ORIGINAL RESEARCH PAPER VOLUME-6 | ISSUE-8 | AUGUST - 2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

USE OF SUBDURAL DRAINS FOR MANAGEMENT OF CHRONIC SUBDURAL HEMATOMA AFTER BURR HOLES CRANIOSTOMY

Neurosurgery

Kumar Sanjeev Assistant Professor, Department of Neurosurgery Pandit Jawahar Lal Nehru Memorial Medical College and Hospital, Raipur (Chhattisgarh) India.

Sahana Debabrata Assistant Professor, Department of Neurosurgery Pandit Jawahar Lal Nehru Memorial Medical College and Hospital, Raipur (Chhattisgarh) India.

Sahu Rajiv Associate Professor, Department of Neurosurgery Pandit Jawahar Lal Nehru Memorial Medical College and Hospital, Raipur (Chhattisgarh) India. Corresponding Author

Jain Amit Assistant Professor, Department of Neurosurgery Pandit Jawahar Lal Nehru Memorial Medical College and Hospital, Raipur (Chhattisgarh) India.

Singh Deepak Associate Professor, Department of Anaesthesia Pandit Jawahar Lal Nehru Memorial Medical College and Hospital, Raipur (Chhattisgarh) India.

ABSTRACT

Introduction: Chronic Sub dural Hematoma (SDH) is a common problem encountered in neurosurgical practice. Surgical intervention has remained the gold standard. Even though, there is no clear consensus regarding different mode of surgical interventions. Published practice parameters are highly controversial till date. We have tried to address one of such controversies in this present article.

Material and Methods: This is a retrospective review of 216 hemispheres drained through double burr holes craniostomy. The decisions to place subdural drain were on surgeon's preference and beliefs. Radiological and symptomatic recurrences were noted in both drain and no drain group.

Results: Cohort was divided into two groups, drain versus no drain. Subdural drain was placed in 94/216 (43.51%) hemispheres. No drain was placed in 122/216 (56.48%) hemispheres. In drain group, there were 23 (24.46%) radiological recurrence of which only 5 (5.31% of drain group) were symptomatic. In no drain group, there were 39 (31.96%) radiological recurrences and 11 (9.01% of no drain group) symptomatic recurrences. The difference was not statistically significant.

Conclusions: The use of subdural drain was associated with lower radiological and symptomatic recurrences without any statistical significance. Only one fourth of radiological recurrences became symptomatic requiring re-intervention. More randomised control trials are required to formulate guidelines.

KEYWORDS:

Chronic SDH, Burr Hole Craniostomy, Subdural drain, Recurrence in Chronic SDH

INTRODUCTION:

Chronic subdural hematoma (SDH) has been defined as subdural collection of blood of more than three weeks duration. Surgical intervention for chronic subdural hematoma is one of the most rewarding surgeries in neurosurgical practice. This disease mostly affects the elderly population and as population in general is increasing due to increase in life expectancy; more and more cases are being diagnosed and treated. Various surgical methods have been discussed in the past and practice parameters and beliefs vary between different institutions. There is still a lack of consensus regarding optimal management and no definite guidelines have been laid down. Various procedures used include twist drill and aspiration, burr-hole craniostomy with or without subdural drain, single versus two burr hole craniostomy and craniotomy. This study focuses on the outcome of two burr holes craniostomy with or without subdural drain placement with respect to radiological and symptomatic recurrence.

MATERIALAND METHODS:

This is a retrospective study conducted from June 2012 to June 2017 at the department of Neurosurgery, Pt. JLNM Medical College Raipur. Total 298 patients were admitted with chronic subdural hematoma in neurosurgery department. Data were recorded from case files, operation record register and radiological department. The inclusion criteria were all patient with symptomatic chronic subdural hematoma who underwent two burr holes craniostomy. Patient who underwent craniotomy for chronic SDH, patient on anticoagulants or antiplatelet drugs and patient who died or lost to follow up in which recurrence could not be identified, were excluded from the study. Out of total 298 chronic SDH patients, 29 underwent craniotomy, 34 had significant coagulation or platelet dysfunction, 14 died and 35 were lost to follow up. After exclusion of these cases total 183 number of patients underwent two burr holes craniostomy and were included in this study. Thirty three patients had bilateral chronic subdural hematoma. Total number of hemispheres drained was 216. Demographic, clinical and radiological parameters were recorded. The outcomes were noted in form of radiological and symptomatic recurrence in both groups of drain versus no drain. Radiological recurrence was defined as any asymptomatic collection which was persisting or recurrent, revealed on follow up scan at the end of one month. Symptomatic recurrence was defined as any symptomatic collection either persisting or recurrent at any duration of time. All patients underwent surgery under local anaesthesia with placement of two burr holes, one in frontal and second in parietal. Dura was coagulated and opened widely. Outer membrane perforated to drain subdural fluid, and residual collection was evacuated with copious irrigation of normal saline until effluent fluid burr holes was clear. Subdural drain was placed on surgeon's preference and belief. Post operatively patient received adequate hydration in supine position with high flow oxygen for 48 hours. Fisher's exact test and Chi square test was used for statistical analysis.

RESULTS:

Out of 183 patients, there were 151 males and 32 females. The mean age of presentation was 51.03 years (range 22-83 years). Seventy six (41.53%) patients could remember the history of trauma. Clinical presentation was only headache in 102/183(55.73%), headache with contralateral deficit in 36/183 (19.67%), headache with decreased consciousness level in 29/183 (15.84%) and headache with contralateral deficit with decreased conscious level in 16/183 (8.74%) of cases. Bilateral chronic SDH was present in 33 (18.03%) cases. Total number of hemispheres drained was 216. Subdural drain was used in 94/216 (43.51%) hemispheres. No drain was placed in 122/216 (56.48%) hemispheres. The decision of drain placement was surgeon's choice. The cohort was divided into two groups – drain group or no drain group. In drain group, there were 23 (24.46%) radiological recurrence of which only 5 (5.31% of drain group) were symptomatic. Symptomatic recurrences were 21.73% of radiological recurrences requiring interventions. In no drain group, there were 39 (31.96%) radiological recurrences and 11 (9.01% of no drain group) symptomatic recurrences. Symptomatic recurrences were 28.20% of radiological recurrences requiring interventions. Total numbers of radiological recurrences in the study population were 62/216 (28.70%). Total numbers of symptomatic recurrences in the study

population were 16/216 (7.40%). Out of total recurrences only 16/62 (25.80%) became symptomatic. Statistical analysis did not reveal any significant difference in radiological and symptomatic recurrences between the groups. The results has been summarised in Table.

Total Number of cases	183
Bilateral Chronic SDH	33
Total number of hemispheres drained	216
Mean Age	51.03 years (range 22-83 years)
Male: Female ratio	151:32, 4.71:1
History of Trivial Trauma	76 (41.53%)
Presentation a. Headache b. Headache with contralateral deficits c. Headache with decreased mentation d. Headache with deficit with decreased mentation	 102 36 29 16
Surgical intervention	
(1) Drain placed	94
a. Radiological Recurrence	23 (24.46%)
b. Symptomatic Recurrence	5 (5.31%)
(2) No drain placed	122
a. Radiological Recurrence	39 (31.96%)
b. Symptomatic Recurrence	11 (9.01%)

DISCUSSION:

Although trephination of skull dates back to the Neolithic period, it was Wepfer who first gave pathological description of chronic SDH, as two cases of "serum accumulation between duramater and piamater" in 1675[1]. The term pacchymeningitis hemorrhagica interna was introduced by Virchow for chronic subdural hemorrhagic collections and following failure of surgical trials via auditory meatus, it was assumed to be an incurable disorder[2]. This led to a number of unfortunate patients leading their life in mental asylums. Cushing in early twentieth century demonstrated the utility of neurosurgical procedures for chronic SDH but his work was limited by the lack of imaging modalities[3]. More patients were being diagnosed after Dandy's work on pneumoencephalography[4]. Cure rates and intervention rates improved after advent of CT scan. In the current era with better and easily availability of imaging facilities, increase in life expectancy and refinement and advancement of neurosurgical techniques, number of cases diagnosed and their outcomes have improved, considerably.

Definitive data regarding the incidence of chronic subdural hematoma, in the pre- CT era is lacking. In autopsy series published by Osler there were 197 cases of chronic subdural hematoma among 1185 cases[5]. In early CT scan era the incidence reported was 1-2 cases/100000 population per year[6]. Newer studies have reported the incidence to be as higher as 13.1 case/1,00,000[7]. Patients older than 40 years of age form almost 80 percent of cases and the peak incidence occurs in the 8th decade. In our series mean age of presentation was 51.03 years (range 22-83 years). There is a clear male gender predilection among published series[8]. We had also found similar results with male to female ratio 4.71:1.

Trauma is the most common cause of chronic SDH development. Nearly two-third of patient remember some type of trivial trauma[8,9]. In our series memorable history of trauma was present in only 41.53% of patients. Other contributing factors being atrophic brain either due to aging or chronic alcoholism, degenerative brain disease, intracranial hypotension (idiopathic or secondary to shunt over-drainage, CSF leak, repeated lumber punctures, seizures[10], use of anticoagulant or antiplatelet drugs. In our series most of the cases had an atrophic brain with or without history of trivial trauma.

The development of chronic subdural hematoma is a slow process. The inciting event is minor asymptomatic haemorrhage likely due to tearing of bridging veins. This leads to formation of clot. With time secondary changes occur in the clot. The actual pathogenesis is debatable. Various theories have been postulated. In 1932, Gardner proposed osmotic gradient theory and emphasized on increase in protein and lipid content of SDH fluid resulting increase oncotic pressure, as causative factor. This theory has been defeated by Weir et al[11] who suggested SDH fluid to be of same tonicity as CSF and blood. Microscopic examination has revealed fresh RBCs within the SDH component, along with pro-inflammatory and anti-inflammatory cells. With current understanding it appears that hematoma expansion occurs because of local angiogenesis and inflammation leading to repeated haemorrhage due to fibrinolysis (local coagulopathy). Long standing inflammation leads to formation of granulation tissue as outer membrane adhered to dura and an inner membrane close to piamater. The pressure effect by hematoma reduces the cerebral blood circulation to the underlying brain[12].

Presentation of chronic SDH varies from asymptomatic to comatose condition. Chronis SDH is asymptomatic in large number of cases. On examination they have mild cognitive impairment. Nearly two third of patients remember history of trauma[8,9]. Most patient presents with nonspecific refractory headache. The characteristic history of raised ICP type and headache increasing on head movement is found in rarely. The symptom development is slow and with recurrent bleeds they become readily symptomatic. Some patients present with neurological deficits in form of contra-lateral weakness, speech difficulties and decreased mentation. In our series only headache was seen in 55.73%, headache with contralateral deficit in 19.67%, headache with decreased consciousness level in 15.84% and headache with contralateral deficit with decreased conscious level in 8.74% of cases

Of all the controversies related to chronic subdural hematoma, radiological evaluation is an exception. They are readily diagnosed on non contrast CT scan. In cases of sub-acute subdural haematoma, subtle findings of isodense bilateral collections with effacement of sulci are seen. MRI can further delineate the diagnosis. Chronic SDH appears as crescent shaped concavo-convex collection between brain parenchyma and calvaria. When under pressure underlying sulci efface and contralateral ventricular shift becomes evident. It is not uncommon to see midline shift of more than 1 cm without much symptoms unlike in acute subdural hematoma. This happens because of the chronicity of process, allowing brain to shift and compensate for the extra intracranial volume. The occurrence of symptoms mainly depends upon individual's cerebral compliance. This is the main reason why young patients become symptomatic with thin collection in comparison to elderly with age related atrophic brain. The appearance of blood on CT scan depends upon age of blood and recurrence of haemorrhage. In early cases blood appears hyperdense. With time it looses its hyperdensity on CT scan. Mixed density hematomas are due to recurrent bleeds. There may be recent bleed in hematoma and patients present like acute SDH. Various classifications have been mentioned in the literature. Based on CT scan chronic SDH has been classified into four types by Naganuma et al[13]. They may homogenous, laminar type, layering or separated type and trabecular type. On T1WI if the haematoma is stable it appears isointense to CSF, it can appear hyperintense to CSF if there is rebleed. On T2WI if haematoma is stable it appears isointense to CSF if there is rebleed the haematoma appears hypointense; on FLAIR it appears hyperintense to CSF. MRI also helps in delineation of membranes.

The treatment strategy of chronic SDH has had a paradigm shift- from 'wait and watch' to 'watch and scan' to 'scan and treat'. There have been few reports of spontaneous resolution to suggest wait and watch policy[13]. For asymptomatic thin chronic SDH, watch and scan policy may be justified. The current practice is 'scan and treat' the symptomatic patients. Both pharmacological and surgical methods have been described. Till now no definitive class I evidences have been published in favour of medical treatment. Medical treatment has primarily been advocated in asymptomatic patients. Corticosteroids (both dexamethasone and prednisolone) had been advised for conservative management, idea being anti-inflammatory and anti-angiogenic[14,15] properties of the drugs. This use of steroid has been supported in only observational studies but there is no trial to support or refuse their use[16,17]. Recently in June 2016 SUCRE trial (RCT) was started to study the role of steroids in chronic subdural hematoma[18]. Some isolated reports have advocated the long term use of mannitol[19], but has not been supported by others. Some clinicians have used the anti-angiogenic property of angiotensin converting enzyme inhibitor with favourable results[20].

Till date surgical intervention is considered the gold standard for chronic SDH. Surgical evacuation permits the reduction in intracranial pressure and increases the flow to underlying compromised brain parenchyma. Surgical options vary from twist drill craniostomy and aspiration, burr holes craniostomy to craniotomy. Twist drill craniostomy and aspiration is a simple bed side procedure under local

anaesthesia. This procedure has been found as effective and safe as burr hole craniostomy by many surgeons[21,22,23,24,25,26]. These authors in their studies have not found any significant difference between the two arms. Weigel R et al[27] in 2003 in his evidence based review between three modalities of surgical intervention (twist drill craniostomy, burr hole craniostomy and craniotomy) found no difference in mortality among three arms, craniotomy had significantly higher morbidity in comparison to twist drill craniostomy and burr hole craniostomy, cure rates were not significantly different among procedures but there was significantly higher percentage of recurrence in twist drill craniostomy. In further elaboration twist drill craniostomy with drain had lower recurrence rate as compared to twist drill craniostomy alone. There was no difference in mortality and morbidity between drain and no drain groups. Twist drill craniostomy had inherent problems due its blind nature which can be managed by careful patient selection with sufficiently thick SDH, making craniostomy at the thickest portion of hematoma. Known complications are brain injury, significant residue, epidural hematoma formation, bleeding from dural vessels and kinking of the subdural drain. It is a very efficacious mode of drainage in frail patients with significant co-morbidities.

Burr holes craniostomy has advantages of both twist drill craniostomy and craniotomy. Hematoma can be evacuated and like craniotomy cavity may be irrigated and subdural drain can be placed. It is relatively safe, has high cure rates and low recurrence. It can be performed in local anaesthesia. Other advantages of burr hole craniostomy are, biopsy of dura mater is possible, epidural bleeding is easily managed, less chance of injury to underlying brain and it can be done safely in thin collections. There has been controversy regarding single versus two burr holes and both have been found to be equally effective in many studies. Some studies had shown that one burr hole is associated with higher recurrence rate and longer hospital stay[28]. The main advantage of two burr holes is copious irrigation is possible leading to more effective clearance of collection at the time of surgery. Another controversy is regarding use of subdural drain versus no drain. It has been evident in many studies that use of drain lowers the recurrence rates. Continuous drainage has lower recurrence rates and shorter hospital stay than one time drainage. Sarnvivad et al[29] reported 16% recurrence with use of drain and 26% recurrence without drain. In Gurelik et al[30] study, recurrence rates in the drain group was10.5 % and 19% in no drain group. There have few sharp contrasts, and other authors have failed to find any significant difference in recurrence among drain and non drain groups[31,32]. In present series there were 24.46% of radiological recurrences out of which 21.73% became symptomatic (5.31 % of drain placement cohort) when subdural drain was placed, and 31.96% radiological recurrences out of which 28.20% became symptomatic (9.01% of no drain placement cohort) when subdural drain was not placed. There was a trend towards decreased radiological and symptomatic recurrences, but failed to reach statistical significance in our study. On pubmed search there is no study which differentiates between radiological and symptomatic recurrences. We feel radiological persistence or recurrences can be seen in many but only symptomatic recurrences require re-intervention. Till date this controversy is unsolved and needs well designed randomised control trials. Although we do not have any scientific background but we feel placement of drain creates negative subdural pressure and help in brain expansion thus reducing recurrence. The position of drain placement is also controversial and attracts individual preferences. In one series it was found the frontal position of drain is associated with lower recurrence rate. There have been studies comparing the results of subdural and subgaleal or subperiosteal drains. Proponents in favour of subgaleal drains emphasize equal cure rates, lower infection and seizure rates and lower chance of acute hemorrhage due to drain tube[33,34], with a slightly higher recurrence rates than subdural drains. Duration of drainage has been studied from recurrence point of view but clear guidelines are lacking. Sindou et al[35] in his report is in favour of 48 hours drainage only while Yu GJ et al[36] advocate longer drainage period. We have adopted the strategy of keeping the drain for 48 hours.

Craniotomy is generally reserved for recurrent cases or multi-compartmental membranous type chronic SDH. The craniotomy required is usually smaller than required for acute SDH. It allows membrane excision thus allowing the brain to expand. Lee J Y et al have not found any significant advantage with partial membranectomy[37]. It requires general anaesthesia and has higher cure rate and morbidity but lesser recurrence rates. Subdural drain may be placed as per individual preference. Endoscopic evacuation has advantage of small craniostomy and direct visualisation of clots leading to more clearance[38].

Incidence of recurrence varies from 5-30% in various series. In our series total radiological recurrences were 28.70% out of which only 25.80% became symptomatic. Various factors have been studied in literature to reduce the recurrence rates after surgical evacuation. Burr hole craniostomy and craniotomy[27], double burr holes[28,34], use of subdural drains[27], intra-operative saline irrigation[39], frontal position of catheter[40], supine position for first three days[41], hyper hydration[42], use of steroids[14,15], keeping the drainage catheter for longer duration[36], subgaleal placement of drain[33], unilateral collection[43], midline shift < 5 mm[44], thickness of hematoma <1 cm[44], non-frontal basal type[44], no history of alcoholism, presence of diabetes[45], less brain atrophy[43], presence of pneumocephalus in postoperative imaging[40], homogenous type[46] on CT scan and younger age, have been found to be associated with lower recurrence rates. Separated type of chronic SDH is associated with higher recurrence rate[47]. Out of these factors only placement of subdural drain has class I evidence in literature[48].

Ivamoto et al[49] in 2016 has published comprehensive systemic review regarding surgical practice parameters. He had made following observations, on the basis of the meta-analysis – (1) that use of drains are associated with lesser recurrence rates (2) there is no significant difference in outcome between twist drill craniostomy with or without drainage, versus, one or two burr hole craniostomy, with or without drainage (3) there is no significant difference in outcome related to post-op patient head position although patient with elevated head position had lower hospital stay (4) Position of catheter tip does not change outcome, although frontal position of catheter is favoured (5) use of thrombin solution for intra operative irrigation is associated with lower recurrence rates (6) lesser duration of drainage (48 hours) is associated with less general complications without change in other outcomes (7) Use of mannitol is not justified (8) ACE inhibitors have not been found to be useful in reducing recurrences.

CONCLUSIONS:

It is clear from this discussion that most of the current management strategies are individual and institutional based. Various factors had been described associated with recurrences. The only practice which has class I evidence is placement of subdural drains. Radiological recurrence may be seen in many but does not always require re-look surgery. Other parameters in management of chronic subdural hematoma have unsolved controversies. More randomised control trials are required for proper formulation of universally accepted guideline which can help clinicians to decide between treatment modalities.

REFERENCES:

1. Hoessly GF. Intracranial haemorrhage in the seventeenth century. A reappraisal of Johann Jacob Wepfer's contribution regarding subdural hematoma. J Neurosurg. 1965;24(2):493-6.
2. Virchow R. Das hamatom der dura mater. Verh Phys Med Ges Wurzburg 1857;7:134
3. Putnam TJ, Cushing H. Chronic subdural hematoma. Arch Surg. 1925;11:329
4. Dandy WE. Ventriculography following the injection of air into the ventricles. Ann Surg. 1918;68:5
5. Osler W. The principles and practice of medicine. 4thy Ed 1901. Appleton and company New York
6. Fogelholm R, Waltimo O. Epidemiology of chronic subdural hematoma. Acta Neurochir. 1975;32:247
7. Kudo H, Kuwamura K, Izawa I et al. Chronic subdural hematoma in elderly people: present status on Awaji Island and epidemiological prospects. Neurol Med Chir 1992;32:207
8. Ernestus RI, Beldzinski P, Lanfermann H et al. Chronic subdural hematoma: surgical treatment and outcome in 104 patients. Surg Neurol 1997;48:220
9. Chen JC, Levy ML. Causes, epidemiology and risk factors of chronic sub dural hematoma. Neurosurg Clin N Am 2000;11:399
10. Kotwica Z, Brzeinski j. Epilepsy in chronic sub dural hematoma. Acta Neurochir. 1991;113:118
11. Weir B. The osmolality of subdural hematoma fluid. J Neurosurgery.1971;34:528-533
12. Yadav Y R, Parihar V, Namdev H, Bajaj J. Chronic subdural hematoma. Asian J Neurosurg. 2016;11(4): 330–342.
13. Naganuma H, Fulkamachi A, Kawakami M et al. Spontaneous resolution of chronic subdural hematoma. Neurosurgery, 1986;19:794
14. Zarkou S, Aguilar MI, Patel NP, Wellik KE, Wingerchuk DM, Demaerschalk BM. The role of corticosteroids in the management of chronic subdural hematomas: A critically appraised topic. Neurologist. 2009;15:299–302.
15. Berghauser Pont LM, Dammers R, Schouten JW, Lingsma HF, Dirven CM. Clinical factors associated with outcome in chronic subdural hematoma: A retrospective cohort study of patients on pre-operative corticosteroid therapy. Neurosurgery. 2012;70:873–80.
16. Dran G, Berthier F, Fontaine D, Rasenrarijao D, Paquis P. Effectiveness of adjuvant corticosteroid therapy for chronic subdural hematoma: A retrospective study of 198 cases. Neurochirurgie. 2007;53:477–82.
17. Sun TF, Boet R, Poon WS. Non-surgical primary treatment of chronic subdural haematoma: Preliminary results of using dexamethasone. Br J Neurosurg. 2005;19:327–33.

18. Henaux PL, Reste PJ, Laviolle B, Morandi X. Steroids in chronic subdural hematomas (SUCRE trial): study protocol for a randomized controlled trial. Trials. 2017;18(1):252.
19. Gjerris F, Schmidt K. Chronic subdural hematoma. Surgery or mannitol treatment. J Neurosurg. 1974;40(5):639-42.
20. Weigel R, Hohenstein A, Schlickum L et al. Angiotensin converting enzyme inhibition for arterial hypertension reduces the risk of recurrence in patient with chronic subdural hematoma probably by an angiogenic mechanism. Neurosurgery 2007;61:788
21. Wang, Qing-Feng MD; Cheng, Cheng MD; You, Chao MD, PhD A New Modified Twist Drill Craniostomy Using a Novel Device to Evacuate Chronic Subdural Hematoma. Medicine. 2016;95(10):3036
22. Horn EM, .ImanFeiz-Erfan, Ruth E.Bristol Robert F.Spetzler, Timothy R.Harrington Bedside twist drill craniostomy for chronic subdural hematoma: a comparative study. Surgical Neurology. 2006;65(2):150-153
23. Camel M. Twist-drill craniostomy for the treatment of chronic subdural hematoma. Neurosurg Clin N Am. 2000;11(3):515-8.
24. Lee SJ, Sun-Chul Hwang, Soo Bin Im, Twist-Drill or Burr Hole Craniostomy for Draining Chronic Subdural Hematomas: How to Choose It for Chronic Subdural Hematoma Drainage. Korean J Neurotrauma. 2016;12(2):107–111.
25. Singh SK, Sinha M, Singh VK, Parihar A, Srivastava C, Ojha BK, Chandra A. A randomized study of twist drill versus burr holes craniostomy for treatment of chronic subdural hematomas in 100 patients. Indian Journal of Neurotrauma 2011;8 (2):83-88
26. Bozkurt G, Selim A, Atilla A, Selçuk P. treatment of chronic subdural hematoma by twist drill craniostomy with irrigation. turkish neurosurgery 2006;16(1):19-24
27. Weigel R, Schmiedek P, Krauss JK. Outcome of contemporary surgery for chronic sub dural hematoma: evidence based review. J Neurol Neurosurg Psychiatry.2003;74:937
28. Taussky P, Fandino J, Landolt H. Number of burr holes as independent predictor of postoperative recurrence in chronic subdural haematoma. Br J Neurosurg. 2008;22:279–82
29. Sarnvivad P, Chiewchanvechakul W, Chumnanvej S. Chronic subdural hematoma: Drainage vs. no drainage. J Med Assoc Thai. 2011;94:1352–6.
30. Gurelik M, Aslan A, Gurelik B, Ozum U, Karadag O, Kars HZ. A safe and effectivemethod for treatment of chronic subdural haematoma. Can J Neurol Sci. 2007;34:84–7.
31. Javadi A, Amirjamshidi A, Aran S, Hosseini SH. A randomized controlled trial comparing the outcome of burr-hole irrigation with and without drainage in the treatment of chronic subdural hematoma: A preliminary report. World Neurosurg. 2011;75:731–6
32. Ahmed S, Agrawal D, Kale SS, Mahapatra AK. A comparative study of treatment of chronic subdural hematoma: Burr hole drainage versus continuous closed drainage. The Indian Journal of Neurotrauma. 2011;8:17–24.
33. Bellut D, Woernle CM, Burkhardt JK, Kockro RA, Bertalanffy H, Krayenbühl N. Subdural drain age versus subperiosteal drainage in burr-hole trepanation for symptomatic chronic subdural hematomas. World Neurosurg. 2012;77:111–8
34. 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.
35. Sindou M, Ibrahim I, Maarrawi J. Chronic sub-dural hematomas: Twist drill craniostomy with a closed system of drainage, for 48 hours only, is a valuable surgical treatment. Acta Neurochir (Wien) 2010;152:545–6.
36. Yu GJ, Han CZ, Zhang M, Zhuang HT, Jiang YG. Prolonged drainage reduces the recurrence of chronic subdural hematoma. Br J Neurosurg. 2009;23:606–11.
37. Lee J Y, Ebel H, Ernestus R, Klug N. Various surgical treatment of chronic subdural hematoma and outcome in 172 patients: is membranectomy necessary? Surg Neurol 2004;61:523-8
38. Mobbs R, Khong P. Endoscopic-assisted evacuation of subdural collections. J Clin Neurosci. 2009;16:701–4.
39. Gurunathan J. Treatment of chronic subdural hematoma with burr-hole craniostomy and irrigation. Indian J Neurotrauma 2005; 2:127-130.
40. Nakaguchi H, Tanishima T, Yoshimasu N. Relationship between drainage catheter location and postoperative recurrence of chronic subdural hematoma after burr-hole irrigation and closed-system drainage. J Neurosurg 2000; 93:791-795.
41. Abouzari M, Rashidi A, Rezaii J, Esfandiari K, Asadollahi M, Aleali H, Abdollahzadeh M. The role of postoperative patient posture in the recurrence of traumatic chronic subdural hematoma after burr-hole surgery. Neurosurgery 2007; 61:794-797.
42. Janowski M, Kunert P. Intravenous fluid administration may improve post-operative course of patients with chronic subdural hematoma: A retrospective study. PLoS One. 2012;7:e35634.
43. Torihashi K, Sadamasa N, Yoshida K, Narumi O, Chin M, Yamagata S. Independent predictors for recurrence of chronic subdural hematoma: a review of 3 consecutive surgical cases. Neurosurgery 2008; 63:1125-1129.
44. Stanisic M, Lund-Johansen M, Mahesparan R. Treatment of chronic subdural hematoma by burr-hole craniostomy in adults: influence of some factors on postoperative recurrence. Acta Neurochir (Wien) 2005; 147:1249-1256.
45. Yamamoto H, Hirashima Y, Hamada H, Hayashi N, Origasa H, Endo S. Independent predictors of recurrence of chronic subdural hematoma: results of multivariate analysis performed using a logistic regression model. J Neurosurg 2003; 98:1217-1221.
46. Nakaguchi H, Tanishima T, Yoshimasu N. Factors in the natural history of chronic subdural hematomathat influence their post operative recurrence. J Neurosurg 2001;95:256-262
47. Shakal AAS, Gamel EEE, Farid AM. Chronic subdural hematoma: complication avoidance. Tanta medical journal 2014,42(1):6-13
48. 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.
49. Ivamoto HS, Lemos HP, Atallah AN. Surgical Treatments for Chronic Subdural Hematomas: A Comprehensive Systematic Review. World Neurosurg. 2016; 86:399-418