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ROLE OF NEURORADIOLOGY IN PREDICTING OUTOME IN SPONTANEOUS INTRACEREBRAL HEMORRHAGE

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ABSTRACT

Introduction: Spontaneous intracerebral hemorrhage (ICH) accounts for 8-13% of all strokes and is associated with a high mortality and morbidity. Western studies have identified various clinical and radiological factors which help in predicting outcome in patients with spontaneous ICH. **Materials and methods:** A consecutive series of 100 patients diagnosed with spontaneous ICH admitted to the neurology department were enrolled from 1stJanuary to 30th June, 2014.Radiological parameters on CT brain (plain) were recorded. In-hospital outcome was measured at the end of 7 days of hospital stay in terms of survival or mortality. Different radiological parameters and their effect on outcome were compared by using Chi square test. Multivariate logistic regression analysis was performed to find independent predictors of mortality with a "p" value of < 0.05 indicating statistical significance. **Results:** The mean age was 47.95 years with SD ± 1.560, with a male preponderance (56%). Of the total cohort, 34% patients expired and 66% survived at the end of 1 week. On univariate analysis age, gender and ICH location had p value >0.05 whereas hematoma volume, presence of IV extension, midline shift and hydrocephalus had p value <0.05. On multivariate logistic regression analysis only higher baseline hematoma volume was an independent predictor of mortality ($p=0.00$). Among 66 survivors, 44% had moderately severe to severe disability with mRS 4 and 5 at the time of discharge. Conclusion-Intracerebral hemorrhage is associated with high in-hospital mortality and long-term severe disability. Larger baseline hematoma volume was an independent predictor of mortality in this study.

INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) leads to hemorrhage in the brain parenchyma in the absence of trauma or surgery. It accounts for 8-13% of all strokes and is associated with a high mortality and morbidity especially in countries of the developing world like Pakistan. Statistics indicate that in the first 30 days almost 50% patients of ICH will expire with one half of these deaths occurring in the first 2 days.[1-3] Spontaneous ICH is one of the most disabling varieties of stroke and only 20% patients attain functional independence after 6 months.[4-5] So far no therapy has been documented to improve outcome after spontaneous ICH with a proven role in reducing either mortality or profound long-term disability. Several international studies have identified various clinical and radiological factors which help in predicting outcome in patients with spontaneous ICH.[6-11] The clinical parameters include altered conscious level (low Glasgow coma scale [GCS]), high blood pressure and renal dysfunction. The radiological parameters include hydrocephalus, baseline volume of the hematoma, midline shift, intra ventricular extension and infratentorial location of the bleed.

Very few local and regional studies have been done on this subject. Most of the data is from studies conducted on western population. The aim of this study was to identify the radiological parameters in patients of spontaneous ICH and its in-hospital outcome in our local population to generate local data for allocation of resources; and to identify patients at high risk for mortality.

MATERIALS AND METHODS

This was a prospective, single center observational study carried out at the department of Neurology Pakistan Institute of Medical Sciences, Islamabad from 1stJanuary 2014 to 30th June, 2014. The study was approved by the hospital ethical committee and carried

out according to international ethical standards of the responsible committee on human experimentation and with the latest version of Helsinki Declaration of 1975.A consecutive series of 100 patients diagnosed with spontaneous ICH admitted to the neurology department were enrolled using non-probability consecutive sampling. This study was an independent project of the department and was not funded by any pharmaceutical organization. Informed consent was obtained from all patients (and in case of unconscious patients from their next of kin). Patients above the age of 13 years with diagnosis of spontaneous ICH who presented within 24 hours of the event onset were included in the study.

Spontaneous ICH was defined as stroke with hemorrhage into the brain parenchyma identified as hyperdense area on computed tomography (CT) scan brain (plain) done at the time of admission (without history of trauma or surgery). Hydrocephalus for this study was defined by the presence of the following on CT brain: Size of both temporal horns greater than 2 mm, ratio of the largest width of the frontal horns to maximal biparietal diameter (ie, Evans ratio) greater than 30% and ballooning of frontal horns of lateral ventricles and/or the third ventricle. Other imaging details noted on CT scan (plain) included volume of hematoma (calculated using ABC/2 formula by radiologist), site of ICH (supratentorial or infratentorial), intraventricular extension and midline shift (measured as maximum displacement of septum pellucidum in millimetres from midline by radiologist with 6mm as the cut-off between the two groups).In-hospital outcome was measured at the end of 7 days of hospital stay in terms of survival or mortality. The disability status was assessed by modified Rankin scale (mRS) in the patients who survived at the time of discharge.

Key exclusion criteria included patients with subdural and epidural hematoma on CT brain, patients with traumatic ICH, patients on anticoagulant or coagulopathy-related hemorrhage and patients with subarachnoid hemorrhage on CT brain. Patients of ICH fulfilling the criteria underwent detailed history and neurological examination. Demographic features recorded included age and gender. Radiological parameters as mentioned above were recorded. Every patient was then observed for outcome within 7 days. The data was entered on a standardized performa.

Statistical Analysis:

Data was analyzed using SPSS version 17. Descriptive analysis was carried out and reported as mean± SD forcontinuous variables whereas frequencies and percentageswere calculated for categorical variables. Different radiological parameters and their effect on outcome were compared by using Chi square test. Multivariate logistic regression analysis using stepwise forward regression was performed to find independent predictors of mortality (with mortality as the dependent variable). A "p" value of < 0.05 indicated statistical significance.

RESULTS

The mean age of patients was 47.95 years with SD ± 1.560, with 17% patients in the 18-30 years age group, 41% in the 31-50 years age group, 39% in the 51-70 years group and 3% above the age of 70 years. A male preponderance was seen with 56% being male and 44% female.

Of the total cohort 34% patients expired and 66% survived at the end of 1 week. The demographics features and imaging characteristics of these patients are represented in Table I.

TABLE I- Demographic features and radiological predictors of mortality

Variable	Expired	Survived	P value
Age group (years)	**18-30**- 8 (23.5%) **31-50**- 9 (26.5%) **51-70**- 15 (44.1%) **>70**- 2 (5.9%)	**18-30**- 9 (13.6%) **31-50**- 32 (48.5%) **51-70**- 24 (36.4%) **>70**-1 (1.5%)	0.12
Gender	**Male**-22 (22%) **Female**-12 (12%)	**Male**-34 (34%) **Female**-32 (32%)	0.148
ICH location	**Supratentorial**- 30 (88.2%) **Infratentorial**- 4 (11.8%)	**Supratentorial**- 58 (87.9%) **Infratentorial**- 8 (12.1%)	0.617
Hematoma volume (Ml)	**<30**-8 (23.5%) **30-60**-13 (38.2%) **>60**-7 (20.6%) **>80**-6 (17.6%)	**<30**-37 (56.1%) **30-60**-27 (40.9%) **>60**- 2 (3%) **>80**- 0 (0%)	0.00
IV extension	**Present**-22 (64.7%) **Absent**-12 (35.3%)	**Present**-19 (28.8%) **Absent**-47 (71.2%)	0.01
Midline shift	**<6mm**-13 (38.2%) **>6mm**-21 (61.8%)	**<6mm**-46 (69.7%) **>6mm**-20 (30.3%)	0.02
Hydrocephalus	**Present**-26 (76.5%) **Absent**-8 (23.5%)	**Present**-28 (42.4%) **Absent**-38 (57.6%)	0.01

On univariate analysis the radiological features associated with mortality included a larger baseline hematoma volume, greater midline shift, intraventricular extension of hematoma and presence of hydrocephalus with p value <0.05 (Figure no I). Site of hemorrhage did not differ statistically among both the patient groups of the cohort(Figure no II shows Various CT brain images).However, on multivariate logistic regression analysis only higher baseline hematoma volume was an independent predictor of mortality ($p=0.00$) while higher midline shift ($p=0.839$), intraventricular extension of hematoma ($p=0.306$) and presence of hydrocephalus (0.999) didn't prove likewise.

FIGURE I

Relationship of different parameters with intracranial bleed.Bar chart showing number of pat respecategory. (Error bars with percentages)

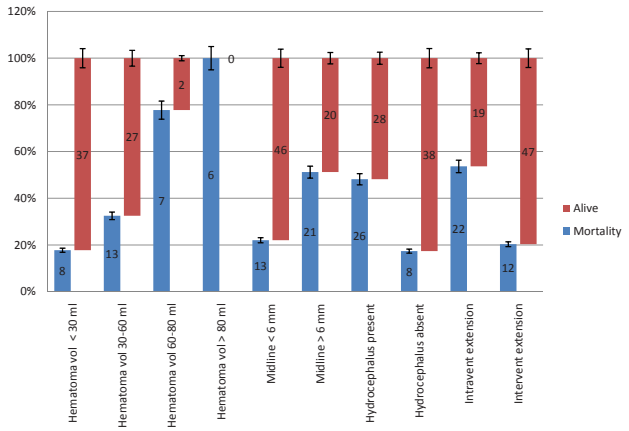
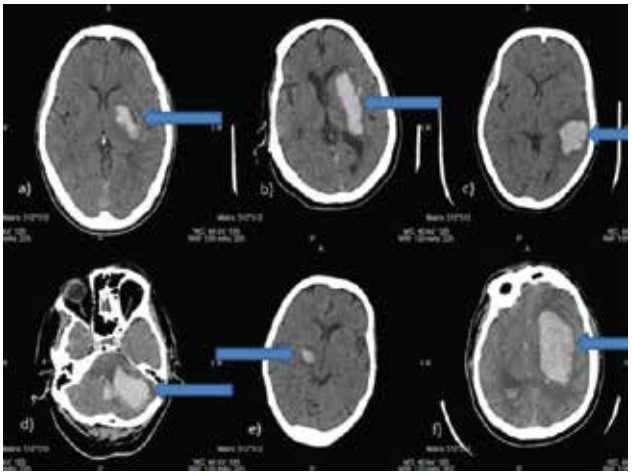


FIGURE II

Figure II illustrates the CT scan images of various patients with spontaneous ICH.

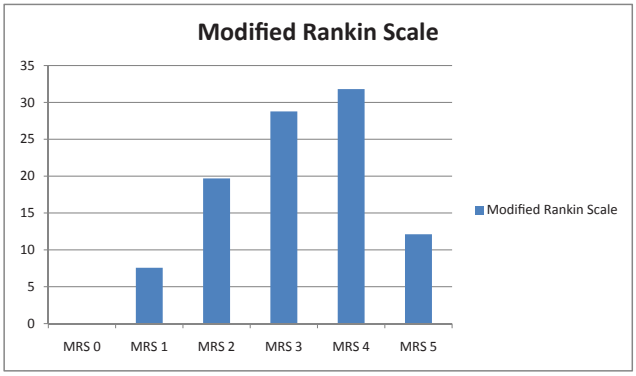


a) Left Basal ganglia bleed as shown in CT brain of one of our patients (arrow head) b) Left Basal ganglia bleed with mass effect in CT brain of another patient (arrow head) c) CT brain showing Left parietal hematoma (arrow head) in one of our patients. d) CT brain revealing Massive Cerebellar bleed with mass effect and intraventricular extension (arrow head) in one of the cases e)Right thalamic hematoma (arrow head) shown in CT brain of one of the patients. f) Massive left sided hematoma (>80mL) with midline shift and intraventricular extension (arrow head) seen in CT brain of one of the patients who expired.

Among the 66 patients who survived 18 (27.2 %) had a modified Rankin score of 0-2 at the time of discharge whereas 29 (44%) had moderately severe to severe disability with mRS 4 and 5 at the time of discharge [mRS 4, 21 (31.8) and mRS 5, 8 (12.1%)] as shown in Figure no III.

FIGURE III

Figure III illustrates the modified Rankin scale score of the survivors at the time of discharge.



DISCUSSION

Intracerebral hemorrhage is a catastrophic medical emergency. Extensive research work is being carried out internationally to salvage patients of ischemic stroke and to reduce the resultant morbidity and mortality. Intracerebral hemorrhage still requires more focus in order to improve the outcome. There is no specific medical treatment and the outcome of surgical interventions is controversial and debatable. There has been considerable interest in predicting outcome after ICH and several studies (mostly western) have identified the clinical and radiological parameters associated with poor outcome. These studies vary in complexity however most of them have identified similar overlapping factors. This study mainly focuses on the CT brain findings of patients of spontaneous ICH. CT brain (plain) is the investigation of choice for patients of ICH with a high sensitivity and specificity for delineating ICH. It is readily available in the emergency departments of most hospitals, takes less time and has a lower cost than MRI brain.

ICH is a grave emergency with a high mortality of almost 35-52%.[1-3]Review of different srevvariable

factors which can predict possible high risk of mortality. In our study the mean age of patients was 47.95 years with SD ± 1.560 with a male preponderance. The age mean is lower than a similar study published in the Indian journal of Neurology in 2013 and another published in the AHA stroke journal in 2003 with mean ages being above 55years and 65years respectively. We had more patients of young stroke. This may be related to genetic and environmental factors but needs validation by further studies. Male preponderance corresponds to the study done in India whereas Western studies have documented predominately female predilection.

In our study location of bleed was not associated with an increased risk of mortality. These results correspond to that of Salihović et al in 2013 where they concluded that there was no statistically significant association between the localization of the hematoma and the outcome of patients.[12] Our study identified hematoma volume as a predictor of mortality both on univariate and multivariate analysis with statistical significance ($p<0.05$). It was seen that hematoma volume less than 30ml was associated with a favorable outcome whereas higher baseline hematoma volumes were associated with higher mortality. The highest mortality rate was recorded in patients with the hematoma volume more than 80 mL (100%), followed by the group of >60 mL (77.8%). These findings are consistent with those of previous studies.[12-14] Therefore, volume of hematoma was an independent factor influencing mortality in patients with ICH. Studies of Godoy et al, Salihović et al and Bakhshayesh et al all showed that mortality was higher in the patients with greater hematoma volume.

On univariate analysis presence of hydrocephalus, greater midline shift and intraventricular extension were associated with significant mortality ($p<0.05$). However, none of these were independent predictors of unfavorable outcome on multivariate analysis ($p>0.05$). Some previous studies have depicted these as independent risk factors for mortality while others failed to prove so as in our study. A study conducted by Cheung and Zou in 2003 showed intraventricular extension of ICH as a poor prognostic factor for mortality.[15] The study byBhattathiri et al showed that favorable outcomes were more frequent when IVH and hydrocephalus were absent.[16] The study by Phan TG et al proved that obstructive hydrocephalus on admission was a predictor of mortality.[17] Our results correspond to those of some other studies which didn't prove hydrocephalus or midline shift as independent predictors of mortality.[7] Different studies have conflicting results on the significance of these factors.[18-20]

Among the 66 survivors in this study almost half were severely disabled at the time of discharge. One review estimated that only 12- 39% of patients of spontaneous ICH are functionally independent.[21]
Our study has certain limitations. The proportion of infratentorial ICH in this cohort is low (12%) while the major proportion was constituted by supratentorial ICH. This small number cannot truly predict the extent of mortality in infratentorial ICH. This was a single center study with only 100 patients.An epidemiological population-based study with larger sample would be able to give results which can be applied on the general population with more certainty. However, our center being the largest specialized unit in the country renders services to nearly one fifth of the population of Pakistan so this data could be representative of patients who have ICH in general population to some extent.

CONCLUSION:

In conclusion, intracerebral hemorrhage is associated with high in-hospital mortality and long-term morbidity with almost half patients discharged in dependent state with severe disability. Larger baseline hematoma volume was an independent predictor of mortality in this study. Presence of hydrocephalus, significant midline shift, hematoma location and intraventricular extension did not affect outcome. Therefore, radiological parameters on CT brain can be used to predict outcome when a patient of intracerebral bleed is received in the emergency department.

REFERENCES:

1. Sacco S, Marini C, Toni D, Olivieri L, Carolei A. Incidence and 10-year survival of intracerebral hemorrhage in a population-based registry. Stroke 2009;40:394-9.
2. Zia E, Engström G, Svensson PJ, Norrving B, Pessah-Rasmussen H. Three-year survival and stroke recurrence rates in patients with primary intracerebralhaemorrhage. Stroke 2009;40:3567-73.
3. Flaherty ML, Haverbusch M, Sekar P, Kissela B, Kleindorfer D, Moomaw CJ, et al. Long-term mortality after intracerebral hemorrhage. Neurology 2006;66:1182-6.
4. Flemming KD, Wijdicks EF, Li H. Can we predict poor outcome at presentation in patients with lobar hemorrhage? Cerebrovasc Dis 2001;11:183-9.

5. Gebel JM Jr, Jauch EC, Brott TG, Khoury J, Sauerbeck L, Salisbury S, et al. Relative edema volume is a predictor of outcome in patients with hyperacute spontaneous intracerebral hemorrhage. Stroke 2002;33:2636-41
6. Chuang YC, Chen YM, Peng SK, Peng SY. Risk stratification for predicting 30-day mortality of intracerebralhaemorrhage. Int J Qual Health Care 2009;6:441-7.
7. Bhatia R, Singh H, Singh S, Padma MV, Prasad K, Tripathi M, et al. A prospective study of in-hospital mortality and discharge outcome in spontaneous intracerebral hemorrhage. Neurol India. 2013;61:244-8.
8. Hallstrom B, Jonsson AC, Nerbrand C, Norrving B, Lindgren A. Stroke incidence and survival in the beginning of the 21st century in Southern Sweden: Comparisons with the late 20th century and projections into the future. Stroke. 2008;39:10-15.
9. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. Worldwide strokeincidence and early case fatality reported in 56 population-based studies: A systematic review. Lancet Neurol. 2009.
10. Almutawa E, Shahda A, Albalooshi M. Spontaneous IntracerebralHaemorrhage(SICH): Factors Associated with in-hospital Mortality. Bahrain Med Bulletin. 2012; 34(2):1-6.
11. Diringer MN, Edwards DF. Admission to a neurologic/neurosurgical intensive care unit is associated with reduced mortality rate after intracerebral hemorrhage. Crit Care Med. 2001 Mar;29(3):635-40.
12. Salihović D, Smajlović D, Ibrahimagić OC, "Does the Volume and Localization of Intracerebral Hematoma Affect Short-Term Prognosis of Patients with Intracerebral Hemorrhage?," ISRN Neuroscience, vol. 2013, Article ID 327968.
13. Godoy DA, Piñero G, and Di Napoli M, "Predicting mortality in spontaneous intracerebral hemorrhage: can modification to original score improve the prediction?" Stroke.2006; 37: 1038-1044.
14. Bakhshayesh B, Hosseininezhad M, SeyedSaadat SM, Hajmanuchehri M, Kazemnezhad E, Ghayeghran A-R. Predicting in-hospital mortality in Iranian patients with spontaneous intracerebral hemorrhage. Iranian Journal of Neurology. 2014;13(4):231-236.
15. Cheung RT, Zou LY. Use of the original, modified, or new intracerebral hemorrhage score to predict mortality and morbidity after intracerebral hemorrhage. Stroke. 2003;34(7):1717-22.
16. Bhattathiri PS, Gregson B, Prasad KS, Mendelow AD; STICH Investigators. Intraventricular hemorrhage and hydrocephalus after spontaneous intracerebral hemorrhage: results from the STICH trial. ActaNeurochir Suppl. 2006;96:65-8.
17. Phan TG, Koh M, Vierkant RA, Wijdicks EF. Hydrocephalus is a determinant of early mortality in putaminal hemorrhage. Stroke. 2000;31(9):2157-62.
18. Demchuk AM, Dowlatshahi D, Rodriguez-Luna D, Molina CA, Blas YS, Dzialowski I. Prediction of haematoma growth and outcome in patients with intracerebralhaemorrhage using the CT-angiography spot sign (PREDICT): A prospective observational study. Lancet Neurol. 2012;11:307-14.
19. Juvela S. Risk factors for impaired outcome after spontaneous intracerebral hemorrhage. Arch Neurol. 1995;52:1193–1200.
20. Lisk DR, Pasteur MD, Rhoades H, Putnam RD, Grotta JC. Early presentation of hemispheric intracerebral hemorrhage: prediction of outcome and guidelines for treatment allocation. Neurology. 1994;44:133–139.
21. Van Asch CJ, Luitse MJ, Rinkel GJ, van der Tweel I, Algra A, Klijn CJ. Incidence, case fatality, and functional outcome of intracerebralhaemorrhage over time, according to age, sex, and ethnic origin: A systematic review and meta-analysis. Lancet Neurol 2010;9:167-76.

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Author's contribution:
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Mazhar Badshah: Study concept and design, data collection, data analysis, manuscript writing, manuscript review
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Ali Zohair Nomani: Study concept and design, data collection, data analysis, manuscript writing, manuscript review
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