THE UNIVERSITY OF TOLEDO MEDICAL CENTER

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Advanced Trauma Life Support Protocol

Adherence to the ATLS protocol during evaluation of an injured patient in the emergency room improves the patient's outcome and decreases initial management errors. Evaluation of the multiple trauma patient is very important.

The first priority is airway control, usually with intubation when needed. Following intubation, the management should consist of ventilation and placement of a chest tube when needed. Circulatory stabilization, vascular access, then get x-rays.

When you do airway control, you also need to have cervical spine control. Nasotracheal intubation has the advantage in patients with suspected cervical spine trauma because this does not require hyperextension of the neck. Evaluate the airway for obstruction!

If there is a facial trauma and swelling in the area of the airway, you probably will need to do a cricothyroidotomy. Cricothyroidotomy is an emergency procedure that is used when routine methods of intubation are not effective or contraindicated.

Breathing and Ventilation

• Clinical evaluation: Chest x-ray evaluation and Arterial blood gases

• Patient has: - Scapular body fractures. - Rib fractures. X-ray shows lung consolidation. - Tachypnea

• After emergency intubation, the arterial blood gases show that oxygenation is poor with absence of breath sounds on one side and there is resonance on percussion on the same side.

• There may be a tracheal deviation to the other side (air pushes against the lung causing deviation of the trachea).

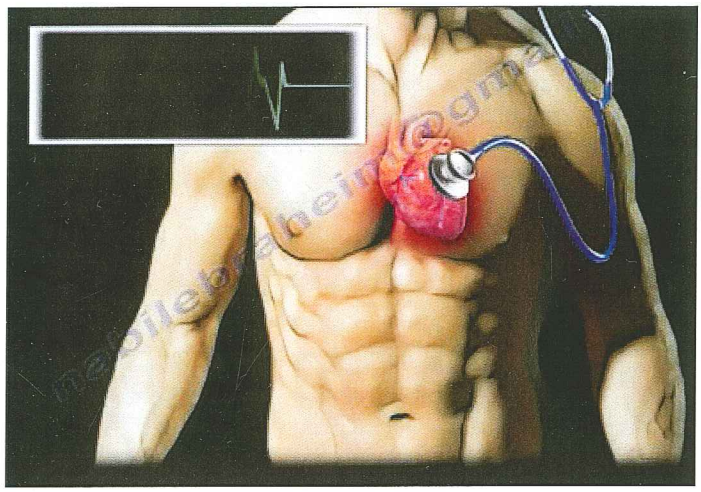
• With a tension pneumothorax, place a large needle into the second intercostal space, midclavicular line.

• The air is trapped in the pleural space between the lung and the chest wall, which is compressing the lung and shifting the mediastinum.

• Need to decompress the pleural space urgently (by needle or placing a chest tube).

• Watch out for a patient with a scapular fracture, because this may also injure the lung.

Circulation and Hemorrhage Control



• Clinical evaluation: Radiographic chest x-ray, Pelvic x-ray and CT scan.

• Means initiation of resuscitation: Direct pressure on the bleeding site and pelvic binder

Disability Evaluation/ Checking Neurological Status

• Check the patient for neurological deficit

Exposure/Environment Control

• Clinical Evaluation: Look for open fracture and rewarm the patient

What causes the patient's death? It is usually the Injury Severity Score (ISS) plus the age of the patient. It is used to predict mortality in patients with a blunt trauma and multiple injuries.

When it is a question of "life or limb", obviously saving the life is more important than saving the limbs. Physicians should strive to preserve the life and the limbs. Adherence to the ATLC protocol will help to achieve this goal.

SECONDARY SURVEY: •Done 12-24 hours after the injury. •Complete exam and updates. •Doing this survey will decrease the incidence of missed injuries by more than 1/3. •We know that about 10%-12% of injuries are missed in the first 24 hours in patients with multiple trauma.

Hemorrhagic Shock

Hypovolemic Shock occurs due to a low blood volume. The trauma patient should be given fluids.The heart rate will be increased and the most reliable early clinical finding is tachycardia. Give the patient 2 liters of bolus Ringer's lactate solution (RL) followed by reevaluation of the vital signs. Patient will have increased heart rate and systemic vascular resistance. Patient will also be cold and clammy.

Cardiogenic shock occurs due to poor pump function of the heart. There will be decreased cardiac output and decreased peripheral resistance.

Obstructive shock is similar to cardiogenic shock. Cardiac tamponade and pulmonary embolism have the same features.

Septic shock has a decreased peripheral resistance and vasodilatation as seen in patients with septic shock and necrotizing fasciitis.

Neurogenic shock occurs in patient with acute spinal cord injury. There will be impaired sympathetic response to the heart and blood vessels. There will also be a circulation collapse with hypotension and bradycardia. The patient will have a decreased systemic vascular resistance and warm skin. Treatment is Swan-Ganz monitoring for careful fluid intake and give pressors.

Neurogenic shock is not a spinal shock where the bulbcavernosus is out with loss of all spinal cord function and reflexes below the level of the lesion.

For hemorrhagic shock, the initiation of resuscitation is based on the degree of hemorrhage. Start by giving 2 liters of crystalloid fluids (usually Ringer's lactate) with two lines. Reevaulation the vital signs. The patient may have rapid response, transient response, or no response. If the patient has a transient response, then the patient is considered to be class 3 or class 4.

O negative blood will be given immediately! Type specific blood transfusion will take about 10 minutes. Cross-matching blood transfusion will take 60 minutes.The ratio of blood given is: Packed RBC = 1, Fresh frozen plasma = 1 Platelets = 1.

Class 3 and 4 may not respond to fluid resuscitation and will require a blood transfusion. There must be adequate fluid resuscitation. If you rely on the hemodynamic parameters alone, you will miss subclinical hypotension. Hemodynamic parameters alone are an inadequate assessment tool for resuscitation.

The terrible trauma triad is: (1) Hypothermia, (2) Coagulopathy and (3) Acidosis. These are life threatening conditions that may become worse by surgery and by anesthesia.

Hypotension: patient with a head injury can run into the problem of episodic hypotension intraoperatively, which causes significant increase in mortality.

Patient with AP pelvis: can be placed in a pelvic binder and "close the book" to help with the hypotension and hemorrhage.

Lateral Compression: Look for another source of bleeding if the patient continues to be unstable despite any effort for resuscitation (probably not from the pelvis).

The patient can be resuscitated in several ways: Base deficit from -2

General Trauma - Shock

CLASS OF HEMORRHAGE

CLASS	Blood Loss	Volume	BP	Pulse Pressure	CNS	Fluid
1	<750	<15%	Normal or increased	Decreased or increased/ Widened	Slightly anxious	Crystalloid
2	750 - 1,500	15% - 30%	Normal	Decreased/ Narrowed	Midly anxious	Crystalloid
3	1,500 - 2,000	30% - 40%	Decreased	Decreased/ Narrowed	Anxious, confused	Crystalloid and blood
4	>2,000	>40%	Decreased	Decreased/ Narrowed	Confused, lethargic	Crystalloid and blood

to +2. Serum lactate level (normal is less than 2.5). Some sources use normal of less than 2. The blood lactate is the end point of anaerobic metabolism. The blood level of lactate reflects a global hypoperfusion that is directly proportionate to the oxygen deficiency. The base deficit is a direct measure of metabolic acidosis and indirect measure of the blood lactate level. Both correlate well with organ dysfunction, mortality, and adequacy of resuscitation.

Normally the body utilizes energy from the breakdown of glucose. Each molecule will give us 2 pyruvate molecules and 2 ATP. If you do not have oxygen, the pyruvate will attach to the protons and give lactic acid. Lactic acid is a pyruvate that is holding onto protons. Lactate acid gives away the protons, the protons attach to bicarbonate and then you will have base deficit. When the patient is acidotic, it means the body is experiencing inadequate tissue perfusion. Then it undergoes anaerobic metabolism to create some energy and the lactate is created. The more the lactate level, the more there will be base deficit.

You want to be aware of the under-resuscitate patient. Be aware of the compensated shock. This patient will be at an increased risk for huge, exacerbated systemic inflammatory response.

• IL-6 plays a major role in the inflammatory response. IL-6 is secreted by the T-cells and by the macrophages. It stimulates the immune response especially during infection and during trauma. The interleukins are a group of cytokines which are secreted proteins and signal molecules. IL-6 warns the body and the immune system against the source of infection or inflammation. For these patients do damage control orthopaedics.

For managing these patients, always do the emergency procedures such as: placing a pelvic binder, angiography, and release of the muscle compartment. Consult vascular surgery for vascular problems and prevent further injury of the spine by embolization of the neck. Reduce a knee or hip dislocation and reduce fractures that will cause soft tissue compromise. Treat open fractures with debridement and a splint. The patient may need traction or external fixation for femur fractures.

Early administration of antibiotics will decrease the rate of infection. If the patient is adequately resuscitated, take the patient to the operating room and fix the fracture.

Damage Control Orthopaedics

In damage control orthopaedics, we use an approach to treat the multiple trauma patient by staging the definitive management. We do this to limit the cumulative trauma effect. Trauma is associated with a surge in the inflammatory mediators. The peak is usually about 2.5 days post-trauma. We delay the definitive management until the acute inflammatory window is closed! We avoid and minimize the second hit. By adopting this damage control, we will decrease the impact of the second hit and avoid adding more trauma to the vulnerable patient.

Definitive care is delayed until the patient's condition improves. In this case, you will use external fixation for the femur and the tibia, and splints for the forearm and the humerus. You can leave external fixation in the femur for up to 3 weeks and in the tibia, external fixation can be left for up to 10 days. In the tibia, if treatment is delayed or if there is pin tract infection, then you have to do stage conversion.

With the pelvis, look for the word "binder", you need a pelvic binder. In multiple trauma, you will delay the surgery on the pelvis for 7-10 days.

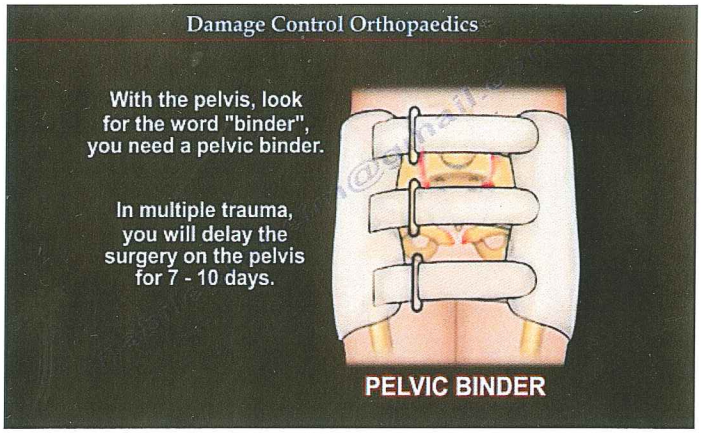
We use damage control when the patient cannot be adequately resuscitated. The patient is acidotic, hypotensive, hypoxic, hypothermic, patient has coagulopathy, you are going to use external fixation. The leukocytes are primed by the initial, primary trauma.

The early total care in a sick patient may not be appropriate and actually may bring severe complications to the patient, such as ARDS and multiple organ failure.

What are the parameters that will help to decide which patient should be treated with damage control orthopaedics? •Injury Severity Score (ISS) more than 40 without thoracic trauma. •ISS more than 20 with thoracic trauma. •Glasgow Coma Scale of 8 or below. •Bilateral femur fracture. •Pulmonary contusion as seen on x-rays. •Multiple injuries with severe abdominal and pelvic trauma. •Hemorrhagic shock. •Hypothermia less than 35 degrees. •Patients with severe head injuries are at risk of hypothermia. •If the International Normalized Radio (INR) is more than 1.5, then the patient could be Disseminated Intravascular Coagulation (DIC). •In head injury patients, the drop in the systemic blood pressure may lower the cerebral perfusion and compromise the brain function.

These groups of patients will have damage control orthopaedics. They find reduction in the rate of ARDS and multiple organ failure with the use of damage control orthopaedics.

The primed immune system of the patient has a huge ability for



response with primed leukocytes that will cause tissue and lung injury. We say yes to a small surgery and no to a big surgery. We stage the treatment with damage control!

This acute inflammatory response window is considered to occur between 2-5 days. This is the period when most of the surge in the inflammatory marker occurs. Only potential life or limb threatening injuries can be treated during this time (compartment syndrome, fractures with vascular injury, unreduced dislocation, open fractures, long bone fractures or an unstable spine).

If timing of surgical intervention is not appropriate, you can get the second hit with acute tissue and lung injury. If the patient is stable, they will go to the operating room. If the patient is not stable, then the case will be delayed. The borderline patient will probably benefit from a delay in surgery. This patient will benefit from damage control orthopaedics!

Interleukin 6 (IL-6) and Interleukin 8 (IL-8) are the prime inflammatory mediators that are released after trauma. You do not want to push the patient towards ARDS or multiple organ failure by creating more mediators secreted. When we are doing early total care, we are doing surgical intervention that makes these mediators increase in production and increase in the ability to produce more damage.

Cytokines are secreted by the macrophages. IL-6 is a potent inducer of the acute phase response. The cytokines are responsible for triggering the inflammatory cascade and promotes abnormal attachment of the leukocytes to the endothelial cells that line up at the arterial lumens. Macrophages secrete IL-6 is also produced by the T cells and by endothelial cells in response to trauma in order to stimulate the immune response.

Spine Concepts, Cervical Rheumatoid Arthritis

Cervical spine involvement occurs in about 90% of patients with rheumatoid arthritis. All rheumatoid arthritis patients should have a cervical spine examination. Start with getting cervical spine x-rays, this helps to diagnose atlantoaxial instability. Early aggressive medical treatment may decrease this risk.

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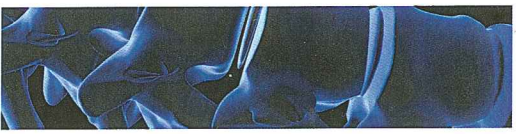
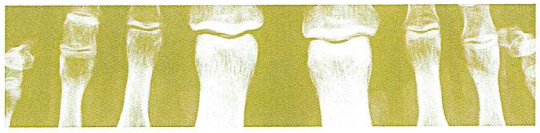


Rheumatoid Arthritis continued

C1-C2 instability is common and can occur in up to 80%. It also occurs due to transverse ligament pathology. The doctor needs to get flexion/extension views in patients with rheumatoid arthritis, especially preoperative x-rays. If it looks bad, stabilize the spine before doing elective total hip or total knee procedures.

ATLANTO-DENTAL INTERVAL (ADI): normal ADI in adults is less than 3 mm. ADI more than 3.5 mm indicates instability of the upper cervical spine may be present. An ADI more than 7 mm indicates a disruption of the alar ligament and these patients can have cervical spine myelopathy.

The posterior atlanto-dental interval (PADI) is a better screening test than the ADI. If the PADI is less than 14 mm, this can predict a spinal cord injury. The patient needs an MRI! A C1-C2 fusion is done if the ADI is more than 10 mm or if the PADI is less than 14 mm

Clinically, the C1-C2 instability could cause neck pain, headache, and myelopathy with abnormal gait, paresthesia and difficulty in fine motor control.

Basilar Invagination occurs in about 40% of patients with rheumatoid arthritis. It occurs if the odontoid process tip is 5 mm or more above Chamberlain's line. In this case, do occiput to C2 fusion, plus or minus odontoid resection.

Subaxial Subluxation occurs in about 20% of patients. An indication for surgery is neurological compromise. If the space available for the spinal cord is less than 14 mm, then do a posterior fusion. Surgery is usually not successful with severe types of neurological impairment.

Surgery should be done if the patient has severe pain, neurological deficit, x-rays showing that the PADI is less than 14 mm, superior odontoid migration, subaxial subluxation, and the sagittal canal diameter is less than 14 mm.

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Dr. Ebraheim, Amanda Critton, Julie Anderson and Ellen Finch do not have any relationships with industry to disclose.

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