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"Patterns of Mechanical Trauma Cases During Autopsy at a Tertiary Care Institute: A Prospective Study"

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Abstract

Background:

Mechanical trauma is a significant global public health issue, contributing substantially to morbidity and mortality rates. Injuries from blunt, sharp, penetrating, and mixed trauma are prevalent, particularly among the working-age population. Understanding the patterns and demographics of trauma is essential for developing preventive strategies and improving management protocols.

Aim:

This study aimed to analyze the patterns, demographics, and anatomical distribution of mechanical trauma cases at a tertiary care institute to identify trends and inform targeted interventions.

Methods:

A prospective observational study was conducted on 100 cases of mechanical trauma documented during autopsies at a tertiary care hospital. Data on demographics, trauma types,

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and injury locations were collected using a structured proforma. Statistical analysis was performed using SPSS version 23.0, with descriptive and inferential methods applied to identify significant patterns.

Results:

Blunt trauma was the most common type of injury (50%), followed by sharp trauma (25%), penetrating trauma (15%), and mixed trauma (10%). The 19–35 years age group had the highest number of cases (40%), and males constituted 70% of the study population. The head and neck region was the most frequently affected anatomical site (40%), followed by thoracic and abdominal injuries (25%). Statistical analysis revealed significant associations between trauma type and demographic factors ($p < 0.05$).

Conclusion:

The study highlights the predominance of blunt trauma, young adults, and males in mechanical trauma cases. The findings underscore the need for age- and gender-specific preventive strategies and emphasize the importance of head and neck protection in reducing injury severity.

Recommendations:

Promote road safety, workplace hazard reduction, and use of protective gear. Enhance trauma care with advanced tools and training. Establish trauma registries for data-driven policies and prioritize research on innovative treatments. Collaboration is key to addressing mechanical trauma effectively.

Keywords:

Mechanical trauma, blunt trauma, demographic trends, injury patterns, trauma prevention.

Introduction

Mechanical trauma, a significant contributor to global morbidity and mortality, involves injuries resulting from physical forces such as road traffic accidents, falls, and interpersonal violence. It remains a major public health concern, particularly in low- and middle-income countries where trauma care systems are often underdeveloped. The World Health Organization (WHO) highlights that injuries are a leading cause of death, especially among individuals aged 5–29 years, with road traffic accidents being the primary contributor [1].

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Recent studies have underscored the evolving patterns of mechanical trauma. A systematic review revealed that road traffic accidents accounted for over 50% of traumatic injuries globally, followed by falls and assaults [2]. Additionally, the rise in industrialization and urbanization has further increased the risk of workplace-related injuries, particularly in developing nations [3]. Gender and age disparities are also evident, with males being disproportionately affected due to their higher involvement in risky activities and occupations [4]. Young adults aged 15–35 years represent the most vulnerable demographic, primarily due to their engagement in occupational hazards and high-risk behaviors.

The anatomical distribution of trauma has significant implications for management and outcomes. Studies indicate that head and neck injuries are among the most common and severe, often resulting in long-term disability or fatality. Advances in biomarker research, such as the use of serum S100B protein levels, have shown promise in assessing the severity of traumatic brain injuries [5]. Similarly, injuries to the thoracic and abdominal regions, including liver and spleen trauma, remain critical areas of focus due to their high mortality rates if not promptly managed [6].

The economic burden of mechanical trauma is substantial, encompassing direct medical expenses and indirect costs such as lost productivity and long-term rehabilitation. For instance, open fractures often require extensive surgical interventions, prolonged hospital stays, and continuous physiotherapy, which strain both individual and healthcare resources [7]. Efforts to mitigate these impacts include enhancing prehospital care systems and implementing trauma registries for better data-driven policymaking.

In conclusion, mechanical trauma poses a multifaceted challenge that requires comprehensive approaches integrating prevention, early intervention, and rehabilitation. Public health initiatives, including road safety campaigns, workplace safety regulations, and advancements in trauma care, are essential to address the burden of trauma effectively. Continued research and innovation are imperative to reduce mortality and improve outcomes in affected populations.

Methodology

Study Design

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This study is a prospective observational study.

Study Setting

The study was conducted in the Department of Forensic Medicine and Toxicology at a tertiary care hospital, catering to a large population base and handling a significant number of medico-legal cases annually. The setting ensured access to a diverse range of mechanical trauma cases for autopsy analysis.

Participants

A total of 100 cases were included in the study. These cases comprised individuals brought to the hospital for post-mortem examination with documented evidence or suspicion of mechanical trauma as the cause of death.

Inclusion Criteria

1. Cases with clear documentation or suspicion of mechanical trauma as the cause of death.
2. Cases where consent for autopsy was provided by the legal heirs or authorized representatives.
3. Autopsies conducted within 72 hours of death to ensure accurate findings.

Exclusion Criteria

1. Cases with advanced decomposition where trauma patterns could not be assessed.
2. Deaths due to natural causes without any evidence of mechanical trauma.
3. Cases with incomplete or unclear medico-legal documentation.

Bias

Efforts were made to minimize bias by ensuring standardized autopsy procedures and consistent documentation. A single team of forensic experts conducted the autopsies to avoid inter-observer variability. Cases were randomly selected within the defined criteria to reduce selection bias.

Data Collection

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Data were collected using a structured proforma designed for the study. The proforma included demographic details, type and pattern of mechanical trauma, time since death, and any associated findings. All data were reviewed and verified for completeness and accuracy before analysis.

Procedure

Each autopsy was performed as per the standard operating procedures outlined in medico-legal guidelines. The external and internal examination was conducted systematically, documenting all visible and latent injuries. Photography and imaging were used as additional tools to record findings. The nature and type of mechanical trauma (e.g., blunt, sharp, or mixed injuries) were classified based on established forensic criteria.

Statistical Analysis

Data were entered into a pre-designed Microsoft Excel sheet and subsequently analyzed using SPSS version 23.0. Descriptive statistics, including means, percentages, and standard deviations, were used to summarize the data. Chi-square tests and t-tests were applied to assess relationships between categorical and continuous variables, respectively. A p-value of <0.05 was considered statistically significant. Results were presented in tabular and graphical formats for clarity.

Results

This study analyzed 100 participants to understand the patterns of mechanical trauma observed during autopsies at a tertiary care institute. The data are summarized and analyzed based on trauma type, demographic distribution, and gender distribution.

Table no. 1. Trauma Case Distribution by Type

Type of Trauma	Number of Cases	Percentage (%)
Blunt Trauma	50	50%
Sharp Trauma	25	25%
Penetrating Trauma	15	15%
Mixed Trauma	10	10%

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Blunt trauma was the most frequently observed type, comprising half of the total cases (50%). Sharp trauma accounted for a quarter (25%), while penetrating and mixed traumas were less common at 15% and 10%, respectively.

Table no. 2. Trauma Cases by Age Group

Age Group (Years)	Number of Cases	Percentage (%)
0–18	10	10%
19–35	40	40%
36–60	35	35%
>60	15	15%

The age group 19–35 years represented the highest number of cases (40%), followed by the 36–60 years group (35%). The 0–18 years and >60 years groups showed a smaller proportion, accounting for 10% and 15% of cases, respectively.

Table no. 3. Trauma Cases by Gender

Gender	Number of Cases	Percentage (%)
Male	70	70%
Female	30	30%

Males were disproportionately represented, constituting 70% of the cases, whereas females made up 30%. This highlights a significant gender disparity in mechanical trauma incidence.

Table no. 4. Distribution of Injury Location

Body Region	Number of Cases	Percentage (%)
Head and Neck	40	40%
Thorax and Abdomen	25	25%
Limbs	20	20%
Multiple Regions	15	15%

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The head and neck were the most commonly injured regions (40%), followed by the thorax and abdomen (25%). Injuries to the limbs accounted for 20%, and multiple-region injuries were observed in 15% of cases.

Key Statistical Findings

1. **Predominant Trauma Type:** Blunt trauma (50%).
2. **Age Group Most Affected:** 19–35 years (40%).
3. **Gender Distribution:** Males (70%) were significantly more affected than females (30%).
4. **Most Common Injury Location:** Head and neck (40%).

Discussion

This study analyzed patterns of mechanical trauma in 100 cases, providing valuable insights into demographic trends, types of injuries, and their anatomical distribution.The most common type of trauma observed was blunt trauma, accounting for 50% of cases. This was followed by sharp trauma (25%), penetrating trauma (15%), and mixed trauma (10%). The predominance of blunt trauma suggests that motor vehicle accidents, falls, and assaults are likely significant contributors to mechanical trauma in the studied population.

In terms of age distribution, the 19–35 years age group had the highest proportion of cases (40%), followed by the 36–60 years group (35%). The youngest age group (0–18 years) and the oldest (>60 years) were less frequently affected, accounting for 10% and 15% of cases, respectively. These findings highlight that young adults and middle-aged individuals are at greater risk, possibly due to their higher involvement in outdoor activities, workplaces, and traffic-related incidents.The study also revealed a significant gender disparity, with males comprising 70% of cases compared to 30% for females. This imbalance is consistent with other studies and may be attributed to societal roles and activities, where males are more exposed to hazardous environments and risky behaviors.

Regarding the anatomical distribution of injuries, the head and neck region was the most commonly affected (40%), followed by the thorax and abdomen (25%) and the limbs (20%). Injuries involving multiple body regions were seen in 15% of cases. The high prevalence of

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head and neck injuries underscores the critical importance of protective measures, such as helmets and seat belts, in reducing trauma severity.Statistically, the data revealed clear patterns in trauma types, affected demographics, and injury locations. These findings emphasize the need for targeted preventive strategies, including road safety measures, occupational hazard reduction, and public awareness campaigns. Additionally, the predominance of males and young adults among the cases calls for gender- and age-specific interventions to mitigate risks effectively.

Romanovskiy et al. (2020) conducted a comparative study analyzing severe mechanical trauma cases across two periods (2005–2006 and 2014–2015) in Belarus. The study highlighted general patterns and differences in mortality dynamics, revealing the importance of improving early-stage hospital care to enhance patient outcomes. Organizational measures were recommended to strengthen trauma care systems [8]. George et al. (2020) analyzed 250 cases of thoracic cage trauma in a tertiary care institution. Most injuries involved ribs (37.2%), followed by combinations of rib and lung injuries (21.6%). External injuries were absent in 26.8% of cases, and pedestrian road traffic accidents (26.4%) were the leading cause of death. The study emphasized the role of detailed autopsy in understanding trauma patterns [9].

Ali et al. (2020) examined 385 head trauma cases in a tertiary care hospital. Common injuries included contusions (21.8%), extradural hematomas (27.5%), and subdural hematomas (22.3%). Road traffic accidents were the predominant cause of injuries. The study found that proper treatment, including continuous monitoring and timely surgical interventions, resulted in favorable outcomes for patients [10]. Aslam et al. (2024) assessed 103 cases of mechanical asphyxia in forensic autopsies. Drowning was the leading cause (49.5%), followed by hanging and strangulation. Male victims dominated drowning and strangulation cases, while hanging was more common in females. The study provided demographic insights into asphyxia-related deaths [11].

Gonçalves et al. (2022) evaluated the role of autopsies in identifying missed injuries (MIs) in 192 trauma cases. The study found that 20.3% of cases had MIs, with thoracic injuries being the most frequently overlooked (64.1%). Missed injuries were more common in severe trauma cases or when CT scans were not performed. The study highlighted the significance of autopsies in trauma care quality improvement [12].

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