



Regional Anesthesia and Acute Rib Fractures: A Retrospective Cohort Study of Rib Fracture Pathways

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Highlights

- In our interim analysis, patients in the Acute Pain Service (APS) group had sustained more total number of rib fractures
- The pre-admission benzodiazepine and opioid use was higher in the APS group
- ICU admission rates were higher among our APS group
- Despite higher ICU admission rates, patients with an APS consult had reduced ICU length of stay compared to non-APS patients
- APS patients' MME usage was nearly double for patients seen by APS as opposed to not
- These initial results are treated with caution given our relatively small sample sizes; further investigation is ongoing

Background

Some studies suggest that 4-8 per 10,000 people will experience rib fracture annually (1). Estimates show that 20- 39% of patients that suffer from blunt chest trauma will develop rib fractures, making this condition a very common, if not the most common, thoracic injury (2). Complications from rib fractures ensue primarily due to poor pain control. Poor pain control worsens baseline atelectasis, further causing decompensation of an often already tenuous pulmonary status. The complications from rib fractures and poorly controlled pain include poor respiratory effort, pulmonary infection, intensive care unit admission, intubation, and ultimately mortality. Depending on the severity of a patient's acute rib fractures, systemic analgesia with oral and intravenous pain medications can often be sufficient for adequate pain control. These regimens, however, come with side effects that make them difficult to employ, especially in severely ill patients.

Moreover, in patients with multiple rib fractures, regional anesthetic techniques, such as peripheral nerve blocks and thoracic epidurals, provide more adequate pain control without the side effects of respiratory-depressing opioid usage (3). Prior studies have shown the inception of an Acute Pain Service (APS) can reduce pain scores perioperatively (4), and early research has shown an improvement in mortality with the inception of a protocolized APS with regards to rib fractures and trauma patients (5).

This study looks to build on prior observations by investigating a single institution and the effects on rib fractures prior to and after the inception of an APS. This study aims to guide the creation and implementation of protocols to improve care of this specific population of patients.

Methods

• Single-institution retrospective cohort research study that analyzes outcomes for patients following rib fractures depending on whether they received intervention or management from our APS

• We compared patients with rib fractures in the hospital prior to the inception of the APS to now (2012-2023) versus after alone (2018-2023)

• Endpoints included ICU admission, ICU length of stay, and morphine milligram equivalent (MME) use, need for supplemental oxygen, ICU readmission, and all-cause mortality

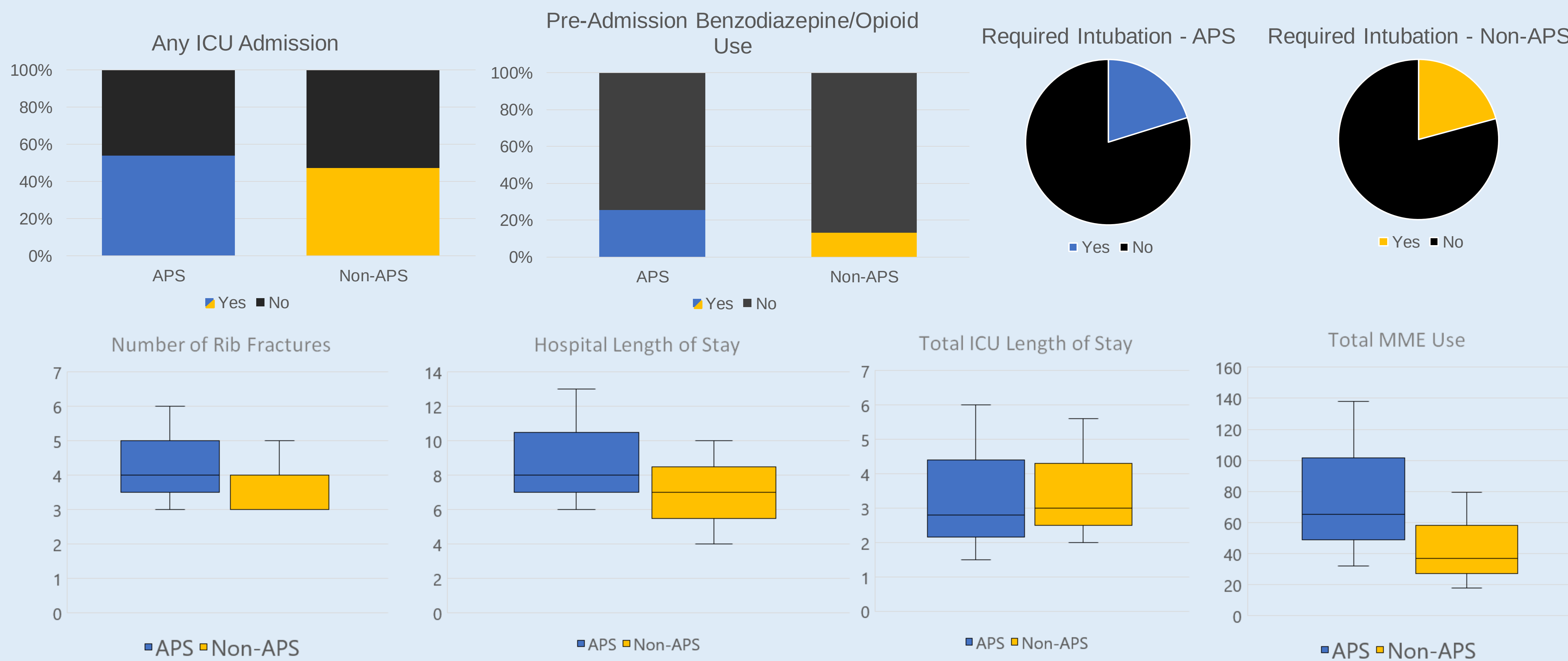
• An interim analysis of our collected data is presented in this abstract; ongoing data collection is taking place. For this interim analysis, the O'Brien-Fleming method was utilized to control for Type I error, with an alpha value of 0.0054 to detect statistical significance

• For analysis of the MME use, a log-gamma model was used, as the data was right-skewed, and the model was adjusted for age, sex, race, initial pain score, rib fracture number, and injury severity score

• Rib fracture severity was determined by use of the Rib Score

Results

- A cohort of 89 intervention patients (post-APS) and 53 control patients (non-APS) were used in this interim analysis
- Injury severity scores were comparable for the two groups; 2.8 ± 1.6 for the APS patients and 3.4 ± 1.4 for the non-APS patients
- The number of rib fractures sustained, however, was higher for our APS group (4.6 ± 2.3 versus 3.6 ± 1.5 for the non-APS cohort)
- Pre-admission benzodiazepine and opioid use was higher in the APS group with 25.6% of these patients prescribed these medications prior to admission, compared to 13.2% of the non-APS patients
- The mortality rate in this group was 2.5% among APS patients and 5.7% among non-APS patients
- APS patients had an ICU admission rate of 53.9% with an average length of stay (LOS) of 4.4 (± 4.2) days. Non-APS patients had an ICU admission rate of 47.2% with an average LOS of 6.5 (± 9.7) days
- Overall, patients in the APS group required 113.6 (median 65.1) MME compared to 56.3 (median 36.9) MME in the non-APS group (Rate Ratio=1.99 in APS vs non-APS, 95% CI = 1.29,3.07, p value 0.002)



Discussion/Future Directions

Both groups represented a similar distribution of patients in their age, race, ethnicity, and BMI. However, patients in the APS group had sustained more total number of rib fractures and did have a higher rate of ICU admission. The pre-admission benzodiazepine and opioid use was also higher in the APS group, *all possible indicators of patients with a more complicated clinical picture.*

Although ICU admission rates were higher among our APS group (which could be due to injury severity that would thereby warrant an APS consult), *our results support that patients with an APS consult had reduced ICU length of stay compared to non-APS patients.* The APS patients further did not have higher use of supplemental O₂, despite the higher ICU admission rate. This could point to the efficacy of APS expertise in treating pain without compromising pulmonary status. In our analysis of MME, results found usage was nearly double for patients seen by APS as opposed to not. One possibility for this result is the relative comfort of APS physicians in prescribing and managing opioids and that patients without an APS consult had underrecognized or undertreated pain. These initial results are treated with caution given our relatively small sample sizes. Ongoing data collection is taking place to better power this study.

Future analysis will include further investigation into the type of APS involvement (medication management, peripheral nerve block, etc.), ICU readmission, and all-cause mortality between the two groups.

Materials

Age	APS (N=89)	Non-APS (N=53)	Total (N=142)
Age (Mean $\pm$ SD)	61.7 $\pm$ 18.2	54.4 $\pm$ 21.9	59.0 $\pm$ 19.9
Age (Median (IQR))	61.0 (50.0, 76.0)	56.0 (35.0, 70.0)	59.5 (45.0, 73.0)
Race	APS (N=89)	Non-APS (N=53)	Total (N=142)
Asian	0 (0.0%)	1 (1.9%)	1 (0.7%)
Black or African American	8 (9.0%)	12 (22.6%)	20 (14.1%)
Other	4 (4.5%)	4 (7.5%)	8 (5.6%)
Unknown	1 (1.1%)	0 (0.0%)	1 (0.7%)
White or Caucasian	76 (85.4%)	36 (67.9%)	112 (78.9%)
Ethnicity	APS (N=89)	Non-APS (N=53)	Total (N=142)
Hispanic or Latino	3 (3.4%)	4 (7.5%)	7 (4.9%)
Not Hispanic or Latino	86 (96.6%)	49 (92.5%)	135 (95.1%)
BMI	APS (N=89)	Non-APS (N=53)	Total (N=142)
Mean $\pm$ SD	27.0 $\pm$ 6.7	25.9 $\pm$ 6.3	7.4 $\pm$ 2.7
Median (IQR)	25.9 (21.7, 31.0)	25.6 (21.1, 29.6)	8.0 (6.0, 10.0)

Table 1. Patient demographics

RibScore

Parameter	Points
≥ 6 fractures	1
Flail chest	1
Bilateral fractures	1
≥ 3 severely displaced fractures	1
≥ 1 anterior, lateral, and posterior fracture	1
First rib fracture	1
Total	6

Table 2. RibScore criteria

References

1. El-Boghdadly, K. and Wiles, M.D. (2019), Regional anaesthesia for rib fractures: too many choices, too little evidence. *Anaesthesia*, 74: 564-568. <https://doi.org/10.1111/anae.14634>
2. Fokin, Alexander A et al. "Surgical Stabilization of Rib Fractures: Indications, Techniques, and Pitfalls." *JBJS essential surgical techniques* vol. 10,2 e0032. 7 May. 2020, doi:10.2106/JBJS.ST.19.00032
3. Nair, Abhijit, and Sandeep Diwan. "Efficacy of Ultrasound-Guided Serratus Anterior Plane Block for Managing Pain Due to Multiple Rib Fractures: A Scoping Review." *Cureus* vol. 14,1 e21322. 17 Jan. 2022, doi:10.7759/cureus.21322
4. Bardiau FM, Braeckman MM, Seidel L, Albert A, Boogaerts JG. Effectiveness of an acute pain service inception in a general hospital. *J Clin Anesth*. 1999;11(7):583-589. doi:10.1016/s0952-8180(99)00101-4
5. Sborov KD, Dennis BM, de Oliveira Filho GR, et al. Acute pain consult and management is associated with improved mortality in rib fracture patients. *Reg Anesth Pain Med*. Published online July 26, 2022. doi:10.1136/rapm-2022-103527