D:\Nsurg\Vol. 23, No. 2, Apr. – Jun., 2019\Nsurg-8.Doc (A) P. 85 – 92 III

ORIGINAL ARTICLE

Catheter Drainage for Chronic Subdural Hematoma

HANIF-UR-RAHMAN,[1] MUMTAZ ALI,[2] RAMZAN HUSSAIN[1]
MUHAMMAD IDREES KHAN,[1] ANISA SUNDAL, [3] NASEER HASSAN
[1]Khyber Teaching Hospital, Peshawar, Pakistan
[2]Lady Reading Hospital, Peshawar, Pakistan
[3]North West General Hospital, Peshawar, Pakistan

ABSTRACT

Objective: *To evaluate the functional outcome of patients having chronic subdural hematoma (CSDH) in terms of Glasgow Outcome Scale subjected to single burr-hole craniostomy and catheter drainage without prior subdural space irrigation.*

Materials and Methods: *This study was performed in Neurosurgery Department, PGMI Lady Reading Hospital, Peshawar, Pakistan from January 01, 2016 to December 31, 2016. Through a Descriptive Case Series Study Design, 116 patients presenting with CSDH were included in the study in a consecutive manner, subjected to single burr hole craniostomy and catheter drainage and followed up for up to 06 weeks.*

Results: *The mean age group of the sample was 37.31 +/- 10.74 years, of which 69% were male and 31%female patients respectively. At the presentation, there were 37.06% of patients in Class I group with GCS13-14, 47.41% of patients in Class II group with GCS 9-12 and 15.52% of patients in Class III group with GCS 3-8. On follow up, Glasgow Outcome Score of the sample was 4.04 +/- 0.75, with 84.48% favorable and 15.52% unfavorable outcome respectively.*

Conclusion: *This study suggested that chronic subdural hematoma managed with single burr hole subdural catheter drainage is associated with a high frequency of a favorable outcome in terms of Glasgow Outcome Score. Admission Glasgow Coma Scale of less than 8 and advanced age are associated with lesser frequency of favorable outcome and more prone to unfavorable outcomes.*

Abbreviations: *CSDH: Chronic Subdural Hematoma. CT: Computed Tomography. GCS: Glaucoma Outcome Scale. CSF: Cerebrospinal Fluid.*

Keywords: *Chronic Subdural Hematoma, Catheter Drainage, Glasgow Outcome Score.*

INTRODUCTION

The study was aimed to evaluate the functional outcome of patients having chronic subdural hematoma patients in terms of Glasgow Outcome Scale subjected to single burr hole craniostomy and catheter drainage without prior subdural space irrigation. Chronic subdural hematoma (CSDH) is termed as chronic intracranial hemorrhage between the dura and arachnoid maters.[1]It occurs usually in patients with minor head trauma and having brain atrophy and coagulopathy as risk factors. It is an encapsulated collection of blood and its breakdown products, grows slowly and usually results from tearing of the bridging veins. First explained by J.J. Wepfer in 1657 and in 1857 Virchow described its pathophysiology, calling it pachymeningitis hemorrhagica interna.[2] In general population the incidence is about 5/100,000/year, but in those aged 70 years and above approaches up to 58/100,000/year.[3] The combination of geriatric population and increasing usage of anticoagulant and antiplatelet drugs is expected to increase the incidence of CSDH substantially in the coming 25 years.[4] Mortality varies from 0 to 6% while morbidity is from 0 to 76%.[5] A traumatic event is reported to occur before the development of CSDH in 60 to 80% of cases but the

Date of Submission: 5-5-2019
Date of Printing: 15-6-2019

exact figure may be much higher as a mild traumatic brain injury may not be recognized in some patients.[6] As predisposing factors, chronic alcohol consumption accounts for 21%, antiplatelet therapy for 11% and oral anticoagulant intake for 10% of the cases respectively. Unilateral hematoma occurs in 82% of the patients mostly on left side (57.2%) while 18% cases present with bilateral distribution.[7]

Especially after the advent of CT and advancements in surgical techniques, there is a considerable decrease in the mortality and morbidity from CSDH. However, there is still controversy, regarding the method of treatment, pathophysiology and surgical management of CSDH. It usually affects the aged patients, particularly after minor traumatic brain injury. In the elderly, there is a reduction in the volume of brain parenchyma resulting in increased subdural and subarachnoid spaces. Trivial head injury or position changes induces bleeding forming hematoma.[8]Clinical presentation is often insidious and may be asymptomatic in the elderly. Symptoms consist of ataxic gait, altered consciousness, cognitive dysfunction or memory loss, headache, aphasia and motor deficit. Non enhanced CT brain is the investigation of choice for confirming the diagnosis of CSDH, appearing as a hypodense crescentic lesion adjacent to the inner table and causing mass effect. For smaller lesions MRI can be performed, appearing hypointense on both T1 and T2 weighted sequences.[9]

Management options for CSDH are both surgical and nonsurgical. Generally nonsurgical measures are considered for asymptomatic patients or patients having mild head ache while surgical treatment is preserved for patients who are neurologically symptomatic.[6] Surgical management has been widely accepted as the most efficient way to treat CSDH. Over the years, burr hole or twist drill craniostomy, craniotomy, endoscopic assisted evacuation and various other surgical techniques have been used. Morbidity associated with craniotomy is higher than craniostomy and recurrence with twist drill craniostomy is much more than burr hole craniostomy and craniotomy respectively. In literature the recurrence rate after surgical evacuation for CSDH varies from 9.2% to 26.5%. Subdural catheter insertion might reduce this, but is not in common practice.[3]

The rationale of the current study was to evaluate the functional outcome of single burr hole subdural catheter drainage without prior subdural space irrigation in our setup. CSDH is a common neurosurgical entity as people are more prone to trivial head injuries and coagulopathies in this part of the world. Surgical treatment for CSDH is controversial, but the mentioned procedure is simple, safe, cost effective, minimally invasive, requires less operative time and expertise, reduces opportunity for surgical complications, is cosmetically better and can be carried out with local anesthesia in moribund patients. The results will be compared with the results of various other surgical procedures performed for treating CSDH and if proved to be effective, it can be used routinely as a first line treatment for CSDH, when indicated.

Furthermore, doing this study will help us to generate local statistics of outcome among CSDH patients. The results will be shared with other neurosurgeons through publication to make them aware about the local magnitude of the problem and on this basis further rectification in the management strategy will be possible.

MATERIALS AND METHODS

Study Design

It is a descriptive case series study design.

This study was performed in Neurosurgery Department, PGMI Lady Reading Hospital, Peshawar, Pakistan from January 01, 2016 to December 31, 2016. 116 patients presenting with CSDH were included in the study in a consecutive manner, subjected to single burr hole subdural catheter drainage and followed up for up to 06 weeks.

Inclusion Criteria

Patients of either gender having age range 18-60 years, who are neurologically symptomatic (GCS < 15) and presenting within 24-48 hours of the development of symptomatology and having a definite diagnosis of CSDH on plain CT brain. Also, asymptomatic patients having a definite diagnosis of CSDH on neuro-imaging but with maximum thickness of hematoma greater than 1 cm.

Exclusion Criteria

Patients with recurrent hematomas, where surgical treatment is not required because of the clinical status or the size of hematoma, where other drainage procedures are indicated, ipsilateral hematomas where CSF diversion procedure within 06 months has been done and mixed density/intensity lesions or lesions with internal septations on neuro-imaging.

Data Collection Procedure

After permission from the ethical committee of hospital, patients with CSDH presenting to Neurosurgery Department Lady Reading Hospital through outpatient and emergency departments were approached. Those who fulfilled the inclusion criteria were included in the study. Informed consent was taken. These patients were further assessed through a detailed history, including biodata, onset and course of symptoms, previous falls, minor head injuries, ischemic heart diseases, coagulopathies, medications and alcohol or drug abuse. A thorough physical and neurological examination followed by necessary investigations were performed. Diagnosis of CSDH was made on the basis of clinical and radiological findings including plain CT brain. The patient contact number was taken for further correspondence. The procedure was carried out either under general or local anesthesia (depending on the pre op clinical condition) and aseptic measures. About 2 cm linear scalp incision was made followed by formation of about 1 cm burr hole in the skull bone over the site of maximum thickness of hematoma and linear durotomy. The tip of a 14 F Foley's catheter was placed in the subdural space and secured by instilling 2 ml of saline in the balloon. The other end was brought out through a separate small stab wound, made about 5 cm away from the first incision and attached to a closed drainage bag placed at the foot end of the patient for passive drainage of the hematoma. The patient was kept in supine position and the closed drainage system was removed on the 2nd post op day. The patients were followed up for up to 06 weeks for clinical improvement either through OPD or in ward. Data was recorded in a predesigned Proforma.

Statistical Analysis

Descriptive statistics like mean ± S.D was calculated for quantitative variables like age and initial GCS in SPSS 22. Frequency/percentage were calculated for categorical variables like gender and outcomes both favorable and unfavorable. Surgical outcome was stratified among age, gender and initial GCS to see the effect modifiers.

RESULTS

The mean age of the patients was 37.31 +/-10.74 years (n = 116). Based on age, patients were divided into03 different groups. Out of 116 patients included in the study, there were 69% male and 31% female patients respectively.

Mean baseline GCS of the sample was 10.4 +/- 2.15. Based on the admission GCS score, patients were divided into 3 classes. Class I with GCS 13-14, Class II with GCS 9-12 and Class III with GCS 3-8 (Table 2).

All the patients were subjected to standard single burr hole craniostomy and discharged on the 4th postop day. Follow up was advised at the end one week then of 6th postop week. On follow up, GOS of the sample was 4.04 +/- 0.75 (Table 3).

Favorable and unfavorable outcomes were observed in 84.48% and 15.52% of the patients respectively (Table 4).

Major post op complications were an incision site pain and nursing in supine position till the catheter was in situ. Clinically insignificant pneumocephalus and residual hematoma were noted on post op CT brains in 03 and 07 patients respectively. No radiological and clinical improvement was noted in 02 patients, so they were subjected to other drainage procedures. Due to co morbidities and poor pre op conscious level 03 patients died in the post op period. Surgical site infection, which was treated conservatively was observed in 02 patients. No clinical and radiological recurrence of the hematoma was noted at the end of follow-up in all those patients who had improved after the first procedure. Favorable outcome was stratified with regards to age groups, gender and classes of GCS on the baseline (Table 5-7).

TABLE 1: *Age Wise Distribution of the Sample (n = 116).*

	N	**Range**	**Min**	**Max**	**Mean**	**SD**
Age of the patient	116	26.00	34.00	60.00	39.3198	10.74393
Age Groups			**Frequency**		**Percent**	
30.01 to 40.00 years			06		5.17	
40.01 to 50.00 years			47		40.52	

50.01 years & above	63	54.31
Total	116	100.0

Table 2: *Baseline Glasgow Coma Scale (n = 116).*

	N	Range	Min	Max	Mean	SD
Baseline Glasgow Coma Scale	116	11.00	3.00	14.00	10.4138	2.15918

GCS Class at Baseline	Frequency	Percent
Class III (GCS 3-8)	18	15.52
Class II (GCS 9-12)	55	47.41
Class I (GCS 13-14)	43	37.06
Total	116	100.0

Table 3: *Follow-up Glasgow Outcome Scale (n = 116).*

	n	Range	Min	Max	Mean	SD
Follow up Glasgow outcome score	116	4.00	1.00	5.00	4.0431	0.75056

Table 4: *Frequency of Favorable Outcome (n = 116).*

Favorable Surgical Outcome	Frequency	%
Yes	98	84.48
No	18	15.52
Total	116	100.0

Table 5: *Age Group Wise Stratification of Favorable Surgical Outcome (n = 116).*

Age Groups	Favorable surgical outcome		Total	p-value
	Yes	No		
30.01 to 40.00 years	06	0	06	
40.01 to 50.00 years	45	02	47	
50.01 years & above	47	16	63	
Total	98	18	116	

Table 6: *Gender Wise Stratification of Favorable Surgical Outcome (n = 116).*

Gender of the patient	Favorable Surgical Outcome		Total	p-value
	Yes	No		
Male	67	13	80	0.002

Female	31	05	36	
Total	98	18	116	

Table 7: *Baseline GCS Class Wise Stratification of Favorable Surgical Outcome (n = 116).*

GCS Class at Baseline	Favorable Surgical Outcome		Total	p-value
	Yes	No		
Class III (GCS 3-8)	0	18	18	0.001
Class II (GCS 9-12)	55	0	55	
Class I (GCS 13-14)	43	0	43	
Total	98	18	116	

DISCUSSION

CSDH is defined as an encapsulated dark red liquefied blood collection, typically requiring about 3 weeks to mature. It commonly occurs in older males addicted to alcohol and having a history of trivial head injury and accompanying coagulopathy. The mortality rate is from 8% to 15.6%.[11-15] However, in specific patient populations, like those suffering from coagulation disorders and old age, show an elevated mortality rate.[16]The preferred surgical method continues to attract debate. There is a lack of uniformity about the treatment strategies for CSDH amongst various surgeons. There is also disagreement about the use of drain, irrigation and steroids.[17-19]

In the literature, multiple authors have assessed the outcome of patients with CSDH, who were surgically treated regarding factors such as bilateral localization, admission GCS and surgical method, recurrence rate, putting or not of drainage systems, drained blood volume, etc., but the results were not always consistent.[19-23] So many different techniques are available to open the skull for removal of subdural hematomas. These include twist drill craniotomies (performed with drills 3 to 5 mm in diameter), burr hole craniotomies (performed with drills 9 to 22 mm in diameter), craniotomies (openings more than 30 mm in diameter), craniotomies (raising a bone flap either free or osteoplastic).[24] Some surgical neurologists make a single burr hole while others like to perform two.[25,26] In order to wash out the blood collection some surgeons prefer irrigation of the subdural space while others avoid it because it may cause introduction of air in to the subdural space leading to recurrence of the hematoma.[27,28] These and other aspects of the treatment are a matter of dispute among neurosurgeons. The dilemma regarding the surgical management of CSDH require a systematic review analyzing the available evidences.[29,30]

The most efficient option for drainage of CSDH is burr hole craniostomy. It is associated with less complications and recurrence rate.[30-32] Management of CSDH with one burrhole and closed drainage system under local anesthesia is effective, simple and safe.[33] Neurosurgeons vary in their approaches to use of one or two burr holes. Single burr hole craniostomy and closed drainage system could be sufficient to drain CSDH with lower or similar recurrence rate, as compared to two burr holes group.[30,31,34] Conversely, single burr hole drainage has been found to be responsible for a significantly elevated postoperative recurrence rate, higher wound infection and prolonged hospitalization as compared to two burr holes drainage.[35] Antunes et al. reported a mortality rate of 15.6% in a series of 100 patients older than 75 years.[12] This percentage is more than the mortality rates found in other series, which did not specifically address the geriatric population; 0.5%[15], 1.5%[36], 3.4%[37], 4.4%[38] and 8%.[39] However, Ramachandran et al and Gonzalez et al. showed in their publications that poor outcome and higher mortality rates were not associated with recurrence.[40,41]

In a retrospective study by Tsai et al, the outcome of unilateral and bilateral hematomas were compared. It was concluded that although the symptomatology of raised intracranial pressure was much obvious in patients with hematoma bilaterally, the post op outcome was almost same in both groups.[42] Admission GCS score is another significant factor determining the

outcome. Amirjamshidi et al. showed in consecutive papers that low admission GCS scores lead to poor outcomes, as this is measured by GOS and elevated mortality.[43,44] Our data is in line with these results, proving that cases with an admission GCS score ≥9 show favorable outcome. Sambasivan performed a large study extending over a 30 year period, in which 2300 patients of CSDH were diagnosed and treated. The age range of the sample was from 24-59 years with a male preponderance of 5:1.[15] A positive history of trivial head trauma in the past will be found in 25-75% of patients, while 25-48% would be negative for any such history.[45-47] The most frequent risk factors for the formation of CSDH are falls and antithrombotic therapy.[48] Post-operative complications in the form of intracerebral hemorrhage, hematoma recurrence, pneumocephalus and brain collapse may involve some patients. Mortality varies from 0-8%, depending on the pre op clinical condition. Subdural empyema occurred in 2% of the cases, especially when the drain was left in situ for more than 72 hours. Long term epilepsy not requiring antiepileptic is a rare complication, in most of the case series. Among other complications are the inability of the cortex to re expand, intra cerebral bleed and tension pneumocephalus. Finally, a permanent neurological deficit can occur in 10% of the patients.[48,49]

Recurrence of the hematoma was noted in 17 (4.6%) patients and most of them (65.0%) were treated by aspiration through the previous burr hole. Favorable outcome was observed in 98.6% patients. Those with poor outcome were in coma preoperatively. This study concluded that one burr hole evacuation with local anesthesia is sufficient in most of the patients and the outcome was favorable even in the elderly provided they are presented before going into coma.[34] History of trivial head trauma was positive in 60.8% of the cases. The median GCS at the time of admission was 14. The hematoma was left sided in 64 patients while it was right sided in 42. In 19 patients (15.2%) the hematoma was on both sides. In 93.6% of the cases use of the drainage systems was done. The recurrence rate was 8.8%. At 6 months follow up good outcome was observed in 103 patients. The mortality rate seen was11.2%. Patients having GCS ≥ 9 on admission showed favorable outcome, while patients with recurrent hematomas showed a worst outcome.[50]

CONCLUSION

This study suggested that:

1. CSDH managed with single burr hole subdural catheter drainage is associated with a high frequency of a favorable outcome in terms of Glasgow Outcome Score.
2. Admission GCS score of less than 8 and advanced age are both associated with lesser frequency of favorable outcome and more prone to unfavorable outcomes.
3. More studies are recommended in terms of mortality and recurrence rates of patients having CSDH subjected to single burr hole catheter drainage to develop future consensus on its routine utilization.

ROLE OF AUTHORS

Dr. Hanifur Rahman: Paper Editing.
Dr. Mumtaz Ali: Results Writing.
Dr. Ramzan Hussain: literature review.
Dr. Muhammad Idrees Khan:
Dr. Anisa Sundal: Results Writing.
Dr. Naseer Hassan: Study Design.

Additional Information
Disclosures and Conflict of Interests:
Authors report no conflict of interest.
Human Subjects: Consent was obtained by all patients/participants in this study.
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Address for Correspondence:
Dr. Hanif-ur-Rahman
Khyber Teaching Hospital, Peshawar
Email: neurosurgeonhanif@gmail.com

REFERENCES

1. Ducruet AF, Grobelny BT, Zacharia BE, Hickman ZL, DeRosa PL, Anderson K, et al. The surgical management of chronic subdural hematoma. Neurosurg Rev. 2012; 35 (2): 155-69.

2. Sousa BE, Brandao SFL, Tavares BC, Borges CBI, Neto FGN and Kessler MI. Epidemiological characteristics of 778 patients who underwent surgical drainage of chronic subdural hematoma in brasilia, brazil. BMC Surg. 2013; 13: 5.
3. Singh KM, Suryanarayanan B, Choudhary A, Prasad A, Singh S, Gupta NL. A prospective randomized study of drain versus no drain after burr-hole evacuation of chronic subdural hematoma. Neurol India, 2014; 62 (2): 169-74.
4. Chari A, Kolias GA, Santarius T, Bond S and Hutchinson JP. Twist drill craniostomy with hollow screws for evacuation of chronic subdural hematoma. J Neurosurg. 2014; 121: 176-83.
5. Lega CB, Danish FS, Malothra RN, Sonnad SS and Stein CS. Choosing the best operation for chronic subdural hematoma: a decision analysis. J Neurosurg. 2010; 113: 615-21.
6. Belkhair S, Pickett G. One versus double burr holes for treating chronic subdural hematoma Meta-Analysis. Can J Neurol Sci. 2013; 40: 56-60.
7. Latini FM, Fiore AC, Romano ML, Spadaro E, Zorrilla PJ, Gonorazky ES. Minimally invasive treatment of chronic subdural hematoma in adults. Results in 116 patients. Neurologia. 2012; 27 (1): 22-7.
8. Lee YG, Oh HC, Shim SY, Yoon HS, Park CH, Park OC, et al. Comparison of drainage volume of chronic subdural hematoma according to drainage catheter type. Yonsei Med J. 2013; 54 (5): 1091-7.
9. Rehman R, Khattak A, Azam F, Alam W, Ullah A. Outcome of chronic subdural hematoma patients treated by two burr holes method. GJMS. 2010; 8 (2): 161-5.
10. Ishibashi A, Yokokura Y and Adachi H. A comparative study of treatments for chronic subdual hematoma:Burr hole drainage versus Burr hole drainage with irrigation. Kurume Med J. 2011; 58: 35-9.
11. Matsumoto K, Akagi K, Abekura M, Ryujin H, Ohkawa M, Iwasa N, Akiyama C. Recurrence factors for chronic subdural hematomas after burr-hole craniostomy and closed system drainage. Neurol Res. 1999; 21 (3): 277-80.
12. Antunes DG, Alliez RJ, Eva L, Reynier Y, Alliez B. Analysis of the surgical treatment of chronic subdural hematoma in 100 elderly patients. Arq Bras Neurocir. 2006; 25: 156–60.
13. Ernestus RI, Beldzinski P, Lanfermann H, Klug N. Chronic subdural hematoma: surgical treatment and outcome in 104 patients. Surg Neurol. 1997 Sep; 48 (3): 220-5.
14. Foelholm R, Waltimo O. Epidemiology of chronic subdural haematoma. Acta Neurochir (Wien). 1975; 32 (3-4): 247-50.
15. Sambasivan M. An overview of chronic subdural hematoma: experience with 2300 cases. Surg Neurol. 1997 May; 47 (5): 418-22.
16. Yasuda CL, Morita ME, Nishimori FY, Yasuda AM, Alves HL. [Chronic subdural hematoma: study of 161 patients and the relationship with coagulation abnormalities]. Arq Neuropsiquiatr. 2003 Dec; 61 (4): 1011-4.
17. 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.
18. 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.
19. Torihashi K, Sadamasa N, Yoshida K, Narumi O, Chin M, Yamagata S. Independent predictors for recurrence of chronic subdural hematoma: a review of 343 consecutive surgical cases. Neurosurgery, 2008 Dec; 63 (6): 1125-9.
20. Torihashi K, Sadamasa N, Yoshida K, Narumi O, Chin M, Yamagata S. Independent predictors for recurrence of chronic subdural hematoma: a review of 343 consecutive surgical cases. Neurosurgery, 2008 Dec; 63 (6): 1125-9.
21. LaLonde AA, Gardner WJ. Chronic subdural hematoma. Expansion of compressed cerebral hemisphere and relief of hypotension by spinal injection of physiologic saline solution. New Eng J Med. 1948; 239 (14): 493-6.
22. Svien HJ, Gelety JE. On the surgical management of encapsulated subdural hematoma: A comparison of the results of membranectomy and simple evacuation. J Neurosurg. 1964; 21 (3): 172-7.
23. Markwalder T-M, Heuler H-J. Influence of neomembranous organization, cortical expansion and subdural pressure on the post-operative course of chronic subdural haematoma – An analysis of 201 cases. Acta Neurochirurgica. 1986; 79: 100-6.
24. 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.
25. Kansal R, Nadkarni T, Goel A. Single versus double burr hole drainage of chronic subdural hematomas. A study of 267 cases. J Clin Neurosci. April 2010; 17 (4): 428-9.
26. Han HJ, Park CW, Kim EY, Yoo CJ, Kim YB. One vs. two burr holecraniostomy in surgical treatment of chronic subdural hematoma. J Korean Neurosurg Soc. 2009; 46: 87-92.
27. Kubo S, Nakata H. Subdural hematoma recurrence. J Neurosurg. 2001; 94: 1023-4.
28. Oishi M, Toyama M, Tamatani S, Kitazawa T, Saito M. Clinical factors of recurrent chronic subdural hematoma. Neurologia Medicochirurgica. 2001; 41: 382-6.

29. Rabow C. Chronic subdural hematoma. Acta Neurochirurgica. 2001; 143: 619.
30. 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.
31. Gökmen M, Sucu HK, Ergin A, Gökmen A, Bezircio Lu H. Randomized comparative study of burr‐hole craniostomy versus twistdrill craniostomy; surgical management of unilateral hemisphericchronic subdural hematomas. Zentralbl Neurochir. 2008; 69: 129‐33.
32. Krupa M. Comparison of two surgical methods as to early results inchronic subdural hematoma. Ann Acad Med Stetin. 2009; 55: 39‐47.
33. Soto‐Granados M. Treatment of chronic subdural hematoma through aburr hole. Cir Cir. 2010; 78: 203‐7.
34. Khadka NK, Sharma GR, Roka YB, Kumar P, Bista P, AdhikariD,et al. Single burr hole drainage for chronic subdural haematoma. Nepal Med Coll J. 2008; 10: 254‐7.
35. Taussky P, Fandino J, Landolt H. Number of burr holes as independentpredictor of postoperative recurrence in chronic subdural haematoma. Br J Neurosurg. 2008; 22: 279‐82.
36. Robinson RG. Chronic subdural hematoma: surgical management in 133 patients. J Neurosurg. 1984 Aug; 61 (2): 263-8.
37. Zumofen D, Regli L, Levivier M, Krayenbühl N. Chronic subdural hematomas treated by burr hole trepanation and a subperiostal drainage system. Neurosurgery, 2009 Jun; 64 (6): 1116-21.
38. Hamilton MG, Frizzell JB, Tranmer BI. Chronic subdural hematoma: the role for craniotomy reevaluated. Neurosurgery, 1993 Jul; 33 (1): 67-72.
39. Camel M, Grubb RL Jr. Treatment of chronic subdural hematoma by twist-drill craniotomy with continuous catheter drainage. J Neurosurg. 1986 Aug; 65 (2): 183-7.
40. Ramachandran R, Hegde T. Chronic subdural hematomas--causes of morbidity and mortality. Surg Neurol. 2007 Apr; 67 (4): 367-72.
41. Gelabert-González M, Iglesias-Pais M, García-Allut A, Martínez-Rumbo R. Chronic subdural haematoma: surgical treatment and outcome in 1000 cases. Clin Neurol Neurosurg. 2005 Apr; 107 (3) :223-9.
42. Tsai TH, Lieu AS, Hwang SL, Huang TY, Hwang YF. A comparative study of the patients with bilateral or unilateral chronic subdural hematoma: precipitating factors and postoperative outcomes. J Trauma. 2010 Mar; 68 (3): 571-5.
43. Amirjamshidi A, Abouzari M, Eftekhar B, Rashidi A, Rezaii J, Esfandiari K, Shirani A, Asadollahi M, Aleali H. Outcomes and recurrence rates in chronic subdural haematoma.Br J Neurosurg. 2007 Jun; 21 (3): 272-5.
44. Amirjamshidi A, Abouzari M, Rashidi A. Glasgow Coma Scale on admission is correlated with postoperative Glasgow Outcome Scale in chronic subdural hematoma. J Clin Neurosci. 2007 Dec; 14 (12): 1240-1.
45. Kotwica Z, Brzezinski J. Clinical course and theresults of the treatment of unilateral chronic subdural Hematoma. Neurol Neurochir Pol. 1992; 1: 293-9.
46. Sakho Y, Kabre A, Badiane SB, Ba MC, Gueye M. Chronic subdural hematoma of the adult in Senegal. Dakar Med. 1991; 36: 94-104.
47. Busch G, Ramm K. Clinical studies on chronic subdural haematomas in 140 adults. Neurochirurgia (Stuttg). 1980; 23: 224-8.
48. Liliang PC, Tsai YD, Liang CL, Lee TC, Chen HJ. Chronic subdural haematoma in young and extremely aged adults: a comparative study of two age groups. Injury, 2002; 33: 345-8.
49. Giray S, Sarica FB, Sen O, KizilkilicO. Parkinsonian syndrome associated with subacute. subduralhaematoma and its effective surgical treatment: a case report. Neurol Neurochir Pol. 2009; 43: 289-92.
50. De-Araújo-Silva DO, Matis GK, Costa LF. Chronic subdural hematomas and the elderly: Surgical results from a series of 125 cases: Old “horses” are not to be shot! Surg Neurol Int. 2012; 3: 150.

Date of Submission: 5-5-2019
Date of Revision: 20-05-2019
Date of Online Publishing: 01-06-2019
Date of Print: 15-6-2019