
Emergent Pelvic Fixation in Patients with Exsanguinating Pelvic Fractures

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- BACKGROUND:** An alternative to embolization or external pelvic fixation (EPF) in patients with multiple pelvic fractures and hemorrhage is a pelvic orthotic device (POD), which may easily be placed in the resuscitation area. Little published information is available about its effectiveness. This study evaluated the efficacy of the POD compared with EPF in patients with life-threatening pelvic fractures.
- STUDY DESIGN:** We evaluated patients with blunt pelvic fractures over a 10-year period. Inclusion required multiple pelvic fractures with vascular disruption and severe retroperitoneal hematoma, open book fracture with symphysis diastasis, or sacroiliac disruption with vertical shear. Patients with EPF were compared with those in whom a POD was used. Outcomes included transfusions, hospital stay, and mortality.
- RESULTS:** There were 3,359 patients with pelvic fractures who were admitted: 186 (6%) met entry criteria; 93 had EPF and 93 had POD. There were no differences in age or shock severity. Both 24-hour (4.9 versus 17.1 U, $p < 0.0001$) and 48-hour transfusions (6.0 versus 18.6 U, $p < 0.0001$) were reduced with POD. Twenty-three percent of each group underwent pelvic angiography, and 24-hour transfusion amounts for those patients were also reduced with POD (9.9 versus 21.5 U, $p < 0.007$). Hospital length of stay (16.5 versus 24.4 days, $p < 0.03$) was less with POD. Although there was decreased mortality with POD (26%) versus EPF (37%), it was not statistically significant ($p = 0.11$).
- CONCLUSIONS:** The therapeutic shift to POD has substantially reduced transfusion requirements and length of hospital stay, and has reduced mortality in patients with unstable pelvic fractures. POD has made a major contribution to the care of critically injured patients with the most severe pelvic fractures. (*J Am Coll Surg* 2007;204:935–942. © 2007 by the American College of Surgeons)
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Traumatic disruption of the pelvic ring is a major cause of life-threatening hemorrhage.^{1–7} The vascular anatomy of the pelvis, coupled with the bulk of cancellous bone, can account for exsanguinating hemorrhage after severe pelvic fractures. Early stabilization, as with other fractures, is a tenet of management, but adequate fracture stabilization of the pelvis is difficult.

Various methods of pelvic fracture stabilization have been described. These include inflatable pneumatic anti-shock garments,^{1,2,8} operative external fixation,^{3,6,9–12} pelvic wrapping with a sheet,¹³ and external orthotic devices.^{14,15}

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At our institution, we have historically used emergent external pelvic fixation (EPF) in patients with exsanguinating pelvic fractures for stabilization. Recently, we have used a pelvic orthotic device (POD) because of its perceived efficacy and ease of application. The purpose of this study was to compare outcomes in patients initially managed with either EPF or POD who have unstable, life-threatening pelvic fractures.

METHODS

Patients admitted over a 10-year period to the Presley Regional Trauma Center in Memphis, TN with fractures of the pelvic ring after blunt trauma were identified from the trauma registry. Study inclusion required multiple pelvic ring fractures associated with vascular disruption and severe retroperitoneal hematoma, open book fracture with symphysis diastasis, or sacroiliac disruption with vertical shear (all anterior-posterior compression fractures II or III). Patients meeting these criteria underwent emergent

Abbreviations and Acronyms

AIS	=	Abbreviated Injury Score
EPF	=	external pelvic fixation
PASG	=	pneumatic antishock garments
POD	=	pelvic orthotic device
VAP	=	ventilator associated pneumonia

stabilization with an anterior frame (EPF) or a pelvic orthotic device (POD, T-POD, Cybertech Medical).

All patients were evaluated by the trauma team in the resuscitation area. If initial assessment revealed an unstable pelvic fracture and the patient was hemodynamically labile, emergent stabilization was performed. Early in the study series, EPF was used. Briefly, anterior fixation was accomplished with pins placed in the anterior superior iliac spine and stabilized with crossing bars. This was usually performed in the operating room. Abdominal evaluation included physical examination, supraumbilical peritoneal lavage, abdominal ultrasonography, or a combination of these. Later in the series, the POD was placed immediately on recognition of the unstable pelvis. After pelvic stabilization, additional hemodynamic instability mandated laparotomy for patients with a positive ultrasound or grossly positive lavage. If the patient had negative abdominal studies and no other obvious extrapelvic source of hemorrhage, pelvic angiography was performed.

Outcomes measured were resuscitative transfusions (blood transfused in the resuscitation area), and total blood transfusions at 24 and 48 hours. Hospital length of stay and mortality were also analyzed. Ventilator associated pneumonia (VAP) was evaluated as a marker of infectious morbidity. All instances of VAP were diagnosed using fiberoptic bronchoscopy with quantitative cultures of the bronchoalveolar lavage effluent, with $> 10^5$ organisms as the diagnostic threshold.

Discrete variables were compared using chi-squared analysis (JMP, version 5.0). Continuous variables were compared using the unpaired *t*-test. Statistical significance was set at $p < 0.05$.

RESULTS

Over the study period, there were 30,048 patients with blunt trauma admitted to the trauma center, 3,359 (11%) of whom had pelvic fractures. Of these patients with pelvic fractures, there were 241 (7%) patients with multiple pelvic ring fractures, open book fractures, or sacroiliac disruption, and 186 of these (77%) underwent emergent external stabilization for their pelvic fractures. Motor vehicle crash was the most common injury mechanism (60%), followed by motorcycle or all-terrain vehicle crash (15%), industrial

Table 1. Characteristics of the Study Population

Variable	POD	EPF	p Value
n	93	93	
Male, n	56	67	0.09
Female, n	37	26	
Age, y	37.6	36.3	0.58
ISS	33.6	38.6	0.02
SBP, mmHg	112.5	101.6	0.07
BE, meq/L	-7.15	-8.50	0.14
GCS	11.9	11.2	0.33
RTS	9.7	8.8	0.13

BE, admission base excess; EPF, external pelvic fixation; GCS, Glasgow Coma Scale score; ISS, Injury Severity Score; POD, pelvic orthotic device; RTS, Revised Trauma Score; SBP, admission systolic blood pressure.

accident (10%), auto-pedestrian accident (9%), and falls (6%). Pronounced associated injuries (Abbreviated Injury Score [AIS] > 2) were seen in all but one patient. Abdominal injuries were most commonly seen (64%), followed by chest injuries (54%) and head injuries (21%).

The study population was comprised of 93 patients (50%) who underwent POD placement and 93 (50%) who underwent EPF. Their characteristics are shown in Table 1. Patients were well matched with respect to gender, age, and severity of shock (as measured by Injury Severity Score, systolic blood pressure, and base excess) on admission. Those managed with EPF had higher Injury Severity Scores than those managed with POD, which was, in part, because of higher abdominal AIS in the EPF group (2.9 versus 1.6; $p < 0.001$). Despite this difference, laparotomy rates were similar between groups (28% for EPF versus 23% for POD; $p = 0.4$).

Table 2 shows transfusion-related outcomes. Patients treated with POD had notably fewer resuscitation transfusions despite the equivalent severities of shock on presentation. Immediate POD placement also substantially reduced transfusions at both 24 and 48 hours when compared with EPF. This is likely because of quicker hemorrhage control in patients with POD placement, reducing both initial and subsequent transfusion requirements.

Pelvic angiography was performed in 23% of each group. Not surprisingly, overall transfusions were higher in

Table 2. Outcomes for Study Groups

Variable	POD	EPF	p Value
Resuscitative, Tx	2.0	3.5	0.004
24 h, Tx	4.9	17.1	0.008
48 h, Tx	5.6	18.6	0.008
Pelvic angiogram, n	21	21	
Mortality, %	26	37	0.11

EPF, external pelvic fixation; POD, pelvic orthotic device; Tx, units of blood transfused.

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