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Original Research Article

POSTOPERATIVE COMPLICATION AMONG PATIENTS WHO UNDERWENT DECOMPRESSIVE CRANIECTOMY FOR TRAUMATIC BRAIN INJURY

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Abstract: *Decompressive craniectomy is a life-saving procedure used to manage severe traumatic brain injury (TBI). While it effectively reduces mortality, the procedure is associated with multiple postoperative complications, which may impact patient recovery and outcomes. Understanding the frequency and nature of these complications is critical for improving patient care.* ***Objective:*** *The objective of this study was to determine the frequency of postoperative complications in patients who underwent decompressive craniectomy for traumatic brain injury at a tertiary care hospital in Karachi.* ***Methods:*** *This descriptive cross-sectional study was conducted at SMBB Trauma Centre, Civil Hospital Karachi, from February 20, 2020, to August 20, 2020. A total of 98 patients who underwent decompressive craniectomy for TBI were included. Data were collected on demographic variables, clinical parameters, and postoperative complications. The mean age, length of hospital stay, duration of injury, and surgery duration were analyzed. Statistical analysis was performed using descriptive statistics.* ***Results:*** *The mean age of the patients was 45.14 ± 9.49 years, with a mean hospital stay of 10.72 ± 6.24 days, mean duration of injury of 8.41 ± 4.69 hours, and mean surgery duration of 4.87 ± 2.14 hours. Of the 98 patients, 60 (61.2%) were male and 38 (38.8%) were female. The most common postoperative complication was subdural effusion, affecting 37 patients (37.76%), followed by contusion expansion in 19 patients (19.39%), external cerebral herniation in 16 patients (16.33%), syndrome of the trephined in 12 patients (12.24%), epilepsy in 7 patients (7.14%), and cerebrospinal fluid (CSF) leakage in 4 patients (4.08%).* ***Conclusion:*** *Decompressive craniectomy is an established treatment for reducing mortality in patients with traumatic brain injury. However, the procedure is associated with significant postoperative complications, such as subdural effusion and contusion expansion, which require timely identification and management. Despite its benefits, the risks associated with decompressive craniectomy necessitate careful postoperative monitoring to improve patient outcomes.*

Keywords: Decompressive Craniectomy, Traumatic Brain Injury, Contusion Expansion, External Cerebral Herniation, Syndrome of Trephined, Epilepsy and CFS Leakage

Introduction

Traumatic brain injury (TBI) is a leading cause of death and disability worldwide. More than 90% of the burden is shared by low- and middle-income countries like Pakistan, taking a heavy toll on the younger and more productive age groups with grave financial implications (1). Outcomes in TBI have improved over the past few decades due to design modifications in the automotive engineering sector and the broader use of preventive strategies like recreational helmet-wearing and improved car seat technology (2). Elevated intracranial pressure (ICP) is the primary culprit contributing to mortality in more than 50% of patients with TBI. The first-tier management protocol for reducing ICP includes using multiple conservative and minimally invasive modalities like hyperosmolar agents, analgesia, deep sedation, and a ventriculostomy (3, 4).

The decompression of the brain aims at reducing ICP by artificially providing space for the brain to expand. Severe intracranial hypertension does not respond to medical management in 10 to 15% of head-injured patients, and decompressive craniectomy appears to be a reasonable alternative treatment in these patients. Still, the long-term functional outcomes of this method, when used to treat an elevated ICP (ICP > 20 mmHg), remain unknown (5,6). Although a DC is helpful in treating uncontrollable ICH, the translation of its effects into an improved outcome is challenged by the lack of robust scientific evidence (7, 8). Similar concerns were raised by the multicentric, randomized, controlled DECRA trial. The surgical method is relatively straightforward, but postoperative complications can severely affect clinical outcomes (9). Ban et al. evaluated postoperative complications among patients who underwent decompressive craniectomy and showed that the patients developed contusion expansion at 12.4%, postoperative epilepsy at 3.4%, external cerebral herniation at 14.6%, subdural effusion at 32.6%, CSF leakage at 2.2%, post-traumatic hydrocephalus 11.2% and syndrome of the trephined 9% complications (10).

The rationale of the study was to determine the frequency of postoperative complications among patients who underwent decompressive craniectomy to establish a local perspective, as there is a lack of regional data. The treatment of traumatic

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brain injury is difficult and often controversial, with no general consensus on their management. Because outcomes are poor, once postoperative complications occur, prevention and regular monitoring are the only tools for preventing fatal complications. Data from this study would potentially offer new information to clinicians that can influence clinical and improve quality of life and patient outcomes in our population.
To determine the frequency of postoperative complications among patients who underwent decompressive craniectomy for Traumatic brain injury.

Methodology

Please take note of the following information:

This study was conducted over a six-month period from February 20, 2020, to August 20, 2020, at SMBB Trauma Center, Civil Hospital Karachi. A total of 98 patients who had experienced traumatic brain injuries within 24 hours and had undergone decompressive craniectomy, and were aged between 20 and 60 years, were included in the study. Patients who did not consent to participate, those with an ASA score of 2 or higher, individuals with known blood coagulation disorders, patients diagnosed with brain death according to the specified criteria, and those experiencing shock due to other significant injuries were excluded from the study. Additionally, patients with non-traumatic cerebral infarcts as confirmed by CT or MRI scan, patients with gunshot injuries as verified by history, physical examination, or imaging studies, and those with a history of malignancy, congestive cardiac failure, chronic liver disease, chronic obstructive pulmonary disease (COPD), or stroke were also excluded. Non-probability consecutive sampling technique was used. WHO sample size calculator was used to calculate the sample size. The sample size was calculated by taking the frequency of external cerebral herniation 14.6%, the margin of error = 7%, and the confidence level =95%. After taking a brief history of demographic information and written informed consent in the local language (Urdu) from patient attendants, decompressive craniectomy was performed by removing a large portion of the frontotemporoparietal cranium (> 12 cm) for lesions confined to one cerebral hemisphere.
Patients with bifrontal or anterior cranial fossa lesions underwent bilateral frontal craniectomy from the anterior cranial fossa to the coronal suture. After craniectomy, epidural hematoma (EDH) and subdural hematoma (SDH) were evacuated when present. Brain parenchymal hemorrhagic contusion was removed in cases with persistent and significant brain swelling after craniectomy and hematoma evacuation. The procedure was performed by an experienced neurosurgeon with over ten years of experience in the presence of the researcher. The prime author followed up with patients for one month to look for the development of postoperative complications.
Data was analyzed on SPSS Version 20. Mean and standard deviations were calculated for the quantitative variables like age, length of hospital stay, duration of injury, and duration of surgery. Frequencies and percentages were calculated for the qualitative variables like gender, diabetes mellitus type II, hypertension, and postoperative complications (Contusion expansion, postoperative epilepsy, external cerebral herniation, subdural effusion, CSF leakage, post-traumatic hydrocephalus, and syndrome of the trephined.

Results

The mean age in the current study was 45.14 years, with a standard deviation of ±9.49. Our study's mean length of hospital stay, duration of injury, and duration of surgery were 10.72±6.24 days, 8.41±4.69 hours, and 4.87±2.14 hours, respectively. Of 98 patients, 60 (61.2%) were male and 38 (38.8%) were female. Around 14 (14.29%) of the patients had diabetes mellitus and 19 (19.39%) had hypertension, as shown in table 1**.**
Several complications occurred after decompressive craniectomy; Subdural effusion was found to be the most common complication, i.e., 37 (37.76%) followed by contusion expansion 19 (19.39%), external cerebral herniation 16 (16.33%), syndrome of trephined 12 (12.24%), epilepsy 7 (7.14%) and CFS leakage 4 (4.08%), as shown in Table 2.

Table 1: Baseline Data of the patients

Baseline Data	Mean ± SD/ n(%)
Age (Years)	45.14 ± 9.49
Length of Hospital Stay (Days)	10.72 ± 6.24
Duration of GBS Injury (Hours)	8.41± 4.69
Duration of GBS Surgery (Hours)	4.87± 2.14
Gender Male Female	 60 (61.22%) 38 (38.78%)
Co-Morbid Diabetes Mellitus Hypertension	 14 (14.29%) 19 (19.39%)

Table 2: Frequency of postoperative complication among patients who underwent decompressive craniectomy for Traumatic brain injury

Postoperative Complication	n (%)
Contusion Expansion	19 (19.39%)
Postoperative Epilepsy	7 (7.14%)
External Cerebral Herniation	16 (16.33%)
Subdural Effusion	37 (37.76%)
CSF Leakage	4 (4.08%)
Post-Traumatic Hydrocephalus	11 (11.22%)
Syndrome of Trephined	12 (12.24%)

Discussion

A well-proven treatment for uncontrollable intracranial hypertension that lowers mortality from traumatic brain injury is decompressive craniectomy. However, there are a number of potential side effects from the therapy that should be recognized and addressed immediately. Most of these side effects result from typical pathophysiologic alterations in CBF, ICP, and CSF circulation after removing a significant section of the skull. The current study looked at a number of surgical problems. In contrast, most other studies focused on managing elevated ICP and clinical

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outcomes, and very few studied the difficulties of decompressive craniectomy (11, 12). Subdural effusion was the most frequent side effect of decompressive craniectomy for traumatic brain injury, and most patients with it recovered on their own (13, 14), which is consistent with our results.

Following a decompressive craniectomy, a new cerebral hematoma or contusion expansion may occur contralaterally or far from the decompressed hemisphere. This complication could arise soon after decompression and be caused by a decrease in or disappearance of the tamponade action. Appropriate management based on close monitoring and early detection is the key to proper management. The current study showed contusion expansion in 19.30% of cases. As reported, 11 of 48 patients (12.4%) developed contusion expansion (13).

Although the exact mechanism underlying postoperative epilepsy is still unknown, it has been proposed that seizures may arise from gradual increases in hyperexcitability and a decreased epileptogenic threshold (5). We adopted this management approach because prophylactic antiepileptic medications may prevent postoperative epilepsy. According to earlier reports, 7.14% of patients experienced postoperative epilepsy (13). However, this complication disappeared after increasing the dosage and adding other antiepileptics.

Brain edema has been identified as the mechanism of external cerebral herniation. (14). An external cerebral herniation may result in cortical injury and venous infarction of the herniated brain tissue by compressing and rupturing the cortical vein. Large craniectomies with augmentative duraplasty reduce the risk of venous infarction by allowing the brain to extend outward without restriction (14, 15). In the present study, this complication occurred in (16.33%) of patients, although craniectomy of more significant than 12 cm in diameter had been performed. However, surgical intervention, such as decompressive lobectomy, was not used in any patient because of the lack of postoperative neurological deterioration, medically responsive ICP, and a CPP of larger than 70 mmHg. Furthermore, external cerebral herniation disappeared all the time without surgical intervention.

Small wound dehiscence caused CSF leakage in (4.08%) of the patients, although it was fixed with straightforward suture application. It has been demonstrated that the prevalence of CSF leaks and fistulae caused by DC might reach 6.3% overall (16, 17). It was observed in 2.9% of patients receiving DC for cerebral venous sinus thrombosis (CVST) (15). It makes sense that a thorough augmentative duraplasty and a waterproof scalp closure would stop CSF from escaping the site and lower the risk of infection.

Posttraumatic hydrocephalus develops when CSF flow is angry, and the CSF circulation fails to normalize (13, 14). In the present study, (11.22%) patients developed this complication. Depending on the diagnostic criteria, the incidence ranges from 0.7 to 86% (18).

Grant and Norcross initially reported the syndrome of the trephined in 1939, describing its symptoms as headache, seizures, mood swings, and behavioral abnormalities (19). Following a decompressive craniectomy, the scalp above the bone defect lowers due to a lack of bone support. This causes the subarachnoid space to shrink, air pressure to be transmitted directly to the brain, and pressure to be applied to the underlying cortex, which disrupts cerebral blood flow and CSF circulation. Patients with the syndrome of the trephined benefit from cranioplasty, and it has been advised to have cranioplasty as soon as possible following decompressive craniectomy (20). In the present study, (12.24%) patients developed this complication.

This study's non-randomized, non-controlled nature and the small number of patients recruited limit our ability to draw firm conclusions. Nevertheless, this study does show that complications following decompressive craniectomy have specific onset times and that some complications can affect postoperative outcomes.

Conclusion

For traumatic brain injury, decompressive craniectomy is a proven treatment that lowers mortality. Some evidence—albeit conflicting—suggests it increases the percentage of good-grade survivors. However, there are a number of serious side effects associated with the medication that should be recognized and addressed right away. It is crucial to do a large enough cranioplasty to prevent cerebral herniation and to have a low threshold diagnosis for bleeding progression in the early postoperative phase. An early cranioplasty, preferably within 12 weeks, as soon as the brain is lax, is advisable to prevent long-term complications of DC.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-SMBB-0383/19)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Coordination of collaborative efforts.
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Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript.
SAJID HUSSAIN (Consultant Orthopaedic Surgeon)
Study Design, Review of Literature.
MUHAMMAD ALI JAMALI (Assistant Professor)
Conception of Study, Final approval of manuscript.
IMRAN JAWAID (Consultant Neurosurgeon)
Manuscript revisions, critical input.
SHUJA SHAUKAT (Registrar)
Data entry and data analysis, as well as drafting articles.

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