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Research Protocol

Surgery Section

Pattern of Chest Injuries and Role of Intercostal Chest Drain in Patients Presenting with Blunt Trauma: A Research Protocol

PANKAJ BABUBHAI KATARIYA[1], SWATI DESHPANDE[2]

ABSTRACT

Introduction: Chest trauma remains a significant contributor to morbidity and mortality worldwide, particularly in rural areas where access to advanced healthcare services is limited. Understanding the patterns of chest injuries and optimising their management is crucial for improving patient outcomes in resource-constrained settings.

Need of the study: Blunt chest trauma is a major clinical concern, often leading to life-threatening complications such as pneumothorax, haemothorax, and respiratory failure. Intercostal Chest Drains (ICDs) are integral to the management of these conditions; however, clinical practice lacks clear, evidence-based guidelines on their optimal use. By evaluating common injury types and the effectiveness of ICDs, this research aims to provide actionable insights that can optimise care and improve outcomes for chest trauma patients in rural areas.

Aim: This study seeks to assess the patterns of chest injuries and evaluate the role of ICDs in their treatment.

Materials and Methods: A prospective observational study will be conducted at Acharya Vinoba Bhave Rural Hospital (AVBRH), Sawangi (Meghe), Wardha, Maharashtra, from March 2024 to March 2026. The study will follow ethical guidelines outlined in the Declaration of Helsinki. Data will be collected using a structured case record form, including: Patient demographics (age, sex, occupation). Clinical findings (vital signs, presenting symptoms). Injury details (mechanism of trauma, such as motor vehicle accidents, falls from height, and sports-related injuries; type and pattern of chest injury). Radiological findings {chest X-ray, Computed Tomography (CT) thorax}. Details of ICD (indication, output volume, duration). Treatment outcomes (complications, length of hospital stay, mortality). The Chi-square test will be used to assess associations between categorical variables. A p-value of <0.05 will be considered statistically significant.

Keywords: Thoracic injuries, Trauma severity indices, Tube Thoracostomy, Wounds

INTRODUCTION

Chest trauma is a leading cause of mortality worldwide, especially among individuals in the first four decades of life. Chest injuries are broadly categorised as blunt or penetrating, with blunt trauma accounting for approximately 70% of cases [1]. Common causes include road traffic accidents, falls, and crush injuries. The patterns of chest trauma include haemothorax, pneumothorax, haemopneumothorax, lung contusion, rib fracture, flail chest, diaphragmatic injury, and other types [2]. Despite the high associated mortality rate, 20% of cases are managed non-invasively, while 18% of patients require a chest drain, and 2.6% undergo thoracotomy [3].

Thoracic trauma occurs in approximately 60% of patients with polytrauma, with a mortality rate of 20%-25% [4]. While guidelines for trauma management emphasise early intervention, determining the need for ICD placement relies on clinical evaluation and imaging. Timely and accurate diagnosis using tools such as chest radiography, extended Focused Assessment with Sonography for Trauma (e-FAST), or CT scans is crucial [5]. Among these, e-FAST is particularly sensitive in emergency settings, outperforming chest X-rays in detecting conditions such as pneumothorax [6].

Although ICD insertion is a relatively straightforward procedure, it requires expertise to minimise complications, including insertional, positional, infectious, and equipment-related issues [7,8]. Due to the lack of fixed definitions and the unpredictable nature of emergency environments, there is significant variation in the frequencies of complications. This study aims to provide actionable insights for optimising care delivery and improving outcomes for chest trauma patients in resource-limited settings.

REVIEW OF LITERATURE

Blunt chest trauma is a major cause of morbidity and mortality in polytrauma patients, often requiring urgent evaluation and management. While most cases are managed conservatively, ICDs remain a cornerstone of treatment for selected patients. However, inappropriate use or technical errors during ICD placement can result in serious complications, emphasising the need for careful decision-making and skilled execution. Delayed or missed diagnoses, such as occult pneumothorax or haemothorax, further complicate chest trauma management [9]. Imaging modalities like e-FAST and CT scans enhance diagnostic accuracy, but resource limitations in rural settings often necessitate reliance on clinical evaluation and plain radiographs. This underscores the importance of tailored strategies for chest trauma care in such environments.

The mortality rate associated with blunt chest trauma varies between 4% and 60% [10]. Judicious selection of patients for ICD placement based on clinical and radiological indicators can reduce mortality and morbidity. For instance, De Lesquin et al. recommend managing traumatic pneumothorax and symptomatic haemothorax with chest tube placement within the first 48 hours following injury [11].

In a cross-sectional study conducted by Kumar AB et al., involving 200 patients, the incidence of pneumothorax was reported to be 44%. All cases of pneumothorax were managed with tube

thoracostomy, and ICDs were typically removed within 5 to 6 days [12]. Cases of minimal haemothorax identified on CT scans were treated conservatively, while most other cases required ICD placement. Conversely, stable patients with minor pneumothorax or haemothorax may benefit from close observation and delayed intervention if necessary [13].

This study aims to address these gaps by comprehensively evaluating chest trauma patterns and the effectiveness of ICDs in managing such patients in a rural tertiary care setting. The findings are expected to inform evidence-based guidelines, enhance patient care strategies, and ultimately improve survival rates and quality of life for patients with chest injuries in resource-limited healthcare systems.

Given the high variability in management and outcomes of chest trauma in rural settings, this study aims to assess the patterns of chest injuries and evaluate the role of ICDs in their treatment.

Study objectives:

- To evaluate the patterns of chest injuries (e.g., pneumothorax, haemothorax, haemopneumothorax) in blunt trauma patients.
- To evaluate the efficacy of ICDs in their management.

Null Hypothesis (H_0): There is no significant relationship between the patterns of chest injuries and the effectiveness of ICDs in managing blunt chest trauma.

Alternate Hypothesis (H_1): There is a significant relationship between the patterns of chest injuries and the effectiveness of ICDs in managing blunt chest trauma.

MATERIALS AND METHODS

A prospective observational analytical study will be conducted at Acharya Vinoba Bhave Rural Hospital (AVBRH), Sawangi (Meghe), Wardha, Maharashtra, from March 2024 to March 2026. Approval for this study has been obtained from the Institutional Ethics Committee of the Datta Meghe Institute of Higher Education and Research (Reference: DMIHER(DU)/IEC/2024/162; dated 01/03/2024). Before participation, each patient will provide written informed consent after being thoroughly briefed about the study's objectives and procedures. All protocols will be strictly followed in accordance with the ethical principles outlined in the Declaration of Helsinki.

Inclusion criteria: The study will include all admitted patients with blunt chest trauma who are above 18 years of age and who provide informed consent to participate.

Exclusion criteria: Patients who discontinue care by leaving the hospital against medical advice (self-discharge) or those transferred to another healthcare facility prior to the completion of treatment will be excluded from the study. Additionally, patients with isolated injuries to the head and/or abdomen, without involve-ment of the chest, as well as those with penetrating injuries, burns, or inhalation injuries, will not be included. Patients who do not provide consent to participate in the study will also be excluded.

Sample size calculation: Sample size was estimated using the formula: SS = (Z-score) ^{2} * p*(1-p) / (e)^2

- SS=Sample Size
- Z-score= Critical value and a standard value for the corresponding level of confidence. (1.96 for confidence level 95%)
- p= cumulative incidence of blunt trauma abdomen =69.78%~ 0.6978 [13]
- e= Margin of error (margin of error of 10% is taken)

SS= (1.96) ^{2} *0.6978(1-0.6978)/ (0.01)^2

SS= 80.4

Adjusting for a dropout rate of 25%, the study was carried out on 100 patients (80.4+19.6=100). All patients with blunt chest trauma, either in isolation or as part of polytrauma, who consent to participate will be included. The following data will be collected using a pro forma, including patient profile details such as age, sex, past medical history, personal history, occupational history, mode of injury, and time since injury.

Study Procedure

At presentation, the patient's vital parameters will be recorded and optimised, and laboratory investigations such as Arterial Blood Gas (ABG) analysis and routine blood counts will be performed. Upon arrival at the casualty or Surgical Outpatient Department (OPD), patients will be evaluated following Advanced Trauma Life Support (ATLS) guidelines [14]. After stabilisation, the pattern of chest injuries will be assessed using a combination of clinical findings and radiological evaluation {(Chest X-ray, e-FAST, and Contrast-Enhanced Computed Tomography (CECT)} based on clinical need. Treatment will proceed concurrently based on initial findings.

There are two main sites commonly used for chest drain insertion: the ventral (Monaldi) approach at the second intercostal space in the mid-clavicular line, and the lateral (Bülau) approach at the fourth to sixth intercostal space in the anterior or mid-axillary line. Although British guidelines generally recommend the Bülau approach, the choice in trauma depends on the clinical scenario, the operator's experience, and the nature of the pleural contents. The Monaldi approach is often preferred for isolated apical pneumothorax, whereas the lateral approach is more suitable for pleural effusions or large pneumothorax [3].

Outcomes: Pain severity will be assessed using the Visual Analog Scale (VAS) at baseline (on admission), 24 hours after ICD insertion, and daily until discharge. ICD output volume will be measured every eight hours and documented, including characteristics such as color and the presence of clots or air leaks.

The duration of ICD placement will be recorded from the time of insertion until removal, based on clinical and radiological improvement. ICD-related complications (e.g., dislodgement, infection, blockage) will be recorded daily during ward rounds. The length of hospital stay will be calculated from the day of admission until discharge or death. Daily follow-ups will continue until discharge or death (in-hospital mortality within 30 days).

Assessment of injury patterns and ICD effectiveness: Injuries will be categorised into standardised types based on clinical and radiological investigations:

- Pneumothorax
- Haemothorax
- Haemopneumothorax
- Lung contusion
- Flail chest
- Rib fractures
- Diaphragmatic injuries

Each pattern will be recorded at the time of diagnosis. Data quality will be rigorously monitored to ensure accuracy, with regular reviews to identify and rectify any discrepancies.

STATISTICAL ANALYSIS

Statistical analysis of all collected data will be carried out using Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics (mean, standard deviation, frequencies, percentages) will summarise baseline variables (e.g., age, gender, type of injury). The Chi-square test will assess the association between injury patterns (e.g., pneumothorax, haemothorax) and the need for ICD insertion. A significance level of $p<0.05$ will be used to identify statistically meaningful results.

Study status: The study has been initiated after obtaining all necessary approvals. Data collection is currently in progress.

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PARTICULARS OF CONTRIBUTORS:
1. Junior Resident, Department of General Surgery, Jawaharlal Nehru Institute of Medical Sciences, Wardha, Maharashtra, India.
2. Associate Professor, Department of General Surgery, Jawaharlal Nehru Institute of Medical Sciences, Wardha, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Pankaj Babubhai Katariya,
G 2, Raghobaji Hostel, Near SGM Hospital, Sawangi Meghe, Wardha, Maharashtra, India.
E-mail: pankajkatariya1997@gmail.com

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