Chapter 23

Amputations

Introduction

Battle casualties who sustain amputations have the most severe extremity injuries.

- Historically, 1 in 3 patients with a major amputation (proximal to the wrist or ankle) died, usually of exsanguination.
- Although complete and near-complete traumatic amputations are visually dramatic, attention must be focused on the frequently associated life-threatening injuries, including control of ongoing hemorrhage from the damaged limb(s).

Goals for initial care are to preserve life, prepare the patient for evacuation, and leave the maximum number of options for definitive treatment.

Indications for amputation following trauma:

- Partial or complete traumatic amputation.
- Irreparable vascular injury or failed vascular repair with an ischemic limb.
- Life-threatening sepsis due to severe local infection, including clostridial myonecrosis.
- A patient in extremis with severe soft-tissue and bony injuries to the extremity precluding functional recovery.

The surgeon must balance the realistic likelihood of ultimate reconstruction of a functional extremity against the risk of death associated with attempts to preserve a limb. It is always desirable to secure the opinion of a second surgeon before amputating. The tactical situation or the patient in extremis may require amputation in cases where the limb might otherwise have been salvaged.

- Battlefield amputations are unique.
  - Most commonly due to explosive munitions, with penetration and blast effects (see Chapter 1, Weapons Effects and War Wounds).
  - Involve a large zone of injury with a high degree of contamination, which may affect the level of amputation and/or reconstructive options.
  - Require staged treatment, with evacuation out of the combat zone prior to definitive closure.

Amputations should be performed at the lowest viable level of soft tissues, in contrast to traditional anatomical amputation levels (eg, classic above the knee, below the knee, etc) to preserve as much limb as possible. In general, a longer residual limb is desirable for final prosthetic fitting, and initial preservation of all viable tissues maximizes the reconstructive and coverage options available at higher levels of care.

The open **length preserving amputation** procedure has two stages: initial and reconstructive.

- **Initial**—Complete the amputation at the lowest possible level of bone and prepare the patient for evacuation to the next level of care.
- **Reconstructive**—Involves final healing of the limb to obtain the optimal residual limb.
- **Note: The final level of amputation and definitive treatment of the residual limb should occur in the stable environment of a CONUS hospital, not in the combat zone hospital.** In the case of host nation casualties or enemy combatants, wherein evacuation is not an option, several debridement and irrigation procedures are generally indicated prior to attempting definitive amputation and closure to prevent high wound failure and infection rates.

- All viable skin and soft tissues distal and proximal to the indicated level of bone amputation should be preserved for use in subsequent closure of the amputation stump. These tissues may be considered "flaps of opportunity" and can add length to the stump. This is especially true for amputations below the knee. Short tibia limbs can be saved with posteriorly based flaps because the gastrocnemius and soleus are frequently preserved following blast injury. To save length, any shape or form of a viable muscle or skin flap should be preserved. Preservation of even oblique or irregular soft-tissue flaps or viable bone lacking distal soft-tissue coverage maximizes the reconstruction options at higher levels of care. Late free tissue coverage can sometimes salvage functional joint levels. Therefore, residual viable tibia (if distal to the tibial tuberosity) should be preserved initially, even if the remaining soft tissues would not initially permit wound closure.

Technique of Amputation

- Surgical preparation of the **entire** limb: to allow for evaluation of planes of injury that may be much higher than initially evident and allow access to the potential need for proximal vascular control.
- Tourniquet control is mandatory. If a tourniquet was placed in the prehospital setting for hemorrhage control, it is prepped entirely within the surgical field.
- Excise nonviable tissue.
  - Necrotic skin and subcutaneous tissue or skin without vascular support.
  - Muscle that is friable, shredded, grossly contaminated, or noncontractile. (This muscle is usually at the level of the retracted skin.)
  - Bone that is grossly contaminated or devoid of soft-tissue attachment for blood supply. Bone is transected at its lowest viable level, regardless of the residual soft-tissue coverage.
- Identify and securely ligate major arteries and veins to prevent hemorrhage in transport.
- Identify nerves and transect them at the level of available muscular coverage to minimize patient pain due to dressing

changes. More proximal traction neurectomy is best reserved for the definitive closure procedure at higher levels of care. Initial traction neurectomy may preclude further reconstructive options at definitive closure as the final level of amputation may be well proximal to the initial level of viable tissue debridement. Ligate the major nerves if they are bleeding (eg, sciatic); tagging of major nerves with colored suture is reasonable, but not mandatory.

- Preserved muscle flaps should not be sutured, but should be held in their intended position by the dressing.
- Flaps should not be constructed at the initial surgery to facilitate later closure.

In blast injuries, particularly landmine injuries, the blast forces drive debris proximally along fascial planes. It may be necessary to extend incisions proximally parallel to the axis of the extremity to ensure adequate surgical debridement of the wound. Each successive debridement should explore all intermuscular and fascial planes to avoid missing areas of purulence or necrosis, without devascularizing the remaining skin flaps.

The residual limb is never closed primarily.

- **Special considerations.**
  - Primary Symes (ankle disarticulation) has a high failure rate due to heel pad necrosis during transport. The wound should simply be debrided, retaining the clean hindfoot (talus and calcaneus).
  - Primary knee disarticulation is problematic due to skin and tendon retraction necessitating reamputation at a higher, often less functional level. It is preferable to leave even a very short (1–2 cm), clean transtibial stump—even though nonfunctional—to prevent retraction, as well as to preserve as much patellar tendon, gastrocnemius, and distal skin as possible.
  - Fractures, when present proximal to the mangled segment, should not determine amputation level, but must be treated appropriately (cast, external fixator) to preserve maximal length and salvage functional joint levels.

- Plan the initial amputation solely on the qualities of the wound and surrounding tissues, never on the hope of achieving a particular level or flap pattern as a final result. The combat surgeon's goals are patient survival, hemostasis, and a thorough and complete debridement. Trying to preserve marginal tissue in the hope that a better stump can be constructed may lead to subsequent infection and a more proximal amputation level.
- For high transfemoral and more proximal amputations (ie, hip disarticulation or hemipelvectomy), particularly when bilateral injuries are present, proximal vascular control via exploratory laparotomy and temporary clamping of the common iliac vessels and/or infrarenal aorta and inferior vena cava can be lifesaving. When this is performed for bilateral proximal amputations, complete proximal fecal diversion with distal colonic washout should be strongly considered concurrently, independent of abdominal injuries, to prevent fecal contamination of wounds.

Dressings and Prevention of Skin Retraction

Because amputations must be left open, skin retraction is likely, causing the loss of usable limb length and making definitive closure difficult. This is particularly true of a patient who is in the evacuation chain for a prolonged period.

Skin Traction

Ideally, skin traction should be maintained throughout the course of treatment. If evacuation times are reliably very short (1–3 days), skin traction may be omitted. If there is the possibility of any delay, use skin traction to preserve limb length. When tactical conditions or resources are not available for application of casts, skin traction may be applied through weights off the end of the bed before and after transport.

- Dry, fine mesh gauze is loosely placed over the open wound. Preserved flaps are not suspended freely, but are held in their intended position by the dressing (Fig. 23-1).
- Absorbent dressing is placed over the residual limb.
- Tincture of benzoin is applied proximally on the skin up to 2 cm from the wound edge, but not including the preserved flap.

- A stockinette for skin traction is applied.
- Wrap the stockinette with a figure-of-8 elastic wrap.
- 2–6 pounds of traction are applied through the stockinette/wrap. This may simply involve a weight attached via parachute cord to the stockinette. However, during transport, hanging weights are problematic and may be substituted with light elastic, such as surgical tubing or elastic exercise tubing applied through a transportation cast as described below.
- A transportation cast may be applied to prevent contracture

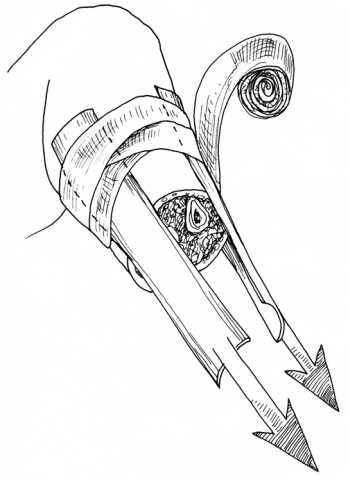

Fig. 23-1. Skin traction.

and allow for continuous traction.

Vacuum-assisted subatmospheric wound therapy dressings may be placed prior to evacuation only if reliable maintenance of suction can be expected during transport and on arrival at the next level of care. If a subatmospheric wound dressing is used, skin traction and countertraction can be achieved via a combination of negative pressure from the device and opposing skin tension using running tied vessel loops over the reticulated open cell foam and secured under tension to the skin edges with staples.

Postoperative Management

- Prevention of contracture.
  - Below-the-knee amputations are at risk for knee flexion contractures. These contractures are preventable by using a long leg cast or splint. Splinting in extension requires closer monitoring and meticulous cast padding placement and cutouts over the patella. Pillows should never support the knee because of the increased risk of flexion contractures.
  - Above-the-knee amputations are at risk for hip flexion contractures. Prone positioning and active hip extension exercises will avoid this complication. When the casualty is supine, sandbags may be also applied to the anterior distal thigh.
- Prevention of hemorrhage: a tourniquet should be readily available at bedside or during transport for the first week following injury.
- Pain control: patient comfort is paramount following amputation, particularly if dressing changes are required. Adequate analgesia should be available, and the patient should be counseled regarding phantom limb pain/sensations.

For Clinical Practice Guidelines, go to http://usaisr.amedd.army.mil/clinical_practice_guidelines.html