Functional Outcome Prediction in Japanese Patients with Nonsurgical Intracerebral Hemorrhage: The FSR ICH Score

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出版情報：Cerebrovascular Diseases. 54 (5), pp.718-725, 2025-01-08. Karger Publishers
バージョン：
権利関係：This is the accepted manuscript version of an article published by Karger Publishers in Cerebrovasc Dis (2025) 54 (5): 718-725 including https://doi.org/10.1159/000543362 and available on karger.com/ced/article-abstract/54/5/718/918898

Supplementary Materials

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Supplementary Methods

Study participants

A total of 1,324 patients with ICH who were hospitalized within 7 days after onset and did not undergo neurosurgical treatment were consecutively registered in the FSR database. Among them, 44 patients with secondary causes of ICH, namely moyamoya disease, arteriovenous malformation, intratumoral hemorrhage, cerebral venous sinus thrombosis, ruptured aneurysm, cavernous hemangioma, arteriovenous fistula, subarachnoid hemorrhage, or trauma, were excluded. Additionally, 172 patients with impaired activities of daily living (modified Rankin Scale score, 3–5) before the ICH onset, 69 patients who underwent neurosurgical treatment during hospitalization, and 22 patients for whom data on functional status were unavailable during 3-month follow-up after the onset were excluded. The patient selection process is shown as a flowchart in online suppl. Figure 1.

Assessment of Risk Factors

Hypertension was defined as blood pressure ≥140/90 mmHg in the chronic stage or a medical history of hypertension. Diabetes mellitus was diagnosed based on the criteria of the Japan Diabetes Society, either before stroke onset or during hospitalization [1]. Dyslipidemia was defined as either a low-density lipoprotein-cholesterol level ≥3.62 mmol/L, high-density lipoprotein-cholesterol level <1.03 mmol/L, triglycerides ≥1.69 mmol/L, or current treatment with a cholesterol-lowering drug. Pre-stroke dementia was defined as any type of dementia that was present prior to the index ICH. The assessment of cognitive and functional status before stroke onset was based on a clinical interview with a knowledgeable informant. Pre-stroke dementia was diagnosed by attending physicians according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition Text Revision criteria [2]. Previous stroke was defined as a history of hemorrhagic or ischemic stroke. Coronary artery disease was defined as a previous history of angina pectoris, myocardial infarction, percutaneous coronary intervention, or coronary artery bypass graft surgery. Information on smoking habits (previous or current cigarette smoking) and alcohol intake (previous or current drinking) was obtained using a standardized questionnaire. Oral anticoagulation was defined as current treatment with any oral anticoagulants, including vitamin K antagonists and non-vitamin K antagonist oral anticoagulants. Antiplatelet medication was defined as the current use of any antiplatelet drugs, such as aspirin, clopidogrel, cilostazol, beraprost sodium, sarpogrelate and dipyridamole. Time from onset to admission was determined based on the patient's medical history as assessed by the attending physicians and divided into four groups (≤1 hr; >1 hr and ≤6 hr; >6 hr and ≤24

hr; >24 hr). Blood pressure on admission was measured by trained nurses in the supine position using either an automated cuff, a mercury sphygmomanometer, or an aneroid sphygmomanometer. Plasma glucose levels were assessed using blood samples on admission. The severity of the stroke on admission was evaluated based on the Japan Coma Scale [3] and National Institutes of Health Stroke Scale (NIHSS) score. The location of the ICH was categorized into three groups: lobar (cortex and cortical–subcortical junction), deep (basal ganglia, thalamus, internal capsule, and deep periventricular white matter), and infratentorial (cerebellar and brain stem), following the classification from previous reports [4, 5].

Multivariable analysis

In the fully adjusted multivariable model, systolic blood pressure and Japan Coma Scale were not used for the variable selection because of their strong correlation with pulse pressure (Pearson's correlation coefficient, r=0.74 for systolic blood pressure) and NIHSS score (Spearman's rank correlation coefficient r=0.68 for Japan Coma Scale), respectively. Regarding the factors of ICH location, we selected only the deep location for inclusion in the fully adjusted multivariable model based on the results of the age- and sex-adjusted model.

Supplementary References

1. Committee of the Japan Diabetes Society on the Diagnostic Criteria of Diabetes M, Seino Y, Nanjo K, Tajima N, Kadowaki T, Kashiwagi A, et al. Report of the committee on the classification and diagnostic criteria of diabetes mellitus. J Diabetes Investig 2010;1:212-228.
2. Shabsigh R, Rowland D. The Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision as an appropriate diagnostic for premature ejaculation. J Sex Med 2007;4:1468-1478.
3. Ohta T, Waga S, Handa W, Saito I, Takeuchi K. [New grading of level of disordered consiousness]. No Shinkei Geka 1974;2:623-627 (Japanese).
4. Sembill JA, Gerner ST, Volbers B, Bobinger T, Lucking H, Kloska SP, et al. Severity assessment in maximally treated ICH patients: The max-ICH score. Neurology 2017;89:423-431.
5. Falcone GJ, Biffi A, Brouwers HB, Anderson CD, Battey TW, Ayres AM, et al. Predictors of hematoma volume in deep and lobar supratentorial intracerebral hemorrhage. JAMA Neurol 2013;70:988-994.

Appendix

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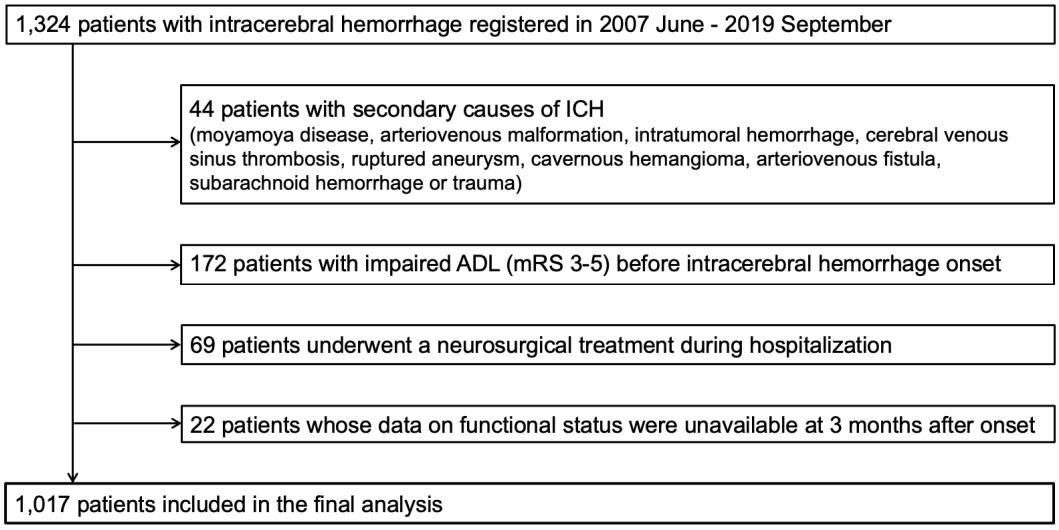
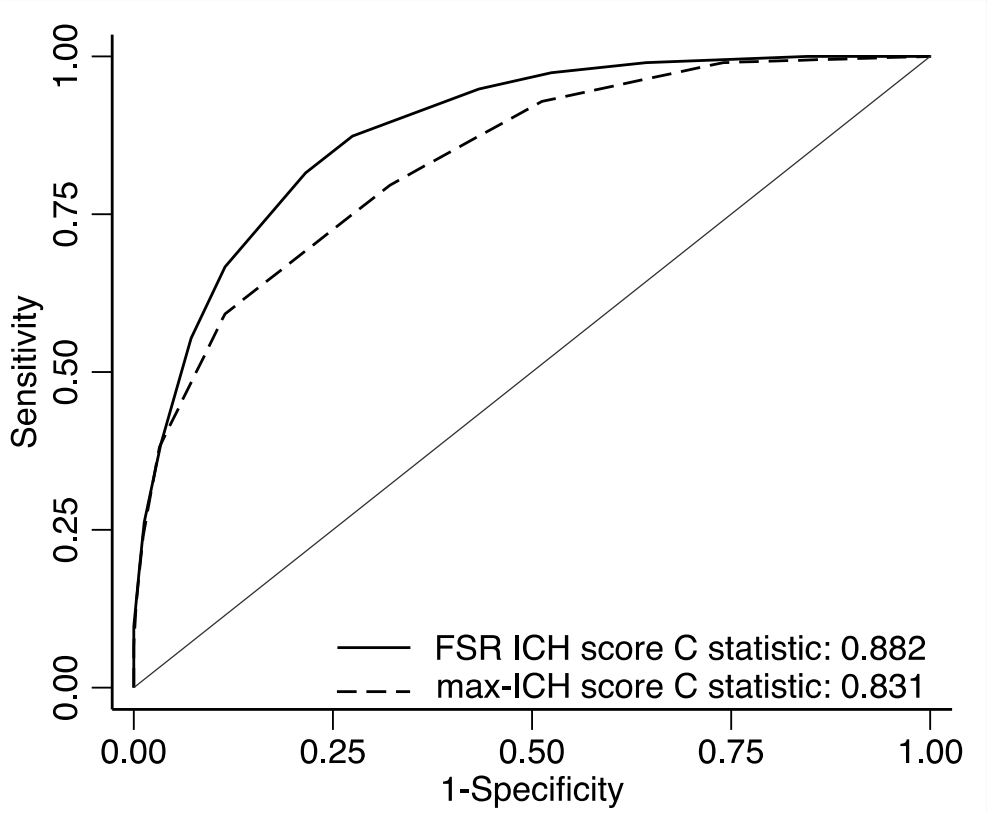
Supplementary Figures

Supplementary Figure 1. Flow chart of patient selection

ICH, intracerebral hemorrhage; ADL, activities of daily living; mRS, modified Rankin Scale.



Supplementary Figure 2. Comparison of the C statistics between the FSR ICH score and max-ICH score for predicting poor functional outcome at 3 months



Supplementary Table 1. Age- and sex-adjusted and fully OR (95% CI) for the development of poor functional outcome

	Numbers of events/at risk (%)	Age- and sex-adjusted		Fully adjusted	
		OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Age (years)					
≤59	50/252 (19.8)	1.00 (Ref.)		1.00 (Ref.)	
60-69	65/267 (24.3)	1.30 (0.86-1.97)	0.22	1.21 (0.71-2.06)	0.48
70-79	108/289 (37.4)	2.40 (1.62-3.56)	<0.001	3.52 (2.01-6.16)	<0.001
≥80	100/209 (47.9)	3.68 (2.41-5.63)	<0.001	5.53 (2.84-10.79)	<0.001
Sex					
Women	141/398 (35.4)	1.00 (Ref.)		1.00 (Ref.)	
Men	182/619 (29.4)	0.98 (0.74-1.31)	0.93	1.05 (0.66-1.68)	0.84
Hypertension					
No	10/38 (26.3)	1.00 (Ref.)		1.00 (Ref.)	
Yes	313/979 (32.0)	1.51 (0.71-3.20)	0.29	2.17 (0.73-6.46)	0.16
Diabetes mellitus					
No	244/796 (30.7)	1.00 (Ref.)		1.00 (Ref.)	
Yes	79/221 (35.8)	1.33 (0.96-1.84)	0.09	1.84 (1.11-3.07)	0.02
Dyslipidemia					
No	213/637 (33.4)	1.00 (Ref.)		1.00 (Ref.)	
Yes	110/380 (29.0)	0.83 (0.62-1.10)	0.20	1.24 (0.83-1.85)	0.29
Pre-stroke dementia					
No	262/910 (28.8)	1.00 (Ref.)		1.00 (Ref.)	
Yes	49/90 (54.4)	1.94 (1.22-3.09)	0.005	3.05 (1.57-5.95)	0.001
Previous stroke					
No	272/862 (31.6)	1.00 (Ref.)		1.00 (Ref.)	
Yes	51/155 (32.9)	1.00 (0.68-1.45)	0.99	1.13 (0.65-1.97)	0.66
Coronary artery disease					
No	283/919 (30.8)	1.00 (Ref.)		1.00 (Ref.)	
Yes	40/98 (40.8)	1.24 (0.80-1.93)	0.33	1.51 (0.76-3.03)	0.24
Smoking					
No	158/468 (33.8)	1.00 (Ref.)		1.00 (Ref.)	
Yes	165/549 (30.1)	1.09 (0.78-1.52)	0.62	1.32 (0.84-2.08)	0.23
Drinking					
No	216/600 (36.0)	1.00 (Ref.)		1.00 (Ref.)	
Yes	107/417 (25.7)	0.73 (0.54-1.00)	0.05	0.67 (0.44-1.02)	0.06
Oral anticoagulation					
No	287/916 (31.3)	1.00 (Ref.)		1.00 (Ref.)	
Yes	36/101 (35.6)	0.96 (0.62-1.51)	0.87	0.60 (0.30-1.19)	0.15
Antiplatelet medication					
No	253/831 (30.5)	1.00 (Ref.)		1.00 (Ref.)	
Yes	70/186 (37.6)	1.10 (0.78-1.55)	0.61	1.17 (0.67-2.04)	0.58
Time from onset to admission					
≤1 hr	113/267 (42.3)	1.00 (Ref.)		1.00 (Ref.)	
>1 hr and ≤6 hr	133/376 (35.8)	0.65 (0.46-0.91)	0.01	0.87 (0.57-1.35)	0.54
6 hr and ≤24 hr	55/229 (24.0)	0.35 (0.23-0.52)	<0.001	0.80 (0.45-1.44)	0.46
>24 hr	22/145 (15.2)	0.17 (0.10-0.29)	<0.001	0.77 (0.36-1.64)	0.49

Systolic blood pressure (mmHg)					
≤159	69/260 (26.5)	1.00 (Ref.)			
160-179	72/249 (28.9)	1.27 (0.85-1.90)	0.24		
180-199	82/244 (33.6)	1.58 (1.06-2.34)	0.02		
≥200	100/264 (37.9)	2.02 (1.37-2.97)	<0.001		
Diastolic blood pressure (mmHg)					
≤89	91/286 (31.8)	1.00 (Ref.)		1.00 (Ref.)	
90-99	60/196 (30.6)	1.05 (0.70-1.58)	0.80	1.21 (0.70-2.11)	0.50
100-109	69/217 (31.8)	1.37 (0.92-2.05)	0.12	1.02 (0.58-1.79)	0.94
≥110	103/317 (32.5)	1.70 (1.17-2.49)	0.006	1.52 (0.89-2.58)	0.13
Pulse pressure (mmHg)					
≤64	76/260 (29.2)	1.00 (Ref.)		1.00 (Ref.)	
65-79	77/263 (29.3)	0.94 (0.64-1.38)	0.75	0.95 (0.56-1.60)	0.84
80-94	72/251 (28.7)	0.88 (0.59-1.31)	0.53	0.49 (0.29-0.84)	0.01
≥95	98/242 (40.5)	1.38 (0.94-2.02)	0.10	0.91 (0.53-1.55)	0.73
Plasma glucose (mg/dL)					
<112	84/327 (25.7)	1.00 (Ref.)		1.00 (Ref.)	
112 ≤ and <139	114/343 (33.2)	1.46 (1.04-2.06)	0.03	1.12 (0.71-1.79)	0.63
≥140	125/346 (36.1)	1.79 (1.27-2.52)	0.001	0.86 (0.51-1.46)	0.58
Japan Coma Scale					
0	39/431 (9.1)	1.00 (Ref.)			
1-3	157/371 (42.3)	7.18 (4.83-10.67)	<0.001		
10-30	88/169 (52.1)	11.59 (7.31-18.35)	<0.001		
100-300	39/46 (84.8)	60.35 (24.49-148.68)	<0.001		
NIHSS score					
0-2	8/243 (3.3)	1.00 (Ref.)		1.00 (Ref.)	
3-6	34/275 (12.7)	4.51 (2.02-10.06)	<0.001	3.91 (1.69-9.04)	0.002
7-13	104/251 (41.4)	28.09 (13.02-60.60)	<0.001	23.56 (10.20-54.42)	<0.001
≥14	177/246 (72.0)	106.05 (48.28-232.92)	<0.001	88.46 (35.81-218.50)	<0.001
ICH location					
Lobar					
No	279/835 (33.4)	1.00 (Ref.)			
Yes	44/182 (24.2)	0.49 (0.33-0.72)	<0.001		
Deep					
No	74/306 (24.2)	1.00 (Ref.)		1.00 (Ref.)	
Yes	249/711 (35.0)	2.00 (1.45-2.74)	<0.001	1.00 (0.62-1.63)	0.99
Infratentorial					
No	290/891 (32.6)	1.00 (Ref.)			
Yes	33/126 (26.2)	0.75 (0.49-1.16)	0.19		
Intraventricular hemorrhage					
No	179/777 (23.0)	1.00 (Ref.)		1.00 (Ref.)	
Yes	143/237 (60.3)	4.94 (3.60-6.78)	<0.001	2.91 (1.90-4.44)	<0.001
Hematoma volume (ml)					
<10	141/613 (23.0)	1.00 (Ref.)		1.00 (Ref.)	
10 ≤ and <30	118/301 (39.2)	2.56 (1.87-3.50)	<0.001	1.07 (0.69-1.64)	0.77
≥30	61/93 (65.6)	6.32 (3.90-10.24)	<0.001	2.39 (1.20-4.76)	0.01

ICH, intracerebral hemorrhage; NIHSS, National Institutes of Health Stroke Scale; OR, odds ratio.