Current outcomes of blunt open pelvic fractures: how modern advances in trauma care may decrease mortality

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ABSTRACT

Background Open pelvic fracture, caused by a blunt mechanism, is an uncommon injury with a high mortality rate. In 2008, evidence-based algorithm for managing pelvic fractures in unstable patients was published by the Western Trauma Association (WTA). The use of massive transfusion protocols has become widespread as has the availability and use of pelvic angiography. The purpose of this study was to evaluate the outcome of open pelvic fractures in association with related advances in trauma care.

Methods A retrospective review was performed, at an American College of Surgeon verified level I trauma center, on patients with blunt open pelvic fractures from January 1, 2010 through April 30, 2016. The WTA algorithm, including massive transfusion protocol, and pelvic angiography were uniformly used. Data collected included injury severity score, demographic data, transfusion requirements, use of pelvic angiography, length of stay, and disposition. Data were compared with a similar study from 2005.

Results During the study period, 1505 patients with pelvic fractures were analyzed: 87 (6%) patients had open pelvic fractures. Of these, 25 were from blunt mechanisms and made up the study population. Patients in both studies had similar injury severity scores, ages, Glasgow Coma Scale, and gender distributions. Use of angiography was higher (44% vs. 16%; P=0.011) and mortality was lower (16% vs. 45%; P=0.014) than in the 2005 study.

Conclusions Changes in trauma care for patients with open blunt pelvic fracture include the use of an evidence-based algorithm, massive transfusion protocols and increased use of angioembolization. Mortality for open pelvic fractures has decreased with these advances.

Level of evidence Level IV.

BACKGROUND

Open pelvic fracture is a morbid injury and very often is a lethal one. Historically, mortality rates have been reported to range from 5% to as high as 50%. Early mortality is related to exsanguinating hemorrhage and late mortality is generally due to pelvic sepsis.

In 2005, Dente and colleagues retrospectively analyzed patients who sustained open pelvic fractures as a result of blunt mechanism between 1995 and 2004. The overall mortality in that series was 45%. Since that study was published, there has been a paucity of published data on the outcomes of open pelvic fractures despite significant advancements in the care of these injuries.

The Western Trauma Association (WTA) published an algorithm for Management of Pelvic Fractures with Hemodynamic Instability in 2008, which provided an evidence-based schema for this injury. The algorithm emphasizes the importance of a multidisciplinary approach with trauma surgery, orthopedics, and interventional radiology. It also addresses diagnostic evaluation, exclusion of intra-abdominal injury, pelvic stabilization, and decisions concerning surgical options and angiography.

The management of coagulopathy has also evolved since the study by Dente et al was published. Implementation of a massive transfusion protocol (MTP) with 1:1:1 ratio of packed red blood cells (PRBC) to fresh frozen plasma (FFP) to platelets has been shown to reduce mortality in patients with traumatic hemorrhage. This is due to expeditious product availability and aggressive transfusion of blood products that enables quick restoration of intravascular volume and treatment of coagulopathy.

Additionally, the use of pelvic angiography and embolization has increased in the last decade and has been found to be an effective adjunct for control of pelvic fracture hemorrhage. Another advancement has been the advent of hybrid operating rooms (ORs), which are increasingly being used in trauma.

The purpose of this study was to examine outcomes for blunt open pelvic fractures in the current era and compare them with previously reported data. We hypothesize that the changes in care of patients with open pelvic fractures have led to a decreased overall mortality.

METHODS

A retrospective review was performed on patients admitted to Community Regional Medical Center (CRMC), an ACS-verified level I trauma center, from January 1, 2010 through April 30, 2016. Patients with open pelvic fractures from blunt mechanism were identified from the trauma registry and were included in this study. Data collected included the following: age, sex, injury severity score (ISS), Glasgow Coma Scale (GCS), Gustilo grade of soft tissue injury, orthopedic management, use of pelvic angiography, operative management, hospital length of stay (LOS), transfusion requirements in the first 24 hours, and final disposition.
Patients with penetrating injuries and closed fractures were excluded.

Patients were initially evaluated in the emergency department (ED) with a collaborative team of in-house residents, fellows, and attending physicians from the departments of trauma surgery and emergency medicine. The WTA algorithm is the guideline by which patients with pelvic fractures are treated at CRMC. The initial diagnosis of pelvic fracture was made by a pelvic X-ray obtained during the primary survey. Hemodynamically stable patients were taken to the CT scanner for an abdominopelvic scan and if contrast extravasation in the pelvis was visualized, the patient was sent for pelvic angiographic and possible embolization. The MTP was initiated in patients who were hemodynamically unstable (any systolic blood pressure less than 90). A focused assessment with sonography for trauma (FAST) or diagnostic peritoneal lavage was performed to exclude intra-abdominal injury. Patients were taken to the OR for laparotomy if the FAST was positive and were sent for angiography if the FAST was negative. Pelvic binders were placed when patients have open book fractures and were hypotensive.

FAST was readily available and used when indicated. Pelvic stabilization in the ED, when performed, involved the use of a commercially available external pelvic stabilizer. A MTP designed to optimize the goal of a 1:1:1 PRBC to FFP to platelet ratio was uniformly used. There was 24 hours availability of pelvic angiography, which was performed in the angiography suite or hybrid OR by an interventional radiologist.

The degree of soft tissue injury was defined using the Gustilo-Anderson and Faringer classification (tables 1 and 2). The data obtained in this study were compared with the 2005 study by Dente and colleagues. Using the 2005 study as a historical control group, comparisons were made between the patient study by Dente and colleagues. Using the 2005 study as a historical control group, comparisons were made between the patient study by Dente and colleagues.
washout and debridement of a complex pelvic wound and developed multiple strokes after one of the debridements.

One patient was transferred to another hospital after a 24-day LOS in the ICU. The remainder of survivors were eventually discharged home (n=7), to a skilled nursing facility (n=6), or to a rehabilitation center (n=7). In the 2005 study, nearly half of the deaths occurred after 24 hours, an average of 17 days after injury and were due to pelvic sepsis, traumatic brain injury, respiratory arrest, buttock necrosis, and pulmonary embolism. None of the patients in this series died of these causes.

Table 5  Comparison of treatments and mortality between 2005 and 2016

<table>
<thead>
<tr>
<th>Study (n)</th>
<th>Patients transfused</th>
<th>Pelvic embolization</th>
<th>Fecal diversion</th>
<th>Length of stay</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 (44)</td>
<td>32 (73%)</td>
<td>7 (16%)</td>
<td>4 (9%)</td>
<td>22</td>
<td>20 (45%)</td>
</tr>
<tr>
<td>2016 (25)</td>
<td>17 (68%)</td>
<td>10 (40%)</td>
<td>3 (12%)</td>
<td>21</td>
<td>4 (16%)</td>
</tr>
<tr>
<td>P value</td>
<td>0.68</td>
<td>0.026</td>
<td>0.70</td>
<td>–</td>
<td>0.014</td>
</tr>
</tbody>
</table>

Although preperitoneal packing is included in the WTA algorithm, no patients in the present series underwent preperitoneal pelvic packing. Preperitoneal pelvic packing is less likely to be effective with open pelvic fractures because the tamponade of the retroperitoneum is already released to the external environment, particularly in patients with perineal wounds. However, early pelvic packing in combination with external fixation has been shown to decrease mortality for hemodynamically unstable patients with severe pelvic ring disruptions.

Fecal diversion has been highlighted in the literature as a useful adjunct to prevent pelvic sepsis, especially in patients with rectal injuries. Use of fecal diversion in the present study population was not different from what has been described in previous studies. As anticipated, it was used predominately in patients with rectal injuries and those with severe perineal lacerations to avoid contamination.

This study is heir to all the limitations of retrospective reviews. Additionally, the relative scarcity of this injury limits the size of the study population. The 2005 report does not note the management of coagulopathy or the patient condition at time to angiography. These could be additional factors that influence outcomes as well. Lastly, only patients as far back as January 2010 were assessed due to lack of electronic medical records before that time.

In conclusion, the care for patients sustaining open pelvic fractures by blunt mechanism has evolved in recent years. Changes include the use of an evidence-based algorithm, better treatment of coagulopathy including MTPs, and increased use of angioembolization. The overall mortality for open pelvic fractures has decreased with these advances.

**Contributors** SSS and JWD contributed to study design, data collection, data analysis, data interpretation, writing, and critical revision. KLG contributed to data interpretation and critical revision. RCD contributed to data collection, data analysis, and data interpretation. KAG contributed to literature search and data collection.

**Competing interests** None declared.

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**REFERENCES**

11 Fehr A, Beveridge J, D’Amours SD, Kirkpatrick AW, Ball CG. The potential benefit of a hybrid operating environment among severely injured patients with persistent hemorrhage: how often could we get it right? *J Trauma Acute Care Surg* 2016;80:457–60.
15 Fitzgerald CA, Morse BC, Dente CJ. Pelvic ring fractures: has mortality improved following the implementation of damage control resuscitation? *Am J Surg* 2014;208:1083–90.