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Perceptions in rib injuries: A multidisciplinary single center survey of clinician differences in risk stratification and management of patients with rib fractures

Matthew C. Johnson [a], Claire P. Miller [a], Allan E. Stolarski [b], Ashar Ata [a], Ashley Bartscherer [a], Sean P. Geary [c], Carl Rosati [a], Joseph DuBose [d], Marcel Tafen [a, *], Steven C. Stain [a]

[a] Section of Trauma and Acute Care Surgery, Department of Surgery, Albany Medical Center, Albany, NY, USA
[b] Department of Surgery, Boston University Medical Center, Boston, MA, USA
[c] Department of Emergency Medicine & Department of Surgery, Division of Surgical Critical Care, Albany Medical Center, Albany, NY, USA
[d] R Adams Cowley Shock Trauma Center, University of Maryland Medical Center, Baltimore, MD, USA

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ABSTRACT

Background: Although associated with significant morbidity, there is no universally accepted management of rib fractures. We hypothesized that variations in risk stratification may influence this.
Methods: A questionnaire was developed to assess providers' perceived risk factors and injury stratification of rib fracture patients at a Level 1 trauma center.
Results: There were 143 responses (36% physician response rate). Hypoxia, age, number of ribs fractured, pre-existing pulmonary disease, and flail chest were identified as the most important risk factors determining morbidity and mortality in blunt chest trauma. While clinicians agreed on predicted mortality for <2 fractured ribs, significant variation for 5–6 and >8 rib fractures was seen. EM and surgery providers significantly differed in assessment of injury severity.
Conclusion: Providers identified common risk factors for increased morbidity and mortality. However, the difference in perceived severity between providers indicates a need for clinical tools to assist in better standardizing rib fracture management.

Introduction

Rib fractures are seen in 9–15% of all trauma cases and are associated with significant morbidity and mortality.[1–3] While there have been substantial improvements in the knowledge and management of rib fractures over the past 20–30 years, there has been little standardization of care.[4,5] General recommendations for the management of patients with rib fractures are provided by major trauma societies, including The Eastern Association for the Surgery of Trauma (EAST),[6] Western Trauma Association (WEST),[7] and the American College of Surgeon's Committee on Trauma (ACSCOT), via the Advanced Trauma Life Support course.[8] Recently, some centers have offered bundled management tools as a possible solution.[14] However, proposed clinical and radiographic scoring systems are not universally accepted,[11–13,15] and one third of clinicians do not follow any guidelines in the management of this patient population.[9] It is unclear if clinicians are aware of the existence of guidelines or if they simply rely on clinical gestalt; however, it appears that the care of these patients varies widely depending on the provider and setting. The aim of this study was to explore beliefs, attitudes, and care decisions of providers with various backgrounds and level of training.

Methods

Survey Design: A questionnaire was developed based on existing research and expert opinions from the departments of

* Corresponding author.Albany Medical College, 47 New Scotland Ave., MC-194, Albany, NY, 12208, USA.
E-mail addresses: Johnsom6@mail.amc.edu (M.C. Johnson), millerc8@amc.edu (C.P. Miller), AlStolar@bu.edu (A.E. Stolarski), AtaA@amc.edu (A. Ata), bartsca@amc.edu (A. Bartscherer), gearys@amc.edu (S.P. Geary), RosatiC@amc.edu (C. Rosati), jjd3c@yahoo.com (J. DuBose), tafenwm@amc.edu (M. Tafen), StainS@amc.edu (S.C. Stain).

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Table 1
Risk factors identified in the literature review as influencing morbidity and mortality associated with rib fractures.

- Age
- Concomitant presence of hemothorax
- Female sex
- Number of ribs fractured
- Bilateral rib fractures
- Flail chest
- Self-reported pain
- Cardiac disease (MI, cardiac surgery, CAD, or CHF)
- Prior anticoagulant use
- Concomitant Pneumothorax
- Male sex
- Concomitant pulmonary contusion
- Hypercarbia (PaCO2 >50 mmHg)
- 1st rib fracture
- Decreased pulmonary function test
- Hypoxia <90% on room air
- Concomitant sternal fracture
- Pulmonary disease (Thoracic operation, obstructive, or restrictive lung disease)
- Injury severity score
- Chronic illness (Diabetes, liver disease, renal disease, etc.)

Abbreviations: MI, Myocardial infarction; CAD, Coronary artery disease; CHF, Congestive heart failure.

surgery and emergency medicine at a 734-bed academic medical center and level one trauma center in upstate New York. The study was approved by the institutional review board. Participants were given the choice to consent to participate in the study or to opt out. The survey began with 12 questions regarding the role and setting of the subject.

Clinicians were asked to select, and then rank, the five factors they considered most important in the initial evaluation of patients with rib fractures. Choices were based on a randomized list of previously identified risk factors for morbity and mortality (Table 1). This was followed by questions asking respondents to estimate the mortality of five clinical scenarios. Next, clinicians were asked to risk stratify three simple clinical vignettes, based on their personal definition of what they would consider mild, moderate, and severe injuries. Finally, participants were asked to choose which therapy was most appropriate for rib fractures of varying severity based on five hypothetical treatment sets. Responses to questions that included the estimation of a quantity (e.g., mortality or morbidity rates) were not open ended but were prepopulated choices based on existing literature and experiences from our institution.[2]

Survey Distribution: This study surveyed clinicians who manage patients with rib fractures. Clinicians were identified via email lists from the surgery and emergency medicine departments. An anonymous link was emailed to administrative personnel (i.e., residency director, nurse manager, etc.) from the previously discussed departments. Study participants included attending physicians, residents, fellows, advanced practice providers, and nurses. The previously identified administrators distributed the link to potential participants and the research team did not have additional contact with the respondents. Response rates were estimated for physicians based on the number identified in each department by the administrative personnel.

Data Acquisition and Analysis: All survey responses, including partial responses, were included in the study. The questionnaire was prepared using Qualtrics (Qualtrics LLC., Provo, UT), and data was collected and analyzed using their online survey software. Additional statistical analysis was completed using Stata 14.0 (StataCorpLLC., College Station,TX). Survey responses were compared across respondent subgroups (specialty, role, and level of training) using Pearson's chi-square and Fischer's exact test. Statistical significance was assessed at an alpha of 0.05. This same process was completed for clinical vignettes and treatment algorithms. When evaluating the perceived mortality of clinical scenarios, we looked at the consensus peak, the point at which the plurality of clinicians agreed on the mortality associated with the described scenario.

Results

A total of 143 responses were received across multiple specialties, roles, and level of physician training, with a physician response rate of 36% (56 of 155) across eligible physicians. Table 2 highlights the pertinent demographics of the study population. Analysis of responses did not identify any differences in subgroup demographics when comparing role (p-value = 0.31), specialty (p-value = 0.71), or level of training (EM, p-value = 0.29; Surgery, p-value = 0.27). Greater than 90% of respondents reported management of trauma as part of their practice.

All groups identified hypoxia, age, number of ribs fractured, preexisting pulmonary disease, and flail chest as the most important risk factors for determining morbidity and mortality, irrespective of specialty, role, and level of training (Fig. 1). There was no difference between each sub-group in the identification of the five most important elements. Compared to physicians, nurses showed less agreement with what risk factors constituted increased morbidity and mortality, leading to statically significant differences between nurses and physicians for age and the number of rib fractures.

The majority of clinicians agreed on the predicted mortality for <2 rib fractures, as defined by the consensus peak, with 53–80% of

Table 2
Demographic characteristics of providers.

		Physician	APP	Total
Emergency Medicine		26	10	36
Level of Training	Resident/Fellow	11		
	Attending	15		
Surgery		29	5	34
Level of Training	Resident/Fellow	17		
	Attending	12		
Specialty	General	13		
	Trauma	8		
	Other	8		
Physician and APP total		55	15	70
Nurses				73
		Total Responses		143

Abbreviations: APP, advanced practice provider.

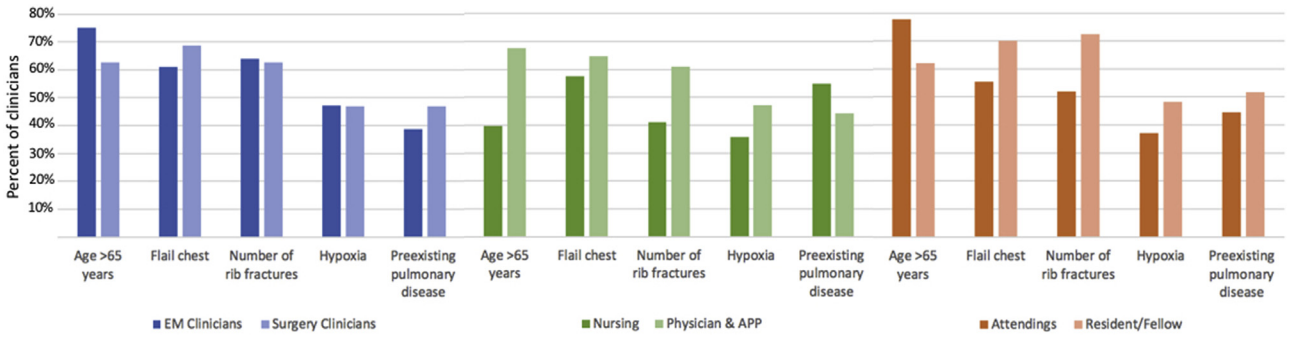

Fig. 1. Comparison of the five most commonly identified risk factors for increased morbidity and mortality of rib fractures by specialty, role in the medical team, and level of education.
* Statistically significant value.
EM: emergency medicine; APP, advanced practice provider.

subjects agreeing on an estimated mortality of 5%. However, for 5–6 rib fractures and >8 rib fractures, there was increasing variation in the predicted mortality with little consensus across specialties, roles, and level of training. The consensus peaks for 5–6 rib fractures ranged from 10 to 20% mortality, at 29–53% agreement. For >8 rib fractures, the lack of agreement was even more pronounced as a consensus peak was not identified in multiple groups, with agreement ranging from 0 to 45% (Fig. 2).

The next series of questions asked subjects to evaluate clinical vignettes, based on their personal identification of mild, moderate, and severe injuries. EM physicians assigned a significantly higher level of severity to 2/3 of the clinical vignettes. In vignette one, 91% of EM clinicians rated the scenario as severe, compared to 64% of surgeons (p-value = 0.014). For the second vignette, 37% of EM clinicians rated the scenario as severe, compared to 3% of surgeons (p-value = 0.001). There was no difference between stratification of these same vignettes when comparing the level of training or role, as shown in Table 3.

Finally, participants were asked to identify the most appropriate therapies for the management of patients with mild, moderate, and severe rib fractures, based on pre-determined algorithms. For mild injuries, the majority of participants in each sub group agreed that NSAIDs, oral narcotics, and lung exercises were the most appropriate (specialty, p-value = 0.08; role, p-value = 0.424; level of training, p-value = 0.193). There were no differences amongst clinicians when selecting treatment algorithms for patients with moderate injuries. In these cases, there was agreement on the use of a combination of NSAIDs, oral narcotics, lung exercises, gabapentinoids, topical anesthetics, and patient controlled intravenous analgesia (PCA) (specialty, p-value = 0.136; role, p-value = 0.584; level of training, p-value = 0.165). In those patients with severe rib fractures, narcotics, lung exercises, gabapentinoids, epidural analgesia, and ketamine were identified as the most appropriate available therapies (specialty, p-value = 0.253; role, p-value = 0.246; level of training, p-value = 0.016). There was no statistical difference seen between specialty or role when comparing attending physicians to those in training. However, when comparing attending physicians to residents and fellows, there was greater variation in the treatment paradigms selected by those in training, leading to a statistical difference between the two groups.

Discussion

We have found that, when directly asked, surgeons and EM providers had a general agreement on what was associated with an increased risk of complications and death in patients with rib fractures. These factors included the number of rib fractures, hypoxia, age, preexisting pulmonary disease, and flail chest. Previous investigations have identified similar risk factors as the most important factors in clinical decision making.[9]

Our local survey, with a 36% physician response rate, provided an opportunity to compare the beliefs of surgeons and EM providers. This is important, as the initial presentation of these patients often deteriorates overtime.[10] Therefore, one could hypothesize that beliefs and attitudes towards rib fractures among providers during a patient's hospital course could vary widely. Therefore, the development of a comprehensive prognostication system could help predict adverse outcomes and guide decision making. Many prognostic tools exist for rib fractures, including the RibScore,[11] Organ Injury Scale (OIS),[12] and Chest Trauma Score (CTS).[13] Each of these prognostication systems have their own strengths; some focus on factors present on admission, while others highlight in-hospital data. However, none of these systems are comprehensive, leaving the clinicians to rely on their clinical gestalt. Therefore, understanding the views of decision makers is an important initial step in the development of a more accurate prognostication tool.

Interestingly, when respondents were asked to stratify the risk associated with clinical vignettes, we found that EM providers were likely to allocate a more severe rating to the patient than surgical providers. It is unclear why this dichotomy exists, and we speculate that this is because EM clinicians see a broader spectrum of scenarios, from the most benign to life threatening rib fractures, and thus have a lower intrinsic scale.

According to the results of this survey, there is a wide variation in the perceived risk of rib fracture severity and anticipated mortality by clinicians. While clinicians generally agreed on the estimated morbidity and mortality of patients with 1 or 2 rib fractures, there was substantial discrepancy with increasing number of rib fractures. In fact, the differences between the providers' assessment of perceived mortality was such that we could not detect any pervasive tendencies across specialties, roles, or level of training. The absence of a consensus can be explained by a combination of factors: rib fracture mortality at our institution significantly differed from national averages (Table 4); some respondents may have had general knowledge of rib fracture mortality from the associated literature, not reflected locally, while others may have had a greater understanding of our institutional morbidity and mortality trends. This issue can be resolved by expanding the geography of this survey.

The majority of clinicians agreed on the most appropriate therapy for each classification, independent of specialty, role, or level of training. The level of training was a possible influence in the

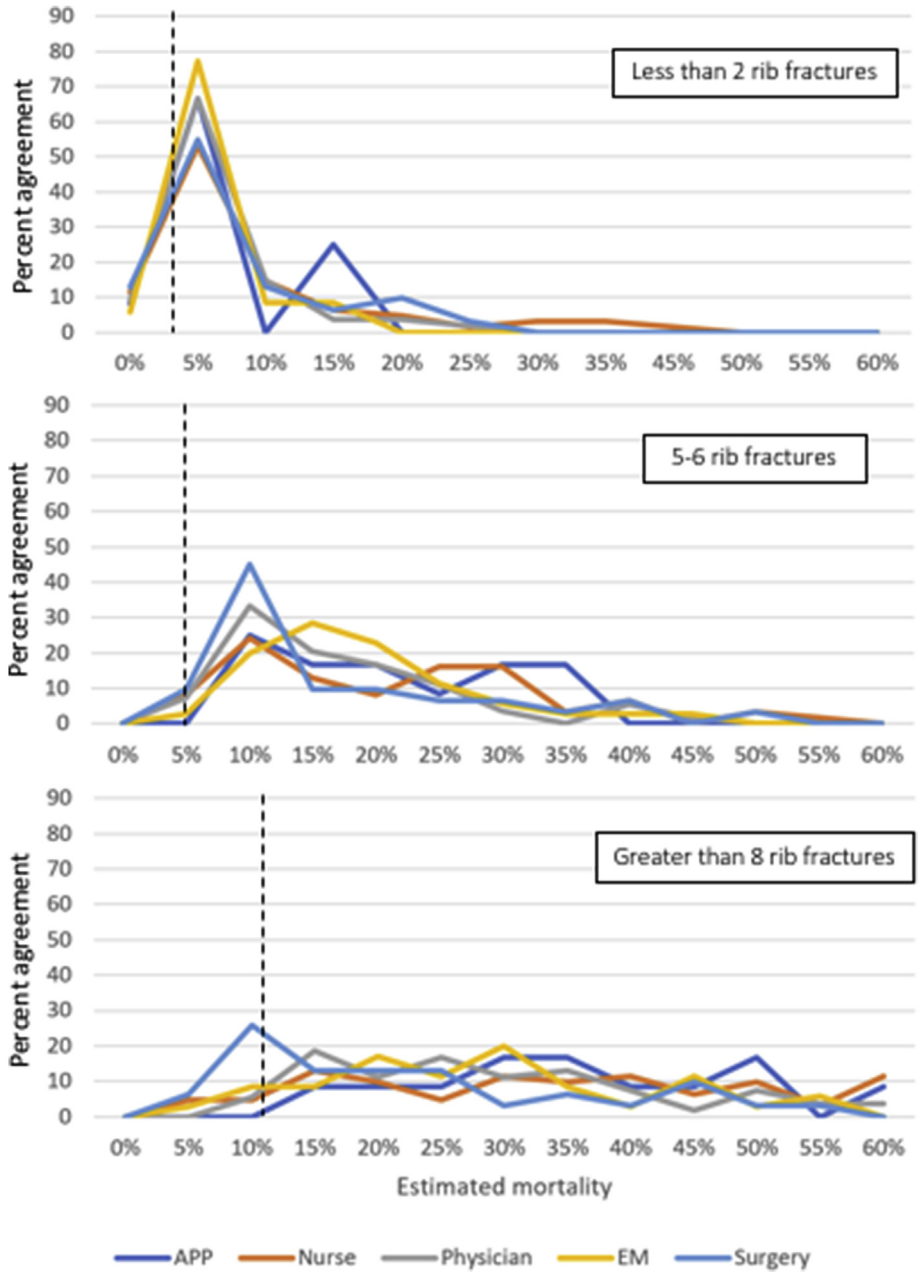

Fig. 2. Comparison of perceived mortality of rib fractures by specialty, role in the medical team, and level of training to internal data. The dashed line represents internal mortality data between January 2011 and December 2014.

management of severe rib fractures, where attending physicians had a significantly better consensus of the appropriate therapy, when compared to residents and fellows.

This study had multiple limitations. We conducted the survey at a single center with a relatively small sample size making the results difficult to generalize. Applying this survey to a highly heterogeneous population proved to be difficult, as many classification subjects felt it was difficult to accurately predict mortality based on the information provided and the system used. The use of the "mild," "moderate," and "severe" classification system was reported to appear subjective to some participants. Additionally, we were unable to find a true mean when assessing for the perceived mortality of rib fractures. Since we used a discrete categorical scale instead of a continuous variable for mortality, we were unable to evaluate a true mean and thus assessed consensus mortality. Finally, we were unable to estimate the response rate across the study due to difficulty ascertaining exactly which groups received the study link, preventing us from completing a non-responder analysis. A clear denominator was only able to be determined for physicians.

Our results show that physicians have mixed attitudes towards the management of rib fractures, likely reflecting various beliefs resulting from diverse personal clinical experiences with this patient population. Further efforts to identify differences among provider groups will help design protocols and target education to ultimately improve the care of chest trauma patients. Given the vulnerability of patients with rib fractures to complications not reflected by their admission status, and the diversity of providers caring for these patients, implementing standardized algorithms that bridge different specialties is important for continuity of care

Table 3
Variation in severity assessment between clinician groups.

	Vignette One			Vignette Two			Vignette Three		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
EM	0%	9%	91%	6%	57%	37%	6%	60%	34%
Surgery	0%	35%	65%	19%	78%	3%	26%	52%	23%
		p-value	0.014		p-value	0.001		p-value	0.068
APP	8%	75%	17%	17%	50%	33%	0%	8%	92%
Nurse	34%	63%	3%	8%	77%	15%	0%	27%	73%
Physician	19%	50%	31%	11%	70%	19%	0%	22%	78%
		p-value	0.002		p-value	0.636		p-value	0.153
Attending	0%	20%	80%	12%	68%	20%	16%	48%	36%
Resident/Fellow	0%	24%	76%	10%	72%	17%	21%	52%	27%
		p-value	0.715		p-value	0.939		p-value	0.779

All values were rounded to the nearest whole number.

Table 4
Comparison of rib fracture mortality between the National Trauma Database (NTDB), Institutional mortality, and survey responses.

	NTDB[a]	Institutional[b]	Survey
Mortality for <2 ribs fractured	5.88%	3.54%	5%
Mortality for 5–6 ribs fractured	10.50%	5.08%	No consensus
Mortality for >8 ribs fractured	34.42%	10.80%	No consensus

[a] NTDB collected between 1994 and 2003 based on ICD-9 codes.
[b] Institutional mortality collected between 1/2011 and 12/2014.

and improved outcomes. Additionally, understanding the views of clinicians will help focus future educational opportunities.

Conclusions

The findings of this survey suggest that providers can identify risk factors for increased morbidity and mortality in patients with rib fractures; however, there is discordance in assessment of injury severity. The need for a prognostic tool to assist clinicians in uniformly identifying higher-risk patients with rib fractures appears evident. Furthermore, clear guidelines are required to standardize care for patients with rib fractures. A larger multicenter study is needed to further establish evidence on the views and practices of providers treating patients with rib fractures.

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