Original Research Article

Study Of ICH Score At 24-Hour Of Hospitalisation as a Predictor Of Mortality In Intracerebral Hemorrhage

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Abstract

Introduction: Intracerebral hemorrhage (ICH) constitutes 10% to 15% of all strokes and remains without any treatment of proven benefit.No standard clinical grading scale for ICH analogous to those for traumatic brain injury, subarachnoid hemorrhage, or ischemic stroke.The intracerebral hemorrhage (ICH) score was developed as a predictive tool for mortality at 30 days after hemorrhagicstroke.The utility of using a predictive scoring system at 24-hours instead of on admission to predict outcomes increases the predictive value of the scoring system.**Aims & Objectives:**To see if ICH score calculated 24-hours after admission is a better predictor of in-hospital and 30-day mortality than ICH-score calculated on admission.**Materials & Methods:**In this prospective observational study carried out at tertiary care center from central India, total 161 cases of Haemorrhagic stroke proven on CT Brain fulfilling inclusion & exclusion criteria were enrolled Initial ICH score was calculated based on CT-Head and GCS score on admission.Repeat ICH score was calculated using follow up imaging and GCS score at 24 hours ($\pm$) 6 hours.CT angiography was done, 24 hours after presentation, to see for the presence of spot sign and its presence or absence was correlated with the hematoma expansion and functional outcome.CT head on admission Follow up CT Head at 24 $\pm$ 6 hours after admission. CT Angiography at 24 $\pm$ 6 hours after admission.**Results:**Mean age of the cases was 53.29 $\pm$10.94in males & 52.96 $\pm$9.45 in females with M:F 4.3:1. Maximum number of cases were falling in Moderate GCS score (9-12) 65(40.37%) 46(28.3%) cases were having severe GCS score (3-8) 82 (50.93%) patients had an ICH score of 2 at presentation. While the ICH score of maximum patients at the end of 24 hours was 0. 56 (34.78%) patients had an ICH score of 0 at 24 hours after hospitalisation. The change in ICH score during the first 24 hours of hospitalisation was highly significant with a p-value of 0.0087.Based on the mRS score, 34 (21.12%) patients had a poor in-hospital functional outcome, while 37 (25.34%) patients had a poor 30-day functional outcome.The on-admission ICH score was significantly associated with both, the in-hospital and 30-day functional outcome as suggested by the p-value which was <0.0001 for both. Higher the on-admission ICH score, the poorer was the functional outcome.On comparing the on-admission and 24-hour ICH score as a predictor of poor functional outcome, the 24-hour ICH score had an RR of 1.71 and 2.69 respectively for having a poor in-hospital and 30-day functional outcome. While the RR with on-admission ICH score was 1.54 and 1.42 respectively for having a poor in-hospital and 30-day functional outcome. This data was suggestive that the 24-hour ICH score was a better predictor of in-hospital and 30-day mortality when compared to the on-admission ICH score. The presence of spot sign on CT angiography was associated with a poor ICH score and functional outcome. Of the 12 patients with positive spot sign on CT angiography, all 12 (100%) had a poor ICH score ($\geq$1), while 9 (75%) had a poor functional outcome.Multivariate analysis was suggestive that the GCS score was the single most significant factor affecting the ICH score as well as the outcome of patients with ICH.**Conclusion:** 1.The 24-hour ICH score is a valid predictor of in-hospital and 30-day mortality and functional outcome in patients with intracerebral hemorrhage.2.The 24-hour ICH score is a better predictor of mortality than on-admission ICH score in patients with intracerebral hemorrhage.3.The presence of 'spot sign' correlated well with a poor ICH score.

Keywords: ICH,Hospital,angiography

Introduction

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Introduction

Intracerebral hemorrhage (ICH) constitutes 10% to 15% of all strokes and remains without any treatment of proven benefit[1].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[2]. Clinical grading 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.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. In essentially every clinical grading scale there exists a compromise between simplicity and accuracy of outcome prediction. To strike the appropriate balance between these 2 factors, the general purpose of the grading scale must be considered. 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 that will allow consistency in communication and treatment selection in clinical care and clinical research.The intracerebral hemorrhage (ICH) score was developed as a predictive tool for mortality at thirty days after hemorrhagic stroke[3]. The ICH score is a 6-point calculation based on five clinical indicators: age > 80 years, Glasgow coma scale (GCS), the volume of the hematoma on baseline CT scan, location (infratentorial or supratentorial), and the presence of intraventricular extension. The ICH score has also been validated for 30-day and one-year functional outcome in additional studies[4,5]. Almost 40% of patients with brain imaging obtained in the first 3 hours after onset of symptoms of ICH experience hematoma expansion and this is highly associated with neurological deterioration[6].Some studies show a strong association between contrast extravasation on computed tomography angiography (CTA) and hematoma expansion and worse outcome[7].Given that components of the ICH score are dynamic soon after ICH onset, particularly with hematoma expansion or interventions and procedures actively changing ICH volume, GCS, and IVH, the utility of using a predictive scoring system at 24-hours instead of on admission to predict outcomes increases the predictive value of the scoring system. Hence the 24-hour ICH score can be a more precise tool for prediction of short-term functional outcome than ICH score calculated on admission.With this background this study was initiated to see if the ICH score calculated 24-hours after admission is a better predictor of in-hospital and 30-day mortality than ICH-score calculated on admission outcome in terms of neurological improvement and mortality based on the modified Rankin Scale (mRS).

Material & Methods

This prospective observational study was conducted at tertiary care hospital & Institution during 2017-2019.Total 161 cases of Intracerebral Haemorrhage (CT brain proved) were included in the study. While cases with ischemic stroke, head injury on presentation, subarachnoid hemorrhage, Cortical Venous Thrombosis. Patients on anticoagulation therapy & subjects with deranged Renal function on admission, who cannot undergo CT angiography due to the risk of contrast-induced nephropathy were excluded from the study.Approval from the institutional ethics committee was sought. Informed written consent in the patient's vernacular language was taken before enrolment for study. Initial ICH score[3] (Table 1) was calculated based on CT-Head and GCS score[8] on admission. Repeat ICH score was calculated using follow up imaging and GCS score at 24 hours (±) 6 hours. CT angiography was done, 24 hours after presentation, to see for the presence of spot sign(See Fig1) and its presence or absence was correlated with the hematoma expansion and functional outcome.of the patient[7]. ICH volume was calculated using the ABC/2 formula[9].We compared outcomes using ICH Score at admission with ICH Score at 24 hours after admission as a tool for prediction of mortality.The primary outcome of interest was poor functional outcome i.e.

modified Rankin Scale mRS (Table 2) of 5 or 6 [3,4,10].The secondary outcome of interest was the use of ICH score as a predictor of short term (one month) functional outcome in patients with ICH, which was confirmed telephonically or during OPD follow-up.We used crude and logistic regression models to assess poor functional outcome and mortality using admission ICH score and 24-hour ICH score as predictors.

Table 1:ICH Score[3]

Components of ICH Score	Points
***GCS score**	
13-15	0
5-12	1
3-4	2
****ICH Vol(cm3)**	
>30	1
<30	2
*****IVH**	
Yes	1
NO	0
Origin of ICH	
Infratentorial	1
Supratentorial	0
Age in yrs	
>80	1
<80	0
Total ICH score	**0-6**

ICH Score.[3] *GCS: Glasgow Coma Scale, **ICH: Intracerebral Hemorrhage, ***IVH: Intraventricular Hemorrhage.

Table 2:modified Rankin Scale (mRS) Score[3,4,10]

Score	Description
0	No symptoms
1	No significant disability despite symptoms.able to carry out all usual duties &activities
2	Slight disability unable to carry out all previous activities but able to look after own affairs without assistance
3	Moderate disability requiringsome help but able to walk without assistance
4	Moderately severe disability .unable to walk without assistance&unable to attend own bodily needs without assistance.
5	Severe disability. Bedridden ,incontinent & requiring constant nursing care &attention
6	Dead

Investigations

All cases were subjected for Investigations.Renal function test (Blood urea Serum creatinine)

- Blood sugar level
- CT head on admission
- Follow up CT Head at 24 $\pm$ 6 hours after admission
- CT Angiography at 24 $\pm$ 6 hours after admission

Statistical Analysis: Collected data was entered into Microsoft Excel spreadsheet. Tables and charts were generated by using Microsoft windows 10 Word and Excel software. Continuous variables (Age, GCS score, Hospital stay, SBP, DBP, Blood sugar level etc.) were compared between poor and good outcome. Categorical variables were expressed in frequency and percentages. Categorical variableswere compared between mortalityand survival by performing chi-square test. For small number, Fisher exact test was used wherever applicable. Association of ICH Score with outcome was performed by calculating relative risk, 95% Confidence interval. Multiple regression analysis was performed to determine independent predictors for mortality in patients with intracerebral hemorrhage (ICH). $P<0.05$ was considered as statistical significance. Statistical software STATA version 14.0 was used for data analysis.

Results

Of the total 161 patients studied, 131(81.875%) patients were male while 30(18.633%) were female. Male to female ratio (M: F) of 4.3:1.ICH score on admission varied from 0 to 4. . 82(50.93%) patients had an ICH score of 2 at admission as compared to 52(32.30%) cases at 24 hrs. 07 (4.35%)cases were having ICH score of 3-4 5(3.11%) at presentation to hospital as compared to 40(24.84 %) cases at 24 hrs.These observations were statistically highly significant.(p=0.0087.)

Table 3: Distribution of patients as per baseline ICH score stratified by 24 hours ICH score. (N=161)

ICH score at 24 Hour	ICH on admission					p-value
	0 (n=45)	1 (n=27)	2 (n=82)	3 (n=5)	4 (n=2)	
No. of patients whose ICH score improved	0	17 (62.96)	3 (3.66)	0	0	<0.0001 *HS
No. of patients whose ICH score remains same	39(86.67)	10 (37.04)	46(56.10)	5 (100)	2 (100)	<0.0001 *HS
No. of patients whose ICH score worsened	6 (13.33)	0	33 (40.24)	0	0	<0.0001 *HS

Table 4: Presence of Spot Sign and its association with ICH score

ICH Score	Spot Sign	
	Present	Absent
Poor (≥1)	12	100
Good (0)	0	49

Sensitivity 100%, Specificity 32.88% , Positive predictive value 10%, Negative predictive value 100%, Accuracy 37.89%

Table 5: Association of the ICH score on admission and outcome in hospital. On mRS

*ICH Score	Outcome (**mRS)		Total	p-value
	Poor (**mRS 5 or 6)	Good (**mRS≤4)		
≥1	34	82	126	P<0.0001 ***HS
0	0	45	45	
Total	34	127	161	

*ICH Score	Outcome (**mRS)		Total	p-value
	Poor (**mRS 5 or 6)	Good (**mRS≤4)		
≥1	33	72	105	P<0.0001 ***HS
0	1	55	56	
Total	34	127	161	

*ICH Score: IntracerebralHemorrhage Score, **mRS: modified Rankin Scale,***HS: Highly Significant.

Table 6: Association of the ICH score on-admission and outcome at 30 -days on mRS.

*ICH Score	Poor(**mRS 5 or6)	Good(**mRS≤4)	Total	p-value
≥1	33	68	101	P<0.0001 ***HS
0	4	41	45	
Total	37	109	146	

Association of the ICH score at 24 hours and outcome at 30 days on mRS

*ICH Score	Poor (**mRS 5 or 6)	Good(**mRS≤4)	Total	p-value
≥1	37	53	90	P<0.0001 ***HS
0	0	56	56	
Total	37	109	146	

*ICH Score: Intracerebral Hemorrhage Score, **mRS: modified Rankin Scale,***HS: Highly Significant.

Table 7:Association of various factors with In-Hospital and 30-days outcomes of patients.

Variable		In Hospital Outcome			Outcome at 30 Days		
		Poor	Good	p-value	Poor	Good	p-value
Age in years		56.5 ±10.75	52.44± 10.87	0.0545 NS	55.37± 8.77	51.61 ±11.11	0.0635 NS
Sex	Male	28	102	0.789 NS	30	87	0.868 NS
	Female	6	25		7	22	
*GCS score		7.76±3.15	11.52 ± 2.68	<0.0001 HS	10.13 ± 2.32	11.57 ± 2.89	0.0069 HS
Blood sugar level		119.64±15.20	131.74 ± 23.47	0.0050 HS	120.62 ±16.47	132.79 ±24.15	0.0051 HS
Hospital stay		5.85 ±2.74	5.14 ± 1.28	0.0314 S	7.08 ± 1.84	4.85 ± 1.06	<0.0001 HS
**SBP		178.23±25.99	168.03 ± 21.64	0.0207 S	175.40 ± 21.29	167.43 ±22.16	0.0582 NS
***DBP		106.47±13.90	102.83 ± 13.26	0.1620 NS	107.29 ±13.87	102.01 ±13.10	0.0388 S

Table 8: Combined Multivariate analysis for predicting mortality in patients of ICH based on the ICH score on Admission and at 24 hours.

Based on ICH Score on admission			
Variables	**Adjusted Odd's Ratio**	**95% Confidence Interval**	**p-value**
GCS Score	0.60	0.49 – 0.74	<0.001HS
Blood Sugar Levels	0.94	0.91 – 0.97	0.001 HS
SBP	1.02	1.00 – 1.04	0.039 S
Based on ICH Score at 24 hours			
Variables	**Adjusted Odd's Ratio**	**95% Confidence Interval**	**p-value**
GCS Score	0.79	0.64 – 0.97	0.026 S
Hospital stay in days	3.34	2.18 – 5.13	<0.001 HS

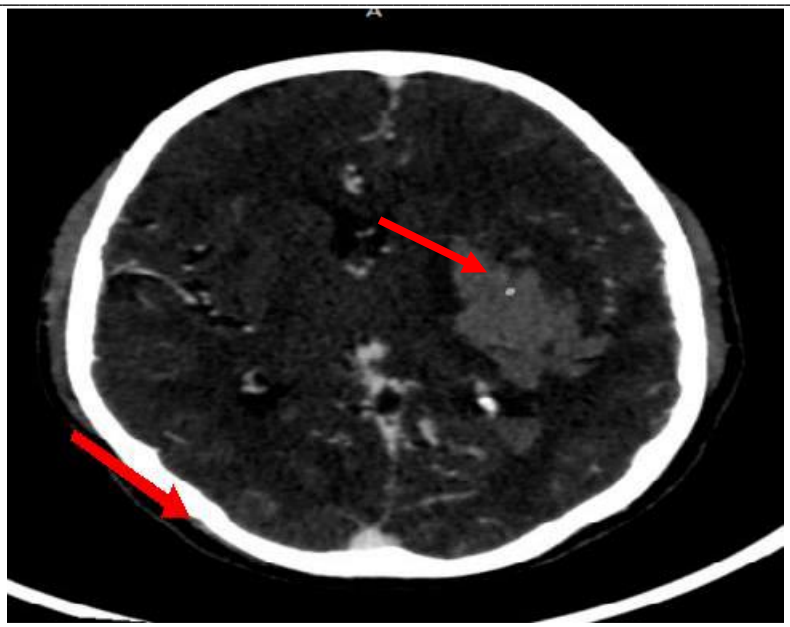

Fig 1:CTA images of a 47-year-old male patient showing a small relatively hyperdense focus (arrow) representing the active contrast extravasation noted within the hematoma (the 'spot sign').

Analysis of of ICH score at admission& at 24 hrs in terms of deterioration , Improvement & non progression also revealed statistically significant difference. p<0.0001 (Table 3)

Spot sign(Fig 1) which is seen as an enhancement within the hematoma on CT angiography was seen in 12 (7.45%) patients out of 161 & these cases were associated with poor ICH score of >1. (Table 4)The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of spot sign and its association with poor ICH score were 100%, 32.88%, 10%, 100%, and 37.89% respectively. On further analysis of these cases for functional outcome on mRS scale showed direct correlation of presence of spot sign and poor mRS score (5-6) suggestive of poor predictor. Since 15 patients out of a total of 161 patients had in-hospital mortality, the patients could not be included in the 30-days follow up, hence we had a total of 146 patients for our follow-up at 30 days.

Out of a total of 101 patients with an ICH score of $\geq$1 on admission, 33 had a poor outcome while 68 had a good outcome at the end of 30 days. Of the 45 patients with an ICH score of 0 on admission, 4 had a poor outcome while 41 had a good outcome.

The data represented here gave us an RR of 1.42 for patients with a higher on admission ICH score to have a poor 30-day functional outcome than those with an ICH score of 0 on admission. The data was statistically significant with a p-value of <0.0001. (Table 5)

The association between the 24-hour ICH score and the outcome at the end of 30-days. Of the total 90 patients with a 24-hour ICH score of $\geq$1, 37 had a poor outcome and 53 had a good outcome at the end of 30 days. (Table 6)

This gave us a RR of 2.69 of patients with a higher 24-hour ICH score, to have a poor outcome than those with a 24-hour ICH score 0. This was within the 95% CI ranging from 2.05-3.53. The data was highly significant, given the p-value was <0.0001.

In multivariate analysis to study the association of factors and outcome for ICH score on admission, GCS score and blood sugar levels on admission were highly significant statistically that impacted the outcome for ICH score on admission.

Other factors that had a statistically significant impact on the association between on-admission ICH scores and outcomes were systolic BP and the duration of hospital stay. diastolic BP were statistically insignificant) while For 30 days functional outcome GCS score, blood sugar levels on admission and duration of hospital stay, had a statistically highly significant impact.(Table 7)

On applying the multiple logistic regression analysis on the factors impacting the in-hospital functional

outcome, GCS score and blood sugar level on admission were found to be highly significant and systolic BP was statistically significant.

Similarly, results of the factors impacting the prediction of mortality by using the 24-hour ICH score on multiple logistic regressions analysis, only the GCS score and the duration of hospital stay significantly impacted the mortality prediction.(Table 8)

Overall mortality was 27.9% 45 cases died out of 161 who had ICH score >1.In hospital mortality was in 15 cases (9.31%) & 30 (21.7%) cases died in 30 days follow up after discharge. This showed ICH score is a good predictor of mortality.

Discussion

The most important findings of the presentstudyis that the ICH-score is a reliable predictor of short term (1 month) functional outcome and mortality in patients with ICH. Moreover, when calculated at the end of 24 hours after hospitalisation, the ICH score had an even better correlation to the functional outcome of patients (both in-hospital and short-term) of ICH. A CT angiography of the brain done along with the follow-up plain CT at the end of 24hours after admission was also helpful in predicting the hematoma expansion and worsening of ICH score and hence the functional outcome.As previously reported various studies have found that almost 40% of patients with brain imaging obtained in the first 3 hours after onset of symptoms of ICH experience hematoma expansion and this is highly associated with neurological deterioration[7]. Also, there is a strong association between contrast extravasationon computed tomography angiography (CTA) and hematoma expansion and worse outcome [11,12]. The present study tried to evaluate this fact.When we analysed the association of ICH score on admission and in-hospital outcome of the patients we found a relative risk (RR) of 1.54 for patients with a higher ICH score on admission to have a poor outcome than those with an ICH score of 0, which was highly significant ($p<0.0001$). Similarly the association of ICH score on admission to 30-day mortality was statistically significant with a p-value of <0.0001.

Moreover, the 24-hour ICH score had a better association with the in-hospital outcome as well as the 30-day functional outcome of the patient than when compared to on admission ICH score.These findings of the present study are well correlating with the data obtained from studies carried out by Aimee M. Aysenne et al. (2013)[13] ,J. Claude Hemphill III et al. (2009)[4] and J. Claude Hemphill III et al. (2001)[3].

The spot sign (Figure 1.) describes the appearance of small focal or multifocal areas of contrast enhancement within a hemorrhage on computed tomography angiography (CTA) source images[14]. The spot sign has been linked to hemorrhage expansion and poor outcomes, including mortality[15,16].In a retrospective analysis of 367 patients with acute ICH, a spot sign was found in 19 percent of patients and was independently associated with hemorrhage expansion [17]. Accumulation of contrast extravasation within the hemorrhage on postcontrast CT also predicts subsequent hemorrhage expansion[18].Although less well studied, tiny spots of contrast extravasation within the hemorrhage on MRI (the MRI spot sign) have also been detected on postcontrast T1-weighted and dynamic T1-weighted images, particularly when performed in the first six hours after ICH onset[19].The MRI spot may be associated with hematoma growth and worse clinical outcomes, but definitive data are lacking[20].A spot sign score which grades the number of spot signs, their maximum dimension, and attenuation, is a strong predictor of hemorrhage expansion; of these features, the number of spot signs appears to be most predictive [17,21-23]In our study, 'spot sign' on CT-angiography was observed in 12(7.45%) patients only which was of low incidence than that found in the study done by Almandoz JED et al. (2010)[7], in whichat least 1 spot sign in 122 of the 573 first-pass CTAs (21.3%). In another study done by Josser E. Delgado Almandoz et al. (2009)[24] the presence of any spot sign increased the risk of significant hematoma expansion (69%, OR=92, $P<0.0001$)In the study done by Ryan Wada et al. (2007)[25] 33% demonstrated presence of spot sign. Hematoma expansion occurred in 11 patients (28%) on follow-up.The results of our study, in which the association of the presence of spot sign was studied with poor ICH score and poor functional outcome was done, was not comparable to the previous studies in the literature. In our study multivariate analysis, the factors predicting the in-hospital functional outcome were the GCS score, systolic BP and blood sugar level on admission. Similarly, the factors predicting mortality by using the 24-hour ICH score were also subjected to multivariate analysis; the GCS score and the duration of hospital stay predicted the mortality.

These results of the present study are well correlating with others[3,8,10,26]. who also got similar results.

Our data supports that early prognostication of outcomes should be avoided when possible, and using an ICH score calculated at a later time (after 24 hours) during the ICH admission is a better indicator of patient outcomes, after the hematoma has been stabilized.

Conclusion

The 24-hour ICH score was a better predictor of in-hospital and 30-day functional outcome and mortality when compared to the on-admission ICH score and the presence of spot sign on CT angiography was associated with hematoma expansion andworsening of ICH score and hence a poor functional outcome.

Study Limitations

Ours was a single-centre study and was limited by a small sample size and our ability to adjust for other factors, such as blood pressure control and interventional procedures, which could affect the outcome.

Study Implications

The ICH Score and other clinical grading scales should be most appropriately used to provide a framework for clinical decision making and to provide a reliable criterionfor assessing the efficacy of new treatments. Our findings further support how crucial the treatment of a patient within the first few hours after development of ICH is, particularly for interventions focused on prevention of hematoma expansion by blood pressure control, consideration of hemostatic agents and evacuation of hematoma or hemi craniectomy when appropriate.

Conclusion

The 24-hour ICH score was a better predictor of in-hospital and 30-day mortality when compared to the on-admission ICH score.The presence of spot sign on CT angiography was associated with a poor ICH score and functional outcome.

- Study implication
- Early prognostication of outcomes should be avoided when possible.
- Using an ICH score calculated at a later time is a better indicator of patient outcomes.
- The presence of ‘spot sign’ correlated well with a poor ICH score.
- The 24-hour ICH score and ‘spot sign’ can be useful tool for predicting which patients are more likely to undergo clinical deterioration.

Study limitations

Ours was a single-center study, with a small sample size but adequate to decide the power of the study

Study implications

- Intracerebral hemorrhage is a medical emergency requiring immediate treatment.
- The ICH Score and other clinical grading scales should be most appropriately used to provide a framework for clinical decision makingand to provide a reliable criterion for assessing the efficacy of new treatments.
- Treatment depends on the amount of blood and the extent of brain injury that has occurred.
- Hemostatic therapy trials with recombinant factor VIIa have demonstrated reductions in hematoma expansion without improvement in clinical outcomes, presumably because of the inclusion of a majority of patients who are unlikely to experience any hematoma expansion and therefore to benefit from hemostatic therapy.
- Further studies and trials are required to be carried out, which should include patients more likely to experience a hematoma expansion and clinical deterioration.

For predicting which patients are more likely to undergo clinical deterioration, the use of 24-hour ICH score and ‘spot sign’ can be very useful tools in guiding therapy in such patients. Our findings further support how crucial the treatment of a patient within the first few hours after development of ICH is, particularly for interventions focused on prevention of hematoma expansion by blood pressure control, consideration of hemostatic agents and evacuation of hematoma or hemicraniectomy when appropriate.

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