

Original Article**Relationship Between Recurrence of Chronic Subdural Hematoma with its Preoperative Volume**Saha K¹, Quader M², Karim MR³, Sarkar T⁴, Khan AI⁵, Uddin MK⁶**Conflict of Interest:** There is no conflict of interest relevant to this paper to disclose.**Funding Agency:** Was not funded by any institute or any group.**Contribution of Author:** Principal Investigator- Dr. Kamalesh Saha**Manuscript Preparation-** Dr. Mahfujul Quader, Dr. Md. Rabiul Karim**Data Collection-** Dr. Tapas Sarkar, Dr. Anisul Islam Khan**Editorial Formatting:** Prof. Md. Kamal Uddin**Copyright:** ©2021 bang.BJNS published by BSNS. This published by BJNS. This article is published under the creative commons CC-BY-NC license. This license permits use distribution (<http://creativecommons.org/licenses/by-nc/4.0/>) reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.**Received:** 04 March, 2021**Accepted:** 17 June, 2021**Abstract:****Background:** Chronic subdural hematoma (CSDH) is commonly encountered in neurosurgical practice. However, surgical evacuation remains complicated by a high rate of recurrence.**Objective:** To assess the relationship between preoperative volume of chronic subdural hematoma and its post-operative recurrence.**Methods:** This hospital based prospective observational study was carried out in the Department of Neurosurgery, Chittagong Medical College Hospital (CMCH), Chattogram during April 2017 to October 2018. A total of 130 patients clinically and radiologically diagnosed with CSDH and underwent surgery were enrolled in the study. Patients were followed up for 6 months postoperatively to observe the recurrence rate by symptom evaluation and radiological investigation.**Results:** Mean age of the study population was 65.77 (± 14.83) years with a range of 18-95 years where 81.5% were male. Among the patients, 51.5% (n=67) had history of trauma and 16.2% (n=21) used anti-coagulant. CT scan finding showed that 20.8% (n=27) had bilateral hematoma, 73.8% (n=96) had ≥ 2 cm thickness of hematoma whereas 70.8% (n=92) had ≥ 1 cm midline shifting. The mean pre-operative volume was 133.36 (± 60.26) ml where 40.0% (n=52) had < 115 ml and 60.0% (n=78) had ≥ 115 ml of pre-operative volume. Recurrence of CSDH was observed in 10.8% (n=14) patients. Patients with bilateral hematoma collection, ≥ 2 cm hematoma thickness, ≥ 115 ml pre operative volume and patients who used anti-coagulants significantly ($p < 0.05$) more recurrence of CSDH. There was a moderate correlation between pre operative CSDH volume and post operative recurrence, which was significant ($r_s = .598, p < 0.001$).**Conclusion:** There is a significant moderate correlation between pre operative CSDH volume and postoperative recurrence.**Key words:** Chronic subdural hematoma, recurrence, preoperative volume.

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Introduction:

Chronic Subdural hematoma (CSDH) is one of the commonest neurosurgical disorders and especially prevalent among the elderly, prevalence is 58 per 100000 per year. Recurrence of chronic subdural hematoma is a problem accounting from 5-30% after operation.¹

CSDH is an encapsulated collection of old blood mostly or totally liquefied and located between dura mater and arachnoid.

The preoperative hematoma volume determined using a computer-assisted volumetric technique was a powerful estimator of hematoma size. A prospective study found that the preoperative hematoma volume

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was a predictor of postoperative recurrence. Additionally, the study also found that the prognosis of no recurrence was very high (94.4 %) if the preoperative hematoma volume was under 115 ml, consistent with a general consideration that patients with large CSDH are at increased risk for the recurrence.²

Therefore, this present study had been carried out to find out the relationship between preoperative volume of chronic subdural hematoma and its post-operative recurrence.

Materials and Methods:

Type of study: This was a hospital based prospective observational study.

Study period: The study was conducted from April 2017 to October 2018.

Place of study: The study was conducted in Department of Neurosurgery, Chittagong Medical College Hospital (CMCH), Chattogram, Bangladesh.

Study population: All the patients admitted in the neurosurgery ward of CMCH with a diagnosis of CSDH during the study period were the population of the study.

Sampling method: Purposive sampling was adopted to select the sample.

Sample size: 130

General objective: To assess the relationship between preoperative volume of chronic subdural hematoma and its post-operative recurrence.

Specific objectives: To find out the socio-demographic and clinical characteristics of the patients with chronic subdural hematoma (CSDH), to identify the risk factors of recurrence of CSDH, and to find out the relationship between preoperative volume of chronic subdural hematoma and postoperative recurrence.

Inclusion criteria:

- 1) All CSDH patients who were confirmed radiologically by CT scan as a chronic subdural hematoma, irrespective of age and sex.
- 2) Patient who agreed to include in this study.

Exclusion criteria:

- 1) Patients with end organ damage.
- 2) Patients with other intracranial pathology like space occupying lesion.

Data collection tool: Predesigned structured data collection form.

Study procedure: After detail history taking and clinical examinations, diagnosis of CSDH was established on CT scans for 138 patients. Volume of CSDH was measured by computerized software (:// Syngoviaworkstion/volume measurement) in 90 patients. For remaining 48 patients' volume was measured by using formula $XYZ/2$ (Sucu 2005) (X=Maximum length of the hematoma, Y= Breadth at the thickest point of the hematoma, Z= Height of the hematoma in cm). Others features that were recorded from CT scan were site, midline displacement (measured by the displacement of septum pellucidum in centimeters from the midline), thickness of hematoma (in cm). Both sided collections were added and used as a hematoma volume.

In all patients, surgery was performed under general anesthesia. Evacuation of CSDH was done by single burr hole in 86 patients, double burr hole in 51 patients and craniotomy in 1 patient. Infusion set cutting the distal end was used as drain tube which was used as extra-osseous over the single burr hole procedure and in double burr hole procedure drain tube was tunneled subcutaneously from the parietal hole, frontal burr hole was the exterior site. Exterior site of drain was 5 cm apart from original scalp incision.

After operation first CT scan was done within 7th postoperative day and further CT scan was done if required according to the symptoms and sign of the patient.

Re-operation was indicated if the original neurological deficit increased, recurred or did not improve, or a new neurological deficit arose that needed further surgery (burr hole evacuation, percutaneous aspiration, craniotomy or craniectomy).

Follow up schedule: 1st follow up recorded- on 7th POD (Post operative day), 2nd follow up – on 1st month, 3rd follow up – on 3rd month, 4th follow up – on 6th month. During the follow up period clinical symptoms and signs were assessed and CT scan was done if there was any doubt of recurrence. All patients or attendants were requested to contact with the researcher at any time without any hesitation.

Statistical analysis: After completion of data collection, the data were checked and edited manually and verified before tabulation. Data were coded, entered and analyzed in a computer. The statistical analysis

was conducted using SPSS (statistical package for social science) version 20 statistical software. The findings of the study were presented by frequency, percentage in tables and graphs. Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample.

Associations of categorical data were assessed using Chi-square test and Fisher Exact's test. Associations of quantitative data were assessed using Student t test. Spearman rank Correlation coefficient was determined to assess the relationship between preoperative volume of subdural hematoma and recurrence of CSDH. For these, $p < 0.05$ was considered significant. Here, all p-values were two sided.

Ethical aspects: Ethical clearance was taken from the Institutional Review Board (IRB) of CMCH. Informed written consent was taken from all patients after adequate explanation of the purpose of the study. They were assured of protection of their autonomy, privacy and confidentiality. They had full freedom on the part of the patients to withdraw their consent at any stage of the study. Their participation and contribution were acknowledged with due respect.

Result:

Among a total of 130 patients, 63.1% (n=82) had mild, 27.7% (n=36) had moderate and 9.2% (n=12) had severe Glasgow Coma Scale score. The mean Glasgow Coma Scale score of the patients was 12.70 (± 2.75) where minimum score was 6 and maximum score was 15.

Table-I

Distribution of patients by co-morbidity (n=130)

Co-morbidity	Frequency (n)	Percentage
Diabetes mellitus	31	23.8
Hypertension	52	40.0
Cardiac diseases	20	11.4
Renal diseases	8	6.1
Respiratory diseases	5	3.8
Others	14	10.8

23.8% (n=31) were suffering from diabetes mellitus whereas 40.0% (n=52) had hypertension.

48.5% (n=63) had no history of trauma whereas 51.5% (n=67) had had history of trauma. 83.8% (n=109) did not use any anti-coagulant whereas 16.2% (n=21) used anti-coagulant. 79.2% (n=103) had unilateral

hematoma whereas 20.8% (n=27) had bilateral hematoma.

Figure 1 shows distribution of patients by hematoma localization.

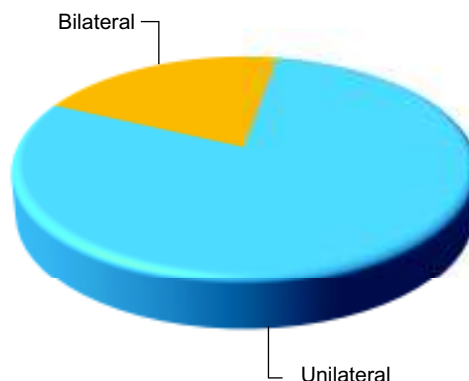


Fig.-1: *Distribution of patients by hematoma localization (n=130)*

Table-II

Distribution of patients by thickness of hematoma (n=130)

Thickness of hematoma (in cm)	Frequency (n)	Percentage
< 2	34	26.2
≥ 2	96	73.8
Mean \pm SD (in cm)	2.40 \pm 1.16	
Range (min-max) (in cm)	0.5-12.0	

Above table shows that among the patients, 26.2% (n=34) had <2 cm thickness of hematoma whereas 73.8% (n=96) had ≥ 2 cm thickness of hematoma. The mean thickness of hematoma of the patients was 2.40 (± 1.16) cm where minimum thickness was 0.5 cm and maximum thickness was 5.0 cm

Table-III

Distribution of patients by midline displacement (n=130)

Midline displacement (in cm)	Frequency (n)	Percentage
< 1	38	29.2
≥ 1	92	70.8
Mean \pm SD (in cm)	1.35 \pm 0.56	
Range (min-max) (in cm)	0.25-2.50	

Above table shows that among the patients, 29.2% (n=38) had <1 cm midline displacement whereas

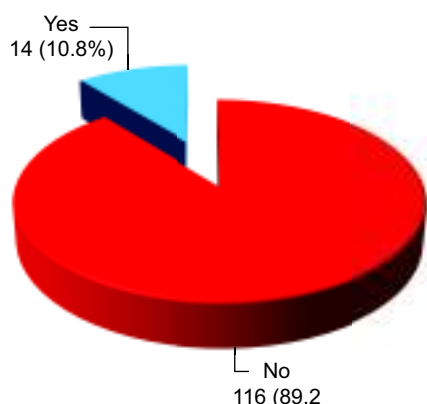


Fig.-2: Distribution of the patients by recurrence of CSDH (n=130)

70.8% (n=92) had ≥ 1 cm midline displacement. The mean midline displacement was $1.35 (\pm 0.56)$ cm where minimum midline displacement was 0.25 cm and maximum midline displacement was 2.5 cm.

40.0% (n=52) had < 115 ml of pre-operative volume where as 60.0% (n=78) had ≥ 115 ml of pre-operative volume. The mean pre-operative volume was $133.36 (\pm 60.26)$ ml where minimum pre-operative volume was 11.0 ml and maximum pre-operative volume was 260.0 ml.

Above figure shows that, 89.2% (n=116) patients had no recurrence of CSDH and the rests (10.8%, n=14) had recurrence of CSDH.

Table-IV
Characteristics of patients in recurrence and non-recurrence group (n=130)

Characteristics	Non-recurrence group	Recurrence group	p value
Gender, n (%)			
Female	19 (16.4)	5 (35.7)	0.135*
Male	97 (83.6)	9 (64.3)	
Age (mean \pm SD)	65.38 \pm 15.15	69.00 \pm 11.78	0.390
GCS(mean \pm SD)	12.83 \pm 2.70	11.57 \pm 3.00	0.105
Hypertension, n (%)			
Present	29 (25.0)	2 (14.3)	0.517*
Absent	87 (75.0)	12 (85.7)	
Diabetes mellitus, n (%)			
Present	45 (38.8)	7 (50.0)	0.565
Absent	71 (61.2)	7 (50.0)	
History of trauma, n (%)			
Present	60 (51.7)	7 (50.0)	1.000
Absent	56 (48.3)	7 (50.0)	
Use of anti-coagulant, n (%)			
Used	16 (13.8)	5 (35.7)	0.051*
Not used	100 (86.2)	9 (64.3)	
Hematoma localization, n (%)			
Unilateral	95 (81.9)	8 (57.1)	0.042*
Bilateral	21 (18.1)	6 (42.9)	
Hematoma thickness (in cm) , n (%)			
< 2	34 (29.3)	0 (0.0)	0.020*
≥ 2	82 (70.7)	14 (100.0)	
Midline displacement (in cm) , n (%)			
< 1	84 (72.4)	8 (57.1)	0.350*
≥ 1	32 (27.6)	6 (42.9)	
Pre-operative volume (in ml) , n (%)			
< 115	50 (43.1)	2 (14.3)	0.045*
≥ 115	66 (56.9)	12 (85.7)	

*Fisher Exact value

Above table shows that gender, age, GCS, hypertension, diabetes mellitus, history of trauma, midline displacement did not affect the recurrence of CSDH. Patients with bilateral hematoma collection, ≥ 2 cm hematoma thickness, ≥ 115 ml pre-operative volume and patients who used anti-coagulants had significantly more recurrence of CSDH.

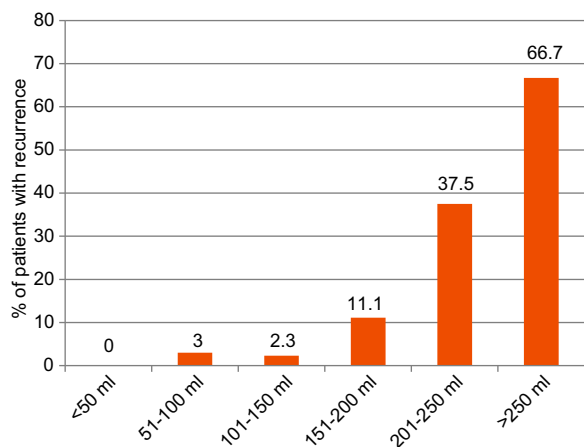


Fig.-3: Association between preoperative volume of CSDH and postoperative recurrence.

Above figure shows that, as the volume increased the proportion of patients with recurrence also increased in the study. Patients with preoperative CSDH volume ≤ 50 ml had no recurrence and 66.7% of patients with volume >250 ml had recurrence of hematoma. There was a moderate correlation between preoperative CSDH volume and recurrence of hematoma, which was statistically significant ($R_s = .598$, $p < 0.001$).

Discussion:

Chronic subdural hematoma (CSDH) is a common entity in neurosurgery with a considerable postoperative recurrence rate.² This hospital based prospective observational study was conducted among 130 patients to assess the relationship between preoperative volume of chronic subdural hematoma and its post-operative recurrence.

In this current study it was observed that the mean age was found 65.64 ± 13.64 years. Similar result was observed in other studies where the mean age of patients with CSDH was ≈ 65 years.³⁻⁷ However, some studies reported higher mean age of patients with CSDH.^{2,8-11} The higher mean age might be due to the geographical variation, racial and ethnic differences.

In this present study, there was male predominance in recurrent of CSDH. Cardiac problem and chance of trauma is more common in male it may be the cause for recurrence in male. Similar observations were also observed by Stanisis et al.² The mean Glasgow Coma Scale score of the patients was 12.70 (± 2.75) which was lower than the study of Huang et al.⁴ This might be due to the delayed hospital admission of the patients of the present study.

Among the patients of the present study, 23.8% were suffering from diabetes mellitus and 40.0% from HTN. Prevalence of HTN varied from 18.9 to 44 percent.^{11,12} The prevalence of DM was found much higher in the present study than other studies. This might be due to geographical variation of disease prevalence around the world. Near about half of the patients (48.5%) had history of trauma. Anti-coagulant was used by 21 (16.2%) patients. Bilateral hematoma was present in 20.8% patients. The overall incidence of bilateral CSDH has been reported to vary from 16% to 20%.¹³⁻¹⁵

Among the patients, 73.8% had ≥ 2 cm thickness of hematoma, 70.8% had ≥ 1 cm midline displacement. The mean pre-operative volume was 133.36 (± 60.26) where 60.0% had ≥ 115 ml of pre-operative volume.

The post-operative courses of CSDH were either resolved or recurrent. Fourteen patients (10.8%) had recurrence of CSDH. More than half of the recurrence of CSDH was diagnosed within 3 months of surgery. The rate of recurrence of chronic subdural hematoma after surgery ranges from roughly 5% to 30%.^{1,3,11,16-19} The pathophysiology of CSDH development appears to be complex and the related literature is controversial. Numerous factors have been reported for recurrence of CSDH including age, bleeding tendency, brain atrophy, bilateral CSDH, hematoma type, diabetes mellitus, hypertension, surgical technique, hematoma thickness, pre-operative volume etc.^{7,7,10,19} Present study did not find any association of recurrence of CSDH with age, gender, GCS, hypertension, diabetes mellitus, history of trauma, thickness of hematoma and midline shifting. However, patients who used anti-coagulant, had bilateral hematoma, ≥ 2 cm hematoma thickness and ≥ 115 ml pre-operative volume had significantly more recurrence of CSDH.

Older people have a predisposition to trauma which might lead to recurrence of subdural hematoma just like primary subdural hematoma.^{16,19} Furthermore,

brain atrophy and greater intracranial space could also explain this tendency for recurrence in elderly population.⁷ However, the present study found that age was not associated with the recurrence of CSDH which was consistent with other studies.^{3,19}

Hypertension and diabetes mellitus were also found to be not associated with recurrence of CSDH which was consistent with other studies.^{7,20}

Recurrence of CSDH was not affected by midline shifting. Ko et al and Oh et al. et al. also found that recurrence of CSDH was not affected by midline shifting.^{3,10} However, the study of Chon et al. reported that midline shifting was an independent predictor of recurrence of CSDH. They hypothesized that prolong symptom duration, advanced age, brain atrophy, width of hematoma, hematoma volume, and increased brain elasticity may influence the persistence of postoperative midline shifting.²⁰ A prolong postoperative midline shifting may cause impaired adhesion between inner and outer neo membrane and thus facilitate postoperative recurrence of CSDH.

Patients who used anti-coagulant had significantly more recurrence of CSDH. Inconsistent result was found in literatures regarding this issue. Lindvall et al. found that there was no association between antiaggregant/anticoagulants and recurrence.^{1,6} On the contrary, Rust et al. reported that the rate of recurrence requiring another surgery is higher in the patients taking an antiaggregant treatment.²¹

Patients who had bilateral hematoma had significantly more recurrence of CSDH. Similar result was reported in other studies.⁷ Bilateral CSDH became a risk factor for recurrence. It is expected that brain re expansion after surgical drainage of CSDH will close the SDH distance. In patients with bilateral CSDH, the rate of atrophic brain detection is high. As there is no expansion in atrophic brain after the surgery, it is probable that recurrence will be higher.⁸ Again, in patients with bilateral CSDH, duration of coagulation is longer (99). The limited coagulation capacity after surgery may be a risk factor for recurrence.

Patients who had ≥ 2 cm hematoma thickness had significantly more recurrence of CSDH. Similar results were reported by Oh et al.¹⁰ Chon et al. hypothesized that wider hematoma have increased tendency to recur

because the subdural space is larger than a small lesion post-operatively.²⁰

CT scanning of a patient with CSDH provides a wealth of information on the intracranial status and remains the most important radiological diagnostic investigation for this disorder (Staniši et al. 2013). CT scanning showed that patients who had ≥ 115 ml pre-operative volume had significantly more recurrence of CSDH. There was a moderate correlation between preoperative CSDH volume and recurrence of hematoma, which was statistically significant ($r_s = .598$, $p < 0.001$). Staniši et al. prospectively investigate the preoperative and postoperative CT scan features to assess whether CT findings can be used as prognostic factors for postoperative recurrence.² They found that the preoperative hematoma volume was a predictor of postoperative recurrence. Additionally, they found that the prognosis of non-recurrence was very high (94.4 %) in our cohort if the preoperative hematoma volume was under 115 ml, consistent with a general consideration that patients with large CSDH are at increased risk for the recurrence.² Increased size of hematoma is attributed to brain atrophy associated with ageing, which may provide the CSDH with a potential space in which to grow.²³ Furthermore, it has been speculated that brain atrophy may lead to inappropriate brain re-expansion postoperatively and thereby create the potential for re-accumulation of the hematoma.^{8,12}

Conclusion:

The results of the present study showed that the rate of recurrence of CSDH was 10.8%. Patients with bilateral hematoma collection, ≥ 2 cm hematoma thickness, ≥ 115 ml pre-operative volume and patients who used anti-coagulants had significantly more recurrence of CSDH. There is significant moderate correlation between preoperative CSDH volume and postoperative recurrence.

Recommendations

On basis of present study, it can be recommended that:

- Clinicians must be aware of the higher recurrent rate of CSDH with ≥ 115 ml pre-operative volume.
- Patients with bilateral hematoma collection, ≥ 2 cm hematoma thickness and patients who are using anti-coagulants should also be strictly monitored for recurrence of CSDH.

Limitations of the study

There were some limitations in the current study:

1. The study population was selected from one selected hospital in Chittagong city, so that the results of the study may not reflect the exact picture of the country.
2. Small sample size was also a limitation of the present study.
3. Hematoma volume and midline shift were measured on the CT Scan film, which were probably less accurate than measuring from CT Scan.
4. Factors influencing recurrence of CSDH in postoperative period were not taking into account in this study.

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