

Geriatric High-Energy Polytrauma With Orthopedic Injuries: Clinical Predictors of Mortality

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Abstract

Background: The impact of orthopedic injuries in the elderly patient with multi-trauma and the effect of operative fixation on these injuries have not been thoroughly evaluated. **Methods:** We reviewed geriatric patients (aged 65 and older) between 2004 and 2010 at a level I trauma center who sustained high-energy polytrauma (injury and severity score [ISS] ≥ 16) with associated orthopedic injuries. Patients were excluded if they had severe head and spine injuries, died on arrival, or had low-energy mechanisms of injury. Logistic regression was conducted to identify factors that predict mortality. **Results:** There were 154 patients who comprised our study group with an average age of 76 years and an ISS of 23. There were 96 males and 58 females. Overall, 52 patients died within 1 year of their admission: 21 patients during their initial hospital stay and 31 patients within 1 year following admission. In all, 64 (42%) patients underwent operative stabilization of their orthopedic injuries. Increased mortality was seen ($P < .05$) in female patients, those with lower admission Glasgow coma score, and those who underwent orthopedic surgery. Patients had worse outcomes if they sustained femur ($P = .014$), clavicle, or scapular fractures ($P = .027$). Other fractures associated with higher mortality included pelvic/acetabular injury requiring surgery ($P = .019$) or spine fractures treated non-operatively ($P = .014$). **Conclusion:** The effect of orthopedic injuries on this geriatric polytrauma group contribute to worse outcomes when they included clavicle, scapula, and femur fractures. We also found that pelvic/acetabular fractures treated operatively and nonoperative spine fractures were associated with higher mortality rates. Risk/benefit consideration is suggested when contemplating operative intervention in these patients.

Keywords

geriatric, polytrauma, orthopedic injuries, fixation

Introduction

The elderly population represents a substantial growing portion of the population. The 2010 US Census showed approximately 40.3 million people aged 65 years and older in the United States compared with 35 million in 2000, representing an increase in 15%.¹ The data also illustrate that the population aged between 45 and 64 years had a growth rate of 32% primarily due to the Baby Boomer population which will be reflected in the next census to come.¹ This trend can be expected to lead to an increase in the number of patients with trauma aged older than 65 years. Trauma is currently the fifth leading cause of death and it is calculated that one-third of the health care resources are being expended on patients older than 65 years of age.¹⁻⁴

Most patients with multiple trauma present with orthopedic injuries, and the elderly patients are no different. A patient with multiple trauma having orthopedic injuries will often have alterations in their lifestyle and social situation as a result of these injuries. In the elderly patients, these implications can be marked. There is a paucity of literature on the elderly

polytrauma with associated orthopedic injuries.⁵⁻⁷ Also, there are currently no guidelines for providing optimal treatment to this specific population. We hypothesize that orthopedic injuries requiring surgery will have higher mortality rates compared to that of elderly patients with polytrauma having orthopedic injuries that do not require surgery.

Methods

Institutional review board approval was obtained. A Level 1 trauma center registry was queried to identify patients aged

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Table 1. Demographics of Study Patient.

	Average	Range	Standard Deviation	P Value
Age	75.6	30	6.8	
ISS	23.0	59	7.4	
GCS	13.5	12	3.4	.05 ^a
Length of stay (LOS)	15.3	81	12.3	.18
Mechanical ventilation days	6.9	43	10.4	.64

Abbreviations: ISS, injury and severity score; GCS, Glasgow coma score.

^aSignificance $P < .05$.

65 years and older between 2004 and 2010 who presented as a patient with polytrauma having orthopedic injuries. A patient with polytrauma was defined by an injury and severity score (ISS) of 16 or greater. Orthopedic injuries were defined by an abbreviated injury score (AIS) of 2 or greater for the extremity subscale. Patients were excluded if they presented with an AIS of 4 or greater for the head and/or spine, as these are potential confounding factors that may independently contribute to poor functional outcomes and impact decisions when surgical fixation would have been recommended if these injuries did not coexist.

Additional exclusion criteria were death on arrival to the emergency department and low-energy mechanism of injury, that is, ground-level falls. A retrospective chart review was completed to collect multiple data points as seen in Tables 1 to 3. Details of all orthopedic injuries were recorded. We then compared those patients who required orthopedic surgical procedures to those who did not have surgical stabilization of their orthopedic injuries.

Demographics

There were 757 patients who presented with an ISS ≥ 16 and an age of 65 years or older. There were 333 patients who were excluded secondary to low-energy mechanisms. A total of 244 patients were excluded secondary to critical (AIS > 4) head and spine injuries. An additional 26 patients were then excluded secondary to the lack of associated orthopedic injuries, leaving 154 patients included in our study population. The average age of patients in this study was 75.6 (range: 65-95) years, with 96 males and 58 females. The average ISS of our patients upon admission to the hospital was 23 (range: 16-75) and Glasgow coma score was 13.5 (range: 3-15).

Hospital Course

The average length of stay was 15.3 days (range: 1-82) and on the ventilator was 6.9 days (range: 0-43). Upon discharge from the hospital, 106 patients were discharged to rehab and only 27 were discharged home (Table 1).

Comorbidities

Major comorbidities recorded included 111 patients with hypertension, 14 with chronic pulmonary obstructive disease,

Table 2. The Effects of Preexisting Comorbidities and Sustained Complications During the Patients' Hospital Stay on Mortality Rates.

Comorbidities	Incidence	Deaths	Mortality Rate, %	P Value
HTN	111	33	30	.11
COPD	14	8	57	.63
DM	46	19	41	.71
Smoking	40	19	48	.17
Complications				
New PE	2	1	50	.50
New DVT	15	3	20	.14
New MI	5	3	60	.96
Pneumonia	15	6	40	.02 ^a

Abbreviations: HTN, hypertension; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; PE, pulmonary embolus; DVT, deep vein thrombosis; MI, myocardial infarction.

^aSignificance $P < .05$.

and 46 patients with diabetes mellitus. There were 40 patients who were smokers (Table 2).

Orthopedic Injury Details

There were 64 patients who underwent orthopedic procedures for their injuries, and 38 of those patients had multiple surgeries. Most commonly, injuries of the spine and pelvic/acetabulum were seen in 87 and 60 patients, respectively. Only 13 spine and 11 pelvic/acetabular fractures were treated surgically.

Statistical Analysis

Statistical analysis using logistic regression was conducted to compare the factors that predict the mortality between these patients. SPSS software (SPSS version 19; SPSS Chicago, Illinois) was utilized.

Results

Complications

Complications included 2 patients with pulmonary embolus, 15 patients with deep vein thrombosis, and 5 patients with myocardial infarction during their hospital admission. There were 15 patients who acquired nosocomial pneumonia which was associated with a significant higher mortality ($P = .019$; Table 3).

Mortality Rates

There was a 14% (21 of 154) mortality rate during their initial hospital admission, and 7 of these patients underwent operative fixation for their orthopedic injuries. An additional 20% (31 of 154) of patients died within 1 year following admission. Thus, overall 52 patients died within 1 year of their original presentations including those who died during their initial admission. This resulted in a 1-year mortality rate of 34% (52 of 154) in

Table 3. Mortality Rate and Incidence of Various Orthopedic Injuries With Associated *P* Values in Elderly Patients Sustaining High-Energy Polytrauma.

Orthopedic Injury	Incidence	Mortality, %	<i>P</i> Value
Foot	4	25	.082
Ankle	17	41	.082
Tibia/fibula	19	47	.072
Femur	31	45	.014 ^a
Pelvis	35	31	.342
Acetabulum	10	50	.342
Pelvis requiring surgery	5	60	.019 ^a
Acetabulum requiring surgery	10	70	.019 ^a
Carpal, metacarpal, and phalanges	7	57	.611
Radius/ulna	24	25	.611
Humerus shaft	7	43	.611
Proximal humerus	5	20	.611
Clavicle	23	39	.027 ^a
Scapula	21	24	.027 ^a
Spine	74	34	.014 ^a
Spine requiring surgery	13	46	.994

^aSignificance $P < .05$.

those elderly patients with high-energy polytrauma who presented with orthopedic injuries.

Of the 58 female patients in our study, 29 underwent operative fixation of their orthopedic injuries. Ten patients subsequently died, showing an increased mortality rate ($P < .05$). Patients who had undergone nonorthopedic procedures showed a mortality rate of 41% (14 of 34). The majority of these concomitant surgeries included exploratory laparotomies ($n = 12$) as well as tracheostomies, percutaneous gastrostomies, craniotomies/ventriculostomies, and vascular procedures.

Patients who had higher mortality rates were noted to have spine fractures that were treated nonoperatively ($P = .014$), pelvis and acetabular fractures requiring surgery ($P = .019$), operative femur fractures ($P = .014$), and clavicle or scapula fractures ($P = .027$; Table 4).

Discussion

The elderly population will grow rapidly in the years to come. With the aging Baby Boomer generation, a higher life expectancy and decreasing rates of mortality secondary to advances in treatment for heart disease, stroke, and cancer, there is an anticipated increase in the incidence of geriatric patients presenting with traumatic injuries. The elderly trauma patient has been shown to have an increased hospital stay contributing to higher hospital fees, therefore reinforcing the statement that a proper guideline of care must be determined.⁸ Their fragility can be depicted in evidence that demonstrates an increased risk of death only after sustaining minor trauma such as hip fractures after ground-level falls, especially with the presence of their highly comorbid medical conditions.⁹ Low-energy injuries have already been thoroughly studied in the elderly patients. In contrast, there is a lack of data pertaining to elderly patients with higher energy multiple trauma. To establish information

for the competent care of the elderly patients with high-energy trauma, we sought to provide insight into the factors and injuries associated with increased mortality. Several studies have shown that the geriatric population has higher mortality rates when sustaining a trauma compared to the younger population.^{3,10-13} Our article focuses on the elderly patients who have sustained high-energy polytrauma and attempts to draw conclusions from the following areas: orthopedic injuries, impact of operative fixation, and associated mortality.

Tornetta et al found that timing of orthopedic interventions did not have any statistical effect on outcomes. It was found that patients who showed higher incidence of death were those who underwent general surgical procedures that was attributed to more severe injuries sustained in these regions.⁵ They also showed that mortality was found to correlate with ISS and resuscitation of the elderly patient and statistically not related to orthopedic injury or timing of surgery.⁵

In our study, there were 34 patients who underwent multiple surgeries of whom 41% (14 of 34) died. In the geriatric patients with polytrauma who underwent operative fixation of their fractures, there were higher mortality rates compared to those who did not have orthopedic operative fixation. Orthopedic injuries requiring operative fixation may indicate that these injuries resulted from such a high-energy mechanism that the stresses imposed by surgery at their current state of health may be significant. We believe that more research is required to discover more definitive associations, but these results demonstrate consideration of the risk-benefit ratio of surgical stabilization that should be discussed.

Timing of surgical fixation has not shown to be a significant factor in mortality as in hip fracture fixation.⁵ Although this can be related to preinjury functional status or preexisting medical conditions,^{3,14} early stabilization and return functional status may prevent problems resulting from prolonged immobilization.^{8,14,15} We did not evaluate this effect on mortality, as it is difficult in a retrospective chart review to determine accurate reasons for delay in surgical stabilization. The ideal treatment for the elderly patient with trauma is still controversial. Some authors affirmed that the best treatment is a conservatory approach, while others sustained that an aggressive treatment is most adequate.^{2,3,8,10,11,13,15}

Despite the lack of evidence-based guidelines for this patient population, many studies have recognized that efforts must be made to find indicators of poor prognosis and obtain a consensus on recommendations that would likely reduce complication rates, length of hospital stay, timing of surgery, surgical time, and, ultimately, mortality.⁶ Keller et al looked at orthopedic injuries significantly associated with in-hospital mortality rates in the geriatric population. They found that clavicle, foot, proximal or head of humerus, humeral shaft, sacroiliac joint, and distal ulna fractures statistics were significantly associated with increased mortality.⁷ We supported this evidence in our findings such that clavicle fractures were associated with higher mortality rates, but we also found femur fractures were associated with higher mortalities. Clavicle fractures are usually non-life-threatening injuries and are treated

conservatively, but it has been reported to show an unexpected increase in mortality in the high-trauma geriatric population. They have been associated with more serious life-threatening thoracic or cranial injuries.¹⁶ We support previous findings that scapula and clavicle fractures during high-energy mechanisms can ultimately serve as indicators to higher mortality rates in the elderly individuals.

Our study included 1-year mortality analysis to depict significant functional decline after 1 year from their injuries and the subsequent associated mortality. We found that femur as well as pelvic/acetabular fractures that required surgery were significantly related to a higher mortality rate. These fractures are a resultant of higher energy mechanisms and may consequently produce a significant amount of stress to a patient with already low-physiologic reserve. Mortality related to pelvic and acetabular fractures that were severe enough as to require operative fixation can be associated with the loss of mobility during the postoperative instructions for nonweight bearing until fractures are determined to be healed. As noted by McGwin et al,³ when comparing injured versus a noninjured cohort of the elderly patients, they found an increased mortality rate in the injured cohort and attributed this to the decrease in function following the injury. Thus, focus should include the rehabilitative period following the initial management of a geriatric patient with polytrauma in order to prevent these complications related to their postinjury functional status.

Immobilization in elderly people has been postulated as an etiology for increased mortality. This has especially shown to be true during halo fixation for spine fractures.¹⁷⁻¹⁹ A study by Harris et al has shown operative treatment in cervical spine fractures do reduce mortality rates at 3 months but not at 1 year.²⁰ We found that patients with spine fractures treated with nonoperative modalities showed higher mortalities compared to those treated surgically during 1 year after sustaining their injuries. Additional research is required to make a definitive conclusion on whether operative treatment of spine fractures will reduce mortality, but we can suspect immobility may potentiate it within this population.

We recognize certain weaknesses in our study and made every effort to improve upon them. We found it difficult to determine the exact reason in a retrospective study why some patients did not undergo operative fixation. For example, a patient may not undergo operative fixation if severe comorbidities or critical condition precludes them from surgery. In addition, delay in treatment is difficult to assess using a retrospective review and we could not quantify the amount of time that elapsed between the injury and arrival to the treating hospital. Also, by requiring an ISS score greater than 16, patients with polyorthopedic trauma with no other associated injuries were excluded. These injuries would have continued building a case for increased mortality seen with prolonged immobilization following significant orthopedic injuries (eg, bilateral femur/tibia/fibula). Finally, since the patient or family ultimately establishes the hospital course and management of the individual, refusal of operative intervention against the physician's advice was sometimes seen.

Conclusion

The effect of orthopedic injuries in this geriatric group with polytrauma contributes to worse outcomes. Also, clavicle fractures serve as an important injury marker demonstrating higher mortality rates. Our study found those patients with orthopedic injuries requiring surgical stabilization fare worse than those not undergoing orthopedic procedures except in spine injuries. Thoughtful risk-benefit consideration is suggested when contemplating operative intervention in these patients.

Authors' Notes

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Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article. Dr. Cannada, is a member of a speakers' bureau or has made paid presentations on behalf of Smith & Nephew, serves as a paid consultant to Zimmer, has received Research support from Smith & Nephew, Synthes, Zimmer, and Arthrex in the form of equipment to the institution, and currently receives research support from the Department of Defense as part of the Major Extremity Trauma Research Consortium, is an editorial board member for Orthopedics Today, and is a board member for AAOS, Orthopaedic Trauma Association, and Ruth Jackson Orthopaedic Society. Dr Watson is a consultant for Bioventus, has received payment for lectures from Stryker, and receives royalties from Biomet. He previously held a patent for DePuy.

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