sciendo Romanian Journal of Orthopaedic Surgery and Traumatology, Volume 1, Issue 2, July-December 2018. pp:78-83
doi:10.2478/rojost-2018-0084

CASE REPORT

Post Traumatic Multi-Injured patients. To wait, to operate or to use Damage Control Orthopedic template? A case report

Osama Al-Odat*, Mahmoud Mousa Odat, Ștefana Luca***, Mădălina Fotea***, Andrei Nicolae Avadanei***, Mateusz Zarzecki******

*Orthopedics and Trauma Surgery Department, Prince Hamza Hospital/ MOH, Amman, Jordan
**Arab Medical Center, Amman, Jordan
***"Grigore T. Popa" University of Medicine and Pharmacy Iași, Romania
****Medical University of Bialystok, Poland

Correspondence to: Osama Al-Odat, MD,
Orthopedics and Trauma Surgery Department, Prince Hamza Hospital/ MOH, Amman,
Fakhr Ad Din Ar Razi 12, Amman, Jordan,
Phone: +962 7 9831 3039, E-mail: osamaodat@odatorthopedics.com

Abstract

Purpose. Damage Control Orthopedics (DCO) is a surgical concept used in the recovery of seriously injured patients. Given that the leading cause of death among trauma patients remains uncontrolled hemorrhage, DCO emphasizes on preventing the "lethal triad" of acidosis, coagulopathy and hypothermia, rather than correcting the anatomy immediately. Thereby, we are presenting the crucial importance of using this technique in severe trauma cases.

Methods. A 23-year-old female was admitted in the Emergency Room as a multi-trauma patient. Following the Advanced Trauma Life Support protocol, fully exposure examination showed bilateral forearm and femur deformities, with bilateral open femur fracture, left ankle deformity and pelvic ecchymosis. X-rays confirmed fractures of the ribs, bilateral pulmonary contusion, fracture of the left ankle fracture, bilateral superior and inferior pubic ramus, and bilateral femur fractures with both bone midshaft fracture on the right leg. DCO was proceeded immediately, during which external fixators were placed on the fractures, while splinting both forearms. After 11 days in the Intensive Care Unit (ICU), the patient underwent the definitive surgeries.

Results. Managing the patient with the DCO protocol first and not rushing with the definitive surgical procedures resulted in a proper stabilization. After two years follow up, the patient fully recovered and returned to a normal life style.

Conclusion. Performing a definitive operation on severely injured patients results in deleterious effects that could lower life expectancy. Short-term physiological recovery should be prioritized over definitive management and DCO should be proceeded in order for the best outcomes to be achieved.

Keywords: DCO, ATLS, Intensive Care Unit, Polytrauma

Abbvreviations: Damage Control Orthopedics – DCO, Emergency Room - ER, Advanced Trauma Life Support – ATLS Intensive Care Unit (ICU)

Introduction

The management of the polytraumatized patient is a complex and challenging issue. Currently, controversies persist between two orthopedic approaches: the Early Total Care and the Damage Control Orthopedics [1]. Damage Control Orthopedics (DCO) is a surgical concept used in the recovery of severely injured patients so that their overall unstable state can be improved. Its purpose is to avoid the worsening of the patient's condition by the traumatic effects of a major orthopedic procedure and to delay definitive fracture repair until a time when the overall condition of the patient is optimized [2]. Clinical studies have demonstrated an increased incidence of multiple organ failure (MOF) after an initial definitive long duration surgery [3].

Given that the leading cause of death among trauma patients remains uncontrolled hemorrhage, the DCO emphasizes on preventing the "lethal triad" of acidosis, coagulopathy, and hypothermia, rather than correcting the anatomy immediately. In addition, DCO protocols follow the new dogma of treating polytrauma patients, Prompt-Individualized-Safe-Management (PR.I.S.M), based on a different way of response from the subjects [4]. Damage control orthopedics also focuses on the management of soft-tissue injury, achievement of provisional fracture stability, while avoiding additional insults to the patient (the second hit). Thereby, we are presenting the crucial importance of using this approach in a severe trauma case.

Materials & Methods

We present the case of a 23-year-old type I diabetic female, who was transferred to the Emergency Room in Amman – Jordan (Arab Medical Center) after being involved in a motor vehicle crash (MVC) as an unrestrained driver, which took place on the 18th of November 2016.

The MVC occurred due to the patient's altered level of consciousness during a hypoglycemic attack, resulting in her losing control of the car and hitting a truck that was driving on the other side of the road. The car accident involved 2 victims: the patient's mother, who was sitting on the passenger's seat, who died on the spot from severe traumatic brain injury with a depressed skull fracture, and the driver - our patient -, who was found unconscious with a deformed left forearm, both femurs and right leg.

The patient was received in the ER as multi-trauma patient post MVC, on oxygen mask 15 liter/ min flow, with cervical neck collar, on long spinal board with 18G IV cannula on her left arm. Considering her condition, Advanced Trauma Life Support (ALTS) protocol was proceeded:

A - the Airway was patent, no foreign bodies, no bleeding, no lost teeth, no signs of airway obstruction, no stridor, no obvious neck or face injuries;

B - the patient had 3rd, 7th,9th rib fracture on the right hemithorax and 4th, 5th rib fracture on the left side, bilateral pulmonary contusion, O2 saturation was 84%. There were no signs of tension pneumothorax, hemothorax or flial chest, so intubation was preceded;

C - Heart rate was 124 bpm, with a blood pressure of 80/ 45 mm Hg. ECG showed sinus tachycardia, ABGs showed pH of 7.278, pCo2 52, pO2 62.7, HCO3 23.8, O2 saturation 88%. 3 units of blood were given. Foley catheter inserted. Pelvis stability test was negative, bilateral lower limb traction was applied. BP became 100/ 60, pulse 105;

D - Glasgow Coma Scale (GCS): 7T, Pupils were reactive bilateral symmetrically;
E - Fully exposure of the patient revealed bilateral forearm deformities, bilateral femur deformities, left open patellar fracture with loss of the lower pole, left leg deformed, pelvic ecchymosis, and left ankle deformity. No other injuries on logrolling the patient.

Chest X-rays demonstrated significant injuries to the thorax, including the fracture of the 3rd, 7th and 9th rib on the right side and the fracture of the 4th and 5th rib on the left side. The other X-rays showed bilateral superior and inferior pubic rami fracture (unstable ring), bilateral femur fracture (right side midshaft segmental, left side midshaft transverse), open

patellar fracture with loss of the lower pole, left leg both bone midshaft fracture and left ankle fracture.

Fig. 1 Pelvis X-Ray, day of injury, November 2016

Fig. 2 Left leg X-Ray, day of injury, November 2016

Table 1. Blood tests prior to DCO 18.11.2016 – 07:19:15

Test Code/ Name	Result	Unit	Normal Range
Hb	**7.65**	g/ dl	12 - 16
PCV	**21.7**	%	37 - 46

Subsequent to the ALTS protocol and clinical examinations, the patient was immediately sent to the operation room for Damage Control Orthopedics (DCO) surgery, the right femur was fixed using external fixator, the fracture of the left femur as well, left leg was fixed using spanning external fixator - washout and debridement of the open patellar fracture - along with splinting of both forearms with backslabs.

Table 2. Blood tests subsequent to DCO 18.11.2016 – 13:00

Test Code/ Name	Result	Unit	Normal Range
Hb	**11.6**	g/ dl	12 - 16
PCV	**33.9**	%	37 - 46
RBC	**3.80**	10^6/ ul	4 – 5.5
MCV	89.2	fl	80 - 94
MCH	30.5	pg	27 - 31

PT	16.4	sec	11 - 15
INR	**1.3**		2 - 3.5

Results

Consecutive to DCO, the patient was sent to the Intensive Care Unit (ICU), where she spent 11 days on respiratory support, antibiotics, anticoagulation & close observation prior to being sent to the definitive surgery. The lactate level was 3.2 mmol/ L and the PH was 7.29 before the definitive surgery. During the definitive surgery, she underwent percutaneous screw fixation of the right superior pubic ramus, removal of the external fixators, retrograde interlocking nail for the left femur, and antegrade intramedullary nail for the left femur with reconstruction of the extensor mechanism after debridement and management of the open patellar fracture.

Ensuing the definitive surgery, the patient returned to the ICU for 4 more days and then

was transferred to the orthopedics ward, where she stayed for 12 days, afterwards being discharged home. Physiotherapy was started immediately and then followed for about one year. The patient's postoperative course was uneventful, with no complications and a remarkable healing as she went back to her normal life and function.

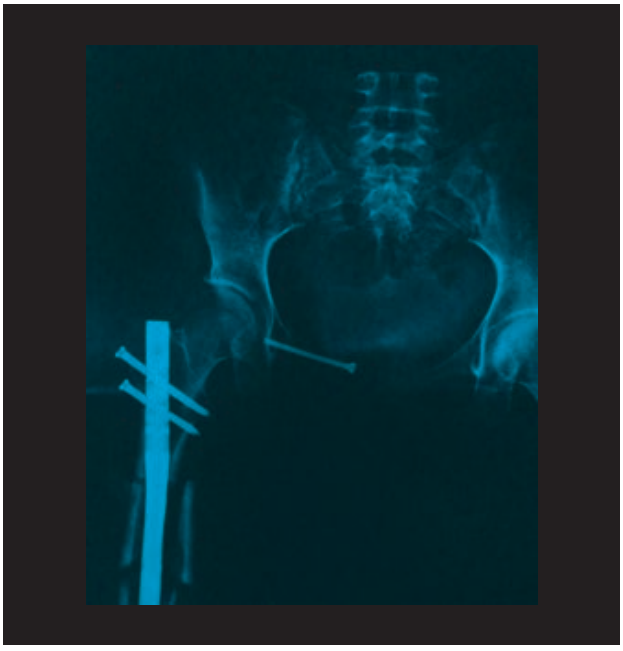

Fig. 3 Post definitive surgery X-ray, November 2018

Fig. 4 Post definitive surgery X-ray, November 2018

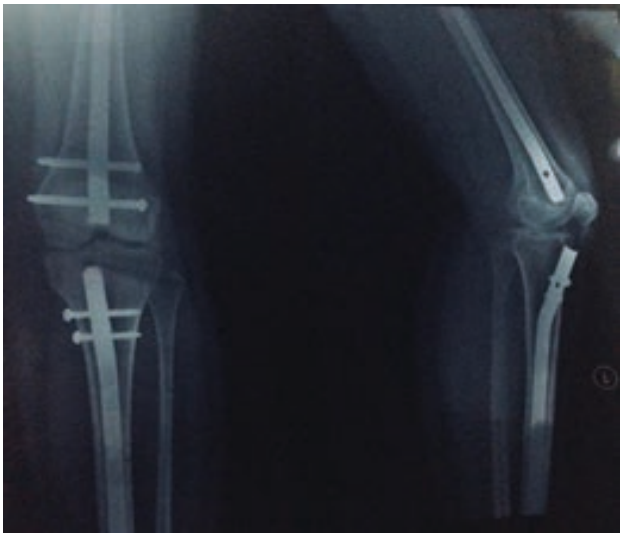

Fig. 5 Post definitive surgery X-ray, November 2018

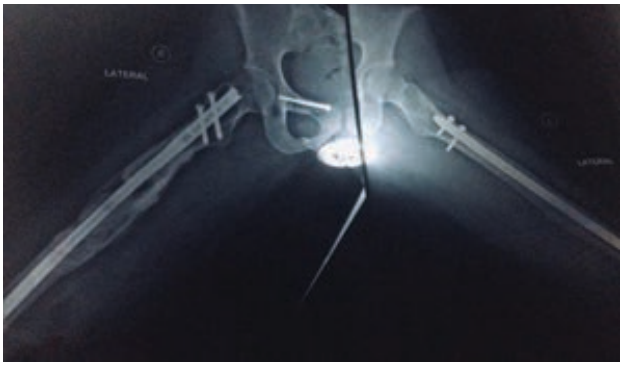

Fig. 6 Post definitive surgery X-ray, November 2018

Discussions

The lethal triad of hypothermia, acidosis, and coagulopathy has been recognized as a significant cause of death in patients with traumatic injuries.

From a historical point of view, since 1980 studies have described a bloody vicious cycle, where hemorrhage and tissue injury cause this predictable triad of complicating factors [5,6]. Ultimately, the triad developed to hemorrhage and eventual death. Also, numerous clinical studies have indicated an increased incidence of multiple organ failure (MOF) after an initial definitive long duration surgery in unstable patients. Thus, DCO aims to defeat three death-threats (metabolic acidosis, low body

temperature and coagulation disorder) resulting from hemorrhagic shock [7].

The purpose of Damage Control Orthopedics is to reduce ongoing hemorrhage and soft-tissue injury through efficient fracture stabilization while minimizing the risk of additional consequences, such as secondary insult to vital organ systems (brain and lungs). The timing of Musculoskeletal Care is based on the improving acidosis: with a pH of 7.25 or greater (7.29 in this case) and a lactate level less than 4.0 mmol/ L (3.2 mmol/ L for the patient) [8].

In the presented case, the treatment scheme was influenced by specific factors, including the severity of the patient's condition, mechanism of injury, and the available services, complying with PR.I.S.M strategy [4].

Following the DCO principles, the medical team approached the following scheme:

1st stage - Temporary stabilization of fractures; Hemorrhage control

2nd stage - Resuscitation in ICU

3rd Stage - Delayed definitive Management until the patient is stable

ATLS primary survey identified bone fractures and deformities, stating the patient's physiologic status is unstable (e.g. 7T GCS score) and addressed life and limb threatening injuries [9]. Early reduction and fixation of fractures assured improved fracture alignment and stability, hemorrhage control, aiding in resuscitation, enhanced mobility, and function restoration [10-12]. After the 1ststage, ICU resuscitation assured that the patient's physiological state is able to withstand the definitive surgery. Delayed definitive Management completed the anatomical correction, resulting in remarkable postoperative healing [13,14]. External fixation was used for significant long bone and pelvic injuries, completing the adjustment of open fracture wounds, removal of devitalized tissue and surgical management of hemorrhage [7,8,11,13].

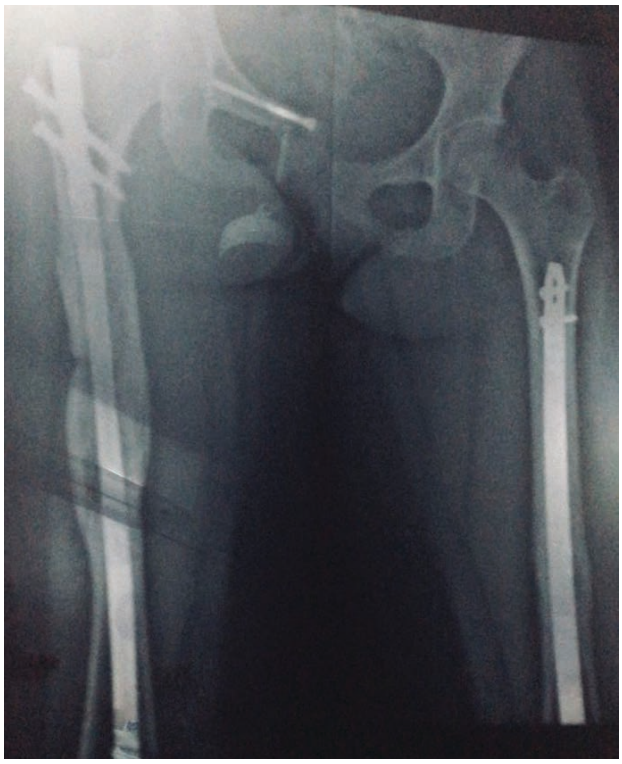

Fig. 7 Post definitive surgery X-ray, November 2018

This case emphasized the fact that the management of immediately life-threatening traumatic injuries should take priority over the management of non-life-threatening conditions (e.g. extremity fractures). In order to obtain visible results and better outcomes, Damage Control Orthopedics assures enormous timesavings and decrease of blood loss during initial treatment if patients with multiple injuries are treated according to the procedure.

Acknowledgement

All authors had equal contributions in writing this paper.

References

1. Vallier HA, Wang X, Moore TA, Wilber JH, Como JJ. Timing of orthopaedic surgery in multiple trauma patients: Development of a protocol for early appropriate care. J Orthop Trauma. 2013; 27(10):543-551.
2. Lamb CM, MacGoey P, Navarro AP, Brooks AJ. Damage control surgery in the era of damage control resuscitation. Br J Anaesth. 2014 Aug; 113(2):242-9. doi:10.1093/bja/aeu233.

3. Amin Osama A et al. Damage control orthopedic surgery (DOC): Is there an Influence on outcome? International Journal of Health Sciences. 2011; 5,2 Suppl 1: 39-40.
4. Giannoudis PV, Giannoudis VP, Horwitz DS. Time to think outside the box: 'Prompt-Individualised-Safe Management' (PR.I.S.M.) should prevail in patients with multiple injuries. Injury. 2017; 48(7):1279-1282.
5. Gerecht R. The lethal triad. Hypothermia, acidosis & coagulopathy create a deadly cycle for trauma patients. JEMS. 2014 Apr; 39(4):56-60.
6. O'Toole RV, O'Brien M, Scalea TM, Habashi N, Pollak AN, Turen CH. Resuscitation before stabilization of femoral fractures limits acute respiratory distress syndrome in patients with multiple traumatic injuries despite low use of damage control orthopedics. J Trauma. 2009; 67(5):1013-1021.
7. Morshed S, Miclau T III, Bembom O, Cohen M, Knudson MM, Colford JM Jr. Delayed internal fixation of femoral shaft fracture reduces mortality among patients with multisystem trauma. J Bone Joint Surg Am. 2009; 91(1):3-13.
8. Vallier HA, Moore TA, Como JJ et al. Complications are reduced with a protocol to standardize timing of fixation based on response to resuscitation. J Orthop Surg Res. 2015; 10(1):155-164.
9. ATLS Student Course Manual, 10th Edition, 2018.
10. Scalea et al. External fixation as a bridge to intramedullary nailing for patients with multiple injuries and with femur fractures: damage control orthopedics. J Trauma. 2000; 48:613-23.
11. Tuttle MS, Smith WR, Williams AE et al. Safety and efficacy of damage control external fixation versus early definitive stabilization for femoral shaft fractures in the multiple-injured patient. J Trauma. 2009; 67(3):602-605.
12. Benz D, Balogh ZJ. Damage control surgery: current state and future directions. Curr Opin Crit Care. 2017 Dec; 23(6):491-497. doi:10.1097/MCC.0000000000000465.
13. D'Alleyrand JCG, O'Toole RV. The Evolution of Damage Control Orthopedics: Current Evidence and Practical Applications of Early Appropriate Care. Orthopedic Clinics of North America. 2013; 44(4):499-507.
14. Frink M et al. Multiple Trauma and Emergency Room Management. Deutsches Arzteblatt international. 2017; 114(29-30):497-503.