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Original article

Predictors of 30-day mortality following hip/pelvis fractures

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ABSTRACT

Introduction: With the cost of healthcare in the United States reaching $2.9 trillion in 2013 and expected to increase with a growing geriatric population, the Center for Medicare and Medicaid Services (CMS) and Hospital Quality Alliance (HQA) began publicly reporting 30-day mortality rates so that hospitals and physicians may begin to confront clinical problems and promote high-quality and patient-centered care. Though the 30-day mortality is considered a highly effective tool in measuring hospital performance, little data actually exists that explores the rate and risk factors for trauma-related hip and pelvis fractures. Therefore, in this study, we sought to explore the risk factors associated with 30-day mortality in trauma-related hip and pelvic fractures.
Materials and methods: Utilizing the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, 341,062 patients undergoing orthopaedic procedures from 2005 to 2013 were identified through a Current Procedural Terminology (CPT) code search. A second CPT code search identified 24,805 patients who sustained a hip/pelvis fracture. Patient demographics, preoperative comorbidities, operative characteristics and postoperative complications were collected and compared using Chi-squared test, Wilcoxon-Mann-Whitney test and multivariate logistic regression analysis.
Results: Preoperative and postoperative risk factors for 30-day mortality following a hip/pelvis fracture were found: ASA classification, ascites, disseminated cancer, dyspnea, functional status, history of congestive heart failure (CHF), history of chronic obstructive pulmonary disease (COPD), a recent blood transfusion, and the postoperative complications: pneumonia, myocardial infarction, stroke, and septic shock.
Discussion: Several preoperative patient risk factors and postoperative complications greatly increased the odds for patient mortality following 30-days after initial surgery. Orthopaedic surgeons can utilize these predictive risk factors to better improve patient care.
Level of evidence: Retrospective study. Level IV.

1. Introduction

The cost of healthcare in the United States reached $2.9 trillion, or $9255 per person, in 2013 – equaling 17.4 percent of the Gross Domestic Product (GDP) [1]. As healthcare expenditures continue to rise, hospitals are seeking avenues to increase quality of care while decreasing costs [2]. In an effort to promote high-quality and patient-centered care, the Centers for Medicare & Medicaid Services (CMS) and Hospital Quality Alliance (HQA) recently began publicly reporting the 30-day mortality rates for patients with acute conditions [3]. By providing the 30-day mortality rates for hospitals, patients and physicians are better able to assess the essential clinical differences among hospitals [4]. Although 30-day mortality is now being highly considered as an effective measure of hospital performance, minimal data exists exploring the rate and risk factors for orthopaedic trauma patients with a hip or pelvis fracture. In order to improve patient care and long-term outcomes, surgeons need to understand the risk factors that increase 30-day mortality in these patients.

Previous studies investigating risk factors impacting mortality for orthopaedic trauma patients have:

- focused on six-month and one year mortality for hip;
- evaluated only specific fracture types, such as geriatric hip fractures;
- included a limited number of risk factors [5–8].

For example, the study by Aharonoff et al. found that for geriatric hip fracture patients, age over 85 years, dependent functional status, history of cancer, ASA score of 3 or 4, and the development

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of one or more postoperative complications were significant risk factors for one year mortality [9]. Belmont et al. determined the in-patient mortality rate following a hip fracture to be 4.5% and that dialysis, cardiac disease, male sex, and injury severity score (ISS) were significant predictors of in-patient mortality; however, this study used a weighted sample and did not evaluate a 30-day mortality [6]. Khan et al., in 2014, determined that 30-day mortality for hip fractures was only related to abnormal creatinine, but this study had a relatively small cohort ($n = 516$) and did not evaluate preoperative comorbidities or postoperative complications as risk factors [10].

Our study aimed to identify the rate and risk factors impacting 30-day mortality for all orthopaedic trauma patients who had sustained a hip or pelvic fracture, allowing surgeons to better assess high-risk patients and ultimately improve patient outcomes and care.

Our hypothesis here are that there are significant pre- and postoperative clinical risk factors associated with 30-day mortality following hip or pelvic fractures in the orthopaedic trauma population.

2. Patients and methods

All procedures performed were in accordance with the ethical standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Utilizing the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, 341,062 patients undergoing orthopaedic procedures from 2005 to 2013 were identified through a Current Procedural Terminology (CPT) code search. A second CPT code search was conducted to identify all patients who underwent surgical fixation of a hip or pelvis fracture. Patients' information was evaluated for complete data regarding 30-day mortality. A number of 24,805 hip/pelvis fracture patients were identified based on these criteria.

Mortality for all patients was defined as death within 30-days following surgery. We investigated whether clinically appropriate patient factors had a significant impact on the rate of 30-day mortality. Patient demographics, preoperative, as well as operative characteristics were collected for each patient. Postoperative complications within 30-days following surgery were also assessed as risk factors for mortality. Bivariate analyses using the chi-squared test and Wilcoxon-Mann-Whitney test were performed to compare risk factors between those who died and those who survived to postoperative day 30, as appropriate. Statistical significance was set at $\alpha = 0.05$.

A multivariate logistic regression was then conducted to determine the risk factors that significantly predict 30-day mortality for orthopaedic trauma patients following a hip or pelvis fracture. All confounding variables, including patient demographics, preoperative comorbidities, operative characteristics and postoperative complications were included in the analysis. Patients with missing data were excluded in the analysis.

Table 1
Select patient characteristics associated with increased mortality following hip/pelvis fracture.

Demographics	All patients	Died (6.2%)	30-day survival (9.38%)
Age, median* (IQR)	83 (73–88)	87 (81–91)	82 (73–88)
ASA, median* (IQR)	3 (3–3)	3 (3–4)	3 (3–3)
BMI, median* (IQR)	24 (21–28)	23 (20–27)	24 (21–28)
Sex, *N* (%)			
Male	7,534* (30.4)	618* (40.2)	6,916* (29.7)
Female	17,271* (69.6)	918* (59.8)	16,353* (70.3)

* $P < 0.05$.

3. Results

Patients with hip or pelvis injuries had a mortality rate of 6.2% ($n = 1536$; 6.2%).

Table 1 lists mortality rates based on select patient demographics. The median age was 83 years (IQR: 73–88) for patients with hip and pelvis fractures, and patients were in the majority female ($n = 17,271$; IQR 69.6). The patients who died within 30-days were significantly older and had a lower median BMI than patients who survived. Of the patients who died, 59.8% were females.

Table 2 provides the individual preoperative risk factors significantly associated with 30-day mortality. Based on the chi-squared analysis, patients with a history of ascites, bleeding disorder, disseminated cancer, dyspnea at rest, history of congestive heart failure (CHF), or a history of chronic obstructive pulmonary disease (COPD) were significantly more likely to die within 30-days following surgery ($P < 0.001$). Steroid use, weight loss greater than

Table 2
Preoperative risk factors for early mortality following hip/pelvis fracture.

Risk factor	Univariate analysis	Adjusted odds ratios			
	Died	30-day survival	*P*-value	OR (95% CI)	*P*-value
ASA class (median)	3 (3–4)	3 (3–3)	< 0.001	2.11 (1.91–2.34)	< 0.001
Ascites, *N* (%)	24 (1.6)	55 (0.2)	< 0.001	7.19 (4.18–12.36)	< 0.001
Bleeding disorder, *N* (%)	361 (23.5)	3,770 (16.2)	< 0.001	1.13 (0.99–1.300)	0.081
Diabetic, *N* (%)	272 (6.2)	4,152 (17.8)	0.893	0.95 (0.82–1.11)	0.532
Disseminated cancer, *N* (%)	134 (8.7)	721 (3.1)	< 0.001	4.80 (3.82–6.04)	< 0.001
Dyspnea, *N* (%)			< 0.001		
None	1295 (84.3)	21,365 (91.8)		1.00 (ref)	
With moderate exertion	168 (10.9)	1,591 (6.8)		1.08 (0.89–1.32)	0.421
At rest	73 (4.8)	313 (1.4)		1.92 (1.42–2.61)	< 0.001
Functional status, *N* (%)			< 0.001		
Independent	811 (52.8)	16,935 (72.8)		1.00 (ref)	
Partially dependent	531 (34.6)	5,261 (22.6)		1.58 (1.40–1.79)	< 0.001
Totally dependent	194 (12.6)	1,073 (4.6)		2.81 (2.34–3.38)	< 0.001
History of CHF, *N* (%)	148 (9.6)	678 (2.9)	< 0.001	1.72 (1.39–2.12)	< 0.001
History of COPD, *N* (%)	308 (20.1)	2,557 (11.0)	< 0.001	1.34 (1.14–1.58)	< 0.001
On dialysis, *N* (%)	64 (4.2)	434 (1.9)	< 0.001	1.82 (1.34–2.47)	< 0.001
Use of steroids, *N* (%)	124 (8.1)	1,315 (5.7)	< 0.001	1.07 (0.86–1.33)	0.547
Weight loss > 10% in last 6 months, *N* (%)	49 (3.2)	347 (1.5)	< 0.001	1.26 (0.89–1.77)	0.187
Hypertension requiring medication, *N* (%)	1,097 (71.4)	15,811 (68.0)	0.005	0.83 (0.73–0.95)	0.005
Recent blood transfusion, *N* (%)	154 (10.0)	1,203 (5.2)	< 0.001	1.36 (1.12–1.65)	0.002

CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease.