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## Analytical study of predictive factors for re-operation of chronic subdural haematoma following primary surgery

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### Abstract

**Introduction:** Chronic Subdural Haematoma (CSDH) is commonly seen in day to day Neurosurgical practice. The incidence of re-operation remains high.

**Objective:** The optimal surgical approach to reduce the re-operation rate has not been identified. The aim of this study is to evaluate the prognostic value of clinical & radiological parameters to predict the re-operation.

**Methodology:** A retrospective review of about 320 patients of Chronic Subdural Haematomas, who got admitted (May 2015 to May 2018) in the "Institute of Neurosurgery, Madras Medical College, Chennai was performed. Clinical and radiographic factors were analysed using Uni & Multi variate analyses.

**Results:** Various significant predictive factors like anticoagulant use, male sex, greater midline shift, presence of loculations/membranes, intraoperative saline irrigation etc. were analysed. The results showed that 0% ( no reduction), 50% and 100% haematoma maximum thickness change were associated with a 41%,6% and <1% rate of re-operation.

**Conclusions:** Among many factors, anticoagulant use, hematoma loculation & the amount of hematoma evacuation on first POD were the strongest predictors.

**Keywords:** chronic subdural hematoma, recurrence, re-operation

### 1. Introduction

The Chronic subdural hematoma (CSDH) is a common form of intracranial haemorrhage, but its optimal management is very unclear. The recurrence rate of CSDH is about 2.5% to 38.5%, depending upon the operative techniques employed. Even though, several studies have been done to identify the predictors of CSDH recurrence, the factors predicting recurrence are not clear. In many of these studies, coagulopathy, anticoagulant intake, male sex, Diabetes, Hypertension, bilateral hematomas, larger preoperative hematoma volume, septations, heterogenous density on CT, preoperative midline shift, larger postoperative hematoma and postoperative pneumocephalus were found to be associated with increased rate of recurrence. The risk of recurrence is reduced with hematomas that appeared homogenous on preoperative imaging.

### 2. Objectives

Many of the reported studies have evaluated the recurrence risk with only a few predictors, possibly missing out the interaction of other variables and confounders. In my study, I have intended to address the problem using a database maintained by a group of neurosurgeons at a single large academic institution for about three years. The focus has been done on identifying the risk factors associated with the need for repeat surgery for the treatment of Chronic Subdural haematomas (CSDH)

### 3. Methodology

I have retrospectively reviewed about 320 consecutive cases of patients with Chronic Subdural haematomas (CSDH) to the Institute of Neurosurgery, Rajiv Gandhi Government General Hospital, Madras Medical College, Chennai (TN), India, between May 2015 to May 2018 and were treated with primary surgical evacuation.

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The following data were recorded: sex, age, surgery date, history of trauma or other mechanism, comorbidities, anticoagulant use and type, GCS, preoperative neurological deficits, hematoma characteristics, laterality, density characters on CT, intensity on MRI, maximum thickness, location, presence and absence of pseudomembranes, presence of loculations, preoperative midline shifts, postoperative CT characters, intraoperative details (type of anaesthesia, type of surgery, number & location of burr holes, opening of membranes, saline irrigation volume, use of drain, type of drain used, postoperative complications, whether the patient required re-surgery. Percent hematoma change after surgery was calculated using the same axial CT cut and the following equation: (Pre-operative maximum hematoma thickness – Postoperative maximum thickness) / Pre-operative maximum hematoma thickness.

The most recent follow up data, including the status of the CSDH (confirmed by CT/MRI scans) were also recorded. The outcome measure was the re operation after the first surgery due to the indications like residual haematomas, continued symptoms, acute SDH or recurrence within 3 months. Even though, there was no unified institutional protocol, the decision to reoperate was made based on either the worsening of neurological symptoms or the increasing levels of midline shifts in the post-operative scan.

Univariable (independent t-test), bivariable (Chi-square) and multivariate (multiple logistic regression) analyses were performed to determine, if any of the studied factors were associated with an increased risk of re operation.

The multivariate logistic regression was performed only with variables that yielded a p value <0.1 in univariable analysis. The Statistical analysis was performed using PASW Statistics 18 (Predictive Analytics Software, SPSS Inc.). Statistical significance was defined by a p value <0.05.

#### 4. Results

During the study period of about 320 patients ( mean age 71.6 years, range 28-96 years, male/female ratio 2.4) underwent a total of 441 operations. The unilateral evacuations were done in about 263 patients and bilateral evacuations in about 57 patients.

A follow up post-operative CT scan was done within the first 24 hours. The mean postoperative follow up period for the entire patient cohort was about 19.2 months (range 1-117 months).

There were about 191 burr hole drainages (BHDs) and about 255 craniotomies.

About 11.9% of patients required the re operation.

About 7 patients, who have been complicated by clinically significant acute SDH required repeat surgery ( $P<0.05$ ).

About 2 patients were complicated by acute coronary syndrome. About 3 patients were complicated by seizures.

About 4 patients have developed subdural empyema in the post-operative period.

About 71, 60 and 22 and 2 patients were receiving Aspirin, Warfarin and Clopidogrel, respectively in the pre-operative period. About 24 patients were receiving more than one of these drugs.

All the patients, who were on anticoagulants had received reversal treatment before surgery (Intravenous injection Vitamin K, Fresh Frozen Plasma, Platelet Infusion). The mean INR on the day of surgery was 1.2 (range 1.0-1.6).

The Pre-operative hematoma thickness and percent hematoma thickness change were not different in patients receiving anticoagulant/antiplatelet therapy, compared with those who did not ( $P=0.67$  and  $P=0.79$ ) respectively.

Univariate analyses showed that the use of warfarin or Clopidogrel, mixed hypo and isointensity on T1 weighted images of MRI, greater midline shift, greater hematoma/fluid thickness on 1<sup>st</sup> Post-operative Day CT, less decrease in maximum hematoma thickness after surgery, use of monitored anaesthesia care and lack of intraoperative irrigation, all subsequently led to higher rates of re-operation.

The Factors such as sex, age, use of anticoagulants, presenting GCS, presence of neurological deficits, hematoma side, preoperative hematoma thickness, preoperative hematoma density characteristic in CT scan, hematoma location, presence of air on post-operative CT scan, opening the internal membrane during the surgery, surgical evacuation technique (either Burrhole drainage or Craniotomy & evacuation) and number & location of burrholes, however, did not affect the re operation rate.

The presence of loculations on preoperative CT scans, a larger amount of intraoperative irrigation volume, lack of drain use or use of smaller size drains (EVDs) showed a nonsignificant trend towards higher re-operation rates.

The Multivariate analysis showed that presence of loculations, clopidogrel use, warfarin use, increased amount of residual hematoma/fluid and decreased percent hematoma change after surgery significantly predicted the need for re-operation.

I have performed a probit analysis to show the probability of re-operation, based on the percent change in hematoma thickness and the preoperative midline shift.

The results showed that 0% (No reduction), 50% and 100% (complete resolution of hematoma after surgery), changes in hematoma thickness were associated with 41%, 6% and <1% re-operation rates respectively ( $P<0.001$ ).

Multivariate analysis showed that both percent change in hematoma thickness and stratified preoperative hematoma thickness values significantly predicted the need for re-operation ( $P=0,001$  and  $0.004$ , respectively). In addition, 0-mm, 8.6-mm, 14.5-mm, 19.6-mm and 24.1-mm shifts were associated with 9%, 15%, 20%, 25% and 30% probability rates of re-operation, respectively ( $P=0.018$ ).

#### 5. Discussion

Chronic Subdural Haematoma is a common form of Intracranial Haemorrhage. If it is large enough to produce mass effect, it is surgically addressed, either by burrhole drainage or by Craniotomy and evacuation. The incidence of recurrence rate ranges from 2.3% to 37.8% for different surgical techniques.

Among the established factors, the presence of coagulopathy, anticoagulant usage, presence of loculations, larger preoperative hematoma volume, presence of significant residual hematoma volume and post-operative Pneumocephalus.

In the two meta-analyses that included 19 randomised clinical trials and 250 studies each, heterogeneity of hematoma on CT, use of intra operative irrigation and drain were identified as factors predictive of the need for re-operation, Even though, several studies have evaluated the recurrence risk with respect to a few factors, likely missing

the interaction between other variables and confounders, our study is among the largest series reported till date.

My results have confirmed the previous observations showing that the volume of residual hematoma/fluid, degree of midline shift and presence of loculations on the pre-operative scans predict the need for repeat surgery. In fact, my results have showed that the volume of residual hematoma/fluid (calculated either alone or in relation to the pre-operative volume as "Percent hematoma change") is the strongest predictor of repeat surgery in CSDH.

My analysis have showed a 50% decrease in maximum hematoma thickness on the first postoperative CT is associated with a less than 10% risk of re-operation.

I also observed that the absence of change in hematoma volume resulted in a 41% re-operation rate (not 100% as expected). The probable explanation for this would be the fluid collected after surgery is a mixture of residual hematoma fluid, CSG and irrigation fluid. Stratification of data based on pre-operative hematoma thickness (0-1cm, 2-3cm and 3-4cm) had showed a similar trend.

Although, the anticoagulant intakes are the well risk factors for the recurrence, this study had investigated the various agents, specifically and individually. This study had found that the usage of Warfarin & Clopidogrel are associated with a higher recurrence rate.

This study showed a significantly higher re-operation rate in hematomas showing mixed intensities on T1 weighted MRI. The outcome was better in patients who underwent intra-operative saline irrigation.

This study did not confirm and validate the role for opening the internal membrane in accordance with previous findings by others. Although, the prior studies have shown that the use of subdural drain reduces the recurrence rate in CSDH, my study is more controversial in this regard.

This study is limited by its retrospective nature. A prospective, randomized controlled trial would be needed to minimize the introduction of bias into the study design. This study is further limited by the fact that different surgeons have different thresholds for operation and reoperation.

## 6. Conclusions

The results of this study showed that the use of Warfarin or Clopidogrel, hetero intensity in T1 weighted MRI, greater hematoma/fluid thickness on the first Post-operative DayCT, decreased percent change in hematoma thickness following surgical evacuation, use of MAC and absence of intraoperative irrigation were predictive of reoperation.

This study had witnessed that, about 0%, 50% and 100% changes in hematoma thickness following evacuation were associated with about 41%, 6% and <1% re-operation rates, respectively.

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