Acute Traumatic Rib Fracture Pain Trajectories: An Observational Study

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Introduction

Rib fractures occurring from trauma have been associated with increased morbidity and mortality.

The Eastern Association for the Surgery of Trauma previously recommended the use of regional anesthesia to treat acute rib fracture pain based on studies of thoracotomy patients[1].

However, recently the recommendations were changed based on rib fracture literature whose statistical methods are limited to retrospective studies assessing total body pain scores in patients with multiple sources of pain[2].

We aimed to describe the pattern of acute pain regression in patients with acute rib fractures as well as to elucidate which fracture patterns or patient characteristics are associated with more severe pain. We will identify pain trajectories for acute rib fracture pain by prospectively collecting site-specific pain scores in polytrauma patients.

The goal of identifying pain trajectories is to tailor the use and duration of multimodal analgesic regimens perioperatively as well as opioid weaning strategies to the specific procedure. To date, there is no acute pain trajectory for rib fractures.

We hypothesized the pain trajectories will follow 3 different patterns (mild, moderate and severe pain) depending on the number, location and severity of the rib fractures, the presence of a flail segment and thoracostomy tubes, as well surgical management and indwelling pain catheters.

Table 1. Patient characteristics

Factor	Value
N	52
Age, median (IQR)	59.5 (34, 69)
Female	16 (31%)
BMI, median (IQR)	27.45 (23.7, 30.61)
Ethnicity	
AAPI	1 (2%)
African American	8 (15%)
Caucasian	25 (48%)
Hispanic	16 (31%)
Missing	2 (4%)
COPD	4 (8%)
Asthma	5 (10%)
Depression	12 (23%)
Anxiety	6 (12%)
Smoking	14 (27%)
Alcohol use	28 (54%)
Chronic pain syndrome	8 (15%)
Opioids use for >3 months	3 (6%)
ASA Physical Status Classification	
I	1 (2%)
II	32 (62%)
III	15 (29%)
IV	1 (2%)
Injury Severity Score, median (IQR)	18.5 (14, 24)
Number of fractured ribs, median (IQR)	6 (4, 8)
Rib fracture laterality	
Bilateral	14 (27%)
Left	21 (40%)
Right	15 (29%)
Polytrauma	42 (81%)
Presence of thoracostomy tubes	4 (8%)

Data are presented as No. (%) or median (IQR)

Methods

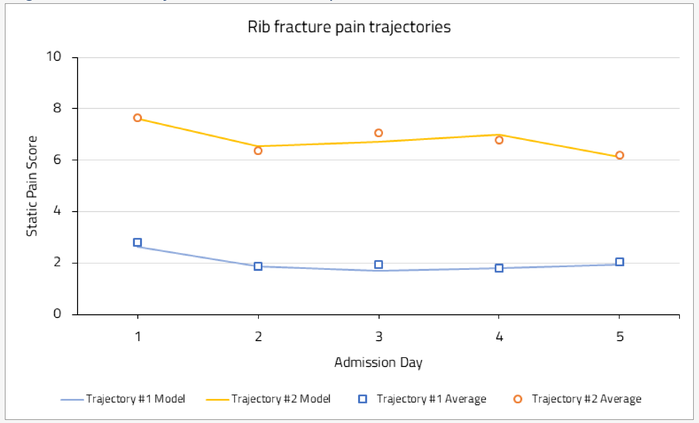
Prospective, observational, non-interventional cohort study.
We aim to enroll 100 patients in this study.

Primary outcome: acute pain trajectories 5 days following injury using latent class analysis

Secondary outcome: characteristics within each acute pain trajectory and association with persistent pain 3, 6, and 12 months after injury

We used group-based trajectory modeling to identify latent classes of pain trajectories. We sequentially modeled 1, 2, 3, and 4 trajectory models and selected the most appropriate models based on the lowest BIC and AIC, as recommended.

Figure 1. Pain Trajectories in trauma patients with rib fractures



Markers represent the actual average daily pain scores for each trajectory group (orange circle = Trajectory #1, blue square = Trajectory #2). The solid lines indicate the modeled trajectory for each group.

Table 2. Model Comparison for Pain Trajectories

Number of Trajectories	BIC	AIC	Entropy	Trajectory Membership			
				#1	#2	#3	#4
2	-489.98	-480.52	0.796	47%	53%		
3	-484.78	-470.6	0.635	14%	38%	48%	
4	-478.62	-460.65	0.721	14%	36%	46%	4%

Abbreviations: BIC = Bayesian Information Criterion, AIC = Akaike Information Criterion
Bolded row indicates selected model based on predefined criteria

Results

We identified that a two-trajectory model best fit our pain data in rib fracture patients (N=52). Patient characteristics are presented in Table 1. The two-trajectory model had the lowest AIC and BIC and the highest entropy (table 2). Figure 1 shows the modeled pain trajectories and average pain scores for each group.

Discussion

The transition of acute pain to chronic pain is complex and multifactorial, with multiple proposed mechanisms of action.[5] It is imperative to focus efforts on preventing the development of chronic pain by aggressively managing acute pain. Acute rib fracture pain has a high potential of converting to chronic pain. However, lack of observational data to direct our care has led to a significant variation in clinical practice in the management of acute rib fracture pain.

The only factor we identified that was associated with the higher pain trajectory was increasing age. These are preliminary results from less than half of our study population. It will be interesting to see the final trajectories and associated factors.

By characterizing pain patterns in rib fractures, providers can predict the trajectory of pain and make a comprehensive treatment plan which may involve single-shot blocks, continuous regional catheters, cryoneurolysis or more sophisticated interventional acute pain management techniques.

References:
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