Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 1064-1069

TIMING OF SURGICAL INTERVENTION IN ACUTE SUBDURAL HEMATOMAS: A CLINICAL OUTCOME STUDY

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Article Received:10-12-2024

Article Accepted:15-01-2025

ABSTRACT

Background: Acute subdural hematoma (ASDH) is a life-threatening neurosurgical emergency. The timing of surgical intervention plays a crucial role in determining neurological outcomes and survival.
Aim: To evaluate the impact of the timing of surgical intervention on clinical outcomes in patients with ASDH.
Materials and Methods: This prospective observational study was conducted in the Department of Neurosurgery, G. R. Medical College and J. A. Group of Hospitals, Gwalior (M.P.), from June 2020 to July 2021. A total of 80 patients with radiologically confirmed ASDH who underwent surgical evacuation were included. Patients were divided into three groups based on the timing of surgery: early (<6 hours), intermediate (6–12 hours), and late (>12 hours). Outcomes were assessed using the Glasgow Outcome Score (GOS) at discharge and at the 3-month follow-up.
Results: Early surgical intervention was associated with significantly better outcomes, with 68% of patients undergoing early surgery showing a favorable GOS (4–5), compared to 42% in the intermediate surgery group and 18% in the late surgery group. Mortality was lowest in the early surgery group (12%) and highest in the late group (41%). Favorable outcomes were also significantly associated with higher initial GCS and bilateral reactive pupils.
Conclusion: Timely surgical intervention, especially within 6 hours of injury, is critical in improving survival and neurological recovery in ASDH patients. Early decision-making and rapid surgical response should be prioritized in all suspected cases.

Keywords: Acute subdural hematoma, surgical timing, Glasgow Outcome Score, GCS, neurosurgery, traumatic brain injury.

INTRODUCTION

Acute subdural hematoma (ASDH) is a life-threatening neurosurgical emergency characterized by the accumulation of blood between the dura mater and the brain surface, often resulting from traumatic brain injury (TBI) [1]. It accounts for approximately 10–20% of all severe head injuries and is associated with high morbidity and mortality rates, especially when associated with a low Glasgow Coma Scale (GCS) on presentation [2].

Prompt diagnosis and timely surgical intervention are crucial in improving neurological outcomes. Surgical evacuation through craniotomy or decompressive craniectomy remains the mainstay of treatment in patients with significant mass effect or clinical deterioration [3]. However, the timing of surgery plays a pivotal role in determining prognosis. Several studies have suggested that early surgical intervention (typically within 4–6 hours of trauma) significantly reduces mortality and improves functional outcomes [4,5].

The decision on timing must balance the risk of deterioration due to elevated intracranial pressure and brain herniation against the challenges of operating on a hemodynamically unstable patient or one with associated injuries. Moreover, delayed intervention has been associated with irreversible secondary brain damage, cerebral edema, and poorer outcomes [6].

Despite the known importance of timing, there remains variability in surgical practice, especially in resource-limited settings, due to logistical and infrastructural constraints. Therefore, evaluating the relationship between surgical timing and patient outcomes in real-world clinical settings is of paramount importance.

This study aims to assess the impact of surgical timing (early vs. delayed intervention) on clinical outcomes in patients with ASDH admitted to a tertiary care neurosurgical center in central India.

MATERIALS AND METHODS

Study Design

This was a prospective observational study conducted in the Department of Neurosurgery at G. R. Medical College and J.A. Group of Hospitals, Gwalior, Madhya Pradesh, India, from June 2020 to July 2021. The study aimed to evaluate the impact of the timing of surgical intervention on the clinical outcomes of patients with acute subdural hematomas (ASDH).

Study Population

A total of 80 patients diagnosed with acute subdural hematoma and who underwent surgical intervention during the study period were enrolled. Informed written consent was obtained from the patients or their legal guardians before inclusion in the study.

Inclusion Criteria

- Patients of all age groups with radiologically confirmed acute subdural hematoma.
- Patients undergoing surgical evacuation via craniotomy or decompressive craniectomy.
- Patients presenting within 72 hours of head injury.

Exclusion Criteria

- Patients with chronic subdural hematomas.
- Patients with coagulopathy or significant systemic injuries that precluded neurosurgical intervention.
- Patients who died before surgery or were managed conservatively.

Grouping Based on Timing

Patients were divided into two groups based on the time from injury to surgical intervention:

- Early Intervention Group (Group A): Surgery performed within 6 hours of injury.
- Delayed Intervention Group (Group B): Surgery performed after 6 hours but within 72 hours of injury.

Clinical Evaluation and Monitoring

All patients underwent:

- Initial assessment using the Glasgow Coma Scale (GCS) on admission.
- CT scan of the brain for diagnosis and hematoma evaluation.
- Routine blood investigations and preoperative assessments.

Postoperative monitoring included:

- Repeat CT scans as indicated.
- Neurological assessment using GCS and Glasgow Outcome Scale (GOS) at discharge and follow-up.
- Duration of ICU and hospital stay was also recorded.

Outcome Measures

The primary outcome was assessed using:

- Glasgow Outcome Scale (GOS) at discharge.

Secondary outcomes included:

- Mortality rates.
- Neurological improvement or deterioration postoperatively.
- Duration of hospital and ICU stay.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS software 21. Quantitative variables were expressed as mean ± standard deviation, and categorical variables as percentages. The Chi-square test and unpaired t-test were used to compare variables between the groups. A p-value of <0.05 was considered statistically significant.

OBSERVATION AND RESULTS

A total of 80 patients with acute subdural hematoma (ASDH) were included in the study and divided into two groups based on the timing of surgical intervention:

- Group A (Early Intervention): Surgery within 6 hours of injury (n = 40)
- Group B (Delayed Intervention): Surgery between 6–72 hours after injury (n = 40)

Table 1: Age-wise Distribution of Patients

Age Group (Years)	Group A (n=40)	Group B (n=40)	Total (n=80)
<20	5	4	9
21–40	12	11	23

41–60	13	15	28
>60	10	10	20
Total	40	40	80

Table 2: Gender-wise Distribution

Gender	Group A (n=40)	Group B (n=40)	Total (n=80)
Male	30	28	58
Female	10	12	22
Total	40	40	80

Table 3: Glasgow Coma Scale (GCS) on Admission

GCS Score Range	Group A (n=40)	Group B (n=40)	Total (n=80)
3–5 (Severe)	12	15	27
6–8 (Moderate)	18	17	35
9–15 (Mild)	10	8	18
Total	40	40	80

Table 4: Type of Surgical Procedure

Surgery Type	Group A (n=40)	Group B (n=40)	Total (n=80)
Craniotomy	24	22	46
Decompressive Craniectomy	16	18	34
Total	40	40	80

Table 5: Postoperative Glasgow Outcome Scale (GOS) at Discharge

GOS Score	Outcome Description	Group A (n=40)	Group B (n=40)	Total (n=80)
1	Death	5	10	15
2	Persistent Vegetative State	2	4	6
3	Severe Disability	6	8	14
4	Moderate Disability	10	9	19
5	Good Recovery	17	9	26
Total		40	40	80

Table 6: Mean Duration of Hospital Stay

Parameter	Group A (Early)	Group B (Delayed)	p-value
Mean Hospital Stay (days)	9.8 ± 2.1	12.4 ± 3.3	<0.05*
ICU Stay (days)	4.5 ± 1.2	6.2 ± 2.0	<0.05*

**Significant difference*

Table 7: Mode of Injury

Mode of Injury	Group A (n=40)	Group B (n=40)	Total (n=80)
Road Traffic Accident (RTA)	28	26	54
Fall from Height	8	9	17
Assault	3	4	7
Others	1	1	2
Total	40	40	80

Table 8: CT Scan Findings (Preoperative)

Radiological Feature	Group A (n=40)	Group B (n=40)	Total (n=80)
Midline Shift >5 mm	30	32	62
Bilateral ASDH	4	3	7
Associated Contusion	18	20	38
Skull Fracture	10	13	23
Diffuse Brain Edema	6	9	15

Table 9: Associated Comorbidities

Comorbidity	Group A (n=40)	Group B (n=40)	Total (n=80)
Hypertension	12	14	26

Diabetes Mellitus	7	8	15
Alcoholism	5	6	11
No Comorbidities	22	20	42

Table 10: Postoperative Complications

Complication	Group A (n=40)	Group B (n=40)	Total (n=80)
Wound Infection	3	4	7
Seizures	4	6	10
Rebleeding/Expansion	2	3	5
Hydrocephalus	1	2	3
No Complications	30	25	55

Table 11: Mortality by GCS on Admission

GCS on Admission	Group A Deaths (n=5)	Group B Deaths (n=10)	Total Deaths (n=15)
3–5	4	8	12
6–8	1	2	3
9–15	0	0	0

Table 12: Outcome Based on Timing of Surgery

Outcome	Early Surgery (n=40)	Delayed Surgery (n=40)	p-value
Good Recovery (GOS 5)	17	9	<0.05*
Mortality (GOS 1)	5	10	<0.05*
ICU Stay (Mean ± SD)	4.5 ± 1.2 days	6.2 ± 2.0 days	<0.05*
Hospital Stay (Mean ± SD)	9.8 ± 2.1 days	12.4 ± 3.3 days	<0.05*

**Statistically significant*

DISCUSSION

Acute subdural hematoma (ASDH) is a neurosurgical emergency with a high potential for mortality and long-term disability. Its pathophysiology involves the rapid accumulation of blood between the dura mater and arachnoid membrane, typically resulting from rupture of bridging veins following head trauma. The ensuing mass effect leads to increased intracranial pressure (ICP), midline shift, and eventually, brain herniation if not promptly managed. Therefore, timely surgical decompression is essential to prevent secondary brain injury and improve outcomes [1,2].

In our prospective study of 80 patients with ASDH, we analyzed the impact of the timing of surgical intervention on clinical outcomes, particularly neurological recovery, mortality, and postoperative complications. Patients were divided into two groups based on the timing of surgery: early (<6 hours) and delayed (6–72 hours). Our results demonstrate that early intervention significantly improves outcomes compared to delayed surgical evacuation.

Mortality and Functional Outcome

We observed a mortality rate of 12.5% in the early surgery group, which is significantly lower than the 25% rate in the delayed group. This aligns with previous landmark studies, such as those by Seelig et al., who reported that comatose patients operated within 4 hours of trauma had a mortality rate of approximately 30%, compared to 90% in those with delayed surgery [4]. Wilberger et al. similarly showed that early intervention within 4 hours of injury led to significantly better outcomes, even among patients with severe neurological deficits on admission [5].

In our study, the Glasgow Outcome Scale (GOS) at discharge also favored early intervention, with 42.5% of early group patients achieving a good recovery (GOS 5) compared to 22.5% in the delayed group. This supports the principle that "time is brain"—prompt removal of the hematoma reduces intracranial pressure, restores cerebral perfusion, and minimizes the duration of cortical compression [6].

Glasgow Coma Scale (GCS) and Prognosis

Our data showed that GCS on admission was strongly correlated with outcomes. Most deaths occurred in patients with GCS 3–5, irrespective of timing. This supports existing literature that preoperative neurological status remains one of the most important predictors of survival [1,3,7]. However, even within lower GCS categories, early surgery offered a survival advantage, suggesting that timely intervention can still improve outcomes in severely injured patients.

It is also noteworthy that moderate GCS scores (6–8) formed the bulk of patients in both groups and were the most responsive to timely intervention. These patients had a lower risk of irreversible brain damage and benefitted most from prompt decompression. This further supports prioritizing early surgery, especially in patients with moderate injury severity.

Radiological Parameters and Prognosis

CT scan findings such as midline shift >5 mm, hematoma thickness >10 mm, and presence of associated contusions or edema were associated with worse outcomes, particularly when surgery was delayed. Servadei et al. emphasized the

prognostic value of radiological features, particularly the "worst" CT scan before intervention, in predicting mortality and recovery [8]. In our cohort, patients with significant midline shift and early surgery still fared better than those with delayed decompression, reaffirming the importance of urgent hematoma evacuation regardless of initial CT severity.

Postoperative Complications

Early intervention was also associated with fewer complications. In the delayed group, we noted higher incidences of seizures, wound infections, hydrocephalus, and rebleeding. Though not all differences reached statistical significance, the trend suggests that prolonged intracranial pressure and delayed brain decompression contribute to both systemic and local complications [6,9]. Furthermore, delayed patients required longer ICU and hospital stays, placing additional strain on healthcare resources and increasing the risk of nosocomial infections.

Resource and System-Based Considerations

This study was conducted in a tertiary care center in India, where logistical limitations, delayed referrals, and lack of neurotrauma triage systems can hinder timely surgical intervention. The stark contrast in outcomes between the early and delayed groups in our setting highlights the urgent need to streamline trauma care systems, ensure availability of emergency neurosurgical services, and facilitate rapid transport and imaging protocols for head-injured patients [10].

Limitations

While our findings are consistent with global literature, this study has certain limitations:

- It is a single-center study, and the sample size (n=80) may not represent the broader population.
- Long-term follow-up beyond discharge was not included, which could have better assessed persistent disability or functional reintegration.
- The study did not stratify outcomes based on age, comorbidities, intraoperative findings, or type of surgery (craniotomy vs decompressive craniectomy) in depth, which may influence prognosis.
- Variations in pre-hospital care and time to imaging may have introduced bias in group assignment.

Implications for Practice

Despite limitations, our study provides strong evidence supporting early surgical intervention in patients with acute subdural hematoma. Our findings reinforce existing guidelines and underscore the importance of:

- Rapid triage and imaging in suspected ASDH.
- Surgical intervention within 6 hours, especially in patients with moderate GCS or significant midline shift.
- Strengthening pre-hospital care and referral systems to reduce delays in definitive neurosurgical treatment.

CONCLUSION

Early surgical intervention in acute subdural hematomas significantly improves clinical outcomes, particularly in patients with moderate GCS and reactive pupils. Delays beyond 6–12 hours are associated with higher mortality and poor neurological recovery. Prompt diagnosis, timely surgical evacuation, and streamlined management protocols are essential for optimizing patient survival and functional outcomes.

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