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CT Scan as a Tool for Predicting Outcome of Stroke due to Intracerebral Haemorrhage at a Referral Hospital

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Abstract

Objective: To find out the correlation of computerised tomography (CT) findings with clinical outcome of intracerebral haemorrhage (ICH) in the regional population of Manipur.

Methods: One hundred consecutive CT scan proven stroke patients following ICH admitted in the departments of Medicine and Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal during January 2004 to December 2004 were studied. 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: Seventy eight percent of patients belonged to the age group between 41 to 70 years. 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%) respectively. 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 (47%) than in thalamic and putaminal / lentiform ICH (30.7% and 27.7% respectively). Maximum number of deaths occurred in the first 3 days which comprised 58.1% of all deaths. 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 90.9% 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.

Conclusion: The present study showed that death and functional status on the 30th day of stroke onset were well correlated with the initial ICH volume which could be regarded as a good indicator for each location.

KEY WORDS: Stroke, Intracerebral haemorrhage, CT scan, Modified Rankin Score

INTRODUCTION

Intracerebral haemorrhage (ICH) is referred to as bleeding in the brain parenchyma itself[1]. It is the most common type of non traumatic intracranial haemorrhage and an important cause of stroke, especially in Asians and Blacks[2]. 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[1].

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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 intracerebral haematoma 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].

So far there is no study to correlate between CT scan findings and outcome of ICH in the regional population of Manipur. Hence, the present study was contemplated to find out the relationship between CT scan findings and outcome of ICH.

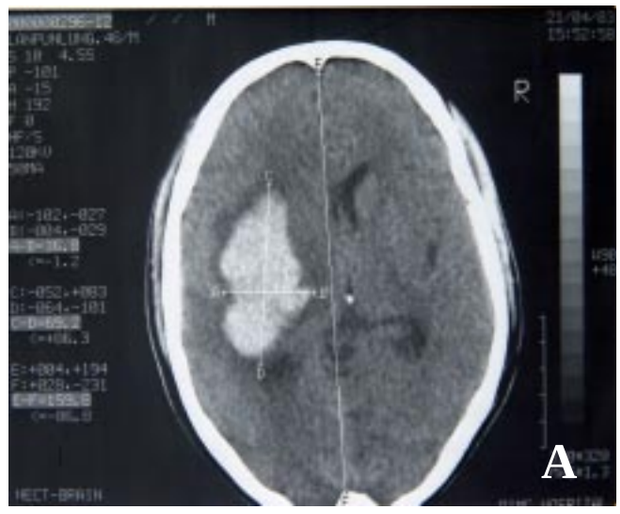
Materials and Methods

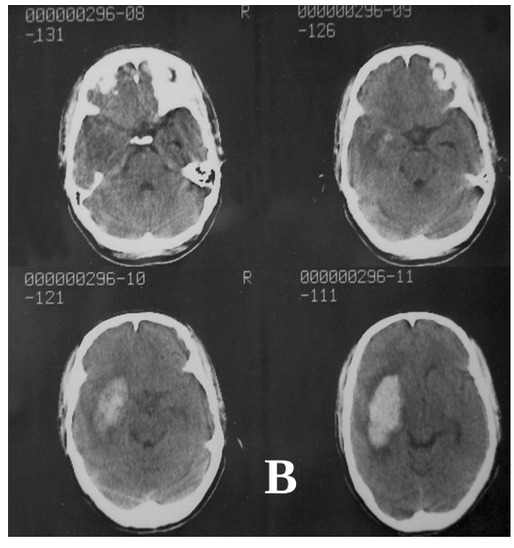
The study was conducted on 100 consecutive cases of intracerebral haemorrhage consisting of 72 males and 28 females who were admitted in the departments of Medicine and Physical Medicine and Rehabilitation of the Regional Institute of Medical Sciences, Imphal during January 2004 to December 2004. Cases 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. CT scan were 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. A standard treatment protocol was followed for all patients under study.

Clinical Examination: A general physical examination was done. Blood pressure and pulse rate were duly recorded on admission. Then, following the guideline of the study proforma, complete neurological system examination was carried out. Careful examination of other systems were also undertaken to uncover any other systemic affection.

The following baseline parameters were recorded in relation with the study: age, sex, vascular risk factors, hypertension (> 140/90 mmHg), diabetes mellitus (preprandial blood glucose level > 140 mg/dL and postprandial 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.

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





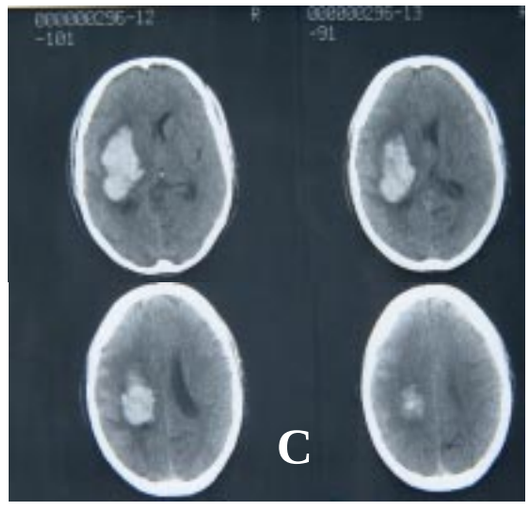


Figure 1: A. Left Putaminal Intracerebral Haemorrhage (ICH) volume measured 0.523 (36.8 x 69.2 x 60) mm³ equivalent to 79.9 ml. Largest axial ICH dimension of 36.8 mm x 69.2 mm; (B&C) Caudocranial dimension of the ICH equal to 60 mm.

(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 intracerebral haemorrhage 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 Broderick et 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.

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].

Result

The age of the subjects ranged from 25 to 85 years with a mean age of 58.6(+ 12) years. Male-female ratio was 2.6:1. Majority of the cases belonged to the age group of 51 to 60 years (31%). The number of cases between 41 to 70 years represented 78% of all cases. The mean time from stroke onset to CT scanning ranged from 4 hours to 94 hours with a mean value of 28.4 (+19.43) hours.

Hypertension was the most common (78%) risk factor. Other risk factors were chronic smoking (24) and chronic alcohol abuse (22), diabetes mellitus (8).

The sites of ICH in order of frequency were putamen (65%), lobar (17%), thalamus (13%), pons (3%) and cerebellum (2%) respectively. Forty nine patients had lesions on the left side, 48 had ICH 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. The interquartile range was between 22.1 ml to 63.0 ml with a median of 41.2 ml.

Pineal gland displacement less than 3 mm was seen in 59% of cases and 3 mm or more in 41 (41%). Intra-ventricular extensions of ICH were present in 31% of the cases.

Table-I. Relationship between location, volume of ICH and Outcome

Location	Cases	Patient's outcome in No. with mean hemorrhage volume (ml)		
		Alive		Death
		Rankin 1-3	Rankin 4&5	
Putamen/ Lentiform	65	18 (16)	17 (44)	30 (76)
Thalamus	13	4 (13)	2 (33)	7 (45)
Lobar	17	8 (30)	6 (57)	3 (67)
Pons	3	0	0	3
Cerebellum	2	1	1	0
Total	**100**	**31**	**26**	**43**

Table 1 showed overall case mortality rate of 43% of all ICH patients within the first month. Among the survivors, 26% associated with poor outcome (Rankin 4 and 5) and 31% with good outcome (Rankin 1 – 3). Among the three locations of ICH, thalamic haemorrhage was commonest (53.8%), followed by putaminal (46.2%) and lobar haemorrhages (17.6%). Outcome was better (Rankin 1 – 3) in lobar ICH (47%) than in thalamic and putaminal/ lentiform ICH (respectively 30.7% and 27.7%). Maximum number of deaths occured in the first 3 days which comprised 58.1% of all deaths.

Table – II : Mean ICH volume and outcome

Patient outcome (Status)	No. of cases	Mean volume + SD (ml)
Rankin 1 - 3	31	21.30 + 12.6*
Rankin 4 & 5	26	45.43 + 15.0*
Death	43	65.60 + 36.6*
Alive	57	32.30 + 18.3ϕ
Death	43	65.60 + 36.6ϕ

*p-value <0.001 ϕp-value<0.001

Table II showed 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 significantly correlated with mean ICH volumes.

Table- III : Mortality by volume of ICH

Volume (ml)	No. of cases	Patient's outcome, n (%)	
		Alive	Death
< 40	48	40 (83.3)	8 (16.7)
41 – 60	25	13(52.0)	12 (48.0)
61 – 80	16	3 (18.8)	13 (81.3)
> 80	11	1 (9.1)	10 (90.9)

p < 0.001

Table III showed a statistically significant association ($p < 0.001$) between mortality and increasing volume of ICH. Mortality was as high as 90.9% when the volume of ICH was more than 80 ml.

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

Findings	No. of cases	Patient outcome	
Pineal gl. displacement		Alive	Death
< 3 mm	59	45 (76.3)	14 (23.7)*
> 3 mm	41	12 (29.3)	29 (70.7)*
Intra-ventricular Extension			
Present	31	8 (25.8)	23 (74.2)ϕ
Absent	69	49 (71.0)	20 (29.0)ϕ

*p<0.001 ϕp<0.001

Mortality was also found to be influenced by pineal gland displacement and intraventricular extension of ICH (Table IV). Mortality was significantly higher among patients of ICH with pineal gland displacement of more than 3 mm and intraventricular extension.

Discussion

Stroke due to intracerebral haemorrhage seems to be increasing in Manipur over the last few years. It is not possible to differentiate reliably between intracranial haemorrhage 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[12] also highlighted that CT scan should be performed ideally within 7 (seven) days after stroke onset.

Present study showed that majority of the subjects belonged to the age group of 41 to 70 years comprising 78% with a mean age of 58.6 years, which is comparable to the studies by McKissock et al[13] and Weisberg[14]and Fieschi et al[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[13] in 81%, by Douglas et al[17] (1982) in 80% and 75% of ICH by Scott et al[18]. Cigarette smoking was associated with ICH in 24% of cases. Comparable observations were made by Shinton and Beevers[19] in 27%, and by Tatu et al[9] in 18% of ICH cases. Regular alcohol consumption was noted among 22% of the subjects. Tatu et al[9] also reported alcoholism in 18% of cases. Diabetes was found in 6% of cases against 10% reported by Nilsson et al[16].

The sites of lesion in intracerebral haemorrhage determined by CT scan in order of frequency in the present study were (i) putamen/lentiform nucleus of basal ganglia (65%) (ii) lobar (17%) (iii) thalamus (13%) (iv) pons (3%) and (v) cerebellum (2%). Feldmann[20] reported the sites of involvement by ICH in order of putamen (35%), lobar (30%), cerebellum (15%), thalamus (10%) and pons (5%). Tatu et al[9] found ICH to be the most prevalent in lobar (36.5%), followed by lentiform area (32%), thalamic (15.7%), cerebellar (8.8%), midbrain and pons (2%), intraventricular haemorrhage (92%), caudate (1%) and multiple (2%). Scott et al[18] in their study found that putaminal bleeding (35%) was the commonest followed by lobar (30%), thalamus (10%), cerebellum (15%), pons (5%) and caudate (5%). The finding in the present study is comparable with Scott et al[18] except for cerebellum which is the least common site in the present study. These 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 65.6 ml. Tatu et al[9] found the mean volume of 34.1 ml for all the patients and 76.2 ml among the worst outcome comprising death in 92%. 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[21] quoted that critical lethal outcome were associated with 50 ml[22] or 80 ml[23] in lobar haemorrhage. Kase[24]found lobar ICH with volume larger than 50 ml who were comatose on admission have mortality close to 100%. 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 and Hazra[7] observed 67.3% mortality among ICH volume greater than 40 ml.

The over all mortality rate of 52% at 30 days was reported by John Bamford[25] with 56% of the death occurring in the first 3 days of onset. In other studies, 30 days ICH mortality rate were found to be 30% by Fieschi[15]and 35% by Anderson[26]. Tatu et al[9] reported over all mortality of 24.2% at 30 days and death in the first 3 days constituted 48% of all deaths. In the present study over all 30 days mortality rate was found to be 43% with first 3 days mortality of 58% of total death which could be comparable to above studies. Similar 30 days mortality rate was found in the study by Frank[27]. However, Silver[28] reported 80%

mortality within 72 hours in their study. These differences in the mortality may be due to variations in population, risk factors and facilities availability.

Anderson[26] 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. Similar pattern of case fatality were also observed in the present study other than cerebellar ICH.

Wiggins et al[29] reported that ICH with hypertension in 62% of cases and mid line shift or pineal gland displacement > 3mm showed mortality rate of 40%. 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.

Intracerebral haemorrhage with intraventricular extension influenced the mortality rate of 65%, 67% and 70% as observed by Wiggins et al[29], Weisberg[13] and Fieschi[14] respectively. In the present study ICH with intraventricular extension influenced the mortality rate of 74% than without intraventricular extension of 29% mortality which is comparable with the above studies.

Tatu et al[9] 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, Rankin 4 - 5 with 32.9 ml and death with 78.8 ml in 95% of cases. 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 80.0 ml in 90.9%. 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

Nevertheless 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 each location. Such results should provide a basis for statistical studies on the prognostic factors of intracerebral haemorrhage for future studies.

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