Time is a Valuable Ally in Polytrauma: A Case Report

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Abstract: The Authors report a case of a 24 years old girl involved in a car accident leading to polytrauma with upper and lower limb multiple fractures. The patient was treated with initial damage control orthopedic interventions and then, at a later time, with definitive surgery. The greatest difficulty in the management of this clinical case was the planning of the definitive secondary stabilization interventions, since they could not all be done in a single step but not even in too many procedures. The decision-making process had also to consider the presence of numerous external fixation devices and therefore patient positioning was a crucial criterion for operative planning. This case emphasizes the importance of surgical planning in polytraumatized patients.

Keywords: Polytrauma, Surgical planning, Timing of surgery, Four-limbs fractures.

INTRODUCTION

Polytraumas, defined as severely injured patients presenting with two or more trauma lesions involving multiple body regions and in whom the combination of injuries would cause a life-threatening condition [1], represents serious emergencies, luckily rarely encountered.

They are usually the consequence of motor vehicle accidents or falls from high [2]. The management of polytraumatized patients has always been a challenge for orthopedics. During the last century many new protocols in prehospital care, resuscitation, and damage control orthopaedics (DCO) have standardized the treatment procedures for such patients.

For polytraumatized patients some procedures are fundamental: they must be admitted in a trauma center as soon as possible, where trauma teams have the necessary clinical experience and can set the best therapeutic options for patients [3].

Early administration of appropriate antibiotics is one of the major factors that has been shown to reduce complications of open fractures; debridement of open wounds is also important, but it can be delayed within 24 hours from the trauma [4].

In the field of orthopaedics, we observed the transition from Early Total Care (ETC) to DCO; this was the main innovation and its principles are still the cornerstones in the management of patients with multiple trauma [5].

The first phase in DCO is standardized control of hemorrhage and stabilization of fractures with external fixator, splinting or skeletal traction.

The last phase in DCO is the conversion to definitive fixation of fractures; this second stage must follow a precise timing, [6] historically if surgical procedures were thought to last more than 6 hours, it was advisable to postpone them to day 5-14 after trauma (the so called “opportunity window”) [7].

The main reason to postpone surgery is the rise of inflammatory mediators, such as Interleukin 6 (IL-6) and Interleukin 8 (IL-8), immediately after trauma; these mediators are proven to have a main role determining multi-organ failure (MOF) [8].

In young patients with no comorbidities it can be useful to dose the blood concentrations of IL-6 because it gives us information about the general state of the patient; if this value is not too elevated, surgery may be performed with a low risk of complications.

CASE REPORT

We report a case of a 24 yo Caucasian female who was admitted to the Emergency Room (ER) of San Raffaele Hospital, Milan, after a violent car accident. She was travelling as a rear passenger; the car fell from a causeway and crashed on a cement base.

Two other people were in the car with the patient: one of them died and the other one reported less severe injuries.

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E-ISSN: 2313-0954/19

On admission, the patient was found to have multiple injuries (between parenthesis AO classification fracture's system): distal right tibia fracture with an intact wedge third fragment (42B2) open multifragmentary diaphyseal right femur fracture (32C3) open multifragmentary left distal femur fracture (33C3.3) left and right alae of sacrum fractures + left and right ischium inferior ramus fracture (61B3) left 3rd and 4th base of the metacarpal bones fractures, left radius and ulna shaft fractures (2R2A3 2U2B2) multifragmentary left distal humeral fracture(13C3) left proximal humeral epiphysis fracture (11C3) multifragmentary right humeral shaft fracture(12C3c). She reported also a paralysis of the left common peroneal nerve and a paralysis of the left radial nerve [9].

Her medical condition was stabilized with blood transfusion and broad-spectrum antibiotic therapy. Six hours after the trauma her lower limb and pelvis fractures were stabilized with modular external fixators.

After 2 days from the trauma, IL-6 was dosed; since it resulted reasonably elevated, consistent with the previous trauma but not as elevated to predict an imminent MOF, we proceeded with definitive surgeries.

The pelvic external fixator was removed and the sacral fractures were fixed using two cannulated lag screws, the left radius and ulna shaft fractures were fixed with 2 locking plates and the left proximal humeral epiphysis fracture was fixed with a LC-DCP plate, tuberosities suture + bone substitutes grafting. 5 days after the trauma, after checking IL-6 level, her left distal humeral fracture was fixed with a posterior approach, splitting the olecranon and using an anatomic posterior radial plate, a medial plate and a lag screw.

Her right distal humeral fracture was fixed with a posterior trans-tricipital approach using an anatomic posterior radial plate. On the same surgery her metacarpal bones fractures were treated as well, with 2 percutaneous k-wires for each metacarpal bone.

Ascertained that IL-6 was once again in normal range, 10 days after the trauma the lower limbs external fixators were removed and the right femur fracture was fixed with a retrograde intramedullary nail, the right tibial fracture was synthesized with an intramedullary tibial nail and the left distal femur fracture was fixed with a Less Invasive Stabilization System (LISS) plate and (lag) screws.

The functional outcome was successful. The patient regained a good active and passive range of motion of the right superior and inferior limbs (ROM right elbow complete 0°-150°; right knee 0°-120°); the recovery of the left elbow (ROM 10°-95°) and knee (ROM 0°-110°) were slower because the fractures in these bone fragments were articular.

The patient was allowed weight bearing mobilization 40 days after the trauma. The complete range of

Figure 1: Preoperative images: 4 limbs fractures with high fragmentationand pelvic fractures.

Figure 2: Postop images: Emergent DCO and aubseguent ORIF of all the fractures.

motion of the left hand (ROM 90°) was obtained 1 month after the surgery. Partial left ankle dorsiflexion deficiency persisted.

DISCUSSION

Priority and optimal treatment of multiple fractures in motor-vehicle trauma is not univocally established. Once the patient is hemodynamically stabilized with

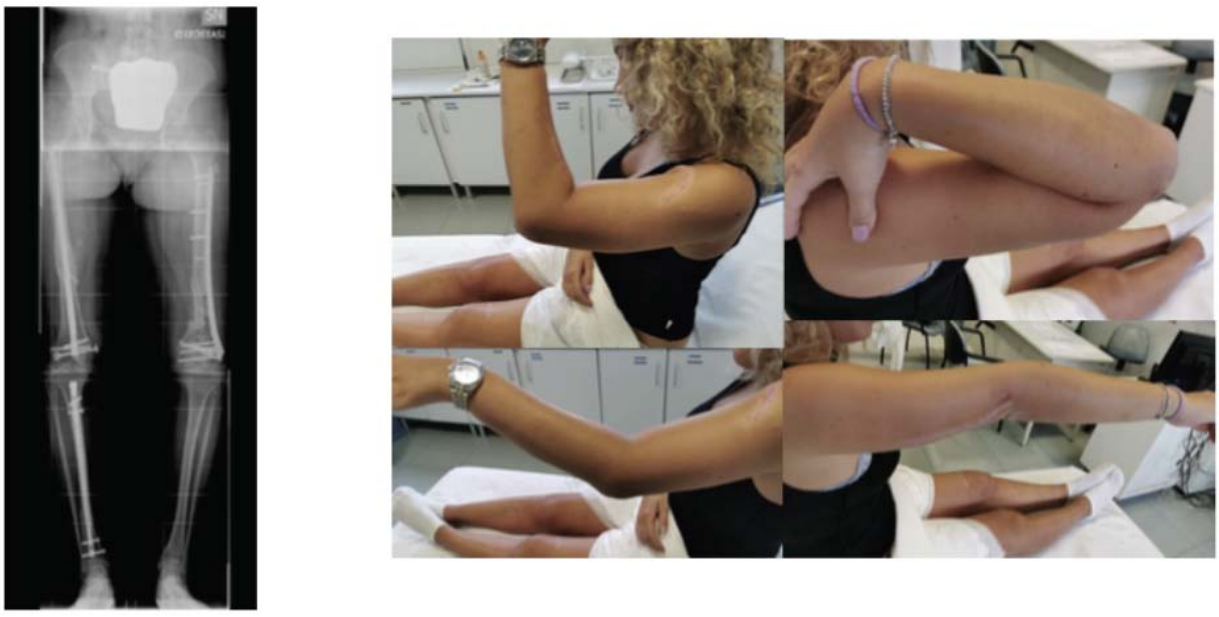

Figure 3: Postoperative images and clinical elbows outcome.

damage control treatment and the external-fixation provides control of life-threatening bleeding and bone segments dislocations, the correct sequence to address other fractures is not well defined.

This is due to the scarce availability of guidelines to address such complex injuries. These fractures result from extremely high energy traumas, usually from motor vehicle accidents or falls from great heights. In the case presented, as the car struck the ground with impressive force, it is difficult to estimate a single mechanism for all the fractures: a multi-hit theory only can explain such an injury pattern. The main challenge in the management of this case was both the type of definitive surgery and, mainly, the time of performing this surgery.

The “damage control” protocol and the position of the patient on the surgical table obliged us to follow a meticulous pre-planned pathway to approach in the best possible manner the different injured bones, avoiding at the same time the risk of MOF. The pelvic ring was the first to be definitively stabilized to avoid the risk of intrapelvic bleeding and to remove the external fixation; this was essential also to position the patient prone on the surgical table during the following operations.

On the same surgical session, fixation of the left proximal humerus and left forearm was performed to better manage the elbow articular fracture on the same side. All these three surgeries were performed with the patient on the supine position.

To avert the risk of MOF, blood level of IL-6 was measured before the operation: since the value was consistent with the recent trauma but not so high to predict an imminent multi organ dysfunction, we proceeded with the surgery [8]. In the second surgical session, performed 3 days later, we were able to lay the patient prone, so that we could treat the left elbow, eventually in the contest of a stable upper limb. This intraarticular fracture would have been much more difficult to reduce and fix without the nearby stabilization.

Lower limbs were fixed in a third surgical session, 10 days after the trauma and external fixation. The timing here was decided accordingly with the “window of opportunity” period, avoiding to perform the demanding surgical operation when the patient was most susceptible to suffer from post-traumatic immunodepression, generally between day 11th to 21st after the initial injury [10].

To further reduce the risk of a multi-organ failure triggered by a tough additional surgical operation, the type of surgery itself was planned with the aim of ensuring the lowest possible invasiveness. On the left femur we opted for a LISS plate plus lag screws, while on the right lower limb the same access was used for positioning the 2 nails, retrograde for the femur and anterograde for the tibia.

CONCLUSION

The timely and carefully planned surgical treatment, which in severe polytrauma must consider the risk of MOF and the patient positioning during different operations, supported the patient to overcome the surgical complications and provided better rehabilitation.

CONFLICT OF INTEREST

None.

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Received on 26-11-2019 Accepted on 24-12-2019 Published on 30-12-2019

DOI: http://dx.doi.org/10.12974/2313-0954.2019.06.3