Assessment and Management of Extremity Trauma

Objectives

Upon completion of this topic, the student will be able to:

1. Describe the anatomy and physiology of the upper and lower extremities.
2. List the steps in assessment of the extremity injury patient.
3. Identify and treat fractures, dislocations, and sprains of the extremities.
4. Discuss the effects of severe extremity injuries/disorders on the entire body.

Case Study

It is a sunny afternoon and you and your partner have just finished eating lunch. You are dispatched to a "person down" in a local neighborhood. Your initial assessment begins when you receive the call. As you respond to the scene, you continue to monitor all updates provided by dispatch. You learn that a city worker has fallen into a sewer drain through an exposed manhole cover. Although the patient extricated himself from the hole, he is unable to walk. As yo and your partner begin to prepare for the call you discuss possible injuries that the patient could have sustained and methods that you can use to quickly access the patient as well as potential treatment plans that could be used based on your assessments. After several minutes you arrive on scene and observe a middle aged male lying on the grass next to the roadway in obvious distress. As you approach the patient, you notice that his lower left leg appears to be i an abnormal position. The man looks to you and your partner and says "You gotta help me, I'm dying here." You look to your partner, nod, and to go to work.

Introduction

Injuries to extremities are extremely common and can include anything from fractures to dislocations and sprains. We will address the anatomy and physiology of the upper and lower extremities, assessment process for the suspected extremity injury patient, and treatments of extremity injuries located.

Describe the Anatomy and Physiology of the Upper and Lower Extremities

The term extremity is defined in the Merriam-Webster dictionary as "a limb of the body."[2] Therefore, the term include not only our arms and legs but our hands, feet, fingers, and toes as well. But how do all of these components interrelate to each other and our bodies as a whole? We will address the issue by differentiating between our upper and lower body and extremities and look at the function and form of each. We will then look at the basic body system that help make up our extremities and how they work together. These systems include: the musculoskeletal, circulatory, integumentary, and the nervous systems. We will begin with the musculoskeletal system.

Musculoskeletal System

The musculoskeletal system is a combination of both the muscular system and the skeletal system. Combined, they allow our bodies to interact with the world that we live in. The muscular system is comprised of three distinct types of muscle fiber: cardiac muscle, smooth muscle, and striated (or skeletal muscle). Our skeletal muscles allow us to mov our limbs and other various parts of our bodies through a process of contraction and relaxation of muscle fibers withi each of the larger muscles. These muscles are attached to our skeletons, by tendons. Tendons are thick, fibrous band that allow our muscles to exert a pulling force on a bone. Our skeletons serve as a framework for our bodies providin support and protection for our organs. This framework allows us to move and acts as anchor points for muscles, tendons, and ligaments. Ligaments, not to be confused with tendons, are also composed of thick fibrous bands. However, they connect bone to bone at our joints and when combined with the pulling forces of the tendon, allow join such as elbows and knees to work effectively. Now that we have a basic understanding of what our musculoskeletal system does, let's look at how it relates to our extremities.

We can break the term extremity down to smaller regions: upper and lower based on their locations in regards to the torso. We will start from the top, the shoulders and arms, and work our way down to the hips and legs. Let's begin. Look to your left or right and move your shoulder. Notice how you can move it forward and back, rotate your arm or even shrug your shoulders. We are able to perform this seemingly mundane task because of bones associated with each arm and all of their associated muscles, tendons, and ligaments. The shoulder region consists of three bones an four joints, three of which are "false or immovable joints" leaving only one "true or articulable joint." In addition, ther are four major muscles and numerous accessory muscles, tendons, and ligaments.

The shoulder begins superiorly with the clavicle, followed by the scapula, and finally the humerus. As the scapula and humerus meet, they form the glenohumeral joint, the only true shoulder joint. Four primary muscles and associated bones allow the shoulder to move in virtually any direction. Continuing on we have the humerus; this is the upper bone in your arm that connects your shoulder and elbow. The lower bones of your arm are commonly called the forearm. These lower bones are known as the radius and the ulna. The major muscles associated with the humerus bone are the biceps and triceps. The bicep and triceps muscles, working in combination (and at times in opposition), allow us to flex, extend, rotate, and even elevate our arms. Distally, the humerus meets with the superior aspects of the ulna (the inner bone of the forearm) and radius (the outer bone of the forearm) forming the elbow joint. These bones and their associated muscles work in conjunction with the humerus and its associated bones to allow us to manipulate our environment.

Next, we come to the wrist. The wrist is comprised of eight small bones and several muscles. Combined, they allow u to move our hand in various directions. We then reach the hand, which is comprised of the palm and fingers. Each pal contains five metacarpal bones. Each of the five metacarpal bones continues distally to our phalanges, commonly called the fingers. The joints of our fingers allow us to manipulate objects combined with the muscles of our forearm and wrists, enabling us to grasp, release, and even twist everyday items.

Now we will look at the lower extremities: the legs, feet, and toes. Each leg contains 30 bones as well as numerous muscles and supporting structures.[4] The leg contains both the largest bone in our body, the femur, and the largest muscle, the gluteus maximus. The leg begins superiorly with the femur. The head of the femur, the greater trochante fits into the cotyloid cavity, a concave structure located on the pelvis forming the hip joint. The associated muscles of the hip generally begin or end within either the pelvis or femur. The muscles, combined with the support of the pelvis and femur, allow us to rotate and move our legs in various directions. The gluteus maximus allows us to maintain ou upright posture by ensuring correct pelvic alignment. This muscle combined with the other muscles of the "thigh" allows us to extend, flex, or retract our legs.

As we continue distally, we reach the knee. The knee consists of the inferior aspect of the femur, a small flat bone called the patella (more commonly called "the knee cap") and superior aspect of the tibia. These bones and their associated ligaments, muscles, and tendons allow us to extend or contract the lower leg. The knee has built in "shock absorbers that reduce the stress associated with everyday events. These shock absorbers are known as meniscus anc are commonly injured.

As we continue past our knee we reach the tibia proper as well as the fibula. These two bones make up the lower portion of the leg. In addition to these bones, we have numerous muscles that make up this region of the leg. We ofte refer to these muscles as our calf muscles. The two main muscles of this area are the gastrocnemius, which is located on the posterior side of the tibia, and the soleus muscle, which lies under the gastrocnemius muscle. These muscles combined with other accessory muscles to enable us to walk, kick, and run.

We have now reached our ankles and our feet. The ankle and foot combined contain 26 small bones, seven within the ankle and 19 within the foot. The ankle is comprised of the inferior aspects of both the tibia and the fibula; together they form the outward edges of the ankle. Much like the wrist area that we discussed previously, there is a set of sma bones that form the ankle. They are known as the tarsus bones and are a set of seven small bones. The metatarsals act as the webbing of the foot and provide structure and form, similar to the palms of our hands. The metatarsals are met by our toes or phalanges. Combined, the muscles of our lower extremities allow us to support our weight.[5,6]

Circulatory System

Our circulatory system is comprised of two interrelated systems, the systemic and the pulmonary. The pulmonary circulatory system is responsible for the transport of blood and oxygen from the heart to the lungs and back. This systemic system is responsible for the transport of the oxygenated blood to our bodies and removes waste products from cells. We will only look at the systemic circulatory system, in particular our arteries and veins. In general, arteries carry oxygenated blood from the heart to the body, while veins carry deoxygenated blood from the body to the heart. We will start once the blood leaves our heart and enters the aorta. The aorta has four branches, one that carries blood to the lower extremities and three to our upper body. The three branches that send blood to our upper body are the brachiocephalic arterial trunk, the left subclavian artery, and the left common carotid artery.

We will begin with our upper extremities, and therefore, the left subclavian artery only. As oxygenated blood flows through the subclavian artery it enters the shoulder region where it enters the axillary artery. This artery further branches out to provide our trunk and shoulder area with blood; additionally, it continues away from the body and forms the brachial artery. This artery is often easily palpated on the interior aspect of the elbow and provides blood tc the upper arm muscles. As the brachial artery continues towards the hands it bifurcates and becomes the radial and ulnar arteries. The radial artery is what we often use to manually obtain a patient's pulse rate and is found on the anterior of the wrist. The radial artery provides blood to the posterior forearm region. The ulnar artery continues toward the hand, but provides the anterior portion of the forearm with oxygenated blood. The two arteries then enter the hand where they further divide and become the arteries of the hand, thumb, and fingers.

It is important to remember that as the blood is sent throughout our bodies it travels through ever smaller vessels until reaching the smallest of the arteries, the arterioles. From the arterioles the blood moves into our capillaries where the oxygen/carbon dioxide exchange occurs. Once the carbon dioxide rich blood enters the capillaries it makes its way into the venules and begins its route back towards the heart. This is accomplished when the blood leaves the hands and enters the distal veins. These veins begin to grow in diameter and continue towards the heart. As the veins grow in diameter they form two separate venous systems, the deep and the superficial. These two systems perform separate but equally important roles. The deep venous system runs away from the surface of our skin and is paired with a related artery, while the superficial venous system runs close to the surface of the body and aids in cooling the body when overheated. As blood departs the venous arch of the hand it enters the radial and ulnar veins. These veins join just below the elbow and form the brachial vein. After entering the brachial vein the blood continues upwards unti it reaches the superior aspect of the cephalic vein and just inferiorly the basilica vein. Once the superficial and deep veins are joined they form the axillary vein which continues towards the heart as it becomes the subclavian vein. The subclavian vein proceeds towards the heart and enters the superior vena cava and the heart proper.

Now that we have a basic understanding of the circulatory system of our upper extremities let's look at our lower extremities. Similar to our upper extremities, our trip begins at the aorta. However, instead of having the blood move into one of the smaller branches almost immediately, it continues through the aorta and into the chest via the thoraci aorta. This aorta runs the length of the thoracic cavity and supplies the tissues, organs, and muscles with oxygenated blood. As this artery continues towards the feet, it continues to separate into many major arteries, until finally reaching the abdominal area. In the abdominal region the aorta is known as the abdominal aorta and bifurcates into the common iliac arteries. These arteries branch to the left and right towards the legs within the pelvic areas and become the external iliac arteries. The external iliac artery continues until reaching the common femoral artery. This artery divides into the deep and superficial femoral arteries as well as the internal circumflex artery. The deep femora artery continues its journey toward the feet and delivers blood to the external muscles of the thigh and femur. The superficial femoral artery continues through the thigh area, delivering blood to the internal aspect of the thigh. The internal circumflex artery runs posteriorly to the muscles and tissues of the gluteus.

Next, we encounter the popliteal artery; this artery originates slightly superior to the knee joint and is a continuation the superficial femoral artery. It provides blood to the knee region. Past the knee the popliteal artery divides into the anterior tibial artery and the tibiofibular trunk. The anterior tibial artery continues towards the ankle and foot providir nutrients to the external muscles and tissues. Just superior to the ankle joint the anterior tibial artery becomes the dorsalis pedis artery. The dorsalis pedis artery begins to provide the ankles and feet with blood as it divides into the foot. The tibiofibular trunk continues a short distance and then divides into the posterior tibial and the peroneal artery The posterior tibial artery runs along the posterior aspect of the leg and provides the bones, muscles, and tissues of the interior lower leg with blood. While the other branch, the peroneal artery, runs along the posterior aspect of the leg, it provides the external muscles, bones, and tissues with blood. Both of these arteries continue toward the ankle and foot where they, along with the other arteries, provide this region with oxygenated blood.

We now begin our trip back towards the heart. As with the upper extremities, the venous system is comprised of two separate systems: the deep and superficial. The deep venous and arterials, the arterial systems, run parallel to one another. Additionally, the vessel names coincide with one another similar to the upper extremities; therefore, we will only discuss the superficial venous system, as a discussion of the deep venous system would be redundant. Beginning with the toes and working superiorly we move from the veins of the toes and travel into the dorsal venous arch of the foot. This arch is a network of veins located on the superficial area on the top of the feet and moving into the great saphenous vein. This large vein moves along the interior of the calf muscle, past the knee and continues towards the thigh. In doing so, other smaller veins such as small saphenous veins, join the great saphenous vein as the blood is collected for its return trip. Just above the knee, additional accessory saphenous veins transport blood from the posterior aspects of the thighs to the great saphenous vein and continue this process as the veins climb towards the femoral vein, where the great saphenous vein terminates. The femoral vein continues upwards to the external iliac vein, which along with the internal iliac vein, combines to form the common iliac vein. The common iliac vein continues to ascend until it forms the inferior vena cava in the abdominal region. The inferior vena cava collects all of the oxygen poor blood from the inferior portion of the body and transports it upwards to the superior vena cava and into the heart.[7,8]

Integumentary System

The integumentary system is our coat of armor. It protects us from the elements and other organisms. It is comprise of our skin, hair, and nails, and is the largest organ in our body. Briefly looking at each of the components of this system starting with the skin, we know the skin is comprised of three layers: the epidermis, the dermis, and the subcutaneous layer. The epidermis is the outer layer that we all see; this layer provides initial protection from the outside world. The layer contains no nerves or blood vessels. The next level, the dermis, generates the cells that are pushed towards the outer layer; this layer does contain blood vessels, nerves, glands, hair follicles and connective tissue. The final layer is the subcutaneous layer or hypodermis. This layer also contains blood vessels and the roots of hair follicles, and can best be remembered as the skin's cushion as it acts as a type of insulation or protection from bumps and bruises to underlying tissues and organs.

Nervous System

The nervous system is comprised of two major systems, the central nervous system which involves the brain and spinal cord and the peripheral nervous system which encompasses everything else and acts as a network to connect our limbs and organs to the brain. The peripheral nervous system can be further divided into the somatic and autonomic nervous systems. The autonomic system controls all automatic functions of the body such as the operation of our organs, the constriction or the dilation of hollow organs, and vessels. The somatic system allows for voluntary movements of limbs and other parts of the body. The system is comprised of efferent and afferent nerves. Efferent nerves carry impulses from the central nervous system to either the muscles or glands, allowing for control of these muscles and create a “cause and effect” response to the surroundings. Afferent nerves carry impulses from the sensor receptors located through the body back to the central nervous system, which causes one to be “affected” by the environment. An example of this is withdrawing a hand after touching a hot item.

Looking at the somatic nervous system and how it relates to the extremities, we will begin at the shoulder and work towards the hand. There are four major nerves of the upper arm: the musculocutaneous, the median, the ulnar, and the radial nerve. These nerves all originate in the brachial plexus; three of them (the musculocutaneous, the median, and the ulnar) move toward the wrists. Only one, the musculocutaneous, provides function to the upper arm muscles. The median and ulnar nerves control the muscles of the forearm and hands. In fact, the median nerve sends branche all the way to the fingers. The radial nerve moves towards the hand and in doing so, branches out sending one branch deep into the muscles (the deep muscular branch) and another towards the surface of the skin (the superficial sensory branch). Both branches provide control over muscles of the forearms and to some extent, the hands. As the nerves continue to the hands, the median nerve branches out becoming the common palmar digital nerves, which in turn branch out to the nerves of the fingers (the proper palmar digital nerves). As the ulnar nerve reaches the wrist it separates into two branches, the deep terminal branch of the ulnar nerve, which goes towards the thumb, and the superficial terminal branch of the ulnar nerve, which goes towards the 4th and 5th digits.

Now we will look at the nerves associated with our lower extremities. The femoral nerve originates from the lumbar region of the spinal cord and then separates into four branches as it innervates the quadriceps. These four branches a the internal and external musculocutaneous nerves, the quadriceps nerve, and the internal saphenous nerve. The internal and external musculocutaneous and quadriceps nerves send nerve branches throughout the upper thigh area. The internal saphenous nerve, on the other hand, continues past the knee to the foot where it stops. The sciatic nerve is the largest nerve within the body and begins within the lumbar region. The sciatic nerve goes through the upper leg and continues to the knee area, where it branches into the common fibular and tibial nerves. The fibular branch continues towards the feet and branches once again, this time into the superficial and deep fibular nerves. As these names suggest, the superficial nerve runs along the outer aspect of the leg, while the deep nerves lie towards the tibi and work towards the interior aspect of the lower leg and eventually the foot. The tibial nerve continues past the knee branching off to the knee continuing to the foot itself. The feet are innervated by nerves (much like the hands), with the soles of the feet being controlled by the internal and external plantar nerves, both of which are branches of the tibial nerves. The final branches of the superficial fibular nerve, the external and internal dorsal cutaneous nerves, run into the each of the toes.[13,14]

Now that we have completed our brief discussion on the major body systems that affect the extremities, and have a basic understanding of their components and the functions that they serve, we are now able to move onto the next section, patient assessment.

List the Steps in Assessment of the Extremity Injury Patient

We begin with the scene survey and initial assessment. Information provided by those on scene and relayed through the Emergency Medical Dispatch (EMD) will allow us to paint a picture in our minds before arrival. As you arrive on scene you will begin your initial survey. This survey will allow you to identify and mitigate any potential hazards, enhancing your safety, and that of the patient’s, and bystanders. If potential hazards exist the best course of action may be to stage and wait for additional resources. If the scene appears to be safe, approach carefully remaining alert for hidden dangers and potential indications of the mechanism of injury and nature of illness.

Once you observe the patient, you are able to conduct your initial assessment. This initial assessment assists you in identifying potentially deadly injuries or conditions that must be treated immediately. To begin you must first develop your general impression of the patient. This process is often started even before you are able to speak with the patient.

Before you do so, ask yourself four questions:

1. Does the patient appear to be conscious and alert?
2. Does the patient’s airway appear to be open and unobstructed?
3. Does the patient appear to be breathing adequately or is he or she having difficulties?
4. Does the patient have any visible external bleeding? If so, where? If in contact with the patient, does the patient

have a strong pulse?

Negative responses to one or more of these questions indicate a potentially life-threatening condition. Depending on the suspected nature of injury or illness, a rapid trauma or medical assessment should be completed immediately. If the patient appears stable conduct the actual initial patient assessment. Remember, if the patient is in obvious distres treat the most obvious life-threating injury/illness first and then evaluate the remaining injuries as the patient stabilizes.

Ensure that you utilize all required personal protective equipment (PPE), prior to coming into physical contact with the patient.[15]

Assess the patient's mental status, utilizing the AVPU scale provided below. Altered mental status is an indication of a potentially life-threatening injury/illness, and a rapid assessment should be conducted.

A - **A**lert. The patient is alert and awake (eyes are open) and is able to respond to questions.

V - **V**erbal. The patient is able to respond to verbal stimuli when spoken to, such as the patient's eyes may be closed but may open when asked questions.

P - **P**ain. If the patient is not alert and does not respond to verbal stimuli, attempt to obtain a reaction to pain from your patient.

U - **U**nresponsive. The patient is non-responsive to all attempts to elicit a response.[16]

Next, check the basics. Simultaneously check airway, breathing, and circulation (ABCs). If the ABCs are compromised take immediate action to correct the problem. Failure to do so may cause the patient's demise.

Your findings in the initial patient assessment will direct you towards your next step. It may be a rapid trauma or medical assessment as in the case of a potentially life-threatening injury/illness or detailed physical exam. We will firs look at the rapid trauma assessment or RTA.

Rapid Trauma Assessment

A rapid trauma assessment (RTA) is indicated when you suspect one or more of the following conditions: significant mechanism of injury, altered metal status, and multiple body-system trauma as per local standard operating procedures and medical protocols.

Pay particular attention to areas where trauma may have been focused, however, do not focus on the most dramatic injury. Many times the most obvious injury is not the most dangerous. The goal of the rapid trauma assessment is to locate and identify all potentially life threatening conditions.

- Step 1: Reassess your patient's mental status utilizing AVPU; has there been a change since the initial assessment?
- Step 2: Assess the head, utilizing DCAP-BTLS (Deformities, Contusions, Abrasions, Punctures/penetrations, Burns, Tenderness, Lacerations, and Swelling) and crepitus. First, visually examine the head and note bleeding from the eyes, ears, nose, or mouth.
- Step 3: Assess the neck for DCAP-BTLS and crepitus and ensure that the airway is secure. Remain alert for obvious bruising, redness, or swelling to the shoulder area.
- Step 4: Assess the chest for DCAP-BTLS and crepitus. Expose the chest and visually inspect it for signs of injury and respiratory difficulty.
- Step 5: Assess the abdomen for DCAP-BTLS and crepitus. Expose the abdomen and visually inspect for obvious injuries. Note any signs of distention or discoloration as this could be a sign of internal hemorrhaging.
- Step 6: Assess the pelvis for DCAP-BTLS and crepitus. Expose the pelvic area; if possible, consider the patient's privacy. Visualize the pelvic area for any obvious signs of injury and deformities. Note the presence of priapism If observed, suspect a lower spinal cord injury. If the patient is conscious, ask him or her if he or she feels pain in the pelvic area. If none is noted, evaluate the pelvic ring for stability, gently pressing medially (towards the center) on the pelvic ring (Iliac crest), then gently compress the pelvis (symphysis pubis) posteriorly. DO NOT ROCK on the pelvic ring. If movement is felt, suspect a pelvic fracture.
- Step 7: Assess all extremities for DCAP-BTLS and CMS/PMS (Circulation, Movement and Sensation/Pulse, Movement and Sensation). Expose all four extremities and inspect for obvious injuries to include amputations, deformities, and obvious fractures. Check distal pulses in all extremities and capillary refill in both the fingerna and toenails. Inspect the color and temperature of each extremity. The lack of distal pulse, a capillary refill of 2 seconds or greater, and coolness or ashen skin color indicates a loss of perfusion to that extremity. Evaluate the cause and attempt to correct it. Should the cause be a fracture, splint the fracture quickly in an attempt to restore circulation (see Tables 1 and 2 for specific treatments). If the extremity has good perfusions and the fracture is not life-threatening, do not attempt to splint the fracture at this time. Check for medical alert

bracelets or necklaces to attempt to identify prior medical conditions that may affect treatment. If the patient i alert and orientated attempt to determine if CMS/PMS is intact.

Motor functions and sensitivity can be quickly evaluated by asking the patient to slightly squeeze your fingers and lightly returning the squeeze or by asking the patient to push down lightly with their feet and then squeezing their toes. Compare the finding from both sides of the body. If the patient is unable to move their extremities and/or not feel the sensation, suspect a spinal injury. If weakness is found on one side, the patient's motor functions may be impaired possibly due to a brain injury or a stroke. If the patient has both lower and upper extremity fractures, treat the lower extremity fracture first due to the potential for rapid blood loss. Reevaluate your transport priority and the need for assistance.

- Step 8: Utilizing all cervical spine precautions, log roll the patient. Inspect the back for obvious signs of injury and deformity. Gently palpate the back and assess the back for DCAP-BTLS and crepitus. Once you have assessed the back, roll the patient onto his or her back, secure to a back board, and prepare for transport.

Upon completion of the RTA, obtain and assess the baseline vitals and obtain a SAMPLE (Signs/symptoms, Allergies, Medications, Pertinent past history, Last oral intake and Events leading to injury/illness) history if possible. If your patient is stable, vital signs should be assessed every 15 minutes until the emergency department is reached. If the patient is not stable, reassess vital signs at a least every five minutes. Treat any injuries that were found during the RTA and if possible, perform a detailed physical exam.[17,18,19]

Detailed Physical Examination

Not all patients that you see will receive a detailed physical examination. Often, it is not indicated, time is limited, or you are treating life-threatening injuries or conditions. If time permits and the patient is stable, this examination can assist you in obtaining a clearer picture of the patient's condition. This examination consists of a complete head to toe examination, inspecting each region of the body for DCAP-BTLS, abnormalities, discoloration, bleeding, and numerous other region specific injures. Additionally, when inspecting a suspected injury to an extremity, utilize the six Ps (Pain, Pallor, Paralysis, Paresthesia, Pressure and Pulse).

- Pain - Does the patient complain of pain or tenderness when the injured limb is moved or touched?
- Pallor - What is the color of the injured area? What is the patient' overall skin color?
- Paralysis - Is the patient able to move or manipulate the injured area?
- Paresthesia - Does the patient complain of unusual feeling such as numbness or tingling in the injured limb?
- Pressure - Does the patient complain of the feeling of increased pressure in the injured extremity? If so, this could indicate internal bleeding and/or uncontrolled swelling.
- Pulse - Is there a distal pulse?

Once completed, obtain a set of vital signs to compare to the initial baseline set that was obtained earlier.[21]

Identify and Treat Fractures, Dislocations and Sprains of the Extremities

We interact with our environment through the use of our extremities. Our legs and feet allow us to walk, run, and jum while our hands and arms allow us to manipulate objects. Often this interaction leads to injuries to our extremities; these may be in the form of a broken bone, a dislocation, a sprain, or a burn, to name a few common injuries.

FRACTURES (TABLE 1)[22,23,24]	
TYPE	DESCRIPTION AND CAUSES
Open (compound fracture)	Open fractures typically occur when a bone suffers a high energy direct or indirect impact. An open fracture presents with an external wound with bone ends protruding from the wound. In some cases, the bone ends may slide back into the body and only an external laceration will be visible.
Closed (simple fracture)	Closed fractures typically occur when a bone suffers a direct blow, indirect impact, or twisting force. A closed fracture may be difficult to identify in the field and can be confused

	easily with sprains and other soft tissue type injuries.
Comminuted (multi-fragment fracture)	Comminuted fractures occur as a result of a crushing type injury in which the affected bone is splintered or there are two or more breaks in a single bone. These breaks result in at least three separate bone fragments. These fractures may be either open or closed.
Stress (hairline fracture)	Stress fractures occur as a result of repetitive force being applied to the same area resulting in cracks or fractures in the effected bones. Stress fractures occur commonly in athletes.
Greenstick	Greenstick fractures occur most often in infants and children as result of pliant bones. These fractures often occur as a result of a direct blow during a fall or a twisting movement, resulting in a partial or incomplete fracture of the bone. A greenstick fracture may be difficult to identify in the field and can be confused easily with sprains and other soft tissue type injuries.
Epiphyseal	An epiphyseal fracture is a fracture that occurs at or on the epiphyseal or growth plate of a child's bone. Injuries to the growth plate are often incurred during high impact events such as falls or sports-related activities. If an epiphyseal fracture is not treated properly the affected bone could potentially stop growing or become deformed.
Pathological	A pathological fracture is any break in a weakened bone that is a result of a disease. Examples of associated disease include bone cancers, osteoporosis, and similar diseases.
Spiral (torsion fracture)	Spiral fractures occur as a result of a significant twisting force being applied to a bone, such as during a skiing accident. This twisting force causing the affected bone to twist apart.
Oblique	An oblique fracture is a break in the bone at an angle to the long axis of the bone itself.
Transverse	A transverse fracture is a break in the bone straight across the long axis of the bone itself.

Now let's discuss dislocations and sprains. Dislocations (also known as subluxation) occur most commonly as force is applied indirectly towards a joint resulting in the articulating end or ends of a bone becoming displaced from the "socket." This results in either a complete (luxated) or incomplete (subluxated) dislocation. At times, dislocated joints will reduce or reposition themselves back within their joints. Should this occur, treatment is still required. The supporting ligaments, tendons, and other tissues have been potentially stretched or damaged and need to be supported to prevent further injury.

Sprains are injuries to the joints in which stretching and tearing of the joints supporting ligaments have occurred. Sprains often present as a fracture would and it is difficult to determine in the field whether the patient has suffered a fracture or sprain.

Signs and Symptoms

Common symptoms of these types of injuries are pain and tenderness to the damaged area. In extreme cases, numbness may be present. Often the area around the specific injury will be swollen and bruised as soft tissues, blood vessels, and possible nerves will be damaged. The patient may be unable to bear weight on or move the injured bone or joint properly. The injured area may be deformed and could be rotated or moved at an odd angle. At times the patient may state that he or she can feel bones "grinding together" (formally called crepitus) and will appear to guard the injured area. With open fractures, you will find an obvious external wound and associated bleeding as well as probable exposed bone ends or fragments.[25]

Treatment

It is often difficult to differentiate on scene if the patient has suffered a fracture, sprain, or dislocation. Therefore, we will address only the basic treatments that can be used to stabilize an injured area for all three possibilities. We will begin with some general guidelines for the treatment of extremity injuries:

1. Expose the injured area (if you did not do so during your assessment) so that you are able to inspect the extremity.
2. Re-check CMS/PMS as well as a distal pulse.
    a. If there is no distal pulse, attempt to carefully realign the extremity to restore the pulse. (Should you be unable to realign the limb or if resistance is felt during the process, splint the extremity in the position found).
3. Priority of treatment for fractures, sprains and dislocations should be as follows:
    a. Pelvic fractures.
    b. Femur fractures.
    c. Lower extremity fractures.
        i. Open fractures.
        ii. Stop/reduce the loss of blood. This can be accomplished with the application of direct pressure and pressure dressings. Ensure that you utilize dry, sterile dressings. Do not irrigate the wound as this coul increase the chance of infection later.
        iii. Wrap any exposed bone ends or fragments with a dry sterile dressing.
        iv. Apply ice as needed to assist in the reduction of localized swelling.
        v. Treat as a closed fracture.
        vi. Closed fractures (See Table 2 for specifics locations).[26,27]
    d. Upper extremity fractures.
        i. Open fractures (See Table 1 above for details).
        ii. Closed fractures (See Table 1 for specifics locations).
    e. Dislocations.
    f. Sprains.
4. Splint the suspected injury prior to moving the patient unless there is a potential hazard present. When splinting, attempt to splint both above and below the suspected injury location. This may involve two or more joints.
5. Remain alert for signs and symptoms of shock.

Remember that the treatments suggested are not all inclusive and are only meant to be a representation of treatments available. Follow all local protocols and standard operating procedures.

INJURIES TO THE UPPER EXTREMITIES (Table 4)[28]	
INJURY LOCATION	TREATMENT
Clavicle and Scapula	STEP 1: Assess the circulation, movement and sensation distally of the injured limb. STEP 2: Sling the injured arm to the body in a slightly upward angle to reduce the downward

	force on the injured area. If needed, apply a splint to the humerus and/or the radius and ulna. STEP 3: Secure the injured arm to the patient's body using a swathe to hold it in place. Ensure that the swathe is firm enough to prevent movement of the injured arm, yet loose enough to ensure that circulation to the distal aspects of the arm remain intact. Consider the application of a cold pack to assist with pain and swelling. Note: If the patient's arm is positioned above the head, do not attempt to move, but rather splint in position.
Humerus	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. If blood flow or sensation is compromised, traction must be applied and the bone placed back in line generally prior to splinting. STEP 2: Splint the injured arm using a padded board splint; position the splint by using swathes to secure it snuggly in place. STEP 3: Sling the injured arm to the patient's body by placing the sling under the lower aspect of the arm and around the patient's neck, attempting to ensure that pressure is not applied to the humerus. STEP 4: Secure the injured arm to the patient's body using a swathe to hold it in place. Ensure that the swathe is firm enough to prevent movement of the injured arm yet loose enough to ensure that circulation to the distal aspects of the arm remains intact.
Elbow Fractures (Distal humerus and superior ulna) (Olecranon process)	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. It is generally best and safest to splint in the position found as long as CMS is present distally. If a distal pulse is not found consider the need to apply manual traction to the injured arm in an attempt to regain a distal pulse. STEP 2: Apply two, soft padded splints or a formable splint to the affected arm; ensure that they are long enough to immobilize the affected arm. Secure the splints with gauze and ensure that circulation to the distal aspects of the arm remains intact. STEP 3: Sling the injured arm to the patient's body. Consider utilizing a pillow or other soft object to assist you in maintaining proper positioning of the injured arm. STEP 4: Secure the injured arm to the patient's body using a swathe to hold it in place. Ensure that the swathe is firm enough to prevent

	movement of the injured arm yet loose enough to ensure that circulation to the distal aspects of the arm remains intact.
Forearm Fractures (Radius, Ulna and Wrist)	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. If compromised or severe angulation is found consider the need to apply manual traction. If not, attempt to splint the injured arms in the position found. STEP 2: Apply a splint to the affected area large enough to immobilize the elbow joint. Should the patient's wrist be affected, ensure that the splint immobilizes both the elbow and wrist areas. Consider placing a roll of gauze or a similar object in the patient's palm to assist in positioning the patient's hand in a functional position. STEP 3: Apply a sling and swathe to the injured area, securing it to the patient's body.
Hand and Finger Injures	STEP 1: Assess the circulation, movement and sensation distally on the injured limb. Attempt to splint the injury in either the position found or position of function. Remove any jewelry if possible from the affected area. STEP 2: Apply a splint to the affected area large enough to immobilize both the elbow and wrist areas. Consider placing a roll of gauze or similar object in the patient's palm, to assist in positioning the patient's hand in a position of function. STEP 3: Wrap the injured area in a bulk dressing securing the splint to the arm firmly. Ensure that CMS remains intact. STEP 4: Apply a cold pack to the injured area and elevate.

A Note on Splinting

Splinting is used to secure a suspected fracture site in an effort to reduce the likelihood of further damage to the adjacent muscles, nerves, and blood vessels caused by the fractured bone ends. To accomplish this, there are various types of splinting options, including rigid, formable, and traction splints. Depending upon numerous factors such as varying medical protocols, cost, size, and required training, some options may not be available to you and your agency. In this case, the term "padded" splint will be used in regards to splinting. Table 3 below provides examples of each type and common uses for splinting.

SPLINTS (TABLE 3)			
	RIGID	FORMABLE	TRACTION
EXAMPLES	Padded board splints, padded wire ladder splints and padded card board splints	Air splints, vacuum splints and SAM splints	Hare and Sager Traction Splints
USES	Stabilization of fracture site, when joint isolation and limb immobilization is required	Stabilization of fracture site when joint isolation and limb immobilization is required	Stabilization of fracture site when joint isolation and constant traction is required to maintain limb

			alignment

INJURIES TO THE LOWER EXTREMITIES (TABLE 4)[29]	
INJURY LOCATION	TREATMENT
Pelvis	STEP 1: When a pelvic fracture is suspected, stabilize the pelvic area immediately utilizing a long spine board and pelvic stabilization device such as a pelvic sheet wrap, a SAM pelvic splint, or a traumatic pelvic orthotic device as needed to manage the onset of shock. A pneumatic anti-shock garment (PASG) may be utilized as a last resort if approved by local medical control. STEP 2: Administer supplemental oxygen as indicated. STEP 3: Transport to the hospital rapidly. STEP 4: Continue to reassess the patient's vital signs every five minutes until arrival at the hospital. Remain alert for uncontrolled internal hemorrhaging which may result in up to 2,000 ml of blood loss. Additionally, remember that the genitals of both sexes are very vascular and an injury to that area may result in rapid blood loss. Apply dressings as needed.
Hip Dislocation and Proximal Femur Fracture	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. If compromised or if the patient's leg is rotated at an odd angle and/or appears shortened, apply manual traction to reposition the limb and restore a distal pulse, as directed by medical control. Splint in the position found if the limb does not need to be realigned. Use pillows, blankets, or other soft material to assist in positioning the limb. Ensure that if a splint is applied, distal circulation and sensation are not impeded. If severe uncontrolled bleeding is present and local medical protocols dictate, consider the use of a PASG. STEP 2: Transport to the hospital rapidly. STEP 3: Continue to reassess the patient's vital signs every five minutes until arrival at the hospital.
Femur	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. NOTE: Fractures to the femur may result in open wounds so ensure that the general guidelines for these types of injuries are utilized. STEP 2: Apply a traction splint to realign the femur ends and control/reduce blood loss along with any further soft tissue damage. Once in

	position, reassess the distal pulse to ensure it is present. Remember, a femur fracture often results in extreme blood loss and can easily lead to shock. STEP 3: Transport to the hospital rapidly. STEP 4: Continue to reassess the patient's vital signs every five minutes until arrival at the hospital.
Knee Injuries	STEP 1: Assess the circulation, movement, and sensation distally of the injured limb. STEP 2: If an adequate distal pulse is found splint the knee in the position found. Most commonly this will be in a flexed or bent position. If this should be the case, place a pillow or soft object below the knee to assist in keeping it elevated and apply two long splints, one on either side of the leg. Next, secure the injured leg to the splints securing both above and below the knee, ensuring that the knee is immobilized. Finally, prepare for transport. Should the knee be found in the straight position, simply apply splints to either side of the leg and secure the splints both above and below the knee, once again ensuring that the knee will not move. If a distal pulse is not located, advise medical control and apply manual traction to reposition the limb only as directed. STEP 3: If possible, elevate the injured limb and apply a cold pack as needed.
Tibia and Fibula	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. If a distal pulse is not present, or if there is a visible deformity, apply gentle manual traction to realign the fracture. STEP 2: Before releasing traction, apply a padded splint to the injured limb. Ensure that it runs the entire length of the leg, thus immobilizing the fracture site. Secure the splint and ensure that a distal pulse is still present. STEP 3: If possible, elevate the injured limb and apply a cold pack as needed.

Ankle and Foot	STEP 1: Assess the circulation, movement, and sensation distally on the injured limb. If a distal pulse is not present, or there is a visible deformity, apply gentle manual traction to realign the fracture. STEP 2: Before releasing traction, apply a padded splint to the injured limb. Ensure that it runs the entire length of the leg, thus immobilizing the fracture site. Secure the splint and ensure that a distal pulse is still present. STEP 3: If possible, elevate the injured limb and apply a cold pack as needed.

The Effects of Severe Extremity Injuries and Other Disorders on the Entire Body

Injuries to the arms, legs, hands, and feet can actually become life-threatening if left untreated. A relatively mundane injury such as a burn or an infection could potentially lead to a life/limb threatening conditions such as shock, compartment, or crush syndromes.

Burns

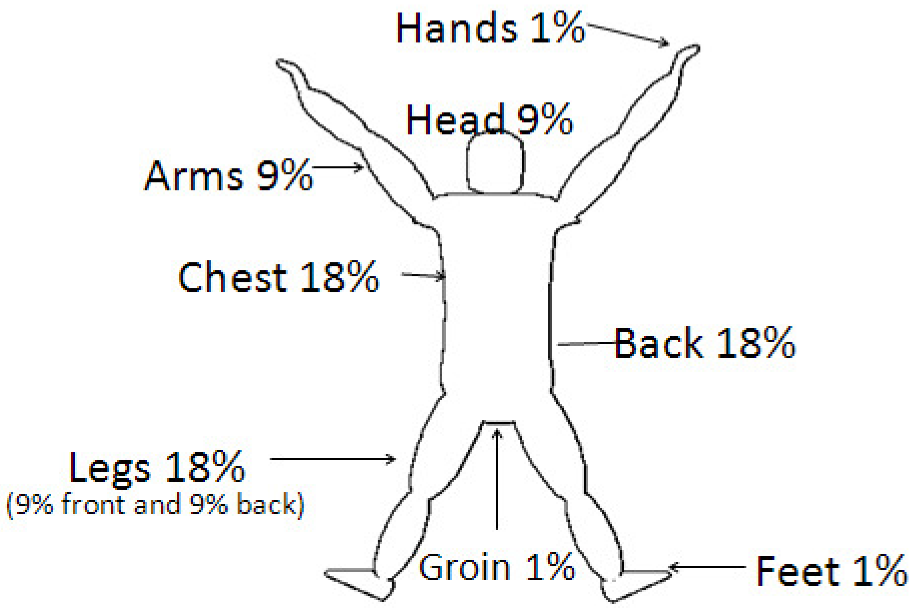
Burns occur by heat, friction, electricity, chemicals, and exposure to radiation. All burns affect our bodies, but do so in different ways. Therefore, treatment will vary. In this case, only the treatment of thermal and electrical burns will be discussed. First, it must be understood how to classify burns and estimate their severity. Burns are classified by depth and severity ranging from superficial (or first degree) to full thickness (or third degree). Table 5 explains the signs and symptoms of each.

BURNS (Table 5)[30]	
CLASSIFICATION	SIGNS AND SYMPTOMS
First Degree (Superficial)	Local reddening of the epidermis and inflammation of the affected area, localized pain, and possible sensitivity to touch.
Second Degree (Partial Thickness)	Pale, mottled skin with areas of redness and blisters. These burns involve both the epidermis and dermis and may appear wet or moist and are very painful.
Third Degree (Full Thickness)	Charred, leathery, or waxy colored skin may be present in the areas of the most damage. This degree of burn involves the epidermis, dermis, and subcutaneous layers, resulting in underlying tissue and nerve damage. Often the burn will appear dry and little pain will be reported.

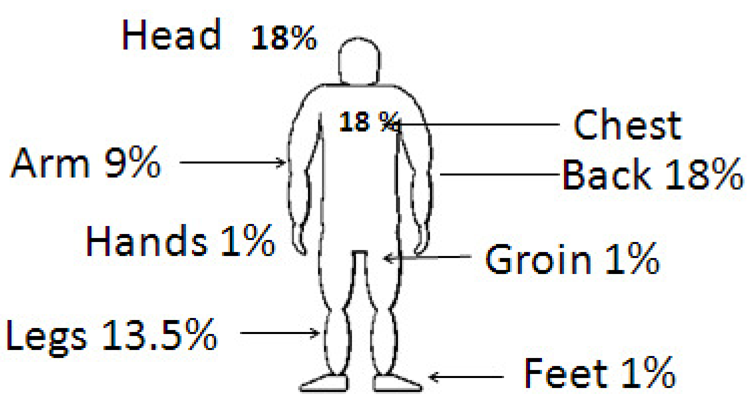
Note: Burns do not affect the skin uniformly; a burn will often vary in depth and severity. A full thickness burn will often have areas of partial thickness and superficial burns.

In addition to the depth, it is important to estimate the total body surface area (TBSA) that has been affected; this allows for the further classification of the burn as minor, moderate, or critical. To accomplish this, the “rule of nines” is often used. The rule of nines is calculated upon the patient’s TBSA. The patient’s body can be divided into increments of approximately nine percent. Diagrams 1 and 2 demonstrate these details.

Adult Rule of Nines
Diagram 1



Child Rule of Nines
Diagram 2



Once the affected TBSA has been estimated, Table 6 is used to classify the severity of the burn.

BURN CLASSIFICATION (Table 6)		
CRITICAL	MODERATE	MINOR
3rd degree burn over 10% of TBSA 2nd degree burn over 30% of TBSA Significant electrical or chemical burns Inhalation burns Preexisting medical conditions or injury complication Pediatric or geriatric	3rd degree burn over 2-10% of TBSA 2nd degree burn over 10-30% of TBSA	3rd degree burn over less than 2% of TBSA 2nd degree burn over less than 10% of TBSA

patient		
Any 2nd or 3rd degree burn to the face, hands, feet, groin, and joints and all circumferential burns are classified as critical.		

Now it's time to review some treatments for burns to the extremities. The first priority, like any call, is to ensure our own safety and use all body substance isolation (BSI) protocols applicable when making contact with the patient. In addition, make sure that the source of the emergency has been extinguished.

Thermal Burns

These burns occur as a result of a heat source such as a hot object, scalding water, flame, and even the sun.

1. Treatment begins only after all active burning has stopped. This can be accomplished by moving the patient away from the heart source, extinguishing flames, or applying cool water to burning skin.

2. Once the patient has been removed from the heat source, remove all restrictive or constricting clothing such as shoes, belts, and jewelry. Quickly assess the patient's TBSA that has been burned using the rule of nines.

3. Assess the patient's ABCs:

A. If the patient's airway is involved or he or she appears to be in respiratory distress, the burn is automatically classified as critical. Apply high flow oxygen. In some cases, intubation may be indicated.
B. If, in your estimation, the patient suffered 2nd degree burns to over 20% of his or her TBSA, 3rd degree burns o any portion of the body, or local protocols dictate, consider the need for fluid resuscitation utilizing the Parkland Burn Formula or similar resuscitation strategy.

4. Once the patient's ABCs have been addressed, cover the burned area with a dry, sterile dressing; ensure that any blisters are not broken during application of the dressings. If appropriate, splint the affected limb loosely to limit movement. Additionally, attempt to keep the patient warm by using a covering.

5. Consider the need for pain management, utilizing approved analgesic medications.

6. Evaluate transport needs utilizing local SOPS and protocols.[31]

Electrical Burns

These burns can occur as a result of lightning strikes, alternating currents (AC) such as in a residential electrocution, c direct currents (DC) as in burns resulting from batteries and similar devices.

1. As with thermal burns treatment can only begin after all active burning has ceased. This could involve disconnectin the patient from the power source, extinguishing open flames, or simply turning off the power source. Remember, if the power is still "live" requested immediate assistance.

2. Once the patient has been removed from danger, assess the patient's ABCs:

A. Initially treat the electrical burn patient as you would a thermal burn, using steps 3A and 3B from above. After this has been accomplished, establish and monitor an ECG for dysrhythmias, remaining alert for cardiac arrest and/or severe dysrhythmias.

3. Remove all restrictive or constricting clothing and jewelry. While doing so, look for entry and exit wounds as well a related thermal burns. If thermal burns are found refer to the thermal burn treatment section. Treat any life-threatening injuries found and consider the need for C-spine precautions.

4. Once the assessment and ABCs have been addressed, cover any burned area with a dry, sterile dressing; ensure that blisters are not broken during application of the dressings. If appropriate splint the affected limb loosely and trea other injuries found. Additionally, attempt to keep the patient warm.

5. Consider the need for pain management, utilizing approved analgesic medications.

6. Evaluate transport needs utilizing local SOPS and protocols.

Embolisms and Infections

As with burns, embolisms and infections can lead to potentially serious or even deadly consequences if left unchecked This section is intended to identify what embolisms and infections are, their signs and symptoms, and some basic treatment methods for each.

An embolism is a potentially deadly, complete or partial blockage of an artery caused by blood clots or other blockage that have traveled from another location and become lodged within the artery, resulting in an arterial occlusion. Thes embolisms can be caused by a variety of underlying medical issues such as deep vein thrombosis, atherosclerosis, cancer, and numerous other diseases or trauma such as a recent break in a bone, surgery or even prolonged immobility.

Signs and Symptoms

Embolisms are often difficult to identify in the field and may be missed if a thorough assessment is not performed. Ar embolism within an extremity will often cause the appearance of poor perfusion and circulation distal to the point of blockage. This results in a lack of a distal pulse as well as cyanosis and cooling of the limb. Depending upon the location and severity of the embolus, distal sensation may be altered resulting in spasms, weakness, pain, , or even paralysis of the affected extremity.

Treatment

Treatment for an embolism in the prehospital setting is supportive in nature:

1. Place the patient in a position of comfort, and encourage him or her to limit movement.
2. Provide supplemental oxygen as indicated.
3. Consider the need for pain management, utilizing approved analgesic medications.
4. Treat any conditions found during your patient assessment.
5. Continue to reevaluate the patient as indicated per local medical protocols.
6. Transport to the emergency room.[32]

Infections occur when the body is invaded by various microorganisms such as viruses, bacteria, fungi, and other organisms that reproduce and cause a reaction within. Often, the body is able to fight off these invaders after a brief period and the individual recovers fully. However, in severe cases the body fails and medical intervention is required i the invasion becomes pathogenic.

Signs and Symptoms

Due to the immense variety of potential infections, it is impossible to address each type and their associated signs an symptoms here. However, a brief overview of some of the more common indictors of an infection related to laceratio and minor abrasions are provided.

Among the most common identifiable signs and symptoms is a reported prolonged decrease in the patient's overall energy levels. This is known as malaise. An increase in body temperature may be present and may be localized in the area of the actual infection, or the patient may be afebrile. Increased inflammation, swelling, and pain are often present as well. In more severe cases, drainage may be observed seeping from the wound, and a rotting odor may b detected emitting from the wound.

Treatment

As with an embolism, treatment for an infection in the field is generally supportive in nature:

1. Place the patient in a position of comfort and encourage limited movement.
2. Provide supplemental oxygen as indicated.
3. Consider the need for pain management, utilizing approved analgesic medications.
4. As indicated, rinse the wound with sterile water.
5. Loosely bandage the wound and consider the use of a splint to limit mobility.
6. Treat any conditions found during the patient assessment.
7. Continue to reevaluate patient as indicated per local medical protocols.

Transport to the emergency room.

Shock

Shock is the failure of the cardiovascular system to circulate adequate oxygenated blood throughout the body as well as the failure to remove waste byproducts from cells. Left untreated, this disorder will quickly lead to death. While there are several types of shock, only hypovolemic shock will be addressed here.

Hypovolemic shock occurs as a result of the loss of a large amount of blood. It is important to remember that extrem blood loss may or may not be readily visible as the human body is able to conceal large amounts of fluids within it. Shock occurs in three stages: compensated, decompensated, and irreversible. The goal is to identify and treat potential shock patients either before or during the early stages of compensated shock.[33,34]

Depending on the extent of the patient's blood loss, hypovolemic shock may quickly affect the circulatory, respiratory, and nervous systems. Among the first signs of compensated hypovolemic shock is a slight change in the patient's mental status as he or she becomes anxious and agitated. Often the patient will complain of increased thirst. Additionally, the patient will become tachycardic and may display rapid shallow breathing. The victim's skin will often become pale, cool, and moist to the touch, and a capillary refill time of over two seconds is often observed as the patient's body attempts to shunt needed blood from the extremities to the major organs. If the treatment is not begun, blood pressure drops and the patient moves into decompensated shock. During this period, the patient's diastolic blood pressure begins to rise. This phenomenon is called narrow pulse pressure and is caused by low cardiac output, due to a loss of total blood volume. During this stage, the patient's level of consciousness quickly decreases tc the point of unconsciousness, the pulse rate continues to rise, and blood pressure continues to drop rapidly. The patient's breathing rate may slow or stop altogether. At this point, the patient is near death and extreme measures must be taken to save him or her. If not, the patient will quickly fall into irreversible shock, during which the body begins to shut down and death becomes imminent.

If the potential shock victim is identified and blood loss is minimized, shock can be combatted. The following steps are crucial to accomplish this:

1. Ensure that the patient is supine and attempt to keep him or her warm.
2. Provide supplemental oxygen via a nonrebreather mask at 15L/min; be prepared to assist in ventilations and intubation as needed.
3. Control all obvious bleeding whether internal or external. Often proper immobilization and splinting, combined with the application of direct pressure, and at times, elevation of an injury site, will provide the needed control.
4. Attempt to maintain the patient's systolic blood pressure at or above 90 mmHg by initiating IV therapy utilizing a crystalloid solution such as normal saline.
5. Maintain the patient's body temperature, loosen tight fitting clothing, and cover with a blanket or sheet as needed.
6. Provide medications as indicated per local protocols.
7. Transport rapidly.

Compartment and Crush Syndromes

Compartment syndrome is the increased internal pressure of a region of the body as a result of internal bleeding, mo commonly the tibia and forearm. This increased pressure results in compression of the muscles, nerves, and blood vessels within the affected area. This most commonly occurs after the patient has suffered a crush type injury, fracture, or constriction and sudden reperfusion of an extremity, such as after the removal of a tourniquet.

Signs and symptoms include extreme deep, severe pain that is disproportional to the injury and a reported increased pressure of the affected area with a taut, firm feeling. Additionally, the patient may complain of numbness or the sensation of pins and needles distal to the affected area. Delayed capillary refill time may be observed.

Should you suspect that your patient is suffering from a possible compartment syndrome there is little that you are able to accomplish in the prehospital setting. It is recommended that the affected limb be splinted to limit movement. If possible, attempt to position the limb at the same level as the patient's heart and treat all injuries possible. Notify medical control immediately and provide rapid transport.[35,36]

Crush syndrome presents itself after a crush injury has occurred in which a portion of the victim's body is trapped or impinged between two heavy objects. This crushing force leads to fractures, bruising, and internal and external bleeding, as well as soft tissue and nerve damage. Signs and symptoms include entrapment for longer than 30 minutes. Often the patient's vital signs are relatively stable while entrapped and all CMS functions above the impinger point are intact. Distally, however, pulse is weak or absent, and the victim is unable to move or feel any sensation. Th patient may have an altered mental status. Upon release from the entrapment, rapid onset hypovolemia is observed resulting in unconsciousness. Dysthymia may also appear, most likely due to post traumatic stress. Underlying metabolic issues include an increase of several waste products such as potassium and phosphate as well as others tha may require later treatment.[37,38,39]

Treatment

Prior to release: establish ABCs. If possible establish two IV sites, ensuring that large amounts of normal saline are administered. If approved by local medical protocols consider the administration of sodium bicarbonate and calcium ir an effort to abate hyperkalemia. If it is not possible to administer an IV, consider the use of a short term tourniquet t prevent the release of toxins into the patient's body. Obtain a baseline EKG.

After release: Treat any obvious life-threatening injuries. If possible, start an IV and the tourniquet may be moved at the direction of medical control. The victim should be placed on an EKG and monitored for heart rhythm irregularities.

Summary

By now you should understand the anatomy and physiology of the extremities as well as why and how the body systems interact with each other in regards to these extremities. We discussed the proper steps to rapidly assess both a medical and trauma patient in regards to potential extremity injuries. We also discussed both traumatic and medica related extremity injuries and disorders and suggested treatments.

Case Study Conclusion

You assess the patient utilizing the rapid trauma assessment approach. During your assessment you discover that the patient's left tibia is positioned at an odd angle and appears to be fractured. Based on this obvious deformity, you advise your partner to grab two, long padded splints and some bandages. While he is gone you quickly assess the circulation, movement and sensation distally on the injured limb. You find a strong distal pulse and there does not appear to be any visible deformity. Your partner returns with the materials and you apply a padded splint to both side of the injured limb, ensuring that it runs the entire length of the leg, totally immobilizing the fracture site. You hold th splints in place and tell your partner to secure the splints using the bandages. Once secured, you ensure that a distal pulse is still present, and it is. You and your partner carefully move the patient onto the stretcher where you elevate the injured limb slightly and apply cold packs to reduce the swelling. You and your partner load the patient into the ambulance and head to the emergency room. While en route you reassess the patient and find that although in slight pain, he is resting comfortably. You contact medical control and advise them of your findings and treatments. Upon arrival, you quickly transfer care to the on duty ER staff. Later you learn that your assessment was correct, and the patient did in fact have a fracture tibia. He is now in a cast and will make a full recovery.

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