Research Article

Predictors of Clinical Outcome in Acute Haemorrhagic Stroke over a 30 Day Period Using Computed Tomography Scan

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Abstract

Background: Stroke is a major public health problem and a major cause of death and disability with a large percentage of death from stroke occurring in the developed countries. Several studies have tried to predict clinical outcome using various clinical and radiologic factors to account for the mortality risk in patients with stroke and most of these data are from the West and Asian countries. **Objective:** To determine the computed tomography findings that predicts clinical outcome in patients with acute haemorrhagic stroke. **Methods:** This is a descriptive cross-sectional study comprising of 153 adults diagnosed of haemorrhagic stroke having a brain computed tomography findings of haemorrhage. Non enhanced CT Images of the brain were obtained using the Toshiba Activion 16-slice CT scanners, Japan 2012. Computed tomography findings were used to predict outcomes among patients with haemorrhagic stroke. **Results:** The mean volume of hematoma for patients who survived was 23.12 ml ± 6.7 and 45.15 ml ± 14.05 for patients that died within the 30 day period. This was statistically significance p=0.02. Hematoma volume, ventricular extension of blood, midline shift presence of subarachnoid haemorrhage and location of haemorrhage correlated with clinical outcome over the period. However, independent predictors of clinical outcome are hematoma volume >30 ml (odd ratio=27.5), ventricular extension of blood (odd ratio=8.4), presence of subarachnoid haemorrhage (odd ratio=20.7). **Conclusion:** Heamatoma volume, intraventricular extension of blood and presence of subarachnoid haemorrhage are predictors of mortality in patients with haemorrhagic stroke.

Keywords: Predictors; Outcomes; Haemorrhagic stroke; Computed tomography

Introduction

Stroke is a major public health problem and a major cause of death and disability among adults especially in the developing countries where disease burden is changing from communicable to non-communicable diseases. The population of people who suffer from stroke is also on the increase worldwide with a large percentage of death from stroke occurring in the developed countries including Nigeria. [1] The stroke mortality in Nigeria is very high with a reported 30-day fatality rate ranging from 28-40% and stroke prevalence of 1.14 per 1000. [2,3]

Stroke is basically classified into two subtypes; haemorrhagic stroke (presents as spontaneous cerebral haemorrhage and subarachnoid haemorrhage) and ischaemic stroke (cerebral thrombosis or embolism). Neuroimaging with computed tomography and magnetic resonance imaging is the cornerstone in diagnosis and differentiating the subtypes for the purpose of initiating appropriate therapy. Of the major stroke subtypes spontaneous intracerebral haemorrhage has the highest mortality and accounts for 10% to 15% of stroke [4,5] and more than 40% 30-day mortality compared to ischaemic stroke. [5,6] Computed tomography is the imaging modality in evaluation of haemorrhage stroke as it can detect acute intracerebral haemorrhage within a few minutes of onset of stroke. [7] From the computed tomography information that can be generated include the volume of the hematoma, location of haemorrhage, presence of, intraventricular extension of haemorrhage, subarachnoid and evidence of mass effect as evidence by midline shift and ventricular compression. This information can be used to predict clinical outcome of patients with haemorrhagic stroke which cannot be obtained using only clinical examination. [8-10] Computed tomographic findings such as volume of haemorrhage, location and intraventicular extension have been reported widely as strong predictors of clinical outcomes in patients with intracranial heamorrage. [11-13]

Several studies have tried to predict clinical outcome using various clinical and radiologic factors to account for the mortality risk in patients with stroke and most of these data are from the West and Asian countries. [8,11,14,15] Moreover some of these studies combined cases of haemorrhagic stroke and ischaemic stroke, therefore accounting for mortality risk in these mixed stroke types may not be reliable. The aim of this

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study is to determine the computed tomography findings that predict clinical outcome in patients with haemorrhagic stroke over a 30- day period at University of Abuja teaching Hospital.

Materials and Methods

Study design

This was a prospective descriptive cross sectional study which spanned from July 2017- June 2019.

Study area

This study was carried out at the Radiology Department of University of Abuja teaching hospital, Gwagwalada, (F.C.T). The Hospital is located in Gwagwalada whose geographical coordinates are 8° 56' 29" North and 7° 5' 31" East.

Study population

This comprising of one hundred and fifty three adult from 18years and above clinically diagnosed of haemorrhagic stroke with computed tomographic findings of haemorrhage.

Patients with intracranial haemorrhage resulting from trauma, iatrogenic following surgical intervention, suspected haemorrhagic metastatic deposit, ischemic stroke, haemorrhagic transformation of previously acute cerebral ischemia and patients 18years and below were excluded from the study.

All patients who met the inclusion criteria had a non -contrast CT of the brain using Toshiba Activion 16-slice CT scanners, Japan 2012. A range of 120-140 kvp and 150-300 mAs were used and images were acquired in the axial plane at 2.5 mm from the base of the skull to the vertex.

Information retrieved from the CT of the brain include: location of haemorrhage, volume of haemorrhage which was measured using the ABC/2 formula for CT volume estimation of haemorrhage [16] and classified according to ICH score into < 30 ml, 30-60 ml and ≥ 60 ml. Other parameter accessed include intraventricular extension of haemorrhage, perilesional oedema, ventricular compression, presence of subarachnoid haemorrhage, location of haemorrhage and presence of midline shift which was categorized into three according to Lobato classification as < 5 mm, 5–15 mm, and > 15 mm. [17] Other relevant information obtained include age, sex, clinical presentation at admission, level of consciousness using the Glasgow coma score (GCS), risk factor, and duration of stay in the hospital which were documented using a well-structured questionnaire. Clinical outcome over 30-day period were group into two; those that survived within the 30days and those that died within the 30 days.

Data analysis

Data was collated and analyzed using SPSS 19.0 software 2010 by IBMR USA. The results were presented in the form of tables and pictogram. Spearmen correlation was done to determine the relationship between CT findings and outcome. Multiple logistic regression analysis was used to determine independent predictors of mortality. *P*-value <0.05 was taken as statistically significant.

Ethical considerations

The study was approved by the Research Ethical Committee of the hospital

Results

There were one hundred and fifty three patients with haemorrhagic stroke during the study period comprising of 89 (58.1%) male and 64 (41.8%) female. The mean age was 56 ± 12 with age range of 41 – 76 years. Majority of the patients were in the age group 60-64 accounting for 22.2% [Table 1]. In 138 (90.2%) patients the identified risk factor for stroke was hypertension. Figure 1 shows level of consciousness at the time of presentation, 75 (49.0%) were unconscious with GCS of 3-8, 45 (29.4%) patents were semiconscious with GCS of 9-12 and 33 (21.6%) were conscious with GCS of 13-15. There were wide varieties of clinical presentation among the studied population which ranged from headache, vomiting, convulsion, dysphagia and dysphasia, however more than two-third of the patient presented with more than one clinical symptom. The commonest combined clinical presentation was headache and vomiting and headache and convulsion representing 58.8% and 32.7% respectively.

The mean hematoma volume for 153 patients was 57.13 ml ± 27.54 ml, range 5.46 ml- 88.26 ml. Hematoma of greater than 60 ml accounted for 69 (45.1%) patients [Table 2]. The mean volume of hematoma for patients who survived within the 30 day period was 23.12 ml ± 6.7 and 45.15 ml ± 14.05 for patients that died. The difference in mean volume of hematoma between

Table 1: Age and sex distribution of subjects with haemorrhagic stroke.

Age group (years)			Male		Female	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
40-44	10	6.5	6	3.9	4	2.6
45-49	23	15.0	15	9.8	8	5.2
50-54	21	13.7	9	5.9	12	7.8
55-59	32	20.9	21	13.7	11	7.2
60-64	34	22.2	20	13.1	14	9.2
65-69	22	14.4	12	7.8	10	6.5
70-74	6	39.9	2	1.3	4	2.6
75-79	5	3.3	4	2.6	1	0.7
Total	153	100.0	89	58.1	64	41.8

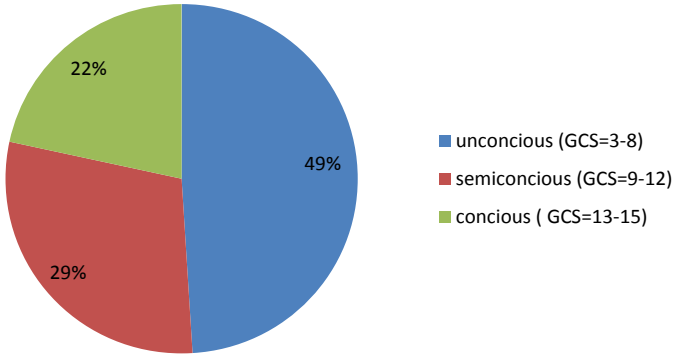

Figure 1: Level of conciouness of patients with acute heamorragic stroke presentation.

those that survived and died was statistically significance (p=0.02).

Among patient with hematoma volume of less than 30 ml, 29 (70.7%) patients survived and 12 (29.3%) died within 30-day period while in patients with large volume of hematoma greater than 60 ml 39 (56.5%) patients died before the 30-day period. The relationship between volume of hematoma and outcome was statistically significant. p=0.0017. Volume of hematoma correlates positively with outcome (Spearman correlation=0.63) [Table 2].

Fourteen (50.0%) out of 28 patients with midline shift of <5 mm survived and 14 (50.0%) died, 11 (42.3%) patients out of 26 with midline shift of 5-15 mm survived and 15 (57.7%) died, while those with midline shift of >15 mm; 12 (38.7%) patients out of 31 survived and 19 (61.3%) died. Midline shift correlates positively with outcome and the relationship was statistically significant. (Spearman correlation=0.34, p-value=0.044) [Table 2].

Out of the 131 patients with CT findings of presence of perilesional oedema, 75 (57.3%) survived and 56 (42.7%) patients died during the 30 day period. While 9 (40.9%) patients out of 22 patients with no evidence of perilesional oedema survived and 13 (59.1%) died. The CT findings of perilesional oedema correlates with the outcome positively, however this was not statistically significant. (Spearman correlation=0.78, p-value=0.27) [Table 2].

CT findings of ventricular compression was seen in 119 (77.8%) patients from which in 63 (52.9%) outcome was death and 56 (47.1%) survived during the 30 day period. There was a positive correlation between ventricular compression and outcome. This relationship was not statistically significant (Spearman correlation=0.59, p-value=0.35) [Table 2].

Presence of ventricular extension of haemorrhage [Figure 2] was seen in CT images of 44 (28.8%) patients with haemorrhagic stroke, 23 (52.3%) patients died and 21 (47.7%) survived the 30-day period. The relationship between ventricular extension of haemorrhage and outcome was statistically significant. Ventricular extension of haemorrhage correlates positively with outcome. (Spearman correlation=0.95, p-value=0.051) [Table 2].

Out of the 25 (16.3%) patients with subarachnoid haemorrhage, in 22 (88.0%) patients outcome was death and 3 (12.0%) of patient survived during the 30 day period. The presence of subarachnoid haemorrhage correlates with outcome positively and this was statistically significant. (Spearman correlation=0.29, p-value=0.0022). [Table 2].

In terms of location of haemorrhage, lobar location of haemorrhage was seen in 42 patients representing 27.4% and subcortical in 111 patients representing 72.5%. The basal ganglia were the commonest location for haemorrhage representing 30.1%, followed by thalamus 18.9% and parietal lobe (13.7%). The relationship between the location of haemorrhage and outcome was statistically significant p=0.032 [Table 3].

The mean hematoma volume for patients with GCS 3-8, 9-12 and 13-15 was 53.22 ml ± 18.26, 35.16 ml ± 15.47 and 22.11 ml ± 9.89 respectively. The relationship between GCS and volume of hematoma was statistically significant P=0.053 [Table 4].

Table 2: Relationship between CT findings and outcome.

CT findings			Outcome					
			Survived		Death			
	n=153	(%)	N=84	%	N=69	%	r_s	p -value
Size								
<30 ml	41	26.8	29	70.7	12	29.3	0.63	0.0017
30-60 ml	43	28.1	25	58.1	18	41.8		
>60 ml	69	45.1	30	43.5	39	56.6		
Midline shift								
<5 mm	28	18.3	14	50.0	14	50.0	0.34	0.044
5-15 mm	26	17.0	11	42.3	15	57.7		
>15 mm	31	20.3	12	38.7	19	61.3		
Absent	68	44.4	47	69.1	21	30.9		
Perilesional oedema								
Present	131	85.6	75	57.3	56	42.7	0.78	0.27
Absent	22	14.4	9	40.9	13	59.1		
Ventricular comp								
Present	119	77.8	56	47.1	63	52.9	0.59	0.35
Absent	34	22.2	28	82.4	6	17.6		
Ventricular extension								
Present	44	28.8	21	47.7	23	52.3	0.95	0.051
Absent	109	71.2	63	57.8	46	42.2		
Subarachnoid H								
Present	25	16.3	3	12	22	88.0	0.29	0.0022
Absent	128	83.7	81	63.3	47	36.7		

r_s- Spearman correlation
Ventricular comp- ventricular compression
Subarachnoid H-Sub arachnoid Haemorrhage

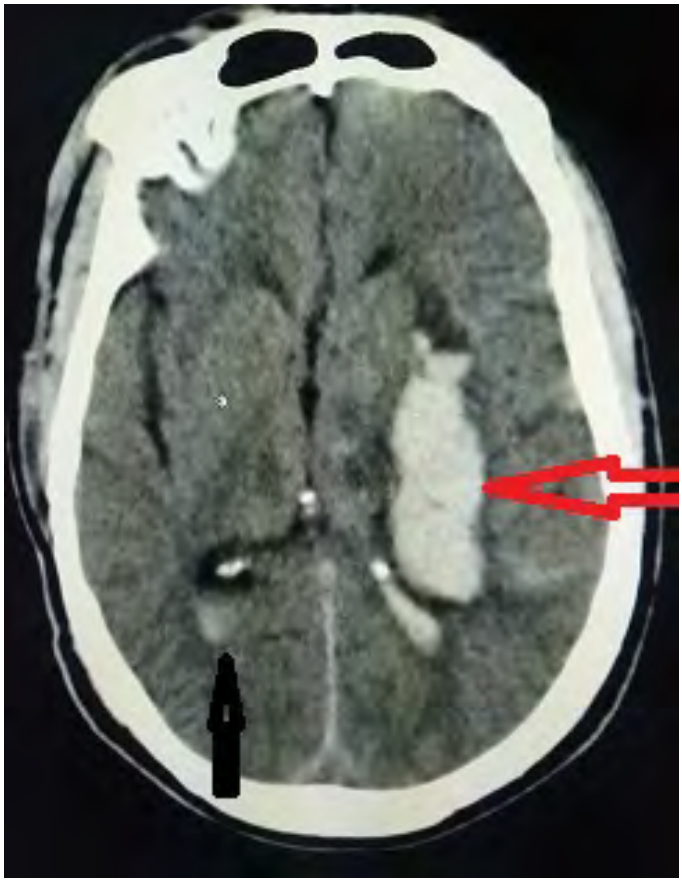

Figure 2: Non contrast CT showing ventricular extension of haemorrhage (black arrow) and left parietal lobe haemorrhage (red arrow).

Table 3: Relationship between location of hematoma and outcome.

CT findings			Outcome				
			Survived		Death		
	F	(%)	F	%	F	%	p -value
Lobar	42	27.4					
Parietal	21	13.7	117	11.1	4	2.6	
Occipital	12	7.8	8	5.2	4	2.6	
Frontal	6	3.9	6	3.9	0	0.0	
Temporal	3	2.0	3	2.0	0	0.0	
Subcortical	111	72.5					
Basal ganglia	46	30.1	18	11.8	2.8	18.3	0.032
Thalamus	29	18.9	6	10.5	13	8.5	
Internal capsule	19	12.4	8	5.2	11	7.2	
Brainstem	11	7.2	4	2.6	7	4.6	
Cerebellum	6	3.9	4	2.6	2	1.3	
Total	153	100.0	84	54.9	69	45.1	

Spearman correlation= 0.45

There was a negative correlation between hematoma volume and GCS. This was statistically significant. (p=0.005, Pearson correlation or Spearman correlation=-0.89).

Using multiple logistic regression analysis, hematoma volume, ventricular extension of bleed, subarachnoid haemorrhage and GCS were independent factors that were associated with mortality in patients with haemorrhagic stroke during a 30 day period. Patients with hematoma volume greater than 60 ml were predicted to have a twenty-seven times chance of adverse outcome (mortality) compared to those with hematoma volume less than 30 ml and between 30-60 ml. (odd ratio=27.5, 95% CI of 9.46 - 110.57 p=0.00) [Table 5]. Patients with ventricular extension of bleed and subarachnoid haemorrhage were predicted to have eight times chance and twenty times chance of dying respectively. Ventricular extension of bleed (odd ratio=8.4, 95% CI of 6.3- 56.42, p=0.031), subarachnoid haemorrhage (odd ratio=20.1, 95% CI of 46- 102.78, p=0.002 [Table 5].

Discussion

Of the major stroke subtypes spontaneous intra-cerebral haemorrhage is associated with high mortality and morbidity. Clinical Outcomes in patients with haemorrhagic stroke still remains very poor considering the much improvement in outcomes in ischemic stroke. [14] From our study the mortality recorded among patients with haemorrhagic stroke was 54.9% during the 30 day period. Our value was higher than what was recorded in other studies with a 30 day mortality which ranges from 35-52%.[14,18]. This is not surprising considering our peculiarity in the study region where presentation to hospital by patients is usually late and patients have to pay out of pocket for basic investigation in a country where there is extreme poverty.

Computed tomographic findings that were associated with mortality over 30 day period in this study are hematoma volume, midline shift, ventricular extension of hematoma, presence of perilesional oedema and presence of subarachnoid haemorrhage. Our findings are consistent with report from other studies. [8,14] However, in multiple logistic regression analysis hematoma volume, ventricular extension of bleed and presence of subarachnoid haemorrhage were independent factors associated with mortality.

The volume of the hematoma has a great role in determining outcome and studies have showed that hematoma volume is an independent poor prognostic factor associated with mortality and functional outcome. [14,18,19] Mortality increased with increasing

Table 4: Relationship between GCS and mean volume of hematoma.

GCS	Haematoma volume		
	Mean	std	p-value
13-15 Mild	22.11	9.89	0.053
9-12 Moderate	35.16	15.47	
3-8 Severe	53.12	18.26	

Table 5: Multiple logistic regression analysis of independent predictor of mortality.

CT Findings	Odds ratio	95% Confidence Interval	p-value
Size	27.5	9.46 - 110.57	0.00
Midline shift	1.4	0.66 – 5.89	0.67
Perilesional oedema	0.2	0.31 – 7.6	0.61
Ventricular comp	1.8	0.6 – 17.1	0.43
Ventricular extension	8.4	6.3 – 56.42	0.03
Subarachnoid H	20.1	46 – 102.78	0.002
Location of hematoma	4.4	6.4 – 28.8	0.37

Ventricular comp-ventricular compression
Subarachnoid H-sub arachnoid Haemorrhage

hematoma volume and our study showed that hematoma volume >30 ml was associated with increased mortality. This was consistent with finding in other studies. [8,19,20] However, Bhatia et al. [14] in their study stated that a hematoma volume of 42 ml as the cut-off value associated with mortality. From our study the mean hematoma volume was significantly lower among survivals (23.12 ml) compared to those associated with mortality (45.12 ml). This was in agreement with study of Bhatia et al. [14] however our values were much higher than what was obtained in their study but differ from values obtained by Molshatzki et al. [21] Although there is no clear criteria cut off for hematoma volume that is associated with good prognosis (survival), however several studies have shown that hematoma volume of <30 ml is associated with good outcome and volume > 30 ml is associated with bad outcome. [8,19,20] Moreover with large hematoma volume, the intracranial pressure is increased with resultant poor perfusion of the brain resulting in poor clinical outcome.

The baseline hematoma volume at admission is considered a powerful determinant of 30-day mortality. Studies have shown that having a prior knowledge of the baseline hematoma is important so as to prevent further expansion of the volume of hematoma which is associated with increased mortality. [22,23] Preventing hematoma expansion is what is being targeted by the clinicians in treatment of patients with intracerebral haemorrhage and in doing this stratification of high risk patient who may require timely intensive therapies may become easier and as such reducing mortality. [22,23] There was a significant difference in hematoma volume with GCS score and an inverse relationship exist between hematoma volume and GCS, as patients with low GCS had larger hematoma volume. This finding was also obtained by Goofing et al. [19] and Mahdy et al. [20] However Mahdy et al. [20] demonstrated that the use of both National Institutes of Health Stroke Scale (NIHSS) scoring scale and GCS to predict outcome in patients with intracranial haemorrhage is more informative than using either alone and that NIHSS is an independent predictive index of a 30-day mortality and disability in patients with intracranial haemorrhage. However no consensus has been reach as to which of scoring system (NIHSS and GCS) is more predictive of outcome in patients with intracranial haemorrhage.

The extension of blood into the ventricles from other sites in the brain and subarachnoid haemorrhage is associated and with poor prognosis. Previous study has reported increase mortality and worse clinical outcome over a few days of onset of symptom in patients with intraventicular extension of bleed. [8,23] From our study patients with intracranial extension of bleed are eight times likely to die than those without intracranial extension of bleed. Our findings in is consistent with Nag et al. [8] where intraventricular spread of bleed (OR=7.8) was an independent predictor of 30 day mortality. Extension of blood into the ventricle will further increase the intracranial pressure and resultant obstructive hydrocephalus will tend to lower the cerebral perfusion resulting in poor outcome in patients.

From our study midline shift, was associated with poor clinical outcome, however was not an independent predictor of mortality among patients with haemorrhagic stroke. This finding was in agreement with report by Nag et al. [8]

Conclusion

Hematoma volume, ventricular extension of hematoma and presence of subarachnoid haemorrhage were independent predictors of mortality in patients with haemorrhagic stroke.

Limitation

This is a single institutional based study.

Competing Interests

The authors declare that they have no competing interests.

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