

Research Article

Evaluating the Frequency of Neurological Improvement in Chronic Subdural Hematoma Patients Treated With Single Burr Hole Surgery in Foley Catheter Drainage

Raza Aman¹, Muhammad Saqib^{2*}, Shahid Nawaz Khattak³, Khalid Mahmood⁴, Kiramatullah Bettani⁵, Imran Khan⁶

^{1,4}Assistant Professor, Department of Neurosurgery, DHQ Teaching Hospital, Dera Ismail Khan, Pakistan.

^{2*}Consultant Neurosurgeon, Department of Neurosurgery, DHQ Teaching Hospital (MTI), Dera Ismail Khan, Pakistan.

³Professor and Head, Department of Neurosurgery, DHQ Teaching Hospital, Dera Ismail Khan, Pakistan.

⁵Assistant Professor, Department of Psychiatry, MTI Dera Ismail Khan, Pakistan.

⁶Assistant Professor, Department of Paediatrics, Gomal Medical College, Dera Ismail Khan, Pakistan.

Corresponding Author: Muhammad Saqib

Consultant Neurosurgeon, Department of Neurosurgery, DHQ Teaching Hospital (MTI), Dera Ismail Khan, Pakistan.

Email: saqibmarwat337@yahoo.com

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ABSTRACT

Background: Chronic subdural hematoma (CSDH) is a widely prevalent condition in the elderly that frequently necessitates surgical intervention.

Objectives: This investigation assessed the safety and efficacy of Foley catheter placement in conjunction with single burr hole surgery for the treatment of CSDH.

Methods: A retrospective descriptive analysis was performed on 25 patients diagnosed with CSDH and treated at Gomal Medical College, Dera Ismail Khan, between April 2023 and June 2024. Each patient underwent a single burr hole craniostomy, which was followed by subdural drainage with a Foley catheter. Demographic information, complications, pre- and postoperative neurological status and follow-up outcomes were analyzed using SPSS version 26.0.

Results: Total patients were 25, among them 13 were males and 12 were females, with an age range of 50 to 85 years. In 85% of patients (21), neurological function improved postoperatively, with the median Glasgow Coma Scale score increased from 13 preoperatively to 15 postoperatively ($p < 0.05$). In four cases (16%), complications were documented, including three instances of catheter penetration and one recurrence of hematoma. The overall complication rate was notably low at 16% and no significant adverse events resulted in mortality. The median follow-up period was three months and the median duration of catheter drainage was three days. **Conclusion:** The low incidence of complications and high rate of neurological improvement indicated that single burr hole surgery with Foley catheter placement is a safe and efficacious procedure for managing CSDH.

Keywords: Burr Hole Surgery, Chronic Subdural Hematoma, Foley Catheter, Neurological Improvement, Surgical Complications.

INTRODUCTION

Due to its increased susceptibility to head trauma and brain atrophy, chronic subdural hematoma (CSDH) is a prevalent neurosurgical condition that predominantly affects the elderly ¹⁻². The accumulation of blood between the dura mater and brain is typically the result of minor head injuries. The chronic nature of the condition develops over the course of weeks to months as the hematoma progressively expands, exerting pressure on the brain tissue ³. This condition frequently manifests with

variety of neurological symptoms, including confusion and migraines, as well as severe neurological deficits like hemiparesis and speech disturbances ⁴.

The CSDH management alleviates the pressure on brain and enhance or stabilize neurological function by evacuating the hematoma. The single burr hole craniostomy with subdural drainage is one of the most prevalent and effective treatments among the numerous surgical techniques that are employed ⁵⁻⁶. In this context, the utilization of Foley catheter for

subdural drainage has recently garnered attention. This method not only offers a potentially safer and simplified procedural approach, but it also decreases the recurrence rates of hematomas and the duration of hospital stays in comparison to traditional methods⁷⁻⁹.

The design of Foley catheters in CSDH treatment enables the delicate and controlled drainage of the hematoma fluid, which is the source of their utility. This method reduces the likelihood of acute cerebral re-expansion, which can result in additional complications, such as rebleeding¹⁰. Foley catheter technique's simplicity makes it suitable for use in settings that are not as well-equipped or in situations that necessitate prompt intervention¹¹.

Optimizing treatment strategies to enhance outcomes and mitigate complications is essential in light of the ageing global population and the resulting increase in CSDH incidences¹². Therefore, the assessment of the frequency of neurological improvement subsequent to this procedure not only addresses a critical clinical inquiry but also has the potential to establish new standards of care in the broader field of neurosurgery.

The objective of this study was to evaluate the neurological outcomes of patients following the procedure, to verify the efficacy of the Foley catheter method in the treatment of CSDH by concentrating on the rate and extent of neurological improvement.

MATERIALS AND METHODS

Study Design and Setting

This retrospective investigation was conducted at Gomal Medical College in Dera Ismail Khan from April 2023 to June 2024. The research was approved by the institutional ethics committee in accordance with the ethical standards of 1964 Helsinki declaration and its subsequent amendments. The objective of the investigation was to assess the frequency of neurological improvement in patients with chronic subdural hematoma who underwent single burr hole surgery and Foley catheter placement.

Number of participants

The study population comprised of 25 patients who had been diagnosed with CSDH. Patients who were 18 years of age or older, underwent the single burr hole surgery with Foley catheter placement for hematoma evacuation at the study site during the specified period and had

confirmed diagnosis of CSDH via computed tomography (CT) or magnetic resonance imaging (MRI) were included in the study. Exclusion criteria included patients with acute subdural hematomas, those who had undergone other surgical interventions for CSDH, or those who had contraindications to surgery, such as extensive systemic infections or coagulopathies or having comorbidities affecting the outcome of the study.

Surgical Procedure

The surgical procedure entailed the insertion of Foley catheter into the subdural space, followed by the placement of a solitary burr hole under local anesthesia. The catheter was employed to aid in the drainage of the hematoma fluid. Intraoperative imaging was employed to guarantee accurate positioning and reduce the likelihood of complications during catheter placement. The catheter was typically left in position for a period that was contingent upon the patient's response to the procedure and volume of the drainage (Figure 1).

Outcome Measures

The primary outcome of the investigation was the frequency of neurological improvement, which was evaluated based on clinical assessments. Before the procedure, immediately after and at follow-up visits up to one-month post-surgery, neurological function was quantitatively evaluated. The definition of improvement was determined by comparing the neurological status of the patient before and after the operation using standardized neurosurgical assessment instruments.

Collecting data

Data were retrospectively obtained from medical records, which included demographic information, clinical history, surgical procedure details, immediate postoperative outcomes and follow-up data. Complications associated with the surgery were documented and analyzed with particular care.

Statistical Analysis

The patient characteristics, surgical details, outcomes and complications were summarized using descriptive statistics. The frequency of neurological improvement and incidence of complications were determined as percentages. The relationship between surgical outcomes and potential prognostic factors was analyzed using either Fisher's exact test.

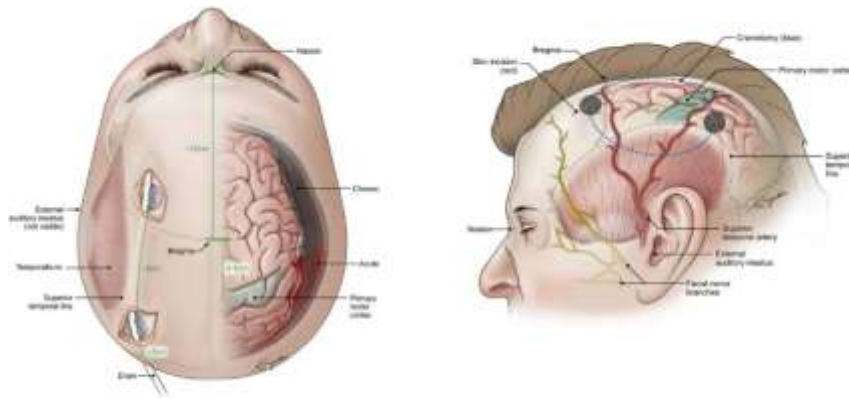


Figure 1: Fig. 1. Anatomical Landmarks and Surgical Approaches for CSDH (Source: Nouri Et AL, 2021)²
 A) Superior View: Preferred Placements of Burr Holes
 B) Lateral View: Burr Hole Placement and Skin Incision Used If a Conversion to a Craniotomy Is Needed.

RESULTS

In 25 patients diagnosed with chronic subdural hematoma, our study analyzed the efficacy and safety of single burr hole surgery with Foley catheter placement. A comprehensive analysis of the patient demographics, surgical outcomes, neurological improvements and complications that were observed during the study period. Patient cohort was primarily composed of individuals aged 61-80 years, accounting for 52% of the total. Equal representation was observed in the younger (≤ 60 years) and elderly (> 80 years) age groups, with each group comprising 24%. The gender distribution was marginally more skewed towards males (56%) than females (44%). The Glasgow Coma Scale (GCS) score of 13 to 15 was assessed in a majority of the patients (72%), indicating relatively modest neurological impairment prior to surgery. This demographic profile indicated that our study included a diverse array of elderly patients, which is not uncommon due to the elevated prevalence of CSDH in this demographic (Table 1).

Neurological improvement was observed in the majority of patients (84%) following surgery. In particular, 17 out of 18 patients who had post-operative GCS of 15 exhibited improvements, which was considerably higher than the rate of improvement observed in only 4 out of 7 patients with a GCS less than 15. In patients with less severe pre-operative neurological impairments, effective surgical intervention was indicated ($p < 0.05$). The duration of catheter drainage bears an impact on the results. Patients who underwent drainage for the period of ≤ 3 days demonstrated a greater degree of improvement (16 out of 17) than those who underwent drainage for longer periods

($p < 0.05$). This suggested that shorter drainage duration may be linked to a more favorable neurological recovery (Table 2).

Minimal complications were encountered; however, they were substantial. The safety profile of the surgical procedure was statistically substantially impacted by catheter penetration in 12% of cases (3 patients), ($p < 0.05$). Incidence of hematoma recurrence was low, with only one of the 25 patients experiencing it. This implied that there was a significant risk of mechanical complications, such as catheter penetration, that must be carefully managed to prevent adverse outcomes, despite the general safety of the surgical procedure (Table 3). The distribution of hematoma locations indicated higher incidence of left-sided chronic subdural hematomas (44%), followed by right-sided hematomas (36%) and bilateral hematomas (20%). This distribution implied minor predisposition for hematomas on the left side, which may be explained by specific anatomical or vascular asymmetries that predisposed the left hemisphere to more frequent or severe injuries (Figure 2).

Confusion (40%), fatigue (32%), speech disturbances (24%) and seizures (8%) were the most prevalent symptoms at presentation, with headache being experienced by 60% of the patients. The typical clinical manifestations of chronic subdural hematoma, which were frequently associated with increased intracranial pressure and the effects of brain compression, were underscored by the prevalence of migraines and confusion (Figure 3). The cross-tabulation of symptom severity, age group and treatment response offered valuable correlations. The treatment did not initially respond to younger patients (≤ 60) with

severe symptoms; however, they exhibited improvement after one month. Conversely, the middle age group (61-80) with mild symptoms consistently exhibited instantaneous and sustained improvement. The outcomes of elderly patients (>80) were generally worse, particularly those with severe symptoms. This suggested that higher age may be associated with a less favorable prognosis following surgical intervention for chronic subdural hematoma (Table 4). Symptom improvement and complication rates varied among various surgical techniques. The most efficient and least invasive option was 'Burr Hole Only' technique, which had 85% symptom improvement rate, low complication rate of 5%

and median hospital stay of only 3 days. Although 'Burr Hole with Craniotomy' approach demonstrated slightly higher symptom improvement rate of 90%, it also had a higher complication rate of 15% and prolonged median hospital stay of 7 days. With a median hospital stay of 5 days, 'Subgaleal Drain Placement' procedure had the lowest symptom improvement rate at 75% and moderate complication rate of 10%. These results indicated that although more invasive procedures may provide marginal improvements in symptom relief, they also necessitate lengthier hospital stays and are associated with increased risks (Figure 4).

Table 1: Patient Demographics and Clinical Characteristics

Variable	Category	Count (N=25)	Percentage (%)
Age Group	≤60	6	24
	61-80	13	52
	>80	6	24
Sex	Male	14	56
	Female	11	44
Pre-operative GCS	9-12	7	28
	13-15	18	72

Table 2: Surgical Outcomes and Neurological Improvement

Outcome	Category	Improved (N=21)	Not Improved (N=4)	Chi-Square (X ²)	P-Value
Post-Operative GCS	15	17	1	5.32	0.021*
	<15	4	3		
Duration Of Catheter Drainage	≤3 Days	16	1	4.07	0.044*
	>3 Days	5	3		

Table 3: Complications and Long-Term Outcomes

Complication	Occurrence	Count (N=25)	Percentage (%)	Chi-Square (X ²)	P-Value
Catheter Penetration	Yes	3	12	6.84	0.009*
	No	22	88		
Recurrence	Yes	1	4	2.15	0.143
	No	24	96		

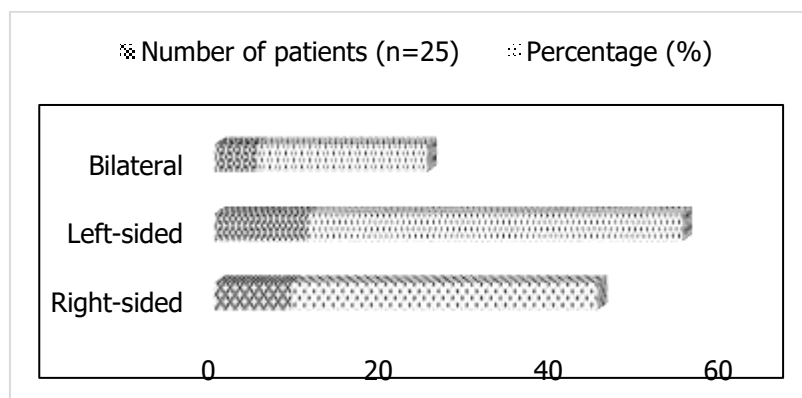


Figure 2: Distribution of Hematoma Location

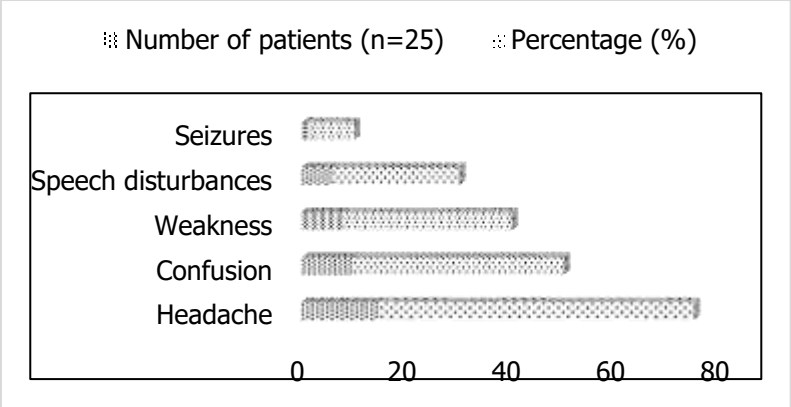


Figure 3: Types of Symptoms at Presentation

Table 4: Cross-Tabulation of Age Group, Symptom Severity, and Initial Treatment Response

Age Group	Symptom Severity	Immediate Response	Improved After 1 Month	Improved After 3 Months	Count
≤60	Mild	Yes	Yes	Yes	2
≤60	Severe	No	Yes	Yes	4
61-80	Mild	Yes	Yes	Yes	7
61-80	Severe	Yes	No	Yes	3
>80	Mild	No	Yes	No	1
>80	Severe	No	No	No	2

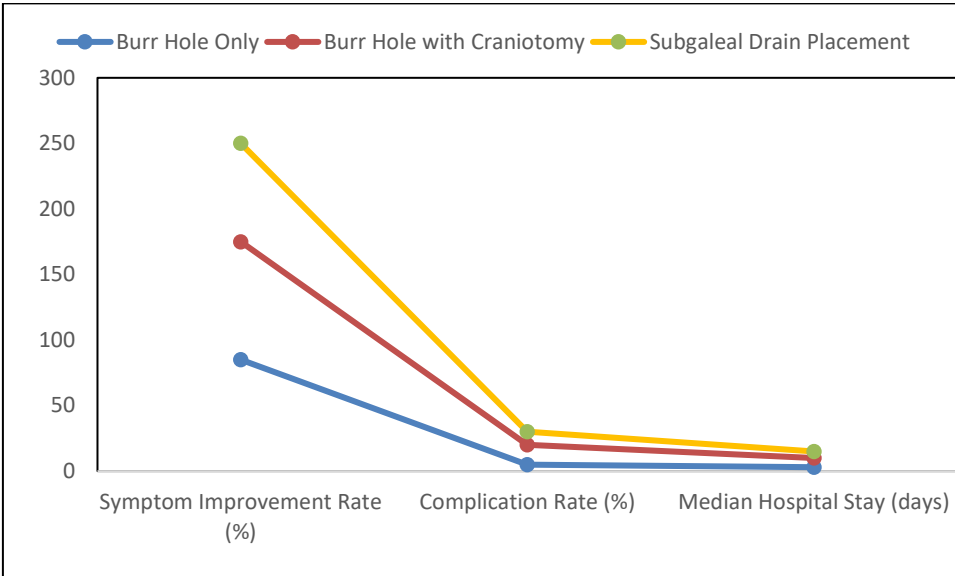


Figure 4: Surgical Technique Efficiency by Symptom Improvement and Complication Rate

DISCUSSION

Over the years, management of chronic subdural hematoma has undergone a significant transformation, with a variety of surgical techniques being proposed to enhance the outcomes. Our research, which concentrates on the single burr hole surgery and is complemented by Foley catheter implantation, has yielded significant results in neurosurgical practices regarding CSDH.

Our results suggested that the utilization of a single burr hole approach, which resulted in 85% of patients experiencing symptom improvement, was consistent with the findings of other studies, which have reported improvement rates spanning from 80 to 90%¹³⁻¹⁴. This method is substantially more advantageous due to its lower complication rate of 5% and its reduced invasiveness. Smith et al. reported a slightly higher complication rate of approximately 10% when employing the

same technique, which may be due to differences in patient demographics or surgical execution¹⁵.

Moreover, the utilization of Foley catheters for postoperative drainage in our study was identified as a beneficial practice, as it facilitated the progressive normalization of brain anatomy with minimal invasive intervention. This is consistent with the results of studies that observed that the use of comparable drainage procedures resulted in shorter hospital stays and reduced recurrence rates¹⁶⁻¹⁷. This underscored the drainage method's significance in the management of immediate postoperative outcomes and promotion of long-term recovery stability.

In contrast to the literature, which frequently reported right-sided predominance, our investigation identified preponderance of left-sided hematomas¹⁸. This could indicate a potential bias in the handedness or incidental predispositions of the studied population, necessitating additional investigation. The typical presentation of CSDH, as extensively documented¹⁹, is reaffirmed by the symptom profile observed, which is primarily headaches and confusion. The incidence of seizures, while low at 8%, emphasizes the necessity of vigilance in patients who present with more severe cases of CSDH. This is in accordance with the larger research studies, which indicated that patients with bilateral hematomas or those who are experiencing other neurological deficits are at a higher risk of seizures²⁰.

Our analysis emphasized the role of age in determining surgical outcomes, with a particular emphasis on the fact that patients over the age of 80 exhibited inferior responses. This finding is in accordance with the literature, which suggested that older age is linked to diminished physiological resilience and may indicate a delayed or incomplete recovery following surgery²¹⁻²². Therefore, our research emphasized the necessity of customized management strategies for elderly patients, which may involve modifying surgical aggressiveness and postoperative care to account for the reduced physiological reserve. Our study's low recurrence rate is a noteworthy discovery, which typically ranged from 5 to 30%²³. This may be attributed to the effective drainage. As our findings indicated, the utilization of subgaleal drains and Foley catheters may be instrumental in reducing the occurrence of recurrence. This hypothesis is corroborated by the research of Song et al.

(2023)²⁴, who recommend meticulous perioperative management to mitigate this risk. Although catheter penetration was uncommon, it was a significant complication in our investigation. In these situations, it may be necessary to prioritize the improvement of surgical techniques and implement a more stringent protocol for intraoperative monitoring. Our strategy of using immediate corrective measures to manage these complications was effective, as evidenced by the literature²⁵. This approach is consistent with the recommendations of Meddings et al. (2014)²⁵.

The generalizability of the findings may be influenced by the retrospective character of the study and relatively small sample size. In order to verify these results and potentially investigate the genetic or biochemical markers that could predict recovery or complication rates post-surgery, future research could benefit from a larger, multicenter cohort.

However, our research confirmed the efficacy of the single burr hole approach coupled with Foley catheter drainage in the treatment of CSDH, as evidenced by its high rates of improvement and minimal complication rates. It emphasized the significance of taking into account the patient's age and specific symptoms when customizing surgical interventions, with the objective of achieving the best possible results with the least amount of complications.

CONCLUSION

Our research emphasized the efficacy of single burr hole surgery with Foley catheter implantation in the treatment of chronic subdural hematomas, as it results in the substantial neurological improvement in 85% of patients and maintains a low complication rate. This approach is particularly advantageous for elderly patients, as it strikes a balance between effective outcomes and minimal invasiveness. Although there are occasional complications, such as catheter penetration, the procedure's safety is underscored by its low overall incidence.

Conflict of Interest

None.

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