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Comparison of the Burr Hole Craniostomy Techniques for the Treatment of Chronic Subdural Hematoma

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ABSTRACT

Objective: To compare three different surgical techniques for chronic subdural hematoma (CSDH), one of the most common neurosurgical diseases increasingly affecting the elderly, and for which there is no standard treatment currently.

Material and Methods: We included 28 patients diagnosed with CSDH and retrospectively analysed their data. The surgical techniques were compared to subgroups of the burr-hole craniostomy technique.

Results: The mean age of included patients was 72.71 ± 10.81 years, and the male/female ratio was 2/5. Preoperative subdural hematoma volume was 113.63 ± 40.74 cc, and the Hounsfield unit value was 33.66 ± 8.67 HU. The mean operative time was 60.89 ± 20.04 min, and the mean hospital stay was 6.17 ± 2.56 days. Detectable radiologic complete recovery was 42.69 ± 17.46 days.

Conclusion: All surgery subgroups experienced successful outcomes during long-term follow-up. The irrigation technique demonstrated no superiority to the other two techniques and the complication rate was significantly lower with the endoscopic technique.

Keywords: Chronic subdural hematoma, drainage without irrigation, Burr-hole, irrigation, endoscopic treatment

INTRODUCTION

Chronic subdural hematomas (CSDH), first described by Virchow in 1857, are characterised by encapsulated blood in a characteristic external “neomembrane.” It usually occurs ≥3 weeks after minor head trauma, being found bilaterally in approximately 20% of cases, and associated with significant morbidity and mortality rates (1).

CSDH is one of the most common neurosurgical disorders having an insidious onset and progression. In addition, its incidence increases in the elderly population. The pathophysiology is not fully understood and many hypotheses have been proposed. With hematoma enlargement, clinical symptoms such as headache, nausea, vomiting, and confusion, seizures, gait, and balance problems may occur due to increased intracranial pressure. Surgical and non-surgical methods have been proposed for the treatment of it, including middle meningeal artery embolization, twist-drill craniostomy (TDC), craniotomy/mini-craniotomy, endoscope-assisted surgical intervention, and burr-hole craniostomy (BHC) among the former’s However, there is no accepted standard of care (2,3,4,5).

Our study aims to contribute to the literature by comparing the results of 3 different surgical techniques.

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MATERIAL and METHODs

In the current study, the data of 28 patients with CSDH who underwent surgery using different surgical approaches in our clinic between October 2017 and November 2022 were retrospectively analysed. The study was approved by the ethics committee (IRB 0600) and all patients provided written informed consent.

We excluded patients having a history of brain surgery (such as ventriculoperitoneal shunting, tumor surgery, cerebral hemorrhage, or functional neurosurgery) and those diagnosed with bilateral subdural hematoma.

The subgroups of the BHC technique were used in the surgical treatment of all of our patients. In 14 of these patients, multiple BHC (anterior and posterior) and subdural drain placements with irrigation were performed. In seven patients, single BHC, and subdural drain placement without irrigation was performed at the anatomical location of the parietal tuber. In the last seven patients, endoscopy was used to insert subdural irrigation drains and multiple BHC (anterior and posterior).

All patients' preoperative, early, and late postoperative follow-up data were analyzed in detail.

Computed tomography (CT) data were obtained in a Digital Images, and Communications in Medicine (DICOM) format and the RadiAnt DICOM Viewer (Medixant, Poznan, Poland) was used to analyze these CT images.

Statistical Analysis: The Statistical Package for Social Sciences Version 22.0 (SPSS, Chicago, IL, USA) software was used for statistical analysis.

RESULTs

The mean age of the 28 patients who underwent surgery for CSDH was 72.71 ± 10.81 years. Twenty patients, or 71.4%, were men and eight patients, or 28.6%, were women. Surgery was performed on the right side of half of the patients. The most commonly reported symptoms of CSDH were limb weakness in 17% of the patients (n = 5), headache in 35% (n = 10), loss of balance in 28% (n = 8), and speech disorder in 17% (n = 5). Twenty patients (71 %) had a history of anticoagulant drug use and 12 (42 %) had a history of trauma. The preoperative Glasgow Coma Scale (GCS) score was 14.6 ± 0.68 and the preoperative score in Karnofsky Performance Scale (KPS) was 85.35 ± 8.81 while the postoperative GCS and KPS scores were 14.89 ± 0.31 and 96.64 ± 9.99, respectively (**Table 1**).

The surgical technique of multiple BHC (anterior and posterior) and subdural drain placement with irrigation was applied in seven patients (25 %), while the technique of single BHC and subdural drain placement without irrigation at the anatomical point of the parietal tuber was applied in 14 patients (50%) (**Figure 1**).

In seven patients (25%), the endoscope-assisted technique of multiple BHC (anterior and posterior) and subdural drain placement with irrigation was applied (**Figure 2**).

The average preoperative subdural hematoma volume was 113.63 ± 40.74 cc and the preoperative Hounsfield unit value was 33.66 ± 8.67 HU. The drainage duration was 71.14 ± 15.29 h. A total of nine (32%) patients developed complications related to the surgical procedure. Among all complications experienced (**Figure 3**), 88% (n = 8) were due to drain malposition, 22% (n = 2) to drain insertion into the brain parenchyma and transient motor deficits, 11% (n = 1) had acute subdural hematoma and subcutaneous hematoma, and 33% (n = 3) had a pneumocephalus. Drainage was terminated early in 2 (25%) of the eight patients with drain malposition. The mean operative time was 60.89 ± 20.04 min and the mean hospital stay was 6.17 ± 2.56 days. During the clinical and radiological follow-up, it was found that the average time for brain parenchyma expansion and subdural hematoma resorption to occur was 42.69 ± 17.46 days, as indicated in **Table 1**.

In our study, the recurrence rate was 7%. In two patients, there was recurrence over long-term follow-up. Those patients were followed up clinically and radiologically under medical treatment. To which they responded, accordingly, no supplemental surgical treatment was performed. In these two patients, complete brain parenchymal expansion and resorption required > 1 year and they were therefore not included in the calculation.

The two cases that developed transient motor deficit due to drain insertion into the brain parenchyma completely recovered by their 1-month follow-up. With respect to other complications, patients responded to medical treatment and did not require additional surgical treatment.

When the patient data were analyzed according to surgical technique, significant differences were found only in operative times and complication rates. With the multiple BHC and irrigation technique, the operative time was 68.57 ± 11.07 min, and the complication rate was 57% (n = 4). With the single BHC without irrigation, the operative time was 45.05 ± 9.19 min, and the complication rate was 35% (n =5). With the endoscope-assisted technique, the operative time was 85.06 ± 12.90 min and there were no complications (**Table 2**).

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Table 1: Data of patients operated for chronic subdural hematoma

	Multiple BHC + irrigation	Single BHC + without irrigation	Endoscopic Assisted	Total
Patient (n)	7	14	7	28
Age (year)	76.14 ± 9.08	69.15 ± 12.26	75.71 ±8.34	72.71 ± 10.81
Gender- F/M	2/5	3/11	3/4	2/5
Side- R/L	5/2	3/4	3/4	1/1
Anticoagulant Drug	71%	78%	57%	71%
Trauma	42%	42%	42%	42%
Preoperative GCS	14.28 ± 0.95	14.78 ± 0.57	14.57 ±0.53	14.6 ± 0.68
Preoperative KPS	82.85 ±12.53	86.42 ±8.41	85.71 ±5.34	85.35 ± 8.81
Postoperative GCS	14.71 ± 0.48	14.92 ±0.26	15	14.89 ± 0.31
Postoperative KPS	90 ± 14.14	95.71 ± 9.37	97.14 ± 4.87	96.64 ± 9.99.
Hematoma Volume (cc)	124.36 ± 55.42	115.61 ± 41.31	98.93 ± 17.46	113.63 ± 40.74
Hounsfield unit value (HU)	35.17 ± 0.64	33.99 ± 9.10	31.34 ± 6.25	33.66 ± 8.67
Drainage Time (hour)	75.42 ± 16.56	68.57 ± 18.48	72	71.14 ± 15.29
Complication (drain malposition, transient motor deficits, pneumocephalus, asdh and subcutaneous hematoma)	57%	35%	none	32%
Operation time (minutes)	68.57 ± 11.0	45.05 ± 9.19	85.06 ± 12.90	60.89 ± 20.04
Hospital stay (day)	8.57 ± 3.99	5.28 ± 1.38	5.57 ± 0.78	6.17 ± 2.56
Radiological resorption (day)	45.42 ± 21.35	40.25 ± 19.28	44.14 ± 10.51	42.69 ± 17.46
Recurrence (n)	none	2	none	2
Recurrence rate(%)	none	14%	none	7%

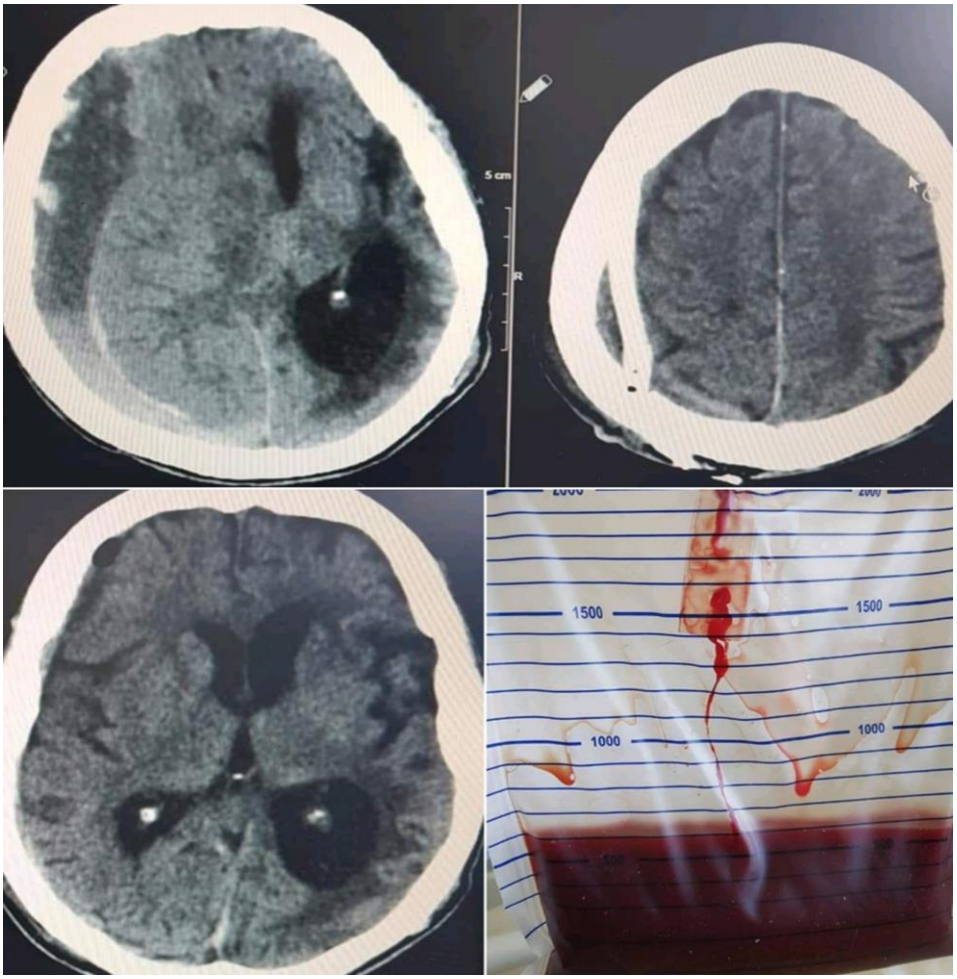

Figure 1: Demonstration of the closed drainage system with preoperative, early postoperative and late period radiological images of a patient in whom single burr hole craniostomy and subdural drain placement technique was applied without irrigation.

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Table 2: Surgery time and complication rates of different surgical techniques

Surgery Technique	Surgery Time	Complication Rate
Mutiple Burr Hole+ irrigation	68.57±11.0	57%
Single Burr Hole+ without irrigation	45.05±9.19	35%
Endoscopic asisted	85.06±12.90	none

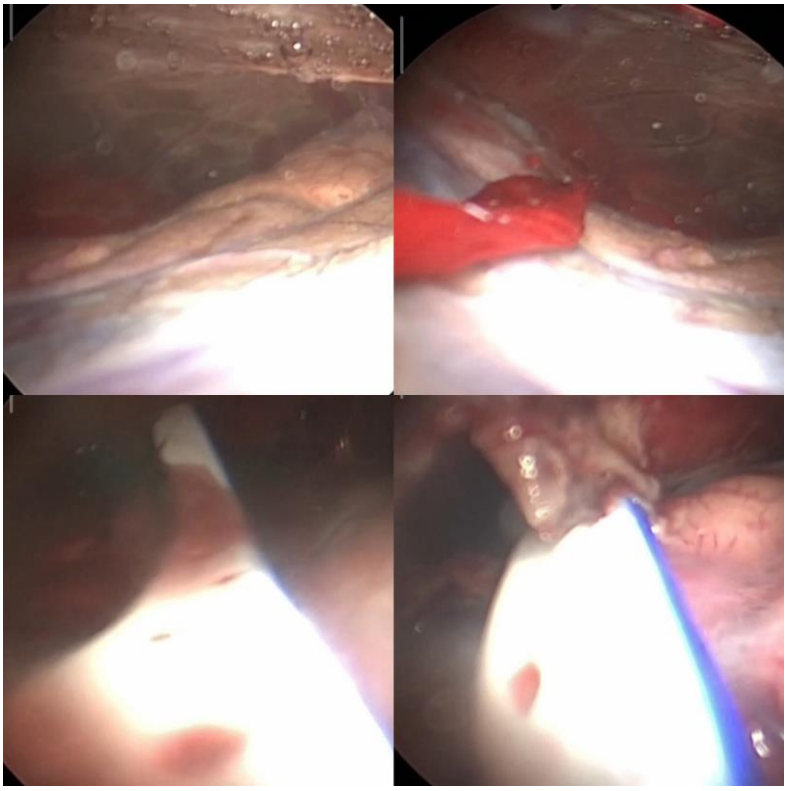

Figure 2: Intraoperative endoscopic images of the patient who was operated with the endoscope-assisted technique and safe placement of the drain by opening the chronic subdural hematoma membrane

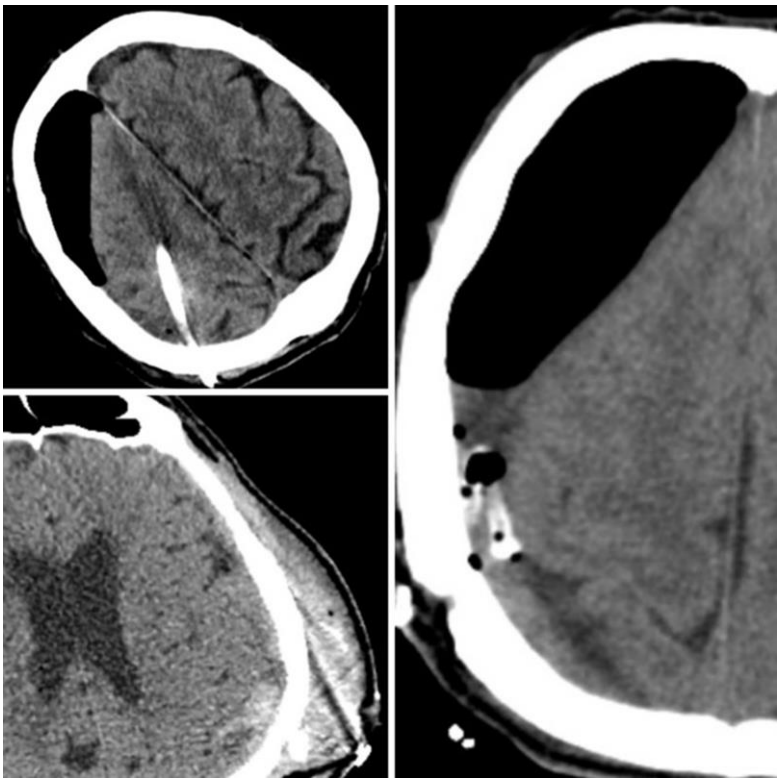

Figure 3: Demonstrating complications. Drain malposition, drain insertion into the brain parenchyma , pneumocephalus and subcutaneous hematoma development

DISCUSSION

A study on 215 patients who had undergone surgery utilizing the BHC approach, showed that a subdural drain decreased mortality and recurrence (6). However, Almenawer et al. assessed 34829 people in a meta-analysis that included 94 cohort studies and found no significant difference between the single and double BHC procedures in terms of recurrence (7). Similarly, in their meta-analysis, Belkhair et al. reported no significant difference between the single and multiple BHC in terms of recurrence rate (8). There was no exitus in our study group and therefore mortality was not reported. In our study, two patients experienced recurrence during follow-up, but similar to previous studies we did not find significant difference between surgical techniques in terms of recurrence rates.

In a meta-analysis of 297 studies, Liu et al. reported that drain placement significantly reduced recurrence without increasing the occurrence of complications (9). In our study, irrigation was to not superior to the other techniques; in fact, we found no significant differences between treatment groups. Drain malposition was never encountered when using the endoscopic technique.

In their meta-analysis, Xu et al. reported no significant difference between drain and non-drain techniques in terms of mortality and complication rates. Moreover, comparing the surgical techniques using or not using irrigation, the recurrence rates were not significantly different. However, placing a drain without irrigation might lead to a less invasive air entry. They also emphasized that the closed drain system in the BHC technique reduces recurrence and irrigation is not necessary in all patients (10). In our study, the superiority of irrigation was not demonstrated, even if it led to less invasive air entry than in the group operated with irrigation.

In a series of 385 patients, Uda et al. used a single BHC and subdural drain placement without irrigation and reported significantly more successful outcomes. They reported a recurrence rate of 4.9% (11). Similarly, our study showed positive outcomes without irrigation. In our study, the recurrence rate was 7%.

In a meta-analysis of 45 studies, Ducruet et al. reported complication rates of 2.5% in TDC, 3.9% with craniotomy, and 9.3% in BHC. They reported mortality rates of 12.2% in craniotomy, 5.1% in TDC, and 3.8% in BHC. They reported recurrence and reoperation rates of 28.1% in TDC, 19.4% in craniotomy and 11.7% in BHC. They reported a good clinical outcome of 93.5% in TDC, 86.4% in BHC and 74.4% in craniotomy (12). In our study, all three surgical techniques resulted in successful outcomes. No significant difference was found in long-term clinical and radiological follow-up, but the complication rate was significantly lower when using the endoscopic technique.

Lega et al. reviewed 830 studies and evaluated TDC, BHC, and craniotomy in a Monte Carlo simulation. Accordingly, BHC was the best treatment option considering recurrence and morbidity rates. However, they found no significant differences among different alternatives for performing BHC i.e., drainage only, irrigation+drainage, and irrigation only (13).

In our study, the outcomes were successful in the techniques and there was no significant difference between them. While irrigation has not been shown to be superior, it has been demonstrated that favorable results can be obtained without irrigation. With the endoscopic technique, low complication rates were significantly superior. However, the operative time was significantly longer than in the single BHC+irrigation technique.

Limitations: The study excluded patients who had a history of brain surgery, such as ventriculoperitoneal shunting, tumor surgery, cerebral hemorrhage, or functional neurosurgery, as well as those who were diagnosed with bilateral subdural hematoma. Second, mortality could not be determined since there was no exitus in any study groups.

Thirdly, we excluded two patients from the analysis of radiological data, as their cases required more than a year for the expansion of brain parenchyma and the resorption of subdural hematoma to occur.

CONCLUSION

Our results indicate that using the BHC technique leads to similar success rates as previously reported. However, the use of irrigation did not make a significant difference. No drain malposition or complications were associated with the endoscope-assisted surgical technique. According to the present results, we believe that the combined use of BHC with endoscopy could help prevent drain malposition and detect possible new bleeding foci.

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Author Contributions: MA, GG: Study design, collecting data, statistically analysis **GG:** Manuscript preparation, Literature search and revisions

Ethical approval: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and/or with the Helsinki Declaration of 1964 and later versions.

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