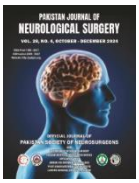

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Original Research

Modified Nakaguchi Classification: Is it a New Way to Measure Outcome of Chronic Subrural Hematoma through GCOSE?

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ABSTRACT

Objective: The κ value of the Modified Nakaguchi classification is 0.78, the highest from other available classification systems for CSDH. The main objective of this study was to evaluate the outcome of CSDH concerning the type of CSDH according to the modified Nakaguchi classification.

Material and Methods: It is a single cohort study conducted at Liaquat University Hospital Hyderabad and Jamshoro in the Neurosurgical Department. The patient's known case of chronic subdural hematoma was included in the study after evaluation of inclusion and exclusion criteria and variables like type of CSDH and GCS and GCOSE on discharge were noted on the pre-designed Questionnaire.

Results: A total number of 63 patients were included in the study, with 69.8% being male and 30.2% female, and the overall mean age was 58.3 years. The most common presentation according to the Modified Nakaguchi Classification was Hypo-dense (30%) and Graded (27%) type. The mean pre-operative GCS was 10.98 and the post-operative GCS mean was 12.87 with a significance of 0.001. A total of 50.8% of patients had upper good recovery on Discharge GCOSE out of which 28.13% of Hypodense and Graded type. Total mortality was 22.2% out of which 28.6% was hypodense and Graded type respectively. The recurrence of CSDH was 11.1% and the most common type was Hypodense (57%).

Conclusion: The Modified Nakaguchi Classification doesn't define the outcome significantly, however, the surgical intervention related to its specific type is significantly associated with the outcome of the patient on the Glasgow coma outcome scale extended.

Keywords: Modified Nakaguchi classification, CSDH, GCOSE, GCS, Outcome.

Abbreviation: CSDH; Chronic Subdural hematoma, GCOSE; Glasgow coma outcome scale extended, GCS; Glasgow coma Scale.

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INTRODUCTION

Chronic subdural is one of the most common neurosurgical disorders and older populations are mostly affected and it increases with increasing age.[1] It is defined as a liquefied hematoma in the subdural space with a characteristic outer membrane, which is defined as an expansion of the Dural border cell layer.[2] The incidence rate is 36.6 to 91% among the older population that went into surgical evacuation.[3 4]

Although the Computer tomography (CT) scan of the brain is the main tool for the diagnosis of CSDH for the prediction of recurrence, three classification systems are usually used i.e. Nomura classification, Nakaguchi classification, and the latest modified Nakaguchi classification.[4] The κ value of the Modified Nakaguchi classification is 0.78 which is the highest of the other two.[4] The outcome associated with modified Nakaguchi classification has not been evaluated despite its gradation type being mostly associated with recurrence.[4]

Burr hole drainage with intraoperative irrigation and subdural drain placement is mostly performed procedure but this condition can recur in approximately 1.3 to 18% that warrant reoperation.[3,4] Atorvastatin and endovascular embolization of MMA in CSDH have been assessed, but the results are either limited and in preliminary phases.[4]

Highlighting the certain type of CSDH either that has the good outcome or bad outcome in patients is currently the active area of research. Previously the outcome was measured by a modified Rankin scale which has certain drawbacks.[5,6] However, we are using the Glasgow coma outcome scale extended, which has not been used previously. It will be helpful for us to establish the management directories according to a certain type that holds certain outcomes. The main objective of the study is to evaluate the outcome of CSDH concerning the type of CSDH according to the modified Nakaguchi classification.

MATERIAL AND METHODS

Study Design and Settings

A Single Cohort study was conducted at Liaquat University Hospital from 1st March 2023 To 1st March 2024 with ERC approval reference number: NSE/2023/120.

Study Population

The patients that were enrolled were those who were presented with chronic subdural hematoma.

Sample Size and Sampling Technique

It was calculated via a formula of quantitative analysis, using the functional outcome of CSDH from a previous study.[7,8] A convenient sampling technique was used.

Inclusion Criteria

The patients who have Chronic Subdural hematoma with or without comorbidities.

Exclusion Criteria

The patient presented with acute subdural hematoma, another intracranial hemorrhage (ICH, EDH), a history of the recent neurosurgical procedure, conditions that affected hemostasis (hemophilia), severe infection, septicaemia, and Subdural empyema, pregnant, significant end-stage diseases and those who had been advised for admission and enrolment in the study but refused.

Data Collection

The patient that was included in this study was presented to us in OPD or emergency, after evaluation of inclusion and exclusion criteria, the

identification of Modified Nakaguchi Classification[4] on CT scan was done (annexed). The pre and post-operative Glasgow Coma Scale[9] was calculated and the patient goes through different types of management. The Glasgow Outcome Scale Extended[10] was assessed on the discharge or expiration of a patient. The recurrences were noted after the readmission of the patient with the same complaints.

Statistical Analysis

The data was analyzed on the SPSS 22 version. The Data was divided into Continuous (Age, pre & post-operative GCS), categorical (Gender, location, modified Nakaguchi classification and surgical intervention), and ordinal (GCOSE) variables dataset. Initially, the Descriptive analysis was performed, mean for continuous variables and Frequency for categorical and ordinal datasets. The distribution of normality was taken out via Shapiro Wilk test for continuous variables. For the association between two related non-parametric data spearman rank tests were performed. However, to see the association of categorical and ordinal variables with continuous variables, ANOVA (for parametric continuous variables, i.e., age and Kruskal Wallis test (for greater than 2 categorical variables, i.e., type of CSDH and non-parametric data, i.e., pre-and post-operative GCS) was performed respectively. The p-value was < 0.05 was considered significant.

RESULTS

General Analysis

A total number of 63 patients were included with 69.8% being male and 30.2% being female. The overall mean age was 58.3 years which is normally distributed, in which females had 60.31 and males had 57.3. The unilateral location of chronic subdural hematoma was 88.9% as compared to the bilateral location of 11.1%. Regarding the classification and its presentation (Figure 1); the most common presentation according to Modified Nakaguchi Classification was Hypo-dense (30%) and Graded (27%) in nature.

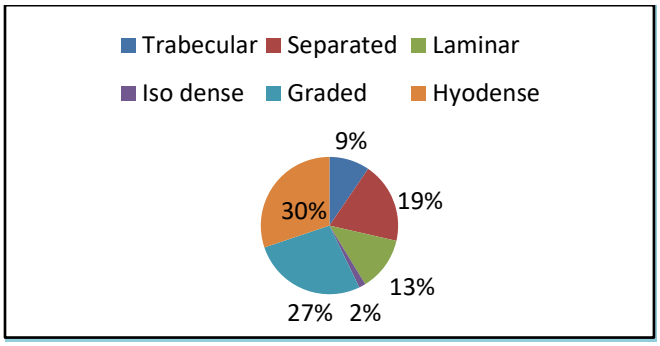

Figure 1: Modified Nakaguchi Classification.

Table 1: Surgical Intervention According to the Type of Chronic Sub-Dural Hematoma

Classification type	Burr Hole No. of patients (%)	T & T No. of patients (%)	DC No. of patients (%)	Conservative No. of patients (%)
Trabecular	4 (6.3%)	2 (3.17%)	0	0
Separated	11 (17.5%)	1 (1.6%)	0	0
Laminar	8 (12.7%)	0	0	0
Isodense	1 (1.6%)	0	0	0
Graded	16 (25.4%)	0	0	1 (1.6%)
Hypodense	17 (27%)	0	1 (1.6%)	1 (1.6%)
Total (63 patients)	**57 (90.5%)**	**3 (4.8%)**	**1 (1.6%)**	**2 (3.17%)**

Key: T&T; Through and through, DC; De-compressive Craniotomy

Management Analysis

Regarding the Management analysis, burr hole drainage was done mostly as shown in Table 1. Through and through the surgical procedure was mostly done in Trabecular and Separated type in CSDH patients. However, the significance was not found (p-value: 0.315 calculated via. Pearson chi-square test regarding surgical procedure.

Management Outcome

Regarding the mean difference (Figure 2) Pre-operative and Post-operative GCS after surgical procedure. The p-value was evaluated via. Spearman Rank test, which was significant i.e., <0.001.

The association between the Type of Nakaguchi Classification (categorical data) and age (parametric, continuous data) was highlighted by the one-way ANOVA test. In contrast, the association of pre-operative and post-operative GCS (non-parametric, continuous data) with the type of classification was elaborated Kruskal–Wallis test. However, the results are found to be insignificant (Table 2).

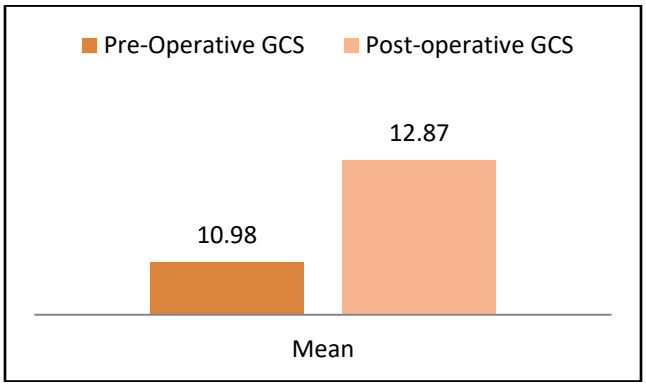

Figure 2: Mean Pre and Post-Operative Glasgow Coma scale.

Functional Outcome

Now the Glasgow coma outcome scale extended (GCOSE) according to the type of chronic subdural hematoma. The GCOSE was calculated postoperatively on the discharge of the patient. A total of 50.8% of patients had upper good recovery on Discharge out of which 28.13% of Hypodense and Graded types had upper Good recovery respectively. Total mortality was 22.2% out of which 28.6% was hypodense and Graded type respectively (See Table 3). However, the association was found to be insignificant (p-value: 0.782 from Pearson Chi-Square Test).

Table 2: Association between Type of CSDH and Age, pre-and post-operative GCS.

Type of CSDH	Age (mean)		Pre-operative GCS (mean)		Post-operative GCS (mean)	
Trabecular	53.5		13.2		15	
Separated	61.0	P-value	8.8	P-value	12.7	P-value
Laminar	61	0.684^	13.1	0.196*	12.9	0.414*
Graded	61	(insignificant)	10.8	(insignificant)	11.9	(insignificant)
Hypodense	54.8		10.7		13.0	

*Applied Kruskal-Wallis test for differences within the group
^Applied ANOVA

Table 3: Functional Outcome of Different Classifications Type according to GCOSE.

Classification Type	Dead No. of patients (%)	LSD No. of patients (%)	USD No. of patients (%)	LMD No. of patients (%)	UMD No. of Patients (%)	LGR No. of patients (%)	UGR No of patients (%)
Hypodense	4 (6.3%)	2 (3.17%)	0	1 (1.58%)	1 (1.58%)	2 (3.17%)	9 (14.3%)
Graded	4 (6.3%)	0	2 (3.17%)	0	1 (1.58%)	1 (1.58%)	9 (14.3%)

Isodense	0	0	0	0	0	0	1 (1.58%)
Laminar	3 (4.76%)	0	0	1 (1.58%)	0	1 (1.58%)	3 (4.76%)
Separated	3 (4.76%)	0	0	1 (1.58%)	1 (1.58%)	3 (4.76%)	4 (6.3%)
Trabecular	0	0	0	0	0	0	6 (6.3%)
Total (63 patients)	14 (22.2%)	2 (3.17%)	2 (3.17%)	3 (4.76%)	3 (4.76%)	7 (11.1%)	32 (50.8%)

Key: GCOSE; Glasgow comma outcome scale extended, UGR; Upper good recovery, LGR: Lower good recovery, UMD: Upper Moderate Disability, LMD: Lower moderate disability, USD: Upper Severe Disability and LSD: Lower Severe Disability

Recurrence Analysis

The recurrence of CSDH was 11.1% and the most common type was Hypodense (57%) and separated (29%). The P-value was calculated by chi-square test between the classification type of CSDH and recurrence admission and it was found to be insignificant (p-value: 0.464) (Table 4). The chi-square is calculated via. Following tabulation (Table 4).

Table 4: Recurrence of Chronic Subdural Hematoma.

Modified Nakaguchi classification	Frequency (%)
Hypodense	4 (57%)
Separated	2 (29%)
Graded	1 (14%)
Total	7 (11.1%)

Table 5: The cross-tabulation between classification type and Recurrence.

Recurrence	Classification						Total
	Trabecular	Separated	Laminar	Isodense	Graded	Hypodense	
Yes	0	2	0	0	1	4	7
No	6	10	8	1	16	15	56
Total	6	12	8	1	17	19	63

DISCUSSION

Chronic Sub-Dural hematoma is one of the common diseases that is presented to the Neurosurgery department mostly in the elderly population and its importance is progressively increasing due to the use of antithrombotic medication.[11] CT scan brain is an important tool for diagnosis, hence the classification system was introduced, the most recent one is a modified Nakaguchi classification with κ value of 0.78, the highest of the others.[4]

A total number of 63 patients were included in the study, 69.8% were male and 30.2% were female, these findings are coherent with the previous study, which showed male preponderance.[4] The mean age in our study was 58.3 years and the unilateral hematoma was the common site as compared to other studies unilateral is the common site and age is somewhat increased, which is 73 to 82 years, the difference in mean age could be due to geographical difference or presences of many other factors i.e. increased incidence of trauma, high burden of infectious disease and decreased life span, although further studies are required.[4,12]

The most common presentation according to Modified Nakaguchi Classification (figure 3) in our study was Hypo-dense (30%) and Graded (27%) as compared to other studies in which hypo-dense (21%) and Isodense (22.8-26%) were common one.[12,13] The difference in the common presentation of CSDH classification could be due to the difference in the time of presentation or it could be due to the lack of census in our

geographical area, however further studies are required.[14]

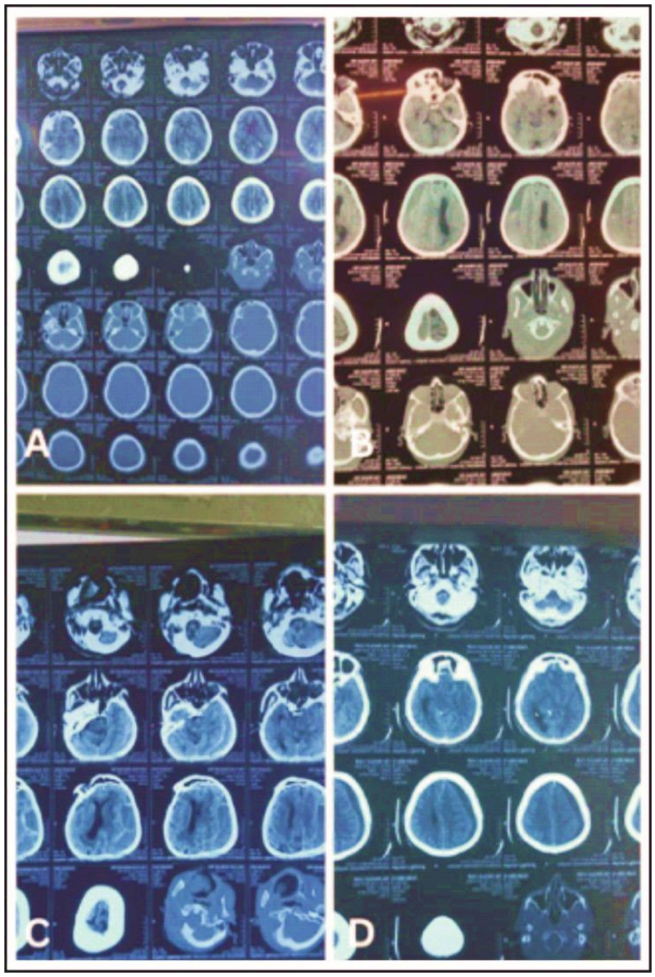

Figure 3: Different types of CSDH according to Modified Nakaguchi classification. A: showed Separated type, B: Showed graded type, C: showed Trabecular type D; Hypodense type. The consent was obtained from the patient to include their scans in this research, with the understanding of information visibility.

The burr hole Drainage was the most common surgical intervention that was used, as in this study and literature.[4,12] There was a significant difference between pre and post-operative GCS after surgical intervention as it is validated by multiple studies in the literature, however, the meta-analysis doesn't support the significance of GCS.[15,16] The association between the Type of CSDH and pre and post-GCS changes has not been seen literature but in our study, all types had a non-significant association with GCS, however, a significant association was found with improvement in GCS.[15]

The Glasgow coma outcome scale extended (GCOSE) was examined on the discharge of patients. In this study; a total of 50.8% of patients had upper good recovery on Discharge out of which 28.13% had Hypodense and Graded type on CT respectively. Total mortality was 22.2% out of which 28.6% have hypodense and Graded type on CT respectively, this mortality is way more than the mortality described in the literature that in-hospital mortality was reported to be 0.7% although the 25-year retrospective study showed the overall mortality of 63%.[17,18] The difference could be due to high viral load, use of anticoagulants in cardiac patients, and large duration of previously conducted studies, still further investigation is required.[19,20]

The association of the type of CSDH with Surgical management and GCOSE was explored altogether and it was found that the CSDH type outcome on GCOSE is significantly associated with the type of Management (p-<0.001). However, the association of the Glasgow coma outcome scale was performed in literature but with hematoma densities classification, not with modified Nakaguchi Classification.[21]

Regarding the recurrence of CSDH, it was 11.1% and the most common type was Hypodense (57%) and separated (29%) in this study, however in the literature hypodense (45%) and Graded type (50%) was found to most common type in recurrence, the reason of this difference could be due to the geographical area or it could be due to difference in time of presentation.[4,13]

CONCLUSION

Modified Nakaguchi Classification of Chronic subdural hematoma didn't define the outcome

measurement of the patient, however, the surgical intervention related to its specific type is significantly associated with the outcome of the patient on the Glasgow coma outcome scale extended.

LIMITATION OF STUDY

This study doesn't account for associated comorbidities and their impact on outcomes. Strict follow-up was absent; the patients recruited for recurrence were those who presented with the same condition again.

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Additional information

Disclosures: Authors declare no conflict of interest related to this research.
Data Availability: The data supporting this study's findings are available from the corresponding author upon reasonable request.
Ethical Review Board Approval: The study conformed to the ethical review board requirements.
Permission Statement: We confirmed that explicit consent was obtained from the patient to include their scans in this research, with the understanding that identifying information may be visible.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest: 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 or within the previous three years 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.

AUTHOR'S CONTRIBUTION

Sr.	Authors full name	Intellectual Contribution to paper
1.	Muzafar Ali Bhand	Study design and methodology.
2.	Sanaullah Pathan	Paper writing.
3.	Hameedullah Khan	Data collection and calculation.
4.	Peer Asad Aziz	Analysis of Data and interpretation of results.
5.	Wafa Haider	Literature review and referencing.
6.	Arslan Mehmood	Editing and quality insurer.
7.	Zeeshan Nasir	Results analysis.