

## VARIATION IN VENTRICULAR PARAMETERS IN NCCT BRAIN AFTER SURGICAL TREATMENT OF CHRONIC SUBDURAL HEMATOMA AND ITS IMPACT IN SURGICAL OUTCOME

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### Abstract

**Background:** Chronic Subdural Hematoma is one of the most frequent entities encountered in Neurosurgery due to the ageing population, the incidence of which is 58.1 per 1 lakh population in over 65 years of age. **Objectives:** To study variation of ventricular parameters, namely Evan's Index, Frontal horn index, Ratio of Frontal Horn to Occipital horn and midline shift by NCCT Brain after Burr Hole evacuation of chronic Subdural Hematoma. **Material & Methods:** It was a Hospital based prospective observational study. Patients > 18yrs with clinicoradiological diagnoses of Chronic Subdural hematoma requiring burr hole evacuation and drain placement in the subdural space. The required sample size was 70 with power 81% which has been calculated with help of Epi Info (TM) 3.5.3 software. However, due to the pandemic and drastic reduction in OPD consultations and emergency admissions there was a reduction in sample size we were able to achieve 42 patients during my study tenure from September 2019 to August 2021. 2 years from September 2019 to October 2021. Patients who are admitted in the Department of Neurosurgery, Kalinga Institute of Medical Sciences, Bhubaneswar diagnose with Chronic SDH on CT Brain during the period September 2019 to October 2021. **Results:** 42 cases out of which 39 were male and 3 were female and an increase was seen at 45-70 years of age with a mean age of presentation of 60.9 yrs. Percentage of male- 90.4% Percentage of female- 9.5%. The most common presenting feature was Headache (64%), followed by altered mental status (19%), limb weakness (14%) and Seizure (2.3%). History of head injury was seen in 47.6% of our cases. All patients were diagnosed with chronic SDH by NCCT Brain and further underwent Burr Hole Drainage with Irrigation. Variation in the ventricular parameters of preoperative and POD 3 and 10 CT Brain scans were compared. Evan's Index was found to decrease in post-operative day 3 and further increase on post-operative day 10. However, this variation was found to be statistically insignificant. Frontal Horn Index and Midline Shift showed gradual increase in the preoperative and POD 3 and 10 scan with statistical significance. However, Variation in ratio of Frontal to Occipital Horn Index did not show statistical significance. **Conclusion:** We conclude that despite of the presence of residual hematoma in early and delayed post-operative CT scan, none of our patients had clinical deterioration requiring re- surgery, hence this infers that, instead of hematoma thickness, ventricular parameters can be used to evaluate the success of surgery.

## INTRODUCTION

Chronic Subdural Hematoma is one of the most frequent entities encountered in Neurosurgery due to the ageing population, the incidence of which is 58.1 per 1 lakh population in over 65 years of age.<sup>[1,2]</sup> Although majority of the CSDHs are due to trauma, intracranial hypotension and defective coagulation could also be responsible.<sup>[3,4]</sup> The presentation of CSDH could vary from no symptoms to headache, seizures, decreased memory, and confusion. Patients could have difficulty in speech, swallowing, and walking. There may be weakness or numbness of arms, legs, and face.<sup>[5]</sup> Isolated third nerve palsy, movement disorders such as choreoathetoid and parkinsonism could be associated with subdural hematoma (SDHs). Pressure effects, neurotransmitter abnormality, and ischemia have been postulated as reasons for this type of presentation. However, despite clinical improvement after surgery, the early post-operative computed tomography (CT) scan often shows persistence of liquid collection in the subdural space which may suggest the possibility of recurrence, incomplete surgery or normal post-operative change. Hence, comparison of ventricular parameters on CT scan in preoperative and post-operative periods may help in prognosticating and predicting early recurrence.<sup>[6]</sup>

Hence, Chronic SDH is associated with reduction in CSF volume which varies with volume of ventricles. However, volume measurement of ventricles is far from accurate because of their shape from CT scan, Evan's index is a useful marker for the assessment of ventricular volume, normal value of which is <0.3. But it can be higher in patients with hydrocephalus. It was one of the first attempts to use an index of comparison of ventricular size in patients with large ventricles.<sup>[7]</sup> With the development of CT scan, other parameters like Frontal Horn Index, Ratio of Frontal Horn to Occipital Horn of Lateral Ventricle and midline shift can be calculated to predict the recurrence of Chronic Subdural Hematoma post-surgery.

## MATERIALS AND METHODS

It was a Hospital based prospective observational study. Patients > 18yrs with clinicoradiological diagnoses of Chronic Subdural hematoma requiring burr hole evacuation and drain placement in the subdural space. The required sample size was 70 with power 81% which has been calculated with help of Epi Info (TM) 3.5.3 software. However, due to the pandemic and drastic reduction in OPD consultations and emergency admissions there was a reduction in sample size we were able to achieve 42

patients during my study tenure from September 2019 to August 2021. 2 years from September 2019 to October 2021. Patients who are admitted in the Department of Neurosurgery, Kalinga Institute of Medical Sciences, Bhubaneswar diagnose with Chronic SDH on CT Brain during the period September 2019 to October 2021.

### Inclusion Criteria

1. Clinicoradiological diagnosis of cSDH undergoing Burr hole evacuation and drain placement in the subdural space.
2. Unilateral and bilateral location.
3. With previous comorbidities like hypertension, diabetes and IHD
4. On antiplatelets and anticoagulants
5. With or without history for head trauma.

### Exclusion Criteria

1. Acute SDH
2. Small localized cSDH requiring only single burr hole.
3. Subdural hygroma and empyema.
4. Age less than 16
5. Metabolic encephalopathy
6. Suspected infective pathology

### Methodology

All operated chronic SDH patients admitted to KIMS Hospital after satisfying the inclusion and exclusion criteria are included in the study. The required clinical, operative and radiological data was collected after due consent of patient and attendant. Cases presenting with headache, altered sensorium, focal neurological deficits were evaluated and diagnosed with chronic SDH by NCCT brain, further they were planned for frontoparietal Burr Hole evacuation and irrigation with or without subdural drain. On an average all patients were shifted to ICU for postoperative care and transferred back to ward on post-operative day 1. Further CT Brain done on post-operative day 3 and subdural drain was removed, patients was monitored and CT Brain was done on Post-operative day 10 and were discharged. In our study we have evaluated the variation of the values of linear parameters of ventricular volume namely: Evan's Index, Frontal Horn Index, Ratio of Frontal Horn to Occipital Horn of Lateral ventricle and Midline shift.

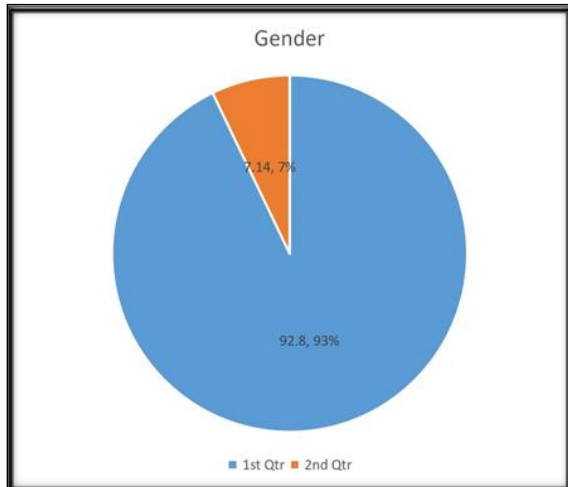
### Statistical Analysis

All data collected were tabled and statistically analyzed by Microsoft Office 2003 (excel) and Statistical Package for Social Science (SPSS) version 22. Parametric data were expressed as mean and SD, and non-parametric data were expressed as number and percentage of the total. SD of 2 groups was done using the paired student's t-test. P value < 0.05 is considered significant.

## RESULTS

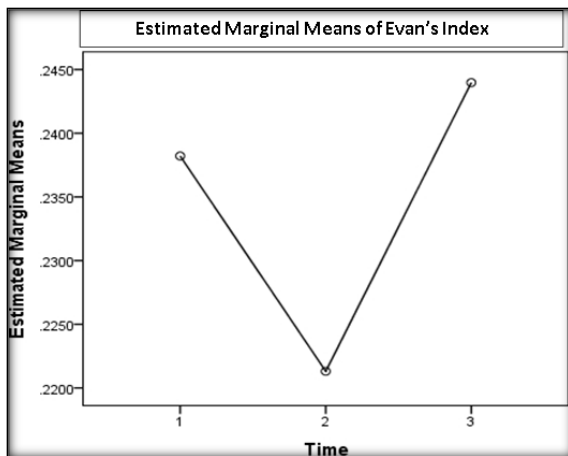
**Table 1: Age Distribution in patient with Chronic SDH**

Age (yrs)	18-35	35-50	50-70	>70
Number (N)	3	6	22	11
Percentage(%)	7.1%	14.2%	52.3%	26.1%



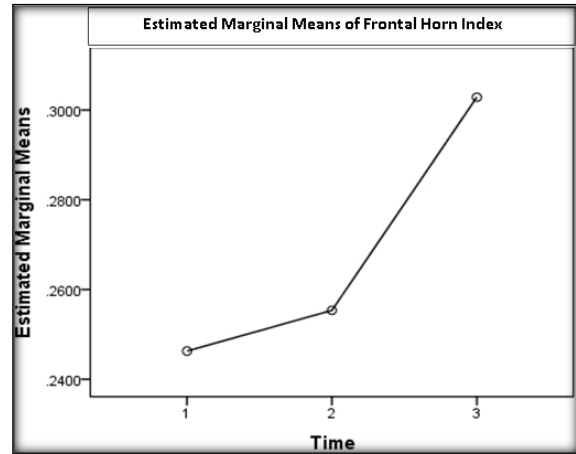
**Figure 1: Sex Distribution in patients with Chronic SDH**

As per table 1 and Figure 1 our study included 42 cases out of which 39 were male and 3 were female and an increase was seen at 45-70 years of age with a mean age of presentation of 60.9 yrs. Percentage of male- 90.4% Percentage of female- 9.5%.



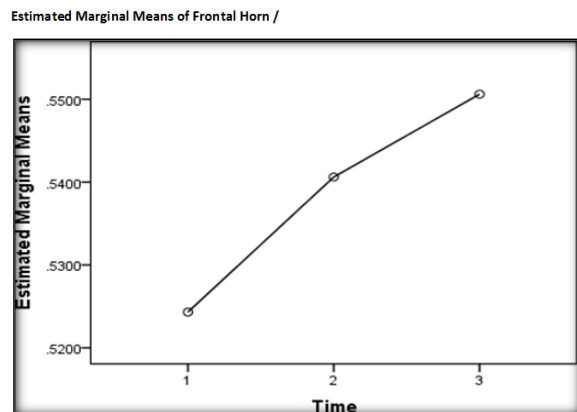
**Figure 2: Graph of variation in Evan's Index - pre op, POD 3 & POD 10.**

As per figure 2 in all the 42 cases of chronic SDH, mean of pre-operative Evan's Index was found to be 0.23 which decreased in post-operative day 3 with a mean of 0.221. Further, it is observed that Evan's Index gradually increased on Post-operative day 10 with a mean of 0.244. However, this variation of Evan's Index in preoperative, post op day 3 and post op day 10 is statistically insignificant with a p value of 0.052.



**Figure 3: Graph showing variation in Frontal Horn Index Pre- op, POD 3 & POD- 10**

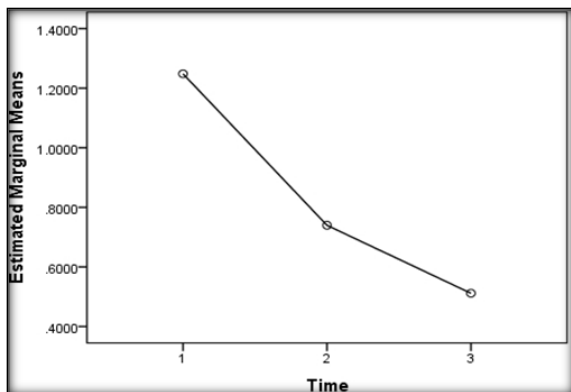
As per figure 3 CT Brain showed a gradual increase in Frontal Horn Index from preoperative to Post-operative day 3 and 10 scans with an increase in the mean from 0.246, 0.255 & 0.303; and standard deviation of 0.12, 0.051 & 0.121 respectively. Hence, there was a significant increase in the Frontal Horn index with a p value of 0.05.



**Figure 4: Graph showing variation in Frontal/Occipital Horn in Pre-op, POD 3 and POD 10**

As per figure 4 the mean of the ratio of frontal to occipital horn was found to be 0.542 in the pre-operative period which gradually increased to a mean of 0.541 post-operative day 3 and 0.551 in post-operative day 10. However, this was found to be statistically insignificant with a p value of 0.275.

Estimated Marginal Means of Midline Shift



**Figure 5: Graph showing variation in Midline Shift in Pre-op, POD 3 & POD 10**

As per figure 5 the mean of midline shift in pre-op period is 1.248 which has gradually decreased to a mean of 0.740 on post-operative day 3 and 0.512 on post-operative day 10, with standard deviation of 1.006, 0.586, 0.464 in pre-operative, Post-operative Day 3 and Post-operative Day 10. Hence, it was concluded that the variation of midline Shift is statistically significant with a p value of <0.001. The most common presenting feature was Headache (64%), followed by altered mental status (19%), limb weakness (14%) and Seizure (2.3%). History of head injury was seen in 47.6% of our cases. All patients were diagnosed with chronic SDH by NCCT Brain and further underwent Burr Hole Drainage with Irrigation. Variation in the ventricular parameters of preoperative and POD 3 and 10 CT Brain scans were compared. Evan's Index was found to decrease in post-operative day 3 and further increase on post-operative day 10. However, this variation was found to be statistically insignificant. Frontal Horn Index and Midline Shift showed gradual increase in the preoperative and POD 3 and 10 scan with statistical significance. However, Variation in ratio of Frontal to Occipital Horn Index did not show statistical significance.

## DISCUSSION

The insidious installation of symptoms in patients with CSDH is related to the intracranial components of accommodation induced by progressive accumulation of this hematoma in the subdural space. However, the presence of new mass in an unexpandable cranium led to the reduction of one or more intracranial components (brain parenchyma, cerebrospinal fluid [CSF] or Vascular compartments). The reduction of intracranial CSF depends on diminution of ventricular size and/or subarachnoid spaces. As shown by study<sup>8</sup> volumetric measurements represent the logical accurate estimate of true ventricular size as well as the size of the other intracranial compartments. Our study includes 42 cases of Chronic SDH, who were admitted and treated in the Department of Neurosurgery Kalinga Institute of Medical Sciences, Bhubaneswar. In the present study, patient details

were entered in a typed proforma with necessary details for the study preoperatively, and were followed up with post-operative CT Brain on Postoperative day 3 and 10. In this study, the cases of Chronic SDH with the exclusion criteria as mentioned in the methodology have a range of age more than 18 yrs. In our literature search.<sup>[9,10,11]</sup> we have found that mean age of chronic SDH is 63 yrs and in our study the mean age of presentation of 60.9 years, with an increased incidence in the age group 45-70 years and minimal incidence in age group < 30 years.

As stated earlier, incidence of chronic SDH is higher in male when compared to female, and even in our study we have found that the incidence was higher in male accounting for 39 (92.8%) out of 42 patients and 3 (7.14%) in female. In our study, the most common presenting feature was headache (n = 27, 64%) followed by altered mental status (n = 8, 19%), limb weakness (n = 6, 14%) and seizure (n = 1, 2.3%). Among the 9 cardiac patients, 4 patients were previously diagnosed with CVA, 3 patients were post PTCA and 2 had Mitral valve replacements. Study has concluded that the use of antiplatelets and anticoagulant is a risk on anticoagulant.<sup>[9]</sup>

In this study, Chronic SDH managed surgically by Burr Hole drainage and Irrigation were included. In the procedure, after burr hole and drainage normal saline is introduced into the frontal drain to prevent pneumocephalus. In the early post-operative scans, there will be persistence of fluid in the subdural space, despite of clinical improvement of the patient, measurement of the hematoma thickness may presents as an unreliable factor to detect recurrence, failed surgery or normal postoperative variant. As followed by studies, the decision to re-operate is based on the presence of symptoms and clinical or imaging signs of cerebral compression. The postoperative CT may show asymptomatic recollection in a clinically improving patient, which is not considered for re-operation.<sup>[9,10,11]</sup>

Several studies conducted the ventricular parameters and conclude that despite the presence of residual hematoma in early and delayed CT scan control, the expansion of ventricle is progressive, which was measured by increase in the Evan's Index from the preoperative scan to the POD-3 and POD -10 scan. The evaluation of variation of ventricle size compared to preoperative data might be a good indicator of success of surgery.<sup>[12,13]</sup>

In our study, the mean postoperative Evan's index was found to decrease on post operative day 3 to a mean of 0.221. Further, it was observed to gradually increase on the post-operative day 10 with a mean of 0.244. However, this variation of Evan's Index in preoperative, post op day 3 and post op day 10 is statistically insignificant with a p value of 0. In a study, have argued that Evan's index represents no good measure of ventricular size as the correlation with ventricular volume was low and have advocated that computation of the frontal to

occipital horn ratio correlated well with ventricular volume but, however while comparing the variation in Frontal to occipital Horn Index in our study we have found no significant variation with a p value of 0.275.<sup>[14,15,16]</sup>

## CONCLUSION

We conclude that despite the presence of residual hematoma in early and delayed CT scan, the expansion of ventricle is progressive and hence it can be used as a useful parameter to evaluate the success of surgery. Frontal Horn Index and Midline shift are more representative of ventricular CSF volume than Evan's Index. Increase in these parameters during the post-operative period can be considered as predictors for recurrence. Evan's index represents no good measure of ventricular size as the correlation with ventricular volume.

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