UNITED STATES MARINE CORPS

FIELD MEDICAL TRAINING BATTALION
Camp Lejeune, NC 28542-0042

FMST 207

Manage Wounds

TERMINAL LEARNING OBJECTIVE

1. Given T/O weapon, supplies, and a casualty in a tactical environment, perform Tactical Combat Casualty Care to reduce the risk of further injury or death using correct interventions. (HSS-MED-2002)

ENABLING LEARNING OBJECTIVES

1. Without references, given a list, **identify the treatment for burns**, within 80% accuracy, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Edition, Current Edition. (HSS-MED-2002ai)

2. Without references, given a list, **identify the treatment required for penetrating eye trauma**, within 80% accuracy, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Edition, Current Edition. (HSS-MED-2002aj)

3. Without references, given a list, **identify the effects of blast injuries on the human body**, within 80% accuracy, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Editing, Current Edition.

4. Without references, given a list, **identify the management of soft tissue injuries**, within 80% accuracy, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Edition, Current Edition. (HSSMED-2002al)

5. Without references, given a list, **identify the management of abdominal injuries**, within 80% accuracy, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Edition, Current Edition. (HSSMED-2002am)

6. Without references, **treat a simulated evisceration**, IAW CoTCCC Guidelines, and the Pre-Hospital Trauma Life Support manual, Military Edition, Current Edition. (HSS-MED-2002an)

MARCH PAWS W FOR WOUND MANAGEMENT

1. ANATOMY OF THE SKIN

The most important function of the skin is to be a protective barrier against the outside environment. The skin also prevents fluid loss and helps regulate body temperature. Skin is composed of three layers: the epidermis, dermis, and subcutaneous tissue (see figure 1).

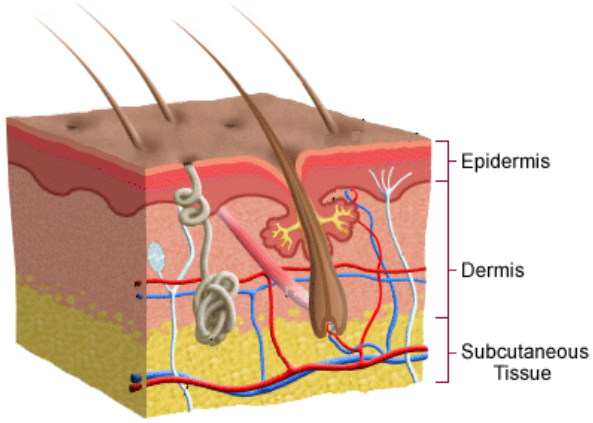


Figure 1. The skin

Epidermis -Composed of 5 stratae

- Basale
- Spinosum
- Granulosum
- Lucidum
  - Only present in the hands and the feet
- Corneum
  - Comprised of keratinized ('dead' cells)

Dermis - Primarily made up of dense irregular connective tissue that cushions the body from stress and strain

Contains:

- Mechanoreceptors (sense of touch)
- Thermoreceptors (sense of heat)
- Hair follicles
- Sweat glands
- Sebaceous glands
- Apocrine glands
- Lymphatic vessels
- Nerves
- Blood vessels

Subcutaneous Tissue - is a combination of elastic and fibrous tissue as well as fat deposits.
Mainly used for fat storage, thermoregulation, and shock Absorption
Contains:

- Fibroblasts (collagen and role in wound healing)
- Adipose Cells (fat cells)
- Macrophages (immune cells – phagocytosis)

2. DEGREE OF BURNS

The severity of a burn is determined by the depth of the burn and the extent of the total body surface area (TBSA) burned. The severity of all burns will vary depending on the source of the burn, duration of exposure, and location of the burn.

Depth: The depth of the burn is related to how deeply the skin is damaged (see figure 5). Estimation of burn depth can be deceptively difficult. Often, a burn that appears to be a partial-thickness burn (second degree) will prove to be third degree burn in 24 to 48 hours. Therefore it is often wise to withhold final judgment of burn depth for up to 48 hours after injury.

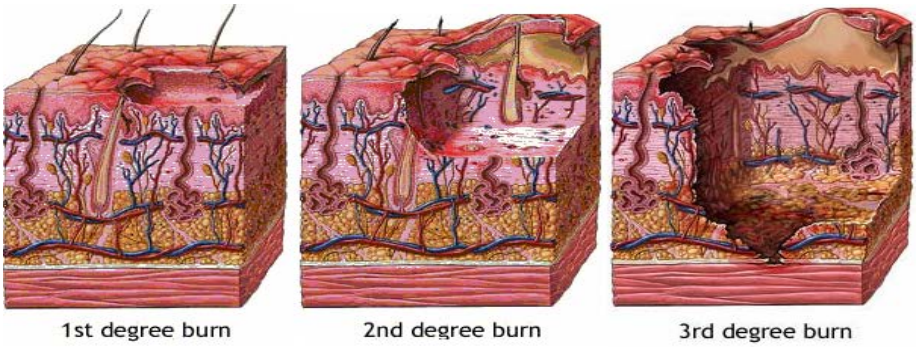


Figure 5. Depth of Burns

Superficial Burn/First-Degree Burn (see figure 6) - first-degree burns involve only the epidermis and are characterized as being red and painful. These wounds heal typically within a week and the casualty will not scar.

Signs and Symptoms:

- Dry, red and inflamed skin
- Painful to touch
- The burned area blanches with pressure
- Minimal swelling (if present)

Figure 6. First Degree burn

Figure 7. Second Degree Burn

Partial Thickness Burns/Second-Degree Burn (see figure 7) - burns that involve the epidermis and varying portions of the underlying dermis. Second-degree burns will appear as blisters or as denuded, burned areas with a glistening or wet appearing base. These wounds will be painful. Because remnants of the dermis survive, these burns are often capable of healing in 2 to 3 weeks.

Signs and Symptoms:
- Skin is moist, with reddened areas
- Blisters or open weeping wounds
- Deep, intense pain
- Edema will be moderate
- Fluid loss may be significant depending on the extent of the burn

Figure 8. Third Degree burn of lower leg

Full Thickness Burn/Third-Degree Burn (see figure 8) - third-degree burns involve all three layers of skin and may have several appearances. Most casualties will have pain because areas of third-degree burn are usually surrounded by second-degree burns.

- Signs and Symptoms:
  - Skin has a dry, leathery appearance
  - The skin can range in color from white, yellow, cherry red, brown, or charred
  - Severe pain around periphery of burn, but little to no pain near center of burn.
  - No capillary refill at affected area

Fourth-Degree/Complete Burn (see figure 9) - fourth-degree burns are those that not only burn all layers of the skin, but also burn underlying fat, muscles, bone or internal organs.

Figure 9. Fourth Degree burn on arm

3. TYPES OF BURNS

Burn injuries have many causes on and off the battlefield. Burns are generated by exposure to extreme heat, a biologic reaction from chemicals, or energy transfer through cells from electrocution or radiation. Many weapons and munitions cause burn injuries. Some, such as incendiary and flame munitions, are designed to cause high heat and burning. Others, such as high explosives, bombs, and mines cause burns secondarily to their primary effect.

Figure 2. Thermal burn to legs

Thermal (see figure 2) - thermal burns are the most common type of burn on the modern battlefield.
They can result from exposure to flame weapons, incendiary weapons, munitions or from explosions from fuel sources (gasoline, diesel, and jet fuel). These weapons are designed to burn at very high temperatures and incorporate napalm, thermite, magnesium, and white phosphorous.
- The primary effect of incendiary and flame m personnel are to cause severe burns.
- Facial burns, particularly if the casualty is in an enclosed space (bunker, ship compartment, or armored vehicle) may be associated with inhalation injury.
Airway burns may result in rapid, life-threatening swelling and obstruction of the
upper airway.
Aggressively monitor airway
status by looking for the following signs
and symptoms:

- Stridor
- Oropharyngeal swelling
- Hoarseness
- Difficulty swallowing
- Carbonaceous sputum (blackened sputum)
- Singed nasal or facial hair
- Dyspnea

Electrical Burns (see figure 3) - electrical injuries are devastating injuries that can easily be underappreciated. In many cases the extent of tissue damage does not accurately

reflect the magnitude of the injury. Tissue destruction and necrosis are excessive compared with the apparent trauma because most of the destruction occurs internally as the electricity is conducted through the casualty.

The casualty will have external burns at the points of contact with the electrical source as well as grounding point. As the electricity courses through the casualty's body, deep layers of tissue are destroyed despite seemingly minor injuries on the surface. Electrical and crush injuries share many similarities. In both injuries there is massive destruction of large muscle groups with resultant release of both potassium and myoglobin. The release of potassium from large muscles causes a significant increase in the serum level, which often results in cardiac arrhythmias. All electrical burns are considered a cardiac emergency and the casualty should be TACEVAC'd to a higher echelon of care. Also, when myoglobin is released into the bloodstream in consderable amounts, it can be toxic to the kidneys and can cause kidney failure. Other signs and symtoms include:

Figure 4. Circumferential burn to foot

- Tympanic membranes may rupture causing hearing loss.
- Intense muscle contractions (tetany) can result in fractures at multiple levels of the spine. Casualties with electrical injuries should have their spine immobilized.
- Intercranial bleeds and long bone fractures may also occur.

Circumferential Burns (see figure 4) - a circumferential burn is a burn that encircles the trunk of the body (chest) or an extremity (arm or leg). Circumferential burns are capable of producing a life or limb threatening condition. They can create a tourniquet-like effect that can render an arm or leg pulse-less.

Circumferential burns of the chest can constrict the chest wall to such a degree that the casualty suffocates from inability to breath. Therefore, all circumferential burns should be handled as an emergency and casualties TACEVAC'd immediately. Escharotomies are surgical incisions made through the burn eschar to allow expansion of the deeper tissue and decompression of previously compressed and often occluded vascular structures.

Radiation Burns - burns associated with nuclear blasts. Radiation is a hazardous material. The initial priorities are to

remove the casualty from the source of contamination, remove contaminated clothing, and irrigate the casualty with water.

- Skin that is exposed to an explosion is burned by the infrared rays emitted at detonation.
- Clothing or shelter can offer some protection.
- Secondary injuries will include first and second degree burns.
- The majority of burns are caused by contact with the secondary sources that ignited such as buildings and clothing.
- If the doses of ionizing radiation are high enough to cause burns to the skin, systemic effects may overshadow the burn itself.

Chemical - injuries from chemicals are often the result of prolonged exposure to the offending agent. This is contrasted with thermal injuries, where the duration of exposure is usually very brief. You may encounter casualties who have suffered chemical burns caused by weapons, chemicals used to fuel or maintain equipment, or chemical spills following damage to civilian installations. The severity of a chemical injury is determined by four factors: nature of the chemical, concentration of the chemical, duration of contact, and MOI of the chemical. Chemical agents are classified as:

Acids:
- chemicals with a pH between 7 (neutral) and 0 (strong)
- Found in cleaners and swimming pool acidifiers

Bases (alkali):
- chemical with a pH between 7 and 14
- found in fertilizer, industrial cleaners, the structual bonds of cement/concrete, and the most common cause of alkali burns in garrison are the batteries used in our radios
- Alkali burns are usually more serious than acid burns, because alkalis penetrate deeper and burn longer

Organic:
- Contains carbon
- Phenols, creosote and petroleum products such as gasoline

3. **BURN SIZE ESTIMATION**

Estimation of burn size is necessary to begin to resuscitate the casualty appropriately and prevent the complications associated with hypovolemic shock. The most widely applied method is known as the “Rule of Nines.”

Rule of Nines: This method applies the principles that major regions of the body in adults are considered to be 9% of the total body surface area (TBSA) (see figure 10). The genital area represents 1%.

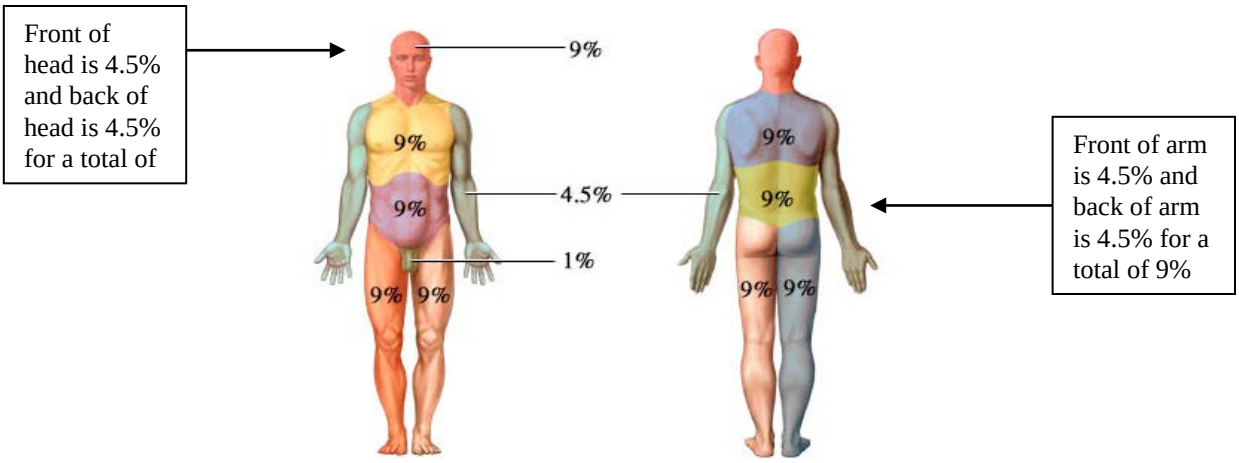


Figure 10. Rule of Nines

Rule of Palms: This method assumes that the palm size of the patient represents approximately 1% of the TBSA. TBSA is estimated by counting the number of the patient's "palms" it takes to completely cover the burn area. The Rule of Palms is helpful for estimating the TBSA of small or irregular shaped burns and small children.

5. TREATMENT OF BURNS

The initial step in the care of a burn casualty is to stop the burning process. The most effective and appropriate method of terminating the burning is irrigation with large volumes of room-temperature water. In the tactical environment however, access to large volumes of water is not always practical. You can also smother any flames with a jacket, blanket, or any other available material. Rolling the casualty on the ground is also effective. Remove all clothing and jewelry; these items retain residual heat and will continue to burn the casualty. However, DO NOT pull away clothing that is stuck to the wound.

Airway - the heat from the fire can cause edema of the airway above the level of the vocal cords and can occlude the airway. Aggressively monitor airway status and oxygen saturation (if a monitoring device is available) in such patients and consider early surgical airway for respiratory distress or oxygen desaturation. O2 should be given, if available.

Breathing - as with any trauma casualty, breathing can be adversely affected by such problems as broken ribs,

pneumothoraces (collapsed lung), and open chest wounds. In the event of circumferential chest wall burns, pulmonary compliance may decrease to such an extent that it inhibits the casualty's ability to inhale. In such cases, prompt TACEVAC of the casualty to higher level of care in order to perform escharotomies of the chest wall is critical.

Circulation - evaluation of circulation includes the determination of blood pressure, evaluation of circumferential burns, and establisment of intravenous access. Accurate measurement of blood pressure becomes difficult or impossible with burns to the extremities. Blood pressure can be estimated by palpating for distal pulses. Even if the casualty has adequate blood pressure, distal limb perfusion may be critically reduced because of circumferential injuries. Burned extremities should be elevated, when tactically prudent, during transport to reduce the degree of swelling in the affected limb.

Two large-caliber IV catheters are required for burns that cover more than 20% of the TBSA. Ideally, the IV should not be placed through or adjacent to burned tissue; however, placement through the burn is appropriate if no alternative sites are available or consider the intraosseous (IO) route.

Detailed Assessment - perform your assessment, keeping in mind that burns themselves are not immediately fatal and can wait until other priorities are addressed. Therefore, assess for additional injuries, such as associated blast, missile or fragment wounds and treat appropriately.

Hypothermia - burn casualties are not able to retain body heat and are extremely susceptible to hypothermia. Make every effort to preserve body temperature. Apply several layers of blankets. Keep passenger compartment of the TACEVAC vehicle or fuselage of the aircraft warm, regardless of the time of year. As a general rule, if you as the provider treating the burn casualty are not uncomforable, the ambient temperature is not warm enough.

Estimate the Depth and Extent of the Burn - use the "Rule of Nines" or the "Rule of Palms" noted above.

Dressing the burn - before TACEVAC, the wounds should be dressed. The goal of the dressing is to prevent ongoing contamination and prevent airflow over the wounds. Cover the burn area with dry, sterile dressings. For extensive burns (>20%), consider placing the casualty in the Heat-Reflective Shell or Blizzard Survival Blanket from the Hypothermia Prevention Kit in order to both cover the burn and prevent hypothermia.

Prehospital care providers have often been unsatisfied and frustrated with the simple application of sterile sheets to a

burn. However, topical ointments and conventional antibiotics should not be applied because they prevent a direct inspection of the burn. Such topical ointments and antibiotics are removed on admission to the burn center to allow direct visualization of the burn and determination of burn severity. Also, some topical medications may complicate the application of tissue-engineered products used to aid wound healing.

Fluid resuscitation- Administration of large amounts of IV fluids is needed to prevent a burn casualty from going into hypovolemic shock. After a burn, the casualty loses a substantial amount of intravascular fluid from the edema, as well as the evaporative losses at the site of the burn. Massive fluid shifts will occur and evaporative losses can be enormous.

The resuscitation of burn shock is aimed at not only restoring the lost volume but also replacement of anticipated losses. When treating a burn casualty, the objective is to calculate and replace the fluids that it is anticipated the casualty will lose over the first 24 hours after the burn injury.

The use of LR solution is the best way to initially manage a burn casualty. Use the USAISR **Rule of Ten.**

-If burns are greater than 20% of Total Body Surface Area, fluid resuscitation should be initiated as soon as IV/IO access is established. Resuscitation should be initiated with Lactated Ringers, Normal Saline, or Hextend. If Hextend is used, no more than 1000 ml should be given, followed by Lactated Ringers or Normal Saline as needed.

-Calculate the Total Body Surface Area burned and round it to the nearest 10. For example, 36% would be rounded to 40%.
-This percent is then multiplied by 10 to get the number of cc per hour of fluid needed. (% TBSA x 10cc/hr for adults weighing 40-80 kg). Therefore, the above casualty would need 400 ccs of fluid per hour.

To Pop or Not to Pop, that is the Question?

The blister on a burn does not provide protection to the skin and limits the ability to apply topical antibiotics. So why don't we pop them? Blisters should only be popped when you have the capabilities to debride the wound, provide pain medications, and apply antibiotic ointments. Do not open the blisters unless the above capabilities are available.

-**NOTE**: For every 10 kg ABOVE 80 kg, increase initial rate by 100 ml/hr.
-**NOTE**: If hemorrhagic shock is also present, resuscitation for hemorrhagic shock takes precedence over resuscitation for burn shock.

While you may not be completely responsible for the care of severely burned patients for 24 hours, this example illustrates the need for burn patients to receive quick attention and prompt evacuation to definitive care.

6. **BURNS TO THE EYES** (see figure 11)

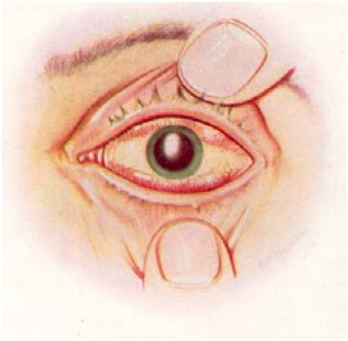


Figure 11. Burns to the eyes

Signs and Symptoms:
- Blurry vision
- Vision loss
- Pain
- Tearing
- Conjunctival erythema

Treatment:
- Thermal burn - irrigate with large amounts of water.
- Chemical burn:
  - *Acids* - irrigate for 5 - 10 minutes
  - *Alkalis* - irrigate for 20 minutes
- Cover eyes with a dry sterile dressing. In a tactical situation, if the patient can partially see out of the affected eye and can otherwise ambulate, defer dressing the eye. Avoid dressing both eyes if only one eye is injured.

Critical Burns Requiring Special Care - The American College of Surgeons Committee on Trauma developed a list of burn injuries that are considered critical regardless of depth or TBSA affected. Treatment in a specialized burn unit will improve the chances of survival and reduce complications or disabilities for casualties with any of the following injuries:
- Inhalation injuries.
- Partial-thickness burns over greater than 10% of the TBSA.
- Full thickness burns in any age group.
- Any burn involving the face, hands, feet, genitalia, perineum, or major joints.
- Electrical burns, including lightning injury.
- Chemical burns.
- All burns complicated by injuries of the respiratory tract, other soft tissue injuries, and musculoskeletal injuries.

Pain Management should be provided to burn victims, and small doses of narcotics should be titrated intravenously (see the Casualty Assessment for analgesia medications) Vital signs

and respiratory effort are monitored for potential adverse effects. Antibiotics are not indicated solely for burns however, they should be given to prevent infection in the case of penetrating wounds.

Treatment of penetrating eye injuries

Figure 20 Rigid Eye Shield

- Check visual acuity. A useful field quantification of visual acuity is (from best to worst): (1) able to read print; (2) can count the number of fingers held up; (3) can see hand motion; and (4) can see light. Vision should be checked with the other eye closed or covered.
- Cover eye immediately with a rigid eye shield (see Figure 20)
– NOT a pressure patch
If the rigid eye shield isn't available, an intact set of protective eyewear may be placed on the casualty to protect the eyes from further trauma.
- Have casualty take 400 mg moxifloxacin in his/her Combat Pill Pack
- Give IV/IM antibiotics if unable to take PO meds
- TACEVAC as soon as possible.
- If shrapnel is suspected, removal of the shrapnel can wait several days as long as aggressive antibiotic therapy is provided and the injury to the eye is repaired as soon as possible after the injury is sustained.

Treatment for impaled object

- Do not remove the object
- Make a thick dressing and cut a hole in the center the size of eye opening
- Pass dressing over impaled object
- Position crushed cup over dressing and bandage in place
- Elevate head to decrease intraocular pressure

Treatment for protruding globe

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

7. 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.

Soft tissue injuries involve the skin and underlying musculature. These injuries are classified as either open or closed.

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 (covered in the Fractures lesson).

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)

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 12)

Figure 12. Abrasion

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.

Lacerations – Torn skin with ragged irregular edges and masses of torn tissue underneath. (See Figure 13)

Figure 13. 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

Figure 14. Avulsion

Avulsion - An injury in which flaps of skin are torn loose or completely pulled off. (See Figure 14)

Treatment

- 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 than with partial or degloving cases.

(See Figure 15)

Figure 15. Traumatic Amputation

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.

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

- TACEVAC

8. 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

9. **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 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 also commonly injured structures of the neck.

Causes
- Blunt trauma
- Penetrating trauma

Signs and Symptoms
- Hemorrhage
- Hemoptysis
- Hematemesis

10. **TREATMENT FOR NECK INJURIES**

- Consider C-spine
- Control sucking neck wounds or lacerations exuding bubbling air with an occlusive dressing
(depending on how serious this is, you may have already treated sucking neck wounds in Massive Hemorrhage or in Respiration)

- Non-life threatening bleeding, apply pressure to bleeding areas
- Consider cricothyroidotomy if airway is compromised
- Administer fluids (*see Circulation lesson*)
- TACEVAC

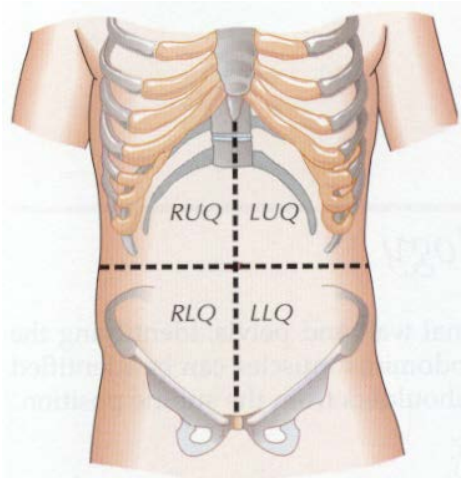
11. ABDOMINAL INJURIES

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 21).

13. 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.



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.

Figure 21. Areas of the Abdomen

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.

14. 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.

15. 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 damage 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.

16. **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.

17. **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 22. Impaled knife in chest

Impaled objects (see Figure 22) 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 23) 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.

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.

Figure 23. Evisceration of bowel

CASUALTY ASSESSMENT AND THE MANAGING OF WOUNDS

Care Under Fire Phase: Soft tissue and abdominal injuries are not addressed in the 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 deformities and soft tissue injuries. Head and face trauma can affect the airway therefore, you must always suspect the potential of airway difficulties. When head trauma has occured, consider the possibility of Traumatic Brain Injury (TBI) and any mechanism of injury that causes head and face trauma can also injure the cervical spine. Use caution to protect the cervical spine, if possible. You must visually inspect the eyes, ears, nose, and throat. 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. Consider pain medications (see Casualty Assessment lesson for details on head injury and pain medications) and give antibiotics for all open wounds. Continually reassess all care provided, document care given, TACEVAC.

REFERENCE

Prehospital Trauma Life Support, current Military Edition
Deployedmedicine.com
CoTCCC Guidelines