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Non-Contrast Computerised Tomography Scan Finding of Intracerebral Haemorrhagic Stroke

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ABSTRACT

Background: Intracerebral haemorrhage is referred to as bleeding in the brain parenchyma itself. It accounts for 10 to 15 percent of all strokes in Whites and about 30 percent in Blacks and individuals of Asian origin. It is a major cause of morbidity and mortality of stroke. Objective: To study the non-contrast computerised tomography scan finding of haemorrhagic stroke due to intracerebral haemorrhage with relation to clinical outcome in a series of cases. **Methods:** Data of 150 cases of CT Scan-proven Intracerebral haemorrhagic stroke cases admitted in the Medicine Department, JNIMS, Imphal from November 2016 to October 2017 were retrospectively analysed. Site, size and volume of haematoma, pineal gland displacement and intraventricular extensions of ICH were correlated with the clinical outcome using a modified Rankin 1-5 scores on the 30th day of stroke onset. Associated risk factors like hypertension, smoking, diabetes and alcoholism were also recorded. **Results:** Hypertension was the most common (78%) risk factor followed by chronic smoking (24%), chronic alcohol abuse (22%) and diabetes mellitus (8%). The sites of ICH in order of frequency were putamen (65%), lobar (17%), thalamus (13%), pons (3%) and cerebellum (2%). Out of them, 49% had ICH on the left side, 48% on the right side and 3% had bilateral lesion. The volume of ICH was within the range of 4 to 196 ml with a mean volume of 46.6 (+ 32.1) ml. Outcome was better (Rankin 1-3) in lobar ICH (48%) than in thalamic and putaminal/lentiform ICH (30.6% and 27.6% respectively). The mean volume of ICH among the deaths was significantly higher than the surviving group (65.60 + 36.6 ml vs 32.30 + 18.3ml). Mortality was as high as 93.8% when the volume of ICH was more than 80 ml. Mortality was significantly higher among patients of ICH with pineal gland displacement of more than 3 mm and intraventricular extension. **Conclusions:** Volume of ICH, Pinear gland displacement >3 mm and intraventricular extension of ICH are the prognostic factors in patients with ICH. The present study showed that death and functional status on the 30th day were well correlated with the initial ICH volume which could be regarded as a good indicator for intracerebral haemorrhagic stroke.

Keywords: CT scan, Intracerebral haemorrhage, Modified Rankin Score, Stroke.

INTRODUCTION

Intracerebral Haemorrhage (ICH) is referred to as bleeding in the brain parenchyma itself. It accounts for 10-15% of all strokes in Whites and about 30% in Blacks and individuals of Asian origin. It is a major cause of morbidity and mortality of stroke.[1] It is the most common type of non-traumatic intracranial haemorrhage and an important cause of stroke, especially in Asians and Blacks.[2]

Numerous epidemiological studies have found that incidence of ICH increases with advancing age and vary with geographical location and races. In addition to advancing age, hypertension and ethnicity, a number of other risk factors have been recently evaluated which include cigarette smoking, alcohol consumption and serum cholesterol levels.[3]

An ICH on CT appears as a homogenous well defined area of hyper attenuation which may be surrounded by a zone of low attenuation attributable to oedema, ischaemia or clot retraction.[4] At some stage, as early as 2 weeks, the haematoma becomes isodense with the surrounding brain and later may leave a smaller area of low attenuation. It is found that the smaller the haematoma, the more likely it was to resolve completely.[5] Numerous workers found in CT that large haematoma volume, mid line shift or pineal gland displacement, intracerebral haemorrhage rupturing into the ventricular system and varying shapes of lesion in different sectional views are the factors that predict mortality.[6,7]

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AIM:

The present study was contemplated to find out the relationship between CT scan findings and outcome of ICH.

MATERIALS & METHODS

The study was conducted on ICH cases who were admitted in the departments of Medicine, Jawaharlal Nehru Institute of Medical Sciences, Imphal during November 2016 to October 2017. Cases that fulfilled the WHO criteria for stroke i.e., rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than vascular origin with CT scan carried out in the Department of Radiodiagnosis in the institute within 7 days of the onset of stroke were included in the present study. Patients with haemorrhage secondary to trauma, brain tumour, CNS infections, recurrent stroke, predominant sub-arachnoid haemorrhage and patients receiving anticoagulant therapy were excluded from the study.

General physical examination, Blood pressure and pulse rate were duly recorded on admission. The following baseline parameters were recorded in relation with the study: age, sex, vascular risk factors, hypertension (> 140/90 mmHg), diabetes mellitus (pre-prandial blood glucose level > 140 mg/dL and post-prandial level > 200 mg /dL), haemorrhage side (left or right or both), haemorrhage location, haemorrhage size and volume, pineal gland displacement on CT scan, intraventricular spread of the haemorrhage, initial level of consciousness (normal, drowsy or comatose), limb paresis, oral comprehension and expression.

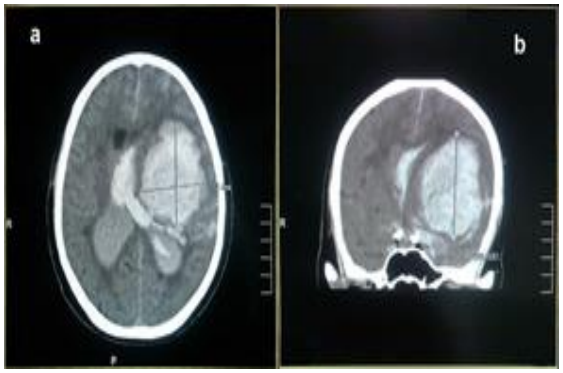

Figure 1: Left Putaminal acute ICH Volume measured 0.523 (L x B x H) mm3 = 0.523 (64 x 52 x 590) mm3 equivalent to 103 ml as Maximum dimension of Length (L) and Breadth (B) of ICH from the axial image (a) and Maximum Height (H) from the coronal image (b) with intraventricular extension

The epicenter of each haemorrhage was used to name the locus of the lesion. The ICH was classified according to the location of the largest blood clot as follows: lobar (frontal, rolandic, parietal, temporal, junctional, occipital), deep (putaminal, thalamic, caudate), posterior fossa (medullary, pontine, midbrain, cerebellar) or intraventricular. Hypodensity surrounding the haematoma, the presence and extent of intraventricular bleeding and mass effect were also recorded. The haematoma size was measured by its greatest diameter. The size of the ICH on a CT scan was estimated by measuring the longest axis of the region of increased attenuation and its greatest width at 90º to this axis. The haematoma volume was evaluated on the CT films by simple formula of an ellipsoid volume = ¾π abc, where a, b and c were the radii of the three spatial dimensions measured in the greatest lesion seen from axial CT scan and counting slices of lesion as described by Brodericket al.[8] Calculated volume was equal to 0.523 X (L x B x H) where L, B and H were the three spatial dimensions of ICH. [Figure 1 & 2]

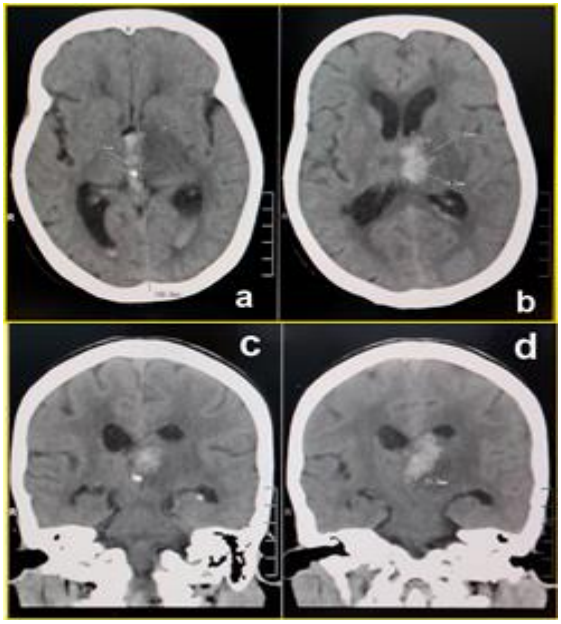

Figure 2: Left Thalamic acute ICH (Volume = 4ml) with intraventricular extension shown in axial image (a & b) and coroneal image (d). Pineal gland displacement of 2.6 mm contralaterally shown in axial image (a)

Patient outcome was evaluated at 30 days post-stroke onset as either death or alive scored in modified Rankin score from 1 to 5 (1=no significant disability, 2=slight disability – unable to carry out previous activities, but able to look after oneself without assistance, 3=moderate disability requiring some help but able to walk without assistance, 4=moderate-severe disability – unable to walk without assistance, 5=severe disability – bed-ridden, incontinent, requiring constant nursing care and attention) as described by Tatu L et al.[9]

RESULTS

A total of 150 consecutive cases of ICH consisting of 108 males and 42 females were included in the study. Their age ranged from 25 to 85 years with a mean (SD) age of 58.6 (+12) years. Male-female ratio was 2.6:1. Majority of the cases belonged to the age group of 51-60 years (31%). The number of cases between 41-70 years represented 78% of all

cases. The mean time from stroke onset to CT scanning ranged from 4-94 hours with a mean (SD) value of 28.4 (+19.43) hours. Hypertension was the most common (78%) risk factor identified [Table 1]. Other risk factors were chronic smoking (24%) and chronic alcohol abuse (22%) and diabetes mellitus (8%). The sites of ICH in order of frequency were putamen (65%), lobar (17%), thalamus (13%), pons (3%) and cerebellum (2%) respectively. Seventy-three three patients had lesions on the left side, 72 had ICH on the right side and 5 had bilateral lesion. The volume of ICH was within the range of 4 to 196 ml with a mean (SD) volume of 46.6 (+ 32.1) ml. The inter-quartile range was between 22.1 ml to 63.0 ml with a median of 41.2 ml. Pineal gland displacement <3 mm was seen in 88 (59%) of cases and ≥3 mm in 62 (41%). Intra-ventricular extensions of ICH were present in 46 (31%) cases. Maximum number of deaths occurred in the first 3 days (37; 58%).

Table 1: Characteristics of the study subjects

Background characteristic	Number	Percentage
Sex		
• Male	108	72.0
• Female	42	28.0
Age (Years)		
• <41	9	6.0
• 41-50	33	22.0
• 51-60	45	30.0
• 61-70	39	26.0
• >71	24	16.0
Hypertension		
• Present	120	80.0
• Absent	30	20.0

Table 2: Relationship between location, volume of ICH and Outcome

Location	Cases		Patient's outcome in No. with mean hemorrhage volume (ml)		
	Number	%	Alive		Death
			Rankin 1-3	Rankin 4 & 5	
Putamen/Lentiform	98	65	27 (16)	26 (44)	45 (76)
Thalamus	19	13	6 (13)	3 (33)	10 (45)
Lobar	25	17	12 (30)	9 (57)	4 (67)
Pons	5	3	0	0	5 (7)
Cerebellum	3	2	2(4)	1 (6)	0
Total & Outcome %	150		47 i.e., 31%	39 i.e., 26%	64 i.e., 43%

Table 3: Mean ICH volume and outcome

Patient outcome (Status)	No. of cases	Mean volume + SD (ml)	p-value
Rankin 1-3	47	21.30+12.6	<0.001
Rankin 4-5	39	45.43+ 15.0	
Death	64	65.60 + 36.6	<0.001
Alive	86	32.30 + 18.3	

[Table 2] shows an overall case mortality rate of 43% of all the ICH patients within the first month. Among the survivors, 26% had poor outcome (Rankin 4 and 5) and 31% had good outcome (Rankin 1-3). Among the three locations of ICH, thalamic haemorrhage was the commonest (53.8%), followed by putaminal (46.2%) and lobar haemorrhages (17.6%). Outcome was better (Rankin 1– 3) in lobar ICH (48%) compared to thalamic and putaminal/lentiform ICH (30.6% and 27.6% respectively).

[Table 3] shows that the mean volume of ICH among the deaths was significantly higher than the surviving group (65.60 + 36.6 ml vs 32.30 + 18.3 ml). Moreover, Rankin score within the first one month was found to be significantly correlated with mean ICH volumes.

Table 4: Mortality by volume of ICH

Volume (ml)	No. of cases	Patient's outcome, n (%)		p-value
		Alive	Death	
< 40	73	61 (83.6)	12 (16.4)	<0.001
41 – 60	37	19 (51.4)	18 (48.6)	
61 – 80	24	5 (20.8)	19 (79.2)	
> 80	16	1 (6.3)	15 (93.8)	

There was a statistically significant association (p< 0.001) between mortality and increasing volume of ICH. Mortality was as high as 93.8% when the volume of ICH was more than 80 ml. [Table 4]

There was a statistically significant between the mortality and (i) extent of pineal gland displacement and (ii) intraventricular extension of ICH [Table 5].

Of all the 150 cases studied 64 died in the first month. Thirty-seven deaths (57.7%) occurred inside the first three days.

Table 5: Mortality by pineal gland displacement and intraventricular extension in ICH

Findings	No. of cases	Patient's outcome		P-value
		Alive (%)	Death (5)	
Pineal gland displacement				<0.001
• < 3 mm	88	67 (76.1)	21 (23.9)	
• > 3 mm	62	19 (30.6)	43 (69.4)	
Intra-ventricular Extension				<0.001
• Present	46	12 (26.1)	34 (73.9)	
• Absent	104	74 (71.2)	30 (28.8)	

DISCUSSION

It is not possible to differentiate reliably between ICH and infarction on the basis of clinical features

alone.[10] For diagnosing and differentiating the type of stroke as early as possible, computed tomography (CT) scanning of the brain is the gold standard investigative procedure and in practice most stroke patients should ideally have a CT scan done.[11] In the present study, CT scan confirmation of ICH was done within 4 (four) days of the clinical onset with the mean time of 28.46 hours of onset which is comparable to the study by Tatu et al.[9] Dennis MS et al also highlighted that CT scan should be performed ideally within 7 days after stroke onset.[12]

Present study showed that majority of the subjects belonged to the age group of 41-70 years comprising 78% with a mean age of 58.6 years, which is comparable to the studies by McKissocket al, Weisberget al and Fieschi et al.[13-15] Male predominance over female (2.6:1)was also observed by Nilsson et al.[16]

Hypertension was found to be the commonest risk factor (78% of the cases) in the present study. Similar observation was reported by Weisberg (81%), Douglas et al (80%) and Scott et al (75%).[14,17-18] Cigarette smoking was associated with ICH in24% of cases. Comparable observations were made by Tatuet al (18%),[9] and Shinton et al (27%).[9,19] Regular alcohol consumption was noted among 22% of the subjects. Tatu et al,[10] also reported alcoholism in 18% of cases.[9] Diabetes was found in 6% of cases which was slightly lower than the 10% reported by Nilsson et al.[16]

The sites of lesion as found out from the current study were more or less comparable with findings made by previous scholars with a few variances.[9,18,20] The differences in frequency of ICH locations could be due to difference in geographical and genetic factors.

The mean volume of ICH in this study was 46.6 ml for all patients and among the deaths mean volume was 65.6ml. Tatu et al found the mean volume of 34.1 ml for all the patients and 76.2 ml among the worst outcome comprising death in 92%.[9] These differences in the mean volume of haematoma could be due to various associated risk factors among different population and the nature of patient recruitment. Lampel quoted that critical lethal outcome were associated with 50 ml or 80 ml in lobar haemorrhage.[21-23] Kase found lobar ICH with volume larger than 50 ml who were comatose on admission have mortality close to 100%.[24] Similar pattern of higher mortality among the patients having larger haematoma volume was also noted in the present study with statistical significant findings of 85.2% and 90.9% mortality among the ICH volume greater than 60 ml and 80 ml respectively. Mukherjee N et al observed 67.3% mortality among ICH volume greater than 40 ml.[7]

30 days ICH mortality rate were reported to be ranging from 24.2% to 48% by previous scholars with majority of the deaths occurring inside the first three days.[9,15,27-29] Similar observations could be seen from the present study. Slight differences in the mortality may be due to variations in population, risk factors and facilities availability.

Anderson reported 28 days case fatality rate among the ICH locations as 100% in brain stem, 30% in cerebellum, 22% in basal ganglia and thalamus, and 21%in lobar haemorrhage.[29] Similar pattern of case fatality were also observed in the present study other than cerebellar ICH. Wiggins et al reported that ICH with hypertension in 62% of cases and mid line shift or pineal gland displacement > 3mm showed mortality rate of 40%.[26] In the present study, ICH with hypertension in 80% of a cases and pineal gland displacement > 3 mm shows (70%) mortality rate. These differences may be due to difference in risk factor incidence such as hypertension. The trend of ICH with intra-ventricular extension increasing the mortality rate as high as 65%, 67% and 70% as observed by Wiggins et al, Weisberg and Fieschi respectively was also seen from the current study.[13,15,26]

Tatu et al found that outcome was closely associated with initial haematoma volume. In their report, Rankin 1-3 was associated with a mean volume of 13.1 ml, Rankin4 - 5 with 32.9 ml and death with 78.8 ml in 95% of cases.[9] Present study showed Rankin score 1 – 3 with initial mean ICH volume of 21.3 ml, Rankin 4 and 5 with 45.4 ml and death with >80 ml in 93.8%. However due to variations in evaluation scales used by various authors, it is difficult to compare the functional status of survivors in different studies.

CONCLUSION

It can be concluded that age and hypertension are the two very common risk factors among the intracerebral haemorrhagic stroke patients. Volume of ICH, Pineal gland displacement >3 mm and intra-ventricular extension of ICH are the prognostic factors in patients with ICH. The present study showed that death and functional status on the 30th day were well correlated with the initial ICH volume which could be regarded as a good indicator for intra-cerebral haemorrhagic stroke.

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