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Computed tomography evaluation of spontaneous non-traumatic intraparenchymal haemorrhage in brain with clinical correlation and assessment of functional outcome

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Abstract

Introduction: The Spontaneous intraparenchymal hemorrhage is the major cause of mortality and morbidity in both developed and developing countries. It often affects major functional areas in brain. It is difficult to assess the neurological status based on only clinical examination.

The objective of the study is to evaluate the site of intraparenchymal haemorrhage. To correlate intra-parenchymal haemorrhage volume and NIHSS score and to establish volume as a predictor of clinical outcome.

Methodology and Materials: This was a prospective study of consecutive 43 patients who presented with spontaneous intra- cerebral haemorrhage to our hospital. All the subjects underwent CT scan of the brain. The CT scan of brain was read and site, size, volume of hematoma, intraventricular extension and follow up by NIHSS score was done.

Results: Hematoma volume increases with increase in NHSS score. A strong positive correlation was found between NIHSS score on Day-1 and volume of hematoma with a r = 0.72, p< 0.001. Positive correlation was found between NIHSS score after 1 week and volume of hematoma with r= 0.46, p= 0.002. Positive correlation was found between NIHSS score day before

discharge and volume of hematoma with r= 0.312, p= 0.064.

Conclusion: In this study it was found that NIHSS score significantly increased with extension of bleed into ventricles, increased with increase in midline shift and increased with volume of hematoma.

A positive correlation was found between NIIHSS score and volume of hematoma. Hence, volume of hematoma can be used a predictor of clinical outcome in follow-up study in cases of non-traumatic spontaneous intra parenchymal bleed in brain.

Keywords: Computed Tomo graphy, Intra parenchymal haemorrhage, Spontaneous intracerebral haemorrhage, Midline shift, Volume of hematoma, NIHSS score

Introduction

Non-traumatic intra cerebral haemorrhage results from rupture of blood vessels in the parenchyma of the brain. It is a major public health problem[1]. It is the most sub-type of stroke, with an annual incidence of 10-30 per 100000 population [1,2] accounting for 2 million (10-15%) of about 15millions strokes worldwide each year. Uncontrolled hypertension is the most common risk factor for spontaneous ICH[3].

Spontaneous Intracranial haemorrhage is the most common reason for cerebrovascular accidents which cause neurological derangements and is the frequent reason for neuroimaging. The main aim of imaging is to know the location and volume of haemorrhage.[4]

Spontaneous Intracranial Haemorrhage (SICH) is the haemorrhage into the brain parenchyma other than traumatic cause; ICH is believed to account for (10%) of all strokes each year[5].

Most of the SICH are caused due to hypertension or micro-aneurysm rupture. The origin of most of the SICH of hypertensive origin are putamen, thalamus, internal and external capsular region and rarely lobar region due to amyloid angiopathy[6].

Even after early imaging and diagnosing of SICH mortality is not reduced over the past 30 years. Therefore, determination of prognostic and functional outcome helps in selecting therapeutic and other modes of treatment options will be made easy[7].

The evaluation of early detection of SICH, localization, size, volume and extension of haemorrhage by Computed Tomography of the brain helps clinician for better therapeutic options as well as for the management of the patient[8].

Attempts were made earlier for the computed tomography evaluation of SICH non – traumatic intra-parenchymal haemorrhage in brain with clinical correlation and assessment by functional outcome but the results were variable in different studies.

NIHSS is a score that helps in predicting neurological deficits. Current study helps in assessing the neurological deficits

Objectives

1. To evaluate site of intra-parenchymal haemorrhage.
2. To correlate intra-parenchymal haemorrhage volume with clinical outcome in an attempt to establish volume as a predictor of clinical outcome.

Materials and Methods

A hospital based Prospective study was conducted in CT department of Raja Rajeswari Medical College and Hospital, Bangalore from September 2021 to September 2022 on patients with clinical suspicion of non-traumatic spontaneous intra parenchymal haemorrhage who undergo CT scanning of Brain at Raja Rajeswari medical college hospital.

Inclusion Criteria

All the Patients with evidence of spontaneous non traumatic intraparenchymal haemorrhage in CT scan.

Exclusion Criteria

1. Patients with head injury.
2. Patients with venous thrombosis.
3. Patients with intra tumoral haemorrhage

Sample size: 43

Method of Collection of Data

A hospital based Prospective study was conducted in CT department of Raja Rajeswari Medical College and Hospital, Bangalore from September 2021 to September 2022. Total 43 patients were included in the study based on the inclusion and exclusion criteria. Ethical Committee approval was obtained before conducting the study. Written informed consent was taken from all the study participants before collecting the data. All the study participants were subjected to CT scan. The following data was recorded – patients age, clinical history, site and volume of haemorrhage. Volume of haemorrhage was calculated by using ellipsoid formula ABC\2.where the measurement will be taken in three perpendicular axis-A, B and C.

Clinical assessment of Intra parenchymal Haemorrhage

The most appropriate way to clinically assess patients with intraparenchymal haemorrhage is by using Glasgow coma scale and NIH stroke scale score.

Statistical Analysis

Data collected was compiled and entered into Microsoft excel sheet and analyzed using SPSS software version 26. All the quantitative variables in the study were expressed in terms of mean and standard deviation. All qualitative variables were expressed as frequency, proportions and percentages. The association of intra parenchymal haemorrhage parameters with prognosis and outcome was compared using chi-square test. Mean of two groups was compared using unpaired t test. Correlation between two parameters was done using Pearson's correlation test.

NIHSS Score[9]

National institute of Health stroke scale is reproducible scale that measures neurological deficit. There are total of 43 points and they divided into 11 parts in the NIHSS, with 13 tests included. It examines the level of consciousness, vision and gaze, facial palsy and extremity weakness, limb ataxia, sensory loss, language and dysarthria and neglect. A normal patient will have NIHSS score of 0. The maximum score is 42. If the volume of hematoma is more the NIHSS score will also be more.

Results

A total of 43 patients with SICH were studied. The sex distribution, age of the patient, location of hematoma, volume of hematoma, intraventricular extension, subarachnoid haemorrhage, midline shift, GCS score on admission, NIHSS score evaluation on admission, one week after admission and before date of discharge were evaluated.

Figure-1 shows that among 43 patients, majority i.e., 26 were males (60 %) and 17 were females (40%). Peak incidence of neurological deficits in both females and males were seen in the age more than 70 years that is 30.2 %. But in males the incidence of SICH was almost equal for all the ages (table-1). The most common site for SICH was basal ganglia, which accounted for 25 patients (58%) followed by thalamus- 11 patients (25.5 %), lobar – 3 patients (6.9%), cerebellar – 2 patients (4.6 %), pontine 1 (2.3 %) midbrain 1 (2.3%).(figure-2).

Out of 43 patients 27 (62 %) had haemorrhage volume between 0 – 30 cc, 09 (20 %) patient had 30- 60 cc, 6

(14%) had 60 – 90 cc and 01 (2.3%) had volume of >90 cc (Table-3). Out of the 43 patients 4(9.3%) patients had NIHSS scale 5- 15, 7 (16.2%) had 16, 32 (74%) 21-42 scores (figure-3). In this study out of the 43 patients 4(9.3%) patients had NIHSS scale 5- 15, 7 (16.2%) had 16, 32 (74%) 21-42 scores (table-2).

Intraventricular extension was seen in 24 patients (55%). It was noted that as the degree of Intraventricular extension increased the mortality rate and NIHSS score was also increased. Patients with grade 1 Intraventricular extension had comparatively better recovery. The study also showed that in patients with no IV extension recovery was good and the mortality rate was also low (table-3).

Mean NIHSS score of Intraventricular extension was 27.81 +/- 4.29 and as compared to 21.56+/- 7.48 among those with no intraventricular haemorrhage and this difference was found to be statistically significant (P=0.001). Similarly, NIHSS after 7 days in patients with intraventricular extension was 21.42 +/- 8.14 and among those with no intraventricular extension, it was 15.11 +/ - 4.75. This difference was statistically significant with a p value of 0.005. NIHSS scale at the date before discharge was 14.50 + /- 6.70 among those with intraventricular extension and in intraventricular extension negative cases it was 8.94 +/-4.38 and this difference was strongly satisfactory (p=0.006) (table-4). Patients with more midline shift had more NIHSS score and poor functional outcome (table-5).

A strong positive correlation was found between NIHSS score on Day-1 and volume of hematoma with a r = 0.72, p< 0.001. Positive correlation was found between NIHSS score after 1 week and volume of hematoma with r= 0.46, p= 0.002. Positive correlation was found between NIHSS score day before discharge and volume of hematoma with r= 0.312, p= 0.064 (FIGURE-4).

Correlation between midline shift and NIHSS score was Strongly positive with a r value of 0.431 (p=0.02). Whereas there was no correlation found between day 7 NIHSS and midlines shift and NIHSS score on day before discharge and midline shift.

Figure 1: Gender distribution of hematoma.

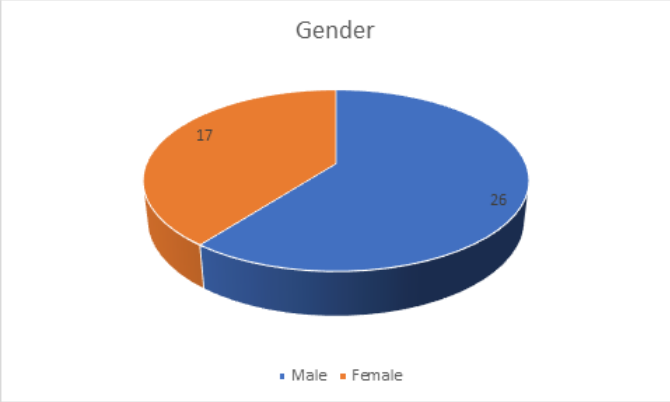


Table 1: Distribution of age and sex of the patients

Age in years	Gender		Total
	Female	Males	
40 - 49	03(17)	07 (26.9)	10 (23.2)
50- 59	04(23)	07 (26.9)	11(25.5)
60- 69	04 (23)	05 (19.2)	09(20.9)
70- 100	06 (35)	07 (26.9)	13 (30.2)
Total	17	26	43 (100)

Figure 2: Location of hematoma

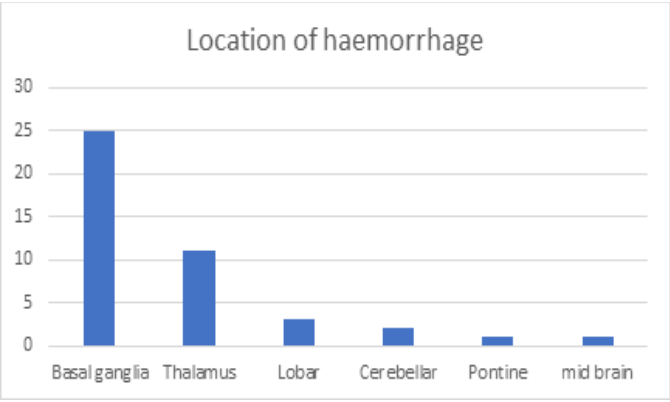


Figure 3: Grading of haemorrhage volume with percentage.

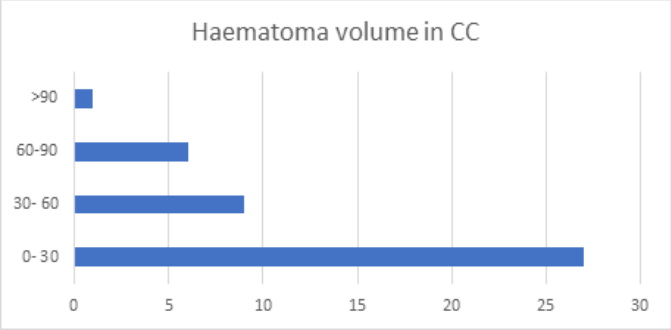


Figure 4: Correlation between NIHSS score and Hematoma volume.

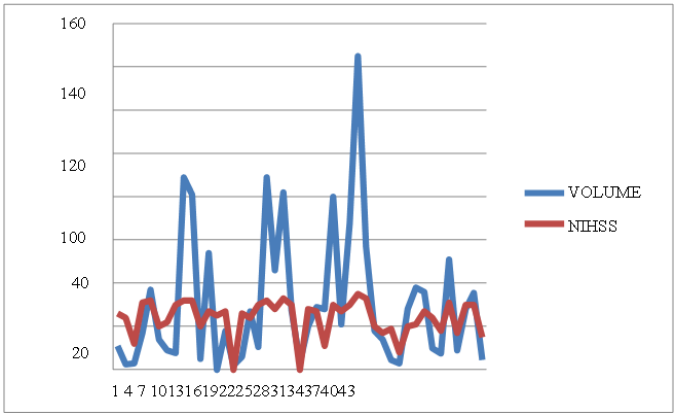


Table 2: NIHSS score on admission with grading.

NIHSS score	Number of patients	Percentage
0-4	00	00
5 - 15	04	9.3
16- 20	07	16.2
> 21- 42	32	74
Total	43	100

Table 3: Correlation between NIHSS Score and IV extension.

NIHSS score	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
0-5	-	-	-	-	-
5-15	-	-	-	-	-
16-20	7	-	3	-	-
> 20 - 42	9	4	5	5	10
Total	16	4	8	5	10

Table 4: comparison of mean NHSS score between patients with and without IV extension.

Day	IV extension- NIHSS score	No IV extension- NIHSS score	P value
Day 1	27.81 +/- 4.29	21.56 +/- 7.48	0.001*
Day 7	21.42 +/- 8.14	15.11 +/ - 4.75	0.005*
Day before discharge	14.50 + /- 6.70	8.94 +/-4.38	0.006*

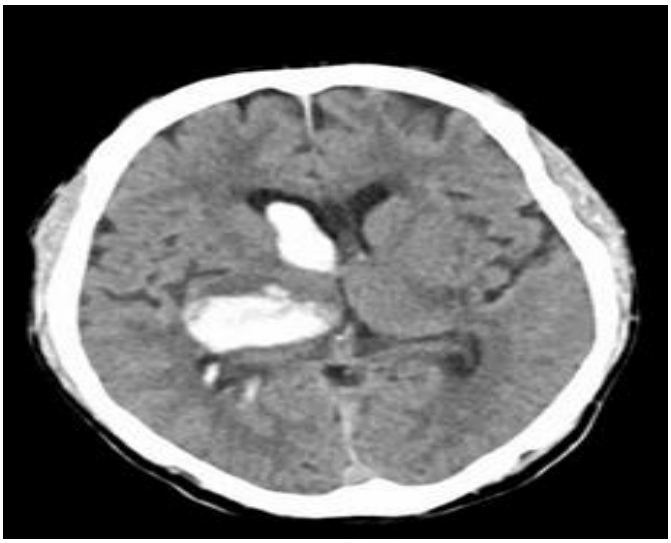
*-Significant

Table 5: Correlation between NIHSS and midline extension

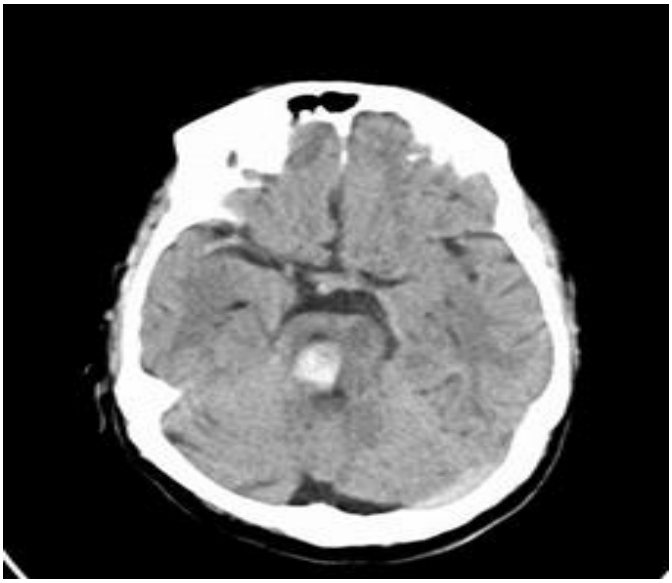
NIHSS score	No midline shift	1-5mm	6-10mm	11-15mm
0-4	-	-	-	-
5-15	4	-	-	-
16-20	5	2	1	-
> 21- 42	9	10	10	6
Total	18	12	11	6

r =0.431 (p=0.02*-significant).

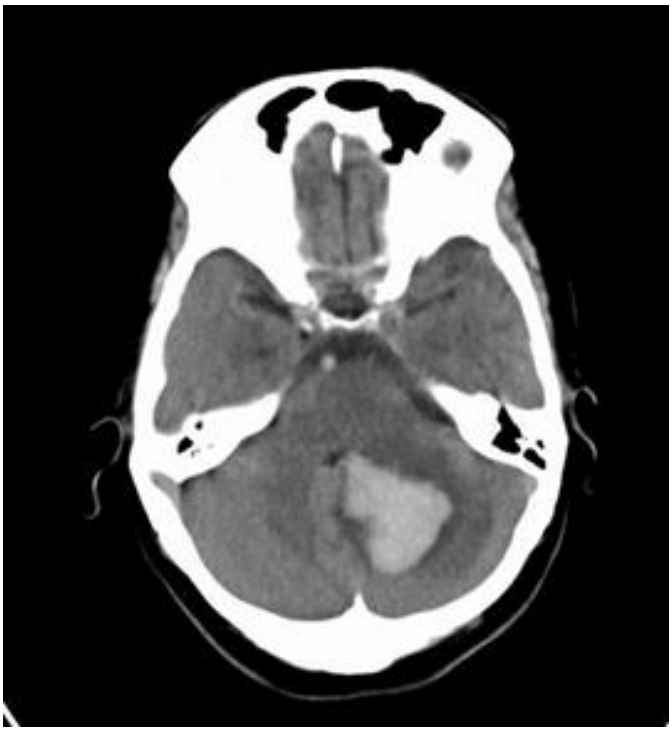
Case-1: Case of right thalamic haemorrhage with a volume of 11 cc intraventricular extension with NIHSS scale 26.



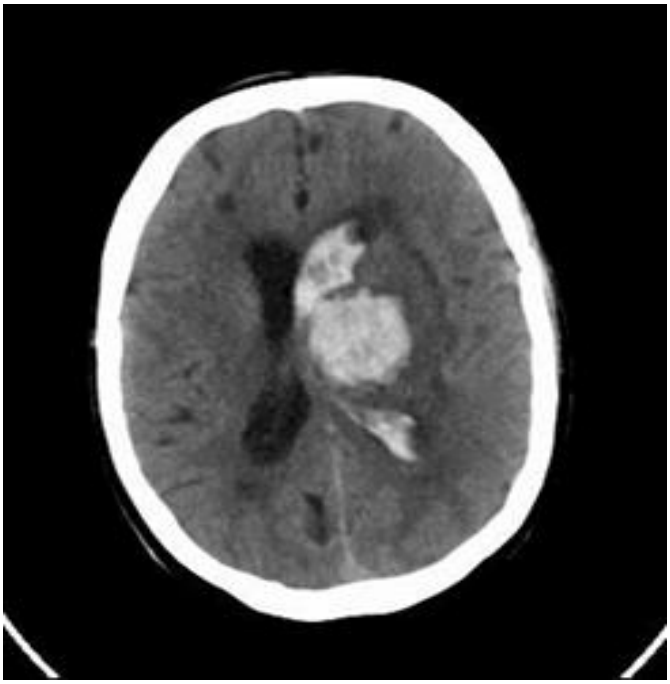
Case 2: Case of Pons hematoma with volume of 4cc with NIHSS score 9 with bad prognosis.



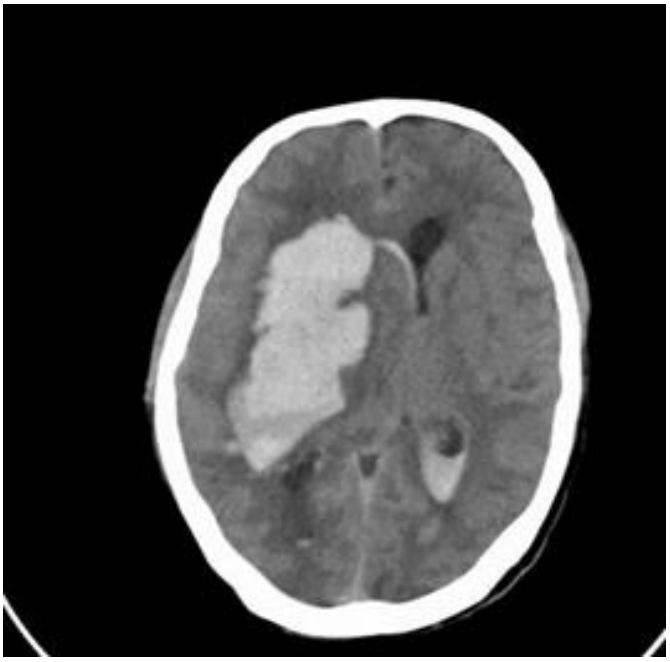
Case 3: Left cerebellar hematoma with volume of 18cc with NIHSS score of 27 cc with bad functional outcome.



Case 4: Case of left thalamus with intra-ventricular extension with a volume of 89 cc with NIHSS scale 32 and patient expired



Case 5: Right ganglio capsular hematoma with intraventricular extension with NIHSS score of 82 cc with NIHSS score of 30



Discussion

This study was conducted to evaluate the site of intra parenchymal haemorrhag; to find correlation between intra - parenchymal haemorrhage volume and NIHSS score to establish volume of haemorrhage as a predictor

of clinical outcome. A total of 43 Patients with evidence of spontaneous non traumatic intraparenchymal haemorrhage in CT scan were included in the study.

In this study male predominance was seen in the occurrence of SICH with male to female ratio of 3:2. This was similar to a study by Rathore etal.,[9] in which there were 93 males and 67 females. In this study mortality rate was found to be 17/43 (39%). All these 17 patients showed NIHSS scores between 21 to 42. The mortality rate in other studies corresponds to 40 to 50 % due to SICH[10,11,12]. Among 26 male patients, mortality was seen in 7 (27%) patients. Among 17 female patients 10 survived and mortality was seen in 7 (41 %) patients. Hence it was noted that mortality rate due to SICH was higher in females compared to males.

In this study it was found that the most common location of bleed was basal ganglia accounting to 25 patients (58%) followed by thalamus 11 patients (25%), lobar 3 patients (7 %), cerebellar 2 patients (4.6%), pons 1 patient (2.3%) and Midbrain 1 patient (2.3 %).

Among 25 (58%) of the patients with basal ganglia as the site of haemorrhage, 4(16 %) of them had good recovery and 7 (28%) patients had moderate recovery 6 (24%) showed severe disability and mortality was seen in 8 (32%) patients. In a study by Rathor etal.,[9] recovery was seen in 86.7% patients with basal ganglia haemorrhage which was more compared to this study. In this study, among 11 (25%) patients with thalamic hematoma, 7(63%) of them showed moderate recovery and 4 (36%) patients expired. A study by Weisberg et al[13] showed similar prognosis.

In this study, patients with lobar haematomas had better prognosis when compared to other SICH with a recovery rate of 100%. It was observed that these patients showed improvement in NIHSS score from the day of admission to the day of discharge. In a study by Rathor etal.,[9] recovery among patients with lobar haemorrhage was 67.1% which was less compared to this study.

In this study, outcome of patients with pontine, cerebellar haematomas was poor compared to a study by Silverstein et al[14]. A study by Louis et al[15] also showed similar outcome, in which pontine haematomas had grave prognosis within 48 hrs. A study by K .H et al showed that cerebellar haemorrhage had 75 % mortality[16].

In this study, 24/43 (55.8%) patients had intraventricular extension Out of 24 patients, majority i.e., 12 (50%) patients showed NIHSS of 5-15 followed by 8 (33.3%) with NIHSS of 16-20. There was only 1 patient with intraventricular extension who showed NIHSS of 0-4. It was noticed that more number of cases with intraventricular extension had scores >5. NIHSS sores were significantly high in patients with intraventricular extension compared to those without it. Mortality among patients with intraventricular extension was 11 (45 %). This observation was higher than an earlier study done by Hel weg et al[17] 60 (39%).

Volume of hematoma is an important indicator of prognosis in spontaneous intracerebral haemorrhage. Patients with volume more than 60 – 90 cc showed higher NIHSS scores which suggests poor functional outcome. In this study among 17 patients who showed mortality, 9 (53%) of them had volume of hematoma > 30cc. Worst outcome was observed among patients with volume of hematoma >50 cc. A study by Bolnder etal.,[18] showed volume of 80 ml as dangerous volume with 90 % mortality.

Midline shift is another prognostic indicator in SICH patients. Patients who had more than 10 mm midline

shift had mortality of 100 % and shift less than 10 mm had mortality rate of 19 %.

Hydrocephalus was noted in 11/43 (25.5%) patients. Among these 11, 6 patients expired (54%). A study by Diringer et al[19] also revealed association of hydrocephalus with poor prognosis among SICH patients 20.

Conclusion

Computed tomography is very good investigation of choice in determination of site, volume, intraventricular extension and assessment of prognosis of spontaneous intracerebral haemorrhage. In this study it was found that Basal ganglion was the most common site for spontaneous intracerebral haemorrhage. NIHSS score predicted the poor functional outcome of the spontaneous intra cerebral haemorrhage. Presence of midline shift, intraventricular extension and hydrocephalus suggested poor prognosis and poor functional outcome for the patient. NIHSS score showed positive correlation with volume of the hematoma in this study. Hence volume of hematoma served as the best prognostic indicator in assessing functional outcome of the patient in this study.

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