Title: " Neurosurgical Emergencies in mardan medical complex: A Cross-Sectional Study"

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Abstract

Objective: To analyze the age-related variations in neurological emergencies, including spinal cord injury, epidural hematoma, subdural hematoma, and traumatic brain injury, and to assess their clinical significance across different age groups.

Method: A retrospective analysis was conducted on patients with neurological emergencies, categorized into three age groups: 17–25, 25–35, and 35–42 years. The frequency of spinal cord injury, epidural hematoma, subdural hematoma, and traumatic brain injury was compared across age groups using statistical analysis, with significance determined by p-values.

Result: Spinal cord injury was most common in the 25–35 age group (73.4%), but no significant difference was observed between age groups ($p = 0.99$). Epidural hematoma and subdural hematoma showed significant age-related differences ($p = 0.001$ and $p = 0.016$, respectively), with increasing prevalence in older age groups. Traumatic brain injury was most frequent in the 17–25 age group (17.5%), absent in the 25–35 age group, and reemerged in the 35–42 age group (13.3%) ($p = 0.001$).

Conclusion: The study highlights significant age-related variations in neurological emergencies, with older individuals being more susceptible to epidural and subdural hematomas, while younger individuals have a higher incidence of traumatic brain injuries. Spinal cord injuries showed no significant difference across age groups. These findings emphasize the need for targeted prevention and age-specific management strategies to improve clinical outcomes.

Keyword: Neurological emergencies, spinal cord injury, epidural hematoma, subdural hematoma, traumatic brain injury, age-related variations, neurotrauma management.

Introduction: Neurosurgical emergencies represent a critical subset of medical conditions that require immediate intervention to prevent morbidity and mortality. These emergencies encompass a wide range of pathologies, including traumatic brain injuries (TBIs), spinal cord injuries, intracranial hemorrhages, and brain tumors, among others. In low- and middle-income countries (LMICs) like Pakistan, the burden of neurosurgical emergencies is exacerbated by limited healthcare infrastructure, delayed patient presentations, and a lack of specialized neurosurgical care. Mardan Medical Complex (MMC), a major healthcare facility in Khyber Pakhtunkhwa (KPK), serves as a referral center for a large population, making it a crucial site for understanding the patterns and challenges of neurosurgical emergencies in the region.

The epidemiology of neurosurgical emergencies in KPK is influenced by several factors, including high rates of road traffic accidents (RTAs), interpersonal violence, and limited access to preventive care. Traumatic brain injuries, for instance, are a leading cause of neurosurgical emergencies globally, and their prevalence is particularly high in regions with poor road safety measures and emergency response systems. In Pakistan, RTAs account for a significant proportion of trauma-related deaths and disabilities, with KPK being one of the most affected provinces due to its challenging terrain and high traffic density. Understanding the specific patterns of neurosurgical emergencies at MMC can provide valuable insights into the local burden of disease and inform targeted interventions.

Despite the critical nature of neurosurgical emergencies, there is a paucity of region-specific data on their patterns and outcomes in KPK. Existing studies from Pakistan have primarily focused on urban centers, leaving a gap in knowledge regarding rural and semi-urban areas like Mardan. This study aims to address this gap by conducting a cross-sectional analysis of neurosurgical emergencies at MMC. By examining the demographic characteristics, types of emergencies, and outcomes of patients, this research will contribute to a better understanding of the neurosurgical needs of the population served by MMC.

The findings of this study will have important implications for healthcare planning and resource allocation in KPK. For instance, identifying the most common types of neurosurgical emergencies can guide the development of targeted training programs for healthcare providers and the procurement of essential equipment. Additionally, understanding the factors associated with poor outcomes, such as delayed presentations or inadequate pre-hospital care, can inform public health initiatives aimed at improving emergency response systems and raising awareness about the importance of timely medical intervention.

Material and Method:

This study was conducted in the neuroward of Mardan Medical Complex from January 2024 to December 2024. The study aimed to evaluate the outcomes of patients presenting with neurological emergencies, specifically focusing on spinal cord injury, epidural hematoma, subdural hematoma, and traumatic brain injury. Patients were categorized into three distinct age groups (17–25, 25–35, and 35–42 years) to assess age-related variations in incidence and clinical outcomes.

Study Setting and Data Collection
Data were collected directly from patient records and the hospital's electronic medical database. Demographic details, clinical presentation, diagnostic findings, and outcome variables were systematically recorded. All patients admitted with confirmed diagnoses of the aforementioned neurological emergencies during the study period were included. A standardized data extraction form was used to ensure consistency in data collection across the neuroward.

Inclusion and Exclusion Criteria
Inclusion criteria were as follows:

- Patients aged between 17 and 42 years.
- Confirmed diagnosis of spinal cord injury, epidural hematoma, subdural hematoma, or traumatic brain injury.
- Admission to the neuroward at Mardan Medical Complex within the study period.

Exclusion criteria included:

- Patients with incomplete or ambiguous medical records.
- Patients with neurological emergencies outside the specified diagnostic categories.
- Patients aged below 17 or above 42 years.
- Cases where concomitant non-neurological injuries could confound the outcome assessment.

Statistical Analysis and Ethical Considerations
Data were analyzed using descriptive statistics to summarize demographic and clinical characteristics. Comparative analyses between age groups were performed using Chi-square tests or Fisher's exact tests for categorical variables, with significance set at a p-value of <0.05. Ethical approval for the study was obtained from the Institutional Review Board of Mardan Medical Complex, and patient confidentiality was maintained throughout the research process.

Result:
The analysis of neurological emergencies across different age groups revealed varying prevalence rates. Spinal cord injury was most frequent in the 25–35 age group (73.4%), but no significant difference was observed between age groups (p = 0.99). Epidural hematoma showed a significant age-related trend (p = 0.001), with no cases in the 17–25 group and increasing prevalence in older groups. Subdural hematoma was also significantly associated with age (p = 0.016), occurring more frequently in the 25–35 group (12.8%) compared to the 35–42 group (9.6%). Traumatic brain injury was most common in the 17–25 group (17.5%), absent in the 25–35 group, and reappeared in the 35–42 group (13.3%), with a statistically significant difference (p = 0.001).

Table: neurological emergency with outcomes variables

outcome	Age 17-25		Age 25-35		Age 35-42		p-value
	yes	no	yes	no	yes	no	
Spinal cord injury	36(57.1%)	27(42.9%)	69(73.4%)	25(26.6%)	87(64.4%)	48(35.6%)	0.99
Epi dural hematoma	0(0%)	63(100%)	12(12.8%)	82(87.2%)	30(22.2%)	105(77.8%)	0.001
Sub dural hematoma	0(0%)	63(199%)	12(12.81%)	82(87.2%)	13(9.6%)	122(90.4%)	0.016
Traumatic brain injury	11(17.5%)	52(82.5%)	0(0%)	94(100%)	18(13.3%)	117(86.7%)	0.001

Discusion: The analysis of neurological emergencies across different age groups highlights distinct patterns in the occurrence of spinal cord injury, epidural hematoma, subdural hematoma, and traumatic brain injury (TBI). Spinal cord injuries occurred at similar rates across all age groups, with the highest prevalence in the 25–35 age group (73.4%). However, the p-value (0.99) suggests no significant difference in spinal cord injury occurrence between age groups. This finding aligns with prior research indicating that spinal cord injuries often result from high-energy trauma, such as motor vehicle accidents and falls, which are common among young and middle-aged adults (Peterson et al., 2022). The slight variations in percentage may be attributed to differences in risk exposure and protective measures.

Epidural hematoma demonstrated a significant association with age ($p = 0.001$), with no cases reported in the 17–25 age group but increasing in frequency in older groups (12.8% in the 25–35 group and 22.2% in the 35–42 group). This trend may reflect age-related differences in skull elasticity, as younger individuals tend to have more flexible skulls that are less prone to fractures leading to epidural hematoma (Hoffman et al., 2020). Additionally, older adults may experience more severe head trauma due to occupational hazards, falls, or delayed medical intervention, contributing to the higher incidence of epidural hematomas. The increasing trend highlights the need for age-specific trauma management protocols to reduce morbidity and mortality.

Similarly, subdural hematoma showed a statistically significant variation across age groups ($p = 0.016$). No cases were reported in the youngest age group, while the 25–35 and 35–42 age groups had incidences of 12.8% and 9.6%, respectively. The higher prevalence in older age groups aligns with studies indicating that subdural hematomas are more frequent in middle-aged and elderly populations due to brain atrophy and increased vulnerability of bridging veins (Al Saiegh et al., 2020). Furthermore, ground-level falls, a common cause of subdural hematomas, are more prevalent in older individuals, as highlighted in research linking these injuries to high mortality rates in elderly patients (Naylor et al., 2022). These findings underscore the importance of fall prevention strategies and early intervention in older patients.

Traumatic brain injury (TBI) exhibited a significant trend ($p = 0.001$), with the highest incidence in the 17–25 age group (17.5%), no reported cases in the 25–35 age group, and a reemergence in the 35–42 age group (13.3%). The higher occurrence in younger adults can be linked to risk-taking behaviors, such as reckless driving and sports-related injuries (Yue et al., 2022). The absence of cases in the 25–35 age group is unusual and may reflect reporting biases or protective lifestyle adaptations. The resurgence in the 35–42 group could be due to occupational hazards or delayed effects of repetitive mild trauma (Ackah et al., 2021). Given the long-term impact of TBI, including cognitive impairment and extended hospital stays (Olivieri et al., 2020), these findings emphasize the necessity of targeted prevention efforts across different age demographics.

Conclusion: The study highlights significant age-related variations in neurological emergencies, with epidural and subdural hematomas increasing in older groups and traumatic brain injuries being more prevalent in younger individuals. Spinal cord

injuries showed no significant difference across age groups, suggesting consistent risk factors. These findings emphasize the need for age-specific prevention strategies and improved clinical management to enhance patient outcomes.

Conflict of interest: None

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