Original article

Indian Journal of Neurotrauma (IJNT)
2011, Vol. 8, No. 1, pp. 17-24

A comparative study of treatment of chronic subdural hematoma – burr hole drainage versus continuous closed drainage

Shameem Ahmed MS, **Deepak Agrawal** M Ch, **SS Kale** M Ch, **AK Mahapatra** M Ch
Department of Neurosurgery, JPN Apex Trauma Centre, All India Institute of Medical Sciences, New Delhi, India

Abstract: The incidence of chronic subdural hematoma (CSDH) is about 5 per 100000 per year in the general population & is higher for those aged 70 years and older. The recurrence rates after the initial drainage procedure range from 5% to 30%, and the treatment strategies for reducing the recurrence rates are the focus of the current research. The aim of this study was to evaluate the results of treatment, especially in terms of recurrence, following surgery for the CSDH obtained with "one time burr-hole drainage "(OTD) vs "continuous closed drainage", using subdural drain (CD). Patients with diagnosis of CSDH, operated at our center during the period from September 2008 through March 2010 were prospectively studied. The patients randomized to two arms, group 1 underwent OTD and group 2 underwent CD. Patients were analyzed by evaluating their hospital clinical, laboratory and radiological data. Recurrence of CSDH was defined as reappearance of clinical symptoms after a minimum period of one month post surgery, with evidence of CSDH in the same site on plain CT head. Clinical outcome was measured using Glasgow outcome score (GOS). Fifty one patients with chronic subdural hematoma were randomized. OTD was done in 26 patients and 25 patients underwent CD. Males outnumbered the females (45 vs. 6). Age ranged from 17 to 85 years (mean 53 ± 15 years). While 47 patients had GCS of 9-15, remaining 4 (7%) had GCS of 8 or less. Deranged coagulation profile was recorded in 9 patients. Imaging showed 9% patients with bilateral CSDH and in 14% patients had isodense CSDH. Hospital stay ranged from 2 to 24 days (mean 3 ± 4 days). Patients with deficit at admission usually had neurological deficit at discharge. GOS at 6 months was better in continuous drainage group (48% vs 44%) but had more complications. Symptomatic recurrence was noticed in 10 (19%) patients; recurrence was lower in the patients in CD group (n= 4, 16%) than in the OTD group (n= 6, 23%) but this was not statistically significant (p value – 0.60). Our study shows that continuous drainage of chronic subdural hematoma does not offer any advantage over simple burr hole drainage.

Abbreviations: Chronic subdural hematoma (CSDH), one time burr hole drainage (OTD), continuous closed drainage (CD).

Keywords: burr hole; chronic subdural hematoma; subdural drain.

INTRODUCTION

Chronic subdural hematoma (CSDH) is common in elderly people and is associated with substantial morbidity and mortality[1,2]. Incidence is about 5 per 100 000 per year in the general population[3]. Because the proportion of people aged 65 years and older is expected to double worldwide between 2000 and 2030[3], a large rise in incidence is expected. Diagnosis can readily be facilitated by brain computed tomography (CT) and magnetic resonance imaging (MRI). Excluding minimal subdural hematoma, therapy is commonly surgical and a dramatic rapid improvement in symptoms is frequently observed. Recurrence rates after the initial drainage procedure ranges from 5% to 30% and is the focus of research[2,3]. A recurring theme in this debate is whether subdural continuous drainage should be used in conjunction with burr-hole craniostomy as emerging evidence suggests that such drainage of the subdural space lowers recurrence rates[3-8]. However, further evidence from randomized controlled trials is needed to guide treatment [2-4]. This study was undertaken with the aim to evaluate the results of treatment, especially in terms of recurrence, following surgery for chronic subdural hematoma obtained with burr-hole drainage and continuous closed drainage using subdural drain.

Address for correspondence :
Dr Deepak Agrawal, Associate Professor
Department of Neurosurgery, JPN Apex Trauma Centre
All India Institute of Medical Sciences, New Delhi - 110029
Phone: +919868103502 Email: drdeepak@gmail.com

MATERIAL AND METHODS

All patients of CSDH who were operated at our center from September 2008 to March 2010 were prospectively enrolled. This study was designed in a randomized

prospective fashion with two arms. They were randomized to Arm 1, underwent one-time burrhole drainage and arm 2, who underwent continuous closed drainage. Randomization done using random allocation software (version 1.0). Only those who agreed to randomization were enrolled. The protocol was approved by the institutional ethics committee.

Inclusion criteria: Symptomatic patients with diagnosis of CSDH based on CT/ MRI study of brain were included. Children below 17 years were excluded.

Exclusion criteria: Patients who were operated once or more (i.e. recurrence) for CSDH were excluded. Patients in whom CSF diversion procedure was done and who subsequently developed CSDH, and patients of CSDH in whom surgery other than burr-hole evacuation was done, were not enrolled. Patients were evaluated at the time of admission based on history, physical examination, blood investigation and imaging studies. Coagulation parameters - platelet count, Prothrombin time (PT), activated partial thromboplastin time (APTT) - were checked. On imaging, CSDH was analyzed as hypodense, isodense, hyperdense, or mixed, on the basis of the density of haematoma relative to brain tissue. Before surgery, written informed consent was obtained from the patient or was obtained from the next-of-kin of comatose patients or those otherwise unable to give consent.

PROCEDURE

General anesthesia or local anesthesia was used as per the surgical team's assessment. In the operating theatre the patient was positioned supine on a horseshoe headrest. Two burr holes (approx 12–15 mm sized) about 5–7 cm apart were made over the maximum width of the hematoma. The dura was opened in a cruciate manner and coagulated with bipolar diathermy. The subdural collection was washed out with saline with a 5 mL syringe very gently. The subdural membrane loculations were not disrupted apart from those easily accessible via the burr holes. When a patient was assigned to no drain group, subdural space was filled with isotonic saline and the scalp closed in two layers. Those assigned to a drain had a soft silicon drain (external diameter 2 mm and length of 20 cm) inserted into the subdural space through the burr hole overlying the large part of the subdural cavity and tunneled for a minimum of 5 cm away from the scalp incision. The subdural space was filled with isotonic saline and the scalp was closed in two layers. The drain was connected to a closed collection bag that was kept in a dependent position for 48 hours. We treated bilateral hematoma as one case, and both sides received the same treatment.

Patients were discharged home or to a local hospital when they no longer needed specialized neurosurgical care. Follow-up evaluation and postoperative cranial imaging was done at discharge, 1 month, 3 months and 6 months postoperatively (OPD and / or telephonically). During follow up, patients and their relatives were asked about their activity of daily living and mobility status.

The primary outcome was measured in terms of recurrence rate. Recurrence of CSDH was defined as reappearance of clinical symptoms after a minimum period of one month after initial surgery with evidence of CSDH on the same site on plain CT head. When recurrence is derived in patients with residual CSDH, then the new imaging should have shown increase in the size and mass effect of CSDH. Secondary outcome was measured by Glasgow outcome score.

Statistical analysis were done using WHO epi info' software version 3.4.3.

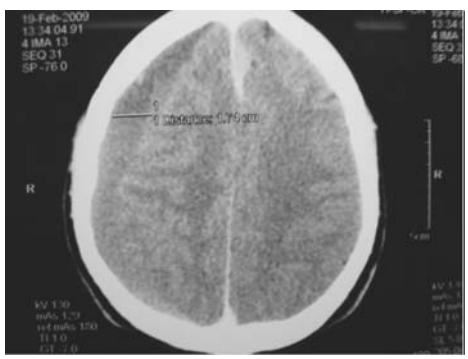

Fig 1: NCCT Head showing unilateral CSDH

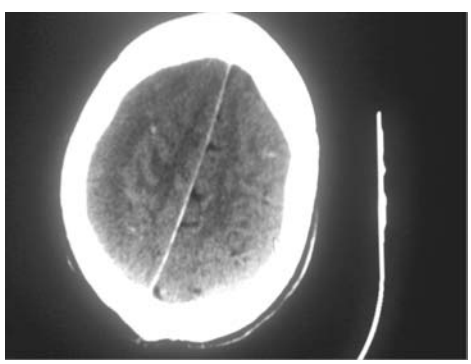

Fig 2: NCCT Head showing isodense bilateral CSDH

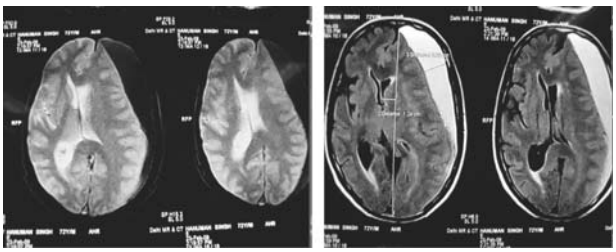

Fig 3: MRI Head (T1WI & T2WI) showing unilateral CSDH

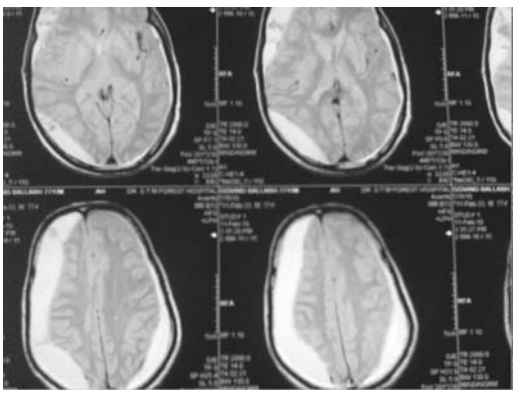

Fig 4: MRI Head (T2WI) showing bilateral CSDH

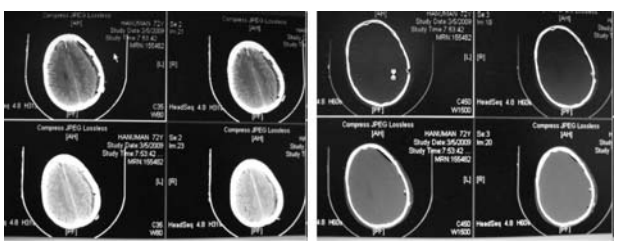

Fig 5: NCCT Head showing CSDH with subdural drain

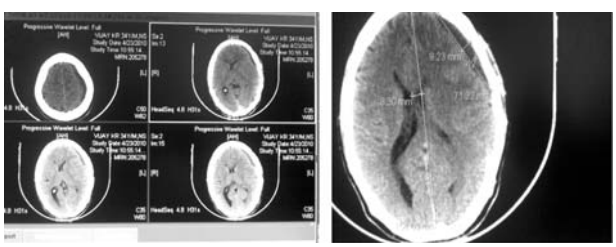

Fig 6: Postoperative NCCT Head showing recurrent CSDH

OBSERVATIONS AND RESULTS

During this study period, 51 patients with CSDH were enrolled. One-time burrhole drainage (OTD) done in 26 patients and 25 underwent continuous closed drainage (CD). Males outnumbered females (45 vs. 6). Age of the patients ranged from 17 years to 85 years with mean age of 53 ± 15 years. Gait disturbance, memory loss, hemiparesis, headache, speech impairment, drowsiness and coma were the most common presentations (Table 1). History of minor head injury in the recent past was present in 76 % of the patients (Table 2).

Level of consciousness was assessed using Glasgow coma score (GCS); 93% of patients had GCS of 9 - 15, and 7% had GCS of 8 or less. Mean GCS was 14 (Table 3). Hematological, radiological and operative findings have been described in Tables 4, 5 and 6 respectively. Hospital stay ranged from 2 days to 24 days with mean stay of 3 ± 4 days. Patients with a gross neurological deficit at discharge had usually deficit at admission. Therefore, the variable for neurological deficit at admission was a very strong and important predictor of deficit at discharge.

Complications were uncommon. One patient developed subdural empyema (CD group), one acute subdural haematoma (CD group); and four patients

Table 1: Clinical presentation of patients with chronic SDH

Clinical Presentation	**No.** (%)
Headache	29 (56%)
Gait disturbances and fall	32 (62%)
Limb weakness	27 (52%)
Incontinence	4 (7%)
Seizure	7 (13%)
Memory disturbances	14 (27%)
Speech impairment	11 (21%)
Altered sensorium	19 (37%)
Vomiting	10 (19%)
Visual disturbances	7 (13%)
Cranial nerve palsy	9 (17%)
Mobility	
Independent	22 (43%)
With support	17 (34%)
Bed ridden	12 (23%)

Table 2: Factors associated with development of chronic SDH in our series

Past History	**No.** (%)
Head injury	39 (76%)
Antiplatelet drug use	6 (11%)
Anticoagulant drug use	3 (5%)
Liver disease	2 (3%)
Alocoholism	19 (37%)
Diabetes	12 (23%)
Hypertension	14 (27%)

Table 3: Admission GCS in patents of Chronic SDH

Admission GCS	Total nos. (%)	Symptomatic Recurrence	Odd's ratio	P ratio
14 - 15	38 (75%)	8	1	0.877
9 – 13	9 (18%)	1	0.53	
3 – 8	4 (7%)	1	1.19	

Table 4: Hematological abnormities seen in patients with chronic SDH in this study

Hematological Recurrence	Total nos. (%)	Symptomatic Recurrence	Odd's ratio	P ratio
Thrombocytopenia (< 1 lac / cu mm)	4 (7%)	2	1	NS
Prolonged PT (Control: patient = 13.7 / >17 sec)	5 (9%)	2	0.8	
Prolonged APTT (Control: patient = 33 /> 45 sec)	4 (7%)	2	1	

Table 5: Radiological features of the patients with chronic SDH

Radiological Features	No. (%)
Side of hematoma	
Left	18 (35%)
Right	26 (51%)
Bilateral	7 (14%)
Density of hematoma	
Hypodense	40 (79%)
Iso dense	5 (9%)
Mixed	6 (12%)
Midline shift (mm)	
< 3 mm	7 (14%)
4 – 6 mm	28 (54%)
> 7 mm	16 (31%)

Table 6: Intraoperative findings in patients with Chronic SDH

Operative Detail	No. (%)
Subdural fluid color	
Straw	13 (26%)
Motor oil	33 (65%)
Mixed	5 (9%)
Subdural fluid pressure	
Low	4 (7%)
Medium	14 (27%)
High	33 (65%)
Membrane	
Thick	23 (45%)
Thin	28 (55%)
Brain expansion	
Full	29 (57%)
Partial	18 (36%)
None	4 (7%)

developed postoperative fever, which responded to empirical antibiotics (Table 7).

Symptomatic recurrence was found in 10 patients (19%). Rate of recurrence was lower in the patients in whom a subdural drain was used than in the no-drain group. However there was no statistically significant difference in both groups. The outcome using GOS was similar in both groups at the end of 6 months (Tables 8 & 9).

Pre-existing coagulation abnormality and bilateral Chronic SDH were the only two risk factors which were significantly associated with recurrence (Tables 10 &11).

Table 7: Complications seen in patients with chronic SDH in our study

Post Op. Parameter	OTD (no / %)	CD (no / %)	P Value
Cranial nerve palsy			
New onset	0	1 (2%)	0.32
Since pre op	2 (4%)	1 (2%)	
Limb weakness			
Improved / No	19 (37%)	21	0.27
Deficit	4 (7%)	(41%)	
Same	3 (5%)	3 (5%)	
Deteriorated		1(2%)	
Seizure			
New onset	01	(2%)	—
Since pre op	1 (2%)	1 (2%)	—
Electrolyte imbalance	3 (5%)	4 (7%)	—
Acute SDH	0	1 (2%)	—
Wound infection/dehiscence	1 (2%)	2 (4%)	—
Post operative fever	1 (2%)	3 (5%)	—
Meningitis	0	1 (2%)	—
Empyema	0	1 (2%)	—

Table 8: Outcome in both groups at discharge, 3 months & 6 months follow up

	Outcome (GOS)	At discharge		3 months follow up		6 months follow up	
		OTD	CD	OTD	CD	OTD	CD
1	Death	1 (2%)	0	0	0	0	0
2	Vegetative	1 (2%)	0	1(%)	0	0	0
3	Severe disabled	2 (4%)	0	0	0	0	0
4	Moderate disabled	3 (5%)	5 (9%)	2 (5%)	2 (5%)	1(%)	1(%)
5	Good recovery	19 (37%)	20 (39%)	16 (41%)	18 (46%)	12 (44%)	13 (48%)

Table 9: Asymptomatic and symptomatic recurrence rates in both groups

Type of operation	Asymptomatic recurrence	Symptomatic recurrence	P-value
CD (n = 25)	6 (24%)	4 (16%)	0.60
OTD (n = 26)	12 (46%)	6 (23%)	

Table 10: Relationship of laterality of initial hematoma to recurrence

Site of Hematoma	Asymptomatic recurrence	Symptomatic recurrence	P-Value
Unilateral (n = 44)	5	2	0.04 (Significant)
Bi lateral (n = 7)	5	4	

DISCUSSION

In our study patients with CSDH treated with OTD had a higher recurrence rate than CD although this did not reach statistical significance. At discharge, patients with or without subdural drains had similar outcome in terms functional status and GOS. Surgical complications were also more in those with drains but these were statistically not significant. Our findings (recurrence of 16% for CD and 23% for OTD) conforms with the results from two prospective studies[8,9]. Wakai and co-workers reported recurrence rates of 5% for drain and 33% for no drain[9]. Tsutsumi et al reported rates of 3.1% and 17%, respectively[8]. We also report recurrence rates very similar to those in the retrospective study by Lind et al who reported a recurrence rates of 10% for drain and 19% for no drain[6]. Conversely, Santarius et al and reported recurrence in 10 of 108 (9·3%) with a drain and 26 of 107 (24%) without subdural drain, which was statistically significant (p=0·003)[3]. They found the medical and surgical complications similar in study groups. In two national surveys, Canadian neurosurgeons preferred one (36%) or two (50%) burr holes to smaller twist-drill holes (9%) or a true bone-flap (5%), both with a subdural drain (81%)[4,10]. By contrast, neurosurgeons in UK and Ireland favored burr-hole drainage without drain[11]. Recently, Zumofen and colleagues reported that two burr holes and an extracranial, subperiosteal, non-aspiring draining system resulted in a recurrence rate of 12% amongst their 147 patients[12].

Kansal et al compared recurrence rates following single burr hole and double burr hole drainage techniques and derived the conclusion that the number of burr holes does not affect the post-operative recurrence rate of CSDH[13].

Deficiency of plasminogen activator inhibitor type I (PAI-1) should be considered in patients with recurrent CSDH that lack another compelling explanation, particularly in patients with a family history of bleeding diatheses. PAI-1 deficiency can be identified by measuring plasma levels and can be treated with an oral course of aminocaproic acid[14]. We also encountered 9 patients with deranged coagulation parameter, recurrence found in 5 of them but PAI-1 was not assessed in them.

Postoperative hematoma density has also been strongly related to the recurrence of CSDH[5]. We also noticed higher recurrence rate with presence of radiological recurrence, bilateral CSDH and in patients with coagulation defects. Several factors associated with the recurrent CSDH were reported in the literature viz. advanced age, cerebral atrophy, alcoholism, renal failure, liver dysfunction, meningeal diffusion of malignant tumors, septum formation in hematoma, inadequate post operative drainage, air collection in the hematoma cavity, and early surgical intervention of the capsule in an underdeveloped hematoma[5,15]. It is also postulated that CSDHs usually develop after a rupture in parasagittal bridging vein due to an accelerative type of trauma. Suzuki et al showed that avoiding an immediate fall in ICP may be an important operative major to prevent further complications[15]. Recurrence is mostly related to the surgical technique applied instead of pre-op features and recurrence may occur due to new damage at the transverse veins as a result of an immediate fall in ICP during, drainage[16]. Asano et al in their study commented about the relationship between the volume of air captured within the hematoma cavity and the length of the period that elapsed for the resolution of the hematoma cavity and reported that the volume of air was greater in patients with recurrences[5]. They also concluded that CD may avoid such problems. We did not identify any reports exploring the use of drains in burr-hole evacuation of CSDH to alter patient outcomes. However, a rapid clinical improvement for those with a raised CSDH pressure has been reported[12,17].

Frontera et al sought to examine predictors of discharge disposition, hospital stay and costs for SDH by doing a retrospective review of 216 SDH patients[18]. The median age was 74 (19-95) and the median admission GCS was 14. Surgical evacuation was performed in 139 (64%) patients. Death occurred in 29 (13%) patients

and poor disposition in 43 (20%). Median hospital stay was 8 (1-99) days. ICU and hospital stay were significant predictors of all measures of cost ($P < 0.05$). SDH size, chronicity and surgical intervention were not predictors of any outcome. They concluded that despite good admission neurological status, death or poor discharge disposition is common after SDH. Hospital stay & costs remain high and have not improved in the last decade. Our data shows mean age of 53 years, mean GCS of 14, 9% had isodense and 12% mixed density collection in CT scan. Hospital stay ranged from 2-24 days (mean 3 days) and 76% had a good outcome at discharge and 1 patient expired.

Concern about heightened operative risk was the main reason why most neurosurgeons avoid use of drains. We also identified more surgical complications in CD group. To prevent recurrences, some neurosurgeons place a subdural drain for a day or two; others do not for fear of puncturing the cortex and causing an intracerebral or subdural haematoma or for fear of formation of a bacterial subdural empyema[19]. Common post operative complications as reported by authors are cerebral hemorrhage, brain edema and convulsions[14]. Complications were more in patients with incomplete drainage and multiple hematoma cavities.

Erol et al found no difference at one month follow up for patients who underwent irrigation/closed drainage for chronic SDH[20]. Closed system drainage should be used after burr-hole irrigation of a CSDH, if the brain does not re-expand. Baseline characteristics, general management, surgical techniques and frequency of post operative complications in our study were similar with those of other series[2,6,7].

Bradley et al in their study on decision analysis regarding choosing the best operation for chronic subdural hematoma based on medline search point, a scale from 0 to 1, the utility of BHD (burr hole drainage) was found to be 0.9608, compared with 0.9202 for twist drill drainage ($p = 0.001$) and 0.9169 for craniotomy ($p = 0.006$). Craniotomy yielded fewer recurrences, but more frequent and more serious complications than did BHD[21]. There were no significant differences for BHD with or without irrigation or postoperative drainage and findings were similar to our study.

CONCLUSIONS

Our study shows that continuous drainage of CSDH (with subdural drain) does not offer any advantage over simple onetime burr hole drainage in terms of recurrence rate. There were also more complications in patients operated with a subdural drain. However, burr hole craniostomy balances a low recurrence rate with a low incidence of highly morbid complications.

REFERENCES

1. Mckissock W, Richardson A, Walsh L. Anterior Communicating Aneurysms: A Trial of Conservative and Surgical Treatment.
Lancet 1965; 1:874-6.

2. Weigel R, Schmiedek P, Krauss JK. Outcome of contemporary surgery for chronic subdural haematoma: evidence based review.
J Neurol Neurosurg Psychiatr 2003; 74:937-43.

3. Santarius T, Kirkpatrick PJ, Ganesan D, Chia HL, Jalloh I, Smielewski P, et al. Use of drains versus no drains after burr-hole evacuation of chronic subdural haematoma: a randomised controlled trial.
Lancet 2009; 374:1067-73.

4. Santarius T, Lawton R, Kirkpatrick PJ, Hutchinson PJ. The management of primary chronic subdural haematoma: a questionnaire survey of practice in the United Kingdom and the Republic of Ireland.
Br J Neurosurg 2008; 22:529-34.

5. Asano Y, Hasuo M, Takahashi I, Shimosawa S. [Surgical outcome of 32 cases in traumatic subdural hygroma].
No To Shinkei 1992; 44:1127-31.

6. Lind CRP, Lind CJ, Mee EW. Reduction in the number of repeated operations for the treatment of subacute and chronic subdural hematomas by placement of subdural drains.
J Neurosurg 2003; 99:44-6.

7. Ramachandran R, Hegde T. Chronic subdural hematomas—causes of morbidity and mortality.
Surg Neurol 2007; 67:367-72.

8. Tsutsumi K, Maeda K, Iijima A, Usui M, Okada Y, Kirino T. The relationship of preoperative magnetic resonance imaging findings and closed system drainage in the recurrence of chronic subdural hematoma.
J Neurosurg 1997; 87:870-5.

9. Wakai S, Hashimoto K, Watanabe N, Inoh S, Ochiai C, Nagai M. Efficacy of closed-system drainage in treating chronic subdural hematoma: a prospective comparative study.
Neurosurgery 1990; 26:771-3.

10. Cenic A, Bhandari M, Reddy K. Management of chronic subdural hematoma: a national survey and literature review.
Can J Neurol Sci 2005; 32:501-6.

11. Zumofen D, Regli L, Levivier M, Krayenbühl N. Chronic subdural hematomas treated by burr hole trepanation and a subperiostal drainage system.
Neurosurgery 2009; 64:1116-21.

12. Markwalder TM, Seiler RW. Chronic subdural hematomas: to drain or not to drain?
Neurosurgery 1985; 16:185-8.

13. Kansal R, Nadkarni T, Goel A. Single versus double burr hole drainage of chronic subdural hematomas. A study of 267 cases.
J Clin Neurosci 2010; 17:428-9.

14. Rughani AI, Holmes CE, Penar PL. A novel association between a chronic subdural hematoma and a fibrinolytic pathway defect: case report.
Neurosurgery 2009; 64:E1192.

15. Suzuki K, Sugita K, Akai T, Takahata T, Sonobe M, Takahashi S. Treatment of chronic subdural hematoma by closed-system drainage without irrigation.
Surg Neurol 1998; 50:231-4.

16. Nagata K, Asano T, Basugi N, Tango T, Takakura K. [Studies on the operative factors affecting the reduction of chronic subdural hematoma, with special reference to the residual air in the hematoma cavity].
No Shinkei Geka 1989; 17:15-20.

17. Markwalder TM, Steinsiepe KF, Rohner M, Reichenbach W, Markwalder H. The course of chronic subdural hematomas after burr-hole craniostomy and closed-system drainage.
J Neurosurg 1981; 55:390-6.

18. Frontera JA, de los Reyes K, Gordon E, Gowda A, Grilo C, Egorova N, et al. Trend in outcome and financial impact of subdural hemorrhage.
Neurocrit Care 2011; 14:260-6.

19. Gökmen M, Sucu HK, Ergin A, Gökmen A, Bezircio Lu H. Randomized comparative study of burr-hole craniostomy versus twist drill craniostomy; surgical management of unilateral hemispheric chronic subdural hematomas.
Zentralbl. Neurochir 2008; 69:129-33.

20. Erol FS, Topsakal C, Faik Ozveren M, Kaplan M, Tiftikci MT. Irrigation vs. closed drainage in the treatment of chronic subdural hematoma.
J Clin Neurosci 2005; 12:261-3.

21. Lega BC, Danish SF, Malhotra NR, Sonnad SS, Stein SC. Choosing the best operation for chronic subdural hematoma: a decision analysis.
J Neurosurg 2010; 113:615-21.