The Intracerebral Hemorrhage Score: A Self-Fulfilling Prophecy?

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BACKGROUND: The ICH Score has become the standard for risk-stratification of 30-d mortality in patients with intracerebral hemorrhage (ICH), but treatment has evolved over the last 17 yr since its inception. We sought to determine if the ICH Score remains an accurate predictor of 30-d mortality in these high acuity patients.

OBJECTIVE: To determine the role the ICH Score has on mortality in current treatment of patients.

METHODS: A retrospective review of 554 patients treated for acute, spontaneous ICH at 2 large academic institutions between 2010 and 2014 was carried out. Surgical intervention in the form of external ventricular drain or craniotomy was performed when indicated. All patients were managed medically until discharge or death.

RESULTS: Over half (53.6%) of the patients presented with ICH of the basal ganglia/thalamus and the majority (71%) presented with ICH Scores of 0 to 2. Overall mortality was 25.1%. Observed mortality in moderate grade ICH Score patients (3 and 4) was lower than expected (49% vs 72%, $P < .001$) and (71% vs 97%, $P < .001$) when compared to the original ICH Score results. Despite differences in ICH and intraventricular hemorrhage volume, and Glasgow Coma Scale there was no difference in surgical intervention (12.2% vs 11.8%, $P = .94$) between the two groups. Withdrawal of care was instituted in 56.6% of all patients who died and increased with ICH Score.

CONCLUSION: In our cohort, the original ICH score did not accurately predict the mortality rate. Patient survival exceeded ICH Score-predicted mortality regardless of surgical intervention. Reevaluation of predictive scores could be useful to aid in more accurate prognoses.

KEY WORDS: Intracerebral hemorrhage, ICH Score, Stroke, Mortality

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Since the intracerebral hemorrhage (ICH) score was first reported in 2001, it has become a widely used prognostic tool to estimate 30-d mortality following nontraumatic ICH.[1] Derived from a cohort of 158 patients, the ICH Score is based on location and volume of ICH, presence of intraventricular hemorrhage (IVH), Glasgow Coma Scale (GCS) on admission, and age of the patient. Further studies have attempted to externally validate the proposed grading system with mixed results.[2-5] Despite attempts to optimize the predictive power of the original ICH Score by including additional independent predictive variables, the ICH Score has not been substantively updated since its inception.[6-9]

The required documentation of ICH severity by The Joint Commission for Comprehensive Stroke Center certification and maintenance has further popularized the use of the ICH Score for patients with nontraumatic ICH without underlying vascular abnormalities. Critical clinical decisions regarding management strategies and goals of care discussions with patients and families are often guided by the mortality and long-term outcome prediction estimated by the ICH Score.[10-12] Concerns have been raised that

ABBREVIATIONS: DNR, Do Not Resuscitate; **DSA,** digital subtraction angiography; **EVD,** external ventricular drain; **GCS,** Glasgow Coma Scale; **ICH,** intracerebral hemorrhage; **IVH,** intraventricular hemorrhage

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the ICH Score may result in a self-fulfilling prophecy whereby the predicted outcome may result in less aggressive treatment.[13] This "prognostic pessimism" may negatively affect outcome in up to 43% of ICH patients in the USA (nearly 7400 patients annually) and has been associated with early "withdrawal of care" or "comfort only measures."[12,14]

While appropriate stratification of patients is necessary to allocate medical resources to patients with higher chances of overall survival, such critical decisions must be made based on accurate and valid prognostic grading systems. After the widespread adoption of the ICH Score, many institutions would communicate with families the often quoted prognostic scales. Patients diagnosed with an ICH Score of 4 or greater are estimated to have 97% to 99% chance of dying within 30 d and physicians have previously advocated for de-escalation or even withdrawal of care based on the perceived futility of further therapy.[15]

Since the introduction of the ICH Score 17 yr ago, significant advances have been made in the medical and surgical treatment of patients with moderate to high grade ICH.[16-19] It is reasonable to consider that modernization of clinical care may result in improved outcomes. While the ICH Score surely represents severity, there is increasing concern that the prognostic values attributed to various grades may be clinically overstated and require updating.[20] In the current study, we sought to determine if (1) the ICH Score still accurately predicts 30-d mortality in patients and (2) evaluate whether patients with high grade ICH Scores receive less aggressive care on the basis of expected mortality.

METHODS

Study Design

This study is a retrospective review of all patients treated for ICH from 2 high-volume academic hospitals between 2010 and 2014. Patients with ICH were identified by first identifying patients with the ICD-9 diagnosis code of "ICH," 431. Records of all identified patients were individually reviewed to determine the accuracy of the diagnosis, location of hemorrhage, availability of initial and subsequent cranial imaging, and hospital and follow-up clinic notes. The study was approved by the institutional IRB for retrospective chart review without need for patient consent.

Study Setting and Population

All patients presenting to either of the 2 study hospitals between 2010 and 2014 with a diagnosis of ICH and etiology related to hypertension, amyloid angiopathy, or coagulopathy (idiopathic or drug-induced) were considered for inclusion. Patients with evidence of trauma, underlying mass lesion, vascular malformation, or venous sinus thrombosis were excluded. When clinically indicated, patients are evaluated with either computed tomographic angiography/venography, digital subtraction angiography (DSA), or magnetic resonance imaging with angiography/venography to evaluate for underlying mass lesion or vascular malformation.

Radiographic evaluation of each initial noncontrast head CT was conducted during the review to determine location and size of the ICH. ICH dimensions were calculated by the Cartesian AxBxC/2 method[4, 21] and location and size of IVH as calculated by the modified Graeb (mGraeb) Score.[22]

TABLE 1. Original ICH Score With Components and Point-Values Assigned

Component	Point value
GCS	
13-15	0
5-12	1
3-4	2
ICH Volume	
<30 cm^3	0
≥ 30 cm^3	1
IVH	
Yes	1
No	0
Infratentorial	
Yes	1
Age	
≥ 80	1
<80	0

Surgical and Medical Care

Patients were seen and evaluated by both a neurosurgeon and neurologist/neurointensivist upon arrival to the hospital or emergency department. Intervention in the form of external ventricular drain (EVD) placement was based on a constellation of hydrocephalus, IVH, need for intracranial pressure monitoring, or introduction of intrathecal thrombolytics (tissue plasminogen activator). Surgical intervention in the form of craniotomy/craniectomy +/– clot evacuation was based on presenting radiographic signs and physical exam. Intervention was deemed appropriate for large ICH with a significant mass effect or midline shift, obstructive hydrocephalus, or basilar cistern/fourth ventricular compression (in the case of posterior fossa hemorrhage). Patients were provided aggressive medical management in the Neurointensive Care Unit in line with contemporary ASA/AHA Guidelines until they improved enough for transfer to the next level of care, expired naturally, or care was withdrawn per family request. All patients were treated by the members of the same Neurosurgical department who rotated between both hospitals insuring that practice patterns were similar between both sites. Prognostication on patient outcome was provided to the patient and/or family based on the original ICH Score variables and mortality rates to aid in decision making, when deemed appropriate by the treating physician.

Application of the ICH Score

For analysis, subjects were stratified according to the ICH Score with ranges from 0 to 6 as initially described by Hemphill et al[1] as shown in Table 1. The 30-d mortality was compared to historically quoted rates based on the current literature, grading patients based on the aforementioned variables.[1,2,6,7,9]

Statistical Methods

Statistical analyses were conducted using SAS 9.4 (SAS Institute, Cary, North Carolina) and statistical significance was assessed at the

TABLE 2. Patient Characteristics of All Patients Treated for Spontaneous ICH

Patient characteristics (n = 554)	n, %
Gender—Female, *n* (%)	251 (45.3%)
Race	
Caucasian	119 (21.4%)
African-American	407 (73.4%)
Asian	7 (1.2%)
Indian	2 (0.4%)
Unknown	19 (3.4%)
Age at admission, years, *mean* ± *SD*	58.2 ± 13.6
Location of ICH, *n* (%)	
Basal ganglia/thalamus	297 (53.6%)
Lobar	179 (32.3%)
Cerebellum	61 (11.0%)
Brainstem	30 (5.4%)
GCS on admission, *median (IQR)*	13 (7-15)
ICH volume, cc, *median (IQR)*	10.7 (3.5-30.2)
mGraeb Score, *median (IQR)*	0 (0-12)
IVH, *N* (%)	277 (50.0%)
EVD, *N* (%)	140 (25.3%)
ICH Score, *N* (%)	
0	158 (28.5%)
1	136 (24.6%)
2	99 (17.9%)
3	82 (14.8%)
4	68 (12.3%)
5	11 (2.0%)
6	0 (0%)
Surgery performed	48 (8.7%)
Overall 30-d mortality, *n* (%)	139 (25.1%)
Withdrawal of care (n = 136)	77 (56.6%)
Time to death (days), *median (IQR)*	2 (1-6)

$P < .05$ level, unless otherwise noted. Descriptive statistics were calculated for all variables of interest and include means and standard deviations or medians and interquartile ranges (IQR) for continuous variables or counts and percentages, as appropriate. Characteristics and outcomes of patients with ICH Scores of 3 and 4 were compared using Chi-square tests for categorical variables and Wilcoxon-rank sum tests for continuous variables.

RESULTS

Patient Characteristics and Mortality

A total of 554 patients presenting with spontaneous ICH were included in the analysis. Patient demographics, neurological status, initial radiographic results, neurosurgical intervention, and mortality are presented in Table 2. The most common location of hemorrhage was in the basal ganglia/thalamus and occurred in 297 (53.6%) patients. Median GCS was 13 (IQR 7-15), median ICH volume was 10.7 cc (IQR 3.5 cc-30.2 cc), and median mGraeb score was 0 (IQR 0-12). IVH was present in half of the patients (50.0%) and an EVD was placed in 25% of patients. Surgical intervention was performed in 48 (8.7%) patients. The total 30-d mortality rate was 25.1% and median time to death for nonsurvivors was 2 d (IQR 1-6). Comfort only measures were initiated in over half of the patients who ultimately died during the 30 d following ictus (56.6% of the 139 patients).

Stratification of patient characteristics by ICH Score is detailed in Table 3. The majority of patients presented with ICH Scores of 0 to 2 (71%). The mortality rate increased in direct correlation with ICH Score and 95% confidence intervals were calculated for these rates. Rates of EVD insertion were highest in patients with ICH Scores of 2 and 3, 51.5% and 47.6%, respectively. Rate of decompressive surgical intervention was consistent at approximately 10% to 15% across all strata of ICH Score. Comfort care orders were placed in approximately 50% of patients that died in each group regardless of presenting ICH Score. Further stratification of all characteristics found in Table 3 by each hospital is found in the Tables, Supplemental Digital Content 1 and 2.

All 554 patients were given ICH Scores based on initial clinical and radiographic presentation. These patients were then followed until discharge and subsequent follow-up or death. Figure contrasts the "observed mortality" vs "expected mortality" as predicted by the ICH Score. Mortality increased with ICH Score, but not to the extent previously reported. In particular, the largest discrepancy between observed and expected mortality was demonstrated among patients with ICH Scores of 3 (49% vs 72%, $P < .01$) and 4 (71% vs 97%, $P < .01$), respectively.

Comparison of ICH Scores of 3 and 4

Given the significant discrepancy between observed and expected mortality rates in the ICH Score 3 and 4 groups, these 2 patient cohorts were further analyzed to determine if a difference in clinical characteristics or intervention rates existed. As shown in Table 4, these 2 groups are further stratified. Notable differences between the 2 groups existed in presenting GCS, mGraeb Scores, ICH volume, presence of IVH, EVD insertion rate, and mortality rate. Important discrepancies were noted in rates of neurosurgical intervention with higher EVD insertion rates in the ICH Score 3 subgroup than the ICH Score 4 subgroup (47.6 vs 19.1%, $P < .001$) despite a higher presence of IVH (81.7% vs 97.1%, $P = .003$) and median mGraeb score (9.5 vs 13, $P = .021$). Additionally, there were no differences in the rate of surgical intervention between the 2 groups (12.2% vs 11.8%, $P = .94$) as would be expected with larger ICH volume, (30.9 cc [IQR 12.5-55.1] vs 53.8 cc [IQR 29.5-77.8], $P < .001$), rate of cerebellar hemorrhage (12.2% vs 19.1%, $P = .24$), in ICH groups 3 and 4, respectively.

There was a significant difference in overall mortality between ICH Score groups of 3 and 4 (48.8% vs 70.6%, $P = .007$), but no difference in median time to death or rate of transitioning to comfort only measures.

DISCUSSION

In this retrospective review of 554 patients with acute, nontraumatic, spontaneous ICH the mortality rate predicted by the

TABLE 3. Clinical and Radiological Outcomes by ICH Group

ICH score	n (n = 554), %	Mortality rate, n, %	Mortality rate 95% confidence intervals	Withdrawal of care, n, %	EVD rate, n, %	Surgery rate, n, %	mGraeb score median (25th-75th)	ICH volume (cc) median (25th-75th)
0	158 (28.5%)	1 (0.6%)	0.11%-3.5%	1 (0.6%)	6 (3.8%)	4 (2.5%)	0 (0-0)	5.4 (1.7-10.3)
1	136 (24.6%)	9 (6.6%)	3.5%-12.1%	4 (2.9%)	30 (22.1%)	14 (10.3%)	0 (0-4.5)	5.3 (2.2-16.0)
2	99 (17.9%)	30 (30.3%)	22.1%-40%	21 (21.2%)	51 (51.5%)	12 (12.1%)	8 (0-15)	11.5 (4.8-32.6)
3	82 (14.8%)	40 (48.8%)	38.3%-59.4%	21 (25.6%)	39 (47.6%)	10 (12.2%)	9.5 (2-19)	30.9 (12.5-55.1)
4	68 (12.3%)	48 (70.6%)	58.9%-80.1%	24 (35.3%)	13 (19.1%)	7 (10.3%)	13 (8.5-18)	53.8 (29.5-77.8)
5[a]	11 (2.0%)	11 (100.0%)	74.1%-100%	6 (54.6%)	1 (9.1%)	1 (9.1%)	16 (11-18)	38.2 (30.2-174.2)

[a]Of note, no patient in our series had an ICH score of 6.

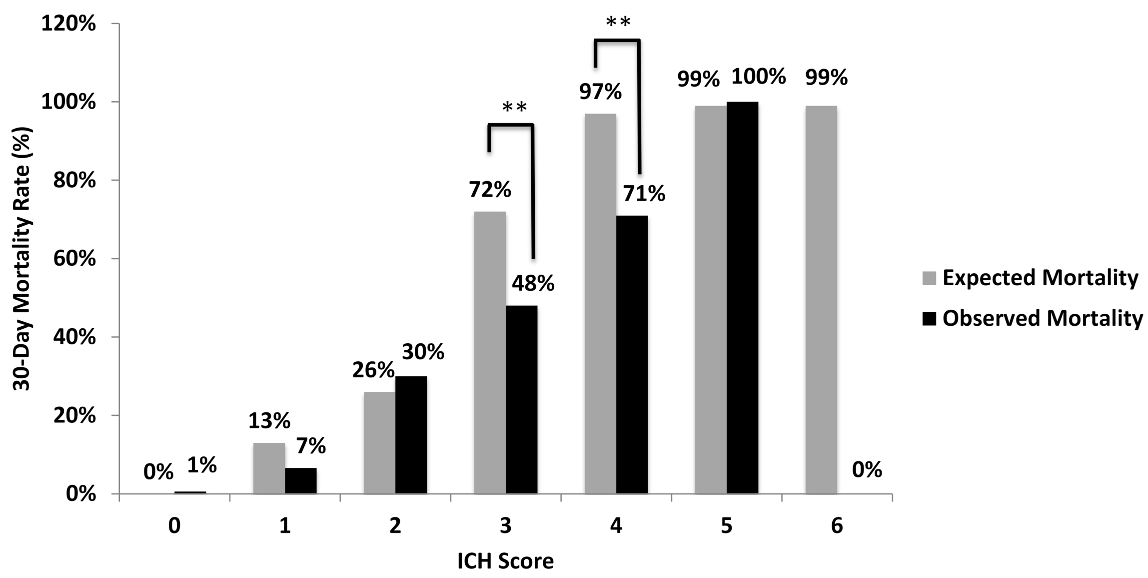

FIGURE. *30-d mortality rate by presenting ICH score. Gray bars show expected mortality rate based on the original ICH Score. Black bars show observed mortality rates in our patient cohort. Significant differences were seen between patients with ICH Scores of 3 and 4 (** denotes $P < .001$).*

ICH Score significantly overestimated mortality in 2 high-volume hospitals with similar practice patterns. This observation is most powerfully demonstrated in the cohort represented by an ICH Score of 3 or 4.

Patient Mortality

The overall 30-d mortality rate in our patient cohort was 25.1%. When stratified by ICH Score, our mortality rates were lower than that which has been previously reported in "moderate grade" scores. As shown in Figure, the observed mortality rate in our patient population was similar to that predicted in Hemphill's ICH Score for "low grade" ICH Scores (0-2) as well as "high grade" (5-6). For the "moderate grade" group of patients (3-4) our observed vs expected mortality rates were significantly different. Historically quoted 30-d mortality rates of 72% and 97% for scores of 3 and 4, respectively, were based on a small sample size of patients (n = 32 for ICH Score of 3 and n = 29 for ICH Score of 4) at a single institution in the original cohort where the ICH Score was developed. In our patient population, the total number of patients with an ICH Score of 3 was 82, of which 40 died (mortality rate of 48.8%) and ICH Score of 4 was 68, of which 48 died (mortality rate of 70.6%).

Surgical Intervention

This study details ICH locations with similar distribution rates as seen in previous studies, with regard to clinical characteristics and location of ICH.[1,3,6,23] Intervention in the form of EVD or surgical decompression ± evacuation of ICH for each ICH Score

TABLE 4. Comparison of ICH Scores 3 and 4 with Respect to Patient Characteristics, Intervention, and Mortality Rates

Characteristic	ICH Score 3 (n = 82)	ICH Score 4 (n = 68)	*P*-value
Sex, Female	39 (47.6%)	29 (42.7%)	.55
Age at admission, mean ± sd	59.8 ± 14.8	60.6 ± 13.1	.71
GCS on admission, median (*IQR*)	6 (4-9)	3 (3-4)	<.001
mGraeb Score, median (*IQR*)	9.5 (2-19)	13 (8.5-18)	.021
ICH volume (cc), median (*IQR*)	30.9 (12.5-55.1)	53.8 (29.5-77.8)	<.001
Cerebellar ICH	10 (12.2%)	13 (19.1%)	.24
IVH	67 (81.7%)	66 (97.1%)	.003
Basal Ganglia ICH	42 (51.2%)	38 (55.9%)	.57
Brainstem ICH	7 (8.5%)	8 (11.8%)	.51
EVD insertion rate	39 (47.6%)	13 (19.1%)	<.001
Surgical intervention rate	10 (12.2%)	7 (10.3%)	.80
Time to death (days), median (*IQR*)	2 (1-4.5)	2 (1-4.5)	.72
Mortality rate	40 (48.8%)	48 (70.6%)	.007
Withdrawal support	21 (25.6%)	24 (35.3%)	.16

group is shown in Tables 3 and 4. Despite higher rates of IVH (81.7% vs 97.1%) and mGraeb scores (9.5 vs 13) in groups of 3 and 4, respectively, the rates of EVD insertion were much lower (47.6% vs 19.1%) in the ICH Score 4 group. Additionally, there was no difference in rate of surgical decompression ± evacuation despite higher volumes of ICH (30.9 cc vs 53.8 cc), lower GCS on admission (6 vs 3) and similar rates of cerebellar ICH (12.2% vs 19.1%), in groups 3 and 4, respectively.

An interesting finding was the lower rate of interventions among the ICH 4 group, particularly with regards to EVD placement. Patients in this group demonstrated higher ICH volume, lower GCS, and higher mGraeb scores, yet the rate of EVD placement was 2.5-fold lower than the ICH 3 group. This is particularly notable given the recent publication by Lovasik et al,[24] which specifically suggests that EVD use is associated with a decreased 30-d mortality rate in patients with an ICH Score of 4, higher ICH volume, and lower initial GCS in both unadjusted and propensity-score adjusted populations. While this analysis was not designed to determine what external factors may have shaped interventional planning, the influence of the ICH Score and possible presumptions of futility must be considered. Our anecdotal experience based on this chart review shows that the consulting neurosurgeon was more likely to cite specific ICH Score mortality statistics among patients with poor prognoses than those with more favorable prognoses.

Withdrawal of Care in ICH

Of all the patients who died in the study population (n = 139), withdrawal of care was initiated for 56.6%, regardless of presenting ICH Score. When stratified by ICH Score, withdrawal of care was initiated in every group and increased proportionally. While the ICH Score appears to be a strong independent predictor of mortality, other chronic or acute comorbid factors can play a large part in determining goals of care and subsequent withdrawal of support. While it is not known to what degree the ICH Score and associated mortality statistics influenced individual facility practice patterns and family communication, however, it is not unreasonable to hypothesize that the evidence-based conclusions of the ICH Score play a role in patient management.

Numerous analyses of the ICH Score have determined that it has reduced predictive ability when withdrawal of care is excluded.[10] The ICH Score has been shown to overestimate mortality among patients without "Do Not Resuscitate" (DNR) orders and underestimate mortality among patients with DNR orders.[12,20] The presence of a DNR order in an ICH patient is associated with a nearly 2.5-fold increase in patient mortality when compared to ICH-Score-matched non-DNR patients.[20,25] However, the impact of DNR orders as a marker of treatment aggressiveness is controversial, as it may serve as a proxy for disease severity or underlying comorbidities not captured in the ICH Score and will only impact patients who experience cardiac arrest.[15,26]

The Hemphill ICH Score has been validated numerous times in the literature, with a pooled area under a receiver operating characteristic curve of 0.8 in an international meta-analysis.[6,27,28] However, many of the studies examining rates of mortality and the ICH Score were performed in the early 2000s, which limit modern applicability based on novel neuro-critical care management strategies, including more avid use of intraventricular tPA, ventilator-associated pneumonia prevention bundles, and novel anticoagulation reversal agents. If novel interventional therapies for surgical aspiration of hematoma and clot resolution[16,17,29] continue to evolve and result in improved outcomes, previous prediction models will become obsolete as the pathogenesis and course of patients will dramatically change. Further prospective studies are needed to validate evolving prediction models and determine if intervention in the form of EVD or surgical decompression and/or evacuation make a difference in both short and long-term mortality and functional outcome. The several variants of the Hemphill ICH Score, including ICH-GS,[30] ICH-FOS,[31] Essen ICH Score,[32] and mICH Score[6] have not replicated the widespread use, validity, or ease of bedside applicability of the original.

Patient Outcome

It has become commonplace in both the neurosurgical and neurocritical care literature to presume poor prognosis based on historically quoted mortality rates and thus proceed with early de-escalation of care or withholding of surgical intervention.[11,13-15,33] Patients who were treated despite having a "poor prognosis" in our series did not portend as badly as expected. This study result suggests that the mortality estimates from the Hemphill ICH Score may not be as readily applicable to current neurosurgical practice. Furthermore, the rate of neurosurgical interventions is associated with ICH Score, with higher ICH Scores demonstrating lower intervention rates. These findings are concerning for what may be considered a self-fulfilling prophecy, wherein aggressive interventions are undertaken less often in patients with a poor mortality prognosis, which may precipitate their mortality. Outcome prediction models must be as accurate as possible to provide patients and their families a reliable estimate of both short- and long-term outcomes. The notion of presumed futility can lead to self-fulfilling prophecies with regard to patient outcome when care is de-escalated early or intervention withheld. Presumptions based on historical data must be continually re-evaluated to ensure that the models reflect modern care.

A higher chance of survival does not necessarily correlate to better long-term functional outcomes of these patients.[5,8,34] While patients may survive their initial insult, many go on to live debilitated lives with modified Rankin Scores of 3+.[34] Given the difference in observed mortality scores in our patient cohort, previous estimates of long-term and functional outcome may no longer be valid. As prognostic scores are continuously reevaluated, a priority should be placed on estimating both mortality and functional outcome as both of these may help patients and families make decisions with respect to withdrawal of care or providing full support.

Limitations of the Study

The limitations to this study include its retrospective nature and inclusion of academic hospitals. The 2 participating centers are both tertiary neurosurgical and neurovascular referral centers and represent the largest neurological ICUs in a metropolitan area of over 6 million people. As such, the pathology treated in these centers likely represents a greater proportion of higher acuity severe and moderate-severe ICH. The intent for withdrawal of care via living will or surrogate decision maker was not documented in the EMR for all cases. Additionally, we did not incorporate and analyze all comorbid factors when determining cause of death, either naturally or with withdrawal of care. While ICH Score plays a very large part in morbidity and mortality, there are often much more complex medical issues which factor into the ultimate decision to de-escalate care.

Additionally, the discussions had with patients and their families with respect to outcomes based on the ICH Score mortality rates were not clearly documented in every patient's chart, and thus hard to verify as a standard practice with each physician.

CONCLUSION

The ICH Score is the most commonly used tool for prediction of 30-d mortality for patients with ICH. Historically quoted mortality rates may no longer be accurate with respect to the current scoring system. Further modifications to the ICH Score are needed to provide a more granular and accurate predictive model. Additionally, moderate to high-grade ICH Scores have historically portended a poor prognosis but our data suggest that some of these patients are surviving at higher rates. Further prospective studies are needed to confirm short and long-term mortality and functional outcome as well as determine who is an appropriate candidate for surgical intervention.

Disclosure

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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***Supplemental digital content** is available for this article at www.neurosurgery-online.com.*

Supplemental Digital Content 1. Table. Distribution of ICH Score, 30-d mortality rate, and withdrawal of care by ICH Score at two separate hospitals.

Supplemental Digital Content 2. Table. Distribution of EVD utilization, surgery rate, modified Graeb Score, and ICH volume by ICH Score at 2 separate hospitals.

COMMENTS

This manuscript represents yet another report calling into question our ability to accurately prognosticate after significant ICH, and raises further concern that health care providers may be providing patients and families with overly pessimistic prognoses that then translate into less aggressive care and death. Given the near certainty of prognosis once the focus of care is shifted to comfort measures only, new prognostic scoring systems should focus on predicting the full range of possible outcomes in the subset of patients where continued aggressive care was pursued, thus answering the more appropriate question that families ask, “what are the possible outcomes to expect if we do continue with aggressive care?”

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The authors present a well-written paper that proposes a critical look on the widely used ICH score by Hemphill et al.[1]

In their retrospective review of 554 patients treated for acute and spontaneous ICH, the authors showed that the ICH Score did not predict the acute mortality rate initially described in the cohort studied and demonstrated that a greater proportion of patients are surviving than predicted by the ICH score.

The data presented make important points of comparison manly between grade 3 and 4. It is important for the reader to note the skewed nature of the data (no patients in grade 6, only 11 in 5) with its inherited statistical implications and effect on the drawn conclusions.

We agree with the authors on their very imperative comment “presumptions based on historical data must be continually re-evaluated to ensure that the models reflect modern care”.

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1. Hemphill JC, 3rd, Bonovich DC, Besmertis L, Manley GT, Johnston SC. The ICH score: a simple, reliable grading scale for intracerebral hemorrhage. *Stroke; a Journal of Cerebral Circulation*. 2001;32(4):891–897.

The authors review a very important topic within stroke, namely the utility of the ICH score in prognosticating survival in the non-traumatic, spontaneous ICH population. The study details the course of 554 patients and surprisingly discovers a significant discrepancy between the “predicted 30-day mortality” for patients with ICH scores of 3 and 4 (ie, 72% and 97% respectively) and the actual rates of death (ie, 48% and 71% respectively). There are a couple of counterintuitive findings within the ICH-4 group in comparison to the ICH-3 patients; for instance, despite a higher frequency and average volume of IVH, patients in group 4 were less likely to have an EVD placed or undergo supratentorial surgical craniectomy for decompression. The hypothesis for this finding is that, due to the grim prognosis portended by the ICH Score, patients with a score of 4 or higher are doomed to a presumed "97%" of death and, thus, interventions are withheld due to ostensible medical futility. Interventions (ie, EVD placement and surgical decompression) seemed to correlate to improved mortality, though not necessarily improved functional status at discharge.

This highlights the ongoing importance of harboring an honest dialogue with our patients regarding the disease process, expectations for outcomes, and individualized medicine. Within the ICH population, for example, there is a tremendous difference between a 45-year-old patient (0 points in the ICH score), with IVH (1 point), an infratentorial clot (1 point), and a GCS of 4 (2 points, total score of 4), in contrast to a 95-year-old patient (1 point), with a large, >30 mL (1 point) supratentorial clot, IVH (1 point), and a GCS of 5 (1 point, 4 points total). This triage process becomes even more complicated when pre-existing goals of care, specific surgeon preference/practices, referral patterns, medical comorbidities, and pre-ICH functional score are taken into account. Thus, while scoring scales like the ICH score serve to help to paint a vague portrait of potential clinical outcomes, each patient presents a unique discussion and decision-making process for the provider. As the authors astutely allude to, all of these expectations may change with innovations such as minimally invasive clot aspiration devices.[1] All in all, the authors accurately identify an important discrepancy between their institutional results and a widely accepted prognostication system, and should be commended for bringing this important discussion to light.

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1. Fiorella D, Arthur A, Schafer S. Minimally invasive con beam CT-guided evacuation of parenchymal and ventricular hemorrhage using the Apollo system: proof of concept in a cadaver model. *J Neurointerv SURG*. 2015;7(8):569–73.