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Management of Chronic Subdural Hematoma: Burr Hole versus Twist Drill – A Prospective Study

Abstract

Introduction: Incidence of chronic subdural hematoma (CSDH) is about 5/100,000/year in the general population and still rising. Two surgical techniques, namely, burr-hole evacuation (BHE) versus twist-drill evacuation (TDE) are commonly used to manage such patients but the preferred surgical method continues to attract debate, and the time for an evidence-based approach is now overdue. In vogue with recent trends, a minimally invasive surgical approach is considered as best; therefore, we tried to establish the hypothesis that TDE is as safe and as effective as BHE for CSDH treatment. **Materials and Methods:** A prospective, randomized, controlled study including forty patients was conducted. The primary outcome variable studied was clinically significant recurrence rate. The secondary outcome variables in postoperative period and follow-up assessment of the patients include Glasgow coma scale (GCS), Markwalder grade, postoperative complication, and operative mortality rate. **Results:** In our study, results of BHE seem to be superior than TDE in terms of recurrence rate (5% vs. 15%), complication rate (15% vs. 20%), and mean Markwalder neurological grading score and mean GCS at time of discharge (0.16 vs. 0.45 and 14.95 vs. 14.65, respectively). TDE seems to be better than BHE in terms of duration of hospital stay (7.4 vs. 8.05). However, these differences were not statistically significant. TDE is having the advantage of being performed at bedside without the need of monitored anesthesia and anesthetist, time saving, and least invasive. Overall results were comparable across both techniques without any significant difference. **Conclusion:** Although both techniques appear to be similar in respect of their primary and secondary outcome variables, but TDE is having the advantage of being performed at bedside without the need of monitored anesthesia and anesthetist, time saving, and small incision.

Keywords: *Burr hole, chronic subdural hematoma, twist drill*

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Introduction

Chronic subdural hematoma (CSDH) is a common clinical entity in neurosurgical practice, especially in the elderly. Incidence is about 5/100,000/year in the general population.[1] Clinical presentation of CSDH is often insidious. Symptoms include decreased level of consciousness, headache, ataxic gait, cognitive dysfunction or memory loss, aphasia, focal neurologic deficit, and motor deficit, for example, hemiparesis. Cognitive decline includes confusional state, psychomotor slowing, gait abnormalities, and subacute dementia. CSDHs often present with atypical and unusual manifestations and can be difficult to diagnose. A high index of suspicion is needed to make the early diagnosis. Thorough history and clinical examination is very important to early diagnosis.[2] Elderly individuals may develop an asymptomatic CSDH.[3]

CSDH can usually be treated with relatively simple and effective surgical procedures. Treatment options include two burr-hole drainage,[4] single large burr-hole drainage, twist-drill craniostomy[5] or a small craniotomy.[6] However, its management is not always straightforward. The preferred surgical method continues to attract debate, and the time for an evidence-based approach is now overdue.

After successful and timely management, most patients return to their premorbid level of functioning.[7,8] Complications associated with surgery include reaccumulation of hematoma, seizures, intracerebral hemorrhage, tension pneumocephalus, and subdural empyema.[9] A overall mortality rate (including mortality because of complications) of 0%–6% has been reported.[7,10] Gökmen *et al*. directly compared two techniques burr-hole craniostomy (BHC) with twist-drill craniostomy (TDC).[11] A significant number of controlled trials have

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been performed in the last few years on different aspects of the surgical treatment of CSDH such as single versus two holes, with or without drainage etc. However, only few trials compared two techniques of the evacuation of CSDH, namely, burr-hole evacuation (BHE) and twist-drill evacuation (TDE). Moreover, therefore, some questions regarding on optimal treatment including the superiority of one technique over other remain. The present study is being conducted for the management of CSDH to compare two surgical techniques, namely, BHE versus TDE for their outcome and therefore to establish the hypothesis that TDE is not only as safe and as effective as BHE for CSDH treatment but also it is better than BHE in terms of bedside, minimally invasive, time-saving procedure without any need of monitored anesthesia.

Materials and Methods

This was a prospective, randomized, controlled study and was conducted in the Department of Neuro Surgery, Army Hospital (Research and Referral), Delhi Cantt, New Delhi, over two calendar years between May 2, 2011 and May 1, 2013. Forty consecutive cases with CSDH were included and divided randomly into two groups, one which was treated with BHE and the other with TDE. The patients were explained about both the procedures and alternatively subjected to one of the two procedures, such that there were randomly twenty patients in each group; intention of treatment was to make patient symptom free without any recurrence or complication with minimal intervention and early recovery.

Inclusion criteria

Persons in the age group of 18–90 years with CSDH on computed tomography (CT) scan/magnetic resonance imaging (MRI) scan.

Exclusion criteria

Patients younger than 18 years of age, CSDH with thick calcified membrane requiring craniotomy and excision of the thick calcified membrane, ipsilateral recurrent CSDH, bilateral CSDH, cerebrospinal fluid shunt *in situ,* subdural hygroma, and subdural empyema.

Methodology

It includes a detailed history, clinical examination, and CT scan/MRI scan to confirm the diagnosis [Figure 1]. All patients underwent surgical evacuation under local anesthesia. Patients in BHE group underwent double BHC (approximately 15 mm diameter) about 8 cm apart over the maximum width of the hematoma under monitored anesthesia (local anesthesia plus sedation). Patients in TDE group underwent double TDC of diameter approximately 4 mm under local anesthesia. The subdural collection was washed out with saline with the insertion of a 5 F feeding tube and soft ventricular catheter, respectively. Anticonvulsant was given in all cases till follow-up. The patients discharged based on

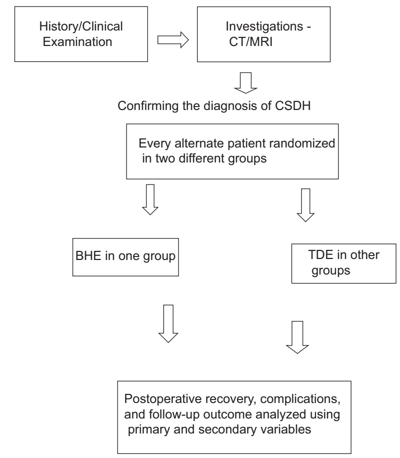

Figure 1: Methodology

postoperative outcome and usually by the 3–7th day after surgery when they no longer needed specialized neurosurgical care.

1. Patients followed in outpatient department at 2-week intervals after operation for 1 month and then monthly till hematoma resolves
2. Follow-up evaluation and postoperative cranial imaging were done at discharge, 1 month, 3 months, and 6 months postoperatively. During follow-up, patients and their relatives were asked about their activity of daily living and mobility status
3. The primary outcome variable studied was clinically significant recurrence rate that means need for reaspiration/redo surgery which is defined as: before discharge if patient does not reach Markwalder neurological grading score (MGS) grade 0 or 1 and CT scan shows residual fluid or air more than 10 mm thick with any midline shift (MLS), or after discharge if there is a recurrence of or increase in symptoms (headache, altered mentation, and hemiparesis) and CT scan shows residual fluid or air >10 mm thick with any MLS
4. The secondary outcome variables in postoperative period and follow-up assessment of the patients include:
   A. Glasgow coma scale (GCS) and Markwalder grade at discharge
   B. Neurological grading system for CSDH devised by Markwalder *et al.*[12] (given below) was used for comparing preoperative, postoperative, 1-month, 3-month, and 6-month follow-up
      - Grade 0: Patient neurologically normal
      - Grade 1: Patient alert and oriented; mild symptoms, such as headache; absent or mild symptoms such as reflex asymmetry or neurological deficit
      - Grade 2: Patient drowsy or disoriented with variable neurological deficit, such as hemiparesis
      - Grade 3: Patient stuporous but responding appropriately to noxious stimuli; severe focal signs, such as hemiplegia

- Grade 4: Patient comatose with absent motor response to painful stimuli; decerebrate or decorticate posturing.

C. Development of postoperative complication (namely, seizures, infection, tension pneumocephalus, and brain injury)
D. Operative mortality rate (death within 30 days of surgery attributable to surgical procedure).

Results

There were twenty patients in each arm. There were three females in each group. It was observed that maximum number of cases, i.e., 19 occurred in the seventh and eighth decade. Mean age in BHE group was 62.85 years and was 60.45 years in the TDE group. This difference was not significant (P = 0.65). In our study, males outnumber females in the incidence of CSDH and the male to female ratio was 5.7:1. Most common factor associated with the development of CSDH was head injury (75%), followed by alcoholism (37.5%), hypertension (27.5%), diabetes mellitus (22.5%), and antiplatelet/anticoagulant drug use (22.5%). Most common clinical presentations were headache, gait disturbances, limb weakness, and altered sensorium [Table 1].

Table 1: Clinical features in patients with chronic subdural hematoma

Clinical presentation	*n* (%)
Headache	28 (70.0)
Gait disturbances	24 (60.0)
Limb weakness	22 (55.0)
Altered sensorium	15 (37.5)
Cognitive dysfunction/memory disturbances	11 (27.5)
Speech impairment	8 (20.0)
Vomiting	7 (17.5)
Seizure	5 (12.5)
Incontinence	4 (10.0)
Visual disturbances	4 (1.00)
Others – for example, vertigo, dizziness	5 (12.5)

It was observed that most of the patients presented with the GCS in the range of 9–15 at the time of admission and only 3 patients were having GCS <9. Mean admission GCS in BHE group was 12.45 and was 12.70 in the TDE group (P = 0.725). Mean GCS at discharge in BHE group was 14.95 and was 14.65 in the TDE group (P = 0.087). This difference was not significant.

Most of the patients presented with the MGS 1 and 2 at the time of admission and 9 patients were having MGS of 3 and no patient of MGS 4. Mean MGS given in Table 2. This difference was not significant (P = 0.11, 0.426, 0.591, and 1.0 respectively).

Table 2: Mean Markwalder neurological grading score in two group of patients of chronic subdural hematoma at admission, discharge, and follow-up

	BHE	TDE	*P*
Mean MGS at admission	1.9	1.9	1.0
At discharge	0.16	0.45	0.11
At 1 month	0.11	0.2	0.426
At 3 months	0.05	0.1	0.591
At 6 months	0	0	1.0

MGS – Markwalder neurological grading score; BHE – Burr-hole evacuation; TDE – Twist-drill evacuation

It was observed that 60% of patients presented with maximum SDH thickness of 16–25 mm. At the time of admission, mean maximum SDH thickness and MLS were 23 mm and 9.15 mm, respectively, in the BHE arm. These were correspondingly 20.85 mm and 8.25 mm in the TDE arm (P = 0.309 and 0.563, respectively). At discharge, these were 7.55 mm and 1.85 mm for BHE and 7.9 mm and 2.05 mm for TDE (P = 0.256 and 0.385, respectively). There was no significance in these differences.

Mean hospital stay was 8.05 days and 7.4 days for BHE and TDE arms, respectively. Although it was slightly higher for patients of BHE arm, this difference was not statistically significant (P = 0.566).

A total of seven patients developed complications. Tension pneumocephalus (15%) was most common complication followed by postoperative fever (7.5%), infection (5%), and seizure (2.5%). There were three patients in BHE arm and four patients in TDE arm developed complications. This difference in complication rate was not statistically significant (P = 0.526).

There were 1 (5%) recurrence in the BHE arm and 3 (15%) in the TDE arm. This difference in recurrence rate was not statistically significant for both arms (P = 0.302). The failure in BHE group was successfully treated by repeat BHE. Of three failures in TDE arm, two were successfully treated by redo TDE while one required a burr hole for hematoma resolution. Thus, of twenty patients in TDE arm, 19 were successfully treated by TDE (cure rate at 1 month = 95%). Of 20 patients in the BHE arm, 19 were successfully treated by BHE (cure rate at 1 month = 95%). These cure rates were not significantly different.

In our study, the outcome of patients was analyzed using MGS score. A number of patients who achieved MGS zero at the time of discharge were 16 (80%) and 13 (65%) for BHE and TDE arm, respectively. Improvement in MGS progressed to 100% for both arms at 6-month follow-up. Only 2 patients were discharged in MGS of 2 and they belong to TDE arm. These two patients were admitted with admission GCS of 7 and 10, respectively, and MGS of 3. Both patients developed postoperative complications and one of them had a recurrence of SDH. One patient in BHE arm died because of his multiple comorbidities such as coronary artery disease, diabetes mellitus, and

Table 3: Outcome in two groups at discharge, 1, 3, and 6 months' follow-up

Outcome MGS	At discharge		At 1 month		At 3 months		At 6 months	
	BHE (%)	TDE (%)	BHE (%)	TDE (%)	BHE (%)	TDE (%)	BHE (%)	TDE (%)
0	16 (80)	13 (65)	17 (89.47)	16 (80)	18 (94.73)	18 (90)	19 (100)	20 (100)
1	3 (15)	5 (25)	2 (10.52)	4 (20)	1 (5.26)	2 (10)	0	0
2	0	2 (10)	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
Death	1 (5)	0	0	0	0	0	0	0

MGS – Markwalder neurological grading score; BHE – Burr-hole evacuation; TDE – Twist-drill evacuation

hypertension. He had an attack of myocardial infarction and died. Operative mortality rate (death within 30 days of surgery attributable to surgical procedure) was zero [Table 3].

Discussion

CSDH is a common neurosurgical problem with increasing incidence because of certain factors such as rising population of the elderly, increasing use of antiplatelets and anticoagulants, wider availability of CT scanners, and rising vehicle caused neurotrauma.

Mean age of presentation in different studies varies from 50 to 70 years. In our study, mean age of presentation was 61.65 consistent with other such studies by Mori and Maeda[13] and Krup and Jans.[14] Sambasivan[15] conducted a large study over a period of 30 years, 2300 cases of CSDH were seen and treated. A male preponderance among the cases was seen in a ratio of 5:1. In our study, male to female ratio was 5.7:1.

Head trauma has been identified as single most common factor associated with 25%–75% cases of CSDH in most of the studies. In our study, history of head trauma was present in 75% of cases which is consistent with other such studies by Santarius *et al*.,[1] Zumofen *et al*.,[16] Ramachandran and Hegde,[17] and Mori and Maeda.[13]

According to Santarius *et al*.[1] 2009, the most frequent presenting symptoms are headache, cognitive decline, gait abnormalities, and hemiparesis. In our series, clinical findings are very much comparable to the above-mentioned studies.

In our study, we concluded that both procedures (BHE and TDE) appear similar in respect of complications, recurrence rate, and outcome. Other nonrandomized studies like Camel and Grubb,[10] Lega *et al*.,[18] and Horn *et al*.[19] have also given similar conclusions.

Recurrence rate was used as the primary criteria by most of the studies, but recurrence has never been adequately defined. Several studies have been published which followed arbitrary meanings of recurrence. Markwalder *et al*. showed in his study that a persistent collection at the operated site is found in 78% of cases up to 10 days after surgery, but this is not an indication for surgery.[12] Similarly, Weigel *et al*.[7] in their meta-analysis of 2003 found that recurrence rates of 33% for twist drill and 12.8% for burr hole which they concluded were statistically significant. However, we followed fairly rigid criteria in defining recurrence as the need for reaspiration (vide supra). Postoperative fluid and/or air collection is a usual phenomenon, but it spontaneously reabsorbed within a month. CSDH recurrence in our study was seen in one patient in BHE group (5%) and three patients in TDE group (15%).

Smely *et al*.[20] compared a prospective series of CSDH patients and opined that TDC is significantly better in outcome than BHC in lowering morbidity (0% vs. 18%), recurrence rate (18% vs. 39%), and duration of hospital stay (4.9 vs. 9.6 days).

Gökmen *et al*.,[11] however, in their randomized study found no significant difference in terms of hospital stay, clinical or radiological outcomes, and recurrence rates between the twist drill and burr hole groups, which are very much similar to our study results. Methodology of our study differs from this study in terms of using irrigation, but results can be extrapolated in terms of the primary and secondary outcome.

In our study, results of BHE seem to be superior than TDE in terms of recurrence rate (5% vs. 15%), complication rate (15% vs. 20%), and mean MGS and mean GCS at the time of discharge (0.16 vs. 0.45 and 14.95 vs. 14.65, respectively). TDE seems to be better than BHE in terms of duration of hospital stay (7.4 vs. 8.05). However, these differences were not statistically significant.

In our study, there were no recurrences after 1 month, and 100% recovery had been achieved in both arms at 6-month follow-up. Gökmen *et al*.,[11] however, advocated for no need of follow-up beyond 3 months because there was 100% cure rate at 3 months in their prospective, randomized, controlled clinical study.

Smely *et al*.[20] reported a mean hospital stay of 9.6 days in their retrospective BHE series and 4.9 days in their prospective TDE series. However, later on, no differences were found in the prospective clinical trials.[19]

There is an inadequate number of well-designed studies directly comparing the two techniques so as to give Class I evidence regarding the superiority of one technique over the other in the present era of minimally invasive surgery. There are only few randomized studies and meta-analyses including Ivamoto *et al*.,[21] Liu *et al*.,[22] Chari *et al*.,[23] and Javadi *et al*.,[24] which compared two techniques and found no significant statistical difference in terms of outcome or complication rate.

Conclusion

Although both techniques appear to be similar in respect of their primary and secondary outcome variables, TDE is having the advantage of being performed at bedside without the need of monitored anesthesia and anesthetist, time saving, and small incision. TDE is unlikely to produce such good results when there is a relatively large organized subdural clot.

Surgical drainage is a relatively safe and effective treatment for CSDH. Class I evidence exists for BHC being the treatment of choice for an uncomplicated primary CSDH. Together with previously published literature, our recent randomized controlled trial provides Class I evidence regarding the equal effectiveness of two techniques, i.e., BHE and TDE for evacuation of CSDH. However, as clearly appreciable, the limitation of our study is its small size; therefore, well-designed and rigorously executed large-size clinical trials are to be conducted to ascertain the individualized ideal treatment strategy.

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Conflicts of interest

There are no conflicts of interest.

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