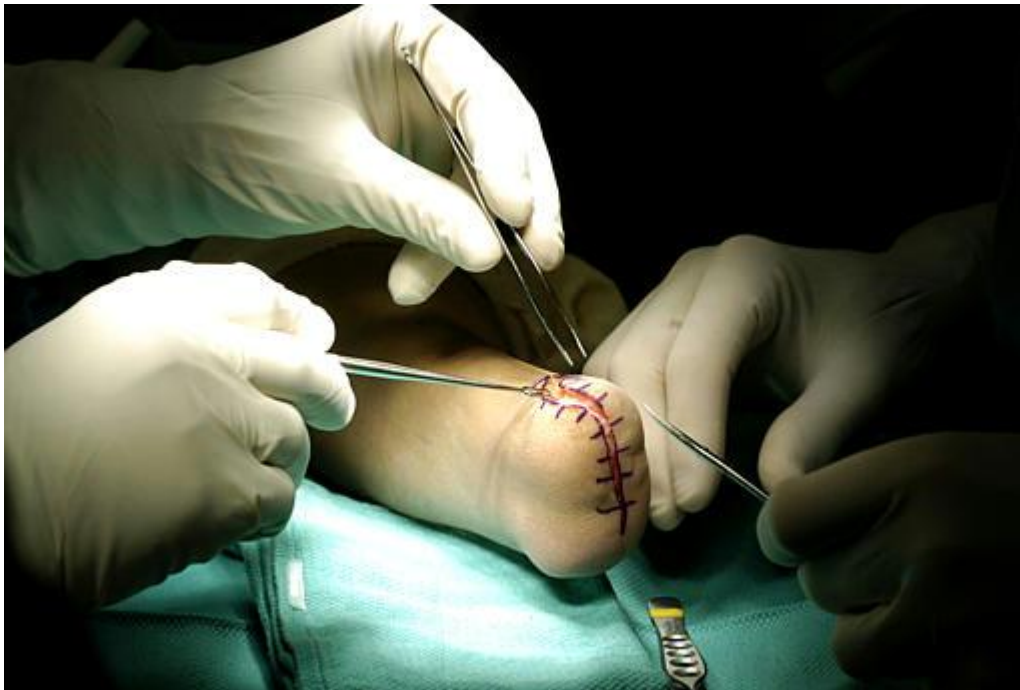


Severe Extremity Injuries in Multitrauma Patients: Rhabdomyolysis (Crush Syndrome) and Traumatic Amputation

[See online here](#)

Upper or lower extremity injuries are common in polytrauma patients. Recognition, assessment, and management of extremity injuries are sometimes not given priority in the management of a polytrauma patient. In this article, we will talk about the most important extremity injuries which are defined as either life-threatening injuries or limb-threatening injuries.



Overview

Life-threatening limb extremity injuries include:

- Pelvic disruption fractures with massive pelvic hemorrhage
- Severe arterial hemorrhage from a lower or upper limb injury
- Crush syndrome

The most common limb-threatening injuries include open fractures and dislocations, traumatic amputation, severe vascular injuries, compartment syndrome, neurological compromise due to limb injury, and degloving injuries.

Degloving injuries are defined as an **upper or lower extremity injury that involves the separation of the skin and underlying subcutaneous connective tissue from**

the underlying fascia. They can be exposing to deep structures of the limb such as bone. They are associated with high morbidity.

Extremity injury may result from penetrating injury for example gunshot wounds or knife injuries, however, not all penetrating injuries are violent in nature. Most penetrating extremity injuries emanates from industrial accidents like injuries from nail guns or are iatrogenic complications of vascular access techniques for other medical complications.

Blunt injuries causing vascular injury are mainly caused by motor vehicle accidents but not limited to falls, assaults, and crush injuries.

Fractured long bones and dislocated joints frequently increase the risk of vascular and muscular injury.

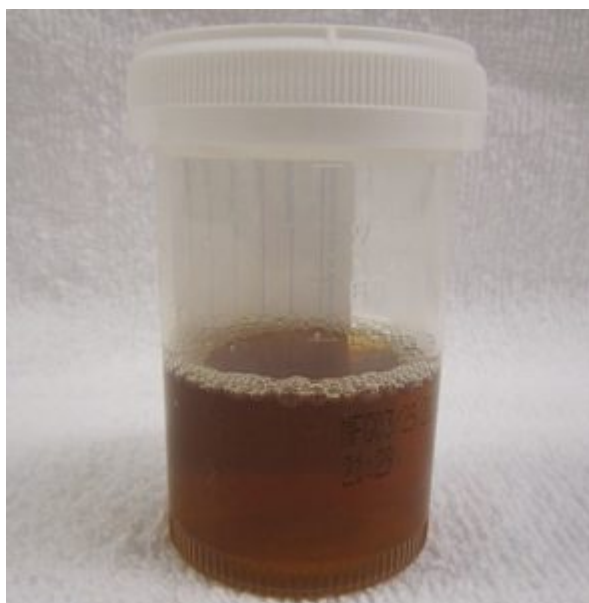
Approach to a Polytrauma Patient with Significant Extremity Injury

When you encounter a trauma patient with significant extremity injury, it is **important to be systematic** and not to jump to the treatment of the most obvious injury of the limb. The first step is to follow the [ABCDE approach](#) with cervical spine immobilization if needed.

The ABCDE approach in a trauma patient takes into considering the **airway, breathing, circulation, disability and exposure injuries** of the patient. The next step in the systemic approach is to address life-threatening extremity injuries before limb-threatening injuries.

The following points summarize how one must approach a polytrauma patient with significant life-threatening extremity injury:

- Apply a pelvic binder
- Start hemostatic resuscitation
- Correct any coagulopathy in any patient with proven or suspected pelvic fracture with major hemorrhage.



[Image](#): "A urine sample from a person with rhabdomyolysis" by James Heilman, MD. License: [CC BY-SA 3.0](#)

If major arterial hemorrhage is seen in a patient with a limb injury, a direct pressure should be applied to the injured artery. A tourniquet might be used. Adequate fluid resuscitation is important to keep urine output above 2 ml per kg per hour and early treatment of hyperkalemia can prevent crush syndrome.

Once life-threatening extremity injuries are addressed, the focus should be directed towards limb-threatening injuries.

Open fractures should be cleaned, fractures must be reduced, and a splint with limb elevation is indicated. Antibiotics might be needed to prevent infection. Assess neurovascular status, arrange for fasciectomy and aim to prevent compartment syndrome from happening or to treat it as early as possible if occurred.

If traumatic amputation occurs, the amputated part should be kept clean and soaked in a saline gauze. Ice might be applied to the amputated part. Reimplantation should be considered as early as possible. It is important to measure the ankle-brachial index and check peripheral pulses to document the vascular status of the injured limb. Early CT angiography and proper surgical intervention are very important in saving the injured limb.

Supportive Management of a Patient with an Extremity Injury

Analgesia should be started as early as possible. Pain is going to affect the patient's vital signs and might be disabling to the patient. Antibiotics should be administered in severe open limb injuries. A tetanus prophylaxis dose should be given if indicated.

Splinting of the injured extremity with elevation might be limb-saving in some cases. After the injured limb is adequately assessed and early treatment is given, one should look for other injuries such as tendon rupture and treat them properly.

Complications such as compartment syndrome and neurovascular compromise should be recognized early and treated properly to save the injured extremity.

A decision must be made as early as possible with one of three options:

1. The patient can be treated at the emergency department and disposition to home is possible.
2. The patient needs to be admitted to the hospital for a delayed operative intervention or inpatient treatment.
3. The patient needs to go to the operative theater immediately to receive urgent life-saving or limb-saving surgery.

Crush Syndrome

Also known as **rhabdomyolysis**, is a syndrome caused by injury inflicted on to the skeletal muscles, where leakage of large quantities of potentially toxic intracellular fluid composition move into plasma. This results in disturbance in myocyte calcium homeostasis in its final pathway

Crush syndrome should be suspected in patients with a history of crush injury or entrapment injury who have the **following laboratory abnormalities:**

- Hyperkalemia, hyperphosphatemia, hyperuricemia, and hypocalcemia from

- soft tissue and muscle cellular damage
- Lactic acidosis
- Elevated creatine kinase and myoglobinuria from massive muscle damage
- Acute renal failure and anuria due to [rhabdomyolysis](#)

Patients with crush syndrome should **always receive a complete neurological assessment** looking for motor weakness, loss of sensation, neuropathic pain, or paresthesia. Compartment syndrome and vascular compromise should be excluded in all patients with crush syndrome.

Signs and Symptoms of Crush Syndrome

Rhabdomyolysis comprises the following:

- Myalgias
- Generalized muscle weakness
- Darkened urine

More nonspecific clinical symptoms include nausea, fever, and vomiting. Most important point to note is that the presentation varies considerably.

In several cases, history reflects the underlying possible causes that may include the following:

- Alcohol and illicit drug use and their resultant unresponsiveness
- Metabolic disorders
- Infection
- Trauma
- Inflammatory myopathies
- Use of prescribed medications
- Heatstroke

Management of Crush Syndrome

The management of crush syndrome can be summarized in the following – adequate intravenous resuscitation with [Hartmann's solution](#) is key in correcting hypoperfusion, lactic acidosis, and acute renal impairment. Sodium bicarbonate administration is controversial and should not be routinely used. Management of rhabdomyolysis is inclined primarily with correct management of fluid and electrolyte anomalies.

Mannitol is used in some centers, however, there is no proven evidence that it actually works in crush syndrome. Calcium gluconate, salbutamol, insulin or even hemodialysis might be needed to correct hyperkalemia in severe cases.

Associated injuries should be treated such as:

- Fractures
- Dislocations
- Wounds
- Neurovascular injuries

Analgesia, antibiotics, and tetanus immunization are indicated. Imaging studies including x-rays and computed tomography scans are indicated to assess the integrity of bone and vascular systems.

Traumatic Amputation

Traumatic amputation is an obvious injury. The severed nerves are very painful to the patient. **Replantation should be attempted within 6 hours after amputation.** The time is calculated using the concept of warm ischemia: time until the amputated part was put in ice and saline.

Multidisciplinary work is key to success in replantation of a traumatic amputation. The general surgeon, vascular surgeon, plastic surgeon, and orthopedics should work together for the sake of the patient and for optimum results. The amputated part might be irrigated with normal saline but should not be debrided.

The following features make the success of replantation more likely:

- Short warm ischemia time
- Amputation of thumb or index fingers
- Traumatic amputations in children
- Multiple amputations
- Upper limb amputations compared to lower limb amputations

Unfortunately, major trauma patients who require emergency surgery and resuscitation for other purposes rather than their extremity injury are not candidates for replantation surgery.

Neurological Compromise in Extremity Injury

If a vascular injury is present, one must suspect there is neurological injury as well. Loss of function, weakness, areflexia, paresthesia, and sensory loss are all **markers of nerve injury**. Transected nerves require operative treatment within 24 hours of neurological recovery.

Degloving Extremity Injuries

The injured limb should be cleaned, and the wounds should be covered with saline-soaked dressings. A plastic surgeon should be consulted urgently. Analgesia, antibiotics, and tetanus prophylaxis should be given if needed. **Any amputated parts should be preserved and reimplanted** if possible to the injured limb. Skin flaps and grafts aim to prevent necrosis of the underlying structures.

References

<https://lifeinthefastlane.com/ccs/extremity-injuries/>

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