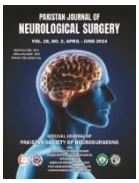

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Original Research

Impact of The Time Taken Before Surgery in Evaluating the Outcome of Extradural Hematoma

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ABSTRACT

Objective: To assess the impact of the time taken before surgery in evaluating the outcome of extradural hematoma.

Materials & Methods: A prospective observational study was done at the Department of Neurosurgery, Pakistan Institute of Medical Sciences (PIMS) Islamabad. Patients with extradural hematoma (>20ml) as per calculation by the scale on axial images of a CT scan brain and scheduled for surgical intervention, aged 18 years to 60 years of either gender were included. Patients underwent surgical treatment as per indications and were scheduled for surgery. Time was recorded for injury, diagnosis, and surgery and calculated from the time of injury to the time of surgery. The favorable outcome was defined in terms of good recovery, and moderate disability, and patients with severe disability, vegetative state, or mortality were defined as with poor outcome.

Results: Overall mean age was 34.09 years with a higher proportion of males (66.7%). Post-surgery, disability was observed in 11.8% of cases and the overall mortality rate was 15.7%. Considering the overall outcomes, 74.5% of the patients had favorable results, whereas 25.5% had unfavorable outcomes. The timing of surgery significantly influenced outcomes ($p < 0.0001$). Patients operated on within 1-6 hours post-trauma had no disability or mortality, with 70.6% favorable outcomes. In contrast, those operated on within 6-12 hours showed 11.8% disability, 11.8% mortality, and 23.5% unfavorable outcomes, with only 2.0% achieving favorable outcomes.

Conclusion: It is evident that a time interval of less than six hours between the traumatic incident and surgical intervention is strongly correlated with better results, including significantly lower rates of disability and mortality.

Keywords: Extradural Hematoma, Arrival Time, Surgery, Functional Outcome.

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INTRODUCTION

An extradural hematoma (EDH), also referred to as an epidural hematoma, is an accumulation of blood between the inner surface of the skull and the Dura mater and these are deemed life-threatening due to the substantial risk of brain herniation and it represents 2% of all head injuries.[1] Extradural hematoma often leads to significant neurological decline, necessitating immediate surgical intervention to avoid severe neurological damage or mortality.[2] The condition is four times more common in males than females.[2,3] It is uncommon in young children due to the skull's flexibility and less prevalent in individuals over 60 because the dura adheres more firmly.[2] A traumatic brain injury (TBI) occurs when a collision, blow, shock, or penetrating wound to the head disrupts the brain's normal functioning.[4] Around 75% of TBIs are mild and are indicated to as concussions. The majority of these cases are caused by road traffic accidents, followed by falls and acts of violence.[4,5] The high prevalence of road traffic accidents contributes significantly to global mortality, making it one of the top ten leading causes of death worldwide.[4,5] EDH is most prevalent in the temporo-frontal areas but it may additionally be detected in the parieto-occipital, parasagittal, and middle and posterior fossae.[6] Individuals with this condition usually experience a chronic, severe headache and, after some hours of an injury, they begin to lose consciousness. EDH's principal bleeding veins are the central meningeal artery, vein, and ruptured dural venous sinuses.[6] The majority of these instances had an excellent prognosis with immediate management, preferably surgical.[7,8] However, some cases also showed positive outcomes with medication when surgery was either contraindicated or unavailable. In instances where immediate intervention was not performed, irreversible neurological deficits, such as cord compression syndrome, or even death, were reported.[7,8]

Given that traumatic extradural hematoma constitutes a neurosurgical emergency, prompt surgical intervention for significant cases is the established course of action.[9,10] The Glasgow Coma score or initial level of consciousness upon admission, patient age, the presence of associated intradural lesions, and the duration between diagnosis and hematoma evacuation, including any delays due to patient transfer to a neurosurgical facility, are among the most crucial factors influencing patient outcomes.[9,11]

The timing between the injury and surgery, as well as the volume of the hematoma, significantly impact surgical outcomes.[12,13] However at the local level mostly, the transfer time for patients with acute extradural hematoma (EDH) in need of surgical decompression remains unacceptably prolonged. Delays are primarily due to factors such as lack of awareness, negligence, or limited nearby medical resources, the time required to conduct the initial CT scan, and the time needed for departure upon confirmation of the diagnosis for transfer. However, this study has been done to determine the impact of the time taken before surgery in evaluating the outcome of extradural hematoma.

MATERIAL AND METHODS

Study Design and Setting

A prospective observational study was done at the Department of Neurosurgery PIMS Islamabad.

Duration and Approval

The duration of the study was six months from June 2023 to December 2023 after approval of CPSP. Ref: No. CPSP/REU/NSG/ 2023-042-959.

Inclusion Criteria

All the patients directly reported to the hospital with extradural hematoma (>20ml) as per calculation by the scale on axial images of CT scan brain and scheduled for surgical intervention, aged 18 years to 60 years of either gender were included.

Exclusion Criteria

All the patients with severe comorbidities, pre-existing neurological conditions, referral patients, patients with intracranial hemorrhage (e.g., subdural hematoma, subarachnoid hemorrhage), patients with a history of previous neurosurgical intervention, patients who decline the surgical treatment or not willing to participate in the study were excluded.

Data Collection

Written informed consent was taken from each case after explaining the purpose of the study and all the patients were assured that their information would be confidential and only will be used for research purposes. After taking demographic information and clinical examination, the Glasgow Coma Scale (GCS) score was recorded and was categorized into three groups as; mild head injury (GCS 13-15), moderate head injury (GCS 9-12), and severe head injury (GCS 3-8). All the patients underwent surgical treatment as per indications and were scheduled for surgery. Time was recorded for injury, diagnosis, and surgery and calculated from the time of injury to the time of surgery. Functional outcomes were assessed using standardized scales (e.g., Glasgow Outcome Scale) at the follow-up of the three months. The favorable outcome was defined in terms of good recovery, and moderate disability, and patients with severe disability, vegetative state, or mortality were defined as with poor outcome based on predetermined criteria.

Data Analysis

Data analysis was done using SPSS version 26. Mean and standard deviation were calculated for numerical variables. Frequency and percentage were calculated for categorical variables. A chi-square test was applied and a p-value ≤0.05 was considered as significant.

RESULTS

Demographic Variables

The average age of the patients was 34.09 years with a standard deviation of 16.50 years. Gender distribution showed a higher proportion of males (66.7%, n=34) compared to females (33.3%, n=17). The location of hematomas varied, with 52.9% (n=27) located on the left side, 45.1% (n=23) on the right side, and a small percentage (2.0%, n=1) in the central region. The average size of the hematomas was 44.60 ml, with a standard deviation of 8.51 ml. The mean Glasgow Coma Scale (GCS) score was 10.64±3.58. On average, the time from trauma to surgery was 5.74 hours with a standard deviation of 3.32 hours. Post-surgery, the Glasgow Outcome Scale (GOS) average score was 4.01 with a standard deviation of 1.63 **(Table 1)**.

Table 1: Descriptive analysis of the baseline and clinical characteristics n=51.

Variables		**Statistics**	
Age of the patient (mean +SD)		**34.09±16.50 years**	
Gender	Male	34	66.7
	Female	17	33.3
	Total	51	100.0
Site of hematoma	Left	27	52.9
	Right	23	45.1
	Central	1	2.0
	Total	51	100.0
Size of hematoma (mean +SD)		44.60±8.51 ml	
GCS score (mean +SD)		10.64±3.58	
Time from trauma to surgery (mean +SD)		5.74±3.32 hours	
GOS after surgery		4.01±1.63	

Outcomes

The overall outcomes of 51 patients who underwent surgery for extradural hematoma were evaluated. Post-surgery, disability was observed in 11.8% (n=6) of the patients and the overall mortality rate was 15.7% (n=8. Considering the overall outcomes, 74.5% (n=38) of the patients had favorable results, whereas 25.5% (n=13) had unfavorable outcomes **(Table 2)**.

Table 2: Overall outcomes of patients after surgery of extradural hematoma n=51.

Outcomes		Frequency	Percent
Disability	Yes	6	11.8
	No	45	88.2
	Total	51	100.0
Mortality	Yes	8	15.7
	No	43	84.3
	Total	51	100.0
Overall outcomes	Favorable	38	74.5
	Unfavorable	13	25.5
	Total	51	100.0

Time Taken Before Surgery Associated with Extradural Hematoma

The analysis showed significant differences based on the timing of the surgery, with p-values of 0.0001 for disability, mortality, and overall outcomes like patients who operated within 1-6 hours post-trauma, there were no cases of disability or mortality (0.0%), and overall 70.6% (n=36) favorable outcomes, while in the 6-12 hour group, 11.8% (n=6) found with disability, 11.8% (n=6) mortality, and 23.5% (n=12) had unfavorable outcomes, while only 2.0% (n=1) had favorable outcomes, as shown in **(Table 3)**.

Table 3: Impact of time taken before surgery among patients with extradural hematoma n=51.

Outcomes		Time From Trauma to Surgery			p-value
		1-6 Hours	6-12 Hours	>12 Hours	
Disability	Yes	0 0.0%	6 11.8%	0 0.0%	0.0001
	No	36 70.6%	7 13.7%	2 3.9%	
Mortality	Yes	0 0.0%	6 11.8%	2 3.9%	0.0001
	No	36 70.6%	7 13.7%	0 0.0%	
Overall outcome	Favorable	36 70.6%	1 2.0%	1 2.0%	0.0001
	Unfavorable	0 0.0%	12 23.5%	1 2.0%	

DISCUSSION

Acute epidural hematoma involves blood collecting in the potential space between the dura mater and the endocranium, often necessitating emergency neurosurgery due to the risk of a rapid increase in intracranial pressure.[14] The outcome may influenced by the preoperative Glasgow Coma Scale (GCS) score and the time elapsed between the injury and the surgery.[14] However, this study was conducted on 51 patients with an average age of 34.09 years to evaluate the influence of the time taken before surgery on the outcome of extradural hematoma and the gender distribution showed a greater percentage of males (66.7%) in contrast to females (33.3%). Consistently Mezue et al,[3] reported that the highest incidence occurred in the 2nd and 3rd decades of life, with an average age of 30.2 years, and in their study, 57 patients were males (83%) and 12 were females (17%). In alignment with this study, Ayogu et al,[14] reported that the majority of patients were male (66), with only five females, resulting in a male-to-female ratio of 13.5:1, and the mean age was 30.25±13.42 years, with 61.9% of patients aged between 25 and 45 years. The study by Wang et al,[15] reported that out of the total, 61.83% of patients were male and 38.17% were female, with an average age of 42.15 ± 9.78 years. Among the

131 patients, 83 (63.36%) were involved in traffic accidents, while 48 (36.64%) experienced falls from height.[15] The predominance of males shows that they are more severely affected by extradural hematoma, which may be due to increased exposure to risk factors such as physical activities, sports, and vocations with higher risks of head injury.

In this study, the average size of the hematomas was 44.60 ml, with a standard deviation of 8.51 ml. The mean Glasgow Coma Scale (GCS) score was 10.64±3.58. On average, the time from trauma to surgery was 5.74 hours with a standard deviation of 3.32 hours. Post-surgery, the Glasgow Outcome Scale (GOS) average score was 4.01 with a standard deviation of 1.63. These results were corroborated by a study conducted by Koipapi et al,[16] which revealed that the average GCS score upon arrival at the emergency department was 11.76 ± 3.59, with approximately 75% of cases experiencing a delay in surgery exceeding 6 hours. Additionally, they identified that motor-traffic accidents were the primary mechanism of injury, accounting for 66% (103 cases), followed by violent events at 15.4% (24 cases), and falls from height at 9%.[16] In the comparison of this study Jung SW et al,[17] found an average GCS score was 12.9, while inconsistently they observed a higher average time until surgery was 23 hours compared to this study, with 37.9% of patients undergoing surgical removal of the hematoma within a time duration of 10 hours.

In this study, the overall outcomes of 51 patients who underwent surgery for extradural hematoma were evaluated. Post-surgery, disability was observed in (11.8% n=6) of the patients and the overall mortality rate was (15.7% n=8). Considering the overall outcomes, (74.5% n=38) of the patients had favorable results, whereas (25.5% n=13) had unfavorable outcomes. These findings were consistent with those reported by Koipapi S et al,[16] where, out of 156 participants, 118 (75.6%) experienced favorable outcomes. Additionally, in their study, the overall in-hospital mortality rate was 29 (18.6%). Furthermore, 18.1% exhibited moderate disabilities, enabling independent living, while 7.1% had severe disabilities, necessitating dependency on most daily activities. The study conducted by Ayogu et al,[14] also showed almost similar findings as 66.2% of the patients achieved favorable functional recovery, while 16.9% experienced residual disability and 16.9% died. In the comparison of this study, Kiboi et al,[18] reported that 86.2% of patients achieved satisfactory functional recovery, while 6.7% experienced residual disability, and 7.1% faced mortality.

Furthermore, the analysis of this study revealed a significant association between the time taken before surgery and disability, mortality, and overall outcomes ($p<0.0001$). Patients who underwent surgery within 1-6 hours post-trauma showed no instances of disability or mortality (0.0%), with 70.6% (n=36) experiencing favorable outcomes. Conversely, in the 6–12-hour group, 11.8% (n=6) experienced disability, 11.8% (n=6) mortality, and 23.5% (n=12) had unfavorable outcomes, while only 2.0% (n=1) had favorable outcomes. These findings are consistent with a study by Khalid et al,[19] reported that patients who underwent surgery within six hours of the trauma had no recorded mortality and achieved a functional recovery rate of 57.8%, whereas those operated on after six hours had a higher mortality rate (4.3%) and lower functional recovery (15.5%).[19] However et al,[18] observed that the extended time intervals between trauma and decompression, reduced preoperative GCS scores, pupillary abnormalities, and individuals aged over 61 years are unfavorable prognostic indicators. In alignment with this study, Sharif et al,[9] concluded that the patients who underwent surgical evacuation within one hour after the trauma had a notably higher frequency of favorable outcomes. Furthermore, the study by Jeong et al,[20] also reported that the shorter duration from trauma to hospital arrival within 6 hours resulted in the likelihood of poor outcomes being 8.41 times higher compared to arrivals after 6 hours. Additionally, there was a 1.46 times higher

likelihood of poor outcomes when the patients' final GCS was lower than their initial GCS. Although the study by Choi DH et al,[21] reported that the total mortality rate stood at 13.9%, while 60.8% of patients exhibited positive outcomes six months after the trauma. Although the time lapse between admission and the brain CT scan did not correlate with the outcome, it notably extended in the unfavorable outcome group.[21] More Niaz et al,[22] also observed that all patients (70%) who underwent surgery within 6 hours of injury had a positive outcome. Patients who are suffering from extradural hematoma should be examined as soon as possible, and if surgical treatment is judged required based on clinical assessments and imaging results, they should be prepared for surgery right away. This prompt response is critical for reducing the morbidity and mortality risk associated with extradural hematoma. Delays in surgical intervention beyond the key six-hour timeframe may lead to higher morbidity and mortality rates. Thus, reducing the time between diagnosis and surgical therapy is critical for improving patient outcomes. Not only does timely surgical evacuation of hematoma lower the likelihood of neurological impairments, but it also improves the overall prognosis and recovery of patients.

CONCLUSION

As per the study conclusion, it is evident that a time interval of less than six hours between the traumatic incident and surgical intervention is strongly correlated with better results, including significantly lower rates of disability and mortality. These findings underscore the vital need for immediate medical attention and appropriate surgical intervention in cases when it is indicated. However, based on several limitations of the study specifically limited sample size, further large-scale and longitudinal studies are recommended to validate the findings.

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Additional Information

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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Aisha Adalat	1. Study design and methodology.
2.	Aisha Adalat, Hamza Ejaz, Muhammad Mujahid Sharif	2. Paper writing.
3.	Aisha Adalat, Hamza Ejaz, Lal Rehman	3. Data collection and calculations.
4.	Aisha Adalat, Hamza Ejaz, Shafiq-Ur-Rehman Jamil	4. Analysis of data and interpretation of results.
5.	Aisha Adalat, Hamza Ejaz, Kashif Ramooz	5. Literature review and referencing.
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