1) just below the knee; (2) just above the knee; (3) at the ankle; and (4) at the thigh. Do not cover the knee itself. Swelling is likely to occur very rapidly, and any bandage or tie fastened over the knee would quickly become too tight. Treat the casualty for shock and evacuate as soon as possible.

**Clavicle Fracture**

A person with a fractured clavicle shows definite symptoms. When the casualty stands, the injured shoulder is lower than the uninjured one. The casualty is usually unable to raise the arm above the level of the shoulder and may attempt to support the injured shoulder by holding the elbow of that side in the other hand. This is the characteristic position of a person with a broken clavicle. Since the clavicle lies immediately under the skin, it may be possible to detect the point of fracture by the deformity and localized pain and tenderness.

If the fracture is open, stop the flow of blood and treat the wound before attempting to treat the fracture. Then apply a sling and swathe splint as described below. Bend the casualty’s arm on the injured side, and place the forearm across the chest. The palm of the hand should be turned in, with the thumb pointed up. The hand should be raised about 4 inches above the level of the elbow. Support the forearm in this position by means of a wide sling. A wide roller bandage (or any wide strip of cloth) may be used to secure the casualty’s arm to the body. A figure-eight bandage may also be used for a fractured clavicle. Treat the casualty for shock and evacuate to a definitive care facility as soon as possible.

**Rib Fracture**

If a rib is broken, make the casualty comfortable and quiet so that the greatest danger the possibility of further damage to the lungs, heart, or chest wall by the broken ends is minimized.

The common finding in all casualties with fractured ribs is pain localized at the site of the fracture. By asking the patient to point out the exact area of the pain, the location of the injury can be determined. There may or may not be a rib deformity, chest wall contusion, or laceration of the area. Deep breathing, coughing, or movement is painful. The patient generally wishes to remain still and may often lean toward the injured side, with a hand over the fractured area to immobilize the chest and to ease the pain.

Ordinarily, rib fractures are not bound, strapped, or taped if the casualty is reasonably comfortable. However, they may be splinted by the use of external support. If the patient is considerably more comfortable with the chest immobilized, the best method is to use a swathe in which the arm on the injured side is strapped to the chest to limit motion. Place the arm on the injured side against the chest, with the palm flat, thumb up, and the forearm raised to a 45° angle. Immobilize the chest, using wide strips of bandage to secure the arm to the chest.

Do not use wide strips of adhesive plaster applied directly to the skin of the chest for immobilization since the adhesive tends to limit
the ability of the chest to expand (interfering with proper breathing). Treat the casualty for shock and evacuate as soon as possible.

**Nose Fracture**

A fracture of the nose causes localized pain and swelling, a noticeable deformity of the nose, and extensive nosebleed.

Stop the nosebleed. Have the casualty sit quietly, with the head tipped slightly backward. Tell the casualty to breathe through the mouth and not to blow the nose. If the bleeding does not stop within a few minutes, apply a cold compress or an ice bag over the nose.

Treat the casualty for shock. Ensure the casualty receives a medical officer’s attention as soon as possible. Permanent deformity of the nose may result if the fracture is not treated promptly.

**Jaw Fracture**

A person who has a fractured jaw may suffer serious interference with breathing. There is likely to be great difficulty in talking, chewing, or swallowing. Any movement of the jaw causes pain. The teeth may be out of line, and there may be bleeding from the gums. Considerable swelling may develop.

One of the most important phases of emergency care is to clear the upper respiratory passage of any obstruction. If the fractured jaw interferes with breathing, pull the lower jaw and the tongue well forward and keep them in that position, jaw thrust position.

Apply a four-tailed bandage (also known as a Barton bandage). Be sure that the bandage pulls the lower jaw forward. Never apply a bandage that forces the jaw backward, since this might seriously interfere with breathing. The bandage must be firm so that it will support and immobilize the injured jaw, but it must not press against the casualty’s throat.

Be sure that the casualty has scissors or a knife to cut the bandage in case of vomiting. Treat the casualty for shock and evacuate as soon as possible.

**Skull Fracture**

When a person suffers a head injury, the greatest danger is that the brain may be severely damaged; whether or not the skull is fractured is a matter of secondary importance. In some cases, injuries that fracture the skull do not cause serious brain damage; but brain damage can and frequently does result from apparently slight injuries that do not cause damage to the skull itself.

It is often difficult to determine whether an injury has affected the brain because the symptoms of brain damage vary greatly. A person suffering from a head injury must be handled very carefully and given immediate medical attention.

Some of the symptoms that may indicate brain damage are listed below. Remember that all of these symptoms are not always present in any one case and that the symptoms that do occur may be greatly delayed.

- Bruises or wounds of the scalp may indicate that the casualty has sustained a blow to the head. Sometimes the skull is depressed (caved in) at the point of impact. If the fracture is open, there may be glass, shrapnel, or other objects penetrating the skull.
- The casualty may be conscious or unconscious. If conscious, the casualty may feel dizzy and weak, as though about to faint.
- Severe headache sometimes (but not always) accompanies head injuries.
- The pupils of the eyes may be unequal in size and may not react normally to light.
- There may be bleeding or cerebrospinal fluid (CSF) leakage from the ears, nose, or mouth.
- The casualty may vomit.
The casualty may be restless and perhaps confused and disoriented

The arms, legs, face, or other parts of the body may be partially paralyzed

The casualty’s face may be very pale, or it may be unusually flushed

The casualty is likely to be suffering from shock, but the symptoms of shock may be disguised by other symptoms

It is not necessary to determine if the skull is fractured when giving first aid to a person who has suffered a head injury. The treatment is the same in either case, and the primary intent is to prevent further damage to the brain.

Keep the casualty lying down. If the face is flushed, raise the head and shoulders slightly. If the face is pale, have the casualty lie so that the head is level with, or slightly lower than, the body. Watch carefully for vomiting. If the casualty begins to vomit, position the head to prevent choking on the vomitus.

If there is serious bleeding from the wounds, try to control that bleeding by the application of direct pressure, using caution to avoid further injury to the skull or brain. Use a donut-shaped bandage to gently surround protruding objects. Never manipulate those objects.

- Be very careful about moving or handling the casualty. Move the casualty no more than is necessary. If transportation is necessary, keep the casualty lying down
- In any significant head or facial injury, assume injury to the cervical spine. Immobilization of the cervical spine is indicated
- Be sure that the casualty is kept comfortably warm, but not too warm
- Do not give the casualty anything to drink. DO NOT GIVE ANY MEDICATIONS. See that the casualty receives a medical officer’s attention as soon as possible

Spinal Fractures

If the spine is fractured at any point, the spinal cord may be crushed, cut, or otherwise damaged so severely that death or paralysis will result. However, if the fracture occurs in such a way that the spinal cord is not seriously damaged, there is a very good chance of complete recovery, provided that the casualty is properly cared for. Any twisting or bending of the neck or back whether due to the original injury or carelessness from handling later is likely to cause irreparable damage to the spinal cord.

The primary symptoms of a fractured spine are pain, shock, and paralysis. Pain is likely to be acute at the point of fracture. It may radiate to other parts of the body. Shock is normally severe, but (as in all injuries) the symptoms may be delayed for some time. Paralysis occurs if the spinal cord is seriously damaged. If the casualty cannot move the legs, feet, or toes, the fracture is probably in the back; if the fingers will not move, the neck is probably broken. Remember that a spinal fracture does not always injure the spinal cord, so the casualty is not always paralyzed. Any person who has an acute pain in the back or the neck following an injury should be treated as though there is a fractured spine, even if there are no other symptoms.

Emergency treatment for all spinal fractures, whether of the neck or of the back, has two primary purposes: (1) to minimize shock, and (2) to prevent further injury to the spinal cord. Keep the casualty comfortably warm. Do not attempt to keep the casualty in the position ordinarily used for the treatment of shock, because it might cause further damage to the spinal cord. Just keep the casualty lying flat and do NOT attempt to lower the head.
To avoid further damage to the spinal cord, **DO NOT MOVE THE CASUALTY UNLESS IT IS ABSOLUTELY ESSENTIAL!** If the casualty’s life is threatened in the present location or transportation is necessary to receive medical attention, then, of course, the HM must move the casualty. However, if movement is necessary, be sure that the HMs do it in a way that will cause the least possible damage.

- **DO NOT BEND OR TWIST THE CASUALTY’S BODY**
- **DO NOT MOVE THE HEAD FORWARD, BACKWARD, OR SIDEWAYS**
- **DO NOT UNDER ANY CIRCUMSTANCES ALLOW THE CASUALTY TO SIT UP**

If it is necessary to transport a person who has suffered a spinal fracture, has a suspected spinal fracture, or the MOI indicates a high IOS of spinal fracture follow these general rules:

- Assume that the patient has a cervical fracture which has the most potential for negative outcomes (i.e. quadriplegic on a ventilator)
- Transport patient lying on the back, face up
- Place pillows or sandbags beside the head so that it cannot turn to either side. **DO NOT put pillows or padding under the neck or head**
- No matter where the spine is broken, use a firm support in transporting the casualty; use a rigid stretcher, or a door, shutter, wide board, etc.
- Pad the support carefully, and put blankets both under and over the casualty
- Use cravat bandages or strips of cloth to secure the casualty firmly to the support

- When placing the casualty on a spine board, one of two acceptable methods may be used
  - **DO NOT ATTEMPT TO LIFT/ROLL THE CASUALTY UNLESS ADEQUATE ASSISTANCE IS AVAILABLE**
  - Remember: Any bending or twisting of the body is almost sure to cause serious damage to the spinal cord
  - One person lifts and supports the head while two other persons each lift at the shoulders and hips, respectively
  - A fourth person aligns the spine board next to the patient
  - The casualty is log rolled as a single unit towards the rescuers. It is **critical** that the head is kept aligned with the neck and the rest of the body
  - The spine board is positioned, the casualty is rolled back onto the spine board and both are lowered gently to the ground, and then the patient is secured in place
  - If there are at least four (preferably six) people present to help lift/roll the casualty, they can accomplish the job without too much movement of the casualty’s body
  - **NEVER** attempt to lift/roll the casualty, however, with fewer than four people

- Evacuate the casualty very carefully

### Pelvic Fracture

Fractures in the pelvic region often result from falls, heavy blows, and accidents that involve crushing. The great danger in a pelvic fracture is that the organs enclosed and protected by the pelvis may be seriously damaged when the bony structure is fractured. In particular, there is danger that the bladder will be ruptured. There is also danger of severe internal bleeding; the large blood vessels in the pelvic region may be torn or cut by fragments of the broken bone.
The primary symptoms of a fractured pelvis are severe pain, shock, and loss of ability to use the lower part of the body. The casualty is unable to sit or stand. If the casualty is conscious, there may be a sensation of "coming apart." If the bladder is injured, the casualty’s urine may be bloody.

Do not move the casualty unless ABSOLUTELY necessary. The casualty should be treated for shock and kept warm but should not be moved into the position ordinarily used for the treatment of shock.

If the HM must transport the casualty to another place, do it with the utmost care. Use a rigid stretcher, a padded door, or a wide board. Keep the casualty supine. In some cases, the casualty will be more comfortable if the legs are straight, while in other cases the casualty will be more comfortable with the knees bent and the legs drawn up.

When the casualty is in the most comfortable position, immobilization should be accomplished. Fractures of the hip are best treated with traction splints. Adequate immobilization can also be obtained by placing pillows or folded blankets between the legs and using cravats, roller bandages, or straps to hold the legs together, or through the use of MAST garments. Then, fasten the casualty securely to the stretcher or improvised support, and evacuate very carefully.

JOINT AND MUSCLE INJURIES

Injuries to joints and muscles often occur together, and it is sometimes difficult to tell whether the primary injury is to a joint or to the muscles, tendons, blood vessels, or nerves near the joint. Sometimes it is difficult to distinguish joint or muscle injuries from fractures. In case of doubt, always treat any injury to a bone, joint, or muscle as though it were a fracture.

In general, joint and muscle injuries may be classified under four headings:

- Dislocations
- Sprains
- Strains
- Contusions (bruises)

Dislocations

When a bone is forcibly displaced from its joint, the injury is known as a dislocation. In some cases, the bone slips back quickly into its normal position, but at other times it becomes locked in the new position and remains dislocated until it is put back into place. Dislocations are typically caused by falls or blows but occasionally by violent muscular exertion. The most frequently dislocated joints are those of the shoulder, hip, fingers, and jaw.

A dislocation is likely to bruise or tear the muscles, ligaments, blood vessels, tendons, and nerves near a joint. Rapid swelling and discoloration, loss of ability to use the joint, severe pain and muscle spasms, possible numbness and loss of pulse below the joint, and shock are characteristic symptoms of dislocations. The fact that the injured part is stiff and immobile, with marked deformation at the joint, will help to distinguish a dislocation from a fracture. In a fracture, there is deformity between joints rather than at joints, and there is generally a wobbly motion of the broken bone at the point of fracture.

As a general rule do not attempt to reduce a dislocation, to put a dislocated bone back into place, unless it is known that a medical officer cannot be reached within 8 hours. Unskilled attempts at reduction may cause great damage to nerves and blood vessels or actually fracture the bone. Therefore, except in great emergencies, HMs should leave this treatment to specially trained medical personnel and concentrate their efforts on making the casualty as comfortable as possible under the circumstances.
The following emergency measures will be helpful:

1. Loosen the clothing around the injured part.
2. Place the casualty in the most comfortable position possible.
3. Support the injured part by means of a sling, pillows, bandages, splints, or any other device that will make the casualty comfortable.
4. Treat the casualty for shock.
5. Get medical help as soon as possible.

HMs should NEVER attempt to reduce the more serious dislocations, such as those of the hip. However, if it is probable that the casualty cannot be treated by a medical officer within a reasonable time, the HM should make a careful effort to reduce certain dislocations (such as those of the jaw, finger, or shoulder) if there is no arterial or nerve involvement (pulse will be palpable and there will be no numbness below the joint). Treat all other dislocations as fractures, and evacuate the casualty to a definitive care facility.

**DISLOCATION OF THE JAW.**—When the lower jaw is dislocated, the casualty cannot speak or close the mouth. Dislocation of the jaw is typically caused by a blow to the mouth; sometimes it is caused by yawning or laughing. This type of dislocation is not always easy to reduce, and there is considerable danger that the operator’s thumbs will be bitten in the process.

For protection, wrap the thumbs with a handkerchief or bandage. While facing the casualty, the HM should press the thumbs down just behind the last lower molars and, at the same time, lift the chin up with the fingers. The jaw should snap into place at once. The HM will have to remove the thumbs quickly to avoid being bitten. No further treatment is required, but warn the casualty to keep the mouth closed as much as possible during the next few hours.

**DISLOCATION OF THE FINGER.**—The joints of the finger are particularly susceptible to injury, and even minor injuries may result in prolonged loss of function. Great care must be used in treating any injury of the finger.

To reduce a dislocation of the finger, grasp the finger firmly and apply a steady pull in the same line as the deformity. If it does not slip into position, try it again, but if it does not go into position on the third attempt, DO NOT TRY AGAIN. In any case, and whether or not the dislocation is reduced, the finger should be strapped, slightly flexed, with an aluminum splint or with a roller gauze bandage over a tongue blade. A dislocated finger can be immobilized by strapping it to a flat, wooden stick, such as a tongue depressor.

**DISLOCATION OF THE SHOULDER.**—Before reduction, place the casualty in a supine position. After putting the heel of a foot in the casualty’s armpit, grasp the wrist and apply steady traction by pulling gently and increasing resistance gradually. Pull the arm in the same line as it is found. After several minutes of steady pull, flex the casualty’s elbow slightly. Grasp the arm below the elbow, apply traction from the point of the elbow, and gently rotate the arm into the external or outward position. If three reduction attempts fail, carry the forearm across the chest and apply a sling and swathe.

An alternate method involves having the patient lie face down on an examining table with the injured arm hanging over the side. Apply prolonged, firm, gentle traction at the wrist with gentle external rotation. A water bucket with a padded handle placed in the crook of the patient’s elbow may be substituted. Gradually add sand or water to the bucket to increase traction. Grasping the wrist and using the elbow as a pivot point, gently rotate the arm into the external position.
Sprains

Sprains are injuries to the ligaments and soft tissues that support a joint. A sprain is caused by the violent wrenching or twisting of the joint beyond its normal limits of movement and involves a momentary dislocation, with the bone slipping back into place of its own accord. Although any joint may be sprained, sprains of the ankle, wrist, knee, and finger are most common.

Symptoms of a sprain include pain or pressure at the joint, pain upon movement, swelling and tenderness, possible loss of movement, and discoloration. Treat all sprains as fractures until ruled out by X-rays.

Emergency care for a sprain includes application of cold packs for the first 24 to 48 hours to reduce swelling and to control internal hemorrhage; elevation and rest of the affected area; application of a snug, smooth, figure-eight bandage to control swelling and to provide immobilization (basket weave adhesive bandages can be used on the ankle); a follow-up examination by a medical officer; and X-rays to rule out the presence of a fracture.

NOTE:
Check bandaged areas regularly for swelling that might cause circulation impairment and loosen bandages if necessary.

After the swelling stops (24 to 48 hours), moist heat can be applied for short periods (15 to 30 minutes) to promote healing and reduce swelling. Moist heat can be warm, wet compresses, warm whirlpool baths, etc.

CAUTION:
Heat should not be applied until 24 hours after the last cold pack.

Strains

Injuries caused by the forcible overstretching or tearing of muscles or tendons are known as strains. Strains may be caused by lifting excessively heavy loads, sudden or violent movements, or any other action that pulls the muscles beyond their normal limits.

The chief symptoms of a strain are pain, lameness or stiffness (sometimes involving knotting of the muscles), moderate swelling at the place of injury, discoloration due to the escape of blood from injured blood vessels into the tissues, possible loss of power, and a distinct gap felt at the site.

Keep the affected area elevated and at rest. Apply cold packs for the first 24 to 48 hours to control hemorrhage and swelling. After the swelling stops, apply mild heat to increase circulation and aid in healing. As in sprains, heat should not be applied until 24 hours after the last cold pack. Muscle relaxants, adhesive straps, and complete immobilization of the area may be indicated. Evacuate the casualty to a medical facility where X-rays can be taken to rule out the presence of a fracture.

Contusions

Contusions, commonly called bruises, are responsible for the discoloration that almost always accompanies injuries to bones, joints, and muscles. Contusions are caused by blows that damage bones, muscles, tendons, blood vessels, nerves, and other body tissues. They do not necessarily break the skin.

The symptoms of a contusion or bruise are familiar to everyone. There is immediate pain when the blow is received. Swelling occurs because blood from the broken vessels leaks into the soft tissue under the skin. At first the injured place is reddened due to local skin irritation from the blow. Later the characteristic "black and blue" marks appear. Perhaps several days later, the skin turns yellowish or greenish before normal coloration returns. The bruised area may be very tender.
As a rule, slight bruises do not require treatment. However, if the casualty has severe bruises, treat for shock. Immobilize the injured part, keep it at rest, and protect it from further injury. Sometimes the casualty will be more comfortable if the bruised area is bandaged firmly with an elastic or gauze bandage. If possible, elevate the injured part. A sling may be used for a bruised arm or hand. Pillows or folded blankets may be used to elevate a bruised leg.

SPECIAL WOUNDS AND THEIR TREATMENT

LEARNING OBJECTIVE:

Describe medical precautions and wound-treatment procedures for the following list of wounds: eye wounds, head wounds, chest wounds, abdominal wounds, crushing injuries, animal bites, and the removal of foreign objects.

The HM should find most general wounds very easy to diagnose and treat. There are other wounds, however, that require special consideration and treatment. They are discussed below.

TREAT FOREIGN BODIES OF THE EYE

Scenario

The HM has a casualty with a foreign body in the eye. All other more serious injuries have been assessed and treated.

Objective

Treat foreign bodies of the eye, minimizing the effects of the injury, without causing additional injury to the eye.

Performance Steps

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Perform visual acuity testing.
2. Assess eyes: pupils, equal and round, regular in size, and react to light (PEARRL).
3. Locate the foreign body.
   a. Method one.
      i. Pull the lower lid down.
      ii. Tell the casualty to look up and to both sides and check for foreign bodies.
      iii. Pull the upper lid up.
      iv. Tell the casualty to look down and to both sides and check for foreign bodies.
   b. Method two.
      i. Tell the casualty to look down.
      ii. Grasp the casualty's upper eyelashes and gently pull the eyelid away from the eyeball.
      iii. Place a cotton-tipped swab horizontally along the outer surface of the upper lid and fold the lid back over the swab.
      iv. Look for the foreign bodies or damage on the globe.

CAUTION:
If the foreign bodies cannot be located, bandage both eyes and seek further medical aid immediately.
4. Remove the foreign body.

**CAUTION:**
Do not put pressure on the globe.

**a. Small foreign body on an anterior surface.**
   i. Hold the casualty's eye open.
   ii. Irrigate the eye.

**b. Foreign body stuck to the cornea or lying under the upper or lower eyelid.**
   i. For a foreign body under the lower eyelid, pull the lower lid down.
   ii. For a foreign body under the upper eyelid, pull the upper lid up.
   iii. Remove the foreign body with a moistened, sterile cotton-tipped swab.

**CAUTION:**
Bandage both eyes if foreign bodies are not easily removed by these methods or if there is pain or loss of vision in the eye.
Seek further medical aid immediately.

**NOTE:**
In hazardous conditions, leave the good eye uncovered long enough to ensure the casualty's safety.

**c. Foreign body stuck or impaled in the eye.**

**CAUTION:**
Do not attempt to remove a foreign body stuck to or sticking into the eyeball.

A medical officer must remove such objects.

   i. Apply dry sterile dressings to build around and support the object.

**NOTE:**
This will help prevent further contamination and minimize movement of the object.

   ii. Cover the injured eye with a paper cup or cardboard cone.

iii. Cover the uninjured eye with a dry dressing or eye patch.

iv. Reassure the casualty by explaining why both eyes are being covered.

**NOTE:**
The eyes move together. If the casualty uses (moves) the uninjured eye, the injured eye will move as well.

Covering both eyes will keep them still and will prevent undue movement on the injured side.

In hazardous conditions, leave the good eye uncovered long enough to ensure the casualty's safety.

**d. Seek further medical aid immediately.**

5. Obtain details about the injury.

   a. Source and type of the foreign bodies.
   b. Whether the foreign bodies were wind-blown or high velocity.
   c. Time of onset and length of discomfort.
   d. Any previous injuries to the eye.

6. Record the procedure

7. Do not cause additional injury to the eye.

   a. Do not probe for foreign bodies.
   b. Do not put pressure on the globe.
   c. Do not remove an impaled object.

8. Evacuate the casualty, as required.
CRUSH SYNDROME

When a casualty is crushed or trapped with compression on the extremities for a prolonged time, there is the possibility for crush syndrome (CS), characterized by ischemia and muscle damage (rhabdomyolysis). With rhabdomyolysis there is an efflux of potassium, nephrotoxic metabolites, myoglobin, purines, and phosphorous into the circulation, resulting in cardiac and renal dysfunction.

1. Recognition.
   a. History.
      i. Suspect in patients in whom there is a history of being trapped (e.g., urban operations, mountain operations, earthquakes, or bombings) for a prolonged period (from hours to days).
      ii. Clear history is not always available in combat, and the syndrome may appear insidiously in patients who initially appear well.
   b. Physical findings.
      i. A thorough examination must be done with attention to extremities, trunk, and buttocks. The physical findings depend on the duration of entrapment, treatment rendered, and time since the casualty’s release.
      ii. Extremities.
         1. May initially appear normal just after extrication.
         2. Edema develops and the extremity becomes swollen, cool, and tense.
         3. May have severe pain out of proportion to examination.
         4. Anesthesia and paralysis of the extremities, which can mimic a spinal cord injury with flaccid paralysis, but there will be normal bowel and bladder function.
      iii. Trunk/buttocks: may have severe pain out of proportion to examination.

THERAPY.—On scene while still trapped. The primary goal of therapy is to prevent acute renal failure in crush syndrome. Suspect, recognize, and treat rhabdomyolysis early in casualties of entrapment. Therapy should be initiated as soon as possible, preferably in the field, while the casualty is still trapped. Ideally it is recommended to establish IV access in a free arm or leg vein.

REMOVING FOREIGN OBJECTS

Many wounds contain foreign objects. Wood or glass splinters, bullets, metal fragments, bits of wire, fishhooks, nails, tacks, cinders, and small particles from grinding wheels are examples of the variety of objects or materials that are sometimes found in wounds. When such objects are near the surface and exposed, first aid treatment includes their removal.

However, first aid treatment does not include the removal of deeply embedded objects, powdered glass, or any widely scattered material of this nature. HMs should never attempt to remove bullets, but they should try to find out whether the bullet remains in the casualty. Look for both entrance and exit wounds. The general rule to remember is this:

NOTE:
Remove foreign objects from a wound when it can be done easily and without causing further damage; but NEVER HUNT FOR OR ATTEMPT TO REMOVE DEEPLY BURIED OR WIDELY SCATTERED OBJECTS OR MATERIALS, except in a definitive care environment.
The following procedure may be used to remove a small object from the skin or tissues if the object is near the surface and clearly visible:

1. Cleanse the skin around the object with soap and water and paint with any available skin antiseptic solution.

2. If necessary, pierce the skin with a sharp instrument; a needle, razor, or sharp knife that has been sterilized by passing it through a flame three or four times.

3. Grasping the object at the end, remove it. Tweezers, small pincers, or forceps may be used for this purpose. (Whatever instrument used should first be sterilized by boiling if at all possible.)

4. If the wound is superficial, apply gentle pressure to encourage bleeding.

5. Cover the wound with a dry, sterile dressing.

If the foreign object is under a fingernail or toenail, HMs may have to cut a V-shaped notch in the nail so that the object can be grasped by the forceps. Do not try to dig the object out from under the nail with a knife or similar instrument.

A curved or barbed object (such as a fishhook) may present special problems. Figure 21-8 shows one method of removing a fishhook that has become embedded in the flesh. As illustrated in Figure 21-8A, the barb on the hook prevents its direct removal. However, if the HM pushes the hook forward through the skin, as shown in Figure 21-8B, then the HM can clip off the barb with a wire cutter or similar tool, as shown in Figure 21-8C. The remainder of the fishhook can then be withdrawn in the manner indicated in Figure 21-8D.

Figure 21-8.—Removing a Fishhook

ANIMAL BITES

A special kind of infection that must be guarded against in case of animal bites is rabies (sometimes called "hydrophobia"). This disease is caused by a virus that is present in the saliva of infected animals. The disease occurs most commonly in wild animals, but it has been found in domestic animals and household pets. In fact, it is probable that all mammals are susceptible to it. The virus that causes rabies is ordinarily transmitted by a bite, but it can be transmitted by the saliva of an infected animal coming in contact with a fresh wound or with the thin mucous membrane of the lips or nose. The virus does not penetrate normal unbroken skin. If the skin is broken, DO NOT attempt wound closure.

If rabies develops in man, it is normally fatal. A preventive treatment is available and it is very effective, but only if it is started shortly after the bite. This treatment is outlined in BUMEDINST 6220.8 series, Streptococcal Infection Control Program.
Since the vaccine can be obtained only at a medical treatment facility or a major ship, any person bitten by an animal must be transferred quickly to the nearest treatment facility for evaluation, along with a complete report of the circumstances surrounding the incident. Remember, prevention is of utmost importance.

Immediate local treatment of the wound should be given. Wash the wound and the surrounding area carefully, using sterile gauze, soap, and sterile water. Use sterile gauze to dry the wound, and then cover the wound with a sterile dressing. DO NOT use any chemical disinfectant. Do not attempt to cauterize the wound in any way. All of the animal’s saliva must be removed from the casualty’s skin to prevent further contamination of the wound.

**CAUTION:**
DO NOT allow the animal’s saliva to come in contact with open sores or cuts on any exposed skin while providing patient care.

When a person has been bitten by an animal, every effort must be made to catch the animal and to keep it confined for a minimum of 8 to 10 days. DO NOT kill it if there is any possible chance of catching it alive. The symptoms of rabies are not always present in the animal at the time the bite occurs, but the saliva may nevertheless contain the rabies virus. It is essential; therefore, that the animal is kept under observation until a diagnosis can be made.

The rabies treatment is given if the animal develops any definite symptoms, if it dies during the observation period, or if for any reason the animal cannot be kept under observation. Remember that any animal bite is dangerous and MUST be evaluated at a treatment facility.

**ENVIRONMENTAL INJURIES**

**LEARNING OBJECTIVES:**

*Explain the classification and evaluation process for burns.*

*Determine the appropriate treatment for each type of burn.*

Under the broad category of environmental injuries, HM’s will consider a number of emergency problems. Exposure to extremes of temperature, whether heat or cold, causes injury to skin, tissues, blood vessels, vital organs, and, in some cases, the whole body. In addition, contact with the sun’s rays, electrical current, or certain chemicals causes injuries similar in character to burns.

**THERMAL BURNS**

True burns are generated by exposure to extreme heat that overwhelms the body’s defensive mechanisms. Burns and scalds are essentially the same injury: Burns are caused by dry heat, and scalds are caused by moist heat. The seriousness of the injury can be estimated by the depth, extent, and location of the burn, the age and health of the casualty, and other medical complications.

**Classification of Severity**

Burns are classified according to their depth as first-, second-, and third-degree burns (Fig. 21-9).
FIRST-DEGREE BURN.—With a first-degree burn, the epidermal layer is irritated, reddened, and tingling. The skin is sensitive to touch and blanches with pressure. Pain is mild to severe, edema is minimal, and healing occurs naturally within a week.

SECOND-DEGREE BURN.—A second-degree burn is characterized by epidermal blisters, mottled appearance, and a red base. Damage extends into but not through the dermis. Recovery takes 2 to 3 weeks, with some scarring and depigmentation. This condition is painful. Body fluids may be drawn into the injured tissue, causing edema and possibly a "weeping" fluid (plasma) loss at the surface.

THIRD-DEGREE BURN.—A third-degree burn is a full-thickness injury penetrating into muscle and fatty connective tissues, or even down to the bone. Tissues and nerves are destroyed. Shock, with blood in the urine, is likely to be present. Pain will be absent at the burn site if all the area nerve endings are destroyed, and the surrounding tissue (which is less damaged) will be painful.

Tissue color will range from white (scalds) to black (charring burns). Although the wound is typically dry, body fluids will collect in the underlying tissue. If the area has not been completely cauterized, significant amounts of fluids will be lost by plasma "weeping" or by hemorrhage, thus reducing circulation volume. There is considerable scarring and possible loss of function. Skin grafts may be necessary.

Rule of Nines

Of greater importance than the depth of the burn in evaluating the seriousness of the condition is the extent of the burned area. A first-degree burn over 50 percent of the body surface area (BSA) may be more serious than a third-degree burn over 3 percent. The Rule of Nines is used to give a rough estimate of the surface area affected. Figure 21-10 shows how the rule is applied to adults.
The Lund and Browder chart for accurate assessment of the % BSA

Figure 21-10.—Rule of Nines
Other Factors

A third factor in burn evaluation is the location of the burn. Serious burns of the head, hands, feet, or genitals will require hospitalization.

The fourth factor is the presence of any other complications, especially respiratory tract injuries or other major injuries or factors. The HM must take all these factors into consideration when evaluating the condition of the burn casualty, especially in a triage situation.

First Aid

1. After the casualty has been removed from the source of the thermal injury, first aid should be kept to a minimum.
2. Maintain an open airway.
3. Control hemorrhage, and treat for shock.
4. Remove constricting jewelry and articles of clothing.
5. Protect the burn area from contamination by covering it with clean sheets or dry dressings. DO NOT remove clothing adhering to a wound.
6. Splint fractures.
7. For all serious and extensive burns (over 20 percent BSA), and in the presence of shock, start intravenous therapy with an electrolyte solution (Ringer’s lactate) in an unburned area.
8. Maintain intravenous treatment during transportation.

   a. Pain resulting from small burns may be relieved with an anesthetic ointment if the skin is not broken.
   b. Relieve mild pain (as with first degree burns) with aspirin. Relieve moderate pain with cool, wet compresses or ice water immersion (for burns of less than 20 percent BSA).
   c. Severe pain may be relieved with morphine or Demerol® injections.

Aid Station Care

Once the casualty has arrived at the aid station, observe the following procedures.

1. Continue to monitor for airway patency, hemorrhage, and shock.
2. Continue intravenous therapy that is in place, or start a new one under a medical officer’s supervision to control shock and replace fluid loss.
3. Monitor urine output (UOP); at least 30cc/kg/hr is minimal output.
   a. Shave body hair well back from the burned area.
   b. Cleanse the area gently with disinfectant soap and warm water.
   c. Remove dirt, grease, and nonviable tissue.
   d. Apply a sterile dressing of dry gauze.
   e. Place bulky dressings around the burned parts to absorb serous exudates.
5. All major burn casualties should be given a booster dose of tetanus toxoid to guard against infection. Administration of antibiotics may be directed by a medical officer or an Independent Duty Corpsman.
6. If evacuation to a definitive care facility will be delayed for 2 to 3 days, start topical antibiotic therapy after the patient stabilizes and following debridement and wound care.
   a. Gently spread a 1/16-inch thickness of or Silvadene Cream® over the burn area.
   b. Repeat the application after 12 hours, and then after daily debridement.
   c. Treat minor skin reactions with antihistamines.

SUNBURN

Sunburn results from prolonged exposure to the ultraviolet rays of the sun. First- and second-degree burns similar to thermal burns result. Treatment is essentially the same as that outlined for thermal burns. Unless a major percentage of the body surface is affected, the casualty will not require more than first aid attention. Commercially prepared sunburn lotions and ointments may be used. Prevention through education and the proper use of sun screens is the best way to avoid this condition.

ELECTRICAL BURNS

Electrical burns may be far more serious than a preliminary examination may indicate. The entrance and exit wounds may be small, but as electricity penetrates the skin it burns a large area below the surface (Fig. 21-11).

Before treatment is started, ensure that the casualty is no longer in contact with a live electrical source. Shut the power off or use a non-conducting rope or stick to move the casualty away from the line or the line away from the casualty.

HMs can do little for these casualties other than monitoring the basic life functions; delivering CPR; treating for shock; covering the entrance and exit wounds with a dry, sterile dressing; and transporting the casualty to a medical treatment facility. Due to the nature of the injury, the patient may require defibrillation with an AED or cardiac defibrillator in order to re-set the electric circuits in the heart so that a normal cardiac rhythm can return. AEDs are the device of choice for HMs; follow the manufacturer’s directions for use.

CHEMICAL BURNS

When acids, alkalis, or other chemicals come in contact with the skin or other body membranes, they may cause injuries that are generally referred to as chemical burns. For the most part, these injuries are not caused by heat but by direct chemical destruction of body tissues. Areas most often affected are the extremities, mouth, and eyes. Alkali burns are more serious than acid burns because alkalis penetrate deeper and burn longer.

Figure 21-11.—Electrical Burns

Photograph provided by HMCS (SS/SW) Christopher Santee of Naval Medical Manpower Personnel Education and Training Command, Bethesda, MD.
When such burns occur, the following emergency procedures must be carried out immediately:

1. Quickly flush the area with large amounts of water, using a shower or hose, if available.
   a. Do not apply water too forcefully.
   b. Flood the area while the clothing (including shoes and socks) is being removed and continue flushing the skin after removal of all clothing.

2. After thorough washing, neutralize any chemical remaining on the affected area.

WARNING:
DO NOT attempt to neutralize a chemical unless HMs know exactly what it is and what substance will neutralize it. Further damage may be done by a neutralizing agent that is too strong or incorrect.

a. For acid burns, make a solution of 1 teaspoon of baking soda to a pint of water and flush it over the affected area.

b. For alkali burns, mix 1 or 2 teaspoons of vinegar to a pint of water and flush it over the affected area.

3. Flush the area again with water and gently pat dry with sterile gauze. Do not rub the area.

4. Transport the casualty to a medical treatment facility.

When treating chemical burns to the eye, the one and only emergency treatment is to flush the eye(s) immediately with large amounts of water or sterile saline solution. Irrigate acid burns to the eyes for at least 5 to 10 minutes with at least 2000 ml of water. Irrigate alkali burns to the eyes for at least 20 minutes. Because of the intense pain, the casualty may be unable to open the eyes. If this occurs, hold the eyelids apart so that water can flow across the eye.

A drinking fountain or field "water buffalo" may be used to supply a steady stream of water. Hold the casualty’s head in a position that allows water to flow from the inside corner of the eye toward the outside. Do not allow the water to fall directly on the eye, and do not use greater force than is necessary to keep the water flowing across the eye.

CAUTION:
Never use any chemical antidotes such as baking soda or alcohol in treating burns of the eye, and do not try to neutralize chemical agents.

After thorough irrigation, loosely cover both eyes with a clean dressing. This prevents further damage by decreasing eye movement.

The aftercare for all chemical burns is similar to that for thermal burns: Cover the affected area and get the casualty to a medical treatment facility as soon as possible.

**WHITE PHOSPHORUS BURNS**

A special category of burns that may affect military personnel in a wartime or training situation is that caused by exposure of white phosphorus (WP or Willy Peter). First aid for this type of burn is complicated by the fact that white phosphorus particles ignite upon contact with air.
Superficial burns caused by simple skin contact or burning clothes should be flushed with water and treated like thermal burns. Partially embedded white phosphorus particles must be continuously flushed with water while the first aid provider removes them with whatever tools are available (i.e., tweezers, pliers, forceps). Do this quickly, but gently.

Firmly or deeply embedded particles that cannot be removed by the first aid provider must be covered with a saline-soaked dressing, and this dressing must be kept wet until the casualty reaches a medical treatment facility. The wounds containing embedded phosphorus particles may then be rinsed with a dilute, freshly mixed 1% solution of copper sulfate. This solution combines with phosphorus on the surface of the particles to form a blue-black cupric phosphate covering, which both impedes further oxidation and facilitates identification of retained particles. Under no circumstances should the copper sulfate solution be applied as a wet dressing.

Wounds must be flushed thoroughly with a saline solution following the copper sulfate rinse to prevent absorption of excessive amounts of copper. (Copper has been associated with extensive intravascular hemolysis.) An adjunct to the management of phosphorus burn injuries is the identification of the retained phosphorescent particles in a darkened room during debridement.

**NOTE:**
Combustion of white phosphorus results in the formation of a severe pulmonary irritant.

The ignition of phosphorus in a closed space (such as the BAS tent or sickbay) may result in the development of irritant concentrations sufficient to cause acute inflammatory changes in the tracheobronchial tree.

The effects of this gas, especially during debridement, can be minimized by placing a moist cloth over the nose and mouth to inactivate the gas and by ventilating the tent.

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**HEAT EXPOSURE INJURIES**

**LEARNING OBJECTIVE:**
Describe the signs, symptoms, and emergency treatment of heat cramps, heat exhaustion, and heat stroke.

Excessive heat affects the body in a variety of ways. When a person exercises or works in a hot environment, heat builds up inside the body. The body automatically reacts to get rid of this heat through the sweating mechanism. This depletes water and electrolytes from the circulating volume. If they are not adequately replaced, body functions are affected, and, initially, heat cramps and heat exhaustion develop. If the body becomes too overheated or water or electrolytes too depleted, the sweat-control mechanism of the body malfunctions and shuts down. The result is heat stroke (sunstroke). Heat exposure injuries are a threat in any hot environment, but especially in desert or tropical areas and in the boiler rooms of ships. Under normal conditions, it is a preventable injury. Individual and command awareness of the causes of heat stress problems should help eliminate heat exposure injuries.

**HEAT CRAMPS**

Excessive sweating may result in painful cramps in the muscles of the abdomen, legs, and arms. Heat cramps may also result from drinking ice water or other cold drinks either too quickly or in too large a quantity after exercise. Muscle cramps are often an early sign of approaching heat exhaustion.

To provide first aid treatment for heat cramps, move the casualty to a cool place. Since heat cramps are caused by loss of salt and water, give the casualty plenty of cool (not cold) water to drink, adding about one teaspoon of salt to a liter or quart of water. Apply manual pressure to the cramped muscle, or gently massage it to relieve the spasm. If there are indications of anything more serious, transport the casualty immediately to a medical treatment facility.
HEAT EXHAUSTION

Heat exhaustion (heat prostration or heat collapse) is the most common condition caused by working or exercising in hot environments. In heat exhaustion, there is a serious disturbance of blood flow to the brain, heart, and lungs. This causes the casualty to experience weakness, dizziness, headache, nausea, and loss of appetite. The casualty may faint but will probably regain consciousness as the head is lowered, which improves the blood supply to the brain. Signs and symptoms of heat exhaustion are similar to those of shock; the casualty will appear ashen gray, the skin cool, moist, and clammy and the pupils may be dilated. The vital signs usually are normal; however, the casualty may have a weak pulse, together with rapid and shallow breathing. Body temperature may be below normal.

Treat heat exhaustion as if the casualty were in shock. Move the casualty to a cool or air-conditioned area. Loosen the clothing, apply cool wet cloths to the head, maxilla, groin, and ankles, and fan the casualty. Do not allow the casualty to become chilled. (If this does occur, cover with a light blanket and move into a warmer area.) If the casualty is conscious, give a solution of 1 teaspoon of salt dissolved in a liter of cool water. If the casualty vomits, do not give any more fluids. Transport the casualty to a medical treatment facility as soon as possible. Intravenous fluid infusion may be necessary for effective fluid and electrolyte replacement to combat shock.

HEAT STROKE

Sunstroke is more accurately called heat stroke since it is not necessary to be exposed to the sun for this condition to develop. It is a less common but far more serious condition than heat exhaustion, since it carries a 20 percent mortality rate. The most important feature of heat stroke is the extremely high body temperature (105°F, 41°C or higher) accompanying it.

In heat stroke, the casualty suffers a breakdown of the sweating mechanism and is unable to eliminate excessive body heat buildup while exercising. If the body temperature raises too high, the brain, kidneys, and liver may be permanently damaged.

Sometimes the casualty may have preliminary symptoms such as headache, nausea, dizziness, or weakness. Breathing will be deep and rapid at first, later shallow and almost absent. The casualty will be flushed, very dry, and very hot. The pupils will be constricted (pinpoint) and the pulse fast and strong. Compare these symptoms with those of heat exhaustion. When providing first aid for heat stroke, remember that this is a true life-and-death emergency. The longer the casualty remains overheated, the more likely irreversible brain damage or death will occur. First aid is designed to reduce body heat fast.

Reduce heat immediately by dousing the body with cold water or by applying wet, cold towels to the whole body. Move the casualty to the coolest place available and remove as much clothing as possible. Maintain an open airway. Place the casualty on his back, with the head and shoulders slightly raised. If cold packs are available, place them under the arms, around the neck, at the ankles, and in the groin. Expose the casualty to a fan or air conditioner, since drafts will promote cooling. Immersing the casualty in a cold water bath is also very effective. If the casualty is conscious, give cool water to drink. Do not give any hot drinks or stimulants. Discontinue cooling when the rectal temperature reaches 102°F; watch for recurrence of temperature rise by checking every 10 minutes. Repeat cooling if temperature reaches 103°F rectally.

Get the casualty to a medical facility as soon as possible. Cooling measures must be continued while the casualty is being transported. Intravenous fluid infusion may be necessary for effective fluid and electrolyte replacement to combat shock.
PREVENTION OF HEAT EXPOSURE INJURIES

LEARNING OBJECTIVE:

Determine the steps needed to prevent heat exposure injuries.

The prevention of heat exposure injuries is a command responsibility, but the medical department plays a role in it by educating all hands about the medical dangers, monitoring environmental health, and advising the commanding officer.

On the individual level, prevention centers on water and salt replacement. Sweat must be replaced ounce for ounce; in a hot environment, water consumption must be drastically increased. Salt should be replaced by eating well-balanced meals, three times a day, salted to taste. In the field, "C" rations contain enough salt to sustain a person in most situations. DO NOT use salt tablets unless specified by a physician. DO NOT consume alcoholic beverages.

At the command level, prevention centers on an awareness of the environment. The Wet Bulb Globe Temperature (WBGT) must be monitored regularly, and the results interpreted with the Physiological Heat Exposure Limit (PHEL) chart before work assignments are made. In addition, unnecessary heat sources, especially steam leaks, must be eliminated, and vents and exhaust blowers must be checked for adequate circulation. The results will be a happier, healthier, and more productive crew.

COLD EXPOSURE INJURIES

LEARNING OBJECTIVE:

Describe the signs, symptoms, and emergency treatment of each type of cold exposure injury.

When the body is subjected to extremely cold temperatures, blood vessels constrict, and body heat is gradually lost. As the body temperature drops, tissues are easily damaged or destroyed.

The cold injuries resulting from inadequate response to the cold in military situations have spelled disaster for many armies such as those of Napoleon and Hitler in their Russian campaigns. The weather (i.e. temperature, humidity, precipitation, and wind) is the predominant influence in the development of cold injuries. Falling temperature interacting with high humidity, a wet environment, and rising wind accelerates the loss of body heat.

Other factors that influence the development of cold injuries are the individual's level of dehydration, the presence of other injuries (especially those causing a reduction in circulatory flow), and a previous cold injury which increases susceptibility by lowering resistance. In addition, the use of any drug (including alcohol) that modifies autonomic nervous system response or alters judgment ability can drastically reduce an individual’s chance for survival in a cold environment.

Like heat exposure injuries, cold exposure injuries are preventable. Acclimatization, the availability of warm, layered clothing, and maintenance of good discipline and training standards are important factors. These are command not medical responsibilities, but the HM plays a crucial role as a monitor of nutritional intake and personal hygiene (with emphasis on foot care) and as an advisor to the commanding officer. The HM is also responsible for acquainting the troops with the dangers of cold exposure and with preventive measures.
Two major points must be stressed in the management of all cold injuries: Rapid re-warming is of primary importance, and all unnecessary manipulations of affected areas must be avoided. More will be said about these points later.

In military operations the treatment of cold injuries is influenced by the tactical situation, the facilities available for the evacuation of casualties, and the fact that most cold injuries are encountered in large numbers during periods of intense combat when many other wounded casualties appear. Highly individualized treatment under these circumstances may be impossible because examination and treatment of more life-endangering wounds must be given priority. In a high-casualty situation, shelter cold-injury casualties, and try to protect them from further injury until there is sufficient time to treat them.

All cold injuries are similar, varying only in the degree of tissue damage. Although the effects of cold can, in general, be divided into two types general cooling of the entire body and local cooling of parts of the body cold injuries are seldom strictly of one type or the other; rather, these injuries tend to be a combination of both types. Each type of cooling, however, will be discussed separately in the sections that follow.

GENERAL COOLING (HYPOTHERMIA)

General cooling of the whole body is caused by continued exposure to low or rapidly falling temperatures, cold moisture, snow, or ice. Those exposed to low temperatures for extended periods may suffer ill effects, even if they are well protected by clothing, because cold affects the body systems slowly, almost without notice.

As the body cools, there are several stages of progressive discomfort and disability. The first symptom is shivering, which is an attempt to generate heat by repeated contractions of surface muscles. This is followed by a feeling of listlessness, indifference, and drowsiness. Unconsciousness can follow quickly.

Shock becomes evident as the casualty’s eyes assume a glassy stare, respiration becomes slow and shallow, and the pulse is weak or absent. As the body temperature drops even lower, peripheral circulation decreases and the extremities become susceptible to freezing. Finally, death results as the core temperature of the body approaches 80°F.

The steps for treatment of hypothermia are as follows:

1. Carefully observe respiratory effort and heart beat; CPR may be required while the warming process is underway.
2. Re-warm the casualty as soon as possible.
   a. It may be necessary to treat other injuries before the casualty can be moved to a warmer place.
   b. Severe bleeding must be controlled and fractures splinted over clothing before the casualty is moved.
3. Replace wet or frozen clothing and remove anything that constricts the casualty’s arms, legs, or fingers, interfering with circulation.
4. If the casualty is inside a warm place and is conscious, the most effective method of warming is immersion in a tub of warm (100 to 105°F or 38 to 41°C) water.
   a. The water should be warm to the elbow never hot.
   b. Observe closely for signs of respiratory failure and cardiac arrest (re-warming shock).
   c. Re-warming shock can be minimized by warming the body trunk before the limbs to prevent vasodilatation in the extremities with subsequent shock due to blood volume shifts.
5. If a tub is not available, apply external heat to both sides of the casualty.
   a. Natural body heat (skin to skin) from two rescuers is the best method. This is called "buddy warming."
   b. If this is not practical, use hot water bottles or an electric re-warming blanket.
      i. Do not place the blanket or bottles next to bare skin.
      ii. Monitor the temperature of the artificial heat source, since the casualty is very susceptible to burn injury.
   c. Because the casualty is unable to generate adequate body heat, placement under a blanket or in a sleeping bag is not sufficient treatment.

6. If the casualty is conscious, give warm liquids to drink. Never give alcoholic beverages or allow the casualty to smoke.

7. Dry the casualty thoroughly if water is used for re-warming.

8. As soon as possible, transfer the casualty to a definitive care facility. Be alert for the signs of respiratory and cardiac arrest during transfer, and keep the casualty warm.

LOCAL COOLING

Local cooling injuries, affecting individual parts of the body, fall into two categories: freezing and nonfreezing injuries. In the order of increasing seriousness, they include chilblain, immersion foot, superficial frostbite, and deep frostbite. The areas most commonly affected are the face and extremities.

Chilblain

Chilblain is a mild cold injury caused by prolonged and repeated exposure for several hours to air temperatures from above freezing 32°F (0°C) to as high as 60°F (16°C). Chilblain is characterized by redness, swelling, tingling, and pain to the affected skin area.

Injuries of this nature require no specific treatment except warming of the affected part (if possible use water bath of 90°F to 105°F), keeping it dry, and preventing further exposure.

Immersion Foot

Immersion foot, which also may occur in the hands, results from prolonged exposure to wet cold at temperatures ranging from just above freezing to 50°F (10°C). Immersion foot is typically seen in connection with limited motion of the extremities and water-soaked protective clothing.

Signs and symptoms of immersion foot are tingling and numbness of the affected areas; swelling of the legs, feet, or hands; bluish discoloration of the skin; and painful blisters. Gangrene may occur. General treatment for immersion foot is as follows:

1. Get the casualty off his or her feet as soon as possible.
2. Remove wet shoes, socks, and gloves to improve circulation.
3. Expose the affected area to warm, dry air.
4. Keep the casualty warm.
5. Do not rupture blisters or apply salves and ointments.
6. If the skin is not broken or loose, the injured part may be left exposed; however, if it is necessary to transport the casualty, cover the injured area with loosely wrapped fluff bandages of sterile gauze.
7. If the skin is broken, place a sterile sheet under the extremity and gently wrap it to protect the sensitive tissue from pressure and additional injury.
8. Transport the casualty as soon as possible to a medical treatment facility as a litter patient.
Frostbite

Frostbite occurs when ice crystals form in the skin or deeper tissues after exposure to a temperature of 32°F (0°C) or lower. Depending upon the temperature, altitude, and wind speed, the exposure time necessary to produce frostbite varies from a few minutes to several hours. The areas most commonly affected are the face and extremities.

The symptoms of frostbite are progressive. Casualties generally incur this injury without being acutely aware of it. Initially, the affected skin reddens and there is an uncomfortable coldness. With continued heat loss, there is a numbness of the affected area due to reduced circulation. As ice crystals form, the frozen extremity appears white, yellow-white, or mottled blue-white, and is cold, hard, and insensitive to touch or pressure. Frostbite is classified as superficial or deep, depending on the extent of tissue involvement.

SUPERFICIAL FROSTBITE.—In superficial frostbite the surface of the skin will feel hard, but the underlying tissue will be soft, allowing it to move over bony ridges. This is evidence that only the skin and the region just below it are involved. General treatment for superficial frostbite is as follows:

1. Take the casualty indoors.
2. Re-warm hands by placing them under the armpits, against the abdomen, or between the legs.
3. Re-warm feet by placing them in the armpit or against the abdomen of the buddy.
4. Gradually re-warm the affected area by warm water immersion, skin-to-skin contact, or hot water bottles.
5. Never rub a frostbite area.

DEEP FROSTBITE.—In deep frostbite, the freezing reaches into the deep tissue layers. There are ice crystals in the entire thickness of the extremity. The skin will not move over bony ridges and will feel hard and solid.

The objectives of treatment are to protect the frozen areas from further injury, to rapidly thaw the affected area, and to be prepared to respond to circulatory or respiratory difficulties.

1. Carefully assess and treat any other injuries first. Constantly monitor the casualty’s pulse and breathing since respiratory and heart problems can develop rapidly. Be prepared to administer CPR if necessary.
2. Do not attempt to thaw the frostbitten area if there is a possibility of refreezing. It is better to leave the part frozen until the casualty arrives at a medical treatment facility equipped for long-term care. Refreezing of a thawed extremity causes severe and disabling damage.
3. Treat all casualties with injuries to the feet or legs as litter patients. When this is not possible, the casualty may walk on the frozen limb, since it has been proven that walking will not lessen the chances of successful treatment as long as the limb has not thawed out.
4. When adequate protection from further cold exposure is available, prepare the casualty for re-warming by removing all constricting clothing such as gloves, boots, and socks. Boots and clothing frozen on the body should be thawed by warm-water immersion before removal.
5. Rapidly re-warm frozen areas by immersion in water at 100°F to 105°F (38°C to 41°C). Keep the water warm by adding fresh hot water, but do not pour the water directly on the injured area. Ensure that the frozen area is completely surrounded by water; do not let it rest on the side or bottom of the tub.
6. After re-warming has been completed, pat the area dry with a soft towel. Later it will swell, sting, and burn.
   a. Blisters may develop. These should be protected from breaking.
   b. Avoid pressure, rubbing, or constriction of the injured area.
   c. Keep the skin dry with sterile dressings and place cotton between the toes and fingers to prevent their sticking together.

7. Protect the tissue from additional injury and keep it as clean as possible (use sterile dressings and linen).

8. Try to improve the general morale and comfort of the casualty by giving hot, stimulating fluids such as tea or coffee. Do not allow the casualty to smoke or use alcoholic beverages while being treated.

   Transfer to a medical treatment facility as soon as possible. During transportation, slightly elevate the frostbitten area and keep the casualty and the injured area warm. Do not allow the injured area to be exposed to the cold.

**LATER MANAGEMENT OF COLD INJURIES**

**LEARNING OBJECTIVE:**

Determine the steps needed for the later management of cold-exposure injuries.

When the patient reaches a hospital or a facility for definitive care, the following treatment should be employed:

1. Maintain continued vigilance to avoid further damage to the injured tissue. In general, this is accomplished by keeping the patient at bed rest with the injured part elevated (on surgically clean sheets) and with sterile pieces of cotton separating the toes or fingers.
   a. Expose all lesions to the air at normal room temperature.
   b. Weight bearing on injured tissue must be avoided.

2. Whirlpool baths, twice daily at 98.6°F (37°C) with surgical soap added, assist in superficial debridement, reduce superficial bacterial contamination, and make range of motion exercises more tolerable.

3. Analgesics may be required in the early post-thaw days but will soon become unnecessary in uncomplicated cases.

4. Encourage the patient to take a nutritious diet with adequate fluid intake to maintain hydration.

5. Perform superficial debridement of ruptured blebs, and remove suppurative scabs and partially detached nails.

**DIVING RELATED DISORDERS**

**LEARNING OBJECTIVES:**

*Explain the basic laws associated with diving related disorders.*

*Identify signs and symptoms of common diving related disorders.*

*Identify treatment methods for common diving related disorders.*

**Introduction**

A general approach to the medical aspects of diving and altitude injuries would be to say it is literally “medicine under pressure.” The physiological insult is by definition “pressure related.” The solution to most dive and altitude related injuries is to reintroduce the patient to pressure. Additionally, the vague and often misleading presentation a diving patient presents adds its own unique pressure in medicine.

*“Caissons Disease”*

The word caisson is a French word meaning “big boxes” Caissons were developed to allow workers a dry environment in which they could work on the bottom. They used these boxes to excavate bridge footings and build tunnels under water.
As the use of caissons increased, a new and unexplained illness began to affect the workers. Upon returning to the surface the workers often experienced dizziness, difficulty breathing and sharp pains in their joints and abdomen. The workers usually recovered but not always completely. The caisson workers often noted that they felt better while on the bottom in the caissons. The malady was logically called, caissons disease. However, workers on the Brooklyn bridge project in New York gave the malady a more descriptive name “the bends.” The “bends” is a slang term used for Decompression Sickness (DCS).

This demonstrates the importance that all medical personnel have a basic understanding of the effects of pressure on the human body. Whether stationed at a diving command or a high mountain airstrip; understanding pressure related emergencies can make the difference by knowing the mechanisms of injury and the presentation with an elevated index of suspicion. Injuries specific to diving are the result of exposure to increased pressure over and above what bodies are normally exposed to at the earth’s surface. The three principle categories for injuries are barotraumas, toxicities, and decompression sickness.

Pressure

Pressure is defined as force acting upon a particular area of matter. While diving there are two factors to consider: the weight of the water over the diver and the weight of the atmosphere above the water. In the field of aviation the effects of pressure must be considered, due to the weight of the atmosphere. The weight of the atmosphere (from sea-level up to the ozone layer) exerts 14.7 psi on the human body. This pressure of the “atmosphere” is constantly exerted on our bodies. Due to the atmosphere being made up of gases and gases having the characteristic of compressing, if people travel to a higher altitude they find air is less dense, therefore weighs less per square inch. Inversely as they descend through the water, more weight is applied causing the gas to be denser.

1 atmosphere = 14.7
1 foot sea water = .445 psi
33 feet sea water = 14.7 psi

Measuring pressure while descending the water column (going deeper) there will be an increase of .445 psi for every foot of seawater descended into. This is known as “hydrostatic pressure.” At 33 feet of seawater (fsw) the amount of pressure on the diver’s body doubles from the surface. This increase remains .445psi/fsw no matter how deep because water does not compress (Fig. 21-12). The deeper a diver descends the more water that is over the diver, the more weight that is acting on the diver.

![Figure 21-12.—Atmosphere and Pressure Relationship](image)

33 fsw = 14.7 psi = 1 atm

*1 square inch of air 20-30 miles high = 1 square inch of water 33 feet high.

Pressure increases linearly, gas volume changes exponentially.
**Barotrauma (Boyle’s Gas Law)**

Boyle’s Law (Fig. 21-13) – For any gas at a constant temperature, pressure, and volume are inversely related. Boyle’s Law predicts gas changes in volume. As a bubble descends the water column, increasing pressure will act on it causing it to compress and shrink in size. Inversely, as it ascends the water column, pressure decreases thereby allowing it to expand/enlarge.

**Barotrauma** is defined as damage to tissues caused by a change in ambient pressure. The human body has gas filled, semi rigid cavities that are subject to changes in volume due to changes in pressure – lungs, sinuses, and middle ear for example. A diver must equalize for this volume change otherwise barotrauma will occur. This is also known as a squeeze on descent and reverse squeeze on ascent.

The most common type of squeeze, “middle ear squeeze,” can be experienced by simply jumping in a swimming pool and swimming to the bottom – pressure increases, the volume of gas in the middle ear decreases resulting in pain. If not corrected/equalized by forcing more gas into the middle ear (valsalva), barotrauma will occur. The space inside the middle ear is enclosed. As a diver descends in the water, pressure is increasing and compressing that space, if the diver does not valsalva and equalize the pressure inside the middle ear to match the pressure being applied outside, damage will occur.

**General Treatment** for middle ear squeeze: Upon surfacing after a middle ear squeeze, the diver may complain of pain, fullness in the ear, hearing loss, or even mild vertigo. Occasionally, the diver may have a bloody nose, the result of blood being forced out of the middle ear space and into the nasal cavity through the eustachian tube.

![Diagram of Diving Laws and Associated Complications](image)

*Figure 21-13.—Diving Laws and Associated Complications*
Treatment consists of decongestants, NSAID’s for pain and inflammation as needed, and discontinue diving until healed. Three days to several weeks depending on severity. If the eardrum is ruptured antibiotics may be prescribed as well. Never administer medication directly into the external ear canal if a ruptured eardrum is suspected or confirmed without consulting an ear, nose, and throat (ENT) specialist.

General Types of Squeezes/Barotrauma – Outer Ear, Middle Ear, Inner Ear, Sinus, Tooth, Dry Suit, Mask, POIS, etc. As noted above, that which affects the middle ear affects other gas-filled, semi-rigid areas as well. Of particular concern are the pulmonary over inflation syndrome (POIS) injuries which are discussed below.

Pulmonary Over Inflation Syndrome (POIS) is barotrauma of the lung. Expanding gas if trapped in the lung(s) and not allowed to escape can result in tearing at the alveolar sacs. This can result in one or several types of POIS - Mediastinal Emphysema, Subcutaneous Emphysema, Pneumothorax, and Arterial Gas Embolism.

Mediastinal Emphysema is the tearing of the lung with air leaking out and remaining inside the chest cavity. Symptoms are mild with a substernal burning sensation or pain on deep inspiration. This is enough air to cause discomfort yet not enough to cause the lung to collapse.

Subcutaneous Emphysema tearing of the lung with air leaking out of the lung then migrating up and out of the chest cavity and stopping at the base of the neck. Air bubbles can be felt beneath the skin.

Pneumothorax is the tearing of the lung with air leaking out and collapsing the lung.

Arterial Gas Embolism (AGE) capillaries on the alveolar sacs at the location of a tear in the lung draw gas into the blood stream. These gas bubbles will follow the circulatory system traveling from the lung to the heart then out to the body via arterial flow. The bubble continues until it becomes lodged ultimately resulting in decreased blood flow and hypoxia downstream from its location, acting like a blood clot.

Severity of symptoms depends on the location of the bubble. The brain and heart are the two most serious locations for AGE to occur with stroke and heart attack symptoms presenting respectively. Due to the obstruction occurring on the arterial side of the circulatory system, symptoms present rapidly. The general rule is “Any neurological deficit within 10 minutes of a diver reaching the surface is considered AGE.”

Given the mechanism of injury for POIS it is entirely possible to have all 4 types of injury at the same time. Any time a diver presents with any POIS symptoms, a neurological exam must be completed to rule out AGE.

Toxicities: Dalton’s Law – increasing partial pressure

As a gas descends in the water column it is exposed to increased pressure and becomes more concentrated (Fig. 21-13). The ratio or percentage of gas (21% oxygen/79% nitrogen in air for example) remains the same, but because gases compress, the number of molecules that fit in a given volume increases. Take human lungs for instance. Tidal Volume at rest is 500ml. At a depth of 33 fsw the body still requires 500ml of Tidal Volume, however, because gases compress twice the amount of nitrogen and oxygen is received in a single breath compared to what is normally received at surface. This is what’s known as “partial pressure”, gas becomes “concentrated” under pressure. This “concentration” relative to atmospheres increases linearly: 33fsw x 2, 66fsw x 3, and 99fsw x 4. At 99fsw the diver is at 4 atmospheres absolute (3 water + 1 surface).
Higher partial pressures/concentrations of gasses have adverse and toxic effects on the body.

**Nitrogen Narcosis** at depths greater than 99 fsw, Nitrogen exerts a progressive depression of the central nervous system (CNS). Nitrogen Narcosis doesn’t cause damage but, its greatest hazard is gross lack of judgment which can cause a diver to make life threatening mistakes at depth.

**CNS Oxygen Toxicity** at partial pressures greater than 1.3, oxygen has a toxic effect on the CNS. Prolonged exposure to oxygen can irritate the tissues of the respiratory tract and lungs resulting in a burning sensation, also called Pulmonary Oxygen Toxicity.

**Carbon Dioxide Toxicity** build up is the waste product of respiration. Hyperbaric environment (increased pp) not required but due to the nature of work diving and ventilation limitations of diving apparatus make this the most common toxicity encountered in diving.

**Carbon Monoxide Toxicity** Carbon Monoxide binds to hemoglobin 200 times faster than oxygen, thereby causing a state of hypoxia. Breathing medium (tanks) contaminated by exhaust from internal combustion engines is the main cause for this toxicity. Hyperbaric environment not required, but increased pp exacerbates effects of carbon monoxide.

**Decompression Sickness: Henry’s Law – absorption/saturation**

The amount of gas which will dissolve in a liquid is proportional to the partial pressure of that gas above the liquid (Fig. 21-13). Take a closed container half filled with water, half with air, increase the pressure inside the chamber by adding more air – air is going to dissolve into the water. Now rapidly open the container reducing the pressure – the air will come back out of the liquid in the form of bubbles. This is the same action as shaking a carbonated beverage prior to opening, it explodes when opened because the pressure is decreased and the gas is forced out of the liquid.

Our bodies are 85% water and on the surface the body is at equilibrium (balance) with the inert gases in breathing air. Tissues are “saturated” to the 14.7 psi of 1 atmosphere of pressure.

Air is 79% Nitrogen, 21% Oxygen. There is about 1% of other trace elements, but not in high enough concentration to have an effect. Our bodies metabolize the oxygen. When the ppO2 falls below the surface equivalent of 16% signs of decreased mental status and function present themselves. Nitrogen is not necessary for anything, it is not metabolized. It is an “inert gas.” It basically provides a buffer or vehicle for oxygen. During a dive, pressure increases due to the weight of water over the diver causing the inert gas to become more concentrated. Thus at depth, because the pressure on the diver has increased, the amount of inert gas dissolved in the diver’s tissue also increases.

Then what happens to this gas on ascent to the surface? The external ambient pressure reduces on ascent, so the partial pressure of inert gas in the breathing mix decreases. Correspondingly, per Henry’s Law, the amount of inert gas dissolved in tissues drops.

When a diver maintains a normal ascent rate from the bottom to the surface, the inert gases have time to “off gas” or come out of solution at a controlled rate where the body can naturally dispose of the gas through the normal process of respiration. If ascent is too rapid the diver’s body exceeds the capacity for dissolved inert gas in its tissues, then the excess gas dissolved in tissues has nowhere else to go except to form bubbles in the body.

Essentially, DCS (decompression sickness) is the formation of bubbles in tissues. Where these bubbles form determines the type and severity of DCS. By following rules for decompression, such as a controlled rate of ascent and limiting time at depth will prevent significant bubble formation and reduce the risk of DCS.
**Decompression Sickness Type I**

Pain – Dull aching pain localized to a joint, normally not made worse with movement. It can progress from a dull ache to a deep ache and typically results from bubble formation in joint tissue. This is the most common manifestation of DCS Type I.

Marbling – When a bubble forms “in” the skin, the dermis and or epidermis, it results in a condition known as Cutis Marmorata. This is a mottling or marbling of the skin or a popular or plaque like violet colored rash. This is often accompanied by an itching or burning sensation. On rare occasions, skin has an orange-peel appearance. This condition is often called “skin bends.” This is not to be confused with Subcutaneous Emphysema; they are two different disease processes.

Swelling – When a bubble forms in the lymphatic system it will cause swelling of the affected lymph nodes. The most commonly involved lymph nodes are in the inguinal and axillary areas. The affected nodes are usually painful and swollen.

**Decompression Sickness Type II**

Central Nervous System (CNS) – When a bubble forms within the CNS it will produce a neurological deficit. Some examples include weakness, decreased sensation, paralysis, confusion, memory loss, visual disturbances, or extreme fatigue. The onset of symptoms takes place 10 minutes after surfacing from a dive up to 48 hours post dive. **Any neurological symptom within the first 10 minutes after surfacing from a dive is considered an Arterial Gas Embolism.**

Pain – This is a different type of pain from that of Type I DCS. If the pain is radiating such as radicular truck pain, pain that follows a dermatome, is an indication of Type 2 DCS.

Lungs – When a bubble forms in the lungs it results in Pulmonary DCS (the chokes). This is characterized by burning, substernal discomfort on inspiration, non-productive coughing that can become paroxysmal, and severe respiratory distress. Symptoms can start up to 12 hours after a dive and persist for 12 to 48 hours.

Inner Ears – When a bubble forms within the inner ears, it results in Inner Ear DCS (staggers). It is characterized by tinnitus (ringing in the ears), hearing loss, vertigo, dizziness, nausea, and vomiting. The affected person will have difficulty walking, hence the name staggers.

**Aviation Bends**

DCS caused by rapid decompression of an aircraft cabin or a rapid vertical climb; typically seen in fighter jets, either of them can produce similar mechanics of surfacing too rapidly in the water. Symptoms will present as Type I or II DCS and are treated accordingly.

**General rules**

DCS Types I and II, and AGE can progress to permanent or life threatening conditions. Recompression in a hyperbaric chamber is the only definitive treatment for DCS and AGE.

Pain alone is not AGE. A Neurological deficit would need to be present for it to be true AGE and present within the **first 10 minutes.**

Other POIS may be present. Recompression therapy is not indicated for pneumothorax or mediastinal and subcutaneous emphysema unless considered severe.
Treatment

ABCs.

- 100% O2 by mask
- Obtain dive history
  - Depth of dive
  - Time spent on dive
  - Time the diver reached the surface
  - What are the symptoms
  - When did they start
  - Have they improved or worsened
  - Does anything make them better or worse
  - Were any other dives prior to last dive, if so depth and time of dive and time spent on surface between dives
  - Are there any prior diving related injuries
- If diving related injury is suspected contact closest recompression facility, Dive Medical Technician(DMT), and or dive medical officer (DMO)
- Upon recommendation transport patient flat on O2 – do not elevate feet or head. If aircraft used maintain cabin pressure / altitude < 1000 feet above sea level
- Start a large bore IV (16 or 18 gauge) at 75cc/hr or KVO as indicated

CAUTION:
Do NOT give medications as they will mask the symptoms.

Differences between AGE and DCS

AGE can occur in as shallow as a few feet of water. DCS requires depth with improper off gassing, excessive time at depth, or both. Get a thorough history!

SUMMARY

A medical emergency can occur at anytime. HMs must be prepared to act expeditiously and confidently, whether in a combat situation, on board a naval vessel, or at the Navy Exchange. This chapter covers the preliminary steps that should be followed when managing sick or injured patients. The preliminary emergency steps include triage, patient assessment, and, when needed, basic life support. Other related topics covered in this chapter are breathing aids, shock, diagnosis and emergency treatment procedures for medical conditions and injuries, and other emergencies.