The American Journal of Surgery (2016) 211, 495-500

The American Journal of Surgery®

Midwest Surgical Association: Scott Woods Memorial Lecture

Patients with pelvic fractures from blunt trauma. What is the cause of mortality and when?

Rahul Vaidya, M.D., F.R.C.Sc.*, Alesha N. Scott, D.O., Fred Tonnos, D.O., Ian Hudson, D.O., M.P.H., Adam J. Martin, B.S., Anil Sethi, M.D.

4G University Health Centre, Detroit Receiving Hospital, 4201 St. Antoine Blvd, Detroit, MI 48201, USA

KEYWORDS:
Pelvic fracture;
Mortality;
Survival time

Abstract

BACKGROUND: Mortality in patients sustaining pelvic fractures has been reported to be 4% to 15%. We sought to investigate the cause of death based on timing and evaluate if type of fracture and Injury Severity Score have an influence on the survival time.

METHODS: Sixty-nine patients of eight hundred sixty seven with a pelvic fracture who died during their hospital admission were included. Fractures were classified using the Arbeitsgemeinschaft Osteosynthesefragen/Orthopaedic Trauma Association system. Cause determined by autopsy in 48/69.

RESULTS: The leading cause of death within 6 hours was abdominal and pelvic hemorrhage; 6 to 24 hours head injury, and greater than 24 hours multiple organ dysfunction syndrome. Survival time did not correlate between fracture type ($P < .12$) or Injury Severity Score. Only 2 patients died of isolated pelvic hemorrhage.

CONCLUSIONS: Despite the advances made in acute management of the traumatized patient in the emergency department, mortality is unavoidable in a small group of patients with hemorrhage being the commonest cause of early death but isolated pelvic hemorrhage rare.

Mortality in patients sustaining pelvic fractures has been reported to be 4% to 15%.[1–7] and are usually related to multiple trauma and massive hemorrhage.[8–12] Hemorrhage as a cause of death has decreased in the last decade possibly as a result of improved management techniques.[10] Various risk factors for mortality have been observed and include increasing age and shock on initial presentation as defined by a systolic blood pressure less than 90 mm Hg.[1,2,6,8,10,13,14] Injury Severity Score (ISS) is a measurement of the cumulative injuries per body area and it has been evaluated in relation to mortality with a higher ISS being associated with a higher risk of mortality.[3,7,15–18] Despite several studies evaluating patients that died after a pelvis fracture there is no universal consensus as to the cause of death after these injuries. Furthermore, no distinction has been made in the cause of death between early (within 24 hours) and late deaths

Investigation performed at Detroit Receiving Hospital, Detroit, MI, 48201, USA.

There were no relevant financial relationships or any sources of support in the form of grants, equipment, or drugs.

The authors declare no conflicts of interest.

Presented at the 2015 MSA Annual Meeting Stuart Woods Memorial Lecture

* Corresponding author. Tel.: +1-313-966-7852; fax: +1-313-966-8400.
E-mail address: rahvaidya2012@gmail.com

Manuscript received August 6, 2015; revised manuscript August 26, 2015

0002-9610/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2015.08.038

(after 24 hours). We felt we could do a better job by carefully reviewing charts in our database and autopsy reports rather than relying on papers with cumulative data from multiple centers as their protocols may be varied, the patient population may be heterogeneous and the data could have been collected over decades. We decided to limit our collection over a 12-year period in this century where we have used standardized Advanced Trauma Life Support protocols. It was our goal to evaluate fracture pattern, ISS, and cause of death in patients who died in an imminent manner (<6 hours), those who died early (6 to 24 hours), and those who died late (>24 hours).

Methods

Setting and patients

We performed an institutional review board approved retrospective review from our level 1 Trauma database Between 1999 and 2013, a total of 867 trauma patients with pelvic fractures were admitted to our level 1 trauma center, 130 of which died. This group does not include fractures resulting from insufficiency, tumor, or infection. From the 130 patients that died, we excluded fractures sustained from gunshot wounds (23) and those patients who presented dead on arrival (38), leaving 69 patients that constituted the study cohort. The mean patient age was 51 ± 20 (median 49, range 16 to 99), and there were 55 males and 14 females. On presentation to the emergency department, patients were evaluated and treated per the Advanced Trauma Life Support guidelines.[19] The protocol includes initial management with blood transfusion and emergent transfer to the operating room for persistently unstable patients for external fixation followed by embolization if indicated. In the last 3 years, we have been more aggressive with retroperitoneal packing. If the patient demonstrates hemodynamic instability after packing they are considered for arterial embolization.

Procedures and data analysis

Basic patient data were obtained from our standardized trauma database for the years 1999 to 2013 and put into customized spreadsheets for analysis. Patients who carried the *International Classification of Diseases, 9th Revision* diagnosis code 808.x were selected from the database, excluding patients with isolated codes 808.0 and 808.1 (acetabular fracture only). Electronic medical records were reviewed to gather detailed data from emergency department treatment notes, death reports, operative reports (open and angiographic), radiographs (X-ray images, computed tomography scan images, and radiology reads), and official medical examiner autopsy reports or autopsy (48/69) or consensus (21).

Demographic data evaluated included age, method of injury, length of stay, cause of death, ISS, the type of surgery performed (cardiothoracic, general, neurosurgical, orthopedic, or vascular), blood products given during hospital course, temporizing pelvic stabilization measures taken, and the course of events leading up to death. Radiographic images and reports were assessed and fractures were classified according to the Arbeitsgemeinschaft Osteosynthesefragen/Orthopaedic Trauma Association (OTA) fracture classification system.[20]

Patients were divided into causes of death and most patients died of; hemorrhage of pelvis/thorax/abdomen, intracranial hemorrhage, and multiorgan dysfunction syndrome/acute respiratory distress syndrome (MODS/ARDS)/cardiopulmonary arrest. Time of death was grouped into imminent (<6 hours), early (6 to 24 hours), and late (greater than 24 hours).

Given expected nonparametric distribution of survival time, Kruskal-Wallis testing was used with survival time as a function of cause of death. Post-hoc subgroup analysis to assess differences between pairs of groups was performed. ISS, though it gives the impression of being interval data, carries a strongly non-normal, right-skewed distribution inadequately remediated by transformation.[21] Relationship between ISS and survival time was therefore explored using ranked ANCOVA, controlling for age as the covariate. Partial correlations were performed between age against survival time in minutes and against ISS. All calculations were performed using SAS 9.3 (SAS Institute, Cary, NC).

Results

A total of 69 patients (8%) of 867 with pelvic fractures died a median of 24 hours and 37 minutes after admission with a range of 10 minutes to 932 hours and 36 minutes. Including the 23 patients that presented with pelvic fracture after gunshot wound, the death rate rose to 10.6%, but these patients were not a part of this cohort. The leading cause of death within 6 hours was abdominal and pelvic bleeding (23/25), between 6 and 24 hours was head injury (8/12), and after 24 hours was MODS (14/32) (Fig. 1). Most patients who died of hemorrhage did so from multiple areas of bleeding and only 2 patients died of isolated pelvic

	Survival time			Total
Etiology	<6h	6-24h	>24h	
Thoracic/Abdominal				
Hemorrhage	23	4	10	37
Head injury	2	8	8	18
MODS/ARDS	-	-	14	14
	25	12	32	69

Figure 1 Cause of death vs survival time.