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A comparative study to evaluate the clinical and biochemical efficacy of mannitol (10%) with glycerine (10%) versus mannitol (20%) in patients with mild to moderate head trauma

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ABSTRACT

Traumatic brain injury (TBI) is a major cause of death and long-term disability globally, affecting individuals' physical, cognitive, and emotional well-being. TBI can result from various mechanisms such as blunt trauma or acceleration-deceleration forces, leading to neuronal damage and functional disruption. Diagnosis typically relies on neuroimaging techniques like CT and MRI. While treatment focuses on symptom management and rehabilitation, research into neuroprotective therapies and emerging interventions offers hope for better outcomes. Effective, personalised care remains essential in addressing the complex, multifaceted nature of TBI. **Objective of the study**: This study aimed to compare the clinical and biochemical efficacy of Mannitol (10%) with Glycerine (10%) versus Mannitol (20%) in patients with mild to moderate head injuries, focusing on intracranial pressure reduction, neurological improvement, electrolyte balance, and safety profiles. **Material and method**: A total of 100 adult patients with mild (GCS 13–15) to moderate (GCS 8–12) head injuries were randomly assigned to two groups: Group A received Mannitol (10%) + Glycerine (10%), and Group B received Mannitol (20%). Both regimens showed comparable efficacy in reducing cerebral oedema and improving neurological status. However, the combination therapy demonstrated better preservation of serum sodium levels and fewer hemodynamic fluctuations. **Conclusion**: In our comparative prospective study, it can be concluded that the efficiency of 20% Mannitol and Mannitol (10%) with glycerine (10%) for the treatment of cerebral oedema in patients with mild to moderate head injury is almost equal.

Keywords
glycerine,
mannitol,
head injury,
traumatic brain injury (TBI),
intracranial injury

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INTRODUCTION

Traumatic brain injury (TBI), also known as intracranial injury, occurs when an external force injures the brain. TBI can be classified based on severity, mechanism (closed or penetrating head injury), or anatomical location. In addition to primary injury, secondary insults such as altered cerebral blood flow and increased intracranial pressure (ICP) contribute significantly to patient outcomes [4].

Common therapeutic interventions include osmotic agents like mannitol and glycerol, which help reduce ICP by drawing fluid out of brain tissue.

Mannitol: A type of sugar alcohol that is also used as a medication. As a medication, it is used to lower increased intracranial pressure. Medically, it is given by injection. Effects typically begin within 15 minutes and last up to 8 hours. Mannitol (20%) has been traditionally used, but its side effects—such as rebound edema, hypovolemia, and nephrotoxicity—have prompted exploration into alternative regimens [5].

Glycerine (glycerol): Glycerine is sometimes used in the management of head injuries due to its osmotic diuretic properties. It helps reduce cerebral edema (brain swelling) by drawing excess fluid from brain tissues into the bloodstream, thereby lowering intracranial pressure (ICP). This can be beneficial in conditions like traumatic brain injury (TBI), stroke, or brain tumors. It is often administered orally or intravenously but is used cautiously due to potential side effects like dehydration and electrolyte imbalance [6].

This study compares the effectiveness of Mannitol (10%) with Glycerine (10%) versus Mannitol (20%) in managing cerebral edema following mild to moderate TBI, evaluating their impact on neurological recovery, coma duration, mortality, and biochemical stability [7].

Materials and Methods

Study Design

This was a prospective, randomized controlled trial conducted at our hospital. A total of 100 adult patients with mild (GCS 13–15) to moderate (GCS 8–12) TBI were included after informed consent.

Patient Selection

- Inclusion criteria : Adults aged 18–65 years with mild to moderate TBI confirmed by CT scan.
- Exclusion criteria : Severe TBI (GCS < 8), polytrauma, prior neurosurgery, significant comorbidities, or contraindications to hyperosmolar therapy .

Randomization

Patients were randomly assigned to one of two groups:

- Group A (n=50) : Mannitol (10%) + Glycerine (10%) administered at 0.5 g/kg each over 20 minutes every 6–8 hours.
- Group B (n=50) : Mannitol (20%) at 0.5–1 g/kg over 20 minutes every 6–8 hours [2].

Monitoring Parameters

- Neurological status : Glasgow Coma Scale (GCS)
- Blood pressure : Pre- and post-drug administration daily
- Biochemical parameters : Creatinine, hematocrit, sodium, potassium on Days 1, 3, and 5
- Outcome : Mortality, duration of coma, adverse effects

Results

Table 1. Outcome Comparison Between Groups

Outcome	Group A (M+G)	Group B (M 20%)
Improved	45	43
Death	5	7
Total	50	50

Mortality rate: Group A = 10%, Group B = 14% (p = 0.32 , NS)

Neurological Outcomes (GCS Improvement)

Table 2 & 3. GCS Scores at Admission and Outcome

GCS Category	Group A (n=50)	Improved	Death	Group B (n=50)	Improved	Deaths
Mild (13–15)	34	34	0	29	29	0
Moderate (8–12)	16	11	5	21	14	7

Improvement in GCS scores :

- Group A: 90%
- Group B: 86%
- p = 0.38 (NS – No significant difference)

Duration of Coma (Hours)

- Group A: 80 ± 41.2 hours
- Group B: 92 ± 38.3 hours
- p = 0.18 (NS)

Electrolyte Changes (Serum Sodium Levels)

- Group A (M+G) : Stable sodium levels over 5 days
- Group B (M 20%) : Gradual decline in serum sodium
  - Day 1: 137 mEq/L → Day 5: 131 mEq/L
  - p = 0.01 (Significant decrease)

Blood Pressure Changes

- Group A : No significant change in SBP/DBP after infusion
- Group B : Significant drop in BP during first 3 days
  - Example: Day 1 SBP decreased from 144 to 136 mmHg
  - p < 0.05 for first three days

Biochemical Parameters (Creatinine, Hematocrit)

Parameter	Group A (Day 1/5)	Group B (Day 1/5)
Hematocrit	34 / 34	34 / 34
Creatinine (mg/dL)	0.9 / 1.0	0.8 / 1.1
Sodium (mEq/L)	138 / 140	137 / 131
Potassium (mEq/L)	4.2 / 4.3	3.9 / 4.1

- No significant changes in creatinine or hematocrit in either group (p > 0.05) [10]
- Potassium levels remained stable (p = 0.42)

Discussion

This study compared the clinical and biochemical efficacy of Mannitol (10%) with Glycerine (10%) versus Mannitol (20%) in 100 patients with mild to moderate TBI. Both treatments showed similar effectiveness in reducing intracranial pressure and improving neurological outcomes.

- Mortality: No statistically significant difference between the two groups (10% vs. 14%; p = 0.32).
- Neurological Recovery (GCS improvement) : Comparable across both groups (p = 0.38).
- Coma Duration : No significant difference observed (p = 0.18).

  However, notable differences were found in electrolyte stability and hemodynamic effects :
- Serum sodium levels were better preserved in the combination group (p = 0.01) [10].
- Blood pressure dropped significantly in the first three days among patients receiving Mannitol 20% (p < 0.05), indicating greater hemodynamic instability [9].

These findings suggest that while both regimens are equally effective in managing cerebral edema, the combination of Mannitol (10%) with Glycerine (10%) offers advantages in terms of electrolyte balance and cardiovascular stability , making it potentially safer for prolonged use [10].

Conclusion

In this comparative prospective study, both Mannitol (10%) with Glycerine (10%) and Mannitol (20%) demonstrated comparable efficacy in reducing intracranial pressure and improving neurological function in patients with mild to moderate TBI.

Key Findings:

- Mortality rate : No significant difference (Group A: 10%, Group B: 14%; p = 0.32)
- Neurological improvement (GCS) : Comparable between groups (p = 0.38)
- Coma duration : No significant difference (Group A: 80 ± 41.2 hrs, Group B: 92 ± 38.3 hrs; p = 0.18)
- Electrolyte stability : Combination therapy showed better preservation of serum sodium (p = 0.01)
- Hemodynamic effects : Mannitol 20% associated with greater drops in blood pressure (p < 0.05)

These results indicate that Mannitol 10% combined with Glycerine 10% is as effective as Mannitol 20% in treating cerebral edema in mild to moderate TBI cases, while offering potential benefits in electrolyte homeostasis and hemodynamic stability [10]. Future larger trials are warranted to confirm these findings and explore long-term outcomes.

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