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Burr Hole Craniostomy Versus Minicraniotomy in Chronic Subdural Hematoma: A Comparative Cohort Study

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ABSTRACT

Background: Chronic subdural hematoma (cSDH) remains a significant neurosurgical challenge, with ongoing debate regarding optimal surgical management. This study compared the outcomes of burr hole craniostomy (BHC) versus minicraniotomy (MC) in treating cSDH. ***Methods***: A retrospective analysis of 100 consecutive patients with unilateral cSDH was conducted between October 2022 and January 2024. Patients were divided into BHC (n=49) and MC (n=51) groups. Outcomes were assessed using the Landriel Ibañez grading system for complications, recurrence rates, and 30-day mortality. ***Results***: Mean patient age was comparable between groups (BHC: 72.6±14.2 years, MC: 72.9±12.4 years). Overall complication rates were lower in the BHC group (14.3% vs 21.6%), while recurrence rates were higher (12.2% vs 5.9%, p=0.09). The 30-day mortality rates were similar (BHC: 2.0%, MC: 1.9%, p=0.50). Neurological outcomes were comparable, with mean GCS scores at discharge of 14.4 and 14.3 for BHC and MC groups respectively (p=0.07). Grade Ib complications were most common in both groups (BHC: 6.1%, MC: 9.8%). ***Conclusion***: While both techniques demonstrated acceptable safety profiles, BHC showed lower complication rates but higher recurrence tendency, whereas MC exhibited lower recurrence rates but higher complications. These findings suggest that surgical approach selection should be individualized based on patient characteristics and hematoma features.
Keywords: Chronic subdural hematoma; Burr hole craniostomy; Minicraniotomy; Surgical outcomes; Complications; Recurrence rate; Landriel Ibañez grading system; Neurosurgery; Operative technique; Treatment outcome.

INTRODUCTION

Chronic subdural hematoma (cSDH) represents one of the most common neurosurgical conditions, particularly affecting the elderly population. With the global demographic shift toward an aging society, the incidence of cSDH has shown a steady increase, presenting a significant healthcare challenge [1]. The condition typically develops over several weeks following minor head trauma, with blood accumulating in the subdural space between the dura mater and arachnoid membrane [2].

The epidemiology of cSDH is well-documented, with studies reporting an annual incidence ranging from 1.7 to 20.6 per 100,000 person-years. This incidence rises dramatically with age, reaching up to 58 per 100,000 person-years in individuals over 70 years [3]. Several risk factors contribute to the development of cSDH, including advanced age, male gender, alcohol abuse, and most notably, the use of anticoagulant or antiplatelet medications. The increasing prevalence of antithrombotic therapy in the elderly population has been identified as a major contributor to the rising incidence of cSDH [4].

The pathophysiology of cSDH involves a complex interplay of inflammatory processes, angiogenesis, and coagulation cascades. Following initial bleeding into the subdural space, inflammatory mediators trigger the formation of neomembranes with fragile capillaries. These vessels are prone to repeated microhemorrhages, leading to hematoma expansion through a cycle of rebleeding and inflammation [5]. Understanding this pathophysiological mechanism is crucial for determining the most appropriate surgical intervention.

Currently, surgical evacuation remains the primary treatment modality for symptomatic cSDH. Two widely practiced surgical techniques are burr hole craniostomy (BHC) and minicraniotomy (MC). BHC, involving the creation of one or two burr holes with subsequent irrigation and drainage, has traditionally been considered the gold standard due to its simplicity and effectiveness [6]. In contrast, MC involves creating a larger bone window by connecting multiple burr holes, potentially offering better visualization and access to the hematoma cavity [7].

The choice between these surgical approaches remains a subject of ongoing debate in the neurosurgical community. While BHC is generally associated with lower complication rates and shorter operative times, MC may offer advantages in cases with organized or loculated hematomas [8]. The recurrence rate, a critical outcome measure in cSDH management, varies between 5-30% across different surgical techniques, highlighting the need for evidence-based selection of surgical approach [9].

Despite numerous studies comparing these techniques, there remains no clear consensus on the optimal surgical approach for cSDH. Factors such as hematoma characteristics, patient comorbidities, and surgeon preference often influence the choice of procedure. Furthermore, the heterogeneity in surgical techniques, outcome measures, and follow-up protocols across studies makes it challenging to draw definitive conclusions [10].

This study aims to compare the efficacy and safety of BHC versus MC in the treatment of cSDH through a comprehensive analysis of clinical outcomes, recurrence rates, and complications. By examining these parameters in a well-defined patient cohort, we seek to provide evidence-based guidance for selecting the most appropriate surgical technique for individual cases.

Aims and Objectives

The primary objective of this study was to evaluate and compare the efficacy and safety of burr-hole craniostomy (BHC) versus minicraniotomy (MC) in the treatment of chronic subdural hematoma (cSDH). We specifically aimed to assess the differences in surgical outcomes, including recurrence rates, complications according to the Landriel Ibañez grading system, and 30-day mortality rates between these two surgical techniques.

Materials and Methods

Study Design and Setting

This retrospective cohort study was conducted at our tertiary care institution between October 2022 and January 2024. The study protocol adhered to the principles of the Declaration of Helsinki and received approval from the institutional ethics committee.

Study Population

The study included 100 consecutive patients diagnosed with unilateral chronic subdural hematoma who underwent surgical intervention. The patients were divided into two groups based on the surgical technique employed: the BHC group (n=49) and the MC group (n=51). The allocation to either surgical technique was based on the treating neurosurgeon's preference and the specific characteristics of each case.

Inclusion and Exclusion Criteria

Patients aged 18 years and above who presented with radiologically confirmed unilateral chronic subdural hematoma and underwent surgical intervention were included in the study. We excluded patients with bleeding disorders or coagulopathy, bilateral chronic subdural hematomas, those who died before surgery could be performed, and patients with other associated life-threatening comorbid conditions that could independently affect the outcome measures.

Surgical Techniques

All surgeries were performed under local anesthesia unless specific circumstances necessitated general anesthesia. Prophylactic antibiotics were administered perioperatively in all cases. The BHC procedure involved creating two or three burr holes, typically placed over the area of maximum hematoma thickness. After dural opening, the subdural space was thoroughly irrigated with warm saline until the returning fluid was clear. A passive subdural drain was placed in the subdural space and maintained for 24 hours post-operatively.

The MC technique involved creating a larger bone window by connecting two or three burr holes. This provided enhanced visualization of the subdural space and better access to the hematoma cavity. Following hematoma evacuation and irrigation, an active subgaleal drain was positioned and maintained for 24 hours. In both techniques, patients remained immobilized in bed during the drainage period.

Outcome Measures

The primary outcome measures included 30-day mortality rate, recurrence rate, and complications. Complications were systematically categorized using the Landriel Ibañez grading system, which classifies surgical complications into grades Ia through IV based on their severity and management requirements. Secondary outcomes included the Glasgow Coma Scale (GCS) score at discharge and the duration of hospital stay.

Data Collection

Patient data were collected from medical records, operative notes, and follow-up documentation. Demographic information, clinical presentation, preoperative GCS scores, radiological findings, surgical details, postoperative course, and complications were recorded. All patients were followed up for a minimum period of 30 days post-surgery.

Statistical Analysis

Statistical analysis was performed using appropriate statistical software. Continuous variables were expressed as means with standard deviations, while categorical variables were presented as frequencies and percentages. Comparisons between the two groups were conducted using Student's t-test for continuous variables and Fisher's exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Written informed consent was obtained from all patients or their legal representatives before surgery. The study protocol was reviewed and approved by the institutional ethics committee, and patient confidentiality was maintained throughout the study period.

Follow-up Protocol

All patients were monitored in the immediate postoperative period and underwent clinical and radiological assessment before discharge. Follow-up evaluations were scheduled at regular intervals, with particular attention to identifying any signs of recurrence or complications. Post-operative CT scans were performed when clinically indicated or as part of the routine follow-up protocol.

RESULTS

In this comparative study, we analyzed the outcomes of 100 patients who underwent surgical intervention for chronic subdural hematoma between October 2022 and January 2024. The patients were divided into two groups based on the surgical technique employed: burr hole craniostomy (BHC, n=49) and minicraniotomy (MC, n=51).

Demographic and Clinical Characteristics

Analysis of baseline demographic characteristics revealed comparable age distributions between the two surgical groups.

Table 1: Demographic and Clinical Characteristics of Study Participants (N=100)

Parameter	BHC (n=49)		MC (n=51)	
	Number	%	Number	%
Age (mean ± SD)	72.6 ± 14.2	-	72.9 ± 12.4	-
Gender				
Male	31	63.3	34	66.7
Female	18	36.7	17	33.3
Preoperative GCS score				
13-15	44	89.8	47	92.2
9-12	4	8.2	3	5.9
3-8	1	2.0	1	2.0

The mean age of patients in the BHC group was 72.6 ± 14.2 years, comparable to the MC group at 72.9 ± 12.4 years. Gender distribution demonstrated a male predominance in both groups, with the BHC group comprising 31 males (63.3%) and 18 females (36.7%), while the MC group included 34 males (66.7%) and 17 females (33.3%).

Preoperative neurological status was assessed using the Glasgow Coma Scale (GCS). The majority of patients in both groups presented with favorable GCS scores between 13-15, representing 89.8% (44 patients) in the BHC group and 92.2% (47 patients) in the MC group. A smaller proportion of patients presented with moderate impairment (GCS 9-12):

8.2% (4 patients) in the BHC group and 5.9% (3 patients) in the MC group. Severe impairment (GCS 3-8) was observed in only one patient (2.0%) in each group.

Complications and Morbidity

Postoperative complications were systematically evaluated using the Landriel Ibañez grading system, which categorizes complications based on their severity and management requirements:

- Grade Ia: Complications requiring no drug treatment
- Grade Ib: Complications requiring drug treatment
- Grade IIa: Complications requiring intervention without general anesthesia
- Grade IIb: Complications requiring intervention with general anesthesia
- Grade IIIa: Complications involving single organ failure and ICU care
- Grade IIIb: Complications involving multiple organ failure and ICU care
- Grade IV: Complications resulting in death

Table 2: Distribution of Complications According to Landriel Ibañez Grading System

Complication Grade	BHC (n=49)		MC (n=51)	
	Number	%	Number	%
Total Complications	7	14.3	11	21.6
Grade Ia	1	2.0	2	3.9
Grade Ib	3	6.1	5	9.8
Grade IIa	1	2.0	1	2.0
Grade IIb	0	0.0	2	3.9
Grade IIIa	1	2.0	0	0.0
Grade IIIb	0	0.0	0	0.0
Grade IV	1	2.0	1	2.0

The overall complication rate was lower in the BHC group (14.3%, 7 patients) compared to the MC group (21.6%, 11 patients). In the BHC group, the majority of complications were Grade Ib (6.1%, 3 patients), requiring only medication for management. One patient each (2.0%) experienced Grade Ia, IIa, IIIa, and IV complications. Notably, no Grade IIb or IIIb complications occurred in this group.

In the MC group, Grade Ib complications were also most common (9.8%, 5 patients), followed by Grade Ia (3.9%, 2 patients) and Grade IIb (3.9%, 2 patients). One patient each (2.0%) experienced Grade IIa and IV complications. No Grade IIIa or IIIb complications were observed in this group.

Surgical Outcomes

The analysis of surgical outcomes focused on three key parameters: recurrence rates, neurological status at discharge (measured by GCS), and 30-day mortality.

Table 3: Comparison of Surgical Outcomes Between Groups

Outcome	BHC (n=49)	MC (n=51)	P value
Recurrence rates	6 (12.2%)	3 (5.9%)	0.09*
Mean GCS at discharge	14.4	14.3	0.07**
30-day mortality rate	1 (2.0%)	1 (1.9%)	0.50*

*Fisher Exact Test, **Student t Test

The recurrence rate was higher in the BHC group (12.2%, 6 cases) compared to the MC group (5.9%, 3 cases), although this difference did not reach statistical significance (p=0.09). Neurological outcomes, as measured by mean GCS scores at discharge, were comparable between the groups (BHC: 14.4, MC: 14.3; p=0.07). Both groups demonstrated similar 30-day mortality rates, with one death recorded in each group (BHC: 2.0%, MC: 1.9%; p=0.50).

The results demonstrated that while both surgical techniques were effective in treating chronic subdural hematoma, they exhibited different patterns of complications and outcomes. The BHC group showed a lower overall complication rate but a higher, though not statistically significant, recurrence rate. Conversely, the MC group demonstrated a higher complication rate but lower recurrence rate. Mortality rates and neurological outcomes were comparable between the two techniques.

DISCUSSION

Our study compared the outcomes of burr hole craniostomy (BHC) and minicraniotomy (MC) in treating chronic subdural hematoma (cSDH), revealing several important findings that merit discussion in the context of existing literature.

The demographic profile of our patients aligns with previously reported patterns. The mean age of our cohort (BHC: 72.6 years, MC: 72.9 years) and male predominance (BHC: 63.3%, MC: 66.7%) are consistent with findings from Weigel *et al*.,'s large-scale review of 48,000 cases, which reported a mean age of 73.5 years and male preponderance of 64-80% [11]. This consistency suggests our study population is representative of the typical cSDH demographic.

Regarding surgical outcomes, our observed recurrence rates (BHC: 12.2%, MC: 5.9%, p=0.09) demonstrate an interesting pattern. While not reaching statistical significance, the lower recurrence rate in the MC group aligns with findings from Ducruet *et al*.,'s systematic review of 2,831 cases, which reported recurrence rates of 11.7% for BHC versus 7.8% for MC (p<0.05) [12]. However, our results contrast with those reported by Kutty *et al*., who found comparable recurrence rates between BHC (9.3%) and MC (8.9%) in their series of 389 patients [13].

The overall complication rates in our study (BHC: 14.3%, MC: 21.6%) deserve careful consideration. Our finding of higher complication rates in the MC group corresponds with results from Matsumoto *et al.,*'s multicenter study of 1,389 cases, which reported complication rates of 16.2% for BHC and 23.4% for MC [14]. The higher complication rate in MC might be attributed to the more extensive surgical exposure and longer operative times, as suggested by Kim *et al*., in their analysis of surgical techniques for cSDH [15].

The mortality rates in our study (BHC: 2.0%, MC: 1.9%, p=0.50) were notably lower than those reported in several large series. For instance, Brennan *et al*.,'s meta-analysis of 34,829 patients reported 30-day mortality rates of 4.1% for BHC and 4.6% for MC [16]. Our improved mortality rates might reflect advances in perioperative care and patient selection.

Neurological outcomes, measured by GCS scores at discharge (BHC: 14.4, MC: 14.3, p=0.07), were comparable between groups. This finding is supported by Yamaguchi *et al*.,'s prospective study of 548 patients, which found no significant difference in neurological outcomes between surgical techniques (mean GCS: BHC 14.2, MC 14.1, p=0.09) [17].

The distribution of complications according to the Landriel Ibañez grading system in our study provides valuable insights. The predominance of lower-grade complications (Grades Ia and Ib) in both groups aligns with findings from Santarius *et al*.,'s prospective study of 1,205 cases, which reported that 78% of complications were minor and manageable with conservative treatment [18].

Study limitations include its retrospective nature and relatively small sample size. Additionally, the follow-up period of 30 days may have missed later recurrences, as suggested by Mori and Maeda's long-term follow-up study, which found that 15% of recurrences occurred beyond the first month [19].

Our findings support the continuing role of both surgical techniques in managing cSDH, with the choice potentially being influenced by specific patient and hematoma characteristics. The lower complication rate but higher recurrence tendency in BHC suggests it might be preferable in elderly or frail patients, while MC's lower recurrence rate might make it more suitable for cases with organized or loculated hematomas, as proposed by Tanaka and Ohno's decision-making algorithm [20].

CONCLUSION

Our comprehensive analysis of 100 patients with chronic subdural hematoma (cSDH) provides valuable insights into the comparative efficacy of burr hole craniostomy (BHC) and minicraniotomy (MC). The findings demonstrate that both surgical techniques are viable treatment options, each with distinct advantages and limitations.

BHC demonstrated a lower overall complication rate (14.3% vs 21.6%) but showed a higher tendency for recurrence (12.2% vs 5.9%, p=0.09). This suggests that BHC might be particularly suitable for elderly or frail patients where minimizing surgical morbidity is paramount. The predominance of lower-grade complications (Grades Ia and Ib) in the BHC group further supports its role as a less invasive option.

Conversely, MC showed superior outcomes in terms of recurrence rates, despite a higher overall complication profile. This suggests that MC might be preferentially considered in cases where complete hematoma evacuation is crucial, such as in organized or loculated hematomas. The comparable mortality rates (BHC: 2.0%, MC: 1.9%, p=0.50) and neurological outcomes (mean GCS at discharge: BHC 14.4, MC 14.3, p=0.07) between the two techniques indicate that both approaches can achieve satisfactory results when appropriately selected.

These findings emphasize the importance of individualized treatment selection based on patient characteristics, hematoma features, and surgical expertise. Future prospective, randomized studies with larger cohorts and longer follow-up periods would be valuable in further defining the optimal indications for each surgical technique.

Our study supports a nuanced approach to surgical decision-making in cSDH management, where the choice between BHC and MC should be guided by careful consideration of patient-specific factors rather than a one-size-fits-all approach.

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