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A prospective study of radiological predictors of mortality in patients with primary spontaneous intracerebral haemorrhage

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Abstract

Introduction: Spontaneous intracerebral hemorrhage (ICH) accounts for approximately 4-14% of all strokes with a higher reported incidence in Asian countries compared to west and is associated with a high morbidity and mortality. Between 32% and 50% of patients die within the first month and only 20% are independent at 6 months. The burden of stroke occurrence, morbidity and mortality is much higher in developing nations. There has been considerable interest in predicting outcome after ICH and a number of studies have investigated the relationship of various clinical and radiological factors and poor outcome.**Aims and Objectives:** In this study, we want to know whether the radiological parameters obtained from a plain CT scan of brain can be used for prognostication purpose in primary spontaneous ICH.**Materials and Methods:** This was a prospective observational study done in Telangana hospitals, Khammam, Which is a tertiary level referral hospital in southern part of India. All consecutive patients admitted with primary spontaneous supratentorial ICH to the emergency department of the hospital between May 2019 and December 2020 were recruited for the study. Primary intracerebral haematoma was defined as spontaneous leakage of blood into the brain parenchyma, documented by a plain CT study of the brain. Secondary ICH due to trauma, rupture of arteriovenous malformations, aneurysmal bleeds, patients above 80 years of age and those presenting after 24 hrs, of ictus were excluded from the study. Informed consent was taken from the patients or their attendants. Patient's attendants were interviewed to obtain a detailed clinical history regarding the onset and progression of headache, seizures and chronology of neurological worsening since ictus. History of hypertension, diabetes mellitus, alcoholism and smoking were recorded. The Glasgow Coma Scale (GCS) score of the patient was documented on admission.
Results: Out of the 138 patients, only 112 patients were finally recruited for the study after making the necessary exclusions. The mortality rate was 28.6% (N= 32). The mean age was 63.20 years (Median 64 years, range 33 to 79 years). There were a total of 68 (60.71%) males and 44 (39.29%) females. Major clinical presentation was headache and altered sensorium in 60 patients (53.57%), loss of consciousness in 35 patients (31.25%) and headache alone in 17 patients (15.18%). The most common risk factor in our study was hypertension 66 (58.9%) followed by smoking 28 (25%), alcohol intake 19 (17%) and diabetes mellitus 18 (16%). The mean GCS was 11 with a median of 13.**Conclusion:** Plain CT study of brain obtained within 24 hours of the ictus can be reliably used for predicting the prognosis of patients with primary supratentorial ICH.
Keywords: Spontaneous intracerebral hemorrhage, CT Scan, GCS.

Introduction

Spontaneous intracerebral hemorrhage(ICH) accounts for approximately 4-14% of all strokes with a higher reported incidence in Asian countries compared to west and is associated with a high morbidity and Mortality. Between 32% and 50% of patients die within the first month and only 20% are independent at 6 months. The burden of stroke occurrence, morbidity and mortality is much higher in developing nations. There has been considerable interest in predicting outcome after ICH and a number of studies have investigated the relationship of various clinical and radiological factors and poor outcome. Few hematological and biochemical parameters at the time of onset of ICH have also been associated with outcome in these patients[1-3].Most of the literature on morbidity and mortality predictors is available from the West and some East Asian countries. This prospective observational study was designed to assess clinical, biochemical and radiological predictors of morbidity and mortality in patients with spontaneous ICH. In this study, we want to know whether the radiological parameters obtained from a

plain CT scan of brain can be used for prognostication purpose in primary spontaneous ICH[4-6]

Aims and Objectives

In this study, we want to know whether the radiological parameters obtained from a plain CT scan of brain can be used for prognostication purpose in primary spontaneous ICH.

Materials and Methods

This was a prospective observational study done in Telangana hospitals, Khammam, Which is a tertiary level referral hospital in southern part of India. All consecutive patients admitted with primary spontaneous supratentorial ICH to the emergency unit of the hospital between May 2019 and December 2020 were recruited for the study. Primary intracerebral haematoma was defined as spontaneous leakage of blood into the brain parenchyma, documented by a plain CT study of the brain. Secondary ICH due to trauma, rupture of arteriovenous malformations, aneurysmal bleeds, patients above 80 years of age and those presenting after 24 hrs, of ictus were excluded from the study. Informed consent was taken from the patients or their attendants. Patient's attendants were interviewed to obtain a detailed clinical history regarding the onset and progression of headache, seizures and chronology of neurological worsening since ictus. History of hypertension, diabetes mellitus, alcoholism and smoking were recorded. The Glasgow Coma Scale (GCS) score of the patient was documented on admission[7-9]

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Radiological Analysis

All patients underwent a plain CT scan of the brain on admission itself. Image analysis was done to assess the following parameters-
1. Volume of haematoma.
2. Midline shift (MLS).
3. Intraventricular haemorrhage (IVH).
4. Hydrocephalus.
5. Side of haematoma (Left/Right).

The volume of haematoma was measured by using the formula ABC/2, where A is the greatest haemorrhage diameter by CT, B is the diameter 90 degrees to A and C is the approximate number of CT slices with haemorrhage multiplied by slice thickness[10]. The primary endpoint was either death in hospital or follow-up of live patients at 30 days[10]

Statistical Analysis

All data were analysed using SPSS software version 16.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were presented as means with standard deviation for continuous variables and as percentages for categorical variables. Bivariate analyses of clinical and radiological predictors of death were undertaken using logistic regression. Those radiological variables having significance were analysed using a multivariate logistic regression model. Model discrimination was validated using AUC (Area Under ROC). A P value less than .05 was considered significant.

Results

Out of the 138 admissions, only 112 patients were finally recruited for the study after making the necessary exclusions. The mortality rate was 28.6% (N= 32). The mean age was 63.20 years (Median 64 years, range 33 to 79 years). There were a total of 68 (60.71%) males and 44 (39.29%) females. Major clinical presentation was headache and altered sensorium in 60 patients (53.57%), loss of consciousness

in 35 patients (31.25%) and headache alone in 17 patients (15.18%). The most common risk factor in our study was hypertension 66 (58.9%) followed by smoking 28 (25%), alcohol intake 19 (17%) and diabetes mellitus 18 (16%). The mean GCS was 11 with a median of 13. The GCS was significantly low for patients who expired (6 vs. 14, p= .001). The mean hospital stay was 11 days with the survivors having significant prolonged stay (mean 13 vs. 4, p < .001). More than half of the deaths occurred in the first 48 hours (53.12%, N= 17). Only 14 patients (12.5%) underwent a surgical procedure with decompressive craniotomy, evacuation was done in 11 (9.8%) and external ventricular drainage alone was done in 3 (2.6%) of the patients. Overall, there was no significant difference in mortality between the conservative and surgical group (p= 0.119). All patients underwent a plain CT brain as part of their management. The mean haematoma volume was 43.4 ± 9.6 ml (range 4 - 230 mL). The average midline shift for the whole series was 1.9 mm (range 0 - 12). Intraventricular haemorrhage was present in 34.8% (N= 39) and hydrocephalus in 32% (N= 36) of the individuals. On bivariate analysis significant radiological predictors of in-hospital mortality were volume of the haematoma, midline shift, IVH and hydrocephalus (Table 1). There was good correlation between the groups volume of the hematoma and MLS with GCS. (Pearson correlation -0.50 and -0.49 respectively, p < .001 for both). Those with IVH and hydrocephalus had a significant low GCS (p < .001). For multivariate logistic regression analysis, collinear variables were eliminated in the model. After multivariate analysis MLS, presence or absence of IVH and volume of ICH were significant predictors of mortality (Table 2). The regression analysis showed a good validation with an area under ROC curve (AUC) of 0.867 (Fig. 1). Cross tabulation of variables with outcome is given in Table 3 .

Table 1: Unadjusted Logistic Regression Analysis

Variable	P value	OR(Odds Ratio)	95% CI
Demographics and Risk Factors	.022	2.719	1.157-6.391
Age (≥ 65 years)	.273	0.615	0.258-1.466
Sex (Male vs. Female)	.011	3.397	1.319-8.748
Hypertension	.294	1.756	0.613-5.031
Diabetes Mellitus	.750	1.189	0.409-3.461
Alcohol Smoking	.860	0.962	0.621-1.488
Clinical Variable GCS (≤ 8 vs. > 8)	<.001	0.03	0.009-0.098
Radiological Variable	<.001	12.5	4.486-34.828
Volume of haematoma	<.001	17.72	3.614-86.947
≤ 30 mL vs. > 30 mL	<.001	30.60	9.842-95.158
Midline shift (MLS)	<.001	10.371	4.035-26.660
≤ 6mm vs > 6 mm IVH‡ Present vs. Absent Hydrocephalus Present vs. Absent Side Left vs. Right	.121	1.929	0.841-4.420

Table 2: Multivariate Logistic Regression of Radiological Variables

Radiological Variable	P value	Odds Ratio	95% CI
MLS > 6 mm	.023	20.106	1.526-265.24
Volume of haematoma > 30 mL	<.001	16.85	4.13-68.61
IVH	.007	9.067	1.840-44.69
Hydrocephalus	.266	2.517	0.494-12.821
Side	.865	0.880	0.202-3.839

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Table 3: Cross Tabulation of Variables with Outcome

Variable		Outcome	
		Dead (n=32)	Alive (n=80)
Age (years)		66.75 (2.062)*	61.787 (2.079)
Sex	Male	68.8%	57.5%
	Female	31.2%	42.5%
Hypertension		78.1%	51.2%
Diabetes Mellitus		21.9%	13.8%
Alcohol		18.8%	16.2%
Smoking		31.2%	22.5%
GCS		6 (3-14)†	14(6-15)
Volume (mL)		92.96	23.6
MLS (mm)		4.71	0.81
IVH		84.4%	15%
Hydrocephalus		68.8%	17.5%
Side	Right	43.8%	60%
	Left	56.2%	40%

Discussion

In this study, we demonstrated that the following radiological parameters- 1) MLS, 2) IVH and 3) Volume of haemorrhage can be used to predict the prognosis of patients with primary spontaneous supratentorial intracerebral haemorrhage. Since primary intracerebral haemorrhage is an entity which accounts for 15% to 20% of all strokes and have a high mortality rate with poor consensus regarding management, the prognostication of such patients assumes paramount importance. Since infratentorial haemorrhages constitute a separate entity with respect to treatment and natural history, unlike many other studies we did not include them in our study. Our mortality rate of 28.6% was similar to many other series. Many studies combine clinical and radiological variables together in their model. This would lead to the problem of collinearity with each other and necessary elimination will have to be carried out on grounds of clinical practicality. This collinearity is due to the fact that the radiological variables are an effect of the clinical condition rather than the cause[10]In our study, IVH has been found to be the strongest radiological predictor (P= .007) with an OR of 8.43. Across several studies, IVH is consistently associated with a worse outcome. IVH was present in 84.4% of patients with poor outcome when compared to only15% in those who had good recovery. A study by Leira et al, showed a 2.6 times chance of neurological deterioration following IVH. The blood collected in the ventricle can obstruct the ventricular system and produce hydrocephalus. Blood in the ventricle also make the patient seizure prone. Both these factors contribute to the neurological deterioration. Diringer et al, in their study found that apart from other variables, pineal body shift and hydrocephalus were significant predictors of mortality. In their multivariate analysis, the P value was reduced to 0.1 to fit other variables into the model. In our study, hydrocephalus did not attain clinical significance (P= .123).

Conclusion

Plain CT study of brain taken in first 24 hours of ictus is has a significant value not only in diagnosing but also in predicting the outcome in patients with primary spontaneous ICH. Volume of haemorrhage, MLS and IVH were statistically significant predictors. The relative small number of patients and its single institutional nature were major limitations of our study. Multi-institutional studies with larger number of subjects are required to further validate the radiological prognostic variables.

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Conflict of Interest: Nil
Source of support:Nil

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