Factors Associated with Early Reoperations Following Cranial and Spinal Neurosurgery in a Tertiary Care Center in Nepal

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Abstract

Introduction: Complications following neurosurgical procedures often lead to reoperations, resulting in poor outcomes and increased healthcare costs. Reoperation rates can serve as a quality indicator for surgical care. This study aimed to analyze factors associated with unplanned reoperations after cranial and spinal surgeries. Our objective is to identify factors contributing to early reoperations within 30 days of cranial and spinal neurosurgical procedures.

Materials and Methods: We retrospectively analyzed data from patients who underwent cranial or spinal surgeries at a tertiary care hospital between 2019 and 2023. Patients requiring unplanned reoperations within 30 days were included. Statistical analysis was performed using SPSS version 27.

Results:A total of 3880 patients were operated and the reoperation of 64 patients were analyzed, with a mean age of 38.5 years (range:1-72). The reoperation rate was 1.6%. Most patients were adults, and there was a female predominance. The majority of reoperations occurred within the first seven days after the initial surgery. The most common reason for reoperation were hematoma formation. Hematoma evacuation and decompressive hemicraniectomy were the most frequently performed reoperations.

Conclusion: This study highlights the importance of identifying risk factors and improving perioperative care to reduce early reoperations. The findings emphasize the need for close postoperative monitoring during the critical first seven days to enhance patient outcomes and optimize healthcare resources.

Keywords: Complications, Quality of Care, Neurosurgery, Reoperation, Risk factors

Introduction

Complications following neurosurgical interventions that necessitate reoperation often lead to unfavorable treatment outcomes and increased healthcare costs. Understanding the risk factors associated with these complications facilitates the development and implementation of targeted preventive strategies.[1] Key indicators for assessing surgical quality include perioperative mortality, length of hospital stay, 30-day unplanned readmission rates, and unplanned returns to the operating room.[2] Compared to other surgical specialties, neurosurgery has relatively high mortality and morbidity. Consequently, the evaluation of postoperative morbidities and mortality has emerged as the principal approach for assessing surgical quality employed by physicians, healthcare institutions, and regulatory agencies.[3]

The rate of reoperation has received limited attention in the existing literature; however, it has been posited as a viable parameter for the assessment of surgical outcomes.[4]Common indications for reoperation include postoperative hemorrhage, incomplete tumor excision, elevated intracranial pressure, shunt malfunction, both superficial and intracranial surgical site infections, and cerebrospinal fluid (CSF) leaks that occur postoperatively. These conditions often result from

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thrombocytopenia, hypertension, prolonged intraoperative duration, a dependent functional status, and morbid obesity.[5]
Reoperations not only impact patient outcomes and increased cost but also serve as marker of perioperative quality of care[6,7]. Unplanned reoperation due to complications from a primary surgery may be limited to specific timeframes, including 30 days, 90 days, 2 years, or the primary admission period.7Early unplanned reoperations (EURs), occurring within 7 days of the first surgery, are particularly significant as they highlight potential deficiencies in surgical techniques, or perioperative management. Understanding the timing and causes of reoperations can help healthcare providers implement preventive strategies to improve patient safety and optimize resource utilization.[8]

This study reviews surgical returns to the operating room over five years, focusing on the timing, causes, and factors associated with unplanned reoperations within 30 days following cranial and spinal surgeries at a tertiary care center. By identifying these factors, we seek to enhance quality improvement initiatives and contribute to the literature on surgical outcomes in neurosurgery.

Objectives

General objectives:

- To analyze the factors associated with early reoperations following cranial and spinal neurosurgical procedures in a tertiary care center.

Specific objectives:

- To identify the common indications for early unplanned reoperations within 30 days of index surgery.
- To determine the frequency and timing of reoperations.
- To evaluate types of reoperations performed and their underlying causes.
- To assess the demographic and clinical characteristics of patients undergoing reoperations.

Research design and Methodology

Study Design

A retrospective cohort study was conducted to analyze factors associated with early reoperations following cranial and spinal surgeries.

Study Population

The study included patients admitted to the Department of Neurosurgery at Tribhuvan University Teaching Hospital (TUTH) who underwent cranial or spinal surgeries and required unplanned reoperations within 30 days of the index surgery.

Study Period

Data were collected retrospectively from January 2019 to December 2023.

Inclusion and Exclusion criteria

Inclusion criteria

- Patients who have undergone cranial or spinal neurosurgical intervention
- Patients requiring reoperation within 30 days of the index surgery
- Patients of all age groups

Exclusion criteria

- Patients who had prior cranial or spinal surgeries on the same site before the study period

Study Site and Justification

TUTH, Department of Neurosurgery

Data Collection

- Patient records were reviewed to extract relevant data, including:
  - Demographics: Age, gender, and comorbidities
  - Index Surgery Details: Type of surgery, indication, duration and complications
  - Reoperation Details: Timing, indications, and types of reoperations performed.
  - Outcomes: Length of hospital stay and clinical outcomes post-reoperation

Data analysis

Statistical analyses were performed using SPSS version 27 (SPSS Inc., Chicago, IL).
Categorical variables were expressed as frequencies and percentages.
Continuous variables were expressed using as mean ± standard deviation (SD)

Ethical consideration

This study was approved by the Institutional Review Board (IR) of the Institute of Medicine.
Patient confidentiality was maintained.

Results

A retrospective analysis was conducted involving 3880 patients. Among them, 64 patients underwent reoperations within 30 days following cranial and spinal neurosurgical procedures. The reoperation rate is 1.6%. Gender distribution showed a female predominance (54.7%), while males accounted for 45.3%.

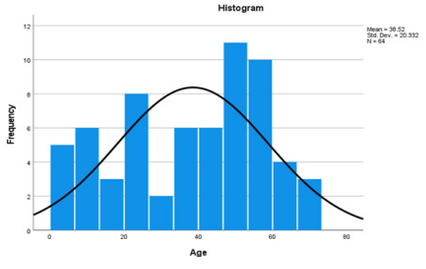

Figure 1: Age distribution of the study population

The mean age of the patients was 38.52 years (range: 1–72 years), with most patients in the adult age group. (Figure 1)
Cranial surgeries accounted for the majority of reoperations (92.2%). In spinal procedures, 7.8% required reoperation, with residual disc material and surgical site infection being the leading causes.

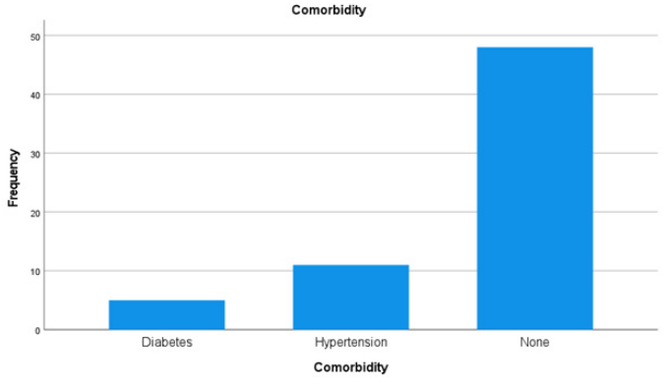

Figure 2: Distribution of comorbidity

Among the patients, 48 (75%) had no comorbidities. The most common comorbid conditions were hypertension (11 patients, 17.2%) and diabetes (5 patients, 7.8%).(Figure 2)

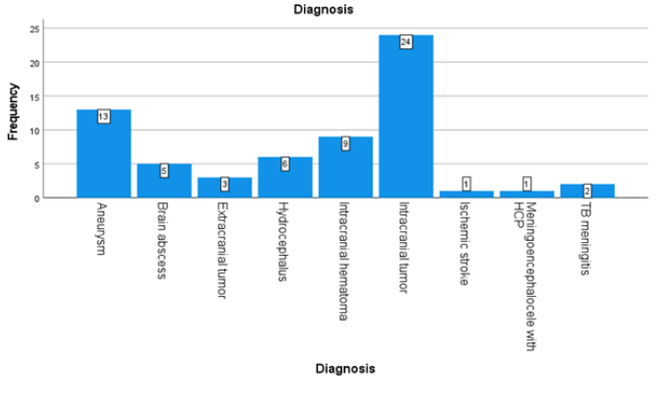

Figure 3: Distribution of diagnosis

The highest number of reoperations were done for intracranial tumor followed by aneurysm. (Figure 3)

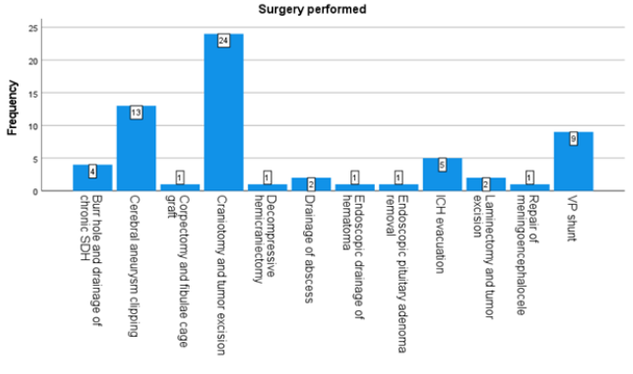

Figure 4: Distribution of surgery performed

The most common primary procedures were Craniotomy for tumor excision and Aneurysm clipping. Other procedures included decompressive craniectomy, spinal decompression, and shunt placement. (Figure 4)

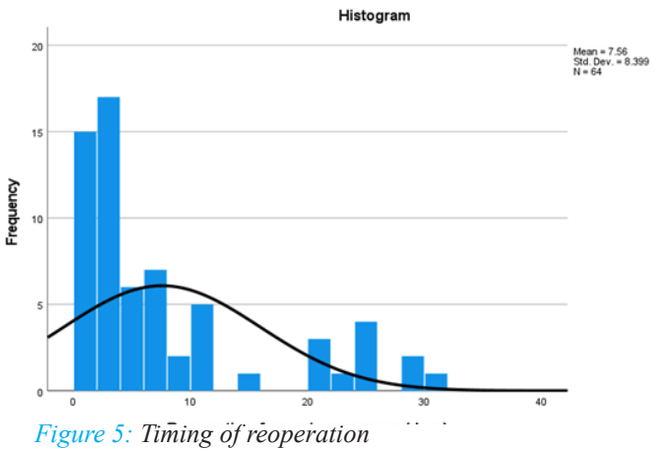

Figure 5: Timing of reoperation

The mean time to reoperation was 7.56 days (range: 1–30 days). 68.7% of reoperations occurred within the first seven days of the index surgery, highlighting the early postoperative period as critical. (Figure 5)

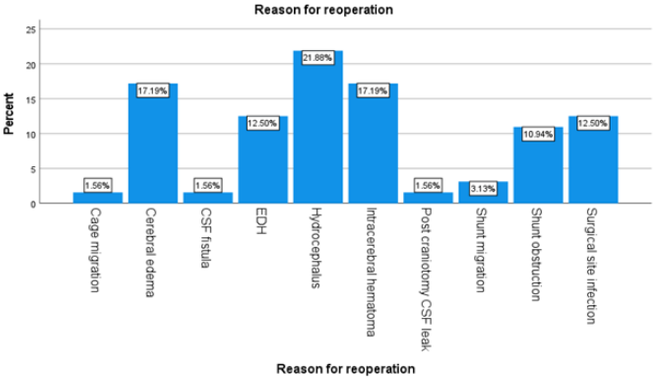

Figure 6: Reason for reoperation.

The primary indications for reoperation included postoperative hematoma (ICH and EDH 29.69%), hydrocephalus (21.88%), and cerebral edema (17.19%). Other causes included surgical site infections, shunt malfunction, and CSF leaks. (Figure 6)

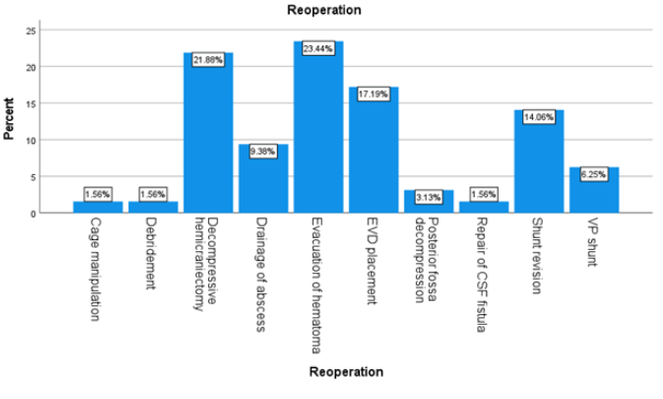

Figure 7: Distribution of reoperation

The most frequent reoperations included hematoma evacuation (ICH and EDH,23.44%), Decompressive hemicraniectomy (21.8%), and External ventricular drain (EVD) placement (17.19%). (Figure 7)

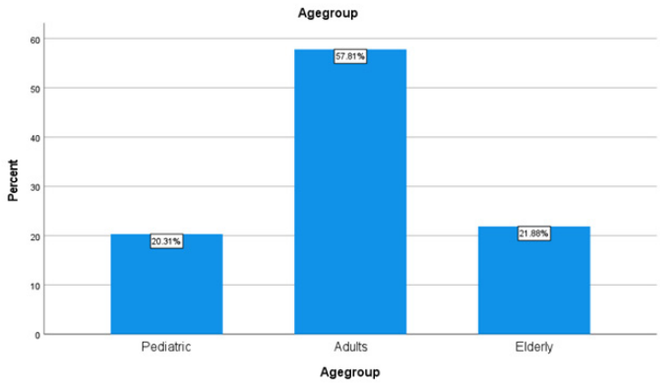

Figure 8: Distribution of cases according to age group

In this study, most patients undergoing reoperation were adults, followed by the elderly. (Figure 8)

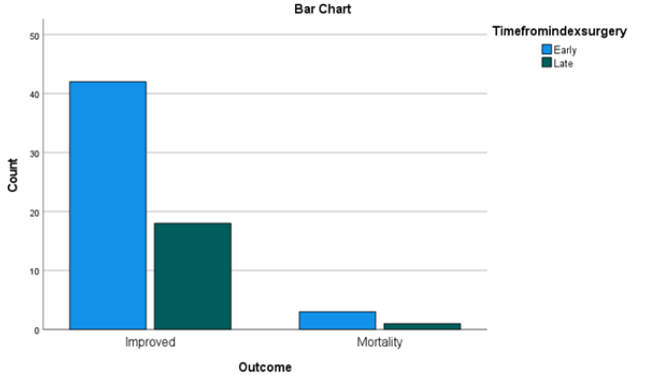

Figure 9: Time of reoperation from index surgery and outcome (Early- within 7 days, Late- >7 days)

Most patients showed clinical improvement following reoperation, although detailed functional outcomes were not analyzed. (Figure 9)

Discussion

The results of this study provide valuable insights into the timing, causes, and clinical factors associated with early reoperations following cranial and spinal neurosurgical procedures. By analyzing a cohort of 64 patients, the study highlights key areas for improvement in perioperative and postoperative care to reduce complications and enhance patient outcomes.

A comprehensive analysis of morbidity and mortality linked to unplanned returns to the operating room is crucial for improving healthcare quality. This metric serves as an important indicator of surgical adverse events and the safety of interventions across various subspecialties. Monitoring these return rates enables healthcare providers to identify patterns that reveal deficiencies in surgical practices and postoperative care, thereby guiding targeted strategies to enhance patient outcomes and uphold high standards of care.[9]

The finding that the majority of reoperations (68.7%) occurred within the first seven days of the index surgery underscores the critical importance of early postoperative vigilance. This timing reflects complications closely linked to intraoperative factors, such as inadequate hemostasis or early physiological instability, rather than long-term disease progression. Similar patterns have been observed in studies by Dasenbrock et al., which emphasize the need for robust early monitoring protocols.[5]

In the Wahba et al. study, the most commonly performed surgery was for treating surgical site infections.[10] In our study of craniotomy and tumor excision, the common reoperations included hematoma evacuation, decompressive hemicraniectomy, and EVD placement.

Postoperative hematoma and hydrocephalus are significant factors leading to reoperations. Implementing routine postoperative imaging in high-risk patients may enable early detection of these complications, potentially reducing the need for urgent surgical interventions.

Postoperative hematoma was the most common cause of reoperation, accounting for 29.69% of cases. This aligns with global studies, such as those by Algattas et al., which reported hemorrhage as a primary reason for unplanned surgeries.6 Factors like hypertension, prolonged surgical duration, and significant blood loss may predispose patients to this complication. Implementing stricter intraoperative hemostasis protocols and postoperative blood pressure management strategies could reduce this risk .

Hydrocephalus, the second most frequent indication for reoperations, highlights the need for early recognition of ventricular dilatation. The use of external ventricular drains (EVDs), as seen in 17.19% of the reoperations, demonstrates the importance of timely cerebrospinal fluid (CSF) diversion in managing hydrocephalus .

In a study by Tervonen et al., patients aged 6 months or younger with intraventricular hemorrhage and congenital defects as causes of hydrocephalus were found to have a higher risk of shunt revision. Most revisions occurred within the first year following the initial shunt.[11] In this study, shunt revision was performed due to obstruction and migration within 30 days of the index surgery.

Cerebral edema accounted for 17.19% of reoperations, reinforcing the role of optimized intraoperative fluid management and close postoperative observation in mitigating this complication .

Cranial surgeries accounted for the majority of reoperations (92.2%), with hematoma evacuation and decompressive hemicraniectomy being the most common procedures. This observation aligns with existing literature, which indicates that the intricate nature of cranial surgical procedures is associated with an elevated risk of early complications necessitating reoperation.

Moghavem et al. studied readmission within 30 days for cranial neurosurgical service, and their analysis showed that readmission was highest for the patient initially admitted for neurovascular insult.[12] This finding is similar to our study In contrast, spinal surgeries had a relatively low reoperation rate (7.8%). When reoperations were needed, residual disc material and surgical site infections were the primary causes. Enhanced

imaging and intraoperative visualization techniques may help reduce residual disc complications, while improved aseptic protocols could mitigate infection risks.

The study emphasizes the need for enhanced perioperative care to minimize early complications . Key recommendations include:

1. Routine Postoperative Imaging:

• Early detection of hematomas and ventricular dilatation can guide timely interventions.

2. Targeted Risk Stratification:

• High-risk patients with hypertension and prolonged surgical duration, should receive tailored postoperative care, including closer hemodynamic monitoring and early mobilization.

The study provides real-world data from a resource-limited tertiary care setting, addressing gaps in the literature on reoperations in such contexts. Its focus on early reoperations within 30 days allows for actionable insights into perioperative care.

The relatively limited sample size of 64 patients may pose constraints on the statistical power and generalizability of the findings. As a single-center, retrospective study, it may be subject to selection and reporting biases. The absence of multivariate analysis limits the ability to identify independent predictors of reoperations.

To further strengthen these findings, future research could benefit from incorporating larger, multicenter cohorts. This approach would help validate the results and improve their applicability across diverse populations. It should conduct prospective studies to accurately capture intraoperative and postoperative variables. It should also utilize multivariate regression models to identify independent predictors of reoperations and inform predictive risk models. Moreover it should investigate the cost-effectiveness of interventions, such as routine imaging or enhanced recovery protocols, in reducing reoperation rates.

This study highlights the critical importance of early postoperative monitoring, tailored perioperative care, and targeted interventions to reduce reoperations. The findings provide a foundation for quality improvement initiatives, particularly in resource-constrained settings. By addressing modifiable risk factors and enhancing perioperative management, healthcare practitioners can optimize patient outcomes and reduce the economic burden of unplanned reoperations.

Conclusion

This study highlights the critical importance of identifying factors associated with early reoperations in cranial and spinal neurosurgery. The findings indicate that most reoperations occur within the first seven days post-surgery, primarily due to postoperative hematoma, hydrocephalus, and cerebral edema. The most frequently performed reoperations included hematoma evacuation, decompressive hemicraniectomy, and external ventricular drain placement.

These results emphasize the need for vigilant early postoperative monitoring and timely interventions to reduce the incidence of unplanned reoperations. By addressing modifiable factors such as perioperative management and patient optimization, healthcare providers can improve patient outcomes and reduce associated costs.

Future research should prioritize larger, multicenter datasets to validate these findings and identify effective strategies to reduce reoperation rates. Implementing quality improvement initiatives based on these insights can further enhance surgical outcomes and overall healthcare quality in neurosurgery.

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