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Implementation of a Rib Fracture Triage Protocol in Elderly Trauma Patients

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ABSTRACT

Elderly patients are highly susceptible to rib fractures after trauma. The use of a clinical pathway to determine resource allocation for patients with rib fractures has resulted in positive treatment outcomes. This retrospective study assessed the efficacy of a triage protocol involving trauma services on hospital length of stay in elderly patients with fractured ribs. Patients who had 3 or more ribs fractured experienced a statistically significant reduction in hospital length of stay after protocol implementation. We conclude that elderly patients with 3 or more rib fractures should be systematically referred to a trauma specialist.

Key Words

Elderly, Protocols, Rib fractures, Standardization of care, Triage

Rib fractures are a common consequence of blunt chest trauma, typically a result of motor vehicle crashes and falls. It is estimated that two thirds of all blunt chest trauma involves at least 1 rib fracture with a disproportionate share of these patients being elderly (older than 65 years).[1] Elderly patients are particularly susceptible to rib fractures because with increased age, the ribs become more brittle and osteopenic.[1,2] Consequently, rib fractures are more commonly considered a life-threatening event in elderly trauma patients than in younger trauma patients.[3]

The detrimental effects of age on outcomes associated with rib fractures have been extensively examined.[4-7] Bulger and colleagues[5] noted that, compared with younger adults with similar Injury Severity Scores (ISS), patients 65 years and older were more likely to present in shock (systolic blood pressure < 90 mmHg), develop pulmonary complications, and have longer hospital and intensive care unit (ICU) stays and higher mortality rate. Older adults were also less likely to be discharged back to their homes. These findings continue to be replicated by other researchers.[3,6,8,9]

With respect to mortality due to rib fractures, Sharma and colleagues[1] found 18% mortality rate in adults aged 65 yeas and older with any number of rib fractures, versus 9% for those aged 18 to 64 years. Kent and colleagues[3] noted that 77% of patients older than 60 years who died with a primary injury to the chest wall had no worse injury than rib fractures.

It has been well documented that the use of protocols in patients care is beneficial and improves patient outcomes. Most attribute the increases in effectiveness and efficiency associated with the use of protocols to the protocol's ability to streamline clinical decision making and subsequent patient care.[10] The use of a clinical triage pathway, or protocol, to determine resource allocation for patients with rib fractures has been found to decrease the incidence of pneumonia, length of hospital stay, and length of ICU stay, even when adjusted for age, ISS, and the number of fractures.[11–14]

RATIONALE FOR THIS STUDY

The goal of this study was to assess the efficacy of the implementation of a rib fracture protocol among elderly trauma patients. Routine deliberations of the Trauma Performance Improvement and Patient Safety Committee (Trauma PIPS), affiliated with the investigational hospital, identified patients who had multiple rib fractures but were not evaluated by the trauma service. Several of these patients required extended hospital stays. As a result, trauma surgeons and emergency physicians collaboratively developed and implemented an emergency department rib fracture protocol. Elderly patients found to have 3 or more fractures, hemodynamic abnormality, or hemopneumothorax were automatically referred to the trauma service. Patients not meeting these criteria but with risk factors for morbidity and mortality including age greater than 64 years, fall from higher than ground level,

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or recent use of warfarin or clopidogrel were also referred to the trauma service. The treatment and disposition of patients with 2 or fewer rib fractures not meeting the criteria described earlier were carried out according to the emergency physician's discretion. The resulting Emergency Department Rib Fracture Protocol was implemented in the last quarter of 2008.

Mortality among trauma patients in the investigational hospital would result in too small a sample size to allow analysis. Consequently, the use of reduction in mortality rate as a measure of protocol effectiveness would not be diagnostic with respect to the success of the protocol. Given this, it was decided to use hospital length of stay (LOS) as the primary measure of protocol effectiveness. It was hypothesized that the implementation of the Rib Fracture Protocol would result in a reduction in LOS for patients with 3 or more fractured ribs. The study was approved by the hospital's institutional review board.

METHODS

Sample

The study took place at a level 1 trauma center in Iowa. The hospital is the receiving hospital for the central third of the state, serving a medium-sized city as well as rural and isolated population areas. The Trauma ICU is staffed by 4 trauma surgeons who have primary responsibility for these patients. Retrospectively, trauma patients 65 years of age and older admitted during the time period of January 1, 2007, to December 31, 2010, with at least 1 rib fracture, were included in the study. The 4 years were stratified into 2 time periods: Pre-Protocol Implementation (2007-2008) and Post-Protocol Implementation (2009-2010). Patients were also stratified by the number of ribs fractured (<3, 3 or more). The outcome variable was hospital LOS.

Statistical Methodology

All analyses were performed using IBM SPSS Statistics Version 19 (Armonk, New York). Categorical variables were analyzed using chi-square tests. Continuous variables were analyzed using *t* tests or analysis of variance as appropriate. All statistical tests used were 2-sided with an alpha value of .05 or less. Bonferroni correction was applied to adjust for alpha inflation where appropriate. The sample size needed to detect a statistical significant difference between the 4 groups with a power of 0.80, using an alpha value of .05 or less 2-tailed, and a moderate effect size was 112.[15]

RESULTS

Patient Characteristics

Demographic and clinical characteristics can be found in Table 1. A total of 81 patients were included in the pre-protocol phase and 67 patients in the post-protocol phase. Of the 148 patients, 76 (51.35%) were male, and 58 (39.19%) had less than 3 rib fractures. For mechanism of injury,

TABLE 1 Demographic and Clinical Characteristics

	Pre-protocol		Post-protocol		Total	
	N	%	N	%	N	%
Sex						
Male	46	56.79%	30	57.69%	76	51.35%
Female	35	43.21%	37	71.15%	72	48.65%
Total	*81*		*67*		*148*	
Ribs fractured						
Less than 3 rib fractures	30	37.04%	28	41.79%	58	39.19%
3 or more rib fractures	51	62.96%	39	58.21%	90	60.81%
Mortality						
Less than 3 rib fractures	3	3.70%	2	2.99%	5	3.38%
3 or more rib fractures	6	7.41%	3	4.48%	9	6.08%
Total	*9*	11.11%	*5*	7.46%	*14*	9.46%
Mechanism of injury						
Motor vehicle accidents	30	37.04%	12	17.91%	42	28.38%
Falls	44	54.32%	39	58.21%	83	56.08%
Other	7	8.64%	6	8.96%	13	8.78%

TABLE 2 Injury Severity Characteristics[a]

	Pre-protocol Implementation			Post-protocol Implementation		
	N	Mean	SD	N	Mean	SD
Age						
Less than 3 fractured ribs	30	79.70	7.88	28	79.64	9.37
3 or more fractured ribs	51	79.06	8.50	39	79.54	8.11
Injury Severity Score						
Less than 3 fractured ribs	30	11.50	7.20	28	10.68	9.25
3 or more fractured ribs	51	18.63	12.44	39	17.13	9.67
Systolic blood pressure						
Less than 3 fractured ribs	30	139.13	25.45	28	152.82	23.25
3 or more fractured ribs	51	129.25	36.50	39	139.23	27.44
Glasgow Coma Scale						
Less than 3 fractured ribs	30	14.88	0.33	28	14.21	2.48
3 or more fractured ribs	51	13.79	3.47	39	14.10	2.77

[a]*None of the differences were statistically significant with* $\alpha \leq .05$.

56.08% of the patients fractured their ribs due to falls while 28.37% fractured their ribs in a motor vehicle accident. Fourteen (9.46%) patients died over the course of the study.

Table 2 displays the means and standard deviations for age, injury severity (ISS), first systolic blood pressure, and first Glasgow Coma Scale score. None of the differences between pre- and post-protocol implementation reached statistical significance.

A 2 (Protocol Phase: pre vs post) × 2 (Rib Fractures: less than 3 vs 3 or more) analysis of variance was performed on the outcome variables of ICU LOS and hospital LOS. A statistically significant difference was found within ICU LOS ($F_{1,105}$= 4.959; P = .028) and hospital LOS ($F_{1,105}$= 4.254; P = .042) when comparing the number of ribs fractured. As can be seen from the means displayed in Table 3, this significance occurred because patients with 3 or more ribs fractured had longer lengths of stay. A statistically significant difference was also found within hospital LOS when comparing protocol phase ($F_{1,105}$= 7.820; P = .006). This significance occurred because of the decrease in hospital LOS from pre-protocol to post-protocol intervention.

DISCUSSION

The study presented here emphasizes the importance of a systematic, standardized approach to the triage of patients with rib fractures. The emergency department rib fracture protocol identifies patients at risk for serious complications and ensures involvement of the Trauma service in their care.

By referring patients with 3 or more fractured ribs to the Trauma service, we noted a decrease in hospital LOS among elderly patients with 3 or more fractured ribs. Our protocol identifies patients at risk for serious

TABLE 3 Length of Stay Measures

	Pre-protocol Implementation			Post-protocol Implementation		
	N	Mean	SD	N	Mean	SD
ICU length of stay						
Less than 3 fractured ribs	26	0.54	1.24	10	1.90	2.33
3 or more fractured ribs	48	3.67	7.30	25	4.72	6.97
Hospital length of stay						
Less than 3 fractured ribs	30	4.77	3.93	28	4.93	3.33
3 or more fractured ribs	51	10.24	13.59	39	8.74	9.83

complications and ensures involvement of the trauma service in their care. Age, the number of fractures, and associated markers of injury severity were selected as criteria for referral to the trauma service in light of the evidence outlined in the introductory paragraph. There was no change in practice other than concentration of these patients on the trauma service, where multidisciplinary care could be obtained. Care of the elderly patient with rib fractures at our institution includes aggressive pain control with patient-controlled analgesia, early mobilization, and multidisciplinary care including physical and occupational therapy, physical medicine and rehabilitation, social work, and pharmacy. We, therefore, conclude that elderly patients with 3 or more rib fractures should be systematically referred to a trauma specialist.

As outcomes in the elderly improve and mortality rate decreases, mortality becomes less useful as an indicator of recovery and process-oriented outcomes (eg, "time-to" measures such as ICU days, ventilator days, and hospital days; functional outcomes such as discharge disposition and return to previous level of activity) gain importance.[6,16-20] Elderly trauma patients with rib fractures, particularly those with isolated chest injuries, should benefit from this shift toward process-oriented measures. The reduction in variability afforded by standardization of care may make studying the effects of interventions on process-oriented measures like time-to-discharge easier, as increased variability tends to obscure these effects. Triage protocols, such as the one implemented in this study, are an important step toward a process-oriented approach.

Limitations

This study examined a relatively small group of patients at a single institution. Consequently, the results of this study may not generalize to other populations. This study was also a retrospective study; therefore, all contributions to variability could not be systematically controlled. Despite these limitations, the study demonstrates that a triage protocol in the care of the elderly patient with rib fractures results in decreased hospital stay.

CONCLUSION

Elderly patients with 3 or more rib fractures, evidence of hemothorax, pneumothorax, or hemodynamic abnormality, recent use of anticoagulant or antiplatelet medications, or fall from a height greater than standing should be systematically referred to a trauma specialist by the emergency physician. This standardization of care reduces hospital LOS in more seriously injured patients.

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