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Review article

Review of urgent care for open fractures

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Abstract: A review of the current state of urgent management of open fractures is presented, a common pathology in our environment whose management every traumatologist should know. This pathology is characteristic of young men in high-energy impacts (traffic accidents), but its incidence is becoming more frequent in elderly women in low-energy mechanisms. The initial management of the open fracture should be identical to that of the critically ill patient, and until life-threatening medical pathology is ruled out, the open fracture should not be evaluated. During treatment, the most important thing is early antibiotic prophylaxis and early debridement. Although the stabilization of the fracture can be deferred, it is important to perform it at the same time as debridement, as well as wound closure. Once the pathology has been treated in the emergency room, deferred definitive treatment should be considered, as well as the start of rehabilitation.

early.

Keywords: Open fracture, antibiotic prophylaxis, debridement.

1. Epidemiology

The incidence of open fractures depends on the characteristics of each country and culture. Studies estimate for European countries an incidence of between 3-20 open fractures per 100,000 inhabitants each year [1-2]. Although the most representative mechanism of action is high-energy trauma secondary to a traffic accident in a young man, these only account for 20% of the total and open fractures are increasingly common in elderly women with low-energy trauma [1- 6]. The most typical location in high-energy mechanisms (between 20-50% depending on the series) is the distal tibia with great repercussions on the soft tissues, making these injuries a real problem for trauma surgeons. However, in low energy accidents - and in the total compendium of open fractures, since low energy mechanisms are more incident - the phalanx is the most frequently injured bone [4,5].

2. Classification

Despite the multiple classifications (Mangled Extremity Severity Score, Injury Severity Score, NISSSA, OTA 2010…) the most used in our setting and in the literature is the Gustilo and Anderson 1984 classification (Table 1) [4,7]. .

TABLE 1. Gutilo and Anderson 1984

	Size	Contamination	Soft parts	Fracture
Gustilo I	<1cm	clean	Minimum	single stroke
Gustilo II	>1cm	moderate	Avulsion or flap	
Gustilo III	Not valuable	polluted	extensive damage	unstable fracture
A			adequate coverage	
B.			Requires reconstruction techniques	
C.			Arterial damage requiring repair	

The major criticisms of Gustilo's classification are its low degree of description of bone and soft tissue damage, and the considerable interobserver variation, especially among inexperienced surgeons. However, it is an easy-to-understand classification, it incorporates prognostic information, and since most studies have taken it as a reference, practically all protocols and clinical guidelines use it in their algorithms [6,8].

3. Immediate attention

3.1. initial evaluation

Since open fractures are often associated with high-energy accidents, the clinician must learn to routinely rule out injuries that put the patient's life at immediate risk. Following the ATLS principles, once the patient's airway, breathing, and circulation are secured, the only three musculoskeletal conditions that require immediate attention are 1) massive hemorrhage in traumatic amputation; 2) bilateral femoral fractures; and, 3) massive traumatic rhabdomyolysis [9].

Once the association of these pictures with the open fracture has been ruled out, the Guide marked by the BAPRAS for the evaluation of the patient with an open fracture:

1. Perform neurovascular examination.
2. Remove coarse contamination.
3. Photograph the wound.
4. Cover the wound with moist compresses containing saline without antiseptics.
5. If there is a dislocation, perform a closed reduction. If this is ineffective, the member in the position found.
6. Immobilize the fracture with a splint.
7. Repeat the neurovascular examination.
8. Administer antibiotics.
9. Assess the administration of tetanus prophylaxis.
10. Take orthogonal radiographs.

No debridement should be attempted in the emergency room, nor should a "digital" exploration of the wound be performed. It is also not recommended to wash the wound since it only transports dirt particles into the wound. Wound management at this time should be restricted to removing gross dirt, photographing the wound, and sealing it until the operating room [8].

A secondary evaluation of the patient should be carried out in order to discover soft tissue injuries or fractures that initially went unnoticed as well as to evaluate the appearance of muscle necrosis or the dreaded compartment syndrome [8,9].

3.2. wound culture

Performing a wound culture in an open fracture and when to perform it is a widely debated topic in the literature. Currently, the evidence suggests that cultures should not be routinely performed, and would only be recommended for fractures that occur in unusual or marine environments. In the case of being performed, cultures are usually valid after debridement and not before, since the flora mostly involved in surgical site infection corresponds to that of the hospital environment [4,6,10]

3.3. Tetanus prophylaxis

Despite the fact that there is no consistent clinical evidence, the guidelines advise administering the Tetanus prophylaxis in the emergency room using tetanus toxoid vaccine.

In patients with incomplete immunization, the vaccination program should be completed and tetanus immunoglobulin 250 units IM should be co-administered in children over 10 years of age and adults with incomplete immunization. In the case of very dirty wounds, with more than 12 hours of evolution or if the patient weighs more than 90kg, another dose of 250 IM units can be administered [6,8].

3.3. Systemic antibiotic prophylaxis

Open fractures not only damage the bone but also the soft tissue and neurovascular structures of the muscular compartment. These lesions render irrigation ineffective in the damaged tissues. Hypoperfusion together with the contamination typical of the injury mechanism make open fractures a suitable environment for bacterial proliferation [4].

Antibiotic prophylaxis should start as soon as possible, especially before the first 3 hours. Surgical site infection rates are low in Gustilo I and II types only with close coverage against Gram + -eg. with first generation cephalosporins the infection can be stopped. Although there is still no high-impact evidence to support it, it is recommended that in Gustilo III fractures treatment against Gram be added - using third-generation cephalosporins or aminoglycosides. Penicillin may be added if the wound is especially contaminated with fecal material. In those allergic to beta-lactams, clin damycin 600 mg/kg instead of cephalosporins seems a suitable option [4,6-8,11].

Although the prevalence of MRSA is increasing, there is no evidence that adding glycopeptides is more successful than protocols without this antibiotic. Regarding fluoroquinolones, there is no evidence of their superiority over cephalosporin + aminoglycoside, and their deleterious effect on fracture healing is known, so they should be avoided [8,11].

The antibiotic should not be administered more than 24 hours for Gustilo I fractures. For Gustilo II-III fractures, prophylaxis should be extended up to 72 hours or up to 24 hours after definitive closure of the soft tissues, whichever occurs earlier [4,6, 8.11].

Following this evidence, the BAPRAS recommends:

1. Cefuroxime 1.5g/8h IV as soon as possible until debridement.
2. New dose of cefuroxime and gentamicin 1.5 mg/kg from debridement, maintained do cefuroxime until definitive closure or up to 72h, whichever occurs earlier.
3. There is evidence on adding gentamicin 1.5 mg/kg with vancomycin 1g or teicoplanin 800 mg at the time of anesthetic induction of definitive closure, thus improving infection rates. This medication should not be continued postoperatively [8].

3.3. Local antibiotic prophylaxis

The administration of local antibiotic therapy only has significant evidence in type III Gustilo fractures with polymethylmethacrylate cement impregnated with aminoglycosides. Its potential benefits are to increase the concentration of intralesional antibiotics while decreasing their systemic load: thereby reducing their side effects and the need for more antibiotic therapy [4,6,8].

4. Primary surgical intervention

The first surgical intervention should prioritize surgical debridement and stabilization of the lesion.

4.1. Timing

The treatment of open fractures has classically involved an emergency whose treatment should not be postponed for more than 6 hours. However, this guideline has very little supporting literature and an increasing number of articles suggest that primary surgery can take up to 12 hours without increasing infection rates. The most relevant factors for prognosis are 1) the Gustilo grade; 2) early administration of antibiotics; and 3) that the surgery is carried out by qualified personnel; and not the time until the first surgery.

Emergent surgery would only be recommended if contamination carries a risk of clostridial infection (faecal or marine water), is associated with compartment syndrome, vascular injury, or other lesions [4,6,8]

4.2. debridement

Early debridement performed by experienced surgeons is a fundamental pillar in the treatment of open fractures. The goal is to remove all necrotic or contaminated tissue.

so that the open fracture heals in sterile conditions similar to those of the closed fracture.

Before starting the intervention, the wound should be reassessed and the fracture reexplored medi before the intensifier before starting the intervention.

The limb should be washed with a soapy solution and brushed to remove surface particles. Subsequently, the field will be prepared with the antiseptic solution. The use of the tourniquet is controversial, although it should be avoided in injuries that have distorted the anatomical architecture due to the risk of neurological injury, its use is usually preferred because it facilitates examination of the injury.

The evaluation must be carried out by plans systematically. Although the skin and subcutaneous tissue often go unnoticed, the "zone of injury" must be taken into account. There are two meanings for this term; according to the AO, the "zone of injury" is the true size of the injury beyond the visible skin wound; according to the BTLS it involves that region of the skin and the TCS apparently healthy but at risk of devitalizing after hours. In both cases, the conclusion is the same, it is important to explore the wound following the fasciotomy lines.

The muscle must be evaluated following the rule of the four "C"s: 1) color (pink); 2) with traction; 3) consistency (muscle tears with forceps); and 4) bleeding ability. Large neurovascular structures must be preserved and repaired.

The vitality of the bone can be evaluated by means of the "tug test": any bone fragment that is easily detached by pulling must be extracted since it is not vascularized. For the largest fragments whose blood supply is unclear, it can be punctured with a needle hypodermic on the inserted soft tissues: if these do not bleed, the bone tissue they contain will become necrotic, so it must also be removed The paprika test (bleeding from the ends of the fractures and from the cortical surface) can produce false positives due to the contribution of healthy tissues.Intramedullary bleeding should not be confused with the viability of the bone.For all this study it is better that the tourniquet does not drain the field.

Bone fragments cannot serve as a graft: necrotic and avascular bone does not favor union but rather infection. The exception to this rule will be the fragments with cartilage that contribute to joint stability, these must be washed and cured before being reduced by absolute fixation. If this absolute fixation is not achieved, the bone fragment will be lost and will contribute to infection.

If the wound does not allow for systematic debridement, a "Second look" can be repeated after 24-48h, although the AO tolerates serial debridement, the BAPRAS guideline recommends it [4,6,8].

4.3. Washed

The washing will be done when the wound is clean. Lavage does not replace the removal of the fragments of coarse contamination that should be carried out throughout the debridement.
Even without scientific evidence, the most commonly used rule is 3L for each degree of Gustilo (for the amount that saline bags usually contain).

Although there is a belief that high-pressure washing is more effective, the FLOW study and others have demonstrated its deleterious effect on bone regeneration and its ability to transport bacteria deep into the wound. For this reason, low pressure washings are currently recommended due to their efficiency and cost-effectiveness. High-pressure pulsatile lavage should be reserved for wounds that are already infected or heavily contaminated.

The use of physiological saline is consistently recommended over other agents because it is more cost effective, less irritating, less cytotoxic, and is associated with fewer reinterventions, despite being less effective. Antiseptics are associated with cell toxicity, antibiotics impede wound healing, and surfactants are associated with higher reoperation rates [12].

4.4. Stabilization

Once the wound has been debrided, the reduction and fixation of the fracture must be carried out. It is important to point out that although the reduction and fixation of the fracture should be performed as soon as possible, and if possible at the same time as the debridement, it corresponds to another surgery, and therefore a new sterile field must be prepared, another one must be used. surgical material and surgeons and nursing team will have to wash and glove again.

A stable fracture prevents soft tissue damage and multi-organ failure due to systemic inflammatory syndrome, facilitates wound and patient care, and allows early recovery of the limb. Therefore, the fracture must be stabilized as soon as possible.

Fixation methods are the same as for closed fractures: external fixators, plates, or pins may be used, although with certain conditions. Gustilo I fractures can be treated as a closed fracture. Regarding the Gustilo II and III fractures, the decision is more controversial. According to the BCLS, the following must be taken into account:

1) Anatomy of the fracture. The best management for shaft fractures of the radius, ulna, and humerus is plate fixation. Minimally invasive anatomical locking plates are also of choice for periarticular locations. However, plate should be avoided for fixation of open tibial fractures due to the high risk of infection (20-40%). Pins are preferred in the shaft of the lower limb with minimal bone loss. For fractures with extensive bone loss, comminuted or multilevel articular fractures, or those associated with joint instability, the external fixator continues to be the gold standard.

2) Time to coverage. If the wound can be closed at the same time as stabilization with either sutures or flaps, internal fixation is preferable over external fixation without increased infection rates. If the wound cannot be closed at the time of the intervention, the external fixator is the choice.

3) Degree and location of bone tissue loss. If the loss of bone tissue is minimal, it can be treated with external or internal fixation with bone graft; but if the loss is greater, the external fixator with bone transport techniques is preferred.

4) Degree of contamination. Internal fixation should be avoided in heavily contaminated wounds.

In conclusion, for slightly contaminated fractures, which can be covered immediately and with little bone loss, internal fixation is preferable because it is superior in 1) maintaining bone alignment; 2) preserve bone vascularity; 3) have lower re-surgery rates; and, 4) better tolerance rates. However, external fixation should be reserved for complex fractures or fractures with extensive bone loss, difficult skin coverage, or high contamination, despite the risk of 1) malalignment; 2) delayed consolidation; 3) infection of the pins; and, 4) the low tolerance of the patient [4,6,8].

4.5. wound closure

Wound closure should be performed as soon as possible, ideally at the time of delivery. debridement and stabilization of the fracture and preferably within the first 72 hours.

Despite the theoretical risk of infection with anaerobic bacteria, primary closure of a wound subjected to debridement and lavage is associated with 1) less morbidity; 2) shorter hospital stay; 3) lower costs, and 4) lower infection rate. If this closure must be deferred, negative pressure therapies have good results as bridging therapy. They should never be considered a substitute therapy for plastic covering.

High-concentration antibiotic-impregnated cement bullets covered with a semipermeable membrane appear effective, but the results have not yet been evaluated by clinical trials [4,6,8].

5. Results

The ultimate goal of open fracture management should be the normal functional recovery of the limb. Once the initial management in the emergency room has been carried out, the injury must be re-evaluated, and in the event that it requires secondary treatment, this must be planned and carried out promptly. Once the patient is able, they should start an early rehabilitation to maximize the early mobility of the limb. The two most serious complications are infection and nonunion [6,8].

6. Conflict of interest

The authors declare that there was no conflict of interest

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