

## Correlation between Degree of Midline Shift at Computed Tomography Scan of Brain and Glasgow Coma Scale Score in Spontaneous Intracerebral Hemorrhage

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Spontaneous intracerebral hemorrhage (stroke) affects the vasculature of brain. It is the third leading cause of death after ischemic heart disease and cancer, and an important cause of hospital admission and long term disability. CT scan is an initial diagnostic procedure of choice in acute stroke. This study was carried out to find the relationship between midline shift of brain in spontaneous intracerebral hemorrhage with Glasgow coma scale score in Dhaka Medical College Hospital in a period of one year. A total of 64 patients were studied. Out of this 32 has spontaneous intracerebral hemorrhage with mass effect and 32 had no mass effect. All the patients were evaluated by CT scan findings. In this study 46 person were male (77.87%) and 18 (28.125%) were female, which showed definite predominance of male, with a male female ratio approximately 2.6:1. Majority belong to age group 51-70 years (78.13%). Hypertension was found to be most common risk factor (78.12%), followed smoking (56.25%), diabetes mellitus (3.75%) and heart disease (2.25%). The altered level of consciousness were severe in 22 persons (34.34%), moderate in 30 (46.87%), and mild in 12 (18.75%). Septum pellucidum shift in CT scan found 10 mm or less than 10 mm in 19 persons (59.38%) and greater than 10 mm were 13 (40.62%). A significant negative correlation was found between septum pellucidum shift with Glasgow coma scale score.

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**Key words:** Glasgow Coma Scale, CT Scan, Midline shift, Intracerebral Haemorrhage

### Introduction

Spontaneous intracerebral hemorrhage (SICH) is a blood clot that arises in the brain parenchyma in the absence of trauma or surgery, commonly due to hypertension, vascular anomalies, tumors, amyloid angiopathy, eclampsia and various drugs. Hypertension, however, remains the single greatest risk factor for SICH. Spontaneous intracerebral hemorrhage accounts for 10 to 15% of all strokes and is associated with a higher mortality rate. Only

38% of affected persons may survive 1 year.<sup>1</sup> The classic presentation of spontaneous intracerebral hemorrhage is sudden onset of focal neurological deficit progressing over hours with accompanying headache, nausea, vomiting, altered consciousness but is rarely seen in ischemic stroke. Elevation of blood pressure in as many as 90% of patients with spontaneous intracerebral hemorrhage. Seizures occur in approximately 10% of patients.

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Incidence of CVD per head of population rises steeply with age.<sup>2</sup> There is much less difference in the incidence of cerebral infarction between males and females but in developing countries like Bangladesh males are 3.5 times more affected than females.<sup>3</sup> However the mortality is higher in woman, about 16% of all women are likely to die of CVD, whereas that in men is 8%.<sup>4</sup>

Computerized tomography (CT) scanning is the initial diagnostic procedure of choice in acute stroke. Hematomas, even just a few millimeters in diameter, are rapidly and accurately identified at CT scans. The change in the CT scanning appearance of intracerebral hematoma over time has been well studied. The ability of CT scans to rapidly demonstrate surgically corrected lesions, fracture and subarachnoid hemmorage.

Intracerebral midline shift is a mass effect of hemorrhage volume and any other intracranial space occupying lesions like tumor, abscess, and cyst. Presence of midline shift is inversely related to prognosis; a positive predictive value of 78% to poor outcome in the presence of shift greater than 5 mm in patients over 45 years of age, and positive predictive value of 70% to unfavorable outcome at midline shift greater than 1.5 cm were observed.<sup>5</sup>

There are a number of methods of measuring a midline shift at CT scan brain. Cisternal, sellar/suprasellar obliteration, vertical displacement of cerebral mass and midline shifts using the falx, pineal gland and septum pellucidum shift also.

The Neurological status is assessed by the Glasgow coma scale score in respect to the magnitude of the midline shifts.

### Glasgow coma scale:

Response	Score	Obtain score	Total
<b>Eyes open</b>			
Spontaneous	4		
To Speech	3		
To Pain	2		
Absent	1		
<b>Verbal</b>			
Converses/ Oriented	5		
Converses/Disoriented	4		
Inappropriate	3		
Incomprehensible	2		
Absent	1		
<b>Motor</b>			
Obeys	6		
Localizes Pain	5		
Withdraws (flexion)	4		
Decorticate (flexion) Rigidity	3		
Decerebrate (extension) Rigidity	2		
Absent	1		

The sum obtained in this scale is to be used to assess coma and impaired consciousness.

Mild is 13 through 15 points

Moderate is 9 to 12 points

Severe 3 through 8 points

Patients with score less than 8 are in Coma.

Patients with relatively normal consciousness (GCS Score 13-15) rarely require surgery, whereas deeply comatose patients (GCS Score 3-5) rarely benefit from surgery. Surgery is therefore usually considered to have the most potential benefit for the group of patients with GCS Score between 6 and 12 or in patients with deteriorating status.

### Methods

#### Research approach

This cross sectional study was carried out in 64 patients, out of this 32 had spontaneous intracerebral hemorrhage with mass effect taken as Group A and 32 had spontaneous intracerebral hemorrhage without mass effect

taken as Group B, the age range was 32-75 years. These patients were purposively collected from Department of Radiology and Imaging in collaboration with Department of Neuro-Medicine in Dhaka Medical College Hospital in one year. All the patients were evaluated by CT findings. On admission Glasgow coma scale score were recorded from participant's treatment sheet and reviewed by the neurologist.

#### *Inclusion criteria*

The participant underwent CT scan of brain and demonstration of SICH with or without mass effect.

#### *Exclusion criteria*

Participant of CVD with normal CT scan.  
Participant with ischemic infarction.  
Participant with intracerebral hemorrhage due to trauma or surgery, and anticoagulant therapy.  
Bi-lateral intracerebral hemorrhage.

#### *Variables*

Age, sex and Glasgow Coma Scale Score(On admission).

#### *Clinical presentation*

Headache, vertigo, hemiparesis/hemiplegia, impaired consciousness, speech disturbance cranial nerve palsy, neck rigidity, pulse and blood pressure (in mm of Hg).

#### *Risk factors*

Hypertension, IHD/Heart disease, smoking, diabetes mellitus, family history of CVD, past history of CVD, H/O oral pill (in case of female).

#### *CT scan findings*

Site of lesion, arterial territory, mass effect (using septum pellucidum shift).

#### *Measurement of the midline shift*

The cerebral midline shift was measured using septum pellucidum shift in mm. Between the anterior horn of the lateral ventricles on the CT slice containing the third ventricle and / or pineal gland. The measurements were taken by the built in calipers in the CT scan system monitor.

Septum pellucidum shifts were divided into two groups: shift of 10 mm or less and greater than 10 mm. The admission GCS Score of patients in each group was noted.

#### **Results**

In the present study, out of 64 clinically diagnosed Hemorrhagic stroke patients 32 had Spontaneous intracerebral hemorrhage with mass effect, 24(75%) were male and 08(25%) were female, other 32 had spontaneous intracerebral hemorrhage without mass effect purposively taken as a Group B and 22(68.75%) were males and 10(31.25%) were females, which shows a definite preponderance of males with a male: female ratio of approximately 2.6:1

Almost equal number of patients belonged to the age group of 51-60 years (31.25%) and 61-70 years (40.62%) followed by patients of above 70 years of age (12.50%) in the group who had mass effect and in the Group B were almost the same (Table I).

The mean age of the patients was  $63.3 \pm 11.1$  years with the range of 32- 75 years.

Table I: Age distribution of the study subjects

Age in Years	Group A No (%)	Group B No (%)
30- 40	01(3.13%)	02(6.25%)
41 – 50	04(12.50%)	03(9.37%)
51 – 60	10(31.25%)	13(40.62%)
61 – 70	13(40.62%)	12(37.51%)
>70 Years	04(12.50%)	02(6.25%)
Total	32(100.00%)	32(100.00%)

In the present study, hypertension was found to be the most common risk factor present in both the Group A and Group B, which were 78.12% and 71.87%, respectively. These were found to be present among 62.50% (5 patients) of total 8 female patients as against 62.50% (20 patients) of total 24 male patients in Group A. The habit of smoking was present among 82.50% (20 patients) were in Group A and 56.25% (18 patients) were in Group B. Diabetes Mellitus was found in 37.50% in both groups and Heart Disease were 21.87% & 25%, respectively.

Table II: Risk factors of the study subjects

Risk Factors	Male	Female	Total
<b>Group A</b>			
Hypertension	20(62.50%)	05(62.50%)	25(78.12%)
Smoking	19(79.16%)	01(12.50%)	20(62.50%)
Diabetes Mellitus	09(37.50%)	03(37.50%)	12(37.50%)
Heart Disease	05(20.83%)	02(25.00%)	07(21.87%)
H/O Oral Pill	00(00.0%)	02(37.50%)	02(6.25%)
<b>Group B</b>			
Hypertension	18(81.81%)	05(50.00%)	23(71.87%)
Smoking	17(77.27%)	01(10.00%)	18(56.25%)
Diabetes Mellitus	08(36.36%)	04(40.00%)	12(37.5%)
Heart Disease	05(22.72%)	03(30.00%)	08(25.00%)
H/O Oral Pill	00(00.0%)	03(30.00%)	03(9.37%)

The most common presentation hemorrhagic CVD was hemiparesis/hemiplegia in both Group A and Group B (93.75% & 71.87%), which was found among 63 clinically diagnosed hemorrhagic stroke patients. High blood pressure (75.00% & 56.25%), impaired consciousness (62.50 % & 43.75%), Headache (68.75% & 53.12%), Cranial nerve palsy (25.00% & 15.62%), Dysphasia (46.87% & 31.25% ), and Vertigo (53.84% & 28.12% ) were the other major clinical features with which the hemorrhagic stroke patients were admitted to the hospital.

Table III: Clinical presentations of the study subjects.

Sign/Symptoms	Group A No (%)	Group B No (%)
Hemiparesis/ Hemiplegia	30(93.75%)	23(71.87%)
Impaired consciousness	20(62.5%)	14(43.75%)
Dysphasia	15(46.87%)	10(31.25%)
Cranial Nerve Palsy	08(25.00%)	05(15.62%)
High blood pressure	24(75.00%)	18(56.25%)
Headache	22(68.75%)	17(53.12%)
Vertigo	14(53.84%)	09(28.12%)
Neck Rigidity	25(78.12%)	22(68.75%)

Among 64 study subjects (Group A plus Group B) supratentorial site was involved in 54(84.37%) and infratentorial site was involved in 10(15.63%) at CT scan.

Supratentorial site were also classified as deep 49(76.57%) and lobar 05(7.81%). And infratentorial sites were divided into cerebellar 6 (9.38%) and pontine 04 (6.25%).

Table IV: Distribution of the Site of Intracerebral hemorrhage as detected in CT-Scan ( Group-A + B, n=64)

Sites	No of ICH	%
Supratentorial		
Deep:		
Basal Ganglia	24	37.50%
Thalamus	02	03.10%
Intraventricular	07	10.93%
Paraventricular	14	21.94%
Internal Capsule	02	03.10%
Lobar:		
Temporoparietal	02	03.10%
Temporal	03	04.68%
Infratentorial		
Cerebellar:	06	09.40%
Pontine:	04	06.25%
Total	64	100%

It is evident that majority (75.0%) of the ICH occurred due to rupture of MCA branch followed by anterior and posterior cerebral artery (Group A plus Group B) (n=64)

Table V: Arterial territory of hemorrhage as detected in CT - Scan

Arterial Territory	Number of ICH	Percentage
Anterior Cerebral Artery	06	9.40%
Middle Cerebral Artery	48	75.00%
Posterior Cerebral Artery	04	6.20%
Cerebellar Artery	06	9.40%
Total	64	100.00%

In this study, the level of consciousness, as estimated from the Glasgow coma scale score. 13-15 had 04(12.50%) patients of SICH with mass effect, 9-12 had 11(34.37%) and low GCS score 3-5 had 17(53.13%) patients respectively of same group. On the other hand, in the group of without mass effect 25.00% had 13-15 score and 59.38% had 9-12, 15.62% (05 patients) had 3-5 score.

Table VI: Distribution of the patients according to Glasgow coma scale score between SICH with or without mass effect (n=64)

Group of patients	Mild (13-15)	Moderate(9-12)	Severe(3-8)
With mass effect: Group A (n=32)	04(12.50%)	11(34.37%)	17(53.13%)
Without mass effect: Group B (n=32)	08(25.00%)	19(59.38%)	05(15.62%)
Total= 64	12(18.75%)	30(46.87%)	22(34.38%)

Septum pellucidum shifts in CT scan were divided into 2 groups - shifts of 10 mm or less 59.38% (19 patients) and greater than 10 mm had observed in 40.62% (13 patients) of the patients who had SICH with mass effect.

This study was carried out in 64 patients, out of this 32 had spontaneous intracerebral hemorrhage with mass effect taken as Group A and 32 had spontaneous intracerebral hemorrhage without mass effect taken as Group B. The Glasgow coma scale score of each group were expressed as Mild (13-15), Moderate (9-12) and severe (3-8). The chi-square test ( $\chi^2$ ) was done and p value is <0.01. The association is highly significant.

Table VII: Comparison between the GCS Score of SICH with mass effect (Group A) and SICH without mass effect (Group B)

Group	GCS Score			Total	p
	Mild (13-15)	Moderate (9-12)	Severe (3-8)		
SICH with mass effect (Group A)	4	11	17	32	<0.01
SICH without mass effect (Group B)	8	19	5	32	
Total	12	30	22	64	

A total of 32 hemorrhagic stroke patients with mass effect measured using septum pellucidum shifts in CT scan were divided into 2 sub-groups: shifts of 10 mm or less 59.38% (n=19) and greater than 10mm had observed in 40.62% (n=13) of the patients who had SICH with mass effect. The GSC scores of patients in each sub group were noted. The group of 10 or less had 5-15 score, Mean±SD 10.32±2.89 and greater than 10 mm group had 3-9, Mean±SD 6.46±1.85

Table VIII: Relationship between septum pellucidum shift 10 mm or less and greater than 10 mm with GCS score (n=32)

Septum pellucidum Shift	N	Mini mum GCS	Maxi mum GCS	Mean	Std. Dev	p
≤10 mm	19	5.00	15.00	10.3158	2.89	<0.001
> 10 mm	13	3.00	9.00	6.4615	1.85	

The septum pellucidum shifts of 32 intracerebral hemorrhage with mass effect patients were correlated with the Glasgow coma scale score. A significant negative correlation was found between these two parameters.

The septum pellucidum shifts were range from 0.8 mm to 22 mm (Mean  $\pm$ SD, 8.41  $\pm$ 5.78) and The GCS score were range from 3-15 (Mean  $\pm$ SD, 8.75  $\pm$ 3.14)

The value of spearman's correlation coefficient was r=0.857, the p was <0.01 and it was significant.

Table IX: Relationship between the midline shift measure at septum pellucidum level at CT Scan Brain and Glasgow coma scale score (n=32)

	N	Mini mum mm	Maxi mum mm	Mean	Std. Dev	p
Septum pellucidum shift in mm	32	0.8	22.00	8.41	5.78	<0.01
GCS	32	3.00	15.00	8.75	3.14	

The septum pellucidum shifts of 32 intracerebral hemorrhage with mass effect patients were correlated with the Glasgow coma scale score. A significant negative correlation was found between these two

parameters. The value of spearman's correlation coefficient was r=0.857 and it was highly significant (p < 0.01).

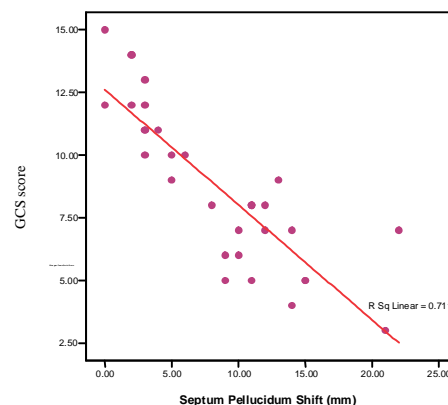


Fig 1. Scatter diagram showing the significant negative relationship (r = -.857) between septum pellucidum shift and Glasgow coma scale score.

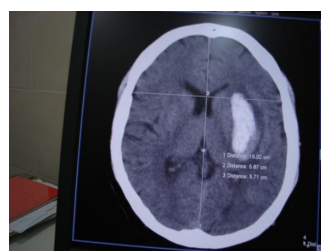


Fig 2. Noncontrast axial CT scan of brain of 63 years male patients showing spontaneous intracerebral haemorrhage with mass effect measured using septum pellucidum shift 1.6 mm. the GCS score of the study subject was 7.

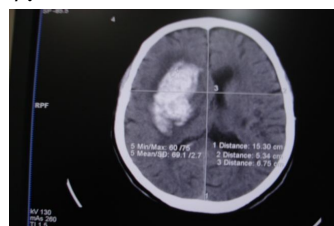


Fig 3. Noncontrast axial CT scan of brain of 69 years male patients showing spontaneous intracerebral haemorrhage with mass effect measured using septum pellucidum shift 14.1 mm. the GCS score of the study subject was 5.

## Discussion

The main goal of the study was to evaluate the degree of midline shift at CT brain correlates well with Glasgow Coma Scale Score. In the present study, 32 had Spontaneous intracerebral hemorrhage with mass effect, 24(75.00%) were male and 08(25.00%) were female, Other 32 had Spontaneous intracerebral hemorrhage without mass effect purposively taken as a Group B and 22(68.75%) were males and 10(31.25%) were females, which shows a definite preponderance of males with a male: female ratio of approximately 2.55:1 The age range from 32-75 years. And the mean age of the patients were  $63.3 \pm 11.1$  years. These findings are not far from another study Bashar et al, 1992.).<sup>7</sup>

In the present study, the male preponderance was noted, which is consistent with another study.<sup>2</sup> The update on stroke, 2004, from Neurology Research centre (NRC) of Dhaka Medical College Hospital had shown strikingly male preponderance (M: F=4:1). The higher preponderance of males in this study may be due to cultural attitude of our society that the females are less frequently brought to the hospital than the males.

The septum pellucidum has been used as a dynamic landmark in determining midline shift by Ross et al (1998).<sup>6</sup> The septum pellucidum shift has been correlated with level of consciousness. It is a relatively simple method of measuring brain shift because of easy identification of the septum pellucidum in most scans.

Septum pellucidum shifts in CT scan were divided into 2 sub groups: shifts of 10 mm or less (59.38%, n=19) had GCS Scores ranging from 5 to 15 with an average GCS of 10-11 (Actual value 10.32) and greater than 10mm septum pellucidum shift (40.62% n=13) had a GCS score range of 3 to 9 , with a

substantially lower mean GCS score Of 6 (actual value 6.46) .these two sub group had highly significant difference  $p < 0.01$ . Which is closely resemble to the study Santiago et al. (2000), they observed 65.6% (n=21) had shift of 10 mm or less ,GCS score range 11-12 and 34.4% ( n=11) had greater than 10 mm septum pellucidum shifts and these two group had significant difference in means.<sup>8</sup>

In this study, comparison between septum pellucidum shift with GCS score shows the septum pellucidum shifts of 32 intracerebral haemorrhage with mass effect patients were correlated with the Glasgow coma scale score. A significant negative correlation was found between these two parameters.

The value of spearman's correlation coefficient was  $r=0.857$  and it was very significant ( $p < 0.01$ ). Ross et al. (1989)<sup>6</sup> in their study showed both septum pellucidum and pineal gland shift and correlated them with level of consciousness. A Correlation was found between a decrease in the level of consciousness and significant increase in the mean lateral brain displacement at the pineal gland (from 3.8 to 7.0mm) and septum (5.4 to 12.2mm). When outcome was examined in patients who were stuporous or comatose on admission, a significant increase in septal shift was found significant relationship between outcome and degree of pineal or aqueductal shift.

## Conclusion

The study shows there is a significant inversely correlation of the GCS score with degree of midline shift measure using septum pellucidum shift. The GCS score of  $\leq 10$  mm of septum pellucidum shift compare with greater than 10mm of septum pellucidum shift is significantly different. The GCS score of SICH with mass effect compare with the GCS score of SICH without mass effect is significantly different.

Thus radiologist should carefully and elaborately interprets the spontaneous intracerebral haemorrhage with midline shift at CT scan brain, and help clinicians to evaluate the level of consciousness which is significant predictor of outcome of our valuable patients

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