Prognostication of functional outcome in primary intracerebral haemorrhage by clinical-computed tomographic correlations.

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Abstract

Background: Primary intracerebral hemorrhage (PICH) is bleeding into the neuroparenchyma that may extend into the ventricles or the subarachnoid space in the absence of an underlying lesion and accounts for approximately 10 to 15 percent of all cases of cerebrovascular accidents. The study aims to explore the utility of multi-detector computed tomography in the evaluation of primary intracerebral hemorrhage and correlation of CT derived parameters with modified Rankin score in prognostication.

Aims And Objectives: To correlate the prognostic parameters of primary intracerebral hemorrhage on computed tomography (CT) with the functional outcome of the patient using modified Rankin Score (mRS).

Methodology: A prospective study was conducted involving 34 eligible adult patients. The location, volume of the hematoma, midline shift and intraventricular extension score (IVHS) were correlated with the mRS at the first- and second-month following hospital discharge. Statistical analysis included Chi-square test and Kruskal Wallis test.

Results: The CT findings of 34 (18 male and 16 female) eligible adult patients with age ranging from 29 to 86 years were analyzed and correlated with modified Rankin Score. Patients with gangliocapsular hemorrhage showed good neurological recovery as compared to those with

lobar and infratentorial bleeds. A statistically significant association was established between the prognostic parameters on CT and mrs (p < 0.05). Volume of hematoma greater than 60 cc, significant midline shift and IVHS more than 17 were associated with moderate to severe disability and poor functional recovery. At one-month post-discharge, the majority of patients had moderate to severe disability i.e., 26 patients (76.5%) and only 11 patients (32.6%) achieved functional independence by the second month.

Conclusion: The functional outcome of the patient correlated well with the prognostic parameters derived from CT and the modified Rankin Score. Therefore, CT is a readily available and reliable modality for the prognostication of intracerebral hemorrhage. Identification of factors which may influence the quality of care is crucial as most therapeutic decisions have to be individualized.

Keywords: primary intracerebral haemorrhage, multidetector computed tomography, prognostic parameters, modified Rankin Score, functional outcome, neuroimaging.

Introduction

Primary intracerebral haemorrhage (PICH) is bleeding into the neuroparenchyma that may extend into the ventricles or the subarachnoid space in the absence of an underlying lesion and originates from the spontaneous rupture of small vessels in the setting of chronic hypertension or cerebral amyloid angiopathy. Intracerebral haemorrhage (ICH) accounts for approximately 10 to 15 percent of all cases of cerebrovascular accident and is associated with the highest mortality rate, with a 1-year mortality rate of 64 percent.(1) Intracerebral haemorrhage (ICH) accounts for 20-30% of all cerebrovascular accidents among Asian population, approximately twice that of the West. In most cases, the functional outcome among survivors is poor and limited number of patients gain functional independence after six months. (2)

An early and accurate prediction of ICH outcome in the emergency department is crucial for decision-making and in assessing patient prognosis. (3) Multidetector computed tomography (CT) is the first line investigation in the assessment of primary intracerebral haemorrhage. The modified Rankin scale is a global disability index that has been widely used for evaluating neurological recovery following a cerebrovascular accident and as a primary endpoint in randomised clinical trials of emerging acute stroke treatments. (4)

The study aims to compare the volumetric parameters and ancillary findings related to haematoma expansion and mass effect derived from computed tomography with the modified Rankin score for prognostication of disability outcome and neurological recovery of the patient. Evidence suggests that aggressive care can increase the probability of survival and physical independence, even in the worst initial prognostic group. (5) Therefore, identification of such factors is crucial to improve quality of care as most therapeutic decisions have to be individualized. (6)

Aims And Objectives

1. To prognosticate primary intracerebral haemorrhage on computed tomography.

2. To evaluate the outcome of the patient in terms of neurologic disability using the modified Rankin Score (Mrs).

Materials And Methods

A prospective analytical observation study was conducted involving 34 adult patients with clinical suspicion of primary intracerebral haemorrhage over a study duration

of 18 months. The CT scans were performed on Siemens Somatom Perspective 128 slice scanner and Hitachi Supria 32 slice scanner. The patients diagnosed with primary intracerebral hemorrhage on CT were followed up for assessment of the degree of neurological disability using the modified Rankin Score at 1 month and 2 months. The location, volume of the hematoma, midline shift and intraventricular extension score (IVHS) were correlated with the mRS at the first- and second-month following hospital discharge to establish a clinic radiological correlation. Statistical analysis included Chi-square test and Kruskal Wallis test.

Results

Table 1: Distribution of the study subjects based on site of bleeding.

		N	%
Site of Bleeding	Gangliocapsular	13	38.2%
	Thalamic	5	14.7%
	Lobar	12	35.3%
	Cerebellar	2	5.9%
	Pontine	1	2.9%
	Midbrain	1	2.9%

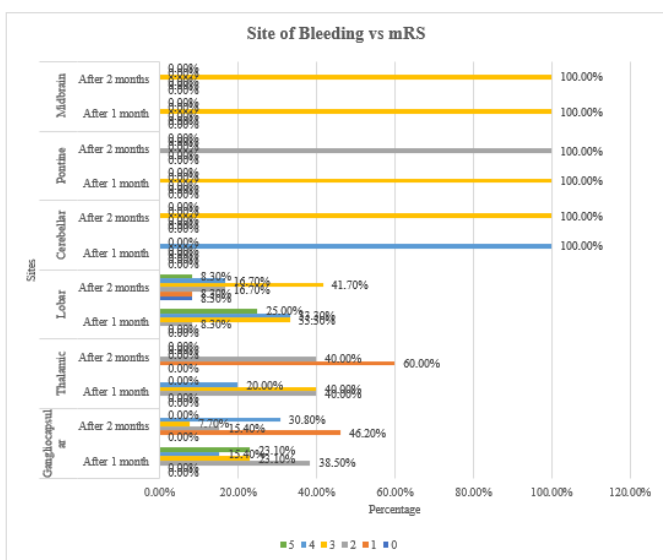Fig. 1: Bar diagram showing association between site of bleeding and mRS among the study subjects

Table 2: Association between volume of hematoma and mRS among the study subjects

Modified Rankin Scale		Volume of Hematoma								p-value#
		<30 cc		31 to 60 cc		61 to 90 cc		>90 cc		
		N	%	N	%	N	%	N	%	
After 1 month	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.017*
	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
	2	8	50.0%	0	0.0%	0	0.0%	0	0.0%	
	3	5	31.3%	4	50.0%	2	40.0%	0	0.0%	
	4	2	12.5%	3	37.5%	2	40.0%	2	40.0%	
	5	1	6.3%	1	12.5%	1	20.0%	3	60.0%	
After 2 months	0	1	6.3%	0	0.0%	0	0.0%	0	0.0%	0.014*
	1	9	56.3%	1	12.5%	0	0.0%	0	0.0%	
	2	2	12.5%	3	37.5%	2	40.0%	0	0.0%	
	3	3	18.8%	4	50.0%	1	20.0%	1	20.0%	
	4	1	6.3%	0	0.0%	2	40.0%	3	60.0%	
	5	0	0.0%	0	0.0%	0	0.0%	1	20.0%	

Table 3: Association between midline shift and mrs among the study subjects

Modified Rankin Scale		Midline Shift								p-value#
		Absent		1 to 5 mm		6 to 10 mm		>10 mm		
		N	%	N	%	N	%	N	%	
After 1 month	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.010*
	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
	2	4	33.3%	4	57.1%	0	0.0%	0	0.0%	
	3	5	41.7%	2	28.6%	4	36.4%	0	0.0%	
	4	3	25.0%	1	14.3%	2	18.2%	3	75.0%	
	5	0	0.0%	0	0.0%	5	45.5%	1	25.0%	
After 2 months	0	1	8.3%	0	0.0%	0	0.0%	0	0.0%	0.029*
	1	4	33.3%	5	71.4%	1	9.1%	0	0.0%	
	2	4	33.3%	1	14.3%	2	18.2%	0	0.0%	
	3	3	25.0%	1	14.3%	4	36.4%	1	25.0%	
	4	0	0.0%	0	0.0%	4	36.4%	2	50.0%	
	5	0	0.0%	0	0.0%	0	0.0%	1	25.0%	

Table 4: Comparison of IVHS with modified Rankin Scale among the study subjects.

Modified Rankin Scale		IVH Score			p-value#
		Mean	SD	Median	
After 1 month	0	-	-	-	0.004*
	1	-	-	-	
	2	0.38	1.06	0.00	
	3	2.91	4.32	0.00	
	4	9.89	8.65	14.00	

	5	16.00	8.90	19.00	
After 2 months	0	0.00	-	0.00	0.028*
	1	1.70	2.98	0.00	
	2	4.86	8.30	0.00	
	3	5.89	6.79	4.00	
	4	15.50	8.50	18.50	
	5	23.00	-	23.00	

In the study which includes 34 patients, 18 were males (52.9%), and remaining 16 were females (47.1%). The most common location of bleed was gangliocapsular region accounting for 13 patients (38.2%) followed by 12 cases of lobar (35.3%) and 5 cases of thalamic bleeds (14.7%). Infratentorial bleeds were less common; 2 cerebellar (5.9%), 1 pontine (2.9%) and 1 midbrain hematoma (2.9%).

Among the cases with gangliocapsular and thalamic bleeding, majority were of lower grade mRS. On the contrary, among those with lobar and infratentorial bleed, majority were of higher grade mRS, both after 1 and 2 months. 6 patients with gangliocapsular bleed (46.2 %) showed good recovery from moderate to severe disability by the second month. 5 patients with thalamic bleeds showed good recovery. However, 7 patients of lobar haematoma (58.4 %) had moderate to severe disability during the first month without significant recovery by the second month. No significant improvement in neurological disability was seen among the subjects with infratentorial bleed.

The higher the volume of the haematoma, greater the degree of neurological disability. Patients with haematoma volume of more than 60 cc were associated with higher mRS whereas patients with volume of less than 60 cc showed significant improvement in functional outcome.

In this study, there was a statistically significant association between midline shift and mRS of the patients. It was found that a midline shift of more than 6

mm was associated with moderate or severe morbidity whereas midline shift of less than 6 mm had relatively favourable outcome. Patients with intraventricular extension of haemorrhage had a worse prognosis compared to those who had no IVH. The IVH score was used to quantify the grade of intraventricular extension in our study and it proved to have a significant association with the functional outcome. An IVHS of 17 to 20 was associated with mild to moderate disability and IVHS of 20 to 23 was associated with moderate and severe impairment.
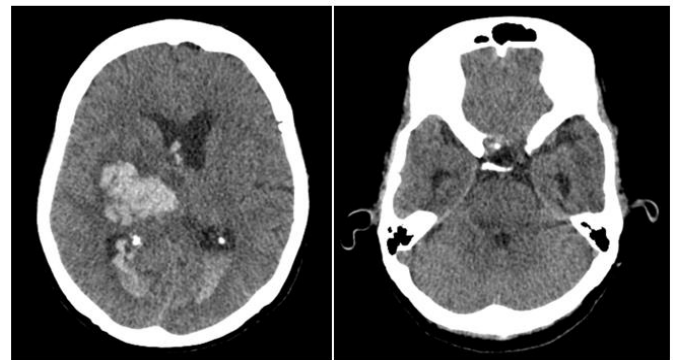

Fig. 2: Right gangliocapsular hematoma. hematoma volume of 21 cc with midline shift of 3 mm to the left. IVH score of 6. mRS at 2 months – 2 (slight disability).
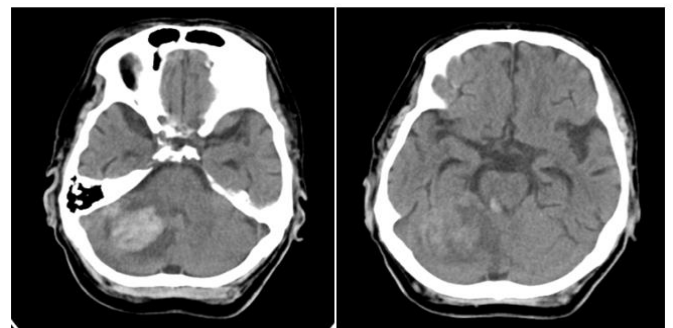

Fig. 3: Right cerebellar hematoma. Hematoma volume of 12 cc. No midline shift or IVH. mRS at 2 months – 4 (moderately severe disability)
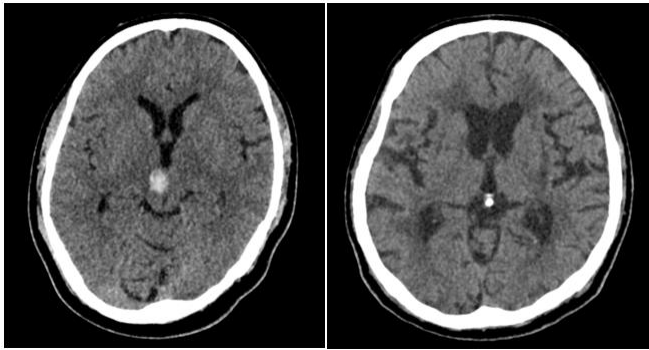
Fig. 4: Midbrain hematoma. Hematoma volume of 3 cc. No significant midline shift or IVH. mRS at 2 months – 3 (moderate disability)

Discussion

Primary intracerebral haemorrhage can be attributed to hypertension or cerebral amyloid angiopathy; the former being more common. The most common site of primary intracerebral haemorrhage is the gangliocapsular region, followed by the thalami. Gangliocapsular and thalamic bleeds are associated with good functional outcome following disability limitation and rehabilitation. However, patients with lobar and infratentorial bleeds have poor functional outcome post discharge.

The volume of the haematoma, midline shift and intraventricular extension have a strong positive correlation with the severity of disability. A study conducted by Salihovic et al. showed that mortality and morbidity are directly proportional to the volume of bleed and associated with higher rates of mortality. (7)A study by Hallevi et al. showed that IVHS is a novel tool for estimation of intraventricular hematoma volume and revealed that an IVHS greater than 18 (corresponding to IVH volume of 36 cc) was associated with poor outcome. (8)

In the present study, the modified Rankin score calculated at the end of the first and second month was correlated with the prognostic parameters obtained on imaging. This study revealed that haematoma volume greater than 60 cc,

midline shift of more than 6 mm and IVHS greater than 17 are associated with moderate to severe disability and poor functional recovery. A study by Diringer et al. showed that the combination of intraventricular haemorrhage and hydrocephalus was a bad prognostic factor. (9)

Conclusion

Computed tomography is a reliable and efficient modality in diagnosing and evaluating primary intracerebral haemorrhage. The site of the haematoma, volume, degree of midline shift and intraventricular extension can be assessed accurately within a short span of time, enabling effective patient triage. Prompt evaluation of the volume of haematoma and other ancillary findings can help prognosticate the neurological outcome and individualise the treatment options.

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