Preoperative Blood Loss of Isolated Acetabular Fractures
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INTRODUCTION: Acetabular fractures are often a result of high energy mechanisms that are frequently associated with intracranial, thoracic, abdominal, pelvic ring, and extremity injuries. Given the desire to improve patient outcomes and avoid risks associated with blood transfusions, there has been extensive investigation of intraoperative and postoperative management of blood loss in pelvic ring and acetabular fractures. However, the preoperative impact of an isolated acetabular fracture is often over-shadowed by the devastating and deleterious effects of their associated injuries, and as such, there is a paucity of literature on the quantity of blood loss in the preoperative setting for isolated acetabular fractures.

METHODS:
Retrospective study at two large, academic, level-one trauma centers of patients with isolated acetabular fractures from 2010 to 2018. Exclusion criteria included nonsurgical management, surgical intervention greater than three days from injury, intraabdominal injury requiring exploratory laparotomy or high-grade hepatic and splenic lacerations requiring angiographic embolization, thoracic injuries requiring surgical treatment, long bone fractures except for pilon or ankle type fractures, pelvic ring fractures, and sacroiliac joint diastasis or sacral fractures. Patient body mass index, gender, mechanism of injury, preoperative hemoglobin values, and preoperative transfusions were collected through the electronic health record. Preoperative blood volume and preoperative blood loss were calculated with use of Nadler’s Formula and a hemoglobin balance equation respectively. Preoperative blood loss and preoperative transfusions were both separately analyzed based on fracture pattern and patient variables.

RESULTS:
After exclusion criteria, 608 of the 1,159 patients remained for analysis. The sample consisted of 438 males and 170 females. The mechanisms of all fractures consisted of 437 motor vehicle or motorcycle collisions, 58 falls greater than ten feet, 88 falls less than ten feet, and 25 other injuries. The mean calculated preoperative blood volume for all individuals was 5.38L. The mean preoperative hemoglobin charted among all patients was 11.98g/dL. The mean time from injury to surgery was 1.7 days.

There were 28 transverse, 235 posterior wall, 5 posterior column, 19 anterior column, 37 both column, 155 transverse with posterior wall, 21 T-Type, 38 anterior column posterior hemitransverse, 61 posterior column with posterior wall, 5 both column with posterior wall, 1 posterior column anterior hemitransverse, and 3 T-type with posterior wall acetabular fractures. There were no anterior wall fractures after exclusions.

The mean (± standard deviation) preoperative blood loss of all fractures was 1,148.6mL (±652). The mean preoperative blood loss was calculated for each fracture pattern: transverse 1,214.5mL (±717.2), posterior wall 1,021mL (±595.4), posterior column 1,117.5mL (±605.1), anterior column 1,131mL (±663.2), both column 1,401.9mL (±653.6), transverse with posterior wall 1,201mL (±706.6), T-type 1,340.8mL (±669.4), anterior column with posterior hemitransverse 1,317.7mL (±659.9), posterior column with posterior wall 1,075.6mL (±556.4), both column with posterior wall 1,847.6mL (±413.1), posterior column with anterior hemitransverse 703.9mL, and T-type with posterior wall 1,832.4mL (±1,064.4). A one-way ANOVA (F11,596=2.87, P=0.0011) and Kruskal-Wallis test (H=29.5, 11 d.f., P=0.0019) demonstrated statistically significant differences in the means of preoperative blood loss among acetabular fracture patterns.

Using the Pearson’s Correlation, time from injury to surgery and preoperative blood loss was found to have a statistically significant positive linear correlation (r=0.27, p<0.001). There was no significant difference in preoperative blood loss for gender (one-way ANOVA, F1,606=2.87, P=0.0011) and Kruskal-Wallis test (H=29.5, 11 d.f., P=0.0019) demonstrated statically significant differences in the means of preoperative blood loss among acetabular fracture patterns.

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There were 50 patients transfused preoperatively prior to exclusions and 13 after exclusions. When appropriate, a Fisher Exact test or Wilcoxon Two-Sample test were used to evaluate preoperative transfusions. Preoperative transfusion demonstrated a significant association with acetabular fracture pattern (p<0.001), preoperative hemoglobin value (p<0.001), preoperative blood loss (p<0.001), and time from injury to surgery (p<0.001). There were no significant associations of body mass index (p=0.749), preoperative blood volume (p=0.542), gender (p=1.0), or mechanism of injury (p=0.228) with preoperative transfusion.

DISCUSSION AND CONCLUSION:
The time from injury to surgery had a significant association with preoperative blood loss and preoperative transfusion. This may be expected given that unreduced fractures are more prone to bleeding and as more time is allowed, a higher
likelihood of resuscitation. This highlights that unreduced acetabular fractures may effect hemodynamics extend beyond the first 24 hours from injury.

Acetabular fractures may lose greater than one liter of blood in the preoperative setting, and patient factors as well as mechanism of injury had little bearing on volume lost. These findings lead the authors to believe that osseous anatomy of the acetabulum and fracture pattern may be significant contributors to blood loss. For example, fractures with higher proportions of exposed cancellous bone may have a tendency for more bleeding. The current study corroborates these beliefs as more preoperative blood loss was seen in associated fracture patterns with the greatest being both column and T-type fractures or variants thereof.

Given the known risks and complications of transfusions and severity of acetabular injuries, the establishment of an anticipated preoperative blood loss for isolated acetabular fracture types is clinically relevant. Despite its limitations, this novel study's findings may improve a provider's assessment and management of patients following acetabular fractures.