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EVALUATING THE EFFECTIVENESS OF EPIDURAL VERSUS INTRAVENOUS TRAMADOL FOR PAIN MANAGEMENT IN MULTIPLE RIB FRACTURES

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Abstract

Background: Pain management in patients with multiple rib fractures is a critical aspect of care, as inadequate pain control can lead to serious complications such as pneumonia, atelectasis, and prolonged hospital stays. This study compares the efficacy of epidural analgesia versus intravenous opioids in managing pain among patients with multiple rib fractures.

Methods: A prospective interventional study was conducted at the Department of General Surgery, SSIMS&RC, Davangere, from March 2022 to October 2023. A total of 36 patients with more than three rib fractures were randomly assigned to two groups:
Group A (epidural analgesia) and Group B (intravenous opioids). Pain levels were assessed using the Visual Analogue Scale (VAS) on Days 0, 3, and 7. Data were analysed using independent sample t-tests, with a p-value of <0.05 considered statistically significant.

Results: On Day 0, the mean VAS scores were comparable between Group A (9.28 ± 0.669) and Group B (9.61 ± 0.608), with no significant difference ($p = 0.127$). By Day 3, pain scores decreased in both groups, but Group A showed a trend towards lower pain levels (6.25 ± 1.571) compared to Group B (7.19 ± 1.167), though this difference was not statistically significant ($p = 0.065$). By Day 7, Group A experienced significantly lower pain levels (2.81 ± 1.167) compared to Group B (5.19 ± 1.109), with a statistically significant difference ($p < 0.001$).

Conclusion: Epidural analgesia provides superior pain control compared to intravenous opioids, particularly in the later stages of recovery, for patients with multiple rib fractures. These findings suggest that epidural analgesia should be considered as a first-line treatment for pain management in this patient population, potentially leading to faster recovery and reduced hospital stays.

Keywords: Rib fractures, pain management, epidural analgesia, intravenous opioids, Visual Analogue Scale (VAS), thoracic trauma, analgesia comparison.

Introduction

Multiple rib fractures (MRFs) are a common injury associated with blunt thoracic trauma, often resulting from motor vehicle accidents, falls, or direct blows to the chest. MRFs are present in approximately 10% of all trauma cases and up to 80% of patients with significant thoracic injuries[1]. These fractures are associated with substantial morbidity, including pain, respiratory compromise, and a higher risk of developing complications such as pneumonia, atelectasis, and acute respiratory distress syndrome (ARDS) [2].

The mechanism of pain in multiple rib fractures primarily involves direct injury to the intercostal nerves and muscles, leading to sharp, localized pain with each breath or movement, and the inflammatory response further exacerbates pain due to tissue damage and irritation. Effective pain management is crucial in patients with MRFs, as inadequate pain control can lead to diminished coughing efficiency, poor secretion clearance, and progressive respiratory deterioration [3]. Consequently, the risk of developing pneumonia and other respiratory complications is heightened, particularly in older patients and those with pre-existing chronic lung diseases [4]. Pain management in MRF patients not only improves ventilatory function but also plays a vital role in preventing these serious complications.

Various analgesic techniques are employed in the management of pain associated with MRFs, including systemic opioids, regional anaesthesia, and multimodal pain management strategies [5].Among these, epidural analgesia has been traditionally favoured for its superior pain control, particularly in patients with severe rib fractures. Opioids work by binding to opioid receptors in the central nervous system, blocking pain signals and altering pain perception. They are indicated for moderate to severe pain, particularly post-surgical and in chronic pain. Common side effects include respiratory depression, constipation, nausea, and sedation, with a risk of dependence. Opioids are highly effective for pain relief and offer benefits like anxiolysis and sedation. They interact with CNS depressants, increasing the risk of respiratory depression. Opioids can be administered orally, intravenously, or epidurally. Intravenous opioids act within 5-15 minutes, while epidural administration takes 20-30 minutes, offering prolonged relief. The cost varies, with epidural administration generally being more expensive. Several guidelines recommend epidural analgesia over systemic opioid administration, citing its effectiveness in reducing pain and improving respiratory function in patients with thoracic injuries[6]. However, the use of epidural analgesia in trauma patients is often limited by contraindications, technical difficulties, and the risk of complications, prompting a need for further evaluation of its efficacy compared to intravenous opioids.

This study aims to compare the efficacy of epidural analgesia versus intravenous opioids in managing pain in patients with multiple rib fractures. By evaluating the visual analog scale (VAS) scores over seven days, we seek to determine which modality provides better pain relief, ultimately improving patient outcomes and reducing the incidence of complications.

Aim: Use of epidural analgesia vs intravenous opioids in multiple rib fracture patients.
Objective: To know the efficacy of epidural analgesia in the multiple rib fracture

Methodology

This prospective interventional study was conducted at the Department of General Surgery, SSIMS&RC, Davangere, Karnataka, between March 2022 and October 2023. The study aimed to evaluate the efficacy of epidural analgesia compared to intravenous opioids in managing pain among patients with multiple rib fractures. A total of 36 patients, aged between 18 and 75 years, who presented with more than three rib fractures, were enrolled in the study. The patients were divided into two groups: Group A, which received epidural analgesia, and Group B, which received intravenous opioid analgesia.

Patients meeting the inclusion criteria were selected for the study. The inclusion criteria were as follows:

- Patients aged 18 to 75 years both males and females

- Patients with more than three rib fractures.
- Consenting for the procedure.
- Patients willing to provide informed consent.

The exclusion criteria were as follows:

- Patients aged below 18 years or above 75 years.
- Patients requiring neurosurgical intervention.
- Pregnant and lactating women.
- Patients with medical illness like Chronic kidney disease, Chronic liver disease

The study involved a structured process of patient selection, randomization, and intervention. After obtaining informed consent, participants were randomly assigned to one of the two groups. Group A received epidural analgesia, where an epidural catheter (No. 16G) was inserted under aseptic conditions after cleaning the site with Betadine 5% solution and a spirit swab. Tramadol was administered via the epidural route at a dose of 2 mg/kg body weight. This dose was repeated twice daily, and the effectiveness of pain relief was assessed using the Visual Analogue Scale (VAS).

Group B, on the other hand, received intravenous opioid analgesia. Tramadol hydrochloride 50 mg, diluted in 100 ml of normal saline, was administered intravenously to the patients. Similar to Group A, the dose was repeated twice daily, and VAS scores were recorded to evaluate pain intensity.

Pain assessment was conducted using the Visual Analogue Scale (VAS) score assessed by the same medical supervisors on Day 0, Day 3, and Day 7 for both groups. The VAS is a validated tool that measures pain intensity on a scale of 0 to 10, with 0 indicating no pain and 10 indicating the worst possible pain. This tool was chosen for its simplicity and reliability in measuring pain levels in clinical settings.

Data collection included demographic details such as age and sex, along with VAS scores on the specified days. Additionally, the study monitored the number of patients who completed the study and those who were deceased during the study period.

Statistical analysis: The data were systematically recorded and entered into a spreadsheet for analysis. Statistical analysis was performed using appropriate software, with continuous variables, such as VAS scores, being compared between the two groups using the independent sample t-test. A p-value of <0.05 was considered statistically significant, indicating a meaningful difference between the two groups in terms of pain management efficacy.

Results

Table 1: Descriptive Statistics of Age by Group

	Group	Mean	SD	Minimum	Maximum
Age	A	37.6	12.4	23	58
	B	41.3	13.7	22	64

This table provides descriptive statistics for the age distribution of participants in Groups A and B. The mean age of participants in Group A was 37.6 years (SD = 12.4), with ages ranging from 23 to 58 years. In Group B, the mean age was slightly higher at 41.3 years (SD = 13.7), with ages ranging from 22 to 64 years. The age distribution across both groups shows a similar range, although Group B has a slightly older average age.

Table 2: Sex Distribution by Group

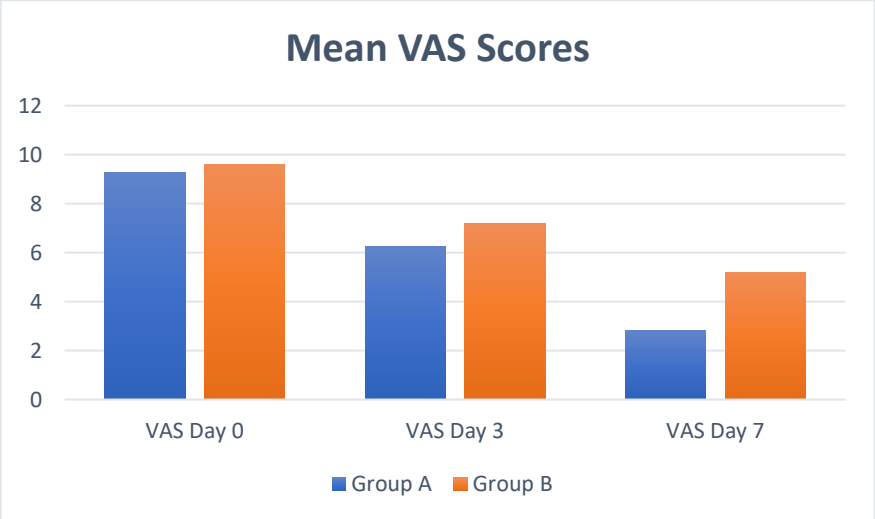
Group		Sex		
		F	M	Total
A	Observed	6	12	18
	% within column	60.0 %	46.2 %	50.0 %
B	Observed	4	14	18
	% within column	40.0 %	53.8 %	50.0 %
Total	Observed	10	26	36
	% within column	100.0 %	100.0 %	100.0 %

In Group A, 6 participants (33.3%) were female and 12 participants (66.7%) were male. In Group B, there were 4 females (22.2%) and 14 males (77.8%). Overall, the study had a male predominance, with both groups having more male participants than female participants. The distribution of sex within each group was fairly balanced, with Group A having slightly more females compared to Group B.

Table 3. Comparison of VAS score between the groups

Group Descriptives

	Group	N	Mean	Median	SD	P value
VAS Score day 0	A	18	9.28	9.00	0.669	0.127
	B	18	9.61	10.00	0.608	
VAS Score day 3	A	16	6.25	7.00	1.571	0.065
	B	16	7.19	7.00	1.167	
VAS Score day 7	A	16	2.81	3.00	1.167	**<0.001**
	B	16	5.19	5.00	1.109	



The table above presents the mean, median, standard deviation (SD), and p-values for the Visual Analogue Scale (VAS) scores recorded on Days 0, 3, and 7 for the two study groups (A and B). On Day 0, the mean VAS scores were 9.28 (SD = 0.669) for Group A and 9.61 (SD = 0.608) for Group B, with no statistically significant difference between the groups (p = 0.127), indicating comparable baseline pain levels.

By Day 3, there was a reduction in pain scores in both groups, with Group A having a mean VAS score of 6.25 (SD = 1.571) and Group B a mean score of 7.19 (SD = 1.167). Although Group A showed a trend towards lower pain scores, the difference was not statistically significant (p = 0.065).

On Day 7, a more pronounced difference was observed, with Group A reporting a significantly lower mean VAS score of 2.81 (SD = 1.167) compared to Group B's mean score of 5.19 (SD = 1.109). The p-value for this comparison was <0.001, indicating a statistically significant difference. This suggests that Group A, which received epidural analgesia, experienced better long-term pain relief compared to Group B, which received intravenous opioids.

Discussion

The management of pain in patients with multiple rib fractures is crucial, as inadequate pain relief can lead to severe complications such as pneumonia, atelectasis, and prolonged hospital stays[1][2]. In this study, we compared the efficacy of epidural analgesia versus intravenous opioids in controlling pain in patients with multiple rib fractures. Our findings demonstrate that epidural analgesia provides superior pain control, particularly in the later stages of recovery.

Sociodemographic Comparison:

The mean age of participants in this study was slightly higher in Group B (41.3 years) compared to Group A (37.6 years), although this difference was not statistically significant. This age distribution aligns with previous studies, where older age has been associated with a higher risk of complications following rib fractures[14]. The sex distribution in our study showed a predominance of male participants in both groups, consistent with other studies indicating that men are more likely to suffer from rib fractures, often due to higher rates of trauma-related incidents[15]. However, the effect of age and gender on pain perception and recovery remains complex. Studies like those by Bulger et al.[16] have suggested that older age may correlate with poorer outcomes and higher pain levels, though our study did not find significant differences in pain perception based on these factors.

Comparison of Pain Management Results:

On Day 0, both groups had comparable baseline pain levels, as indicated by the VAS scores (Group A: 9.28, Group B: 9.61). This consistency across the groups allows for a reliable comparison of the analgesic effects of the two treatments over time. By Day 3, although pain levels had decreased in both groups, Group A (epidural analgesia) showed a trend towards lower pain scores compared to Group B (intravenous opioids), though this difference was not statistically significant (p = 0.065). By Day 7, however, the difference became pronounced and statistically significant (p < 0.001), with Group A experiencing markedly lower pain levels. This finding is consistent with previous studies that have highlighted the effectiveness of epidural analgesia in managing pain in patients with rib fractures[7][8].

A study by Malekpour et al.[9] examined the use of epidural analgesia versus paravertebral block in patients with rib fractures and found that epidural analgesia significantly reduced pain scores and improved respiratory outcomes. Similarly, a retrospective study by Bachoumas et al.[10] demonstrated that patients with rib fractures who received epidural analgesia had lower intubation rates and better pain control compared to those who received systemic analgesics. Our study aligns with these findings, reinforcing the notion that epidural analgesia offers superior pain management in this patient population.

However, contrasting results have been reported in some studies. Richardson et al.[17], in a randomized controlled trial, found no significant difference in pain relief between epidural analgesia and intravenous opioids in patients with severe rib fractures. This discrepancy might be attributed to

differences in study design, patient populations, and the criteria used for pain assessment. Additionally, Werner et al.[18] reported that while epidural analgesia provided better pain relief, the benefits did not significantly outweigh the risks in certain subgroups, particularly those with contraindications for epidural catheter placement.

The superior efficacy of epidural analgesia in our study can be attributed to its ability to block the transmission of pain signals more effectively than systemic opioids, which act primarily on central pain pathways[11]. Moreover, the use of epidural analgesia has been associated with a reduction in the incidence of nosocomial pneumonia, likely due to improved pain control and subsequent better respiratory function[12]. In contrast, intravenous opioids, while effective in reducing pain, may not provide the same level of analgesia as epidural techniques, particularly in cases of severe thoracic trauma[13].

The improvement in pain scores in the epidural group was not only statistically significant but also clinically meaningful, as reflected in the substantial reduction in VAS scores by Day 7. This outcome suggests that epidural analgesia may be more beneficial for long-term pain control in patients with multiple rib fractures, potentially leading to faster recovery and shorter hospital stays. Similar conclusions were drawn by Karmakar and Ho[19], who emphasized the importance of epidural analgesia in managing complex pain syndromes following thoracic injuries.

However, some studies have raised concerns about the potential complications associated with epidural analgesia, such as hypotension, urinary retention, and epidural hematoma, which could limit its use in certain patient populations[20]. Despite these concerns, the overall benefits observed in our study support the use of epidural analgesia as a first-line treatment in the appropriate patient population.

Limitations and Future Directions:

Our study's limitations include the relatively small sample size, which may limit the generalizability of the results. Additionally, while the study was prospective, it was not blinded, which could introduce bias in pain assessment. Future research with larger, multicenter trials and blinded assessments would be valuable in further validating these findings. Moreover, exploring the long-term outcomes of patients receiving different analgesic modalities could provide further insights into the optimal management of pain in this population.

CONCLUSION

This study conveys that tramadol hydrochloride for pain relief is good, however epidural analgesia is more effective in managing pain in patients with multiple rib fractures. The significant reduction in pain scores by Day 7 underscores the importance of considering epidural analgesia as a first-line treatment for severe thoracic injuries. Epidural analgesia is safe, cost effective and the efficacy can be prolonged as well compared to opioids. These findings are consistent with the existing literature and support the integration of epidural analgesia into clinical practice for optimal pain management in multiple trauma cases.

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