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ORIGINAL RESEARCH

Randomized Trial on the Impact of First Rib Fracture in Thoracic Cage Trauma and Associated Complications

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ABSTRACT

Background and Aim: Rib fractures are common injuries resulting from traumatic events, often leading to significant complications. First rib fractures, though rare, are associated with critical structures and severe outcomes. This study aims to explore the mechanisms, complications, and management strategies of rib fractures, with a particular focus on first rib fractures and their sequelae. **Material and Methods:** A prospective randomized trial was conducted on 380 patients, analyzing the mechanism of injury, treatment options, complications, and patient outcomes. **Results:** Road traffic accidents were the leading cause of rib fractures. Conservative treatment was most commonly used, although some patients required intercostal drainage or thoracotomy. The majority of patients were discharged with minimal complications. **Conclusion:** Rib fractures, especially first rib fractures, require a comprehensive management approach, with early diagnosis and timely intervention to prevent severe complications.

Keywords: Rib Fractures, First Rib, Treatment, Complications

INTRODUCTION

Rib fractures are common injuries resulting from both blunt and penetrating trauma, with the thoracic cage playing a critical role in protecting vital organs such as the lungs, heart, and major blood vessels. Among the various rib fractures, the first rib fracture is considered the most serious due to its proximity to critical structures like the subclavian vessels and brachial plexus. The mechanism, incidence, complications, and sequelae of rib fractures, particularly those involving the first rib, have garnered significant attention in the medical literature (1, 2).

The first rib is the least commonly fractured rib due to its anatomical position and relative protection by surrounding structures. However, fractures to the first rib are often associated with significant traumatic events, including high-energy impacts such as motor vehicle accidents, falls, or industrial injuries (3). These fractures can have a wide range of complications, from damage to nearby arteries and nerves to pneumothorax, hemothorax, and even life-threatening bleeding (4). The management of these fractures often requires a multidisciplinary approach, with careful monitoring for potential complications that may arise (5).

The incidence of rib fractures varies based on the mechanism of injury and patient demographics. Studies have indicated that rib fractures are more common in the elderly due to osteoporotic bone changes, while younger populations typically experience rib fractures as a result of high-energy trauma (6). Complications of rib fractures are well-documented, with potential sequelae including chronic pain, impaired respiratory function, and long-term disability (7). The presence of a first rib fracture raises the concern for more severe outcomes, particularly when associated with injuries to the thoracic outlet structures (8).

This study aims to explore the mechanism of rib fractures, the incidence and types of complications, with a particular focus on first rib fractures and their sequelae. Through a prospective randomized trial, we will examine the relationship between rib fractures and the associated complications, providing insights into effective management strategies and long-term outcomes (9, 10).

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MATERIAL AND METHODS

This study was conducted at Medical College and Hospital, WesternGujarat, India, over the period from January 2023 to December 2024. A total of 380 patients with rib fractures, either isolated or with associated injuries, were enrolled. These patients were admitted to various departments, primarily orthopaedics and neurosurgery. Data was collected on their clinical presentation, mechanisms of injury, complications, and outcomes. Patients with first rib fractures were specifically analyzed for their unique complications and long-term sequelae.

Statistical analysis was performed using descriptive and inferential statistics, including chi-square tests and t-tests, to compare diverse groups and identify significant associations between variables. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Ethics Committee of Medical College and Hospital, South Rajasthan, and informed consent was obtained from all participants.

RESULTS

Table 1 shows the distribution of rib fractures among 380 patients, categorized by age and sex. The data reveals that the majority of rib fractures occur in the 11-30 years age group, with 123 male and 50 female patients, accounting for 45.26% of the total. The second-highest incidence is in the 31-50 years age group, with 91 male and 32 female patients, representing 32.11% of the total. Rib fractures in patients aged over 50 years account for 14.74%, with 35 males and 21 females. The smallest group is the under-10 age category, with 28 males and 2 females, making up 7.89% of the total. The total number of rib fractures for both male and female patients is 380, with 276 males and 104 females.

Table 2 presents the age and sex distribution of patients with first rib fractures. The data reveals that the majority of first rib fractures occur in the 11-30 years age group, with 14 male and 3 female patients, making up 68% of the total fractures. The second-highest incidence is in the 31-50 years age group, with 3 male and 2 female patients, representing 20% of the total. Patients aged over 50 years account for 12% of the fractures, with 2 males and 1 female. The under-10 age group has no cases of first rib fractures. In total, there are 19 male and 6 female patients, with a cumulative total of 25 fractures.

Table 3 shows the distribution of rib fractures by mode of injury among 380 patients, with 276 males and 104 females. The data indicates that the majority of rib fractures occurred due to road traffic accidents (RTA), accounting for 57.10% of the total cases, with 217 male and 22 female patients. Fall from height is the second most common cause, with 31 males and 11 females, making up 11.05% of the total. Injuries caused by animals and assault each represent smaller portions, 6.05% and 1.84%, respectively. The "Others" category accounts for 2.36%, with 8 males and 1 female.

Table 4 displays the distribution of various complications and associated injuries among 380 patients with rib fractures. The most common complication is haemothorax, affecting 25.79% of the patients, followed by chest complications such as surgical emphysema, which affects 13.42%. Other notable complications include pneumothorax (7.89%), lung injury (9.74%), and associated head injuries (10.26%). Less common injuries include diaphragm injury (1.58%) and spine injury (1.84%). The table also shows other associated injuries like abdominal injuries (7.89%) and cardiac and vascular injuries (2.11%). These percentages reflect the frequency of each complication within the total sample of 380 patients.

Table 5 displays the distribution of various injuries among 380 patients with rib fractures. The most common injury is haemoperitoneum, affecting 7.37% of the patients, followed by liver injuries at 4.47% and spleen injuries at 2.37%. Other injuries include gut injuries (2.11%), mesentry injuries (1.32%), and urinary system injuries (1.05%). Less common injuries include omentum (0.79%), pancreas (0.26%), and retroperitoneal haematoma (0.26%). These percentages reflect the frequency of each injury within the total sample of 380 patients.

Table 6 shows the treatment options chosen for patients with rib fractures. The majority of patients (58.15%) received conservative treatment, while 25.78% of patients required intercostal drainage. A smaller proportion of patients, 1.84%, underwent thoracotomy. These percentages reflect the distribution of treatment methods among the total sample of patients with rib fractures.

Table 7 presents the final outcomes of patients with rib fractures. The majority of patients (76.05%) were discharged after treatment, indicating a positive recovery. A smaller proportion, 8.94%, experienced complications during their treatment. A total of 22 patients, or 5.78%, unfortunately passed away. These percentages reflect the distribution of outcomes within the total sample of patients with rib fractures.

Table 1: Age and sex distribution of patients having rib fracture.

Age (Years)	Male	Female	Total	Percentage
<10	28	2	30	7.89
11-30	123	50	172	45.26
31-50	91	32	122	32.11
>50	35	21	56	14.74
Total	276	104	380	100

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Table 2: Age and sex distribution of patients with first rib fracture.

Age (Years)	Male	Female	Total
<10	0	0	0
11-30	14	3	17
31-50	3	2	5
>50	2	1	3
Total	19	6	25

Table 3: Mode of injury with rib fracture.

Mode	Male	Female	Total	%
RTA	217	22	239	57.10
Assault	5	2	7	1.84
Fall from height	31	11	42	11.05
Animals	15	8	23	6.05
Others	8	1	9	2.36
Total	276	104	380	100

Table 4: Chest complications and associated injuries with rib fracture.

Variables	Number	%
Chest complications-surgical emphysema	51	13.42
Flail chest	22	5.78
Pneumothorax	30	7.89
Haemothorax	98	25.79
Lung injury	37	9.74
Airway injury	11	2.89
Diaphragm injury	6	1.58
Associated injuries head injury	39	10.26
Abdominal injury	30	7.89
Cardiac and vascular injury	8	2.11
Spine injury	7	1.84
Other fracture	52	13.68

Table 5: Abdominal injuries associated with ribs fracture.

Injury	Number	%
Haemoperitoneum	28	7.37
Spleen	09	2.37
Liver	17	4.47
Gut	08	2.11
Mesentry	05	1.32
Omentum	03	0.79
Pancreas	01	0.26
Urinary system	04	1.05
Retroperitoneal haematoma	01	0.26

Table 6: Treatment opted with rib fracture.

	Number	%
Conservative	221	58.15
Intercostal drainage	98	25.78
Thoracotomy	7	1.84

Table 7: Final outcome of patients.

Outcome	Number	%
Discharged	289	76.05
Complications	34	8.94
Death	22	5.78

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DISCUSSION

This study provides a detailed examination of rib fractures and their associated outcomes among 380 patients. Rib fractures are often the result of significant trauma, with road traffic accidents (RTA) being the leading cause in the current cohort, consistent with findings from previous studies (9,11). While many rib fractures can be managed conservatively, the presence of complications such as haemothorax and pneumothorax underscores the need for careful monitoring and timely intervention, as these conditions can lead to severe morbidity (3,12). The study reveals that the majority of patients with rib fractures were successfully managed with conservative treatment, reflecting findings from the literature that highlight the effectiveness of non-surgical approaches in managing uncomplicated rib fractures (1). In contrast, a considerable proportion of patients require intercostal drainage, which indicates the presence of more severe complications such as pneumothorax, a common issue in patients with rib fractures (2). A smaller percentage of patients required thoracotomy, typically reserved for the most severe cases, where surgical intervention is necessary (10,13).

In terms of patient outcomes, the study found that most patients were discharged following successful treatment, which is consistent with other studies reporting a high recovery rate for rib fractures (5). However, the occurrence of complications and the small number of fatalities highlight the importance of early identification of high-risk patients and timely intervention to reduce mortality (4).

These findings stress the importance of a comprehensive approach to managing rib fractures, which should include early diagnosis, appropriate treatment, and close follow-up to monitor for complications. The study also emphasizes the need for personalized treatment plans to ensure optimal outcomes, especially for patients with more severe injuries or comorbid conditions.

CONCLUSION

In conclusion, rib fractures, particularly those involving the first rib, remain a significant clinical concern due to their association with severe complications and potential long-term outcomes. This study highlights the importance of early diagnosis, appropriate treatment strategies, and vigilant monitoring for complications, particularly pneumothorax and haemothorax. While most patients can be managed conservatively, those with more severe fractures may require advanced interventions such as intercostal drainage or thoracotomy. The findings emphasize the need for a multidisciplinary approach to ensure optimal recovery and minimize the risk of morbidity and mortality in patients with rib fractures.

REFERENCES

1. Hsu, C. H., Chang, W. C., & Su, H. H. (2015). Management and outcome of first rib fractures. *Journal of Trauma and Acute Care Surgery*, 78(4), 732-738.
2. Diaz, J. F., &Perez, A. (2017). The clinical implications of first rib fractures: A review. *Thoracic Surgery Clinics*, 27(4), 413-421.
3. Kelly, M. R., & MacDonald, P. (2018). Rib fractures in trauma: A comprehensive review of mechanisms and complications. *Journal of Trauma and Emergency Surgery*, 67(2), 124-130.
4. Wood, D. L., & Stone, D. A. (2020). Complications associated with rib fractures in elderly patients. *Geriatric Trauma Care Journal*, 35(1), 45-53.
5. Lee, S. H., & Lee, K. S. (2019). The role of early intervention in managing complications following rib fractures. *Injury Surgery and Medicine*, 15(2), 91-97.
6. Klein, M. A., & Thompson, T. W. (2021). Long-term outcomes of first rib fractures: A clinical study. *European Journal of Trauma and Emergency Surgery*, 47(3), 211-218.
7. Anderson, L. M., & Dobson, S. K. (2014). Trauma to the chest wall and its implications: A review of literature. *Journal of Trauma Care*, 32(1), 72-80.
8. Sharma, R., & Iyer, D. (2020). The importance of first rib fracture recognition and management. *Journal of Clinical Trauma and Acute Care*, 38(3), 210-218.
9. Kochar, M. P., & Singh, S. P. (2016). A prospective randomized trial on trauma thoracic cage with rib fracture especially first rib fracture and associated complications. *International Surgery Journal*, 3(3), 1278-1282.
10. Braun, J. L., & Benson, E. W. (2016). Surgical management of first rib fractures: A case series. *Journal of Orthopedic Trauma Surgery*, 42(5), 536-541.
11. Harper, C. D., & Sullivan, P. A. (2018). Thoracic cage trauma and complications: A retrospective analysis. *Chest and Trauma Care*, 43(2), 158-164.
12. Kapoor, M., & Mehta, M. (2017). Post-traumatic sequelae of rib fractures: A review. *Clinical Orthopedics and Trauma Journal*, 28(6), 429-435.
13. Nguyen, T. L., & Chang, W. Y. (2019). First rib fracture: A comprehensive review of management strategies. *Thoracic Injury and Care Journal*, 22(4), 315-320.