CLINICAL CASE

COMPLEX TRAUMA OF THE LIMBS "LIMB AND LIFE THREATENING INJURIES"

T.C. Munteanu[1], D. Zamfirescu[1,3], M. Nagea[2], A. Dimitriu[2], N.Ciurea[2], Olivera Lupescu[1,2]
[1]The University of Medicine and Pharmacy "Carol Davila", Bucharest, Romania
[2]Orthopedic and Traumatology Clinic, The Emergency Clinical Hospital, Bucharest, Romania
[3]Plastic Surgery and Reconstructive Microsurgery Clinic, The Emergency Clinical Hospital, Bucharest, Romania

Corresponding author: Tiberiu-Ciprian Munteanu
Phone no. 0040748207070
E-mail: tiberiumunteanu@yahoo.com

Abstract

Complex limb trauma are extremely severe and pose a threat both to the patient's life, because of their systemic impact, as well as to the vitality of the traumatized limb, because of potentially severe septic complications. Post-traumatic (post fracture) osteitis is most often a consequence of an open fracture (always contaminated) or a closed operated fracture which was contaminated by pathogenic germs, the most common of which is Staphylococcus aureus (but Gram-negative bacteria, such as Klebsiella, Pseudomonas and Proteus are also worth mentioning). The consequence of an acute osteitis which was incompletely or inadequately treated is chronic osteitis, which requires long-term treatment, with inconsistent outcome results. To describe this topic, we present the case of a 15 year old pacient, which presents at the hospital as a surgical emergency, following a complex high energy trauma cause by a smash-up, whose survival and then healing, in spite of complete and correct approach, were extremely problematic/challenging, and called for a massive amount of human, financial and temporal resources.

Keywords*: crushing injury, haemoragic shock, osteitis, debridement, vascular graft, pluridisciplinary team*

Introduction

This paper aims to show the importance of a correct approach in case of a complex trauma of the limbs, and also the manner in which not only the integrity of the limb in question is endangered, but also the life of the patient. Such a trauma is caused by a high-energy traumatic agent. This energy is transmitted to the involved tissue, and often has an impact on all the structures of the limb, triggering nociceptive reflexes, initially responsible for the induction of the traumatic shock. Due to massive bleeding from the focal areas of the trauma, hypovolemia and acute anaemia rapidly ensue. These are collectively given the generic name of haemorrhagic shock, which endangers the patient's life immediately after trauma. Afterwards, due to the muscular injuries that occur with the crushing, muscular lysis products are released in the systemic circulation and lead to the crush syndrome which has significant effects on the body homeostasis. By renal and hepatic impairment, this can also lead to critical consequences a few days after trauma. Furthermore, there is the risk of systemic dissemination of potential local infectious complications. All these create life threatening circumstances.

Alongside the systemic impairment, there are also powerful local complications, considering that all tissues in the injured segment- bones, muscles, nerves, blood vessels, are affected. Due to the severity of the damage, after a complex trauma, there is the risk of serious complications which might threaten the integrity of the limb; the most serious of such complications is infection.

Initial massive contamination through lacerated wounds, which expose various areas of the subcutaneous tissues, creates a major septic risk, both locally, as well as generally.

Therefore, this can lead to the pathological entity called Traumatic (post-fracture) Osteitis which is an extreme complication of an open fracture, subsequently to a complex, high energy trauma by crushing. Responsible for this septic complication are varied pathogenic germs, the most common of which is Staphylococcus aureus, but Gram-negative bacteria, such as Klebsiella, Pseudomonas and Proteus are also worth mentioning. The magnitude of the septic consequences depends on the extent of bacterial contamination, damage to the bone and soft tissue, devascularization as well as on the quality of fracture care in the first stages of treatment. Clinically, there are 2 forms of Traumatic Osteitis: Septic pseudarthrosis and Osteitic Callus. In the first instance, infection occurs and the fracture fails to consolidate, and in the second one, infection occurs, the fracture consolidates, but with persistence of the infection, inducing an extended and hypertrophic process of hyperostosis [1].

Case report

The patient, 15 years old, was admitted to the emergency ward, unconscious, following a high energy complex trauma, produced by crushing of the left leg, with impact on the left thigh, knee and lower leg as a result of a road accident in which a car had collided with the scooter that the patient was riding, projecting him in a roadside ditch. Emphasis should be placed on the significant initial pollution (including soil contamination) of the wound, as it would be significant in the future evolution. For the wound that showed significant bleeding at the root of the left thigh, a tourniquet was applied by the regional service (situated 110 km away from the hospital) and afterwards the patient was emergently sent to Bucharest. Clinical examination in ER (emergency room) revealed traumatic and haemorrhagic shock state suggested by extreme haemodynamic instability (systolic blood pressure of 40 mmHg), signs of severe acute anaemia (Hb= 3,5g%ml), large wound of the thigh and left lower leg with extensive tissue laceration on 2/3 of the circumference of the left lower thigh and lower leg, abnormal mobility and bone crepitation at multiple levels of the left side inferior limb, minimal diuresis. The first goal of the therapeutic conduct was the salvage of the patient's life.

The life-saving protocol is:

- immediate notification of the multidisciplinary team: orthopaedic, cardiovascular and plastic surgeons etc.- rapid evaluation of the patient in the trauma room
- immediate resuscitation measures - parenteral supply and compression dressing at the basis of the thigh
- immediate notification of the OR (operating room) personnel
- no evaluation of the lesions of the lower left leg attempted in the trauma room because correct exploration and treatment of the wound must be carried out under circumstances that ensure the patient's safety, in all possible aspects, which are possible only in the operating room
- patient was transferred rapidly and directly to a place for the efficient treatment to be supplied: the OR .

Venous access on several I.V lines was set up - CVC (central venous catheter) and 3 large peripheral veins, compression was maintained at the level of the thigh, on the wound, rapid radiological intraoperative evaluation was performed with the C-arm, as well as swab sampling for bacteriological evaluation was performed from the wound.

After performing the radiological investigation, the following were detected: bifocal left femur fracture - femural diaphyseal fracture and distal epiphyseal separation, and Grade IIIB Gustillo-Anderson bifocal open lower leg fracture: displaced proximal comminuted epi-meta-diaphyseal tibial and fibular fracture and distal third of both tibia and

fibula fractures with injury of the Achilles tendon.

Figure 1 - Initial aspect of the wounds

Figure 2 - Extended deperiostation

Urgent surgery was performed according to the principles defining open fractures treatment, consisting of: mechanical, chemical and surgical cleansing. Detailed haemostasis of the thigh-wound by ligature of the femoral vein was carried out, followed by full and thorough exploration of the lower limb, revealing extended muscular periosteal lesions of the thigh (Figure 2). This outcome required wide and thorough debridement, with the excision of all necrotic and contaminated tissues as well as repeated chemical cleansing of the focal area; after that, a multiplane external fixation device (Figure 3) was implanted with the help of digital radiology in order to stabilize all lesions (from the level of the thigh to the level of the distal segment of the leg), ensuring that the metallic material in the focal area of the fracture was in minimal quantity.

Following the first intervention, due to the systemic impairment due to the severity of the initial trauma, the patient required one week of monitoring and treatment in the Intensive Care Unit, where sustained general treatment was performed, including blood transfusions, broad spectrum antibiotherapy, volume and electrolyte repletion, proteic support. At the same time, and of significant importance, the wound required repeated debridement in the operation room, at maximum 2-day intervals, under general anaesthesia. The evolution was slow, but favourable, with granulation of the cutaneous defects. (Figure 4) Administration of broad-spectrum antibiotics was continued, as the microbiological tests performed on the initially collected samples were positive for Klebsiella and Staphylococcus Aureus.

Figure 3 - External fixator for thigh, knee and lower leg

Figure 4 - Granulation of the cutaneous defects

The covering of skin damage also had positive results. The secondary suture at the level of the thigh and the split-thickness skin graft applied on the lower leg were very well integrated. Thus, the favorable evolution of the

infection and the consolidation of the multifocal fractures allowed for the extraction of the external fixation device.

Despite the healing of the wounds, on the internal surface of the thigh drainage was persistent through a fistula, and for this reason an instillation-aspiration system was used to clean the area. Because the drainage persisted, negative pressure therapy is also used, but it didn't lead to the disappearance of the fistula.

Figure 5 – Persistent drainage via a fistula on the inner thigh

Figure 6 – MRI positive for Post-traumatic osteitis

Under these circumstances, in order to determine the cause of this fistula with persistent drainage, an MRI investigation was performed, which revealed several pathological aspects: pseudarthrosis at the level of the femoral fracture, a massive sequestrum measuring approx. 20 cm, and the expansion of the infectious process at the level of the entire diaphysis, with the typical appearance of a pandiaphysitis of the left femur, and pathognomonic for this severe complication of open fractures – traumatic osteitis (Figure 6).

At this point, there were two theoretical indications: firstly, amputation, which would be supported by the expansion at the level of the coxofemoral joint (which, in this particular case, was a potential threat to the patient's life) and by the risk of major septic dissemination, both locally and generally. The age of the patient, specifically 15 years, the adequate equipment available in the hospital, and a team of skilled doctors willing to become actively involved, were all factors that decisively lead to choosing the second option. Therefore, it was decided to perform surgical treatment with preservation of the limb, sequestrectomy (Figures 7, 8) within safety limits, insuring bone stability by means of an external fixation device, followed by osteoplasty with the replacement of the remaining free space with a vascularised bone graft.

Figure 7 – Removal of the sequestrum

Figure 8 – Sequestrum removed

The bone graft was collected at contralateral peroneal level, together with vascular pedicle, and involved several steps:

1. Harvesting planning (Figure 9)
2. Harvested fibula with vascular pedicle (Figure 10)
3. Fixation of the bone graft with a condylar plate and 7 screws (Figure 11). Again, doctors tried to use as little metallic material as possible in the local area of the fracture.
4. Microvascular suture of the pedicle

Figure 9 - Harvesting planning

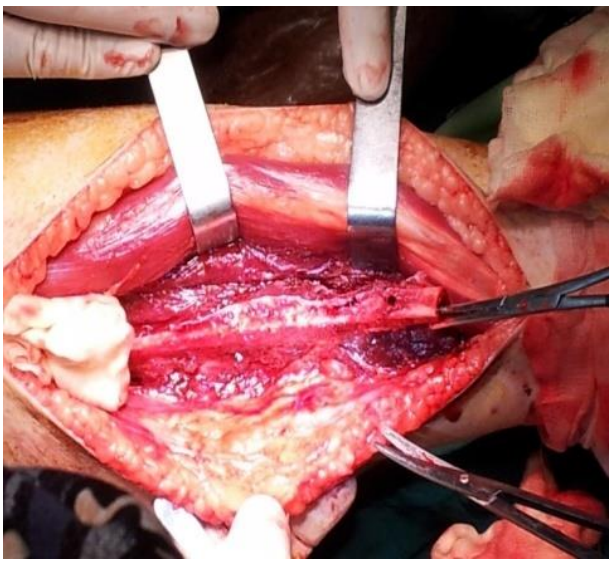

Figure 10 - Harvested fibula with vascular pedicle

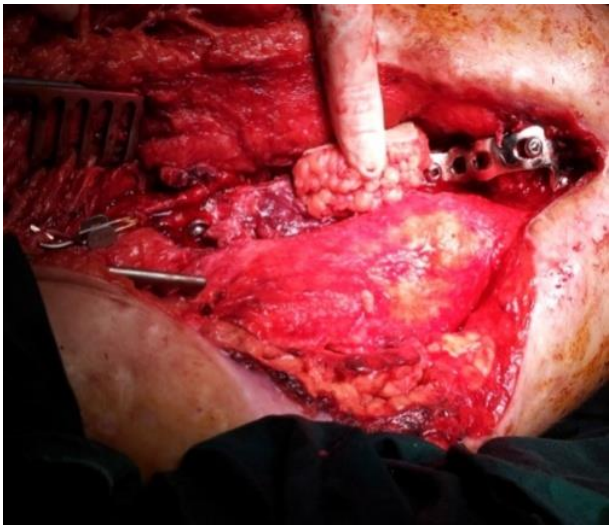

Figure 11- Fixation of the bone graft with a condylar plate

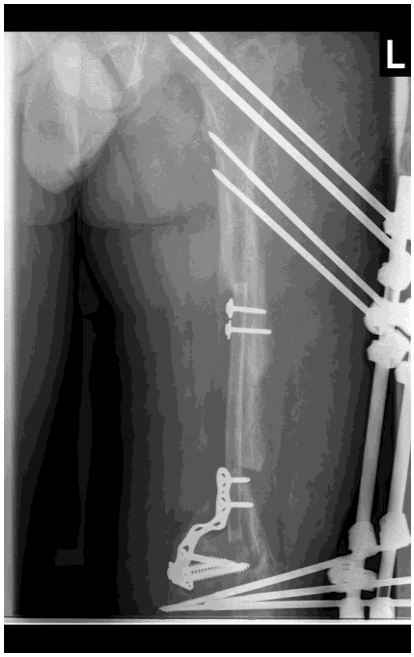

Figure 12 – Radiological aspect after the second intervention

The success of this approach was a result of cooperation among the members of a pluridisciplinary team – orthopaedic surgeons, plastic surgeons, anaesthesiologists and intensive care doctors, together with the OR personnel which ensured that the monitoring of the patient and all surgical intervention were carried out in safety and thoroughly.

The evolution was according to expectations; the bone graft was well integrated and began to consolidate. (Figure 13) The patient started progressive walking with the protective support of an external fixation device, which afterwards was removed and recuperation was resumed (Figure 14).

Taking into consideration the severity of the lesions caused by the initial trauma and the subsequent complications, postoperative treatment included primarily sustained musculo-articular recovery kineto-therapy, support on the behalf of the family, school and society for the socio-professional reinsertion and thrombo-prophylaxis, as well as multidisciplinary rigorous monitorization.

First year clinical examination from the last surgical intervention showed patient walking without crutches or any other external help, fracture healing, thus proving the effectiveness of the treatment (Figure 15).

Figure 13 - The bone graft was well integrated and began to consolidate

Figure 14 – After the removal of the external fixation device

Figure 15 – Clinical examination after the first year from the last surgical intervention

Discussion

Beyond the impressive trauma and initial assessment, the case presented here stands out due to several physiopathological, clinical, and not lastly social considerations. The rich

vascularisation in the affected areas meant that from the very beginning there was a high risk of massive bleeding. Following the crushing of strong muscles, significant quantities of anaerobic metabolism products were released in the systemic circulation, such as myoglobin or potassium, which are responsible for systemic complications, which did not take place on the grounds of proper monitorization and pluridisciplinar treatment. Despite the sustained treatment, the most redoubtable local complication arose, the infection, which led to a complex surgical intervention of thorough debridement. It was performed by an interdisciplinary team of surgeons, all other therapeutical measures being ineffective. Because of possible psychological consequences that could occur after the amputation, especially at such an early age, the doctors focused their efforts on saving the patient's limb, after securing his vital functions.

- As a consequence of initial significant contamination and extensive muscular injuries, the risk of infection proved to be substantial, wherefore, according to the international protocols all the necessary actions were carried out, in order to avoid such a situation: initial rigorous surgical debridement, repeated for multiple times later on, multiplane external fixation, other complex methods, adapted to the complex lesions.
- Behind all these operations, there was the key element - a multidisciplinary medical team: orthopaedists, plastic surgeons, vascular surgeons, anesthesiologists etc., assisted by nurses and other staff members, amounting to more than 70 people, who led to the success of the therapy and, implicitly, saved the patient's limb and possibly even his life. Therefore, we can purport that this case ascertains the gravity of complications of a severe trauma and the vital importance of the care deserved by it.

Conclusions

- This case illustrates the evolutional diversity of complex limbs trauma, which initially, endangers a patient's life, through traumatic and haemorrhagic shock and requires sustained local and general, resuscitation and rebalancing measures.

References

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