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Pelvic ring fractures: has mortality improved following the implementation of damage control resuscitation?



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Abstract

BACKGROUND: Over the last 10 years, the paradigm of damage control resuscitation (DCR) has been associated with improved patient outcomes. This study investigates the outcomes of both closed and open pelvic ring fractures at a single institution before and after the formal implementation of DCR principles.

METHODS: A retrospective chart review was performed in an urban level I trauma center of all patients who sustained open or closed pelvic ring fractures between 2002 and 2012.

RESULTS: Two thousand two hundred forty-seven patients presented with pelvic fractures between 2002 and 2012. Overall mortality was 10% ($n = 212$). Only 8% of all patients with closed fractures required DCR compared with 28% of patients with open fractures. There was no difference in mortality when comparing DCR and pre-DCR cohorts for either open or closed pelvic fractures.

CONCLUSIONS: Interestingly, although DCR seems to lead to more efficient initial resuscitations, further improvements in patient mortality were not realized with formal implementation of DCR principles.

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Pelvic ring fractures are common in patients after traumatic injury, and are a source of significant morbidity and mortality. In fact, the incidence of pelvic fractures in patients who present to large trauma centers is roughly 10%, with an overall mortality rate of 14%.¹ Unlike a

closed pelvic ring fracture, the less common open pelvic ring fracture is more likely to be fatal.² Indeed, in a previous review, the overall mortality of open pelvic fractures was found to be 45%.³ An open pelvic fracture is defined as a fracture that extends to the surrounding skin (perineum, buttock, groin) or into the viscera (bladder, rectum, vagina).⁴ Most pelvic fractures are caused by blunt force trauma, with the most common cause being motor vehicle crashes.² Because of the anatomy of the pelvis, mortality following a pelvic ring fracture, especially if that fracture is open, is most often due to either hemorrhage or pelvic sepsis.²⁻⁴

The resuscitation paradigm for patients following significant injury has drastically changed over the past decade. An increased recognition of the early coagulation disorders

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after traumatic injury has led to the changes in transfusion practices and there is now a major focus on simultaneously managing a patient's inflammatory, metabolic, and coagulation pathways.^{5,6} Termed "damage control resuscitation" (DCR), this new paradigm, at its core, involves restoring intravascular volume with packed red blood cells (PRBCs), plasma (FFP), and platelets (PLT) at high, empiric fixed ratios (1:1:1).⁵⁻⁷ In fact, recent studies conducted in large, level I trauma centers have shown that instituting a massive transfusion protocol (MTP) with the above ratio of blood products significantly reduces overall patient mortality.⁸⁻¹⁰ Thus, DCR has become standard practice in many major trauma centers.¹⁰

On February 1, 2007, Grady Memorial Hospital instituted a formal MTP based on DCR principles. We hypothesize that those patients with pelvic ring fractures who presented to Grady Memorial Hospital after the institution of the MTP will have lower overall mortality rates and a lower incidence of systemic infectious complications. This study retrospectively examines the outcomes of patients who suffered from pelvic ring fractures both before and after DCR was implemented at Grady Memorial Hospital.

Patients and Methods

The records of 2,247 patients who presented with pelvic ring fractures between January 1, 2003 and December 31, 2012 (both closed and open) were reviewed. All patients were cared for by the Emory University Trauma Service at Grady Memorial Hospital, a state of Georgia level I trauma center. This study was approved by the Institutional Review Board of Emory University.

Massive transfusion protocol

Massive transfusion is classically defined as the need for transfusion of greater than 10 units of PRBCs in a 24-hour period. Before implementing a formal MTP, Grady Memorial Hospital treated critically ill patients with significant amounts of crystalloid and did not begin transfusing blood or coagulation factors until during or after damage control surgery was underway.⁷ It was not until a formal MTP was

implemented on February 1, 2007 that the goal of care became efficiently delivering blood products with a ratio of PRBC:FFP:PLT of 1:1:1, while minimizing the need for crystalloid resuscitation.⁸⁻¹¹ An attending physician or fellow from the departments of surgery, anesthesia, emergency medicine, or critical care is able to trigger the MTP based on the patient's clinical picture.¹¹ After a total of 18 units of PRBCs are given, a 4-mg dose of recombinant factor VIIa is made available to be used at the attending physician's discretion to combat coagulopathic bleeding.⁸ An additional 4-mg dose of recombinant factor VIIa (to be given 30 minutes later) is made available as well. Finally, 10 units of cryoprecipitate are given every hour.⁸ Blood gases and coagulation parameters are drawn every other hour to monitor the patient's response to therapy.¹¹ Within the last 2 years, the protocol also calls for the routine use of tranexamic acid based on data from a large, multi-institutional randomized clinical trial.¹² The MTP at Grady Memorial Hospital is summarized in Table 1.

Data collection

Patients were identified using the Trauma Registry of the American College of Surgeons. The population was identified within the registry using International Classification of Disease-9 codes 808-808.9. Data were then collected by reviewing each patient's medical record, blood bank records, and the hospital's operative logs. Patients were then separated into 2 groups. The first group included patients who were cared for from February 1, 2007 to December 31, 2012, in the era of DCR. This group was compared with patients who presented before the implementation of the MTP (January 1, 2002 to January 31, 2007) (pre-DCR).

Data collected for each patient included the following: demographic information, date of arrival/discharge, length of stay (LOS), patient disposition, comorbidities, mechanism of injury, vital signs at the time of presentation, type of pelvic ring fracture (open or closed), orthopedic treatment of pelvic ring fractures, the presence of abdominal injuries, the use and results of angioembolization, the use and results of damage control laparotomy, number of

Table 1 The MTP at Grady Memorial Hospital¹⁰

Time (h)	PRBCs (units)	Plasma (units)	Platelets (units)	Cryoprecipitate (units)	rFVIIa (mg)
Initiation	6	6			
.5	6	6	8-10		
1.0	6	6		20	4*
1.5	6	6	8-10		4*
2.0	6	6		10	
2.5	6	6	8-10		
3	6	6		10	

MTP = massive transfusion protocol; PRBCs = packed red blood cells; rFVIIa = recombinant factor VIIa.

*rFVIIa to be given at the attending physician's discretion.

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