Clinical Profile of Patients with Acute Intracerebral Hemorrhage and ICH Score as an Outcome Predictor on Discharge, 30 Days and 60 Days Follow-up

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Abstract

Background: Intracerebral Hemorrhage (ICH) is one of the most common causes of morbidity and mortality worldwide accounting for 10-15% of all strokes types. ICH score is a validated tool to predict mortality and morbidity at 30 day follow up period.

Objective: To prospectively evaluate the predictive utility of ICH score in patients presenting with Acute ICH on discharge, 30 days and 60 days follow-up period.

Design: Prospective observational study

Materials and Method: This study was conducted in the Department of Neurology, Government Medical College, Kota, Rajasthan, India from January 2016 to August 2016. 120 consecutive patients presenting with acute ICH were studied. Data collected included demographics, clinical parameters, cranial Computed Tomography (CT) findings and ICH score on presentation. Primary outcome was defined as mortality/morbidity during hospitalisation, on discharge, 30 days and 60 days follow-up. Modified Rankin score (mRS) was used to assess the outcome.

Statistical analysis used: SPSS 19 statistical software

Results: Of the total 120 patients with Acute ICH (108 supratentorial and 12 infratentorial) studied, 48 (40%) patients died during hospitalisation. Mean age was 66.9 ± 13.5 Years. Hydrocephalus, midline shift and IV extension on presenting CT scan was observed in 20 (16.6%), 44 (36.6%) and 48 (40%) patients respectively. The independent predictors of increased mortality with statistical significance (p<0.001) were presence of vomiting, seizures, loss of consciousness, lower GCS (≤ 8), higher ICH score and ventilator requirement. Statistically significant (p≤0.001) radiological features associated with mortality included infratentorial location, presence of hydrocephalus, higher midline shift (58.3% vs 22.2% OR=2.6), intraventricular extension of hematoma and a higher baseline hematoma volume. ICH score on admission was significantly (p<0.001) positively correlated with the mRS score on discharge (R=0.667), 1 month (R=0.66) and 2 months (R=0.765) follow-up.

Conclusions: ICH Score is a useful tool to predict outcome during hospitalisation, on discharge, 1 month and 2 month follow-up. We suggest that ICH score assessment and documentation should become standard procedure in acute care and follow up of patients with Intracerebral Hemorrhage.

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 mortality and morbidity.1,2 Between 32% and 50% of patients die within the first month and only 20% are independent at 6 months.3,4 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.5-10 Few hematological and biochemical parameters at the time of onset of ICH have also been associated with outcome in these patients.

The Intracerebral hemorrhage (ICH) score was developed as a predictive tool for mortality at 30 days after hemorrhagic stroke.8 The ICH score is a 6-point calculation based on five clinical indicators: age > 80 years, Glasgow coma scale (GCS), volume of hematoma on baseline CT scan, location (infratentorial or supratentorial) and the presence of intra-ventricular extension. The ICH score has been validated for 30-day and one-year functional outcome in additional studies.11,12 Studies have also assessed its utility study as a predictor of in-hospital mortality and discharge outcome in spontaneous intracerebral hemorrhage.13

Majority of the studies have correlated the ICH score with the in-hospital mortality, morbidity at discharge, 30 days and 12 months functional outcome. Also there is a paucity of Indian literature on the utility of ICH scores in patients with Acute Intracerebral haemorrhage.

This prospective observational study was designed to study the clinical profile of patients presenting with Acute Intracerebral Hemorrhage (ICH) at Government Medical College, Kota and to assess the predictors of mortality in patients with spontaneous ICH. We also aimed to assess the utility

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of ICH score as an outcome predictor as assessed by modified Rankin scale (mRS) at the time of discharge from the hospital, 30 days and 60 days follow up.

Materials and Method
This study was conducted in the Department of Neurology, Government Medical College, Kota, Rajasthan, India from January 2016 to August 2016. 120 consecutive patients presenting with acute ICH were studied after obtaining written informed consent.

Inclusion and exclusion criteria were as follows:

**Inclusion Criteria**
- All patients diagnosed to have acute spontaneous Intracerebral Hemorrhage.

**Exclusion Criteria**
- History of trauma
- Patients with subdural and epidural hematoma
- Aneurysmal, arteriovenous malformation (AVM), anticoagulant or coagulopathy-related hemorrhage
- Patients who denied informed consent

Data collected included demographics, risk factors, clinical parameters, cranial Computed tomography (CT) findings and ICH score on presentation. Detailed history of the presentation including headache, vomiting, seizures, loss of consciousness and focal neurological deficits was obtained. On admission, detailed examination including vitals, systemic examination, Glasgow Coma Scale (GCS) and ICH score were recorded. Baseline hematological and biochemical parameters were assessed. All subjects underwent a plain computed tomography (CT) head at the time of admission. Imaging details on CT scan including volume of hematoma (using formula ABC/2), site of hematoma, intraventricular extension (present or absent), hydrocephalus (present or absent), mid line shift (measured as maximum deviation of septum pellucidum in millimetres from midline) were recorded. During hospitalisation, the reason for and details of mechanical ventilation, presence of any infection and details of neurosurgical intervention (if performed) were also recorded.

Primary outcome was defined as mortality/morbidity during hospitalisation, on discharge, 30 days and 60 days follow-up. Modified Rankin score (mRS) was used to assess the outcome.

**Statistical Analysis**
SPSS software version 19 was used to analyse the data. Continuous variables were analysed using unpaired ‘t’ test for normally distributed data and MannWhitney U test for skewed data. Categorical variables were analysed using Chi square test. The relation of ICH score to mRS score at discharge, 1 month and 2 month follow up was analysed by Kendall’s correlation test. Area under curve was derived of ICH score and ICH volume by ROC curve. Bivariate and multivariate logistic regression analysis using stepwise forward regression was performed to find independent predictors of mortality. Odds ratio (OR) and 95% confidence intervals (CI) were calculated. A P value < 0.05 was taken as significant.

**Results**
During the study period, total 120 patients were enrolled after considering the inclusion and exclusion criteria. The mean age of patients (range 40-88 years) was 66.9 ±13.5 years (Table 1). Of all the patients, 72(60%) patients survived and were discharged while 48 patients (40%) died.

Out of all the patients, hemorrhage was supratentorial location in 108 patients while 12 patients had infratentorial hemorrhage.

There was no statistically significant difference in age and sex between ICH patients who survived and those who died. There was increased number of patients with poor treatment compliance among patients who died compared to the survived patients.

The independent predictors of increased mortality with statistical significance (p<0.001) were presence of vomiting, seizures, loss of consciousness, lower GCS (< 8), higher ICH score.

We also observed that there was a statistically significant higher incidence

### Table 1: Unadjusted logistic regression analysis of Demographic and risk factor as predictors of mortality

<table>
<thead>
<tr>
<th>Demographic and Risk factors</th>
<th>Survived (n=72)</th>
<th>Died (n=48)</th>
<th>P value</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>68.6±10.0</td>
<td>64.4±17.2</td>
<td>0.095</td>
<td>0.97(0.95-1.004)</td>
</tr>
<tr>
<td>Sex (Male)</td>
<td>40(55.6%)</td>
<td>20(41.7%)</td>
<td>0.136</td>
<td>0.57(0.27-1.19)</td>
</tr>
<tr>
<td>Delay in presentation (hrs), Median (IQR)</td>
<td>8 (7-47)</td>
<td>5.5 (5.5-15)</td>
<td>&lt;0.001</td>
<td>-</td>
</tr>
<tr>
<td>DM</td>
<td>0</td>
<td>4(8.3%)</td>
<td>0.013</td>
<td>0.38(0.30-48)</td>
</tr>
<tr>
<td>HTN</td>
<td>32(44.4%)</td>
<td>28(58.3%)</td>
<td>0.136</td>
<td>1.7(8.3-7)</td>
</tr>
<tr>
<td>Smoking</td>
<td>32(44.4%)</td>
<td>8(16.7%)</td>
<td>0.025</td>
<td>0.25(0.10-61)</td>
</tr>
<tr>
<td>Alcohol</td>
<td>16(22.2%)</td>
<td>8(16.7%)</td>
<td>0.046</td>
<td>0.31(1-10)</td>
</tr>
<tr>
<td>Tobacco</td>
<td>28(38.9%)</td>
<td>16(33.3%)</td>
<td>0.536</td>
<td>0.8(4.1-7)</td>
</tr>
<tr>
<td>Poor treatment compliance</td>
<td>16(50%)</td>
<td>28(100%)</td>
<td>&lt;0.001</td>
<td>2.7(9.4-1)</td>
</tr>
</tbody>
</table>

### Table 2: Unadjusted logistic regression analysis of clinical features as predictors of mortality

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Survived (n=72)</th>
<th>Died (n=48)</th>
<th>P value</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>24(33.3%)</td>
<td>20(41.7%)</td>
<td>0.353</td>
<td>1.4(7.3)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>40(55.6%)</td>
<td>44(91.7%)</td>
<td>&lt;0.001</td>
<td>8.8(2.9-27.1)</td>
</tr>
<tr>
<td>Seizure</td>
<td>4(5.6%)</td>
<td>24(50%)</td>
<td>&lt;0.001</td>
<td>17(5.3-54)</td>
</tr>
<tr>
<td>Loss of consciousness</td>
<td>20(27.8%)</td>
<td>40(83.3%)</td>
<td>&lt;0.001</td>
<td>13(5.1-32.5)</td>
</tr>
<tr>
<td>Focal neurological deficit</td>
<td>72(100%)</td>
<td>24(50%)</td>
<td>&lt;0.001</td>
<td>4(2.8-5.7)</td>
</tr>
<tr>
<td>Systolic BP (mean)</td>
<td>179.3±18.0</td>
<td>188.3±35.5</td>
<td>0.069</td>
<td>1.01(0.99-1.028)</td>
</tr>
<tr>
<td>Diastolic BP (mean)</td>
<td>103.9±10.7</td>
<td>106.7±16.7</td>
<td>0.268</td>
<td>1.01(0.98-1.044)</td>
</tr>
<tr>
<td>Mean Arterial Pressure</td>
<td>128.8±11.7</td>
<td>133.4±21.6</td>
<td>0.131</td>
<td>1.01(0.995-1.041)</td>
</tr>
<tr>
<td>GCS (Median)</td>
<td>13.5(6-15)</td>
<td>4.5(6-12)</td>
<td>&lt;0.001</td>
<td>6.2(0.54-7.4)</td>
</tr>
<tr>
<td>GCS ≤8</td>
<td>16(22.2%)</td>
<td>36(75%)</td>
<td>&lt;0.001</td>
<td>0.14(0.06-32)</td>
</tr>
<tr>
<td>ICH Score</td>
<td>1.1±0.8</td>
<td>3.3±16</td>
<td>&lt;0.001</td>
<td>4.9(2.70-9.06)</td>
</tr>
<tr>
<td>Infection</td>
<td>20(45.5%)</td>
<td>24(54.6%)</td>
<td>0.013</td>
<td>0.38(18.83)</td>
</tr>
</tbody>
</table>
of infection observed in patients who died than who survived. 

Statistically significant (\( p \leq 0.001 \)) radiological features associated with mortality included infratentorial location of hemorrhage, presence of hydrocephalus, higher midline shift (58.3% vs 22.2% OR=2.6), intraventricular extension of hematoma and a higher baseline hematoma volume.

Patient who died had a shorter stay as compared to those who survived. (median 3.5 vs. 8 days, \( P < 0.0001 \)).

Ventilator requirement was also observed to be a poor prognostic factor with statistical significance. Majority (91.7%) had a ventilator requirement among the patients who died, while only 5.6% patients among those who survived required ventilator support.

Figure 2 represents the number of patients presenting with different ICH scores on admission. Maximum number (n=40) had ICH score 2, which was followed by patients with ICH score 0 (n=24), 1 (n=24), 3 (n=8), 5 (n=4) and 6 (n=4).

We also recorded modified Rankin scale (mRS) of all the patients on discharge/death, at 1 month and 2 months follow up. Among the survived patients who were discharged, the number of patients with mRS of 1,2,3,4 and 5 were 4(5.6%), 12(16.7%), 16(22.2%), 20(27.8%) and 28(37.5%) respectively, i.e. majority of them falling between mRS 3-5, being moderate to severely disabled. During the follow up, the percentage of patients having mRS of 1-2 gradually increased, suggesting gradual improvement in these patients. Figure 2 shows the trends of mRS of all the survived patients during the follow-up.

The mortality rates observed with individual ICH scores (Figure 4) were as follows: 0 (16.7%), 1 (0%), 2 (30%), 3 (57.2%), 4 (62.5%), 5 (100%) and 6 (100%). Thus, with increasing ICH scores, mortality rates increased, reaching 100% in patients with ICH scores of 5 and 6.

To assess the utility of ICH scores in predicting mortality/moderate to severe disability on discharge, 1month and 2 months follow-up, we used receiver operating characteristics (ROC) curves (Figure 5). ICH score on admission was significantly (p<0.001) positively correlated with the mRS score on
Clinical grading scales play an important role in the evaluation and management of patients with acute neurological disorders, especially traumatic brain injury and various types of stroke. Such scales serve several valuable purposes that follow from the standardization of assessment afforded by these tools. While many grading scales are used for prognostication and treatment selection in neurological disease, the foremost purpose of these scales is to improve communication and consistency among healthcare providers. Another utility of these scales is the ability to use these scales for risk stratification for treatment selection in clinical care and enrolment criteria for clinical research. To be generally applicable, a clinical grading scale must be simple enough to use without significant special training, statistical knowledge, or extensive time commitment. It also must be reliable in patient stratification and should be composed of elements that are associated with outcome and that would likely be assessed, in general, as part of routine clinical care.

Examples of widely used clinical grading scales include the GCS for traumatic brain injury (and other disorders), the Hunt-Hess and World Federation of Neurological Surgeons (WFNS) scales for aneurysmal SAH, the National Institutes of Health Stroke Scale (NIHSS) for ischemic stroke, and the Spetzler-Martin scale for arteriovenous malformations.

Despite the common occurrence and high morbidity of ICH, there remains few widely used clinical grading scales for ICH. Accurate prediction of outcome after spontaneous intracerebral hemorrhage (ICH) is necessary to estimate the prognosis and prepare a treatment plan accordingly. Various scales have been developed to estimate prognosis in patients with spontaneous ICH.\(^\text{14,15}\) Of them, the ICH score has proven to be reliable in predicting 30-day mortality in different populations and clinical circumstances.

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 was to provide a standard assessment tool that can be easily and rapidly determined at the time of ICH presentation, even by physicians without special training in stroke neurology and that will allow consistency in communication and treatment selection in clinical care and clinical research.

When individual parameters of ICH score are considered, GCS score has shown to be an independent prognostic marker in patients with acute ICH. In our study also, we observed that GCS ≤ 8 was an independent predictor of mortality and long term morbidity when compared to patients with GCS > 8.

Although age has been found to be an independent predictor of ICH outcome in some prior prediction models, we did not find it to be an independent prognostic marker similar to many earlier published studies.

Other parameters of ICH score i.e. ICH volume, presence of intraventricular extension and infratentorial haemorrhage origin were the other factors independently associated with 30-day mortality in the earlier studies and therefore were included in the ICH Score. All the three parameters were also found to be statistically significantly associated with prognosis in our study as well.

The purpose of this study was not to develop a new ICH outcome prediction model or to test whether various prediction models were more accurate with regard to predicting individual patient outcome. Rather, the point of this study was to assess the validity of an existing, simple, and previously validated scale, the ICH Score in patients of Intracerebral haemorrhage in our patients.

As observed in previous studies, mean ICH and ICH scores were significantly higher in patients who died in the present cohort. The mortality rates observed with individual ICH scores were as follows: 0 (16.7%), 1 (0%), 2 (30%), 3 (57.2%), 4 (62.5%), 5 (100%) and 6 (100%).

The 30-day mortality from ICH in various studies has been found to vary from 35 to 52%, with one-half of these deaths occurring within the first 2 days.\(^\text{16-18}\) In a study conducted by Rohit Bhatia et al, the in-hospital mortality was found to be 32.7%.\(^\text{13}\) In our study, 48 (40%) patients died during hospitalisation.

More recent studies have also identified lesion size, level of...
consciousness, midline shift, blood pressure or pulse pressure, kidney dysfunction, IVH and pupillary abnormality, as factors influencing outcome in ICH patients.29,30

In our study, the independent predictors of increased mortality with statistical significance (p<0.001) were presence of vomiting, seizures, loss of consciousness, lower GCS (≤ 8), higher ICH score.

Statistically significant (p ≤ 0.001) radiological features associated with increased mortality included infratentorial location of hemorrhage, presence of hydrocephalus, higher midline shift (58.3% vs 22.2% OR=2.6), intraventricular extension of hematoma and a higher baseline hematoma volume.

Some studies suggest that early prognostication of outcomes should be avoided whenever possible, and using an ICH score calculated at a later time (24 hours) during the ICH admission is a better indicator of patient outcomes, after the hematoma has been stabilized and definitive therapies have been provided.31 In our study, 40% patients died during hospitalisation, majority of them within initial 48 hours. Moreover, a lot of patients didn’t present within the initial 24 hours of symptom onset. So to keep a uniformity of the data collection and analysis, we calculated ICH score at the time of admission only. A prospective study of the impact of time from symptom onset to calculation of the ICH score may be warranted to determine when, after ICH, the ICH score becomes reliable.

The ICH Score has been validated for 30 days as well as for long-term functional outcome after acute intracerebral hemorrhage (ICH).32 Studies have also analysed its utility to predict in-hospital mortality.33 In our study also, we found a significantly (p<0.001) positive correlation of ICH score on admission with the mRS score on discharge (R=0.667), 1 month (R=0.66) and 2 months (R=0.765) follow-up.

Many ICH patients improve after hospital discharge and this improvement may continue even post-ICH.

The study has few limitations including a relative small number of patients. Another important limitation was that we calculated only ICH score on admission.

However, even with these limitations, this study clearly demonstrates that the ICH Score is a validated clinical grading scale for outcome considered as mortality or functional outcome throughout the first 2 months after acute ICH.

Our study demonstrates that the ICH Score is a valid clinical grading scale for stratifying likelihood of favorable functional outcome after hospitalisation and during follow-up at 1 and 2 months. This is in addition to prior studies which have demonstrated the ICH Score as a validated predictor of risk of 30-day mortality. Our study results also show that a substantial proportion of patients with acute ICH improve after hospital discharge as assessed by mRS. This study has also helped to elucidate the course of improvement (or lack thereof) after acute ICH. This is important clinically because it helps patients, families, and providers plan for ongoing care needs.

**Conclusion**

ICH Score on admission is a useful tool to predict outcome during hospitalisation, on discharge, 1 month and 2 month follow-up. The independent predictors of increased mortality with statistical significance in the present study were presence of vomiting, seizures, loss of consciousness, lower GCS (≤ 8), higher ICH score and ventilator requirement. Statistically significant(p≤0.001) radiological features associated with mortality included infratentorial location, presence of hydrocephalus, higher midline shift, intraventricular extension of hematoma and a higher baseline hematoma volume. A prospective study of the impact of time from symptom onset to calculation of the ICH score may be warranted to determine when, after ICH, the ICH score becomes reliable. We suggest that ICH score assessment and documentation should become standard procedure in acute care and follow up of patients with Intracerebral Hemorrhage.

**References**

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