

Optimum prognostic cut-point of baseline and early change in NIHSS and GCS scores in intracerebral hemorrhage: INTERACT1+2 studies

Shoujiang You¹, Danni Zheng², Yongjun Cao¹, Candice Delcourt², Sohei Yoshimura³, Shoichiro Sato³, Xia Wang², Richard I Lindley², Thompson Robinson⁴, Craig S Anderson^{2,5}, John Chalmers²

1. Department of Neurology, The Second Affiliated Hospital of Soochow University, Suzhou, China.
2. The George Institute for Global Health, Faculty of Medicine, University of New South Wales, Sydney, NSW, Australia.
3. Department of Cerebrovascular Medicine, National Cerebral and Cardiovascular Center, Suita, Osaka, Japan
4. Department of Cardiovascular Sciences and NIHR Leicester Biomedical Research Centre, University of Leicester, Leicester, UK
5. The George Institute China at Peking University Health Science Center, Beijing, PR China

Background and aims

To determine the optimal cut-point of baseline and early change in National Institutes of Health Stroke Scale (NIHSS) and Glasgow Coma Scale (GCS) scores for outcome prediction in acute intracerebral hemorrhage (ICH).

Methods

Data from participants of the INTERACT trials, where early change in NIHSS and GCS scores were from baseline to 24 hrs. The optimal cut-points for predicting 90-day clinical outcomes (death and dependency on the modified Rankin scale [mRS]) were determined using Youden's Index and multivariable logistic regression models.

Results

In the INTERACT2 trial, baseline NIHSS with a cut-point of 10 was superior to baseline GCS score and early change in GCS and NIHSS scores for predicting death or major disability (sensitivity 77.5%, specificity 69.1%, positive predictive value [PPV] 74.6%, negative predictive value [NPV] 72.4%) within 90-days (aOR, 95%CI 6.40 [5.25-7.81], P<0.001) as well as major disability (sensitivity 74.9%, specificity 42.4%, PPV 55.9%, NPV 76.1%) alone (aOR, 95%CI 4.29 [3.56-5.17]).

Early increase in NIHSS score with a cut-point of 1 point optimally predicted death (sensitivity 63.8%, specificity 80.2%, PPV 26.8%, NPV 95.1%) within 90-days (aOR, 95%CI 5.44 [4.05-7.31], P<0.001).

Sensitivity analyses involving INTERACT 1 dataset largely confirmed our main results.

Conclusions

In ICH patients, a baseline NIHSS score ≥ 10 is optimal for predicting bad outcome (death or major disability; major disability), whereas any early increase in NIHSS score predicts death better than baseline NIHSS and GCS scores.

Table 2. Predictors of outcome at 3-month in INTERACT 2 derivation cohort

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden index	aOR	95% CI	P-value
Death or major disability^a								
Baseline GCS (≤ 13)	47.5	76.5	70.2	55.5	0.240	2.46	2.02-2.99	<0.001
Baseline NIHSS (≥ 10)	77.5	69.1	74.6	72.4	0.446	6.40	5.25-7.81	<0.001
24 h change in NIHSS score (≥ 1)	34.9	87.4	75.5	54.6	0.222	2.98	2.38-3.73	<0.001
24 h change in GCS score (≤ -1)	27.9	93.0	81.4	53.9	0.209	3.65	2.77-4.80	<0.001
24 h change in NIHSS score (≥ 4)	16.8	96.5	84.5	51.0	0.134	4.48	3.07-6.53	<0.001
24 h change in GCS score (≤ -2)	18.1	97.1	87.4	51.8	0.152	4.97	3.36-7.36	<0.001
Death								
Baseline GCS (≤ 13)	61.6	67.0	20.4	92.7	0.286	2.42	1.83-3.18	<0.001
Baseline NIHSS (≥ 12)	82.1	60.0	21.9	96.1	0.420	4.03	2.93-5.55	<0.001
24 h change in NIHSS score (≥ 1)	63.8	80.2	26.8	95.1	0.439	5.44	4.05-7.31	<0.001
24 h change in GCS score (≤ -1)	55.3	86.2	31.2	94.5	0.415	5.10	3.78-6.89	<0.001
24 h change in NIHSS score (≥ 4)	38.8	92.7	37.8	93.0	0.315	6.11	4.40-8.51	<0.01
24 h change in GCS score (≤ -2)	44.3	92.9	41.3	93.7	0.372	6.91	4.99-9.58	<0.001
Major disability^b								
Baseline GCS (≤ 12)	32.8	80.0	53.9	62.3	0.127	1.95	1.61-2.36	<0.001
Baseline NIHSS (≥ 10)	74.9	42.4	55.9	76.1	0.324	4.29	3.56-5.17	<0.001
24 h change in NIHSS score (≥ 1)	27.9	78.3	48.6	59.5	0.061	1.20	0.99-1.46	0.059
24 h change in GCS score (≤ -1)	21.3	84.5	50.2	59.4	0.058	1.16	0.93-1.44	0.187
24 h change in NIHSS score (≥ 4)	11.5	90.3	46.6	58.0	0.018	0.97	0.74-1.28	0.849
24 h change in GCS score (≤ -2)	11.9	89.8	46.1	58.1	0.017	0.86	0.65-1.12	0.259

GCS indicates Glasgow Coma Scale; NIHSS, National Institute of Health Stroke Scale; PPV, positive predictive value; NPV, negative predictive value; aOR, adjusted odds ratio; CI, confidence interval.

Adjusted for baseline variables: age, sex, recruitment of China, baseline hematoma volume (log-transformed), antithrombotics usage, presence of intraventricular hemorrhage.

^aDeath or major disability was defined as having a modified Rankin Scale score between 3 and 6.

^bMajor disability was defined as having a modified Rankin Scale score between 3 and 5

Table 3. Predictors of outcome at 3-month in INTERACT 1 validation cohort

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden index	aOR	95% CI	P-value
Death or major disability^a								
Baseline GCS score (≤ 13)	52.6	80.3	71.4	64.4	0.329	3.07	1.76-5.35	<0.001
Baseline NIHSS score (≥ 8)	86.8	60.6	67.3	83.1	0.474	7.78	4.28-14.11	<0.001
24h change in NIHSS score (≥ 2)	30.5	89.2	72.2	58.2	0.196	2.80	1.44-5.42	0.002
24 h change in GCS score (≤ -1)	27.8	90.6	73.2	57.7	0.184	2.53	1.26-5.09	0.009
24 h change in NIHSS score (≥ 4)	19.8	96.6	84.1	56.6	0.163	3.95	1.45-10.79	0.007
24 h change in GCS score (≤ -2)	17.6	97.5	86.8	56.3	0.152	5.80	1.75-19.21	0.004
Death								
Baseline GCS score (≤ 13)	69.6	69.1	22.5	94.6	0.387	3.94	1.60-9.69	0.003
Baseline NIHSS score (≥ 12)	69.6	64.3	20.1	94.2	0.339	3.48	1.40-8.69	0.008
24 h change in NIHSS score (≥ 4)	51.2	93.8	50.0	94.1	0.450	6.34	2.44-16.48	<0.001
24 h change in GCS score (≤ -1)	44.2	85.1	26.4	92.7	0.293	2.07	0.83-5.15	0.117
24 h change in GCS score (≤ -2)	34.9	93.3	38.5	92.2	0.281	2.80	0.92-8.52	0.07
Major disability^b								
Baseline GCS score (≤ 14)	69.4	54.2	46.7	75.4	0.237	2.48	1.46-4.21	<0.001
Baseline NIHSS score (≥ 9)	79.9	58.6	52.8	83.4	0.385	5.60	3.16-9.92	<0.001
24 h change in NIHSS score (≥ 8)	97.9	7.7	38.3	86.4	0.056	0.45	0.14-1.47	0.185
24 h change in GCS score (≤ 1)	26.4	83.3	48.1	65.9	0.097	0.72	0.33-1.57	0.412
24 h change in NIHSS score (≥ 4)	89.6	10.6	37.0	63.4	0.002	0.84	0.37-1.92	0.681
24 h change in GCS score (≤ -2)	93.8	7.3	37.2	66.7	0.011	1.78	0.73-4.32	0.206

GCS indicates Glasgow Coma Scale; NIHSS, National Institute of Health Stroke Scale; PPV, positive predictive value; NPV, negative predictive value; aOR, adjusted odds ratio; CI, confidence interval.

Adjusted for baseline variables: age, sex, recruitment of China, baseline hematoma volume (log-transformed), antithrombotics usage, presence of intraventricular hemorrhage.

^aDeath or major disability was defined as having a modified Rankin Scale score between 3 and 6.

^bMajor disability was defined as having a modified Rankin Scale score between 3 and 5



苏州大学附属第二医院
核工业总医院
中法友好医院



The George Institute
for Global Health
Australia

