# COMPONENTS OF FIELD MEDICINE

# COMBAT MEDICINE

# MEDICATION APPENDIX

## Medications Used During Tactical Combat Casualty Care (TCCC)

## Pain Relief

The Committee on Tactical Combat Casualty Care (CoTCCC) recommends the following medications be used in providing pain relief to casualties. The choice of which medications to use is based on the patients ability to remain in the fight.

Mobic (meloxicam) is a Non Steroidal Anti-Inflammatory Drug (NSAID) given for pain relief. This drug is usually given as soon as possible following injury to casualties who are still able to fight. The CoTCCC recommends this drug be supplied to individual operators as part of a Combat Pill Pack. This drug was chosen because it has no documented platelet dysfunction, meaning that unlike other NSAID's such as Motrin, it does not interfere with the body's natural blood clotting abilities. Although it takes up to five hours to reach its maximum level of effectiveness, it has a long duration time and is stable even at high temperatures.

Tylenol (acetaminophen) 8-Hour Bi-layer Caplets is an analgesic and antipyretic (fever lowering) medication intended to be given with at the same time Mobic is given. The outer layer of the caplet is designed to dissolve quickly to provide quick relief. The CoTCCC recommends this medication because it acts quickly and helps to bridge the gap until the Mobic takes effect. It also should be issued to operators as part of the Combat Pill Pack and should be given to casualties who need pain relief for their injuries but are still able to participate in combat operations.

Morphine is an Opiod (narcotic) and is considered the "gold standard" of analgesia. It should only be administered to a casualty out of the fight who already has IV access established. Dosage should be 5mg given every 10 minutes until pain relief is achieved. Because patients who receive narcotics often suffer from nausea and vomiting, Phenergan (promethazine) should also be administered. Narcan (naloxone) should also be *on hand* whenever narcotics are used in the event the patient suffers from respiratory depression.

Oral Transmucosal Fentanyl Citrate (OTFC) is an Opiod (narcotic) that provides a means of delivering effective, rapid onset pain relief without starting an IV. This medication is produced in a lozenge form. It should be given only to patients who can no longer participate in combat operations. It should be administered by taping the "lozenge-on-a-stick" to the patient's finger and placing the lozenge in the patient's mouth. Once analgesia is achieved the patient may pass out and the lozenge will fall out of his or her mouth. Similar to morphine, promethazine may be needed to reduce nausea and Narcan should be on hand.

Phenergan (promethazine) is given to reduce nausea. It is administered IV, IO, or IM in dosages of 25 mg or 50 mg.

Narcan (naloxone) is an Opiod reversal agent. It is designed to prevent or reverse the effects of narcotics such as morphine or OTFC. It should be administered in an initial dose of 0.2 mg IV, IO, or IM (up to 10 mg total).

## Antibiotics

Infection is a late cause of morbidity (sickness) and mortality (death) in battlefield wounds. For this reason the CoTCCC has recommended casualties receive antibiotic treatment as soon as possible. The biggest challenge for you is the logistical requirements that prevent you from carrying a wide variety of items. The CoTCCC identified the antibiotics that provided the most "bang for the buck". The following medications were chosen for their, broad coverage, minimal side effects, resistance to heat or cold, simple dosage requirements, and minimal storage requirements.

Avelox (moxifloxacin) is the oral antibiotic of choice. The dosage is one 400 mg tablet by mouth, once a day. This should be administered to all casualties who can tolerate oral medications as soon after injury as possible.

Cefotan (cefotetan) is the parenteral (injectable) antibiotic drug of choice. The dosage is either 2 grams IV/IO delivered over the span of 3 to 5 minutes or 2 grams IM. This should be given to casualties who can not take oral medications. This includes casualties who are unconscious or those who have significant facial wounds. Patients in hypovolemic shock should not be given antibiotics orally because reduced blood flow to the stomach impairs the body's ability to process oral medications.

Invanz (ertapenum) is the recommended alternative to cefotetan in the event it is not available (as has been the case). The dosage is 1 gram administered IV, IO, or IM. This should be given to casualties who can not take oral medications. This includes casualties who are unconscious or those who have significant facial wounds. Patients in hypovolemic shock should not be given antibiotics orally because reduced blood flow to the stomach impairs the body's ability to process oral medications.

Combat Medicine
Review Questions

**NOTE: The following questions are offered for review purposes. <u>This is NOT intended as a sole source of test preparation</u>. Remember all test questions are based on an ELO and any ELO can be used to create a test question.**

1. What are the anatomical landmarks for a cricothyroidotomy?
2. What are the components of the cardiovascular system?
3. What are the three basic groups that IV solutions fall into?
4. What causes a Flail Chest?
5. What are the three types of muscles in the body?
6. What major abdominal organs are in the Right Upper Quadrant?
7. What is the initial treatment of a life threatening extremity wound?
8. The skeletal portion of the thorax is formed by what?
9. What are the three types of head injuries?
10. What are the 10 procedural steps of performing an emergency cricothryoidotomy?
11. What are two serious consequences of Tension Pneumothroax?
12. What plasma substitute is the IV fluid of choice for volume replacement due to trauma in a tactical situation?
13. What is the Hemostatic agent used on the battlefield?
14. Which lung is larger than the other and is divided into three lobes?
15. What are the major types of facial injuries?
16. Treatment for strains and sprains includes R.I.C.E. What does R.I.C.E stand for?
17. What is the second leading cause of preventable death on the battlefield?
18. What is homeostasis?
19. Where should a tourniquet NEVER be placed?
20. What major abdominal organs are in the Right Lower Quadrant?
21. For which type of injury is a Modified Barton bandage used?
22. How much blood is in the average adult?
23. What is the difference between a strain, sprain, and dislocation?
24. What are the four classifications of hemorrhagic shock?
25. What major abdominal organs are in the Left Upper Quadrant?
26. What is the most common complication associated with emergency cricothyroidotomy?
27. What are the two types of bruising associated with closed skull injuries?
28. What anatomical landmarks are necessary in order to perform needle thoracentesis?

29. What are the classifications of abdominal organs?
30. What are the causes of cervical spine neck injuries?
31. What is Phlebitis?
32. What are the three phases of Tactical Combat Casualty Care?
33. What are the four types of bones in the body?
34. What is the definitive management of hemorrhagic shock?
35. What are the three types of distributive shock?
36. What are signs and symptoms of intrinsic cardiogenic shock?
37. What major abdominal organs are in the Left Lower Quadrant?
38. What are signs and symptoms of vasculature neck injuries?
39. What are the procedural steps for needle thoracentesis?
40. What is subcutaneous emphysema?
41. What causes an Open Pneumothorax (Sucking Chest Wound)?
42. What are the three types of hemorrhage and what are their distinguishing traits?

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FMST 401

# Introduction to Tactical Combat Casualty Care

## TERMINAL LEARNING OBJECTIVE

1. Given a casualty in a tactical environment, **perform Tactical Combat Casualty Care** to reduce the risk of further injury or death. (8404-MED-2010)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **define the principles of Tactical Combat Casualty Care (TCCC)**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2010a)

2. Without the aid of reference, given a description or list, **define the first phase of TCCC**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2010b)

3. Without the aid of reference, given a description or list, **define the second phase of TCCC**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2010c)

4. Without the aid of reference, given a description or list, **define the third phase of TCCC**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2010d)

## OVERVIEW

Tactical Combat Casualty Care (TCCC) was developed to emphasize the need for continued improvement in combat pre-hospital care. The Committee on Tactical Combat Casualty Care (CoTCCC) was established in 2001 and is part of the Defense Health Board. CoTCCC is a standing multi-service committee charged with monitoring medical developments in regards to practice, technology, pharmacology and doctrine. New concepts in hemorrhage control, airway management, fluid resuscitation, analgesia, antibiotics and other lifesaving techniques are important steps in providing the best possible care for our Marines and Sailors in combat.

The TCCC guidelines are published every 4 years in the Prehospital Trauma Life Support manual. It has been recognized that TCCC guidelines and curriculum will need to change more often than the 4-year cycle of the PHTLS textbook publication. The National Association of Emergency Medical Technicians (NAEMT) will include the updated TCCC guidelines and curriculum on its website as they are approved as a way to help get this new information out to the combat medical personnel in the military that need it.

## 1. PRINCIPLES OF TACTICAL COMBAT CASUALTY CARE (TCCC)

The principles of Tactical Combat Casualty Care are fundamentally different from those of traditional civilian trauma care, where most medical providers and medics train. These differences are based on both the unique patterns and types of wounds that are suffered in combat and the tactical conditions medical personnel face in combat. Unique combat wounds and tactical conditions make it difficult to determine which intervention to perform at what time. Besides addressing a casualty's medical condition, responding medical personnel must also address the tactical problems faced while providing care in combat. A medically correct intervention at the wrong time may lead to further casualties. Put another way, "good medicine may be a bad tactical decision" which can get the rescuer and the casualty killed. To successfully navigate these issues, medical providers must have skills and training oriented to combat trauma care, as opposed to civilian trauma care.

The specifics of casualty care in the tactical setting will depend on the tactical situation, the injuries sustained by the casualty, the knowledge and skills of the first responder, and the medical equipment at hand. In contrast to a hospital Emergency Department setting where the patient IS the mission, on the battlefield, care of casualties sustained is only PART of the mission. TCCC recognizes this fact and structures its guidelines to accomplish three primary goals:

**1. Treat the casualty**

**2. Prevent additional casualties**

**3. Complete the mission**

In thinking about the management of combat casualties, it is helpful to divide care into three distinct phases, each with its own characteristics and limitations.

2. **FIRST PHASE OF TCCC**

**Care Under Fire** - care rendered at the scene while both the Corpsman and the casualty are still under effective hostile fire. The risk of additional injuries from hostile fire at any moment is extremely high. The need for medical care must be weighed against the need to move to cover and to suppress hostile fire rapidly.

If the casualty is responsive they should be directed to move to cover and/or apply a tourniquet if needed. Casualties, who are able, should remain engaged as combatants. If the casualty is unable to move and unresponsive, risking additional lives by exposure to fire to move the casualty may not be warranted.

Immediate control of extremity hemorrhage with a tourniquet is the most important life-saving intervention in Care Under Fire and is the only medical care that should be rendered before the casualty is moved to cover.

Available medical equipment is limited to that carried by the Corpsman and casualty, however the only medical equipment needed during this phase is a CoTCCC recommended tourniquet.

3. **SECOND PHASE OF TCCC**

**Tactical Field Care** - care rendered once the Corpsman and casualties are no longer under effective hostile fire. This also applies to situations in which an injury has occurred on a mission, but there has been no hostile fire.

Available medical equipment is still limited to that carried into the field by mission personnel but now there is more time to fully assess the casualty and reassess any treatment provided in the Care Under Fire phase. Time to evacuation may vary from minutes to hours.

Priorities of Tactical Field Care

- Disarm all casualties with an altered mental status

- Obtain airway

- Assess and treat external hemorrhaging

- Manage shock/fluid resuscitation

- Hypothermia prevention

- Pain relief/antibiotics

4. **THIRD PHASE OF TCCC**

**Tactical Evacuation (TACEVAC)** - casualties are transported to a higher level of care. Tactical evacuation care encompasses both medical evacuation (MEDEVAC) and casualty evacuation (CASEVAC).

CASEVAC platforms are typically armed tactical assets that bear no Red Cross markings. They provide unregulated movement from the point of injury to the first point of advanced medical care.

MEDEVAC refers to regulated casualty movement using dedicated medical evacuation platforms (ground vehicles, rotary wing aircraft, etc) that are crewed by medical personnel.

Additional personnel and medical equipment should be provided in this phase which allows for an enhanced level of medical care compared to the first two phases. Electronic monitoring systems capable of providing blood pressure, heart rate and pulse oximetry may be available during evacuation.

## TACTICAL COMBAT CASUALTY CARE

**Throughout Block 4, each lesson will reinforce the principles of TCCC. At the end of each lesson you will find a gray box that will highlight the critical task that you will be expected to perform during your Casualty Assessment Performance Evaluation.**

**REFERENCE**:

Prehospital Trauma Life Support (PHTLS), current Military Edition

## Intro to TCCC Review Questions

1. What are the three goals of TCCC?

    1)

    2)

    3)

2. What is the first phase of TCCC?

3. What is the only life-saving intervention done during Care Under Fire?

4. Which phase of TCCC is Tactical Field Care?

5. List four priorities of Tactical Field Care.

    1)

    2)

    3)

    4)

6. What does TACEVAC encompass?

7. Which phase of TCCC has the most readily available medical equipment?

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FMST 402

# Manage Shock Casualties

## TERMINAL LEARNING OBJECTIVES

1. Given a casualty in an operational environment**, treat for shock to reduce the risk of further injury or death**. (8404-MED-2001)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **identify standard medical terminology related to the cardiovascular system**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2001a)

2. Without the aid of reference, given a description or list, **identify the anatomy of the cardiovascular system**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2001b)

3. Without the aid of reference, given a description or list, **identify the different types of shock**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2001c)

4. Without the aid of reference, given a list of types of shock, **identify the signs and symptoms of each type of shock**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2001d)

5. Without the aid of reference, given a list, **identify the appropriate treatment of each type of shock**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2001e)

6. Without the aid of reference, given a simulated shock casualty and a Corpsman Assault Pack, **manage simulated shock casualties**, to prevent further injury or death, per Pre-Hospital Trauma Life Support, Current Military Edition. (8404-MED-2001f)

## OVERVIEW

Shock is regarded as a state of generalized cellular hypoperfusion in which delivery of oxygen to the cells is inadequate to meet metabolic needs. There is no laboratory test to diagnose shock. The initial step for managing shock in the injured patient is to recognize its presence. By far, the most common cause of shock in the trauma casualty is hemorrhage and the safest approach in managing the trauma casualty in shock is to consider the cause of it as being hemorrhagic until proven otherwise.

## 1. CARDIOVASCULAR SYSTEM TERMINOLOGY

Systolic Blood Pressure (SBP) - the force of the blood against blood vessels produced by ventricular contraction. (Normal systolic B/P = 120-140 mmHg)

Diastolic Blood Pressure (DBP) - the pressure remaining in the blood vessels while the heart is refilling. (Normal diastolic B/P = 60-80 mmHg)

Preload - the amount of blood returning into the heart from the systemic circulatory system (venous return).

Afterload - the resistance to blood flow that the heart must overcome to pump blood out to the arterial system.

Stroke Volume - amount of blood pumped by the heart with each contraction.

Capillary Refill Test - quick test performed on the nail beds as an indicator of tissue perfusion (normal = less than 3 seconds).

Nervous System - autonomic nervous system is divided into two components:

Sympathetic nervous system *(*controls the fight-or-flight response): The goal of this system is to maintain sufficient amounts of oxygenated blood to critical areas while shunting blood away from nonessential areas. Response includes:

- Heart beats faster and stronger
- Increases ventilations
- Constricts blood vessels of nonessential organs
- Dilates blood vessels of muscles

Parasympathetic nervous system (rest and digest): Division of the nervous system that maintains normal body functions. Response includes:

- Heart beats slower
- Decreases ventilations
- Increases dilation of blood vessels to nonessential organs

Metabolism – energy produced in the body by oxygen and glucose

Aerobic metabolism describes the use of oxygen by the cells. This is the body's main combustion process. Cells in the body do not contain an alternate power source.

Anaerobic metabolism occurs without the use of oxygen. It is the back-up power system in the body and uses stored body fat as its energy source. The lack of perfusion in cells by oxygenated blood results in anaerobic metabolism and decreased function for organ survival. If anaerobic metabolism is not reversed, cells cannot continue to function and will die.

## 2. ANATOMY OF THE CARDIOVASCULAR SYSTEM

The cardiovascular system consists of the heart (a pump), the blood (circulating fluid), and the vascular system (the container that holds the blood).

Pump - the heart is a muscle composed of four chambers, the right side receives blood from the body and the left side pumps blood to the body (see figure 1). For the heart to work effectively, an adequate amount of blood must be present in the ventricles (preload). When the preload is decreased, the heart muscles are not stretched enough and the stroke volume is reduced. Too much blood in the heart creates a state of increased afterload, also reducing the stroke volume.

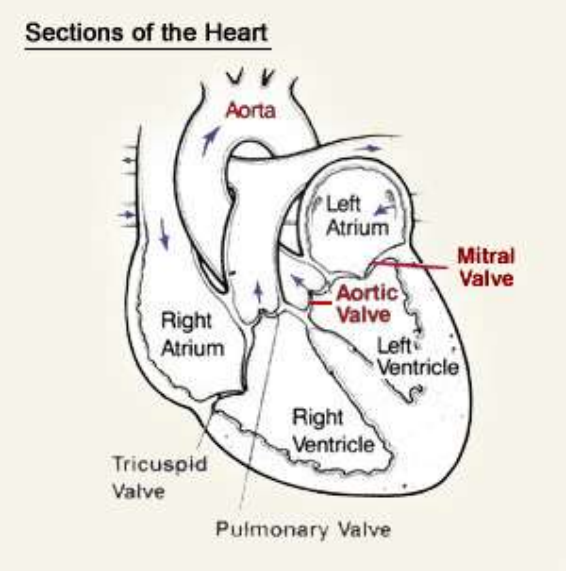


**Figure 1. Flow of blood**

Fluid - blood is composed of many substances. Red blood cells (RBC) contain hemoglobin and carry oxygen. White blood cells (WBC) are used by the body to fight infection. Platelets in the blood are essential for clotting. The volume of fluid within the container must equal the capacity of the vascular system in order to properly perfuse the tissues of the body.

Container - arteries, veins, and capillaries are the highways that take the blood throughout the body. The aorta is the largest artery in the body. At the smallest level, the capillaries may be no bigger than a single cell wide. The size of the entire "container" is controlled by muscles in the walls of the arteries and veins. These muscles are under the control of the brain via the sympathetic nervous system. By expanding and contracting the vessels, the size of the container is altered.

3. **TYPES OF SHOCK**

Shock is classified by its cause. Shock can occur in three ways that are associated with failure of some component of the cardiovascular system, the pump, volume, and container. The major types of shock are: **Hypovolemic**, **Distributive**, and **Cardiogenic** (see figure 2).

| The Three Types of Shock | | | | | | |
|---|---|---|---|---|---|---|
| | | **Hypovolemic** | **Distributive** | | | **Cardiogenic** |
| | | | **Neurogenic** | **Septic** | **Psychogenic** | |
| **Vital Sign** | **Skin Temp** | Cool, Clammy | Warm, Dry | Cool, Clammy | Cool, Clammy | Cool, Clammy |
| | **Skin Color** | Pale, cyanotic | Pink | Pale, Mottled | Pale | Pale, Cyanotic |
| | **Blood Pressure** | Drops | Drops | Drops | Drops (briefly) | Drops |
| | **LOC** | Altered | Lucid | Altered | Altered (briefly) | Altered |
| | **Cap Refill** | Slowed | Normal | Slowed | Slowed (briefly) | Slowed |

**Figure 2. Signs Associated with Types of Shock**

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.

***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.

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 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 usually 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 (see figure 3).

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

**Figure 3. Classes of Hemorrhagic Shock**

Class I Shock - this stage has few clinical manifestations. The casualty's body is able to compensate to maintain homeostasis.

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. You can 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.

"A tactically relevant definition of shock is: (1) unconsciousness or altered mental status (confused or drowsy) not due to coexisting TBI or drug therapy; and/or (2) abnormal (i.e., weak or absent radial pulse."
PHTLS 7th Ed. P. 623

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 figure 2.

Treatment
As stated in the Manage Hemorrhage lesson, you must stop the bleeding. Depending on which phase of field care you are in; 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 CASEVAC (see Combat Fluid Resuscitation lesson).

Distributive (Vasogenic) Shock - shock that occurs when the vascular container (blood vessels) dilate (enlarge) without a proportional increase in fluid volume. As a result, the hearts preload decreases, and cardiac output falls. There is still the same amount of blood in the blood vessels but they are dilated too much and not enough blood is returning to the heart. Causes can be from spinal cord trauma, simple fainting, severe infections, or allergic reactions.

Septic Shock - life threatening infections occurring primarily in a hospital setting. Toxins are released into the bloodstream and cause blood vessels to dilate. Septic shock and hypovolemic shock have many similar signs and symptoms. Septic shock is virtually never encountered within minutes of an injury. You should focus on prevention of septic shock. The Committee on Tactical Combat Casualty Care recommends administering the oral antibiotic *moxifloxacin* and the parental (injectable) antibiotic *ertapenum* at the time of injury to prevent wound infections. You will learn more about medications during the lesson on Casualty Assessment.

Signs and Symptoms
See figure 2.

Treatment
It usually takes between 5-7 days for septic shock to develop. However, you may be called on to care for a casualty who sustained an injury and did not promptly seek medical attention. If so, your 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 figure 2 and below)

- Injuries consistent with spinal injury
- Bradycardia with hypotension (low heart rate with low blood pressure should be a red flag, start suspecting neurogenic shock)
- 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

- Maintain ABC's
- Spinal Immobilization (if mechanism of injury causes a high suspicion of spinal injury)
- Oxygen therapy to keep oxygen saturation >92% (if available)
- Obtain IV access and give fluids, if necessary
- Trendelenburg position (head down, feet elevated)
- Keep patient warm
- 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. Usually, 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 figure 2 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's 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.

Signs and Symptoms (see figure 2 and below)

- Abnormal pulse (irregular rate and rhythm)
- Chest pain
- Shortness of breath
- Nausea and vomiting

Treatment
- Maintain ABC's
- Obtain IV access
- Oxygen therapy to keep oxygen saturation >92% (if available)
- CASEVAC

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

Signs and Symptoms

Tension Pneumothorax:
- Chest trauma
- Shortness of breath/dyspnea
- Tachycardia
- Cyanosis
- Decreased/absent lung sounds on affected side
- Jugular vein distention/tracheal deviation (late sign)

Cardiac Tamponade:
- Chest Trauma
- Shortness of breath/dyspnea
- Tachycardia
- Cyanosis
- Distant heart tones
- Narrowing pulse pressure

**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.

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:

a. the casualty is bleeding at a rate of 25 to 100 mL/min
b. the IV fluid administration rate is equal to the bleeding rate
c. the scene time and transport time exceed 30 minutes

Transport of the trauma casualty should never be delayed to start an IV.

You 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 Tactical Fluid Resuscitation.

**CASUALTY ASSESSMENT AND SHOCK CASUALTIES**

**Care Under Fire Phase:** 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 hemostatic dressing like Combat Gauze.

**Tactical Field Care Phase:** Shock is very difficult to treat in a hospital setting let alone in a field or combat environment. Don BSI. 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 Tactical 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.

**REFERENCES**

Pre-Hospital Trauma Life Support, Current Military Edition

Shock Review

1. List the three major types of shock.

2. Describe the signs or symptoms associated with Class III Shock.

3. List the two medications administered to prevent a casualty from developing septic shock.

4. Which is more important for a casualty in shock, IV fluid or rapid transport? Why?

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FMST 403

## Manage Hemorrhage

### TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, standard field medical equipment and supplies, **treat hemorrhage** to prevent further injury or death. (8404-MED-2002)

### ENABLING LEARNING OBJECTIVE

1. Without the aid of references, given a description or list, **identify the types of hemorrhage**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002a)

2. Without the aid of references, given a description or list**, identify the signs and symptoms of hemorrhage**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002b)

3. Without the aid of references, given a description or list, **estimate the amount of blood loss**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002c)

4. Without the aid of references, given a description or list, **identify the methods of hemorrhage control**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002d)

5. Without the aid of references, given a description or list, **apply a tourniquet to stop the bleeding**, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002e)

6. Without the aid of references, given a simulated casualty with life-threatening hemorrhage and a Corpsman Assault Pack, **manage simulated hemorrhage**, to prevent further injury or death, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002f)

## OVERVIEW

Historically, 20% of all injured combatants die on the battlefield. Of that 20%, approximately 65% will die of massive, multiple trauma and are probably not salvageable. Based on the data from the Vietnam conflict, over 60% of battlefield casualties died of exsanguination (bleeding out) within 3 to 5 minutes and could have been saved with timely intervention. In order to continue to decrease these statistics, you must be able to rapidly identify and manage internal and external hemorrhage. You must also recognize the type of bleeding, apply the appropriate hemorrhage control techniques, understand the varying degrees of risk associated with types of hemorrhage, and understand how to estimate blood loss.

### 1. TYPES OF HEMORRHAGE

Hemorrhage is defined as blood escaping from arteries, veins or capillaries.

Arterial - if an artery near the surface is damaged, **bright red blood** will gush out in spurts that are synchronized with the heartbeat.
Venous - blood from the veins is **dark red**. Venous bleeding is characterized by a steady, even flow.
Capillary - capillary blood is usually **brick red** in color. If capillaries bleed, the blood oozes out slowly.

External Hemorrhage - Loss of blood from wounds that damage the large vessels of the extremities are a common source of massive external hemorrhage in combat. The cause of external hemorrhage can be varied depending on the setting in which the injury has taken place. Some of these causes include, but are not limited to, gunshots, stabbings, shrapnel, vehicle accidents and blasts. The importance for you lies in the identification of life threatening hemorrhage versus non-life threatening hemorrhage. The difference between life threatening and non-life threatening exists in the amount of blood loss and the class of shock of the patient.

Signs and Symptoms
- Massive blood loss
- Obvious sign and symptoms of shock
- Class III or IV shock

Internal Hemorrhage - Blood loss into the chest or abdomen cannot be controlled in the field. Despite aggressive treatment and fluid resuscitation, casualties with major internal vascular injuries frequently die in the field. The patient with severe internal hemorrhage may develop hypovolemic shock before the extent of the blood loss is realized. Internal hemorrhage requires immediate surgical intervention at a higher capability of care. Bleeding, however slight, from any body orifice is serious, as it usually indicates an internal source of hemorrhage that may not be readily evident. Signs that may indicate serious internal injury (or disease) would include bleeding from the mouth, rectum or blood in the urine. Nonmenstrual bleeding from the vagina is always significant. Internal hemorrhage can be caused by the following examples of injuries: blunt trauma, concussion injuries from blasts, vehicle accidents, falling from heights, collapsing buildings and closed fractures (bones or bone fragments lacerate arteries or large veins).

The FMST may see:

- Hematemesis (vomiting of bright red blood)
- Hemoptysis (coughing up of bright red blood)
- Melena (black tarry stools)
- Hematochezia (bright red blood from the rectum)
- Hematuria (blood in the urine)
- Ecchymosis (bruising)
- Rapidly forming hematoma and edema
- Rigidity with or without rebound tenderness upon palpation in abdomen
- Signs of shock

2. **ESTIMATING BLOOD LOSS (EBL)** (see Figure 1)

Gather a quick estimation of blood loss based on the following factors:

- Look for blood surrounding the patient.
- Inspect clothing for blood saturation.
- Inspect bandage saturation for associated blood loss. See Figure 1 for amount of blood each dressing will hold when fully saturated.
- Determine level of shock

| | Small Battle Dressing | Medium Battle Dressing | Large Battle Dressing | Abdominal Battle Dressing |
|---|---|---|---|---|
| Amount of estimated blood | 300 ml | 750 ml | 1000 ml | 2500 ml |
| *EBL | About 6% | About 15% | About 20% | About 50% |
| *Amounts are based on the average adult blood volume of about 5 liters. | | | | |

**Figure 1. Estimating Blood Loss Based On Saturation of Dressings**

**Massive hemorrhage may be fatal within 60 – 120 seconds. Treatment should not be delayed and controlling major hemorrhage should be the first priority over securing the airway.**

## 3. METHODS OF HEMORRHAGE CONTROL

Direct Pressure

Direct pressure, applied over a bleeding site, is the initial technique used to control external hemorrhage for non life-threatening bleeding. Most external hemorrhage is readily controlled by direct pressure at the bleeding site, even carotid and femoral bleeding! Performing direct pressure correctly requires two hands pushing against the casualty's wound, while lying on a flat and hard surface. You must lean into delivery of direct pressure and never let up on it to check the wound. If you need to perform other procedures, a pressure dressing can be made using bandages and ace wraps. If direct pressure fails to control extremity hemorrhage, the next step is to use a tourniquet. The only time a tourniquet will be the first step in controlling hemorrhage is in the Care Under Fire phase.

Bandages and Dressings

A bandage is any material used to hold a dressing in place. It can be applied to wrap or bind a body part or dressing. The bandage also provides additional pressure to the dressing or splint and protects and covers the dressing completely.

Things to keep in mind about bandages/dressings

- Ensure the dressing is tight enough.
- Provide pressure over the entire wound.
- Dressings must cover the entire wound, bandages must cover entire dressing.
- Leave the fingers and toes exposed
- Assess circulation and neurological status using **PMS:**
  **P**ulse (check pulses in extremities)
  **M**otor (movement)
  **S**ensation (can the patient feel you touching them?)
- If hemorrhage continues:
  **DO NOT** remove the first pressure dressing; apply a second one over the first

The following provides brief information regarding the types of bandages and dressings that you may encounter:

Kerlix gauze

Advantages:

- Extremely absorbent
- Weave of material makes roll semi-stretchable
- Sterile
- Good for packing cavities

Disadvantages:

- Looses bulk when wet
- Catches debris and snags very easily

**Aspirin use on the battlefield?**

The use of aspirin or any other blood thinner while in a combat setting can lead to increased blood loss not only during surgical procedures, but also when injured on the battlefield. Aspirin is not sold over the counter at exchange outlets while deployed, nor should it be given to Marines or Sailors without a doctor's order. Be sure to educate your Marines and other Sailors on this topic.

Ace wrap

Advantages:

- Can be applied quickly
- Gives pressure to the entire affected area
- Provides excellent support for sprains and strains

Disadvantages:

- Can decrease peripheral circulation

Cravats or Triangular Bandages (37"x37"x52")

Advantages:

- Versatile
- Come in small packages with safety pins
- Can be used as a tourniquet

Disadvantages:

- Has very little absorbency

Combination Dressing/bandage (see Figures 2 & 3)

Cinch Tight, Sterile Compression Bandage (8" x 10") (See Figure 2) These pressure dressings are four-inch wide elastic wraps with an 8"x10" absorbent cotton pad attached close to the end of one side of the elastic wrap. On the other side of the absorbent pad, in the middle on the elastic wrap side, is a steel S-hook that allows for self-application of the dressing and gives it the ability to be applied tightly. Finally, at both ends of the elastic wrap are Velcro strips that allow for ease of securing the dressing.

**Figure 2. Cinch tight dressing**

Instructions for use

- Open and remove bandage.
- Unroll the bandage and place absorbent pad on wound with hook on top.
- Anchor elastic wrap onto Velcro strip at bandages edge.
- Feed elastic bandage through hook and pull to secure absorbent pad in place.
- Wrap the elastic bandage tightly in the direction through which it was pulled.
- Press the Velcro strip at the very end onto the bandage to secure it.

**NOTE: Cinch Tight Dressings are being phased out and replaced with the "H" Bandage.**

"H" Bandage Combat Dressing (See Figure 3)
These pressure dressing bandages are 4" wide elastic wraps with 8" x 10" absorbent cotton pad attached close to the end of one side of the elastic wrap. On the other side of the absorbent pad, in the middle on the elastic wrap side is a hard plastic H-anchor that allows for wrapping the dressing around the anchor to apply pressure directly over wound. It also gives it the ability for self-application. Pressure dressings can be applied to extremity, chest, abdominal, and head wounds.

**Figure 3. "H" Bandage**

Instructions for use

- Open and remove pressure dressing.
- Place pressure dressing over injury with steady pressure, isolating Velcro end.
- Pull draped elastic end and secure to Velcro end.
- Feed wrap through lower leg of H anchor, pulling firmly.
- Wind wrap back around injury site and feed wrap through upper leg of H – anchor, pulling firmly.
- Continue wrapping elastic wrap around injury site, keeping the wrap tight.
- Firmly attach Velcro end of wrap and secure with plastic hooks on sides of wrap.
- For fractures of the arm, the elastic wrap can be used as a sling or swathe.

Expedient (Improvised) Dressing and Bandages

- Patients clothing.
- Patients equipment.
- Your only limitation is YOUR imagination!!!!

Hemostatic Agents

The recommended hemostatic agent dressing of choice by the CoTCCC is QuikClot Combat Gauze (see Figure 4). Celox Gauze and ChitoGauze may also be used if Combat Gauze is not available. A hemostatic agent causes the wound to develop a clot that stops the flow of blood and will remain within the wound until removed by medical personnel. It is applied to wounds with moderate to severe bleeding (venous or arterial). Hemostatic agents have strengths and liabilities and carry with them the requirement for specific training for all members of the combat team. Hemostatic agents are the first line treatment of life threatening hemorrhage in a tactical setting that is not amenable to tourniquet placement.


**Figure 4. Combat Gauze**

QuikClot Combat Gauze

Combat Gauze is tailored to the needs of combat and tactical medical personnel. It combines surgical gauze with an inorganic material that stops arterial and venous bleeding in seconds. It creates no heat, is inert and non-allergenic. It can be fit to any size or shape wound, including penetrating wounds. Combat Gauze comes in rolls four yards long by three inches wide. Remember, hemostatic agents are only to be used when in the Tactical Field Care Phase of TCCC.

Application Procedures: (see Figure 5)

- Expose injury by opening or cutting away clothing.
- Remove excess blood from wound while preserving any clots that may have formed, if possible.
- Locate the source of the most active bleeding.

- Remove Combat Gauze from package and pack it tightly into the wound directly over the site of the most active bleeding. (More than one roll of Combat Gauze may be required to control the hemorrhage.)
- Combat Gauze may be re-packed or adjusted in the wound to ensure proper placement.
- Apply direct pressure quickly with enough force to stop the bleeding.
- Hold direct pressure for a <u>minimum</u> of 3 minutes.
- Reassess for bleeding control.
- Once applied, Combat Gauze is not to be removed (except by proper medical authority). If bleeding continues, reinforce would with another roll of Combat Gauze and hold pressure.
- Leave Combat gauze in place and secure with a pressure dressing.
- Document, place empty package near wound, and transport patient.

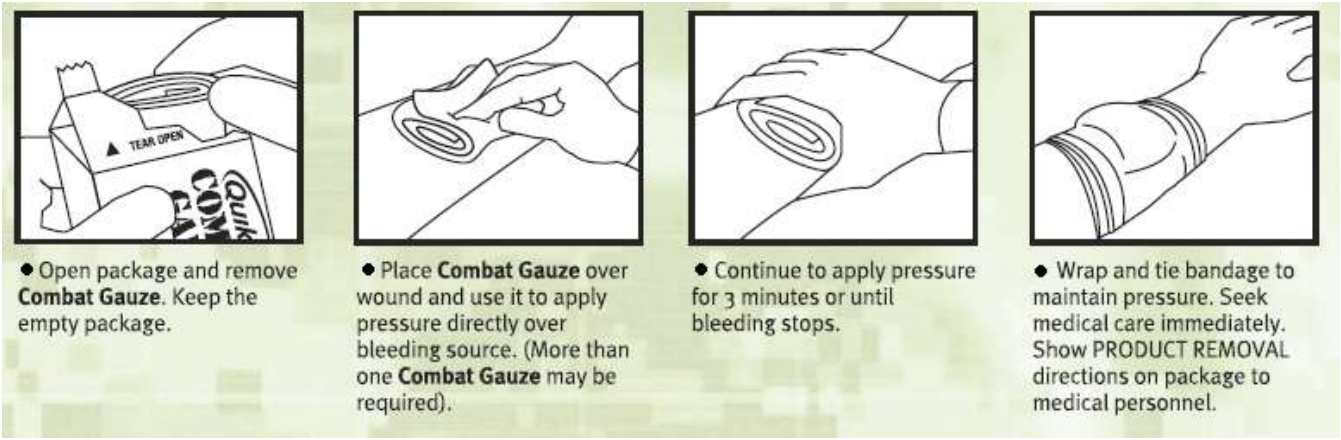


**Figure 5. Application Procedures**

## 4. TOURNIQUET APPLICATION

In civilian trauma care the use of a tourniquet is reserved for when direct pressure fails; **this is not the case in Care Under Fire**. The initial treatment for an extremity hemorrhage in a tactical setting is a tourniquet. A pressure dressing can be used later in the care process of a combat casualty. The standard "web belt through the buckle" tourniquet issued by the military during Vietnam was not highly regarded by the combat medic community. The U.S. Army Institute of Surgical Research identified the Combat Application Tourniquet (CAT) as the one best suited for battlefield use and is the CoTCCC recommended tourniquet. This tourniquet can be rapidly applied with one hand to one's own or another's extremities. This tourniquet is issued throughout all U.S. combatant forces. If the CAT is not available, the provider should be able to make a "field expedient" tourniquet. The use of the tourniquet in a combat setting is not limited to solely the CAT; there may be other brands

**Figure 6. Casualty who was saved using a tourniquet**

of tourniquets. While it may have a different name, the principles of use are similar. The goal is to stop arterial bleeding in an extremity to prevent loss of life. Imagine trying to control the bleeding of the casualty in figure 4 without a tourniquet!

Characteristics of the CAT (see Figure 7)

- US Army Institute of Surgical Research and CoTCCC recommended
- Lightweight
- Easy to apply and use


**Figure 7. CAT Tourniquet**

SOF-T Tourniquet (see Figure 8)

- Special Operations Forces Tactical Tourniquet
- Also recommended by the CoTCCC
- True 1-1/2 inch constriction band
- Aluminum windlass rod
- Application remains the same, regardless of location

**Figure 8. SOF-T Tourniquet**

Field Expedient Tourniquet (see Figure 9)

- If CAT is unavailable, choose a material about two inches (2") wide.
- Material such as rope, wire and string should **NOT** be used because they can cut into flesh.
- Tie a strong windlass (stick) to a cravat or other strong material.
- Slide one or two rings on each side of the cravat.
- Tie the cravat around the affected limb, two to four inches above the wound, loosely. (This will allow the windlass to turn, creating circumferential pressure to stop the bleed.)
- Twist the windlass until the hemorrhage is

**Figure 9. Improvised Tourniquets**

controlled.
- Slide the ring to the windlass and secure windlass to the ring(s).

Tourniquet Application

Application site - a tourniquet should be applied approximately 2-3 inches above the hemorrhaging wound, directly on the skin. However, during Care Under Fire, this may not be possible. Place the tourniquet proximal to the wound, over the clothing due to tactical requirements. However, once out of the Care Under Fire Phase, reassess tourniquet application by exposing site and placing tourniquet 2-3 inches above the wound, directly on the skin. Do NOT place a tourniquet below the knee or elbow or over a joint due to there being two bones, i.e., Tibia/Fibula below the knee, and Radius/Ulna below the elbow, which can splint the hemorrhaging vessel and make it impossible to control the bleed.

**What about those Rings???**
Examples of good rings to use:
- Key chain rings
- Sport drink rings
- Boot laces tied into a ring
- Anything that is in a ring shape with the approximate diameter of 1-2 inches

Application tightness - apply tourniquet tight enough to block arterial flow. Generally, the bigger the limb, the tighter the tourniquet. So a leg will require more pressure to control bleeding than an arm will. If injured limb is still present, check distal pulse to ensure it is occluded.

Other considerations - it may be necessary to use more than one tourniquet to control severe bleeding. A second tourniquet should be applied just proximal to the first, if needed. Another thing to remember is that a tourniquet will be painful for the conscious casualty to tolerate but don't stop tightening until the hemorrhage is controlled. Pain management should be considered provided the casualty does not have signs of Class III or IV shock. You must document placement of a tourniquet by placing a "T" and the time of application on the casualty's forehead or other conspicuous spot. After application, do not cover a tourniquet under any condition, leave it exposed to ease monitoring for continued hemorrhage.

Converting a Trouniquet to a Dressing

Tourniquet use is the first line of hemorrhage control while in the Care Under Fire phase. Only when in the Tactical Field Care phase should you even consider converting a tourniquet to a pressure dressing. Do **NOT** convert a tourniquet to a pressure dressing under the following conditions:

- The casualty is in Class III or IV shock (you will learn what this is in the Shock lesson).
- There has been a complete amputation below the tourniquet.
- There is no one to monitor the casualty for rebleeding.
- Tourniquet has been in place for more than 6 hours.
- Short transport time to surgical intervention.

**CASUALTY ASSESSMENT AND HEMORRHAGE CONTROL**

**Care Under Fire Phase:** Hemorrhage control is the only intervention performed during this phase! You must be able to recognize "life-threatening" hemorrhage. For extremity hemorrhage, use a tourniquet. For non-extremity hemorrhage, use direct pressure. NO HEMOSTATIC AGENT USED DURING THIS PHASE!

**Tactical Field Care Phase:** During this phase, reassess your treatment performed during Care Under Fire Phase to control the hemorrhage. Don BSI. Assess the airway and intervene if necessary. Complete a head to toe assessment using DCAP-BTLS (deformities, contusions, abrasions, punctures, burns, tenderness, lacerations, and swelling) noting and treating additional injuries. Determine if vascular access is required (see Tactical 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 TACEVAC.

**References**:

Prehospital Trauma Life Support, current Military Edition
Committee on Tactical Combat Casualty Care Meeting Minutes, 22-24 July 2008
MCRP 3-02G

**Field Medical Training Battalion**

# HEMORRHAGE CONTROL
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT (**Rank Last Name, First Name) | **PLT** |
|---|---|
| | |

| **PROCEDURAL STEPS FOR PERFORMING HEMORRHAGE CONTROL** | **1ST** | | **2ND** | | **3RD** | |
|---|---|---|---|---|---|---|
| | **P** | **F** | **P** | **F** | **P** | **F** |
| ***State the indication for applying a tourniquet (life-threatening extremity hemorrhage)** | | | | | | |
| Apply pressure to slow bleeding | | | | | | |
| ***Apply tourniquet 2-3 inches proximal to the hemorrhage site. (Do not apply over a joint, below the knee or below the elbow)** | | | | | | |
| ***Pass self-adhering band through the inside AND outside slit of the friction adaptor buckle.** | | | | | | |
| Pull the self-adhering band tight and securely fasten the band back on itself. | | | | | | |
| ***Twist the Windlass Rod until the bleeding stops.** | | | | | | |
| ***Lock the rod in place with the Windlass Clip.** | | | | | | |
| Secure the rod with the Windlass Strap. Grasp the strap, pull it tight, and adhere it to the opposite hook on the Windlass Clip. | | | | | | |
| Document the time of placement; mark the patient's forehead with "T" | | | | | | |

| **GRADING CRITERIA** | **1ST** | **2ND** | **3RD** |
|---|---|---|---|
| **Total Non-Critical Items (3 or greater constitutes a failure)** | | | |
| **Total Critical Items (Any critical items missed constitutes a failure)** | | | |
| **"Stop & Think" (2 allowed for critical items, third constitutes a failure)** | | | |

| **1st Evaluator:** | **2nd Evaluator:** | **3rd Evaluator:** |
|---|---|---|
| **PASS / FAIL** | **PASS / FAIL** | **PASS / FAIL** |
| **Student signature:** | **Student signature:** | **Student signature:** |
| **Notes:** | **Notes:** | **Notes:** |

Hemorrhage Review

1. List four signs or symptoms of internal hemorrhage.

1. Identify the appropriate treatment for life threatening hemorrhage during "Care Under Fire".

2. Where on the extremities should a tourniquet **NOT** be placed?

4. During which phase of TCCC is the use of hemostatic agents authorized?

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FMST 404

# Maintain Airway

## TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, **manage respiratory trauma** to reduce the risk of further injury or death. (8404-MED-2003)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list**, identify standard medical terminology related to the airway**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2003a)

2. Without the aid of reference, given a description or list, **identify the anatomy of the airway**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2003b)

3. Without the aid of reference, given a description or list, **identify the signs and symptoms of a compromised airway**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2003c)

4. Without the aid of reference, given a description or list, **identify treatments for a compromised airway**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition. (8404-MED-2003d)

## OVERVIEW

Airway management plays a prominent role in the management of trauma patients. The failure to maintain oxygenation and ventilation causes secondary brain injury, compounding the primary brain injury produced by the initial trauma. Cerebral oxygenation and oxygen delivery to other parts of the body provided by adequate airway management and ventilation remain the most important components of prehospital patient care. Inability of the respiratory system to provide oxygen to the cells or inability of the cells to use the oxygen supplied results in anaerobic metabolism and can quickly lead to death.

1. **AIRWAY TERMINOLOGY** (see Figure 1)

Pharynx – Muscle lined with mucous running from the back of the soft palate to the upper end of the esophagus; divided into three sections

-Nasopharynx

-Oropharynx

-Hypopharynx

Nasal Septum – Separates the left and right airways of the nose

Nares – External openings of nasal cavity

Larynx (voicebox) – Cartilaginous box located above the trachea, containing vocal cords and muscles that make them work

Epiglottis – Leaf-shaped structure that acts like a gate, directing air into the trachea and solids/liquids into the esophagus

Trachea (windpipe) – Main trunk of the system of tubes air passes to and from the lungs

2. **ANATOMY OF THE AIRWAY**

Upper Airway

- Consists of the nasal cavity and oral cavity

Lower Airway

- Consists of the trachea, its branches and the lungs. On inspiration, air travels through the upper airway and into the lower airway. The actual gas exchange occurs in the alveoli. The alveoli are where the circulatory and respiratory systems meet.

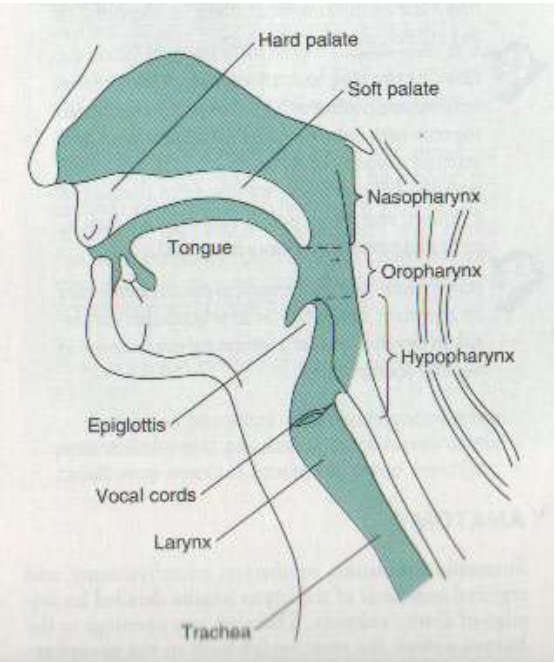


**Figure 1. The Airway**

## 3. SIGNS & SYMPTOMS OF AIRWAY COMPROMISE

Trauma can affect the respiratory system's ability to adequately provide oxygen and eliminate carbon dioxide. Hypoventilation, or inadequate ventilation in order to perform gas exchange, is one of the most common respiratory problems. If left untreated, hypoventilation results in CO2 build-up, acidosis, and eventually death. Management involves improving the patient's ventilation rate and depth by correcting existing airway problems and assisting ventilation as appropriate.

Decreased Neurological Function

Decreased minute volume can be caused by two clinical conditions related to decreased neurological function:

- Flaccidity of the tongue
- Decreased level of consciousness

If a patient is supine, the base of the tongue will fall backward and occlude the hypopharynx. To prevent the tongue from occluding or to correct this problem when it occurs, maintaining an open airway must be assured in any supine patients with a diminished LOC, regardless of whether signs of ventilatory compromise exist. A decreased LOC will also affect ventilatory drive and may reduce the rate of ventilation, the volume of ventilation, or both.

Mechanical Obstruction

Another cause of decreased minute volume is mechanical airway obstruction. The source of these obstructions may be neurologically influenced or purely mechanical in nature. Foreign objects in the airway may be objects that were in the patient's mouth at the point of injury:

- Teeth
- Gum
- Tobacco
- Bone
- Blood
- Vomit

Outside objects may also threaten airway patency:

- Glass
- Rocks
- Debris

Management of mechanical airway obstructions can be extremely challenging. Foreign bodies may become lodged and create occlusions. Crush injuries and edema may be present. Patients with facial injuries often present with blood and vomit. Treatment of these problems is aimed at immediate recognition of the obstruction and the steps taken to ensure airway patency.

Assessment of the Airway

- Look for obvious injuries; continue to talk to the casualty
    - Talking suggests an open airway
- Be aware of patient's LOC while in the supine position
- Patient may need to remain in the position found if they are maintaining their own airway in order to avoid aspiration

Conducting a Physical Examination

- Look
- Listen
- Feel, feel

Look

- Look at the casualty's face, neck , nose and lips for:
    - Cyanosis or edema
    - Any obvious injuries
    - Blood or any debris
- Open the casualty's mouth and look for foreign objects or abnormalities
    - Broken teeth
    - Tobacco or food products
    - Debris
- Look for bilateral, normal chest rise and fall during breathing
    - Be aware of unilateral chest rise/fall
    - Any paradoxical movement of the chest wall
- Look for use of accessory muscles and increased work of breathing

Listen

- Listen for the presence or absence of breath sounds
    - Listen to the quality of the respirations
    - Listen for any tachypnea or bradypnea
    - Listen for the rhythm and depth of respirations
- Listen for any sounds signaling a compromise to the upper airway
    - Tongue occluding the hypopharynx causing a snoring sound
    - Blood or vomit causing gurgling noises
    - Any foreign bodies lodged in the airway

Feel, Feel

- Placing your hand on the casualty's chest and lowering your ear to their mouth provides you with multiple senses to check the respiratory system. In combat, one or more of these senses may be diminished due to explosions, gunfire, night operations, etc.
    - Feel for warm breath against your face when casualty exhales
    - Feel for equal chest rise and fall with your hand as casualty breathes

## 4. TREATMENTS FOR A COMPROMISED AIRWAY

Manual Maneuvers of the Airway

The tongue is connected to the mandible and moves forward with it. Any maneuver that moves the mandible forward will pull the tongue out of the hypopharynx. This can be accomplished using 2 different methods:

- Trauma Jaw Thrust
- Trauma Chin Lift

Manual Clearing of the Airway

The first step in airway management is a quick visual inspection of the oropharyngeal cavity. Foreign material or other objects may be found in the mouth of a trauma patient. These can be swept from the mouth using a finger, but should be avoided in low-light situations or when the object is lodged deep in the airway. Positioning the patient on their side will allow gravity to assist in clearing any secretions or objects.

Nasopharyngeal Airway (NPA)

The NPA (see Figure 2) is a soft, rubberlike device that is inserted through one of the nares and then along the curvature of the posterior wall of the nasopharynx and oropharynx. This adjunct is used for both conscious and unconscious patients who are unable to maintain their own airway. When inserted, this adjunct can cause bleeding.

**Figure 2. Inserting a Nasopharyngeal Airway**

King Laryngeal Tracheal Tube (King LT airway)

The King LT (see Figure 3) is a single lumen, blindly inserted airway created as an alternate to tracheal intubation or mask ventilation, resulting in minimal airway trauma with little training necessary. This adjunct is used only for unconscious patients, as the presence of an intact gag reflex may cause gagging or vomiting when inserted (see Figure 4). The King LT is latex-free and can be autoclaved up to 50 cycles.

**Figure 3. King LT**

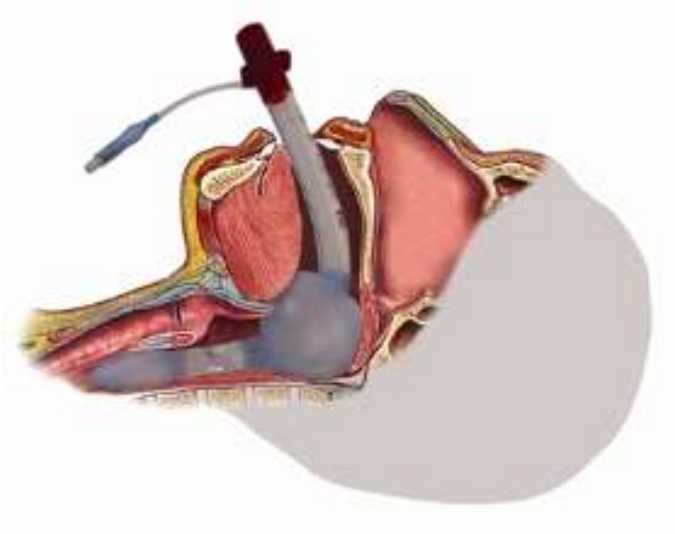

**Figure 4. King LT Placement**

**CASUALTY ASSESSMENT AND AIRWAY MANAGEMENT**

**Care Under Fire Phase:** Treatment of the airway is deferred during this phase of care.

**Tactical Field Care Phase:** During this phase, reassess your treatment performed during Care Under Fire Phase to control the hemorrhage. Don BSI. Assess the airway and intervene if necessary. Use the least invasive airway that will provide treatment. Monitor breathing and look for signs and symptoms of airway compromise. Reassess all care provided. Document care given, prevent hypothermia, and TACEVAC.

**REFERENCE:**

Pre-Hospital Trauma Life Support, current military edition

Maintain Airway Review

1. Identify the three sections of the pharynx.

2. Identify four types of mechanical airway obstructions.

3. Identify the two manual airway maneuvers.

4. Identify the contraindication for using a King LT airway.

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FMST 405

## Perform Emergency Cricothyroidotomy

### TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, standard field medical equipment and supplies, **perform emergency cricothyroidotomy to restore breathing**, within the scope of care, reducing risk of further injury or death. (8404-MED-2008)

### ENABLING LEARNING OBJECTIVES

1. Without the aid of references, given a description or list, **identify important anatomical landmarks for an emergency cricothyroidotomy**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition and Emergency Medicine, current edition. (8404-MED-2008a)

2. Without the aid of references, given a description or list, **identify the indications for performing an emergency cricothyroidotomy**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition and Emergency Medicine, current edition. (8404-MED-2008b)

3. Without the aid of references, given a description or list, **identify the proper equipment for performing an emergency cricothyroidotomy**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition and Emergency Medicine, current edition. (8404-MED-2008c)

4. Without the aid of references, given a description or list, **identify the procedural sequence for performing an emergency cricothyroidotomy**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition and Emergency Medicine, current edition. (8404-MED-2008d)

5. Without the aid of references, given a description or list, **identify potential complications of an emergency cricothyroidotomy**, within 80% accuracy, per Prehospital Trauma Life Support, Current Military Edition and Emergency Medicine, current edition. (8404-MED-2008e)

6. Without the aid of references, given a casualty and a Corpsman Assault Pack, **perform an emergency cricothyroidotomy**, to prevent further injury or death, per the FMST Performance Examination Checklist. (8404-MED-2008f)

1. **ANATOMICAL LANDMARKS** (see Figure 1)

**Trachea** - also known as the windpipe. It is the cartilaginous and membranous tube descending from, and continuous with, the lower part of the larynx to the bronchi.

**Thyroid Cartilage** - also known as the "Adam's Apple." The thyroid cartilage is located in the upper part of the throat. The thyroid cartilage tends to be more prominent in men than women.

**Cricoid Cartilage** - located approximately ¾-inch inferior to the thyroid cartilage. The cricoid and thyroid cartilage form the framework of the larynx.

**Cricothyroid Membrane** - soft tissue depression between the thyroid and cricoid cartilage. This membrane connects the two cartilages and is only covered by skin.

**Carotid Arteries** - two principal arteries of the neck.

**Jugular Veins** - two principal veins of the neck.

**Esophagus** - muscular tube extending downward from the pharynx to the stomach. The esophagus lies posterior to the trachea.

**Thyroid Gland** - largest endocrine gland, the thyroid gland is situated in front of the lower part of the neck. Consists of a right and left lobe on either side of the trachea.

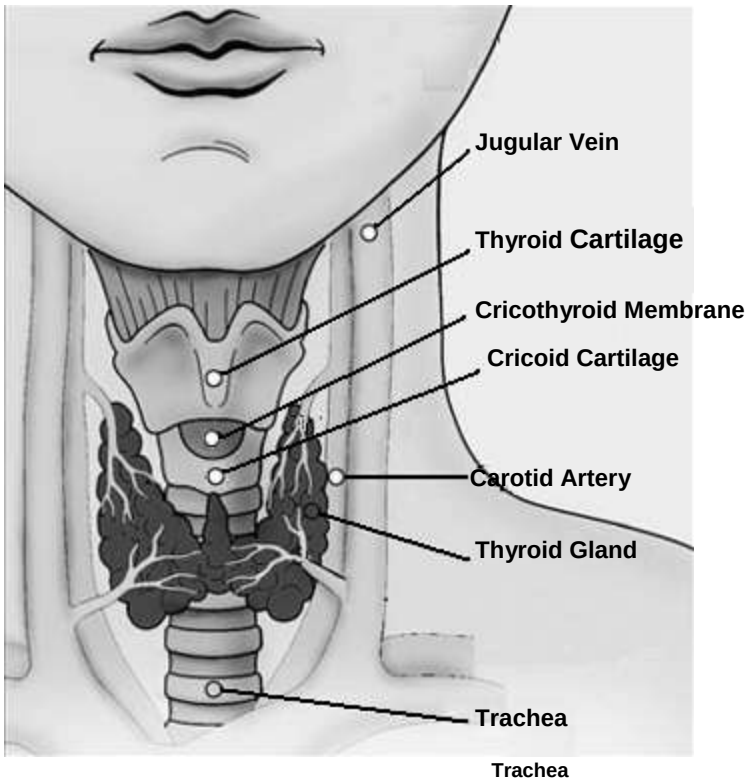



**Figure 1. Anatomical Landmarks**

2. **INDICATIONS**

**Definition** - Emergency cricothyroidotomy is a surgical procedure where an incision is made through the skin and cricothyroid membrane. This allows for the placement of a tracheal tube into the trachea when control of the airway is not possible by other methods.

There are many reasons an emergency cricothyroidotomy may be required. Listed below are a few of the most common reasons:

Obstructed airway and/or swelling of tissues will usually prevent the passage of an endotracheal tube through the airway. Therefore, a surgical airway distal to the obstruction is required. Causes of an obstructed airway include facial and oropharyngeal edema from burns or foreign objects (food or teeth).

Congenital deformities of the oropharynx or nasopharynx will inhibit or prevent nasotracheal or orotracheal intubation.

Trauma to the head and neck would preclude the use of an ambu-bag, oropharyngeal airway, nasopharyngeal airway and endotracheal tube insertion.

- Massive midface trauma
- Facial fractures (mandible fracture)
- Nasal bone fractures
- Cribiform fractures

Cervical spine fractures in a patient who needs an airway but whose intubation is unsuccessful or contraindicated.

**Contraindications** - Massive trauma to the larynx

3. **PROPER EQUIPMENT**

There are several types of pre-packed kits but you can also put together your own. CoTCCC has not recommended a specific emergency cric kit but has defined a set of preferred features for surgical airway kits.

- Scalpel: # 10 blade
- Antiseptic (Alcohol or Povidone-Iodine)
- 6 – 7 mm endotracheal tube with 10cc syringe for balloon cuff
- Means to secure tube (securing ribbon, tape or sutures)
- Instrument to expose and define the opening (Trach Hook or Curved Kelly hemostats)
- Gauze (Petroleum and sterile)
- Bag-valve-mask (BVM) and oxygen source, if available

4. **PROCEDURAL STEPS**

**Step 1** - **Assess patient**

Assess airway, LLF, attempt other airways. Make the decision to perform emergency cricothyroidotomy.

**Step 2** - **Gather equipment**

Ensure all equipment is available and assemble prior to starting the procedure.

**Step 3** - **Prepare and position patient**

The patient should be placed in a supine position, with the neck placed in the neutral position. Stand to one side of the patient at the neck. If you are right handed, stand to the right side of the patient; left handed, to the left.

**Step 4** - **Locate the cricothyroid membrane**

Palpate the thyroid and cricoid cartilage for orientation. The cricothyroid membrane is in the hollow between the two cartilages. If time permits, quickly cleanse the site with alcohol or betadine swabs.

**Step 5** - **Make incision**

- Stabilize the thyroid cartilage using the thumb and middle finger of your non-dominant hand to hold the skin taut.

- Using the scalpel, make a **vertical** incision through the skin approximately 1 inch long over the cricothyroid membrane. (See Figure 2)

- Visualize the cricothyroid membrane.

- Enter cricothyroid membrane by making a **horizontal** incision through the cricothyroid membrane. (See Figure 3)

- **DO NOT** make the incision more than **½ inch** deep or you may perforate the esophagus.

**Figure 2. Vertical Incision**

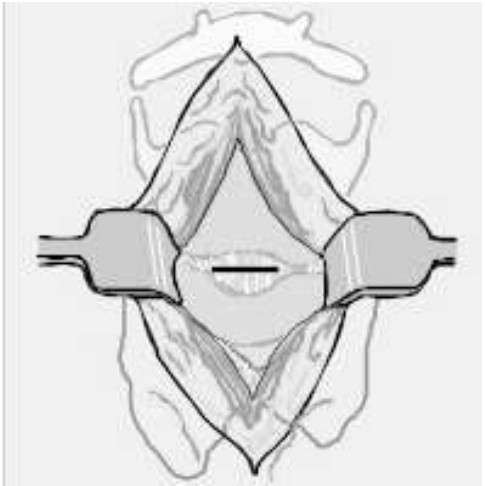


**Figure 3. Horizontal Incision**

**Step 6** - **Open Incision**

- Use Trach Hook or curved Kelly hemostats to open incision.

**Step 7** - **Insert Tube**

- Lubricate and insert the endotracheal tube into the opening.

- Ensure the tube is inserted no more than 3 to 4 inches so the tube does not slip down the right main-stem bronchus with any movement.

- Inflate balloon with 10cc's of air.

**Step 8** - **Check for proper placement**

- Connect a bag-valve-mask device or manually ventilate patient with two breaths.

- Check for breath sounds. If no ventilations are heard, pull the tube out and reinsert it.

- Recheck for breath sounds to ensure tube is positioned correctly.

- If breath sounds are **absent on the left** side only, the tube has been inserted down the right main-stem bronchus and should be pulled back a few centimeters. This typically occurs with the use of the endotracheal tube.

- Recheck for breath sounds to ensure tube is positioned correctly.

- Connect to Oxygen Supply (if available)

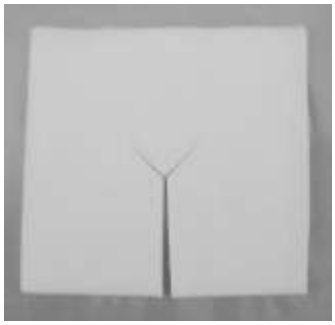


**Figure 4. Y-cut Gauze**

**Step 9** - **Secure Dressing**

- Secure the tube with ribbon, sutures and/or tape.

- Apply petroleum gauze followed by sterile gauze. (See Figure 4)

**Step 10** - **Monitor Patient**

- Continuously reassess and monitor patient.

- 1 breath every 5 seconds if patient is not breathing on their own.

5. **ASSOCIATED COMPLICATIONS**

**Hemorrhage** - **The most common complication.**

Causes

- Minor bleeding may be caused by lacerating superficial capillaries in the skin.

- Significant bleeding may be caused by the laceration of major vessels (carotid arteries and the jugular veins) within the neck.

Treatment

- Minor bleeding is treated with direct pressure and the application of a simple pressure dressing.

- Significant bleeding - treated same as minor. However, if unable to control the bleeding, the vessel may need to be ligated (tied off).

**Esophageal perforation** - the creation of a hole between the esophagus and trachea.

Causes

- Creating an incision too deep through the cricothyroid membrane.

- Forcing the ET tube through the cricothyroid membrane and into the esophagus.

Treatment

- Requires surgical repair at higher echelon of care.

**Subcutaneous emphysema** - the presence of free air or gas within the subcutaneous tissues. Upon palpation, a crackling sensation may be felt as the air is pushed through the tissue.

Causes

- Creating too wide of an incision will allow air entrapment under the skin.

- Air leaking out of the insertion site may get trapped under the skin.

Treatment

- No treatment is necessary; will resolve spontaneously within a few days.

- The placement of petroleum gauze dressing around the incision/insertion site will help reduce the incidence of subcutaneous emphysema.


**Why Don't We Learn How to Intubate? (PHTLS Manual)**

1. No studies have examined the ability of well-trained but relatively inexperienced military medics to accomplish endotracheal intubation.

2. Many Corpsmen and Medics have never performed an intubation on a live casualty or even a cadaver.

3. Standard endotracheal intubation techniques entail the use of a tactically compromising white light in the laryngoscope.

4. Endotracheal intubation can be extremely difficult in a casualty with maxillofacial injuries.

**CASUALTY ASSESSMENT AND EMERGENCY CRICOTHYROIDOTOMY**

**Care Under Fire Phase:** In the absence of life-threatening hemorrhage, there is no care given for a casualty who needs a surgical cricothyroidotomy in this phase.

**Tactical Field Care Phase:** Cricothyroidotomy is a skill you may use during the Tactical Field Care phase. The need to perform an emergency cricothyroidotomy is made after you have attempted to control the airway with other, less invasive methods (i.e. NPA). Remember, once the patient has received a cricothyroidotomy, they are now totally dependent upon you and now become much more difficult to manage in a tactical environment.

**REFERENCES**

Prehospital Trauma Life Support, current Military Edition
Emergency Medicine, current edition

**Field Medical Training Battalion**

# EMERGENCY CRICOTHYROIDOTOMY
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT** (Rank, Last Name, First Name) | **PLT** |
|---|---|
| | |

| **PROCEDURAL STEPS FOR PERFORMING AN EMERGENCY CRICOTHYROIDOTOMY** | **1ST** | | **2ND** | | **3RD** | |
|---|---|---|---|---|---|---|
| | **P** | **F** | **P** | **F** | **P** | **F** |
| *** State the indications for an emergency cricothyroidotomy (obstructed airway, congenital deformities, trauma to head/neck, cervical spine fracture)** | | | | | | |
| *** State the contraindications for an emergency Cricothyroidotomy (massive trauma the larynx or cricoid cartilage)** | | | | | | |
| *** Assess patient and make decision to perform emergency cricothyroidotomy. (ABC's, LLF, Failed attempts at all other airway management)** | | | | | | |
| Assemble and check equipment (Scalpel #10 blade, ET tube, 10 cc syringe, tape, Curved Kelly hemostats/Trach Hook, gauze) | | | | | | |
| Prepare patient (Place patient in supine or semi-recumbent position and place neck in neutral position) | | | | | | |
| *** Locate landmarks (palpate thyroid and cricoid cartilages, locate cricothyroid membrane)** | | | | | | |
| Cleanse the incision site with alcohol or betadine | | | | | | |
| Stabilize the thyroid cartilage using your non-dominant hand | | | | | | |
| Make 1 inch, vertical incision over the cricothyroid membrane | | | | | | |
| Visualize cricothyroid membrane | | | | | | |
| Make ½ inch, horizontal incision to cut through the cricothyroid membrane | | | | | | |
| Open incision with blunt dissection | | | | | | |
| *** Insert endotracheal tube into the incision, directing the tube distally down the trachea (no more than 3 - 4 inches)** | | | | | | |
| Inflate balloon with 10cc's of air | | | | | | |
| *** Ventilate patient with two breaths & check for proper placement (Auscultate epigastric area - If patient has epigastric sounds, remove and retry, observe for bilateral rise/fall of chest, misting or fogging in E.T. tube and auscultate for breath sounds bilaterally)** | | | | | | |
| Lung sounds on right side only (deflate cuff, pull back ¼- ½ inch, re-inflate cuff, recheck placement | | | | | | |
| Secure tube | | | | | | |
| Apply dressing (petroleum gauze on insertion site, dry sterile dressing over petroleum gauze) | | | | | | |
| Reassess & monitor patient (if not breathing on own, 1 breath every 5 seconds, suction as necessary) | | | | | | |
| State complications of cricothyroidotomy (hemorrhage, esophageal perforation subcutaneous emphysema) | | | | | | |

**Field Medical Training Battalion**

# EMERGENCY CRICOTHYROIDOTOMY
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| GRADING CRITERIA | 1ST | 2ND | 3RD |
|---|---|---|---|
| Total Non-Critical Items (5 or greater constitutes a failure) | | | |
| Total Critical Items (Any critical items missed constitutes a failure) | | | |
| "Stop & Think" (2 allowed for critical items, third constitutes a failure) | | | |

| 1st Evaluator: | 2nd Evaluator: | 3rd Evaluator: |
|---|---|---|
| PASS / FAIL | PASS / FAIL | PASS / FAIL |
| Student signature: | Student signature: | Student signature: |
| Notes: | Notes: | Notes: |

Cricothyroidotomy Review

1. List the four indications for an emergency cricothyroidotomy.

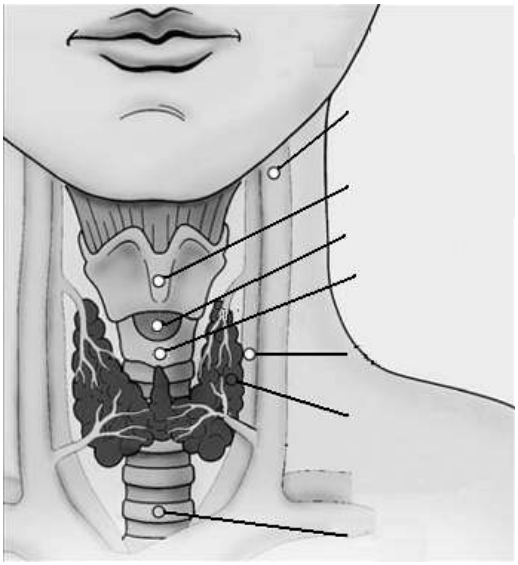
2. List the ten steps in performing an emergency cricothyroidotomy.

| | |
|---|---|
| 1) | 6) |
| 2) | 7) |
| 3) | 8) |
| 4) | 9) |
| 5) | 10) |

3. Identify the three common complications from performing an emergency cricothyroidotomy.

4. What equipment is necessary to perform an emergency cricothyroidotomy?

5. Identify the anatomical landmarks below



# UNITED STATES MARINE CORPS

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FMST 406

## Manage Respiratory Trauma

## TERMINAL LEARNING OBJECTIVES

1. Given a casualty in an operational environment, **manage respiratory trauma** to reduce the risk of further injury or death. (8404-MED-2003)

2. Given a casualty with a tension pneumothorax in an operational environment, equipment and supplies, **perform a needle thoracentesis** reducing the risk of further injury or death. (8404-MED-2009)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **identify standard medical terminology related to the respiratory system**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2003e)

2. Without the aid of reference, given a description or list, **identify the anatomy of the respiratory system**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2003f)

3. Without the aid of reference, given a description or list, **identify the signs and symptoms of respiratory trauma**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2003g)

4. Without the aid of reference, given a description or list, **identify treatments for chest injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2003h)

5. Without the aid of reference, given a simulated casualty with a chest injury and Corpsman Assault Pack, **manage the simulated casualty**, to prevent further injury or death, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2003i)

6. Without the aid of reference, given a description or list, **identify important anatomical landmarks for needle thoracentesis**, within 80% accuracy, per the Prehospital Trauma Life Support, current Military Edition. (8404-MED-2009a)

7. Without the aid of reference, given a description or list, **identify the indications for needle thoracentesis**, within 80% accuracy, per the Pre-Hospital Trauma Life Support Manual, current Military Edition. (8404-MED-2009b)

8. Without the aid of references, given a description or list, **identify the proper equipment for performing needle thoracentesis**, within 80% accuracy, per the Pre-Hospital Trauma Life Support Manual, current Military Edition. (8404-MED-2009c)

9. Without the aid of references, given a description or list, **identify the procedural sequence for performing needle thoracentesis**, within 80% accuracy, per the Pre-Hospital Trauma Life Support Manual, current Military Edition. (8404-MED-2009d)

10. Without the aid of reference, given a description or list, **identify the potential complications when performing needle thoracentesis**, within 80% accuracy, per the Pre-Hospital Trauma Life Support Manual, current Military Edition. (8404-MED-2009e)

11. Without the aid of references, given a simulated casualty and a Corpsman Assault Pack, **perform a needle thoracentesis**, to prevent further injury or death, per the FMST Performance Examination Checklist. (8404-MED-2009f)

## 1. RESPIRATORY SYSTEM TERMINOLOGY

Dyspnea - Difficult or labored breathing.

Wheeze - A form of rhonchus, characterized by a whistling respiratory sound. It is caused by the movement of air through a narrowed airway.

Stridor - A harsh shrill respiratory sound.

Hyperventilation - An increase in the rate and depth of normal respirations. Responsible for `increasing oxygen levels and decreasing carbon dioxide levels.

Hypoventilation - Loss of ventilatory drive, usually from decrease neurological function most often after a TBI. This can also be cause by an upper or lower airway obstruction, and decreased expansion of the lungs.

Tachypnea – An abnormally rapid rate of respiration.

Bradypnea - An abnormally slow rate of respiration, usually less than 8 breaths per minute.

Hypoxia - An insufficient concentration of oxygen in the tissue in spite of an adequate blood supply.

Apnea - Total cessation of breathing, also known as respiratory arrest.

Subcutaneous emphysema - The presence of free air or gas in the subcutaneous tissues. The face, neck, or chest may appear swollen with painful skin and produce a crackling sound ("Rice Krispies").

## 2. ANATOMY OF THE RESPIRATORY SYSTEM

Thorax (Chest Cavity) (see Figure 1)

The skeletal portion of the thorax is a bony cage formed by the sternum, costal cartilages, ribs and the bodies of the thoracic vertebrae.

Ribs

- Joined in the posterior with the thoracic spine and anterior with the sternum via the costal cartilage.
- A nerve, an artery and a vein are located along the underside of each rib.
- Intercostal muscles connect each rib with the one above.

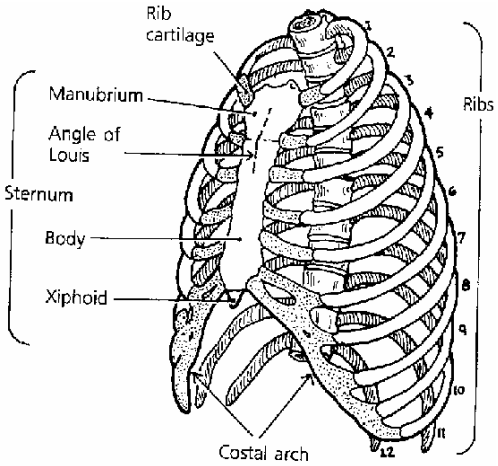



**Figure 1. Thorax**

Diaphragm - The primary muscle of respiration.

Pleura (see Figure 2)

The pleura are thin membranes separated by a small amount of fluid, which creates surface tension and causes them to cling together, counteracting the lung's natural tendency to collapse.

Parietal pleura - a thin membrane that lines the inner side of the thoracic cavity.

Visceral pleura - a thin membrane that covers the outer surface of each lung.

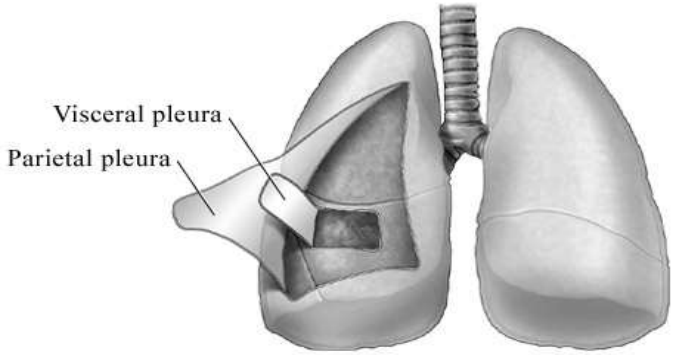



**Figure 2. Pleura**

Lungs (see Figure 3)

- The lungs occupy the right and left halves of the thoracic cavity.
- The left lung is divided into two lobes.
- The right lung is larger than the left lung and is divided into three lobes.

Alveoli - the smallest components of the lungs. They are small saclike structures through which the exchange of carbon dioxide and oxygen take place.

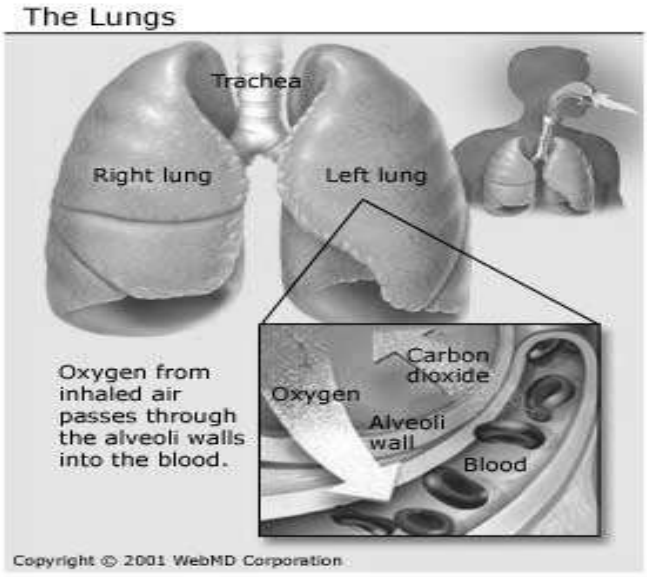



**Figure 3. Lungs**

Mediastinum

The area in the middle of the thoracic cavity in which all the other organs and structures of the chest cavity lie. It encases the:

- Heart
- Great vessels (aorta, superior/inferior vena cava)
- Trachea (windpipe)
- Mainstem bronchi (there are two bronchi- a right and left)
- Esophagus (lies directly behind the trachea)

## 3. SIGNS & SYMPTOMS OF RESPIRATORY TRAUMA

Chest injuries are the second leading cause of trauma deaths each year, although the vast majority of all thoracic injuries (90% of blunt trauma and 70 to 85% of penetrating trauma) can be managed without surgery. Traumatic chest injuries can be caused by a variety of mechanisms; however, these injuries are usually classified as either blunt or penetrating.

Penetrating Injuries - caused by forces distributed over a small area (i.e., gunshot wounds or stabbings). Most often, the organs injured are those that lie along the path of the penetrating object.

Blunt Trauma - caused by forces distributed over a larger area, and many injuries occur from deceleration, bursting, or shearing forces. Conditions such as pneumothorax, pericardial tamponade, flail chest, pulmonary contusion and aortic rupture should be suspected when the mechanism of injury involves rapid deceleration, including motor vehicle collisions, falls, sport injuries and crush injuries.

**Assessment of Respiratory Trauma** - besides the overall mechanism of injury, casualties are asked of any symptoms they may be experiencing if they are conscious and able to communicate. Victims of chest trauma will likely be experiencing chest pain, which may be sharp, stabbing, or constricting. Frequently, the pain is worse with respiratory efforts or movement. The casualty may experience shortness of breath and may feel apprehensive or lightheaded if shock is developing.

The next step in assessment is a physical examination. The components to the physical examination include: observation, auscultation, and palpation.

Observation - casualty is observed for pallor of the skin and sweating, which may indicate shock. The presence of cyanosis (bluish discoloration of skin, especially around the mouth and lips) may be evident in advanced hypoxia.

- Observe frequency of respirations (rate, rhythm, and depth), and the appearance of having trouble breathing (gasping, contractions of the accessory muscles in the neck, or nasal flaring.)

- Look for signs of trachea deviation and distended jugular veins.

- The chest is examined for contusions, abrasions, lacerations, and whether the chest wall expands symmetrically with breathing. Identify whether any portion of the chest wall moves paradoxically with respiration (instead of moving out during inspiration, does it collapse inward and vice versa during exhalation)?

Auscultation - the entire chest is evaluated to identify decreased breath sounds on one side compared to the other which may indicate pneumothorax or hemothorax on the examined side. Pulmonary contusions may result in abnormal breath sounds (crackles).

Palpation - by gently pressing the chest wall with hands and fingers, assessment for the presence of tenderness, crepitus (either bony or subcutaneous emphysems), and bony instability of the chest wall is performed.

**Management of Specific Injuries**

Rib fracture - occurs when pressure is applied with enough force to exceed the strength of the rib. Remember that any fractured rib can cause associated injuries to nearby structures.

Causes - blunt trauma, crushing injuries to the chest.

Signs and Symptoms

- Pain at the site with inhalation/exhalation
- Shortness of breath
- Deformity
- Crepitus
- Bruising to area

Treatment

- Anticipate potential complications such as tension pnuemothorax, pericarditis, or cardiac tamponade.
- Simple rib fractures usually require no treatment other than analgesics.
- Multiple rib fractures may require immobilization of the arm on affected side to protect the ribs.
- Encourage coughing and deep breathing despite associated pain. This is to prevent the collapse of the lung tissue and preventing the exchange of CO2 and O2 (atelectasis).
- Avoid any taping or bandaging that encircles the chest.
- Monitor and TACEVAC as necessary.

Flail chest - a condition of the chest wall due to two or more adjacent ribs being fractured in at least two or more places. The flail segment moves paradoxically in with inspiration and out during expiration (see Figure 4)

Causes - blunt trauma to the chest wall, especially an impact into the sternum or the lateral side of the thoracic wall.

Signs and Symptoms

- Localized chest pain, aggravated by breathing or coughing
- Rapid shallow respirations
- Tenderness and/or bony crepitus with palpation
- Subcutaneous emphysema

Treatment

- Immobilize flail segments upon inhalation using strips of tape.
- If you suspect respiratory failure, give positive pressure ventilation using a bag valve mask.
- Administer analgesics
- Administer oxygen if available.
- TACEVAC to the next capability of care.

As a result of paradoxical chest wall movement during inspiration, the flail segment of the rib cage moves inward (instead of outward), which results in reduced air intake.

**Figure 4. Flail Chest**

Pneumothorax - a simple pneumothorax is caused by the presence of air in the pleural space. The air separates the two pleural surfaces, causing the lung on the involved side to collapse as the separation expands. As air continues to build up and pressure in the space increases, the size of the lung on the affected side continues to decrease. Eventually, the lung may partially or totally collapse.

Causes

- Penetrating trauma from either chest wall injury or abdominal injuries that cross the diaphragm.
- Blunt trauma
- Spontaneous (with no apparent cause)

Signs and Symptoms

- Pleuritic chest pain
- Tachypnea/dyspnea
- Decreased or absent breath sounds on the injured side
- Decreased chest wall motion

Treatment

- Place patient in sitting up or Semi-Fowlers position
- Use BVM if hypoxia is present
- Administer oxygen if available
- If caused by a wound, apply an occlusive dressing to the site
- Monitor for signs and symptoms of a tension pneumothorax
- TACEVAC ASAP

Tension Pneumothorax (see Figure 5) - A type of pneumothorax in which air can enter the pleural space but cannot escape via the route of entry. This is the **second** leading cause of preventable death on the battlefield. This leads to an increase of pressure in the pleural space and eventual collapse of the lung. This pressure forces the mediastinum to the opposite side, which results in two serious consequences: (1) breathing becomes increasingly difficult and (2) cardiac blood flow is severely decreased.

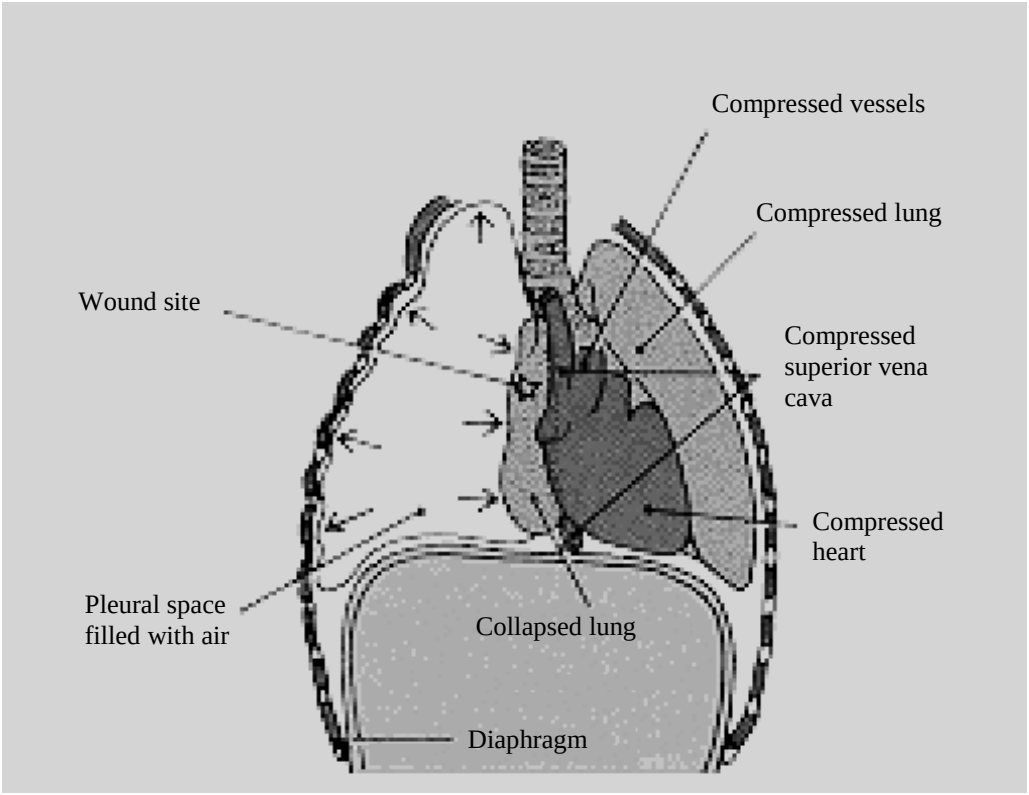



**Figure 5. Tension Pneumothorax**

Cause - chest injuries.

Signs and Symptoms

Early signs

- Unilateral (one sided) decreased or absent breath sounds
- Dyspnea
- Tachypnea

**In some cases, the only signs of a developing tension pneumothorax are compromised oxygenation, tachycardia, tachypnea, and unilateral decreased or absent breath sounds.**

Progressive signs
- Increased dyspnea
- Increased tachypnea
- Increased difficulty ventilating

Late signs
- Jugular vein distention (JVD)
- Tracheal deviation
- Signs of acute hypoxia
- Narrowing pulse pressures
- Signs of uncompensated shock

Treatment

- Treat all chest injuries
- Perform needle thoracentesis
- Administer oxygen therapy if available
- Pain management
- Monitor and TACEVAC

Open Pneumothorax (Sucking Chest Wound) - a collection of air or gas in the pleural space causing the lung to collapse. An open wound allows air to enter when the intrathoracic pressure is negative and blocks the air's release when the intrathoracic pressure is positive; creating a "sucking chest wound," that has the potential to cause a tension pneumothorax.

Causes - most often the result of gunshot wounds, but they can also occur from impaled objects, stabbings, and occasional blunt trauma.

Signs and Symptoms
- Pain at the injury site
- Chest wall trauma
- Shortness of breath
- Tachypnea
- Subcutaneous emphysema
- Decreased chest wall motion
- May hear a moist sucking or bubbling sound as air moves in and out of the chest wall defect.

Treatment
- The immediate treatment is to ***seal the wound*** with an occlusive dressing. This intervention helps to restore air flow into the lung during inspiration, but could lead to the development of a tension pneumothorax. If an exit wound is present tape it on all four sides.
- Assess both anterior and posterior torso for penetrating trauma.
- Monitor for signs and symptoms of tension pneumothorax. If signs of increasing respiratory distress develop, the dressing over the wound should be removed to allow for decompression of any accumulating tension. If this is ineffective, needle decompression and positive pressure ventilation (if available) should be considered if not already employed.

- Administer oxygen if available
- Place patient on affected side
- Pain management
- Monitor and TACEVAC

Hemothorax - the accumulation of blood in the pleural space caused by a laceration of the great vessels within the chest that can significantly compromise respiratory efforts by compressing the lung and preventing adequate ventilation.

Causes - Penetrating or blunt trauma

Signs and Symptoms
- Shortness of breath
- Chest pain
- Tachypnea
- Signs of shock (pallor, confusion, tachycardia, hypotension)
- Decreased breath sounds on affected side
- Hemoptysis (coughing up blood)
- Decreased chest wall motion

Treatment
- Place patient in the Fowler's position
- Treat any chest injuries
- Treat for shock
- Administer O2, if available
- Pain management
- Monitor and TACEVAC

Hemopneumothorax - often with penetrating trauma, a pneumothorax is associated with a hemothorax, and an accumulation of air, blood, and fluid within the pleural cavity.

Causes - penetrating trauma to the chest wall, the great vessels, or the lung.

Signs and Symptoms
- Tachypnea
- Decreased breath sounds
- Signs of shock

Treatment
- Place patient in Fowler's position
- Perform needle thoracentesis to relieve pressure. If blood is withdrawn, immediately remove needle and catheter.
- Administer oxygen, if available
- Treat for shock
- Monitor and TACEVAC

## NEEDLE THORACENTESIS

Needle thoracentesis is a procedure where a needle and catheter are inserted through the chest wall into the pleural space. The catheter provides a pathway for the release of accumulated pressure within the pleural space. This procedure helps reduce pressure on the heart, lungs and major vessels within the chest cavity that have compromised the patient's breathing and circulation.

4. **ANATOMICAL LANDMARKS** (See Figure 6)

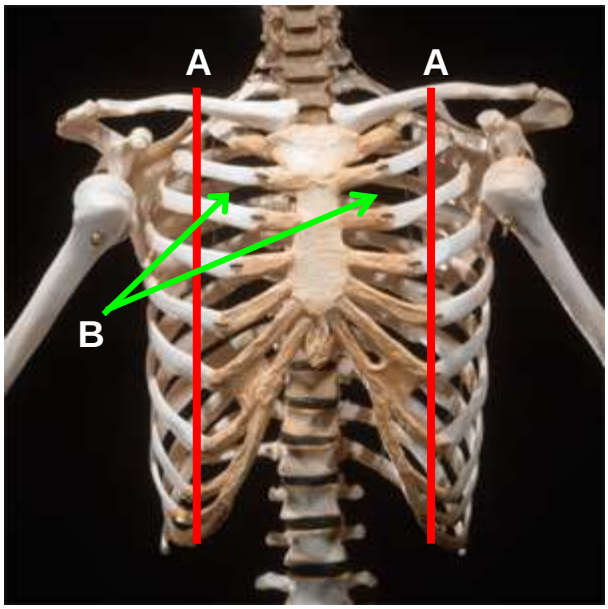
**Mid-Clavicular Line (MCL)**

- Imaginary line that dissects the middle of the clavicle on the right or left side

**2nd Intercostal Space**

- Space between the 2nd and 3rd rib.
- From the MCL, palpate down. The first space immediately after the clavicle is the 1st intercostal space. Continuing down, the first space below the next rib is the 2nd intercostal space.

> An acceptable alternative location is the 4th or 5th intercostal space at the anterior auxiliary line. This method will not be taught during FMST; however you will learn this technique at follow-on training.




**A** – Mid-Clavicular Lines B– 2nd Intercostal Space

Figure 6. Needle Thoracentesis Anatomical Landmarks

5. **INDICATIONS**

**Tension Pneumothorax**

- Any casualty with thoracic injury is at risk for developing a tension pneumothorax.
- Casualties at particular risk are those who have a penetrating wound to the chest and those with signs of rib fracture.
- There are no significant contraindications for needle thoracentesis with penetrating chest trauma.

6. **PROPER EQUIPMENT**

- 14-gauge, 3.25-inch needle/catheter
- Antiseptic solution (if available)
- Gloves

7. **PROCEDURAL STEPS**

**Assess Casualty and Make Decision** - based on mechanism of injury (MOI) and a noted increase in difficulty breathing.

- Inspect - look for bilateral rise and fall of the chest during respirations.
- Auscultate - listen to the lung fields at the mid-clavicular and mid-axillary lines bilaterally if tactical situation allows (it may be hard to hear in a combat setting).
- Palpate - feel for flail segments or crepitus.

**Assemble and Check Equipment** - Gather 14-gauge, 3.25-inch needle/catheter, alcohol swab and gloves.

**Prepare Patient**

- Position the patient in upright position (if possible)
- Explain the procedure to the patient, if conscious
- Expose the anterior chest

**Identify Landmarks **ON THE AFFECTED SIDE****

- Midclavicular line
- 2nd Intercostal space

**Perform the Procedure**

- Cleanse the area
- Insert catheter - Firmly insert the needle into the skin over the top of the third rib into the second intercostal space at a 90 degree angle.
- Puncture the parietal pleura - Ensure the chest cavity has been penetrated, as evidenced by feeling a "pop" as the needle enters the chest cavity. The pressure may be so great that a rush of air may be encountered.
- Remove needle - secure catheter to chest wall.

**Reassess the Patient**

- Inspect, Auscultate, and Palpate (IAP) Chest
- Visually inspect the neck
- Monitor the patient's response to the needle thoracentesis (respiratory rate, lung sounds, and skin color)
- Be ready to insert a 2nd catheter if the patient does not improve.

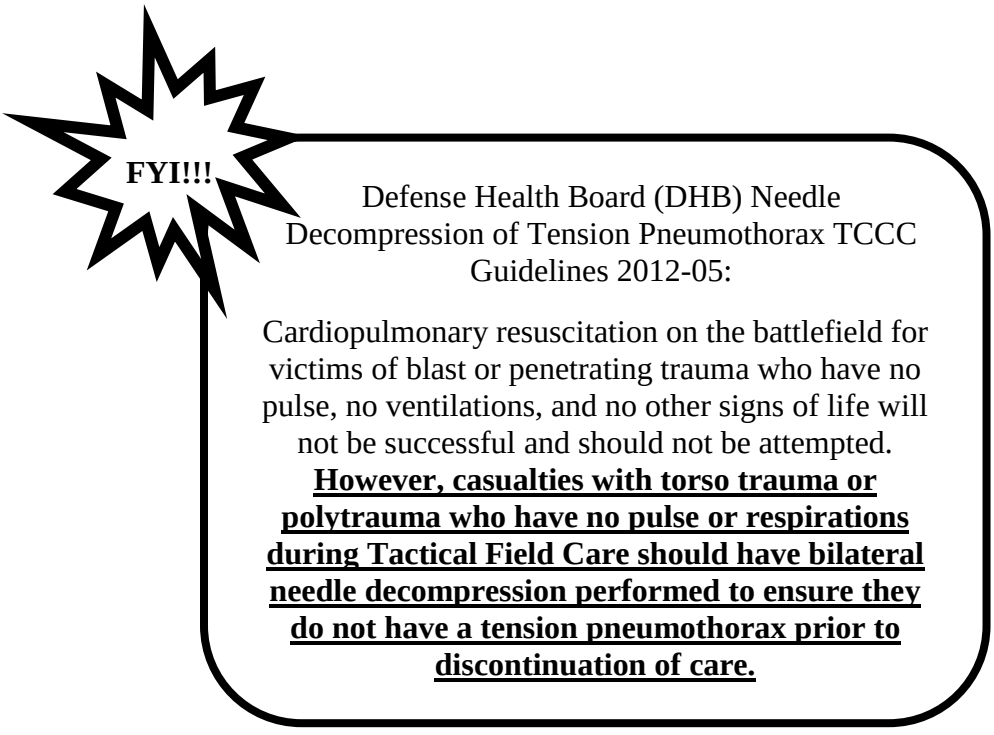
## 8. COMPLICATIONS

**Hemothorax** - blood within the pleural space. May be caused when the needle punctures any vessels within the chest wall.

**Cardiac Tamponade** - pressure on the heart that occurs when blood or fluid builds up in the space between the heart muscle and the pericardium. Ensuring that the insertion site for the needle is at or lateral to the nipple line will help avoid this complication.

**Subcutaneous emphysema** - released air becomes trapped within the subcutaneous tissue. Feels like "Rice Krispies" underneath the skin.

**Misdiagnosis** - performing a needle thoracentesis on a casualty with non-penetrating torso trauma could result in a pneumothorax if not already present.



**CASUALTY ASSESSMENT AND RESPIRATORY TRAUMA**

**Care Under Fire Phase:** In the absence of life-threatening hemorrhage from the respiratory system, the material in this section is unlikely to be addressed in the Care Under Fire phase.

**Tactical Field Care Phase:** During this phase, you will be required to assess the quality of breathing, which will require you to expose the casualty's chest. Consider needle thoracentesis if warranted. Needle thoracentesis is a skill that is used during the Tactical Field Care phase in the treatment of respiratory trauma. If a casualty has a torso injury and difficulty breathing, you should perform a needle thoracentesis. Remember, a tension pneumothorax can develop at any time after an injury, not just immediately after, so continuous assessment of the casualty is necessary. Don PPE. Note and treat all respiratory injuries. Complete a head to toe assessment using DCAP-BTLS noting and treating additional injuries. Determine if vascular access is required (see Tactical 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 TACEVAC.

**REFERENCE**

Prehospital Trauma Life Support, current Military Edition

**Field Medical Training Battalion**

# NEEDLE THORACENTESIS
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT (**Rank Last Name, First Name) | **PLT** |
|---|---|
| | |

| **PROCEDURAL STEPS FOR PERFORMING A NEEDLE THORACENTESIS** | **1ST** | | **2ND** | | **3RD** | |
|---|---|---|---|---|---|---|
| | **P** | **F** | **P** | **F** | **P** | **F** |
| *** State the indication for a needle thoracentesis (tension pneumothorax)** | | | | | | |
| State the possible complications of a needle thoracentesis (hemothorax, cardiac tamponade, subcutaneous emphysema) | | | | | | |
| *** Assess casualty and make decision to decompress (ABC's, LLF, S/SX of pneumothorax)** | | | | | | |
| Assemble and check equipment (14-gauge, 3.25-inch needle/catheter, alcohol) | | | | | | |
| Prepare patient (position, explain, expose) | | | | | | |
| *** Identify landmarks (midclavicular line, 2nd intercostal space, equal/lateral to nipple line)** | | | | | | |
| Cleanse the area | | | | | | |
| *** Insert catheter at 90-degree angle and puncture the parietal pleura** | | | | | | |
| *** Remove needle (allow lung to decompress)** | | | | | | |
| Secure catheter to chest | | | | | | |
| Reassess & monitor patient for improvement (decrease in respiratory difficulty) | | | | | | |

| **GRADING CRITERIA** | **1ST** | **2ND** | **3RD** |
|---|---|---|---|
| **Total Non-Critical Items (3 or greater constitutes a failure)** | | | |
| **Total Critical Items (Any critical items missed constitutes a failure)** | | | |
| **"Stop & Think" (2 allowed for critical items, third constitutes a failure)** | | | |

| **1st Evaluator:** | **2nd Evaluator:** | **3rd Evaluator:** |
|---|---|---|
| **PASS / FAIL** | **PASS / FAIL** | **PASS / FAIL** |
| **Student signature:** | **Student signature:** | **Student signature:** |
| **Notes:** | **Notes:** | **Notes:** |

Respiratory Trauma Review

1. Identify five structures found in the mediastinum.

2. Identify the appropriate treatment for a simple rib fracture.

3. Identify the two serious consequences of a tension pneumothorax.

4. Identify the treatment for a sucking chest wound.

5. Identify the major landmarks used in performing a needle thoracentesis.

6. What are the indications for a needle thoracentesis? Contraindications?

7. List the equipment needed to perform a needle thoracentesis.

8. Explain the acronym IAP and what you are specifically looking for before making the decision to perform a needle thoracentesis.

9. Explain how and where to insert the needle/catheter.

10. Identify the possible complications of performing a needle thoracentesis.

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FMST 407

# Manage Abdominal Injuries

## TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, **treat abdominal injuries** reducing the risk of further injury or death. (8404-MED-2006)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or title**, identify anatomy of the major abdominal organs**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006a)

2. Without the aid of reference, given a description or title**, identify the significance of the types of organs in abdominal injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006b)

3. Without the aid of reference, **identify the two major mechanisms of abdominal trauma**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006c)

4. Without Without the aid of reference, given a description or list, **identify the signs and symptons of abdominal injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006d)

5. Without the aid of reference, given a description or list**, identify the proper treatment of abdominal injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006e)

6. Without the aid of reference, given a simulated casualty with abdominal injuries and a Corpsman Assault Pack, **manage simulated abdominal injuries**, to prevent further injury or death, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2006f)

## OVERVIEW

Unrecognized abdominal injury is one of the major causes of death in the trauma casualty. Early deaths from severe abdominal trauma typically result from massive blood loss caused by either penetrating or blunt injuries. The abdomen contains the major organs of digestion and excretion. The abdominal cavity is located below the diaphragm; its boundaries include the anterior abdominal wall, the pelvic bones, the vertebral column, and the muscles of the abdomen and flanks. Many organs lie in both the abdomen and the pelvis. The simplest and most common method of describing the portions of the abdomen is by quadrants. In this system, the abdomen is divided into four equal parts by two imaginary lines that intersect at right angles at the umbilicus. The abdomen can further be divided to more specifically identify a region of the abdomen (see Figure 1).

## 1. MAJOR ABDOMINAL ORGANS AND THEIR LOCATIONS

Right Upper Quadrant (RUQ)

Colon - the part of the large intestine that extends from the cecum to the rectum.
Right Kidney - one of a pair of organs situated in the body cavity near the spinal column that excrete waste products. The kidneys are bean-shaped organs that consist chiefly of nephrons by which urine is secreted, collected, and discharged through the ureter to the bladder.
Pancreas - a large lobulated gland that secretes digestive enzymes and the hormones insulin and glucagon. Only a small portion of the pancreas is located in the RUQ.
Liver - a large, very vascular, glandular organ that secretes bile and causes important changes in many of the substances contained in the blood.
Gallbladder - a membranous muscular sac in which bile from the liver is stored.

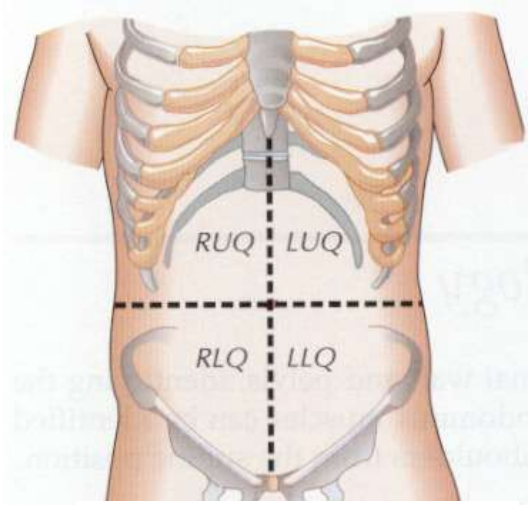

**Figure 1. Areas of the Abdomen**

Left Upper Quadrant (LUQ)

Colon - see above.
Left Kidney - see above.
Pancreas - see above for function. Most of the pancreas is located in the LUQ.
Spleen - a highly vascular, ductless organ that is located in the left abdominal region near the stomach or intestine and is concerned with final destruction of red blood cells, filtration and storage of blood, and production of lymphocytes. Severe bleeding is consistent with injury to this organ.
Stomach - muscular, distensible, saclike portion of the alimentary tube between the esophagus and the colon.

Right Lower Quadrant (RLQ)

Ascending Colon - see above. Ascending means to move upwards.
Small Intestine - the part of the intestine that lies between the stomach and colon; it consists of duodenum, jejunum, and ileum. It secretes digestive enzymes, and is the chief site for the absorption of digested nutrients.
Major artery and vein for right leg - iliac artery and vein.
Appendix - a small sac extending from the large intestine.

Left Lower Quadrant (LLQ)

Descending Colon - see above. Descending means to move downwards.
Small Intestine - see above.
Major artery and vein for left leg - iliac artery and vein.

## 2. SIGNIFICANCE OF ABDOMINAL ORGANS

The abdominal organs can be classified as either "hollow" or "solid" organs, depending on their function.

Solid Organs - solid masses of tissue (liver, spleen, pancreas and kidneys)
*Significance* - highly vascular organs where injury may cause severe bleeding.

Hollow Organs - gastrointestinal/urinary tract through which materials pass. The stomach, intestines, and bladder are hollow organs.
*Significance* - injury to these organs may cause septicemia and toxicity.

## 3. MECHANISMS FOR ABDOMINAL INJURY

Assessing the patient for abdominal injuries begins with knowledge of the MOI. Numerous mechanisms lead to the compression and shearing forces that may damaged abdominal organs. A casualty may experience considerable deceleration forces when involved in motor vehicle crashes, struck or run over by a vehicle, or after falling from a significant height. Any protective gear worn by the casualty should be noted. Abdominal injuries can be caused by blunt or penetrating trauma.

**Blunt Trauma** - Blunt trauma often poses a greater threat to life because potential injuries are more challenging to diagnose than those caused by penetrating trauma. The injuries to abdominal organs result from either compression or shearing forces. In compression incidents, the organs of the abdomen are crushed between solid objects. Shearing forces create rupture of the solid organs or rupture of blood vessels in the cavity because of the tearing forces exerted against their supporting ligaments. The liver and spleen can shear and bleed easily and blood loss can occur at a rapid rate. Increased intra-abdominal pressure produced by compression can rupture the diaphragm, causing the abdominal organs to move upward into the pleural cavity.

**Penetrating Trauma** - A foreign object enters the abdomen and opens the peritoneal cavity to the outside. Penetrating trauma, such as a gunshot or stab wound, is more readily visible than blunt trauma. Multiple organ damage can occur in penetrating trauma, although it is less likely with a stab wound than with a gunshot wound. A mental visualization of the

potential trajectory of a missile, such as a bullet or the path of a knife blade, can help identify possible injured internal organs.

## 4. **SIGNS AND SYMPTOMS**

History of the injury can be obtained from the patient or from bystanders. If the injury is penetrating, questions should focus on the type of weapon, number of times shot or stabbed, and amount of blood at the scene.

Unless there are associated injuries, casualties with abdominal trauma generally present with a patent airway. When abnormalities are found in the assessment of the abdomen, it should be exposed and examined in greater detail. This involves inspection and palpation of the abdomen looking and feeling for soft tissue injuries and distention.

**The most reliable indicator of intra-abdominal bleeding is the presence of shock from an unexplained source.**

Soft tissue injuries include contusions, abrasions, stab or gunshot wounds, obvious bleeding, and unusual findings such as evisceration or impaled objects. Palpation of the abdomen is undertaken to identify areas of tenderness. Ideally, palpation is begun in an area where the casualty does not complain of pain. Then, each of the abdominal quadrants is palpated. While palpating a tender area, the provider may note that the casualty "tenses up" the abdominal muscles in that area. This reaction, called voluntary guarding, serves to protect the patient from pain.

Involuntary guarding represents rigidity or spasm of the abdominal wall muscles when the casualty is distracted. Deep or aggressive palpation of an obviously injured abdomen should be avoided because palpation may dislodge blood clots and/or promote existing hemorrhage and may increase spillage of contents of the GI tract if perforations are present. Great care during palpation should also be exercised if there is an impaled object. Casualties with altered mental status, such as those with a traumatic brain injury (TBI) may have unreliable examination.

Auscultation of bowel sounds is generally not a helpful field assessment tool. Time should not be wasted trying to determine their presence or absence because this diagnostic sign will not alter the field management of the casualty.

The assessment of abdominal injuries can be difficult, especially with the limited diagnostic capabilities of the field setting. An index of suspicion for abdominal injuries should develop from a variety of sources of information, including mechanism of injury (MOI), findings from the exam, and input from the casualty or bystanders. Some signs that raise the index of suspicion are:

- MOI consistent with rapid deceleration or significant compression forces
- Soft tissue injuries to the abdomen, flank, or back

- Shock without an obvious cause
- Level of shock greater than explained by other injuries
- Significant abdominal tenderness on palpation or with coughing
- Involuntary guarding
- Diminished or absent bowel sounds

**FYI:** Only about 15% of casualties with stab wounds to the abdomen will require surgical intervention, but 85% of casualties with gunshot wounds will need surgery for definitive management of their injuries.

## 5. TREATMENT OF INJURIES

The key aspects of field management of abdominal trauma are to recognize the presence of potential injury and initiate transport to a higher echelon of care.

Blunt Trauma

Treatment for blunt trauma to the abdomen includes maintaining the ABCs of the patient, collecting vital signs, gathering information for a history, treating for shock, and placing the patient in the supine position with the knees slightly flexed. Remember that with a patient with blunt trauma you need to keep them calm so that you can perform your duties and not to strongly palpate the abdomen because you do not know the extent of the internal injuries. The final step in treating blunt abdominal trauma is to TACEVAC the patient, as the definitive treatment that patient needs is beyond your scope of care.

**Figure 2. Impaled knife in chest**

Impaled objects (see Figure 2) Because removal of an impaled object may cause additional trauma and because the object's distal end may be actively controlling the bleeding, removal of it in the field environment is contraindicated. The impaled object should neither move nor be removed. If bleeding occurs around it, direct pressure should be applied around the object to the wound with a bulky dressing that stabilizes the object and prevents movement.

Evisceration (see Figure 3) A section of intestine or other abdominal organ is displaced through an open wound and protrudes externally outside the abdominal cavity. Efforts should focus on protecting the protruding segment of intestine or other organ from damage. If the intestine or some of the other abdominal organs become dry, cell death will occur. Therefore the eviscerated abdominal contents should be covered with a sterile dressing that has been moistened with saline. These dressings should be periodically remoistened with

saline to prevent them from drying out. Wet dressings may be covered with a large, dry dressing to keep the casualty warm.

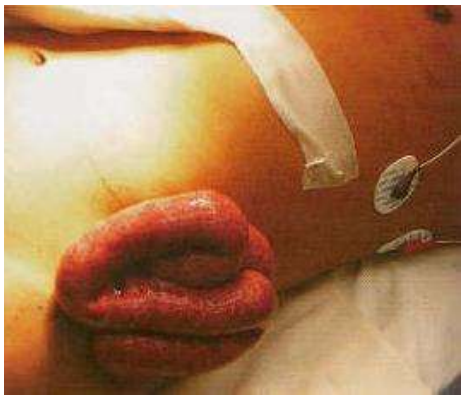

**Figure 3. Evisceration of bowel**

**FYI!** Under normal circumstances, treatment of eviscerated bowel requires only a moist sterile dressing. Abdominal contents normally do not need to be reinserted into the abdominal cavity.

**CASUALTY ASSESSMENT AND ABDOMINAL INJURIES**

**Care Under Fire Phase:** In the absence of life-threatening hemorrhage from the abdomen, the material in this section is unlikely to be addressed in Care Under Fire.

**Tactical Field Care Phase:** During this phase, you will be required to inspect the abdomen using DCAP-BTLS for any signs of injury. Don BSI. Note and treat all abdominal injuries. Complete a head to toe assessment using DCAP-BTLS noting and treating additional injuries. Determine if vascular access is required (see Tactical 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 TACEVAC.

**REFERENCE**

Prehospital Trauma Life Support, current Military Edition

Abdominal Review

1. Which quadrant contains the appendix?

2. Identify the solid organs and explain their significance.

3. Describe the appropriate treatment for an impaled object.

4. Describe the appropriate treatment for an abdominal evisceration.

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FMST 408

## Manage Musculoskeletal Injuries

### TERMINAL LEARNING OBJECTIVE

1 . Given a casualty in an operational environment, standard field medical equipment and supplies, **treat musculoskeletal injuries** to reduce the risk of further injury or death. (8404-MED-2004)

### ENABLING LEARNING OBJECTIVES

1 . Without the aid of reference, given a description or list, **identify the anatomy of the musculoskeletal system**, within 80% accuracy per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004a)

2 . Without the aid of reference, given a description or list, **identify the management of soft tissue injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004b)

3 . Without the aid of reference, given a description or list, **identify the management of fractures**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004c)

4 . Without the aid of reference, given a description or list, **identify the principles of splinting**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004d)

5 . Without the aid of reference, given a simulated casualty with musculoskeletal injuries and a Corpsman Assault Pack, **manage the simulated casualty**, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004e)

1. **ANATOMY OF THE MUSCULOSKELETAL SYSTEM**

Understanding the gross anatomy and physiology of the human body is the foundation on which assessment and management are based. Without a good grasp of the structures of the bones and muscles, one will not be able to relate kinematics and superficial injuries to injuries that are internal.

**Skeletal System** – the mature human body has approximately 206 bones separated into categories by shape.

**Long bones** – femur, humerus, ulna, radius, tibia and fibula

**Short bones** – metacarpals, metatarsals and phalanges

**Flat bones** – sternum, ribs and scapulas

**Sutural bones** – variable and irregularly shaped bones in the sutures between the bones of the skull

**Sesamoid bones** - located within tendons; patella is the largest

**What happended to the "irregular bones"**

- This is a more generalized category that contains bones that do not fall into the long, short or flat classification.

**Muscular System** – the human body has more than 700 individual muscles, which are categorized by function. (See Figure 1)

**Skeletal (voluntary)** – muscle fiber is striated, or striped, and is under the control of the individual's will. Skeletal muscle tissues are usually attached to bones. When muscle fibers are stimulated by an action of a nerve fiber, the fibers contract and relax. This interaction between muscle and nervous fibers produces movement.

**Smooth (involuntary)** – muscle fibers are smooth, or non-striated, and are not under the control of the individual's will. Smooth muscle tissue is found in the walls of hollow organs, such as the stomach, intestines, blood vessels, and urinary bladder. Smooth muscle tissues are responsible for the movement of food through the digestive system, constricting blood vessels, and emptying the bladder.

**Cardiac** – muscle cells are striated and are joined end to end, resulting in a complex network of interlocking cells. Cardiac muscles are involuntary muscles and are located only in the heart. These tissues are responsible for pumping blood through the heart chambers and into certain blood vessels.

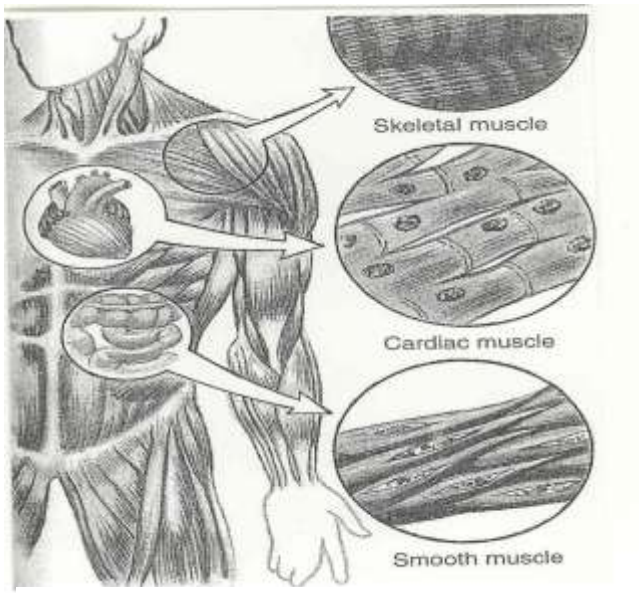


**Figure 1. Three Types of Muscles**

**Osseous Connective Tissue** – this type of tissue, known as "bone tissue" is dense fibrous connective tissue that forms tendons, ligaments, cartilage, and bones. These tissues form the supporting framework of the body. (See Figure 2)

**Tendon** – a band of tough, inelastic, fibrous tissue that connects a muscle to a bone

**Ligament** – a band of tough, fibrous tissue connecting bone to joint

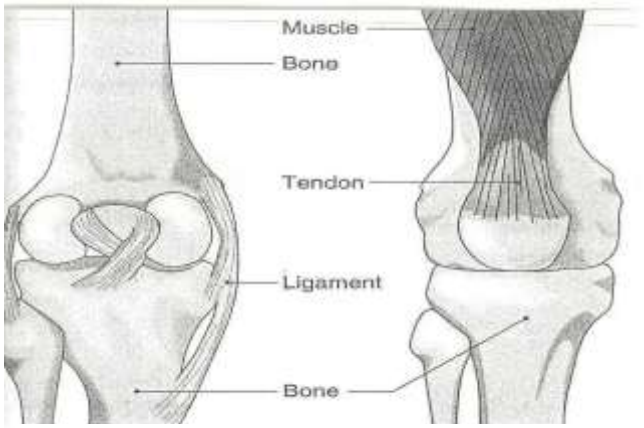


**Figure 2. Osseous Connective Tissue**

## 2. MANAGEMENT OF SOFT TISSUE INJURIES

**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. 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 FMST 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.

**Open Soft Tissue Injuries** – an injury in which the skin is interrupted, or broken, exposing the tissues underneath.

**Abrasions** – Occur when skin is rubbed or scrapped off. (See Figure 3)

Treatment:

- Hemorrhage is usually so minimal that primary treatment may only require cleansing of the wound.
- Small bandages may be applied, but tactical situations will usually preclude applying field dressings that are needed for more serious injuries.
- A large amount of dirt may be ground into the wound, therefore secondary treatment measures should focus on preventing or stopping infections.

**Figure 3. Abrasion**

**Lacerations** – Torn skin with ragged irregular edges and masses of torn tissue underneath. (See Figure 4)

**Figure 4. Laceration**

Treatment:

- Generally the same as for abrasions
- Control hemmorhage
- If major tendons and muscles are completely severed, immobilize limb to prevent further damage.
- Treat for shock

**Avulsion** - An injury in which flaps of skin are torn loose or completely pulled off. (See Figure 5)

Treatment

**Figure 5. Avulsion**

- Control bleeding
- Apply field dressing to avulsed area.
- Prevent further contamination
- Ensure avulsed flap is lying flat and that it is aligned in its normal position.
- Make every effort to preserve the avulsed part (wrap the part in a saline or water soaked field dressing, pack wrapped part in ice, whenever possible. Be careful to avoid direct contact between the tissue and ice.)
- Transport the avulsed part with the patient, but keep it well protected from further damage and out of view of the patient.
- Immobilize extremity or body part as indicated by the severity of the avulsion.

**Traumatic Amputations** - Non-surgical removal of a limb or other appendage of the body. Because blood vessels are elastic they tend to spasm and retract into surrounding

tissue. With complete amputations there is less bleeding then with partial or degloving cases. (See Figure 6)

Treatment

- If life-threatening bleeding is present, apply a tourniquet immediately
- If there is non life-threatening bleeding, a pressure dressing may be used. More than one may be necessary to gain control of bleeding.
- Make every effort to preserve the amputation.

**Figure 6. Traumatic Amputation**

- Wrap amputated part in sterile dressing, place in ice and send with patient
- TACEVAC

**Closed Soft Tissue Injuries** – An injury where there is no open pathway from the outside to the injured site. Examples include strains, sprains and dislocations.

**Strain** - Injury to a muscle or tendon resulting from over stretching or over exertion. The chief symptoms of a strain are pain, lameness or stiffness 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.

Treatment

- Supportive strapping or bandaging
- Immobilize by splinting so that affected muscle is in relaxed position, if injury is severe.
- R.I.C.E. (Rest, Ice, Compression, Elevation)

**Sprain** - A joint injury resulting in partial tearing or stretching of supporting ligaments. 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. (See Figure 7)


**Figure 7. Ankle Sprain**

Treatment

- Treat like a fracture
- Supportive strapping or bandaging
- R.I.C.E. (Rest, Ice, Compression, Elevation)
- Pain management
- TACEVAC

**Dislocation** - When a bone is forcibly displaced from its joint. 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. 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. (See Figure 8)


FIGURE 1. Photo (A) of the left ankle of a 33-year-old male recreational softball player shows tibiotalar dislocation of the ankle. The foot is displaced medially, and the skin is tented over the prominence of the lateral malleolus. Anterolateral radiograph of the same ankle (B) shows that the talus is completely disassociated from the ankle mortise (arrow), and a small avulsion of the fibula is evident (arrowhead).

**Figure 8. Dislocation**

Treatment

- Attempt to reduce only if no pulse is present in the extremity
- Splint as found to immobilize injured part
- Pain management
- Treat for shock
- TACEVAC

Complications

- Hemorrhage caused by seperated bone ends tearing muscle tissue and laceration of blood vessels.

- Nerve damage due to the cutting or pinching of nerves by seperated bone ends or muscle injury.

3. **MANAGEMENT OF FRACTURES**

**TYPES OF FRACTURES**

**Figure 9. Open Fracture**

**Open Fracture** – A broken bone that breaks the overlying skin. The bone may protude through the skin. (See Figure 9) Penetrating objects such as bullets may go through the flesh and break the bone.

**Closed Fracture** - A broken bone with no skin penetration. The tissue beneath the skin may be damaged. (See Figure 10)

**SIGNS AND SYMPTOMS OF FRACTURES**

Inability to move the extremity
Discoloration
Deformity
Edema
Pain with or without movement
Protruding bone
Crepitus (crunching, grating sound/feeling)
Any injury that may indicate fracture (i.e. gun shot wound)

**Figure 10. Closed Fracture**

**GENERAL TREATMENT FOR FRACTURES** – The following guidelines can be applied to any type of fracture, regardless of location.

Control hemorrhage
Treat for shock
Check distal pulses before and after splinting
Immobilize the fracture using splints
Recheck PMS
Relieve pain (whenever possible)
Reductions of fractures are not done in the field, unless distal pulses are not present
Document treatment
Monitor and TACEVAC

4. **PRINCIPLES OF SPLINTING**

**TYPES OF SPLINTS** – Splints are used to immobilize a portion of the body, prevent further damage and alleviate pain.

**Rigid Splints –** cannot be changed in shape. The injured body part must be positioned to fit the splint. Examples include board splints made of wood, plastic, or metal.

**Formable Splints** - Formable splints can be molded into various shapes and combinations to accommodate the shape of the injured extremity. Examples include

vacuum splints, pillows, blankets, cardboard splints, SAM splints and wire ladder splints. (See Figure 11)

**Figure 11. SAM Splint**

**Improvised Splints –** Improvised splints are made from any available material that can be used to stabilize a fracture. Examples include sticks, branches and poles.

**Anatomical Splints -** Use of the casualty's body as a splint. Examples include securing the legs together, securing the arm to the body, and taping the fingers together. (See Figure 14)

**Figure 12. Anatomical Splint**

**Manufactured Splints** – Designed for specific injuries and specific applications. Examples include the traction splint and pneumatic air splints. (See Figures 13 and 14)

**Figure 13. Traction Splint**

**Figure 14. Pneumatic Air Splint**

**Bandages in Splinting** - Bandages can be used to wrap or bind a body part. Bandages hold splints in place, apply additional pressure, and protect the casualty from further harm.

**Sling** - a bandage suspended from the neck to support an upper extremity. When using a sling, position the hand higher then the elbow and never cover the fingers.

**Swathe** - Any band or piece of cloth used to further immobilize a fracture.

## GENERAL GUIDELINES FOR SPLINTING

Control hemorrhage and treat for shock.
Expose fracture site.
Establish distal pulse prior to splinting.
If bone is exposed, ensure to cover the ends with sterile dressing prior to splinting.
Splint fracture in position found.
Attempt to straighten a deformed limb only if it is a closed injury with no distal pulses.
Do not try to reposition or put back an exposed bone.
Move the fractured part as little as possible while applying the splint.
Immobilize the splint above and below the fracture.
Reassess distal pulses after splint is secured.
When in doubt, treat all injuries as a possible fracture.
TACEVAC as needed.

## TECHNIQUES FOR SPLINTING FRACTURES

There are various ways and techniques to immobilize fractures. The FMST must be able to apply the basic splints for the most common fractures:

### Fractured Jaw

- Apply a bandage to immobilize jaw (Modified Barton). (See Figure 15).
- The bandage should pull the lower jaw forward
- Support should be on the head, not behind neck.
- Do not lay casualties with lower jaw fractures on their back. Doing so may cause airway obstruction.

**Figure 15. Immobilizated Jaw**

## Fractured Clavicle

- Immobilize using figure eight bandage. (See Figure 16)
- Bend casualty's arm on injured side, forearm across chest.
- Palm should be turned in, thumb pointed up.
- Hand should be raised 4 inches above elbow.
- Support using a cravat to cradle the arm & tie around the body for immobilization (Sling and Swath). (See Figure 17)

**Figure 16. Immobilizated Clavicle**

**Figure 17. Sling and Swathe**

## Fractured Humerus

- Check for distal pulse
- If fracture is located on the upper arm near shoulder, place padding in the armpit, bandage arm securely to body (See Figure 18).
- If fracture is located in the middle of upper arm, use splint on outside of arm.
- Splint the injury to the body using a full arm wrap (Kerlex or cravat wrap). Support with sling (See Figure 19).
- If fracture is near elbow, splint in position found. Support with sling.
- Re-check distal pulse.

**Figure 18. Upper Arm Splint 1**

**Figure 19. Upper Arm Splint 2**

## Fractured Forearm

- Check for distal pulse
- If only one bone in the forearm is broken, the other may be used as a splint.
- Apply two splints (rigid or formable), one on top and one on the bottom.
- Ensure that the splints cover from wrist to elbow (rigid or formable splint). (See Figure 20)
- Use bandages to hold splints in place.
- Re-check distal pulse
- Place casualty's forearm across the chest, palm turned in and thumb pointing up
- Support with sling

**Figure 20. Forearm Splint**

## Fracture Wrist/Hand

- Check radial pulse
- Splint in position of function leaving fingers exposed (formable splint). (See Figure 21)
- Re-check radial pulse
- Support with sling

**Figure 21. Wrist/Hand Splint**

## Fractured Ribs

- Assess ABCs for possible complications

- Ordinarily, simple rib fractures are NOT bound, strapped or taped if the victim is reasonably comfortable. They may only require analgesics.

- Multiple fractures may require immobilization by strapping the arm of the injured side to the chest to limit motion.

- Arm should be against the chest, palm flat, thumb up and forearm raised to a 45 degree angle. (See Figure 22)

- Secure arm to chest using swath bandage.

- For multiple fractures, you may attempt to immobilize flail segments using tape. (See Figure 23)

- NEVER encircle the chest with any type of constricting bandage. This will only make breathing more difficult!

**Figure 22. Rib Splint**

**Figure 23. Flail Segments**

## Fractured Pelvis

- Check distal pulse

- Place patient in position of comfort (legs straight or knees bent)

- Place pillow or padding between the legs to immobilize hip

- Wrap sheet (or poncho) snuggly around pelvis for support

- Tie knees and ankles together for greater stability (Figure 24)

- Re-check distal pulse

**Figure 24. Pelvis Splint**

## Fractured Femur

- Check distal pulse

- Using four (4) cravats to secure injured leg to the uninjured leg (anatomical splint) (See Figure 25)

- Secure thighs together

- Secure another cravat directly above and below the knees

- Using a figure 8 wrap, secure ankles & feet together

- Re-check distal pulse

**NOTE: Consider traction splinting for midshaft fractures.

**Figure 25. Femur Splint**

## Fractured Patella

-Check distal pulse

- Splint in position of comfort

- Place splint underneath the entire leg. Ensure you have padding at least under the knee and ankle.

- Secure splint in four places (See Figure 26):

  Just below knee

  Just above knee

  Around the ankle

  Around the thigh

- Re-check distal pulse

**Figure 26. Patellar Splint**

## Fractured Tibia/Fibula

- Check distal pulses
- If only one bone is broken, the other can act as a splint
- Utilize the stirrup method with the SAMS splint (See Figure 27)
- Apply splint on both sides of tibia and fibula
- Use kerlex bandage to secure splint
- Immobilize from knee to ankle
- Re-check distal pulse

**Figure 27. Stirrup Splint**

## Fractured Ankle/Foot

- Check pedal pulse
- Splint injury (See Figure 28)
- Wearing boots: use figure 8 with a cravat to secure ankles together.
- Without boots: Wrap ankle with a bandage (kerlex), then use a figure 8 wrap with a cravat to secure ankles and feet together.
- Re-check pedal pulse

**Figure 28. Ankle/Foot Splint**

**Spinal Injury** - The first priority is to ensure the casualty is in a safe location. Next, the FMST may begin spinal immobilization procedures.

**Indications for spinal immobilization:**

High speed vehicle crash (>30mph)

Falls from great heights (2-3x body height)

Direct, blunt neck trauma

Blast injury

**Spinal Immobilization:**

To be effective, the casualty must be immobilized from the head to the pelvis.

Do not block the casualties airway

Use a C-Collar to immobilize the neck

If available secure casualty to a long spine board

If full immobilization is not possible- prevent excessive, unnecessary movement of the casualty.

**NOTE*:*** Remember to treat all life-threatening injuries first prior to treating fractures. Not all casualties will require evacuation.

**CASUALTY ASSESSMENT AND MUSCULOSKELETAL INJURIES**

**Care Under Fire Phase:** If the casualty has a life-threatening hemorrhage, apply a tourniquet. No other musculoskeletal injuries will be treated during this phase of care.

**Tactical Field Care Phase:** During this phase, you will be required to inspect the casualty for any signs of injury. Don BSI. Complete a head to toe assessment using DCAP-BTLS. Note all musculoskeletal injuries and treat if time permits. Note and treat additional injuries. Determine if vascular access is required (see Tactical 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 TACEVAC.

**REFERENCE**

Prehospital Trauma Life Support, current Military Edition

Musculoskeletal Injuries Review

1. List four examples of long bones.
    1)
    2)
    3)
    4)

2. What is the treatment for an avulsion injury?

3. Explain the definition of a sprain.

4. List four signs/symptons of a fracture.
    1)
    2)
    3)
    4)

5. Describe a formable splint and and example.

6. What are the steps for splinting a fractured tibia or fibula?

**UNITED STATES MARINE CORPS**
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FMST 409

## Manage Head, Neck, and Face Injuries

### TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, equipment and supplies**, treat head, neck, and facial injuries** to reduce risk of further injury or death. (8404-MED-2005)

### ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **identify the anatomy of the head**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005a)

2. Without the aid of reference, given a description or list, **identify the types of head injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005b)

3. Without the aid of reference, given a description, **select the appropriate treatment for a head injury**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition (8404-MED-2005c)

4. Without the aid of reference, given a description or list, **identify the anatomy of the neck**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005d)

5. Without the aid of reference, given a description or list, **identify the types of neck injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005e)

6. Without the aid of reference, given a description or list, **select the appropriate treatment for a neck injury**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005f)

7. Without the aid of reference, given a description or list, **identify the anatomy of the face**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005g)

8. Without the aid of reference, given a description or list, **identify the types of facial injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005h)

9. Without the aid of reference, given a description or list, **select the appropriate treatment for a facial injury**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005i)

10. Without the aid of reference, given a simulated casualty with head, face, and/or neck injuries and standard field medical equipment and supplies, **manage the simulated casualty**, to prevent further injury or death, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2005j)

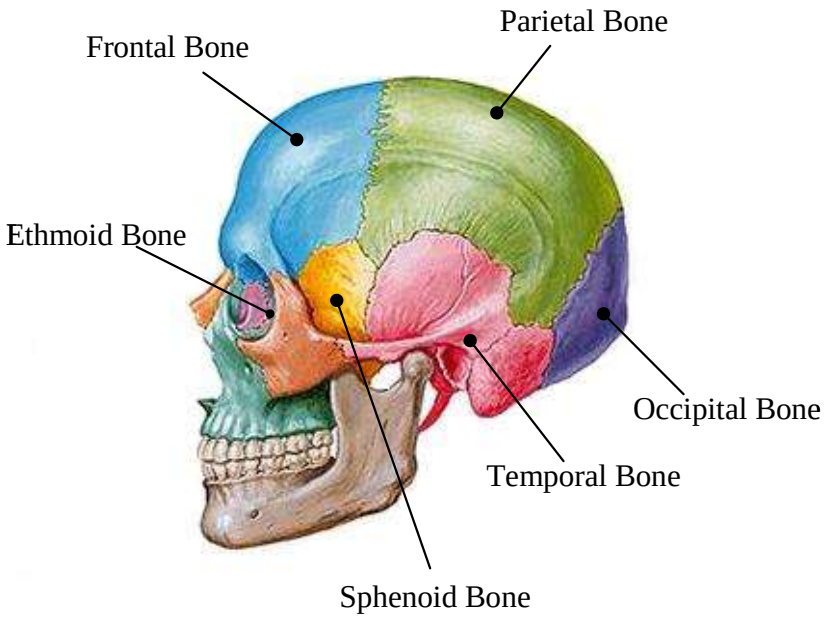


**Figure 1. Anatomy of the Head**

1. **ANATOMY OF THE HEAD**

Head (see Figure 1)

Cranial Vault - the part of the skull that contains the brain. Divided into six sections:

Occipital - the posterior lobe of each cerebral hemisphere that bears the visual cortex and has the form of a 3-sided pyramid
Temporal - a large lobe of each cerebral hemisphere that is situated in front of the occipital lobe and contains a sensory area associated with the organ of hearing
Parietal - forming the upper posterior wall of the head
Frontal - the anterior division of each cerebral hemisphere
Sphenoid - a winged compound bone of the base of the cranium
Ethmoid - a light spongy cubical bone forming much of the walls of the nasal cavity and part of those of the orbits

Brain - divided into three major areas:

Cerebrum - The largest of the three subdivisions of the brain, superiorly situated and sometimes called the "gray matter." It controls willful movement and sensory information such as hearing, speech, visual perception, emotions and personality.

**The brain is protected and cushioned by aprroximately 75 ml of an internal fluid called Cerebral Spinal Fluid (CSF). The CSF also combats infection and cleanses the brain and spinal cord.**

Cerebellum - situated posterior to the brain stem and is sometimes called the "little brain" or "white matter." It coordinates the various activities of the brain, particularly movement, coordination and balance.

Brain Stem - broken down into four parts which connect the spinal cord to the brain and cranial nerves:

Medulla - the most inferior part of the stem which contains the center that regulates respiratory rate, blood pressure, heart rate, breathing, swallowing and vomiting.
Pons - sleep center and respiratory center.
Midbrain - regulates muscle tone.
Reticular Activating System - scattered throughout the brain stem and is important in arousing and maintaining consciousness.

## 2. TYPES OF HEAD INJURIES

Soft Tissue Injuries

Definition - injury to the overlying skin of the scalp, which may be in combination with injury to the skull, brain and/or face. (See figure 2)

Causes
- Penetrating trauma (rifle, impaled objects, missile wounds)
- Blunt trauma (MVA, blast)

Signs and Symptoms
- Profuse bleeding no matter how minor the injury
- Lacerations
- Avulsions
- Pain
- Anxiety
- Edema
- Ecchymosis
- Signs/symptoms of hypovolemic shock

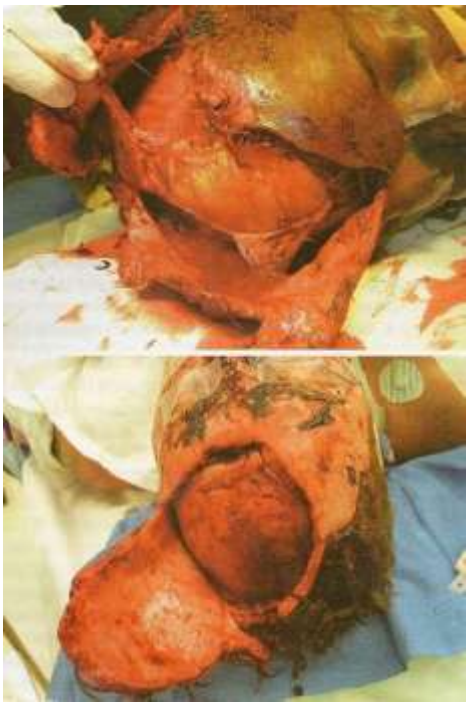

**Figure 2. Injury to scalp**

Skull Injuries

Open Skull Injuries

Definition - injury where cerebral substance is visable through a scalp laceration. Open head injuries usually combine lacerations of the scalp, fragmentation of the skull from fractures, and lacerations of the membranes that cover the brain. The brain may be relatively untouched, or it may be extensively bruised or lacerated.

Causes

- Penetrating trauma
- Blunt trauma

Signs and Symptoms

- Profuse bleeding no matter how minor the injury
- Crepitus
- Edema
- Depressions
- Deformities
- Visualize skull or bony fragments

Closed Skull Injuries

Definition - in closed head injuries there may or may not be lacerations of the scalp, but the skull is intact, and there is no opening to the brain. Injury to the brain itself may be far more extensive in a closed head injury because more of the injuring force is transmitted deeper into the brain due to pressure build-up (see figure 3).

Causes

- Coup-Contrecoup - also known as a deceleration injury. It occurs when the brain strikes the frontal lobe of the skull, then is thrown back against the occipital lobe of the skull (or in the reverse order), causing the brain to bounce off both sides of the cranial vault, resulting in soft tissue damage.
- Blunt Trauma - rising intracranial pressure (ICP) produces complications because the brain is enclosed and pressure cannot be relieved.

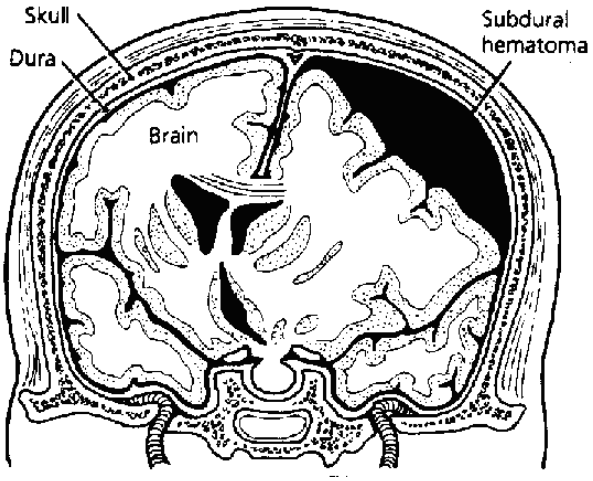


**Figure 3. Closed Head Injury**

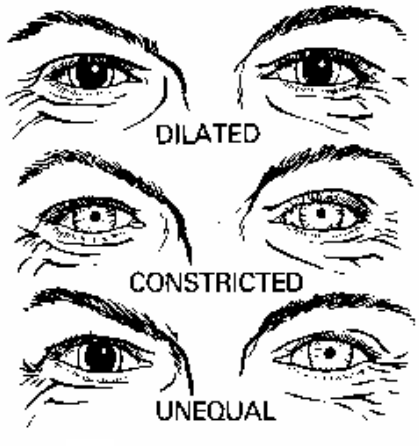


**Figure 4. Pupils**

Signs and Symptoms

- Crepitus around injury site
- Headache
- Neurological symptoms:
  - Altered LOC
  - Restlessness
  - Unequal pupils (see figure 4)

- Bruising, such as:

  Raccoon Eyes (see figure 5) - discoloration of the soft tissue under the eyes indicates basilar skull fracture.

  Battle's Sign (see figure 6) - discoloration of the soft tissue behind the ear indicates temporal bone fracture. This is a late sign and may not be readily seen.

- Drainage - drainage of cerebral spinal fluid from the ears, nose, or eyes. Blood or fluid (CSF) in the ears or nose may indicate a skull fracture.
- Bradycardia
- Increased systolic blood pressure
- Nausea/vomiting
- Decreased Respirations/Cheyne Stokes breathing pattern
- Deformity of the skull (see figure 7).

**Figure 5. Raccoon Eyes**

**Figure 6. Battle's Sign**

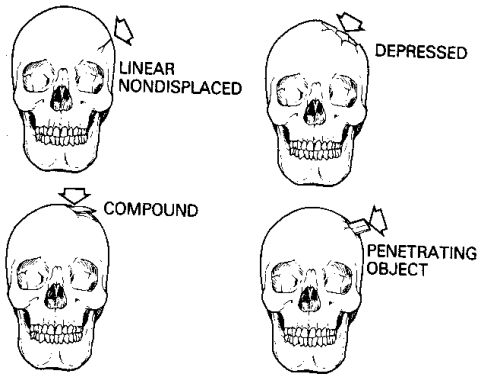


**Figure 7. Skull Injuries**

Brain Injuries

Definition - results from contusion, hemorrhage and/or edema. Damage to the brain and associated intracranial hemorrhage may occur with or without scalp lacertions or skull fractures. If the cranial vault is intact, the resultant swelling or bleeding produces more brain injury by increasing the intracranial pressure.

Causes

- Blunt trauma
- Penetrating trauma
- Coup-Contrecoup injuries

Signs and Symptoms – in addition to the signs and symptoms for closed skull injuries, the following signs and symptoms may also indicate a brain injury:

- Unusual behavior patterns. You must be careful not to misinterpret these symptoms for a psychiatric casualty. (This is the number one indicator of an injury.)
- Altered level of consciousness
- Paralysis
- Convulsions/seizures
- Hyperthermia

Determining Level of Consciousness - The Glasgow Coma Scale (GCS) (see figure 8 below) is a quick and easy method for determining level of consciousness. It is a simple method for determining cerebral function and is predictive of casualty outcome. The GCS score is divided into three sections – eye opening, best verbal response, and best motor response. A score of less than 8 indicates a major injury, 9 to 12 indicates a moderate injury, and 13 to 15 indicate a minor injury. A score of 8 or below is an indication the casualty should be intubated. In the case of operating in a tactical setting, a GCS of less than 8 means to provide some means of an artificial airway (i.e. oral airway, nasal airway, or emergency cricothyroidotomy).

| | |
|---|---|
| Eye Opening | |
| Spontaneous eye opening | 4 |
| Eye opening on command | 3 |
| Eye opening to painful stimulus | 2 |
| No Eye opening | 1 |
| | |
| Best Verbal Response | |
| Answers appropriately (oriented) | 5 |
| Gives confused answers | 4 |
| Inappropriate responses | 3 |
| Makes unintelligible noises | 2 |
| Makes no verbal response | 1 |
| | |
| Best Motor Response | |
| Follows command | 6 |
| Localizes painful stimuli | 5 |
| Withdrawal to pain | 4 |
| Responds with abnormal flexion to painful stimuli (decorticate) | 3 |
| Responds with abnormal extension to pain (decerebrate) | 2 |
| Gives no motor response | 1 |
| | Total _____ |

**Figure 8. Glasgow Coma Scale (GCS)**

## 3. TREATMENT OF HEAD INJURIES

- Provide and maintain patent airway
- Apply c-spine precautions
- Hemorrhage control. Cover open wounds securely enough to aid in the clotting process without pressing skull fragments or impaled objects inward by using donut o-ring.
- Fluid resusciatate to maintain a palpable radial pulse (Do not want to raise intracranial pressure)
- Do not remove foreign bodies or impaled objects
- Check for drainage of CSF from the wound, nose, or ears. Do not pack or suction nose and/or ears if CSF leakage is suspected. Do not let patient clear their nose by blowing. If the casualty has drainage from their nose, check to see if it is CSF by:
  - Use the Halo, or Target Test to check for CSF. Dip a 4 x 4 in the drainage then lay it flat and wait a few minutes. If there is CSF in the blood, the blood will collect in the center, while the CSF remains to the outside creating a halo around the blood.
- Give nothing by mouth (NPO)
- TACEVAC in the High Fowler's position
- Do **NOT** give pain medications

***NO PAIN MEDICATIONS!***
***NO PAIN MEDICATIONS!***
***NO PAIN MEDICATIONS!***

**NOTE:** There is a high mortality rate associated with head trauma. All head trauma patients are assumed to have a cervical spine injury until proven otherwise.

## 4. **ANATOMY OF THE NECK**

Structures

Esophagus - passage from the mouth to the stomach
Trachea (windpipe) - air passage from the larynx to the lungs made of connective tissue and reinforced with 15-20 C-shaped cartilaginous rings
Thyroid gland - stimulates the metabolism of all cells
Larynx (voicebox) - the first part of the trachea which contains the vocal cords
Pharynx - area that extends from the soft palate to the esophagus/trachea
Epiglottis - leaf shaped structure that acts like a gate, directing air to the trachea and solids and liquids into the esophagus

Vasculature

Arteries - left/right common carotid (carry blood to brain)
Veins - left/right internal and external jugular (carry blood away from brain to heart)

Cervical Spine

Vertebrae - seven cervical vertabrae
Spinal Cord - protected by the cervical vertebrae

## 5. **TYPES OF NECK INJURIES**

Trauma of any kind to the neck is signifigant because of the risk of associated injuries to the respiratory tract, the alimentary tract (especially the esophagus), the major vascular structures, major nerves and the cervical spine.

Structures

Definition - injury to associated anatomy of the neck most commonly the trachea and esophagus.

Causes
- Blunt trauma
- Penetrating trauma

Signs and Symtpoms
- Subcutaneous emphysema
- Hematemesis
- Hemoptysis
- Dysphagia (difficulty swallowing)
- Dyspnea
- Hoarseness
- Deformity

Vasculature

Definition - injury to the carotid arteries and/or the jugular veins. These are the most commonly injured structures of the neck.

Causes
- Blunt trauma
- Penetrating trauma

Signs and Symptoms
- Hemorrhage
- Hemoptysis
- Hematemesis

Cervical Spine

Definition - fractures of the cervical vertebrae which are very susceptible to injury because of the relation and position of the skull. These fractures may result in irreversible spinal cord injury.

Causes
- Compression injury (see figure 9).
- Flexion, hyperextension and hyperrotation
- Lateral bending

Signs and Symptoms
- Deformity
- Head fixed in an abnormal position
- Muscle spasms
- Parasthesia in the arms
- Pain
- Paralysis or other neural deficits

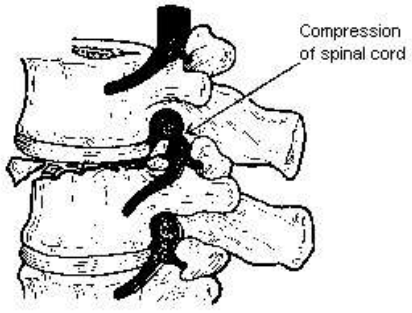


**Figure 9. Compression Injury**

**The only definitive diagnosis for C-spine injury is x-ray. Patient should remain in C-collar until x-rays are read!**

6. **TREATMENT FOR NECK INJURIES**

- Consider C-spine
- Control hemorrhage with a pressure dressing. Apply pressure only to the affected vessels.
- Consider cricothyroidotomy if airway is compromised.
- Administer fluids (*see Combat Fluid Resucitation lesson*)
- **NO PAIN MEDICATIONS!**
- TACEVAC

**FYI!**
**Cricothyroidotomy may be necessary if neck trauma causes blood to be present on the vocal cords, thus causing laryngo-spasms.**

7. **ANATOMY OF THE FACE** (see figure 10)

The facial bones form the stucture of the face in the anterior skull but do not contribute to the cranial vault.

The major facial bones are:

- Nasal
- Zygomatic - a bone of the face below the eye that in mammals forms part of the zygomatic arch and part of the orbit
- Right/left Maxilla - bones that lie on each side of the upper jaw
- Mandible (jawbone) - the lower jaw.

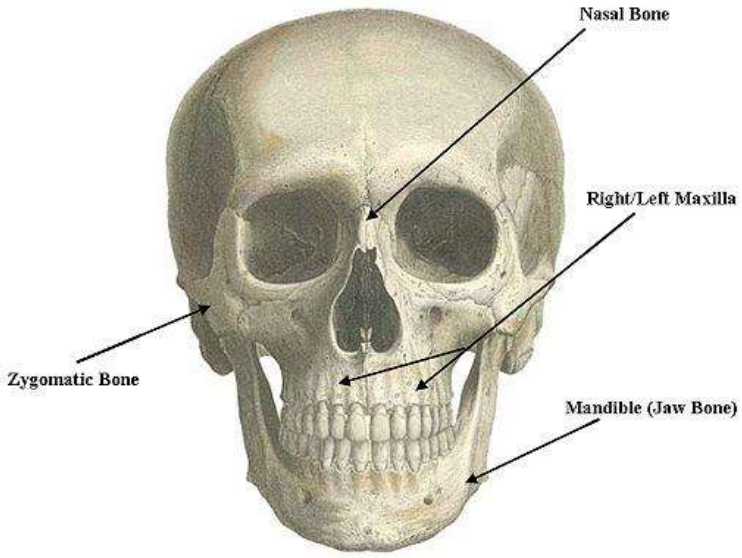


**Figure 10. Major Facial Bones**

8. **TYPES OF FACIAL INJURIES**

Generally serious because of the danger of hemorrhage due to the vast blood supply of the area and obstruction of the respiratory passages.

Soft Tissue Injuries

Definition - damage to the soft tissues of the face without bone injuries

Causes

- Blunt trauma
- Penetrating trauma

Signs and Symptoms

- Massive hemmorhage even with minor wounds
- Edema
- Laceration
- Ecchymosis
- Avulsion

Bone Injuries (Maxillofacial and Mandibular)

Definition - fracture of the major bones of the face (maxillofacial and mandibular). These fractures require great force and may be open or closed.

Causes
- Blunt trauma
- Penetrating trauma

Signs and Symptoms
- Lacerated gums may indicate an underlying fracture
- Casualty cannot open mouth without pain
- Misaligned teeth
- Difficulty swallowing
- Pain at fracture site
- Edema
- Facial asymmetry
- Epistaxis (Nose bleed)
- Ecchymosis
- Lacerations
- Visual disturbances
- Limited ocular movements
- Crepitus

Eye Injuries

Definition - injuries to the eyes that may be associated with other forms of head injury.

Causes
- Blunt trauma
- Penetrating trauma
- Burns
- Foreign objects-debris

Signs and Symptoms
- Loss of vision
- Pain
- Anxiety
- Hemorrhage
- Subconjunctival hemmorrhage
- Orbital bony deformity
- Intraorbital deformity

Fractured Nose - prior to control of bleeding, you must determine that there is no cerebral spinal fluid escaping. If fluid is escaping, treat as a skull fracture. Signs and symptoms will include blood or CSF from the nose and bruising.

9. **TREATMENT OF FACIAL INJURIES**

Soft tissue injuries

- Consider C-spine
- Assess and secure airway
- Hemorrhage control
- Fluid resuscitation protocol for associated shock

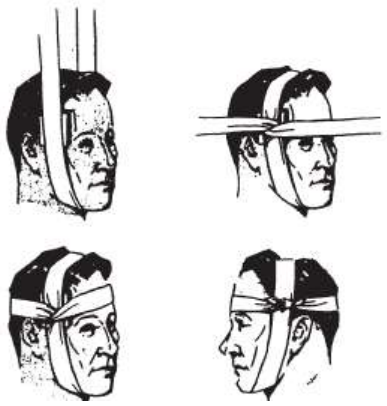

**Figure 12. Modified Barton Bandage**

Bone injuries

- Maintain open airway. Consider use of Nasopharyngeal Airway (NPA) (see figure 11)
- Control hemorrhage
- **NO PAIN MEDICATIONS!**
- Cold pack
- Modified Barton bandage for mandibular fracture (see figure 12)
- TACEVAC

**Figure 11. Nasophryngeal Airway (NPA)**

Eye injuries

- In combat, only patch the affected eye. Member can function effectively with one eye. Member becomes a litter patient if both eyes are covered.
- If the injury to the eye is clearly a minor one, the best advice is to REFRAIN FROM INTERFERENCE. A minor eye injury improperly cared for can easily become a major eye injury.

Treatment of penetrating eye injuries

- Check casualties vision
- Cover eye immediately with a rigid eye shield – NOT a pressure patch
- Have casualty take 400 mg moxifloxacin in his/her Combat Pill Pack
- Give IV/IM antibiotics if unable to take PO meds

Treatment for chemical burns of the eye

- Hold the face under running water with eyes open (see figure 13)
- Flush eyes 5-10 minutes for acid burns
- Flush eyes 20 minutes for alkali
- TACEVAC

**Figure 13. Irrigating The Eye**

Treatment for thermal burns of the eye

- Cover eye with loose dry dressing

Treatment for light injuries

- Cover eye with loose dressing (see figure 14).

Treatment for impaled object

- Make thick dressing and cut hole in center the size of eye opening
- Pass dressing over impaled object (see figure 15)
- Position crushed cup over dressing and bandage in place
- Elevate head to decrease intraocular pressure

**Figure 14. Simple Cravat Bandage For The**

Treatment for lacerations involving the eye

- If only eyelid is lacerated, direct pressure or a pressure dressing will stop bleeding.
- If the eyeball itself is lacerated, do not use pressure, but cover with a loose dressing.

Treatment for protruding globe

- DO NOT attempt to place eye back in socket
- Apply bulky dressing around eye, moist gauze over the globe and cover with a cup secured in place.

**Figure 15. Dressing Over Impaled Object**

Treatment of nose injuries

- Hemorrhage Control
- Pinching nostrils. (Do not tilt patient head back due to postnasal drainage)
- Apply ice to bridge of nose
- Splint by padding
- Monitor and TACEVAC

**CASUALTY ASSESSMENT AND THE HEAD, NECK, AND FACE**

**Care Under Fire Phase:** In the absense of life-threatening hemorrhage from the Head, Neck, or Face, the material in this section is unlikely to be performed in Care Under Fire phase.

**Tactical Field Care Phase:** During Tactical Field Care you will be required to inspect the head, neck, and face for any signs of injury. This includes looking for bone deformity and soft tissue injuries, signs of closed head trauma, and also consider the possibility of Traumatic Brain Injury (TBI). Don BSI. You must visually inspect the eyes, ears, nose, and throat. Assess the 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 Tactical Fluid Resuscitation lesson) and give fluids if necessary. If a head injury is suspected, it is NOT recommended to give casualty fluids by mouth. Consider pain medications and give antibiotics, if warranted. Reassess all care provided. Document care given, prevent hypothermia, and TACEVAC.

**REFERENCE**

Prehospital Trauma Life Support, current Military Edition

Head, Neck, and Face Review

1. Identify the function of the Cerebellum.

2. List the six key points for treatment of a neck wound.

3. List the appropriate treatment for a single eye injury in a combat situation.

4. What is the hallmark sign of a concussion.

**UNITED STATES MARINE CORPS**
FIELD MEDICAL TRAINING BATTALION
BOX 555243
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FMST 410

# Tactical Fluid Resuscitation

## TERMINAL LEARNING OBJECTIVE

1. Given a casualty, equipment and supplies, **start fluid resuscitation** reducing the risk of further injury or death. (8404-MED-2007)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **define medical terminology associated with fluid resuscitation**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007a)

2. Without the aid of reference, given a description or list, **identify the routes for giving fluid**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007b)

3. Without the aid of reference, given a description or list, **identify the different types of IV solutions**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007c)

4. Without the aid of reference, given a description or list, **identify how to properly administer IV fluids**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007d)

5. Without the aid of reference, given a description or list, **identify the potential complications of initiating IV therapy**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007e)

6. Without the aid of reference, given a description or list, **identify how to properly administer intraosseous (IO) fluids**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007f)

7. Without the aid of reference, given a description or list, **identify potential complications of initiating an intraosseous device**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2007g)

8. Without the aid of reference, given a patient and a Corpsman Assault Pack, **initiate peripheral IV access**, with successful infusion, per the Performance Examination Checklist. (8404-MED-2007h)

9. Without the aid of reference, given a training aid and a Corpsman Assault Pack, **initiate intraosseous access in order to infuse fluid**, to prevent further injury or death, per the Performance Examination Checklist. (8404-MED-2007i)

## INTRODUCTION

In civilian settings, it is common practice to establish intravenous (IV) access in all individuals who have suffered significant trauma in the prehospital setting. In tactical military settings, this practice has a number of disadvantages such as imposing costs in both time and equipment. The practice of starting IV access on all casualties preemptively had been outdated by the availability of intraosseous (IO) techniques.

In this lesson, we will discuss the principles of fluid resuscitation in a tactical situation and the decision making process of when to give fluids by mouth, through an IV or through the intraosseous route. Finally, we will discuss what types of fluids and how much fluid to give to a casualty on the battlefield.

## 1. TERMINOLOGY

**Homeostasis** - a state of physiological equilibrium produced by a balance of functions and chemical composition within the body. Homeostasis is usually maintained as long as the fluid volume and chemical composition of the fluid compartments stay within narrow limits or within a state of equilibrium.

**Electrolyte** - an element or compound that, when melted or dissolved in water or another solvent, disassociates into ions and is able to carry an electric current. Fluids containing these electrolytes and water are called crystalloids.

**Crystalloids** - aqueous solutions of mineral salts or other water-soluble molecules. This solution does not have oxygen carrying or blood clotting capabilities.

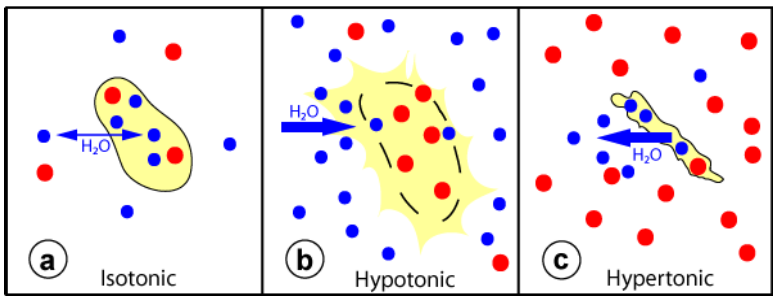
**Colloids** - contain larger insoluble molecules, such as gelatin; blood itself is a colloid. These solutions are all hypertonic in nature.

**FYI…Both muscle tissue and neurons are considered electric tissues of the body. Muscle contraction is dependent upon the presence of calcium ($Ca^{2+}$), sodium ($Na^{+}$), and potassium ($K^{+}$). Without sufficient levels of these key electrolytes, muscle weakness or severe muscle contractions may occur.**

**Isotonic** - a solution that triggers the least amount of water movement from the vascular system in to or out of the cells or surrounding tissue

**Hypotonic** - a solution that causes water to leave the vascular system and enter the cells or surrounding tissue compartments

**Hypertonic** - a solution that draws water from the surrounding cells and tissue compartments back into the vascular system.



2. **ROUTES FOR FLUID RESUSCITATION**

**Figure 1. Casualty with Abdominal Wound Drinking Water**

**Oral Hydration** - Trauma surgeons attached to forward-deployed Medical Treatment Facilities (MTFs) have noted that many casualties are kept on nothing by mouth (NPO) status for prolonged periods in anticipation for eventual surgery. Patients in a combat environment often operate in a state of mild dehydration. Once injured, they can easily develop greater levels of dehydration. The combination of dehydration and hemorrhage greatly increases the risk of mortality. There is very little evidence of emesis during surgery of patients that received oral hydration following injury. Therefore, oral fluids are recommended for all casualties with a normal level of consciousness and the ability to swallow, including those with penetrating torso trauma (see figure 1).

Indications

Injured casualty with normal level of consciousness and ability to swallow

Contraindications

Decreased level of consciousness

**Intravenous Access** - If the casualty does not have a normal level of consciousness, the care provider may start fluid resuscitation by the IV or IO method.

Indications

- Uncontrolled hemorrhage
- Diarrhea or vomiting
- Burns
- Unable to tolerate fluids by mouth
- To give IV medications

Contraindications

- Absence of signs and symptoms of the above indications

**Intraosseous Access** - Battlefield casualties may have a traumatic amputation precluding IV access in an extremity. An IO device offers an alternate route for the administration of fluids in these types of casualties. This device is not meant to replace IV infusion; it is to be used when IV access cannot be obtained.

Indications

- Unable to obtain IV access

Contraindications

- Absence of signs and symptoms of the above indications

3. **TYPES OF INTRAVENOUS SOLUTIONS**

There are several fluid resuscitation strategies used for the management of trauma patients. The primary methods we will discuss are:

- Large volumes of crystalloid
- Colloid solutions
- Whole blood or blood products

**Crystalloids** - Solutions that are isotonic are effective for volume replacement for a short period of time. These solutions do not have any oxygen carrying capacity and contain no proteins. Within 30 to 60 minutes after administration, only about 1/4 to 1/3 remains in the cardiovascular system. The remainder becomes edema in the soft tissues and organs.

**FYI…A casualty infused with 1000 ml of LR will only have 200 ml remaining in the vascular system after 1 hour.**

The rule of thumb is that most patients with hemorrhagic shock generally receive adequate crystalloid resuscitation when about 300 ml has been infused for every 100 ml of lost blood volume. The two most common crystalloids used in the treatment of shock are Lactated Ringer's (LR) and Normal Saline (NS).

LR - the crystalloid solution of choice for the management of shock because its composition is most similar to blood plasma. It contains specific amounts sodium, potassium, calcium, chloride and lactate ions.

NS - an acceptable alternative solution with 0.9% sodium chloride (NaCl)

**Colloids** - Synthetic colloid solutions draw fluid from the interstitial and intercellular spaces into the intravascular space, thereby producing volume expansion larger than the volume of fluid that was infused. This effect is sustained for 8 hours. These solutions do not transport oxygen. **Hextend is the fluid of choice for volume replacement due to trauma in a tactical situation.**

Hextend - Synthetic colloid solution used as a volume expander. Benefits are that it is a smaller, lighter package that is easily carried and it improves perfusion without overloading the patient with a crystalloid solution.

For casualties in shock (defined by a weak or absent peripheral pulses or altered mental status in the absence of brain injury) bolus 500 ml Hextend. If no improvement is noted in 30 minutes, administer another 500 ml. Do not use more than 1,000 ml.

For casualties suffering from both shock and Traumatic Brain Injury (TBI), give fluids only until the radial pulse is restored (titrate).

**Whole Blood** - Because of its ability to transport oxygen, blood is the fluid of choice for severe hemorrhagic shock. Unfortunately this is impractical for first responder care due to issues of blood typing and refrigerator. Blood and blood products are typically available at the forward resuscitative care capability (i.e. Medial Battalion). In combat, type O-negative (universal donor) is supplied and can be given without prior cross-typing.

| *Not in Shock*<br>*(Normal peripheral pulse and mentation)* | *In Shock*<br>*(Altered mental status and weak or absent peripheral pulse)* | *Traumatic Brain Injury (TBI) and weak or absent pulse* |
|---|---|---|
| **- IV Fluids are not needed.**<br>**- If the casualty is conscious, he can drink fluids.** | **- Administer a 500mL IV bolus of Hextend.**<br>**- If after 30 minutes the casualty is still in shock, administer another 500mL IV bolus of Hextend.**<br>*** Do not administer more than 1000mL of Hextend.**<br>**- If shock continues, decide whether to continue resuscitation depending on the logistical and tactical situation.** | **- Altered mental status cannot be used as clinical guideline for shock.**<br>**- Resuscitate to restore the radial pulse.** |

## 4. EQUIPMENT REQUIRED TO INITIATE A PERIPHERAL IV

While there is no standardized set of equipment, there are certain items needed to start an IV. It will be your responsibility to have these items together and "ready to go" if needed in a hasty situation.

### Equipment

Needle/catheter - 18 gauge catheter preferred in the field setting due to ease of insertion

IV Solution - based on the needs of the casualty

Administration set - many different types used; be familiar with your specific equipment

Constriction band - distends the veins to make access easier

Alcohol - or betadine prep pads to cleanse the site

Tape - to secure the catheter in place; tegaderm can be used

### Initiating a Peripheral IV

You have all started IV's in the past. Below is a review of what steps to take when inserting an IV. You will all have a chance to start an IV in the practical application at the end of the lesson.

1) Determine the need for fluid replacement
2) Assemble and check equipment
3) Prepare the patient
4) Select and cleanse site
5) Insert IV
6) Remove constriction band

7) Connect the fluid administration set
8) Administer fluid
9) Secure the IV

## 5. POTENTIAL COMPLICATIONS OF IV THERAPY

No medical treatment is without risk. As a care provider, your first priority is to do no harm. With that said, there are times when your best treatment will result in outcomes that were not desired. Listed below are the most common complications of IV therapy and their treatment.

**Infiltration** (see figure 2) - escape of fluid from the vein into the tissue when the needle/catheter dislodges from the vein.

**Figure 2. Infiltration**

Symptoms

- Edema
- Localized pain or discomfort
- Coolness to touch at the site of cannulation
- Blanching of the site
- IV flow slows or stops

Treatment

- Discontinue IV
- Select an alternate site
- Apply a warm compress to the affected area
- Elevate the limb

Prevention

- Secure the catheter properly
- Limit movement of the limb

**Phlebitis** (see figure 3) - inflammation of a vein due to bacterial, chemical, or mechanical irritation.

Symptoms

- Pain along the course of the vein
- Redness appears as a streak above vein and above the IV site
- Warm to touch
- Vein feels hard or cordlike

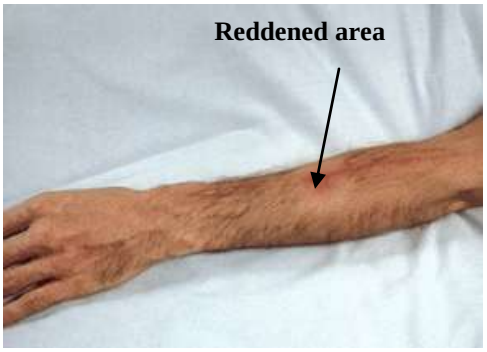



**Figure 3. Phlebitis**

Treatment

- Discontinue IV
- Warm compress to the affected area
- Antibiotics

Prevention

- Ensure aseptic technique when starting IV
- Place date/time when catheter was inserted on the tape
- Rotate infusion sites based on local policies (usually every 72 hours)

**Circulatory Overload (systemic)** - an effect of increased fluid volume which can lead to heart failure and pulmonary edema as a result of infusing too much IV fluid or too rapidly.

Symptoms

- Headache
- Venous distention
- Dyspnea
- Increased blood pressure
- Cyanosis
- Anxiety
- Pulmonary edema

Treatment

- Slow down the flow rate
- Place patient in High Fowlers position

Prevention

- Monitor and control flow rate

**Air Embolism** - air circulating in the blood when introduced through IV tubing.

Symptoms

- Cyanosis
- Hypotension
- Weak and rapid pulse
- Shortness of breath
- Tachypnea

Treatment

- Place patient on left side in Trendelenburg position, so that air in the right ventricle floats away from the pulmonary air flow tract.
- Administer oxygen
- Notify Medical Officer
- Monitor vital signs

Prevention

- Flush IV line thoroughly to remove air prior to insertion
- Monitor tubing during therapy
- Avoid introducing air through any syringe or extension tubing

**Systemic Infection** (see figure 4) - due to poor aseptic technique or contamination of equipment.

**Figure 4. Infection caused by IV**

Symptoms

- Sudden rise in temperature and pulse
- Chills and shaking
- Blood pressure changes

Treatment

- Look for other sources of infection
- DC IV and restart in other limb
- Notify MO and anticipate antibiotic treatment

Prevention

- Ensure aseptic technique when starting IV
- Place date/time when catheter was inserted on the tape
- Rotate infusion sites based on local policies (usually every 72 hours)

## 6. INTRAOSSEOUS FLUID ADMINISTRATION

### Overview

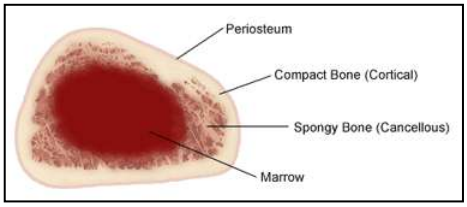



**Figure 5. Cross Section of Bone**

IO infusion devices provide a quick (can be placed in 60 seconds), reliable fluid access when peripheral IVs cannot be started. IO infusion is the medical process of getting fluids, emergency drugs, and even blood into a patient's circulatory system by delivering them into the marrow space inside a bone (see figure 5). The IO space is a specialized area of the vascular system where blood flow is rapid and continues even during shock. Drugs and fluids infused via the IO route reach the central circulation as quickly as those administered through standard IV access.

### Anatomy

The sternum consists of the manubrium, the body and the xiphoid process (see figure 6). At the top of the manubrium is the jugular notch, which is used as a reference point for intraosseous placement. The sternum makes an ideal IO site for several reasons:

- It is very easy to locate and readily accessible
- It is protected from trauma by the flak vest
- It is thinner and easier to penetrate than other bones.
- Most importantly, fluids infused into the sternum reach the circulatory system more rapidly.

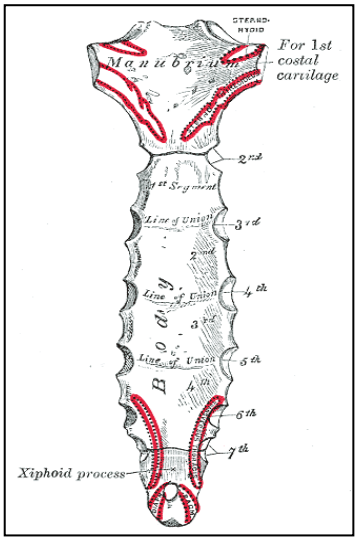



**Figure 6. Sternum**

## Equipment

There are several different manufactures of IO devices. The Committee on Tactical Combat Casualty Care (CoTCCC) concluded that the First Access for Shock and Trauma (FAST1) is the IO device best suited for trauma care on the battlefield. Features such as speedy access, a protected infusion site, and a depth-control mechanism make the FAST1 ideal for emergency use.

## Components of the FAST1

Target/Strain-Relief Patch (see figure 7)

The Target/Strain-Relief Patch is a foam patch with an adhesive back. The key features of the patch are the locating notch, a hole indicating the target zone, a band of Velcro fastening, and a connector tube with a female luer on each end. The patch is placed on the patient with the locating notch matching the patient's jugular notch and the target zone over the patient's midline. The adhesive backing prevents the patch from becoming displaced. The target zone, a circular hole, indicates the location of the designated insertion site.

**Figure 7. Target/Strain-Relief Patch**

Introducer (see figure 8)

The introducer is a hand-held tool. The bone probe cluster, stylet, infusion tube, and depth control mechanism are mounted inside the introducer handle. The bone probe needles are covered by a plastic sharps cap that is removed before use. The introducer allows the operator to push the flexible infusion tube through the skin, tissue, and anterior cortical bone of the manubrium. The force required to penetrate the bone is provided entirely by the operator, it is not spring loaded or battery operated. The depth control mechanism automatically separates the infusion tube from the Introducer body at a pre-set depth, preventing the operator from over or under penetrating the patient's bone.

**Figure 8. The Introducer**

Infusion Tube (see figure 9)

The Infusion Tube is the primary component of the FAST1 System. It consists of a steel portal (the sharp tip which penetrates the bone), a length of flexible infusion tubing, and luer connector. When the tube is inserted by the introducer, the steel portal penetrates the anterior cortical bone of the manubrium. After insertion, the fluid delivery port is within the marrow space of the bone. The entire steel portal is subcutaneous. The tubing delivers drugs or fluids into the manubrial marrow space. The flexibility of the tubing allows it to move with the patient's skin. The Infusion Tube is connected to the fluid source via the connector tube on the patch.

**Figure 9. Infusion Tube**

Protector Dome (see figure 10)

The Protector Dome is a clear plastic cover with Velcro fastening, which mates with the ring on the Target/Relief Patch. After drugs or fluids have begun to flow into the patient, the Dome is placed over the patch. The Velcro secures the dome in position over the site. This is the final step in placing the FAST1 system. The dome covers and protects the infusion site.

**Figure 10. Protector**

Sharps Protection (see figure 11)

Before use, the bone probe cluster and stylet are covered by a clear plastic Sharps Cap. After use, the retracted bone probe needles and stylet tip are pushed into the foam-filled Sharps Plug. This reduces the risk of accidental needle stick injury. For additional protection, the pre-use cap should be placed over the post-use plug once the needles have been fully inserted into the plug.

**Figure 11. Sharps Protection**

**SEQUENCE FOR INITIATING THE FAST1**

a. Cleanse insertion site using aseptic technique.

b. Align finger with jugular notch and place patch, verifying patch is midline.

c. Place Introducer in target on patch. Hold with a firm grasp.

d. Insert Introducer perpendicular to the manubrium. Use continuous increasing pressure to insert.

e. Remove Introducer. Pull straight back.

f. Connect Infusion Tube to Target Patch Tube.

g. Cap introducer using post-use cap supplied.


h. Connect to I.V. tubing.

i. Place Dome once all items are connected.

Points to remember when inserting the FAST1

1. Don't pull back and re-push.
2. Don't use extreme force.
3. Insert Introducer perpendicular to sternum.

## 7. POTENTIAL COMPLICATIONS OF THE FAST1 INSERTION

**The sternal notch cannot be located.**

Probable Cause: Extreme obesity or abnormal sternal anatomy.

Recommended Action: Abort the procedure. Proper targeting requires accurate location of the patient's sternal notch. Employ an alternative method of vascular access.

**The patch has been incorrectly placed.**

Probable Cause: Operator error during application, movement of the skin over the manubrium during application, or patient movement after placement.

Recommended Action: Return the patient to his/her original position. If the patch is still incorrectly positioned, remove it and reposition. During placement, ensure that the skin over the sternum is not stretched away from its normal position.

**The patch will not adhere to the skin.**

Probable cause: Wet skin or thick body hair.

Recommended Action: Shave or dry skin and clean using aseptic technique. The patch can also be taped down using the extended tabs. If the Patch becomes detached during use, it should be taped to the skin.

**The Bone Probe Cluster is fully pushed in, but the Introducer does not release.**

Probable Cause: Excessively thick tissue, extreme misplacement, or irregular anatomy.

Recommended Action: Pull Introducer back; the Infusion Tube may be in place, although the Introducer could not release due to tissue thickness. Verify by withdrawing marrow, and proceed. Re-attempt with a new FAST1. If second attempt fails, seek alternative method of vascular access.

**Introducer does not release with high applied force.**

Probable Cause: Extreme bone hardness or technique error.

Recommended Action: Without pulling back on the Introducer, check that the Introducer is perpendicular to the manubrium surface and that force is being applied directly along the Introducer axis. Some patients may have a very hard bone; if control of the Introducer cannot be maintained, find alternate method of vascular access.

**The Introducer releases but the Infusion Tube falls out of the patient.**

Probable Cause: The Infusion Tube did not adequately penetrate the anterior cortical bone of the manubrium due to excessive tissue thickness or very hard bone.

Recommended Action: Re-attempt with a new FAST1 device.

**Low or no flow through Infusion Tube.**

Probable Cause: There is a severe kink in the tubing, there is a line blockage, or the portal failed to penetrate the manubrium.

Recommended Action: Check for kinked tubing. If no kink can be found, attempt to clear the line by pushing in 10 cc's of fluid. If this fails to improve the flow rate, use an alternative method of vascular access.

**Leakage at the insertion site.**

Probable Cause: Fluids are leaking from inside the manubrium past the tip of the Infusion Tube.

Recommended Action: A small amount of leakage sometimes occurs and is commonly acceptable in IO infusion. The operator must judge whether the patient is receiving an adequate amount of drugs or fluids. If leakage is excessive, an alternative method of vascular access should be used.

**CASUALTY ASSESSMENT AND FLUID RESUSCITATION**

**Care Under Fire Phase:** The material in this section is unlikely to be addressed in Care Under Fire.

**Tactical Field Care Phase:** Knowing when it is necessary to start an IV or IO is critical in the Casualty Assessment process. Using the PO route when available saves you time by not starting unnecessary IVs on casualties that do not need it and saves valuable resources for casualties who do. Using the "minimal fluid resuscitation" technique also increases the casualty's chances of survival by not overloading them with unnecessary fluid. Remember to don proper BSI when performing fluid resuscitation.

**REFERENCES**

FAST1 Intraosseous Infusion System for Adult Patients User's Manual, Pyng Medical Corp
Prehospital Trauma Life Support, current Military Edition

**Field Medical Training Battalion**

# INTRAVENOUS FLUID RESUSCITATION PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT** (Rank, Last Name, First Name) | **PLT** |
|---|---|
| | |

| **PROCEDURAL STEPS FOR PERFORMING AN IV STICK** | **1ST** | | **2ND** | | **3RD** | |
|---|---|---|---|---|---|---|
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Determine the need for fluid replacement (i.e. uncontrolled hemorrhage, diarrhea/vomiting, burns, unable to tolerate fluids by mouth, to give IV meds) | | | | | | |
| Assemble and check equipment (18g needle/catheter, IV solution, administration set, tape, constriction bandage, alcohol, 2x2 gauze, gloves) | | | | | | |
| Prepare patient & select site | | | | | | |
| Cleanse site | | | | | | |
| *** Insert IV** | | | | | | |
| *** Remove constriction band** | | | | | | |
| Connect fluid administrative set | | | | | | |
| *** Administer fluid and monitor flow** | | | | | | |
| Secure IV | | | | | | |
| Discontinue IV | | | | | | |

| **GRADING CRITERIA** | **1ST** | **2ND** | **3RD** |
|---|---|---|---|
| **Total Non-Critical Items (3 or greater constitutes a failure)** | | | |
| **Total Critical Items (Any critical items missed constitutes a failure)** | | | |
| **"Stop & Think" (2 allowed for critical items, third constitutes a failure)** | | | |

| **1st Evaluator:** | **2nd Evaluator:** | **3rd Evaluator:** |
|---|---|---|
| **PASS / REM** | **PASS / REM** | **PASS / FAIL** |
| **Student signature:** | **Student signature:** | **Student signature:** |
| **Notes:** | **Notes:** | **Notes:** |

**Field Medical Training Battalion**

# INTRAOSSEOUS FLUID RESUSCITATION PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT (**Rank Last Name, First Name) | **PLT** |
|---|---|
| | |

| **PROCEDURAL STEPS FOR PERFORMING AN INTRAOSSEOUS FLUID RESUSCITATION** | **1ST** | | **2ND** | | **3RD** | |
|---|---|---|---|---|---|---|
| | **P** | **F** | **P** | **F** | **P** | **F** |
| *** State reason for selecting to perform IO procedure.** | | | | | | |
| Assess patient and make decision to perform IO | | | | | | |
| Assemble and check equipment (alcohol, FAST1 Kit) | | | | | | |
| Cleanse insertion site using aseptic technique. | | | | | | |
| * **Align finger with jugular notch and place patch verifying patch is midline.** | | | | | | |
| Place introducer in target area on patch; hold with a firm grasp. | | | | | | |
| * **Insert introducer perpendicular to manubrium; use continuous increasing pressure to insert.** | | | | | | |
| Remove introducer by pulling straight back. | | | | | | |
| * **Connect infusion tube to target patch; connect IV tubing.** | | | | | | |
| Place dome over infusion tube and secure. | | | | | | |

| **GRADING CRITERIA** | **1ST** | **2ND** | **3RD** |
|---|---|---|---|
| **Total Non-Critical Items (3 or greater constitutes a failure)** | | | |
| **Total Critical Items (Any critical items missed constitutes a failure)** | | | |
| **"Stop & Think" (2 allowed for critical items, third constitutes a failure)** | | | |

| 1st Evaluator: | 2nd Evaluator: | 3rd Evaluator: |
|---|---|---|
| PASS / FAIL | PASS / FAIL | PASS / FAIL |
| Student signature: | Student signature: | Student signature: |
| Notes: | Notes: | Notes: |

Tactical Fluid Resuscitation Review

1. What is the definition of an isotonic solution?

2. What is the preferred fluid resuscitation route for a patient with a normal level of consciousness and the ability to swallow?

3. What is the indication for using the intraosseous route?

4. What are the two most common crystalloids used in the treatment of shock?

5. What is the fluid of choice for a trauma patient in a tactical situation?

6. What gauge needle/catheter is used for IVs in the field setting?

7. Name three potential complications of IV therapy.

8. What is used as a reference point (landmark) for intraossesous placement?

**UNITED STATES MARINE CORPS**
FIELD MEDICAL TRAINING BATTALION
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FMST 411

# Perform Casualty Assessment

## TERMINAL LEARNING OBJECTIVE

1. Given a patient in an operational environment, **perform patient assessment** to identify chief complaint and initiate proper treatment within the scope of care. (8404-MED-2011)

## ENABLING LEARNING OBJECTIVES

1. Without the aid of reference, given a description or list, **identify the procedures for Care Under Fire**, within 80% accuracy, per the Prehospital Trauma Life Support Manual, current Military Edition. (8404-MED-2011a)

2. Without the aid of reference, given a description or list, **identify the procedures for Tactical Field Care**, within 80% accuracy, per the Prehospital Trauma Life Support Manual, current Military Edition. (8404-MED-2011b)

3. Without the aid of reference, given a description or list, **identify the procedures for Tactical Evacuation**, within 80% accuracy, per the Prehospital Trauma Life Support Manual, current Military Edition. (8404-MED-2011c)

4. Without the aid of reference, given a casualty and a Corpsman Assault Pack, **perform casualty assessment**, to prevent further injury or death, per the Prehospital Trauma Life Support Manual, current Military Edition. (8404-MED-2011d)

## OVERVIEW

Casualty Assessment (CASAS) is a systematic process for assessment of the trauma casualty and is essential for recognizing life-threatening conditions, identifying injuries, and determining priorities of care based on assessment findings. Using this systematic approach you will be able to assess, prioritize, and treat each trauma casualty and ensure injuries are not missed.

This lesson will go through all the steps of a complete CASAS; however you will not use every step, every time. The number of steps you complete is based on the tactical situation, the casualty and the time and resources available.

## 1. PHASE 1 – CARE UNDER FIRE

During this phase, the Corpsman and casualty are still under hostile fire. **The first step in saving a casualty is usually to control the tactical situation**. Very limited medical care should be attempted while the casualty and the unit are under hostile fire. Suppression of hostile fire and moving the casualty to a safe position are major considerations at this point. Remember: "The best medicine on the battlefield is fire superiority." Casualties who have sustained injuries that are not life threatening and have the ability to help should continue to assist in suppressing the hostile fire. It may also be critical for you to help suppress hostile fire before attempting to provide care.

Casualties whose wounds do not prevent them from moving to cover should do so to avoid exposing other care givers to unnecessary hazard. If the casualty is unable to move and is unresponsive, the casualty is likely beyond help. Risking the lives of rescuers is not advised. If a casualty is responsive and unable to move, a rescue plan should be developed as follows:

- Determine the potential risk to the rescuers. Did the casualty trip a booby trap or mine? Where is fire coming from? Is it direct or indirect? Are there electrical, fire, chemical, water, mechanical, or other environmental hazards?
- Consider assets. What can rescuers provide in the way of covering fire, screening, shielding, and rescue equipment?
- Make sure all understand their role in the rescue and which movement techniques are to be used (i.e., drag, carry, rope, stretcher). The fastest method for moving a casualty in the Care Under Fire phase is the two person drag (see figure 1). This drag can be used in buildings, shallow water, snow, and down stairs.

**Figure 1. Two Person Drag**

- Management of an impaired airway is temporarily deferred until the casualty is safe, thereby minimizing the risk to the rescuer and avoiding the difficulty of managing the airway while dragging the casualty. Early control of severe hemorrhage is vital. However, the tactical situation dictates that you must maintain firepower supremacy so **only life-threatening bleeding warrants any intervention during Care Under Fire**.

**S**ituation - Determines tactical situation. Return fire to suppress hostile fire. Direct and expect the casualty to return fire if capable.

**H**elp - Verbally direct casualty and/or buddy to apply tourniquet if casualty and rescuer are separated

**I**njury - Determines MOI if possible

**P**atient quantity - Determines the number of patients vs. supplies. Is there need for triage? Are there Marines or other HMs available?

**S**pinal precautions (if warranted)

**L**evel

**O**f

**C**onsciousness - Mental Status – AVPU (A – Alert, V – Verbal commands, P – Painful stimuli, U – Unresponsive)

**M**anage hemorrhage

Identify life-threatening hemorrhage

Apply tourniquet

Move patient to safe location

Reassess tourniquet

***M.A.R.C.H acronym is used by CoTCCC to help remember all lifesaving intervintions in a systemic approach.**

**M: Massive Hemorrhage**
**A: Airway**
**R: Respirtations**
**C: Circulation**
**H: Head Truma/Hypothermia**

2. **PHASE 2 - TACTICAL FIELD CARE**

During this phase, the Corpsman and casualty are no longer under hostile fire. This also applies to situations in which an injury has occurred on a mission, but hostile fire has not been encountered. However, medical equipment is still limited. Medical care during this phase is directed towards more in-depth evaluation and treatment of the casualty, focusing on those conditions not addressed during the Care Under Fire phase of treatment. While the casualty and rescuer are now in a somewhat less hazardous situation, evaluation and treatment is still dictated by the tactical situation. **Casualties who show signs of an altered mental status should be disarmed immediately.**

Airway Assessment

Casualties that are conscious and can talk, scream, or yell can be presumed to have a patent airway. For unconscious casualties, initial attempts to open the airway should be done using the trauma jaw thrust (for casualties whom you suspect C-spine injury) or trauma chin lift.

Once the airway is open, visually inspect for anything that may potentially cause obstruction. Examples include broken teeth, blood, vomit or tissue swelling. Remember the most common cause of airway obstruction in an unconscious casualty is the tongue.

Clear any obstructions with a finger sweep and **insert a nasopharyngeal airway (NPA) to keep the airway open.** Reassess your interventions to ensure the casualty has an open airway. The standard method of "Look, Listen and Feel" can be used to ensure the patient is breathing. If the previously mentioned methods fail to establish an airway, surgical cricothyroidotomy is indicated.

Remember to **reassess any intervention performed** to determine the effectiveness of the procedure performed. Regardless of the method used to establish an airway, you must also judge the quality and adequacy of the ventilations.

Respiration

The goal of this step is to rule out chest wounds that either have become, or could potentially develop into, a tension pneumothorax. **Needle thoracentesis is indicated if the casualty has difficulty breathing and penetrating trauma to the chest area.**

FYI!!! If a casualty is found to be in cardiopulmonary arrest on the battlefield as a result of combat trauma, CPR is NOT recommended.

The only way for you to identify penetrating trauma is to EXPOSE the area. This includes removing tactical gear such as flak jackets and uniform tops. Once exposed you may also discover larger wounds, such as sucking chest wounds, that will need to be treated with an occlusive dressing before moving on to the next step in the casualty assessment process. Inspecting the area includes looking at the posterior. Examining the posterior is not simply the back; remember that rectal bleeding is a sign of internal hemorrhage. This should be checked as well. **Reassess ALL interventions following a log roll!**

Needle decompression should provide immediate relief. An occlusive dressing should not make a sucking sound upon inspiration.

Circulation

Check for the presence and quality of pulses. Determining the presence and quality (weak / strong) of a radial pulse will affect decisions made later during casualty assessment.

Perform a blood sweep of the casualties entire body by gently sliding your hands underneath the casualty and pulling them back, feeling for any bleeding that was not controlled during "Care Under Fire". Control it at this time.

Assess for the possibility of tourniquet conversion. Tourniquets that were placed due to the time constraints of "Care Under Fire" should be converted to a pressure dressing or Combat Gauze as appropriate. (See Hemorrhage Control lesson if you need to review.)

Head to Toe Assessment (**DCAP-BTLS**)

**D**eformities **C**ontusions **A**brasions **P**unctures

**B**urns **T**enderness **L**acerations **S**welling

Again, all life threatening injuries should have been identified and treated by this time. The goal at this stage is to identify and address any additional wounds. You may also identify signs or symptoms that will affect the long term evacuation or treatment of the patient as well. It is important that you carefully inspect the entire casualty. Using the head to toe method described below ensures you do not miss anything.

Head

Check the skull, eyes, ears, nose and mouth for any potential findings. At this time you should also reassess any treatments that have been performed.

Neck

Check the neck to include the C-spine for any irregularities. Jugular vein distension and tracheal deviation are very late signs of tension pneumothorax (a condition you should have treated earlier). If, however, these are encountered at this stage, perform a needle decompression immediately.

Chest

In addition to checking for DCAP-BTLS, you should also attempt to auscultate the chest if the tactical situation permits. Simple rib fractures and flail chest segments should be treated at this time. Reassess any previous treatments, including needle decompression or occlusive dressings, which may have already been performed.

Abdomen

In addition to inspecting for DCAP-BTLS you should also palpate for Tenderness, Rigidity or Distension. Abdominal eviscerations should be treated appropriately. Signs of internal hemorrhage, while not treatable on the battlefield, may affect your decision during tactical evacuation.

Pelvis

If the patient's pelvic area is obviously deformed, DO NOT PALPATE IT, as you will likely cause further instability and damage.

Extremities

Since you are already at the pelvis, palpate the lower extremities first then the upper extremities using the same process (DCAP-BTLS)

Note and treat any minor injuries not already addressed. Reassess any major interventions already performed, especially tourniquets or pressure dressing.

Consider Fluid Resuscitation

Casualties that do not exhibit signs of shock do not require and should not be given IV or IO fluid. They should be encouraged to drink fluids by mouth.

All casualties who exhibit signs of tactically relevant shock (weak pulse and/or altered level of consciousness) should have IV access started using an 18-gauge catheter. Consider the IO route for casualties who require fluid resuscitation but IV access can not be obtained. Administer enough fluid to restore a radial pulse. If giving Hextend, give 500 cc's, wait 30 minutes, and then give another 500 cc's if needed. Do NOT give more than 1000 cc's of Hextend to any patient.

Prevent Hypothermia


The Blizzard Rescue Blanket (NSN 6352-01-524-6932) comes in many colors, including tactical green. It is lightweight and extremely effective in preventing hypothermia.

At this point all life threatening issues should have been identified and treated. You should begin to take precautions against hypothermia. Preventing hypothermia is for more than just patient comfort, it is an important lifesaving step. Hypothermia interferes with the body's blood clotting mechanism and increases mortality.

As soon as all life-threatening injuries are addressed, the patient should have all of their wet clothing removed and replaced with dry clothes or a Blizzard Rescue Blanket. Unless prohibited by wounds, cover the head, as it is a prime source of heat loss. Good hemorrhage control and fluid resuscitation will also help restore the casualty's ability to generate heat.

Monitor Vital Signs

Pain Management

Conscious casualties who remain operationally engaged should be given Mobic (15mg PO qd) and Tylenol Bi-layer Caplet (650 mg 2 PO q8h).

Casualties who cannot continue to remain operationally engaged but have no need for an IV should be given Oral Transmucosal Fentanyl Citrate (OTFC) provided as a "lozenge on a stick" taped to their finger. Reassess the patient every 15 minutes for respiratory depression.

Those who are out of the fight and require an IV should be administered morphine 5mg (IV or IO). This can be given every 10 minutes as necessary. The patient should be monitored for signs of respiratory depression. You should have Naloxone (Narcan) on hand before administering either OTFC or morphine.

Promethazine (Phenergan) 25 mg IV/IO/IM may be administered to counteract the nausea associated with Morphine or OTFC.

Immobilization

Splint any extremities that need it.

Antibiotics

If the patient can tolerate oral medications, administer Moxifloxacin 400mg, PO qd. If not, administer either cefotetan (2g IM/IV/IO) or ertapenem (1g IM/IV/IO). (For more information on giving medications, see the medication appendix at the end of this block.)

Patient Turnover

Document the patient's initial wounds, treatments performed, and response to any treatments. Ensure this, along with the most recent set of vital signs, is transferred with the patient.

3. **PHASE 3 - TACTICAL EVACUATION CARE (TACEVAC)**

During this phase, casualties should be ready for transport to a higher level of care. Since casualty movement following Tactical Field Care may be either CASEVAC or MEDEVAC, the third phase of TCCC has been re-designated Tactical Evacuation Care to include both possibilities. This phase presents the opportunity to bring in additional medical equipment and personnel, allowing for expanded diagnostic and therapeutic measures.

Factors to be Considered

Casualty movement may be difficult up to this point. Improvised litters should be padded, and field-expedient materials should be replaced with conventional supplies as soon as possible.

Patients with torso trauma must be closely monitored during this phase. Expansion of the intrapleural gas may result in tension pneumothorax due to the lower pressure at altitude. All casualties with injuries that interfere with breathing, or have a low $O_2$ saturation should be given oxygen during TACEVAC.

Efforts to prevent heat loss and, if needed, to actively re-warm the casualty should continue during TACEVAC. The casualty must be aggressively protected against cold stress during the evacuation, given the potential for heat loss due to windchill and the lower temperatures encountered at altitude.

Documentation

The following should be documented and maintained with the casualty:

- All wounds received (location, severity, status)
- Treatments rendered (type of treatment, effectiveness)
- Responses (verbal, medication, etc.)

This is also an excellent time to document and maintain thorough vital signs.

- Pulse rate
- Respiratory rate
- Blood pressure
- $SPO_2$

Continual and thorough reassessment of the casualty is CRUCIAL at this point!

ZMIST REPORT

The ZMIST report is given on an individual casualty basis as a means to prioritize and lead to more effective treatment.

- Zap Number

  Given at the unit level, this number identifies the casualty, their gear and their personal information.

- Mechanism of Injury

  What caused the injury? IED blast? Gunshot wound?

- Injuries Sustained

  What is the extent of the injuries? Where are they located?

- Signs & Symptoms

  What signs and symptoms are the casualties showing?

- Treatments Rendered

  What treatments have been done? Are they effective? How are they performing?

**REFERENCE**

Prehospital Trauma Life Support (PHTLS), current Military Edition

**Field Medical Training Battalion**

# CASUALTY ASSESSMENT - TRAUMA
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| **STUDENT (**Last Name, First Name, MI.) | **PLT** |
|---|---|
| | |

| | 1ST | | 2ND | | 3RD | |
|---|---|---|---|---|---|---|
| **CARE UNDER FIRE** | **P** | **F** | **P** | **F** | **P** | **F** |
| *** Determines tactical situation. Return fire to suppress hostile fire. Direct and expect the casualty to return fire if capable.** | | | | | | |
| Verbally direct casualty and/or buddy to apply tourniquet if casualty and rescuer are separated | | | | | | |
| Determines MOI if possible | | | | | | |
| Determines the number of patients vs. supplies. Is there need for triage? Are there Marines or other HMs available? | | | | | | |
| Spinal Precautions (if warranted) | | | | | | |
| Level of Consciousness/Mental Status **–** AVPU<br>(A – Alert, V – Verbal commands, P – Painful stimuli, U – Unresponsive) | | | | | | |
| *** Identify and control external life threatening extremity hemorrhage** | | | | | | |
| *** Apply tourniquet** | | | | | | |
| * **Move patient off the "X"** | | | | | | |
| **TIME: (2 MINUTE MAX TIME LIMIT)** | **1ST** | | **2ND** | | **3RD** | |
| | | | | | | |
| **TACTICAL FIELD CARE**<br>**MASSIVE HEMORRHAGE / AIRWAY MANAGEMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| * **Reassess tourniquet / massive hemorrhage scan (anything missed on the "X" / unable to apply tourniquet on)** | | | | | | |
| Continually talks to patient to ensure airway | | | | | | |
| *** Opens airway with trauma jaw thrust or trauma chin lift** | | | | | | |
| *** Inspect mouth for potential obstructions and clears airway as required** | | | | | | |
| *** Look, listen, and feel (5- 10 Seconds)** | | | | | | |
| Insert appropriate airway adjunct | | | | | | |
| *** Reassess airway - Look, listen, and feel (5- 10 Seconds)** | | | | | | |

**Field Medical Training Battalion**

# CASUALTY ASSESSMENT - TRAUMA
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| RESPIRATORY MANAGEMENT | 1ST | | 2ND | | 3RD | |
|---|---|---|---|---|---|---|
| | P | F | P | F | P | F |
| *** Assess breathing (rate, rhythm, depth)** | | | | | | |
| *** Expose chest and inspect for life threatening wounds** | | | | | | |
| Palpate (Crepitus, fractured ribs, flail segments, subcutaneous emphysema) | | | | | | |
| ***Treat thoracic life threatening injuries** | | | | | | |
| *** Reassess or apply occlusive dressing** | | | | | | |
| *** Log roll and check for exit wounds (beware of spinal integrity)** | | | | | | |
| Posterior assessment (DCAP-BTLS) (Bright red blood in rectum) | | | | | | |
| *** Treat posterior life threatening wounds** | | | | | | |
| *** Ensures spinal integrity** | | | | | | |
| Place patient on litter or spine board if available | | | | | | |
| *** Needle thoracentesis** | | | | | | |
| *** Reassess all interventions** | | | | | | |
| **CIRCULATORY MANAGEMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| *** Assess for presence of carotid pulse** | | | | | | |
| *** Blood sweep (identify and treat major bleeding and/or reassesses prior interventions - head to toe)** | | | | | | |
| *** Assess for bilateral radial pulses (rate and quality)** | | | | | | |
| Estimate palpated blood pressure (Radial = systolic of 80 mmHg, femoral = systolic of 70 mmHg, carotid = systolic of 60 mmHg) | | | | | | |
| Peripheral Perfusion (Skin color, temperature, condition, and <2-3 Sec capillary refill) | | | | | | |
| IV fluid consideration (Based on vital signs, titrate to radial pulses) | | | | | | |
| **FULL BODY ASSESSMENT** **D**eformities, **C**ontusions, **A**brasions, **P**unctures**/P**enetrations, **B**urns, **T**enderness, **L**acerations, & **S**welling **(DCAP-BTLS)** | **1ST** | | **2ND** | | **3RD** | |
| **HEAD ASSESSMENT** | **P** | **F** | **P** | **F** | **P** | **F** |
| Skull (Inspects and palpates the scalp, skull & facial bones, Battle's sign) | | | | | | |

**Field Medical Training Battalion**

# CASUALTY ASSESSMENT - TRAUMA
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| HEAD ASSESSMENT (cont.) | 1ST | | 2ND | | 3RD | |
|---|---|---|---|---|---|---|
| | P | F | P | F | P | F |
| Ears (Blood, CSF, injury) | | | | | | |
| Eyes (PERRLA-EOMI, injury, raccoon eyes) | | | | | | |
| Nose (Blood, CSF, injury) | | | | | | |
| Mouth (Broken teeth, obstructions, odor) | | | | | | |
| **NECK ASSESSMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Posterior (Step offs, deviations) | | | | | | |
| Anterior (JVD, Tracheal deviation) | | | | | | |
| **ABDOMEN ASSESSMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Inspect (Pulsating masses, bruising, distention, and eviscerations) | | | | | | |
| Palpate – All (4) quadrants (Distension, rigidity, and facial grimace) | | | | | | |
| Treat / Reassess abdominal injuries | | | | | | |
| **PELVIS ASSESSMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Inspect (Bruising, obvious injury, meatus / perineum for blood) | | | | | | |
| Palpate (Squeeze medially and roll down pelvis to check for potential fractures) | | | | | | |
| Treat / Reassess pelvis injuries | | | | | | |
| **LOWER EXTREMITIES ASSESSMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Inspect (Obvious injuries) | | | | | | |
| Palpate (Bone crepitus, assess PMS {Movement/sharp/dull test /distal pulse}, note facial grimace) | | | | | | |
| Treat / Reassess lower extremity injuries / Split all fractures (Possible conversion of tourniquet to pressure dressing as indicated) | | | | | | |
| | | | | | | |

**Field Medical Training Battalion**

# CASUALTY ASSESSMENT - TRAUMA
# PERFORMANCE EXAMINATION CHECKLIST v3.0

| UPPER EXTREMITIES ASSESSMENT | 1ST | | 2ND | | 3RD | |
|---|---|---|---|---|---|---|
| | P | F | P | F | P | F |
| Inspect (Obvious injuries) | | | | | | |
| Palpate (Bone crepitus, assess PMS {Movement/sharp/dull test /distal pulse}, note facial grimace) | | | | | | |
| Treat / Reassess upper extremity injuries (Possible conversion of tourniquet to pressure dressing as indicated) | | | | | | |
| **REASSSESMENT** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| Consider pain medications PRN | | | | | | |
| Interventions, LOC, ABCs | | | | | | |
| **TACTICAL EVACUATION** / **OVERALL GENERAL IMPRESSION** | **1ST** | | **2ND** | | **3RD** | |
| | **P** | **F** | **P** | **F** | **P** | **F** |
| ZMIST report | | | | | | |
| Identify transport priority | | | | | | |
| Reassess fluid intervention requirements | | | | | | |
| **TIME: (12 MINUTE MAX TIME LIMIT)** | **1ST** | | **2ND** | | **3RD** | |
| | | | | | | |
| **Scenario** | | | | | | |
| **Total number of non-critical steps missed (Score greater than 10 constitutes a failure)** | | | | | | |
| **Critical steps missed (Any critical step missed constitutes a failure)** | | | | | | |

| **1st Evaluator:** | **2nd Evaluator:** | **3rd Evaluator:** |
|---|---|---|
| **PASS / FAIL** | **PASS / FAIL** | **PASS / FAIL** |
| **Student signature:** | **Student signature:** | **Student signature:** |
| **Notes:** | **Notes:** | **Notes:** |

Casualty Assessment Review

1. List and briefly describe the three phases of Tactical Combat Casualty Care (TCCC).

2. Management of a compromised airway would be taken care of during what phase of TCCC?

3. Briefly describe why prevention of hypothermia is so important for the casualty.

4. Describe why patients who can stay in the fight should not be given morphine.