Utility of Intracerebral Hemorrhage Score for Predicting Prognostic Value in Hypertensive Bleed

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ABSTRACT

INTRODUCTION: Intracerebral hemorrhage (ICH) constitutes 10% to 15% of all strokes and there is no treatment of proven benefit. Despite several existing outcome prediction models for ICH, there is no standard clinical grading scale for ICH analogous to those for traumatic brain injury, subarachnoid hemorrhage, or ischemic stroke.

METHOD: Records of all patients with acute ICH presenting to Bir Hospital (NAMS), Mahaboudha, Kathmandu during March 1st to June 29th 2017 were prospectively collected. Independent predictors of 30-day mortality were identified by logistic regression. A risk stratification scale (the age modified ICH Score) was developed with weighting of independent predictors based on strength of association.

RESULT: Factors independently associated with 30-day mortality were Glasgow Coma Scale (GCS) score (P=0.028), age ≥65 years (P=0.001), ICH volume (P =0.02), and presence of Intraventricular hemorrhage (IVH) (P 0.30). The ICH Score was the sum of individual points assigned as follows: GCS score 3 to 4 (=2 points), 5 to 12 (=1), 13 to 15 (=0); age ≥65years yes (=1), no (=0); infratentorial origin yes (=1), no (=0); ICH volume ≥30 cm3 (=1), ,<30 cm3 (=0); and IVH yes (=1), no (=0). No patient of Age modified ICH score was alive and 83% of the Age modified ICH score of 3 or 4 were dead. Other with the score of 0, 1, 2 were all alive.Thirty -day mortality increased with Age modified ICH Score (P-value< 0.001).

CONCLUSION: The Age modified ICH Score is a simple clinical grading scale that allows risk stratification on presentation with ICH. The use of a scale such as the ICH Score could improve standardization of clinical treatment protocols and clinical research studies in ICH.30

KEY WORDS: intracerebral hemorrhage, medical management, outcome, prognosis, surgery

INTRODUCTION

Intracerebral hemorrhage (ICH) constitutes 10% to 15% of all strokes and has a higher risk of morbidity and mortality than cerebral infarction or subarachnoid hemorrhage (SAH).[1,2] Despite advances in the treatment of cerebral infarction and SAH, there remains no therapy of proven benefit in improving outcome after ICH.[3]

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Studies of surgical hematoma evacuation in ICH using a variety of methods have yielded either negative or inconclusive results.[4–8] Likewise no medical treatment has been shown conclusively to benefit patients with ICH.[9–12]

Studies of ICH treatment have used a variety of selection criteria for patient inclusion. The inconsistency of selection criteria across studies serves to emphasize that there is no standard, widely accepted early prognostic model or clinical grading scale for ICH analogous to those used for cerebral infarction, SAH, or traumatic brain injury. In contrast to the lack of effective treatments for ICH, there exist a number of prognostic models for mortality and functional outcome after ICH.[13–17] These models usually include criteria[30] related to neurological condition, various other clinical and laboratory parameters, and neuro-imaging findings.

Current models vary in complexity, with some including terms for degree of hydrocephalus or IVH and some using algebraic equations to calculate predicted outcome.[13,15,16] Thus, while these models may accurately predict outcome, they vary in their ease of use, especially by personnel not specifically trained in neuroimaging and statistical analysis.

Despite the accuracy of several of these outcome models, no grading scale for ICH is consistently used for triage and acute intervention, whether as part of clinical care or clinical research.

The purpose of this study was to see the implementation of clinical grading scale for age modified ICH score which uses criteria[30] that are predictive of outcome and that can be rapidly and accurately assessed at the time of presentation, especially by personnel not specifically trained in stroke neurology. Also to analyze patients treated with conservative management and or undergone surgery that had 30 days mortality and define control parameters like GCS of patients, ICH volume, site of bleed and age of patient against 30 days mortality.

METHOD

The study was carried out once the research protocol accepted by IRB (Institutional Review Board), the ethical committee of NAMS. Forty-eight patients with age>15 presented to Bir Hospital Emergency or Outpatient department or transferred from an outside if treated conservatively for less than 5 days without history of recent trauma who were admitted during 1st March to 29th June 2017 were included.

All ICH patients treated conservatively or with surgical hematoma evacuation as per indication for surgical evacuation at Neurosurgery and Neurology department, Bir Hospital was included. All patients were followed until 30 days of admission.

All variables used for outcome model development were abstracted from data available at the time of initial ICH evaluation. 30days mortality was recorded with continuous follow up at hospital and phone calls information from family who were discharged.

All variables including sex, age, GCS, IVH, ICH volume, site of ICH, Mean arterial Blood pressure (MAP), and first blood sugar level (RBS) are recorded at the time of admission. GCS scores were recorded at the time of admission after neurological examination, ICH volume were measured on the initial head CT scan with the use of the *ABC*/2 method, in which *A* is the greatest diameter on the largest hemorrhage slice, *B* is the diameter perpendicular to *A*, and *C* is the approximate number of axial slices with hemorrhage multiplied by the slice thickness.[19] The presence or absence of IVH was also noted on initial head CT.

Outcome was assessed as morbidity and mortality within 30 days after ICH. All the base line investigations and all variables are collected by principal investigator or MCh Neurosurgery residents and recorded. Data was initially entered in excel and then analyzed by R statistical software.

RESULT

Demographic information

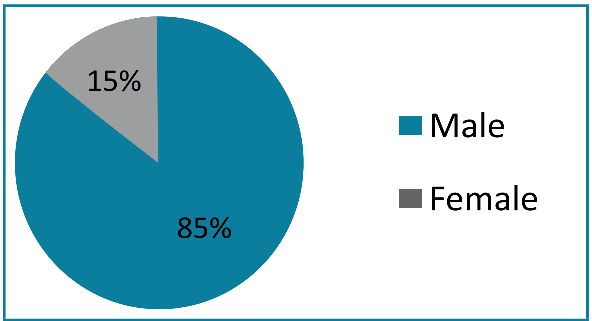

Fig No. 1 Sex distribution

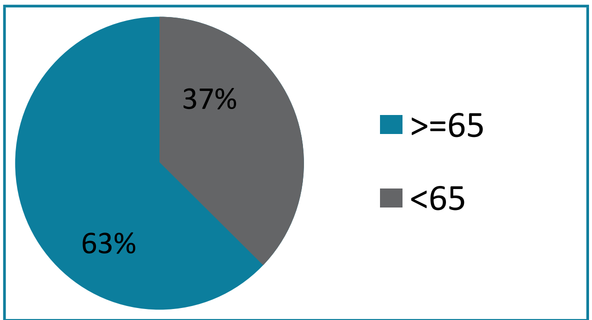

Fig No. 1 Age distribution

Table 1 Univariate analysis of Characteristics of modified ICH Cohort (n=48) Here chi-Square test is applied for the calculation of p-value

Sex	n (%)	30 day mortality, n (%)	p- value
Male	41(85)	14(34)	0.772
Female	7(15)	2(29)	
Tentorial			
Supra	41(85)	12(29)	0.148
Infra	7(15)	4(57)	
IVH			
Yes	25(52)	10(40)	0.307
No	23(48)	6(26)	
Age			
Age <65	30(62)	3(10)	<0.001
Age≥65	18(38)	13(72)	
Volume> 30ml			
Yes	25(52)	13(52)	0.004233
No	23(48)	3(13)	
GCS			
0	21(44)	3(14)	0.0253
1	26(54)	12(46)	
2	1(2)	1(100)	

Of 52 patients, presented to Bir Hospital with ICH from 1st March to 29th June 2017, complete information was available in 48 patients who formed the cohort for data analysis.

Fig No. 1 and 2 showed sex and age distribution respectively. 41(85%) are male and 7(15%) are females. Among them 14(34%) male and 2(29%) female patients were expired within 30 days.

41(85%) had supratentorial ICH, and 7(15%) had infratentorial ICH. 12 (29%) of supratentorial and 4(57%) were expired within 30 days of hospital admission.

Similarly among 25(52%) with IVH and 23(48%) without IVH. 10(40%) and 6(26%) were died respectively. Patients of Age≥65 years and <65 were 18(36%) and 30(62%) respectively. Among them 13(72%) with age ≥ 65 and 3(10%) were dead within 30 days respectively. Among 25(52%) ICH volume ≥30cm^3 and 23(48%) <30cm^3, 13(52%) and 3(13%) were dead within 30 days of admission.Lastly GCS categorized into 0, 1, 2 for GCS of 13-15, 5-12, 3-4 respectively. 3(14%) of total with GCS of 13-15, 12(46%) of GCS of 5-12 and 1(100%) were dead respectively.P-value is significant only in age ≥65, GCS, ICH volume are significant in univariate analysis i.e., P-value<0.05. P-value is not found significant to in Tentorial location category and IVH groups.

Overall 30 day mortality was 16 patients (33.34%). Mean age at ICH was 58.42 (range 15to 88), mean GCS score on admission was12.19 (rang 3 to 15). Mean ICH volume on initial CT scan was 27 ±28 cm^3 (range 10 to 124 cm^3), and mean pulse pressure on hospital arrival was 118.12mm Hg (range 64 to 146mmHg), serum glucose level was obtained in all patients showed with a mean 152.4 mg/dl (range 95-230 mg/dl). Sites of ICH origin and presumed causes were distributed among the Bir Hospital ICH cohort in a manner similar to that previously described for other series of ICH patients. Table 2 summarizes these outcome prediction model which in turn for the basis for the ICH Score. On multivariate analysis, group of all ICH patients, GCS score, age≥65years, ICH volume, were all strong predictors outcome. IVH did not show strong relationship. Infratentorial location could not be calculated due to very less number of patients.

Table 2.Multivariate Analysis of Significant Independent Predictors of 30-day mortality after ICH

Patient Characteristic	Odds Ratio(95% Cl)	P-value
All ICH patients (n=48)		
GCS	0.55(0.32-0.93)	0.028
Age (≥65years)	175.78(7.53-4098.27)	<0.001
IVH	1.88(0.55-6.45)	0.30
ICH volume	22.66(1.52-336.98)	0.02

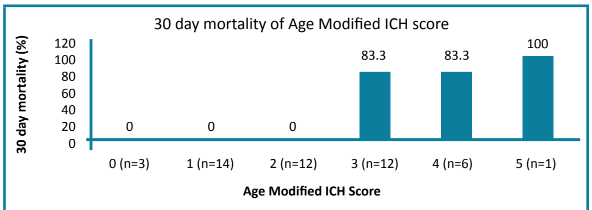

Figure 3. ICH Score and 30-day mortality. Thirty-day mortality increases as ICH Score increases. No patient with an ICH Score 0, 1, 2 were dead. No patient was alive with ICH Score of 5 and no patient in this ICH cohort had an ICH Score of 6 although this would be expected to be associated with mortality.

An outcome risk stratification scale (the ICH Score) was developed from the logistic regression model for ICH patients. The 5 characteristics determined to be independent predictors of 30-day mortality (and therefore included in the logistic regression model) were each assigned points on the basis of the strength of association with outcome. The total ICH Score is the sum of the points of the various characteristics.

Table 3 indicates the specific point assignments used in calculating the age modified ICH Score. Because GCS score was most strongly associated with outcome, it was given the most weight in the scale. The GCS was divided into 3 subgroups (GCS scores of 3 to 4, 5 to 12, and 13 to 15) to more accurately reflect the very strong influence of GCS score on outcome. Of note, in the Bir Hospital ICH cohort, no patient presenting GCS score of 3 or 4 survived to 30days, and only 3 of 21 patients with a presenting GCS score of 13 to 15 died, whereas 12 of 26patients with a GCS score of 5 to 12 died within 30 days. Age ≥65 years were also very strongly associated with 30-day mortality. Because age in the prediction models was dichotomized around the cut point of 65 years and was not associated with outcome in the infratentorial group of patients, only 1 point was assigned for patients aged ≥65years. IVH, infratentorial ICH origin, and ICH volume all had relatively similar strengths of outcome association and were therefore weighted the same in this ICH Score too. IVH and infratentorial ICH origin are dichotomous variables with points assigned when present. ICH volume was dichotomized to <30 and≥30 cm^3. Thirty cubic centimeters was chosen as it represented a cut point for increased mortality and is similar to ICH volume cut points used in prior models. Furthermore, no patient with infratentorial ICH origin in the

University of California, San Francisco (UCSF) ICH cohort had a hematoma volume <30 cm^3.

TABLE 3. Determination of the ICH Score

Component of Age Modified ICH Score Points	Points
GCS score	
3–4	2
5–12	1
13–15	0
ICH volume, cm3	
≥30	1
<30	0
IVH	
Yes	1
No	0
Infratentorial origin of ICH	
Yes	1
No	0
Age, y	
≥65	1
65	0
Total ICH Score	0–6

The ICH Score was an accurate predictor of outcome assessed as 30-day mortality (Figure 3). The range of ICH Scores was 0 to 5, and ICH Scores from the cohort were distributed among the various categories. Each increase in the

ICH Score was associated with a progressive increase in 30-day mortality (*P*< 0.001) suggesting that the ICH Score is an applicable risk stratification tool to all ICH patients. No patient with an ICH Score of 0, 1, and 2 were died until 30 days followed up, whereas all patients with an ICH Score of 5 died. Thirty-day mortality rates for patients with ICH Scores of 3, 4 and 5 were 83%, 83%, and 100%, respectively. No patient in the Bir Hospital ICH cohort had an ICH Score of 6 because no patient with an infratentorial ICH had a hematoma volume ≥30 cm^3. However, given that no patient with an ICH Score of 5 survived, an ICH Score of 6 would be expected to be associated with a very high risk of mortality.

DISCUSSION

The ICH Score is a clinical grading scale composed of factors related to a basic neurological examination (GCS), a baseline patient characteristic (age), and initial Neuroimaging (ICH volume, IVH, infratentorial/supratentorial origin). The purpose of this grading scale is to provide a standard assessment tool that can be easily and rapidly determined at the time of ICH presentation by physicians without special training in stroke neurology and neurosurgery and that will allow consistency in communication and treatment selection in clinical care and clinical research. In our study GCS, Age≥65, ICH volume ≥30cm^3 and Age modified ICH score seems to be statistically highly significant. The GCS score is now a standard neurological assessment tool that is reproducible and reliable.[18] It has been associated with ICH outcome in other prediction models, as it is in the UCSF ICH cohort.[13–15, 24] the unique element of the GCS component of the ICH

Score compared with other ICH prediction models is the division of the scale into 3, not 2, subgroups. Most other prediction models have grouped patients into those with GCS score >8 versus that ≤8.[13, 14]This assumes that the influence of level of consciousness on outcome is very similar for a patient with a GCS score of 8 and a patient with GCS scores of 3. This was not the case in the UCSF ICH cohort since patients with GCS scores of ≤ 4 did much worse than those with higher GCS scores regardless of other factors. In fact, this is being increasingly recognized

In other diseases, such as traumatic brain injury, in which patients with GCS scores of 3 or 4 have been analyzed separately regarding outcome or are being considered for exclusion from certain clinical trials.[30] Likewise, patients with GCS scores of ≥13 tend toward much better long-term outcome, as in the UCSF ICH cohort. Because the GCS score is overwhelmingly the strongest outcome predictor in acute ICH, weighting this component of the ICH Score more than others is justified, and dividing it into these 3 groups is more clinically meaningful than dichotomizing toward the middle of the range of possible GCS scores (range, 3 to 15).

Age has been found to be an independent predictor of ICH outcome in some prior prediction models, while age has not been associated with outcome in others.[13–15, 28] In the UCSF ICH cohorts, only very old age (≥80years) was associated with 30-day mortality. The fact that age has been an inconsistent ICH outcome predictor among various models and may have its strongest influence among the group of very elderly patients suggest 2 possibilities. Either the very elderly sustain worse neurological injury from ICH irrespective of size or location, or overall medical care decisions in elderly patients are less aggressive even if ICH-related neurological injury is not as profound. In the UCSF ICH Cohort, 3 elderly patients who would have been expected to survive their ICH on the basis of clinical neurological condition were provided hospice care because of concurrent medical problems such as dementia or newly diagnosed cancer. This care approach was not taken in any patients aged, 80 years. Nepalese population overall life span ranged from 65-69 according to Census of 2070 B.S. So, we took age ≥65 as a independent factor here which is different from Standard ICH score by UCSF.Validation of the ICH Score on other patient populations will help to elucidate the impact of age on risk stratification after ICH and may help to delineate whether this influence is due to age-related ICH injury, differences in clinical care of the very elderly, or both.

ICH volume is consistently associated with outcome in ICH prediction models.[13, 14] Often ICH volumes has been divided into 3 groups representing small, medium, and large hematoma size.[13, 14] while the specific volume cut points vary depending on the specific model, small hematomas have often been considered as, 30 cm^3 and large hematomas as 60 cm^3.[14] While ICH volumes is a component of the ICH score, its association with outcome was not as strong as some other predictors. In fact, ICH volume was not an independent predictor for outcome in infratentorial hemorrhages. This may be because small hemorrhages in the brain stem or cerebellum may have catastrophic consequences, making tentorial location, not size, and the more important predictor for infratentorial ICH. Additionally, while larger supratentorial ICH volumes were associated with increased mortality, the addition of a "large hematoma" group did not improve the model because patients with larger hematomas who died also had other predictors such as low GCS score, advanced age, or IVH that influenced outcome to a greater degree. This has practical implications for patient treatment in that we believe that the logistic regression model and ICH Score derived from the UCSF ICH cohort would not justify exclusion of a patient for treatment solely on the basis of a large hematoma in the absence of other poor outcome predictors such as low GCS score, advanced age, or IVH. Thus, the ICH volume component of the ICH Score is dichotomized to reflect the strength of association with outcome and weighted accordingly.

Importantly, assessment of ICH volume by the *ABC*/2 method has been shown as accurate and with good interrater reliability.[19]

The presence of any IVH and infratentorial hemorrhage origin was the other factors independently associated with 30-day mortality in the UCSF ICH cohort and therefore included in the ICH Score. In our study due to less number of infratentorial groups of patients, separate analysis could not be obtained. P –value is not stastistically significant in IVH here. Both are easy to assess and are dichotomous variables.

CONCLUSION

Our study showed that the individual factors including age>65 years, GCS<13, presence of IVH,ICH volume (>30cm^3), GCS are the significant independent predictors of the outcome of the ICH patients along with ICH score with 30 days mortality which defer from standard ICH score with Age cut point.

Further study within large scale still is needed to validate this ICH score.

LIMITATIONS OF THIS STUDY

Sample size is less due to duration of time of patients collected data. Age differ from the cut point in standard ICH score. Co-morbidities like progression of neurological deficit, COPD, Ischemic Heart Disease, Atherosclerotic vascular disease, rheumatoid arthritis and other systemic co morbidities were not well studied that may influence mortality of the patients. Further characterization of the degree of IVH and IVH-associated hydrocephalus could provide additional prognostic information.

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