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Intraventricular Hemorrhage Extension is a Strong Predictor of Mortality in Hemorrhagic Stroke

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Abstract

Introduction: *Spontaneous intracerebral hemorrhage (sICH) accounts for 10–15% of all strokes and is characterized by a 30–50% 3-month mortality rate. Intraventricular hemorrhage (IVH) extension can be seen in up to 54% of spontaneous intracerebral hemorrhage and is an independent predictor of worse outcome and neurological deterioration.* **Objective:** *To predict outcome and prognosis in spontaneous intracerebral hemorrhage patient in relation with intraventricular hemorrhage extension.* **Materials and Methods:** *Hospital based prospective study carried out in two hundred hemorrhagic stroke patients. The severity of intraventricular hemorrhage extension was calculated using the Graeb scale and volume of hemorrhage was measured by ABC/2 formula using CT scan.* **Results:** *Mean age of patients of hemorrhagic stroke was 61.64 ± 12.76 years. 66% of patients were male. Mortality rate of hemorrhagic stroke after the age of 60 years was 47.92% in 1st month. 79.80% of patients were died with GCS score less than 8. In our study 96.08% of patient died with >50 ml Hemorrhage group, on the other hand mortality rate was 48% in 30-50ml hemorrhage group and 11.12% in <30ml hemorrhage group. Mortality rate was 61.17% in hemorrhagic stroke with ventricular extension group on the other hand mortality was 21.65% in hemorrhagic stroke without ventricular extension. Those patients with GRAEB score >5 their mortality rate was 75.00% on the other hand mortality was 49.10% in GRAEB score 1-4.* **Conclusion:** *Intraventricular hemorrhage extension increased mortality in spontaneous intracerebral hemorrhage. Increased IVH extension severity, defined by a GRAEB score ≥5, is an independent predictor of poor outcome of Spontaneous intracerebral hemorrhage alone with age, GCS and hemorrhage volume.*

Keyword: *Intraventricular hemorrhage extension, Hemorrhagic stroke, Mortality.*
Number of Tables: *07; Number of References: 40; Number of Correspondences; 04.*

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Introduction:

Spontaneous intracerebral hemorrhage (sICH) has an overall incidence of 24.6 per 100,000 patient-years and the incidence increases with age[1]. sICH accounts for 10–15% of all strokes and is characterized by a 30–50% 3-month mortality rate[2-4]. Intraventricular hemorrhage (IVH) extension can be seen in up to 54% of sICH and is an independent predictor of worse outcome and neurological deterioration[4-13]. Parameters such as age, ICH volume, Glasgow Coma Scale (GCS) or infratentorial origin of hemorrhage, the presence of intraventricular hemorrhage (IVH) represents an established parameter independently impacting clinical outcomes after ICH [11,14]. IVH occurs in up to 45% of ICH patients [5] and previous analyses have suggested an influence of the extent of IVH on functional outcome[15,16].

In ICH patients, the most detrimental consequence of IVH is acute, obstructive hydrocephalus. The occurrence of hydrocephalus has been shown to be an independent predictor of mortality in ICH patients[16].

Observations from retrospective clinical series and prospective clinical trials have confirmed the importance of IVH as a clinical factor associated with poor outcomes including coma, mortality, and long-term functional impairment. The presence of intraven-

tricular blood has been strongly associated with impaired consciousness at presentation[17]. Simple comparison between ICH subjects with and without IVH extension suggests that mortality is substantially increased if IVH is present. Tuhrim was the first to consistently demonstrate a powerful relationship between the presence of IVH in a brain hemorrhage patient and the likelihood of death[18]. This relationship was prospectively demonstrated in several subsequent studies[10,19]. Multivariate regression analysis performed on other convenience samples almost always defines the presence of IVH as an independent risk factor for mortality and poor functional outcome[20-22]. Randomized controlled studies in the past decade have confirmed this point by demonstrating a similar relationship between poor outcomes and the extent of IVH.

Materials and Methods:

This Prospective study was conducted at Department of neurology, Shahid Sheikh Abu Naser Specialized Hospital, Khulna, between the period of 01/01/2019 to 31/01/2020. 200 cases of CT scan proved hemorrhagic stroke patient were included in this study. Hemorrhagic stroke with history of recent trauma to head, intracerebral hemorrhage due to anticoagulant or antiplatelet therapy, CT scan evidence of a subarachnoid hemorrhage, isolated intraventricular hemorrhage, patient with blood dyscrasia and hemorrhagic infarction were excluded from this study.

All stroke patients admitted in Neurology unit evaluated clinically and CT scan was done. Clinical assessment of outcome was done by assessing age, Glasgow Coma Scale (for assessing conscious level), neck rigidity (for assessing ventricular extension), posterior fossa lesion (assessed by seeing signs of brain steam lesion, signs of cerebeller lesion, respiratory pattern and cardiovascular status). We calculate hemorrhage volume in bedside by using ABC/2 formula[23,24]. Volume of hemorrhage was measured by ABC/2 formula using CT scan. CT scan slice with the largest area of hemorrhage was identified. The largest diameter (A) of the hemorrhage on this slice was measured. The largest diameter 90° to A on the same slice was measured next (B). Finally, the approximate number of slices on which the intracerebral hemorrhage was seen was calculated (C). C was calculated by a comparison of each CT slice with hemorrhage to the CT slice with the largest hemorrhage on that scan. If the hemorrhage area for a particular slice was greater than 75% of the area seen on the slice where the hemorrhage was largest, the slice was considered 1 hemorrhage slice for determining C. If the area was approximately 25% to 75% of the area, the slice was considered half a hemorrhage slice; and if the area was less than 25% of the largest hemorrhage, the slice was not considered a hemorrhage slice. These CT hemorrhage slice values were added and multiplied by the slice thickness and determined the value for C. All measurements for A and B were made with the use of the centimeter scale on the CT scan to the nearest 0.5 cm. A, B, and C were then multiplied and the product divided by 2, which yielded the volume of hemorrhage in cubic centimeters. Site of haemorrhage and ventricular extension were recorded. The severity of IVH extension was calculated using the Graeb scale[25]. The Graeb scale is a semiquantitative tool for IVH extension scoring, ranging from 0 to 12 points, with higher scores denot-

ing increased IVH volumes; a maximum of four is given for each lateral ventricle if expanded and filled with blood and up to 2 for the third and fourth ventricle if filled with blood and expanded (16). From day of admission to day 7 all patients were followed up twice daily. In each follow up pulse, blood pressure, Cardiac status, respiratory status, Glasgow Coma Scale, pupil, new focal sign and bed sore were assessed and any change in status were recorded. As shortage of bed in hospital could not allowed long duration stay, so those patients were discharged they were requested to attend follow up on 15th and 30th day in Neurology unit, and those who could not attend the follow up their information (outcome i.e. static / improved / death) had been collected over telephone. Results were calculated using Chi-square test.

Results:

A total of 200 patients of hemorrhagic stroke were incorporated in this study. Majority of the patients incorporated in this study belongs to age group above 60 years (i.e. 48%), followed by 50 – 60 years group (which was 31.5%) and 20.0% in < 50 years group. 66% of patients were male and 34% of patients were female.

Table – I: Shows

• Mortality rate increased with increased age, 46 patients died out of 84 after the age of 60 (i.e. about 54.76%) of all death, followed by 27 patients died in the age between 50 – 60 (i.e. about 32.14% of all death).

The results are as follows –

Table – I: Distribution of patients according to age and 1st month mortality (n=200).

Age of the patients	Group		Total
	Alive	Death	
< 50 yrs	30	11	41
	73.17%	26.83%	20.5%
50 - 60 yrs	36	27	63
	57.14%	42.86%	31.5%
> 60 yrs	50	46	96
	52.08%	47.92%	48%
Total	116	84	200
	58%	42%	100%

Table – II: Shows

• 42% of death occurs with 1 month of onset of intracerebral hemorrhage (ICH). 41.5% of patients were static and 16.5% patients improved in 1st month.

Table – II: Distribution of patients according to outcome in 1st month (n=200).

Outcome	Total	Percentage
Death	84	42%
Static	83	41.5%
Improved	33	16.5%
Total	200	100%

Table – III: Shows

• 99 patients presented with GCS ≤ 8 of which 79 patients (i.e. 79.80%) died on the other hand only 5 patients died (i.e. 4.95%) out of 101 with GCS ≥ 9.

Table – III: Distribution of patients according to initial Glasgow Coma Scale (GCS) and 1st month mortality (n=200).

GCS	Group		Total	Chi-square test (x^2)	Odds ratio	P-value
	Alive	Death				
≤ 8	20	79	99			
	20.20%	79.80%	49.50%	114.97	75.84	< 0.00001
≥ 9	96	5	101			
	95.05%	4.95%	50.50%			
Total	116	84	200			

Table – IV: Shows

• Mortality rate of hemorrhagic stroke in 1st month was 42%. This study shows increased size of hemorrhage increased mortality. Mortality rate of hemorrhage volume > 50 ml was about 96.08% in this study, where as mortality rate of hemorrhage volume < 30 ml was only 11.12%.

Table – IV: Distribution of according to volume of hemorrhage with 1st month mortality (n=200).

Volume of hemorrhage	Group		Total	Chi-square test (x^2)	P-value
	Alive	Death			
< 30 ml	88	11	99		
	88.88%	11.12%	49.50%		
30–50 ml	26	24	50		
	52%	48%	25%	100.7416	< 0.00001
> 50 ml	2	49	51		
	3.92%	96.08%	25.50%		
Total	116	84	200		
	58%	42%	100%		

Table – V: Shows

• 61.17% of patients died in ventricular extension group on the other hand only 21.65% patient died who had no ventricular extension.

Table – V: Distribution of patients according to ventricular extension and 1st month mortality (n=200).

Ventricular extension	Group		Total	Chi-square test (x^2)	Odds ratio	P-value
	Alive	Death				
Present	40	63	103			
	38.83%	61.17%	51.50%	32.0212	5.700	< 0.00001
Absent	76	21	97			
	78.35%	21.65%	48.50%			
Total	116	84	100			

Table –VI: Shows

• 75.00% of patient died in graeb score 5-12 group, on the other hand 49.10% patient died in graeb score 1- 4 group.

Table – VI: Distribution of patients of ventricular extension according to GRAEB score (n=103).

Graeb score	Group		Total	Chi-square test	P-value
	Alive	Death			
1- 4	28	27	55		
	50.90%	49.10%	53.40%		
				7.2434	0.00711
5-12	12	36	48		
	25.00%	75.00%	46.60%		
Total	40	63	103		

Table – VII: Shows

61.17% of patient died with ventricular hemorrhage group on the other hand 21.65% of patient died in non ventricular hemorrhage group

Table – VII: Comparative death analysis of ventricular hemorrhage and non ventricular hemorrhage (n=200).

Distribution	Number	Group		Odds ratio	P-value
		Alive	Death		
Ventricular hemorrhage	103	40	63		
		38.83%	61.17%	5.7000	0.0001
				(CI: 3.0513-10.6479)	
Non ventricular hemorrhage	97	76	21		
		78.35%	21.65%		
Total	200	116	84		

Discussion:

Two hundred patients with hemorrhagic stroke admitted in Department of neurology, Shahid Sheikh Abu Naser Specialized Hospital, Khulna were included in this study within the time period of 01/01/2019 to 31/12/2019. All patients were selected as per inclusion criteria. Their presentation, risk factors and outcome were assessed. In this study shows that mean age of patients of onset of hemorrhagic stroke was 61.64 ± 12.76. This co-relates with studies shows hemorrhagic stroke occurs particularly those older than 55 years of age[26,27]. This study shows that males were affected more than females, 66% of patients were male and 34% of patients were female. This co-relates with studies suggesting that intracerebral hemorrhage is more common in men than women[26,27].47.92% of patients died in age group > 60 years followed by 42.86% in 50 – 60 years and 26.83% in < 50 years group (Table - I), suggest mortality increased with increased age which correlates with study shown by Daverat P and Broderick JP et al[28,29] . This study shows that 42% of patients died 41.5% static and

16.5% were improved in 1st month of onset of stroke (Table - II), which co-relates with the study shown by Broderick et al they shown that 30 day mortality of ICH was 44%, with half of deaths occurring within the first 2 days of onset[29]. Level of consciousness, volume of parenchymal hemorrhage and to a lesser extent intraventricular hemorrhage has been most consistently linked with poor outcome[30-35].

This study shows 79.80% of (79 out of 99) patients died with a GCS ≤ 8, where as 4.95% of patients (5 out of 101) died with GCS ≥ 9 (Table - III), with a p – value < 0.00001 that is statistically significant which strongly co-relates with other foreign studie[29].

Volume of intracerebral hemorrhage as calculated by ABC/2 formulas using on CT-Scan were studied into three different categories < 30 ml, 30 – 50 ml and > 50 ml, Shown 96% death rates of hemorrhage size > 50 ml in 1st month. On the other hand death rates in 30 – 50 ml group were 48% and < 30 ml group were only 11.12% (Table –IV); with a chi-square test result was 100.7416 and p-value < 0.00001, that was statistically significant and coincide with the study shown that increased volume of hemorrhage increased mortality, Broderick J et al shows that a model of 30 day mortality that used the Glasgow coma scale and hemorrhage volume in patients with intracerebral hemorrhage correctly predicted outcome with a sensitivity and specificity of 97%[29].

51.50% of patients (n=103) presented with ventricular extension of which 61.17% (n=63) of patients died within 1 month (Table - V), with p-value < 0.00001 that was statistically significant and co-relates with several studies[36,37]. Tuhrim was the first to consistently demonstrate a powerful relationship between the presence of IVH in a brain hemorrhage patient and the likelihood of death[18].This relationship was prospectively demonstrated in several subsequent studies[10,19]. Multivariate regression analysis performed on other convenience samples almost always defines the presence of IVH as an independent risk factor for mortality and poor functional outcome[20-22]. Randomized controlled studies in the past decade have confirmed this point by demonstrating a similar relationship between poor outcomes and the extent of IVH. 75% of patient died in Graeb score 5 - 12 group, on the other hand 49.10% of patient died in graeb score 1 - 4 group (Table - VI) with chi square test value 7.2434 and p-value <0.05 that is statistically significant. Trifan G in a study shown higher IVH severity as defined as Graeb score ≥5 is associated with worse outcome, while lower IVH severity Graeb scores1-4 has similar outcomes to patient without IVH[38]. In one of these studies, Graeb score ≥5 was associated with increased functional impairment at hospital discharge[39]. In another study, increasing IVH severity decreased survival and functional independence[40]. Comparative death analysis of ventricular hemorrhage and non ventricular hemorrhage (Table - VII) shows 61.17% of patient died in ventricular hemorrhage group on the other hand 21.65% of patient died in non ventricular hemorrhage group with odd ratio 5.7000

and p-value <0.0001 that is statistically significant which co relates with study shown by Trifan G[38].

Conclusion:

Intraventricular hemorrhage extension is a strong predictor of mortality in spontaneous intracerebral hemorrhage. Increased IVH extension severity, defined by a GRAEB score ≥5, is an independent predictor of poor outcome of Spontaneous intracerebral hemorrhage alone with age, GCS and hemorrhage volume. When using risk stratification tools for clinical severity grading after sICH, IVH extension should be given different weights based on the amount of IVH extension present, rather than being used as a dichotomized variable.

Conflict of Interest: None.

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