Grave Prognosis on Spontaneous Intracerebral Haemorrhage: GP on Stage Score

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Background and Objective: *Spontaneous intracerebral haemorrhage (ICH) is more common in Asia than in western countries, and has a high mortality rate. A simple prognostic score for predicting grave prognosis of ICH is lacking. Our objective was to develop a simple and reliable score for most physicians.*
Material and Method: *ICH patients from seven Asian countries were enrolled between May 2000 and April 2002 for a prospective study. Clinical features such as headache and vomiting, vascular risk factors, Glasgow coma scale (GCS), body temperature (BT), blood pressure on arrival, location and size of haematoma, intraventricular haemorrhage (IVH), hydrocephalus, need for surgical treatment, medical treatment, length of hospital stay and other complications were analyzed to determine the outcome using a modified Rankin scale (MRS). Grave prognosis (defined as MRS of 5-6) was judged on the discharge date.*
Results: *995 patients, mean age 59.5±14.3 years were analyzed, after exclusion of incomplete data in 87 patients. 402 patients (40.4%) were in the grave prognosis group (MRS 5-6). Univariable analysis and then multivariable analysis showed only four statistically significant predictors for grave outcome of ICH. They were fever (BT≥ 37.8°c), low GCS, large haematoma and IVH. The grave prognosis on spontaneous intracerebral haemorrhage (GP on STAGE) score was derived from these four factors using a multiple logistic model.*
Conclusion: *A simple and pragmatic prognostic score for ICH outcome has been developed with high sensitivity (82%) and specificity (82%). Furthermore, it can be administered by most general practitioners. Validation in other populations is now required.*

Keywords: *Cerebral haemorrhage, Stroke, Cerebrovascular disease, Intracerebral haemorrhage, Prognostic cerebral haemorrhage score*

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Stroke remains a major cause of mortality and disability worldwide. Spontaneous intracerebral haemorrhage (ICH) accounts for 10-15 % of all strokes. The incidence is twice as common as subarachnoid haemorrhage (SAH) and has a higher morbidity and mortality than cerebral infarction or SAH[1-4]. Approximately 35-50% of patients with ICH die within the first month after bleeding[5,6]. Data from the Asian Stroke Advisory Panel (ASAP) revealed an incidence of ICH ranging from 17-33% of all strokes, twice as high as in western countries[7]. In Thailand, the incidence of ICH was 30 % of all strokes.[6]

Although several randomized therapeutic trials for ICH have been published, neither surgical nor medical treatments have been shown conclusively to benefit patients[8-14]. Prognostic factors for predicting function outcome and mortality thus play a major role in determining the treatment outcome[5,6, 15-26]. Prognostic models usually include both clinical features and neuroimaging findings, such as level of consciousness and haematoma volume. Unfortunately, the published models of prognostic score involved complex algebraic calculations and there provided inconsistent results concerning the validation of the scores. Further, the majority of data was obtained from western countries and was mainly retrospective analysis. Very few studies have been reported from Asia[6,19, 21] .

The purpose of this study was to develop a simple and reliable grave prognostic score for ICH based on clinical and neuroimaging features that would be simple and reliable for nonspecialists. We have termed this the grave prognosis on spontaneous intracerebral haemorrhage (GP on STAGE) Score.

Material and Method

Study Design

A prospective hospital-based study.

Inclusion and exclusion criteria

Between May 2000 and April 2002, consecutive in-patients aged over 15 years of either sexes with the diagnosis of ICH from seven countries in Asia (Hong Kong, Korea, Pakistan, The Philippines, Singapore, Taiwan and Thailand) were enrolled in this study (14 hospitals participated). All patients had computerized tomography (CT) scan or magnetic resonance imaging (MRI) of the brain within seven days after onset to verify the definite diagnosis, location and calculation of haematoma size. Patients whose haematoma were caused by head trauma, anticoagulant or thrombolytic drugs, brain tumor, saccular arterial aneurysm or vascular malformation were excluded from the study. Signed informed consent was required from all patients or closest relatives. The study protocol was approved by the local ethics committees in each country.

Prognostic Variables and Definitions

All clinical variables of each patient were recorded at the initial time of admission. These included: a) clinical presentations: headache and vomiting were defined as a complaint of these symptoms within the first 2 hours of onset (history from patients or relatives), b) vascular risk factors: hypertension (blood pressure > 140/90 mmHg), diabetes mellitus (glucose level > 7.77 mmol/L preprandial on two examinations, or glucose level > 11.10 mmol/L postprandial or HbA_1C > 8.5%), lipid profile (cholesterol, triglyceride, and high density lipoprotein), cigarette smoking, alcohol consumption and phenyl propanolamine (PPA) or other recreational drug use, c) clinical signs: Glasgow Coma Scale (GCS), body temperature (BT: defined as fever if BT$\geq$ 37.8^{o}C via sublingual route, if measured via axilla add 0.5^{o}C), systolic and diastolic blood pressure on arrival, d) neuroimaging: location, volume of haematoma (calculated by the formula (A x B x C)/2 where A, B, and C were diameters of haematoma in length, width and depth, respectively)[27], intraventricular extension and obstructive hydrocephalus. The relevant parameters of treatment during hospitalization were recorded including surgical treatment, medical treatment, duration of admission and complications during admission. The outcome at discharge was documented in all patients using a modified Rankin scale (MRS) and classified into 2 groups, a) grave prognosis (defined as MRS at discharge of 5-6 i.e. death or vegetative state), and b) survivor outcome (defined as MRS at discharge of 0-4). Causes of death were verified in all patients by a team of attending physicians.

Statistical analysis

Univariable analysis was performed to categorize patients with grave and survivor outcomes. An unpaired t-test was used for quantitative data which were normally distributed (e.g., age, blood pressure), and a Mann-Whitney U test for non-parametric data

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Table 1. Comparison of baseline characteristics between grave and survivor outcomes

Characteristics	Number or Mean ± SD (Percentage)		
	Grave outcome (n = 402)	Survivor outcome (n = 593)	p-value
Demographic data			
Age (year)	59.4 ± 14.4	59.6 ± 14.2	0.1039
Male: female	1.2:1	1.2:1	0.9035
Clinical presentations			
Headache	135/337 (40.06%)	223/504 (44.25%)	0.2280
Vomiting	105/377 (27.85%)	189/559 (33.81%)	0.0541
Vascular risk factors			
Hypertension (from history)	247/348 (71.00%)	365/532(68.61%)	0.455
Diabetes mellitus	64/375 (17.07%)	87/568 (15.32%)	0.4733
Cigarette smoking	117/391(29.92%)	210/578 (36.33%)	0.1116
Alcohol consumption	96/393 (24.43%)	176/581 (30.29%)	0.0453
PPA and IVDU	5/286 (1.75%)	7/379 (1.85%)	0.9246
Antithrombotic medication used	76/393 (19.34%)	67/588 (11.39%)	0.0006
Clinical signs			
GCS	8.1 ± 3.9	13.4 ± 2.6	<0.0001
Body temperature (°C)	37.3 ± 1.0	37.0 ± 0.7	<0.0001
Fever (BT>= 37.8°C)	116/393 (29.52%)	76/583 (13.04%)	<0.0001
Systolic BP (mmHg)	178.6 ± 40.0	170.0 ± 32.6	0.0003
Diastolic BP (mmHg)	100.8 ± 23.2	96.6 ± 17.8	0.0014
Neuroimaging			
Location of bleeding			
Supratentorial location	252/302 (83.44%)	451/507 (88.95%)	0.0246
Infratentorial location	50/302 (16.56%)	56/507 (11.05%)	
Haematoma volume (ml)	51.8 ± 57.4	19.3 ± 28.9	<0.0001
Large haematoma (≥30 ml)	222/387 (57.36%)	107/543 (19.71%)	<0.0001
Intraventricular haemorrhage	269/402 (66.92%)	141/585 (24.10%)	<0.0001
Hydrocephalus	193/399 (48.37%)	70/578 (12.11%)	<0.0001
Laboratory investigation			
Serum glucose (mmol/L)	8.76 ± 4.97	7.05 ± 3.14	<0.0001
Cholesterol level (mmol/L)	5.20 ± 1.57	5.29 ± 1.34	0.4442
Triglyceride level (mmol/L)	1.43 ± 0.96	1.29 ± 0.85	0.0571
HDL level (mmol/L)	1.26 ± 0.46	1.30 ± 0.49	0.3250
Treatment			
Surgical intervention	121/397 (30.48%)	127/587 (21.64%)	0.0017
Mannitol	213/339 (62.83%)	216/518 (41.70%)	<0.0001
Dexamethasone	70/331 (21.15%)	47/494 (9.51%)	<0.0001
Glycerol	20/339 (5.90%)	34/522 (6.51%)	0.7167
Furosemide	42/328 (12.80%)	33/496 (6.65%)	0.0027
Duration of admission (day)	14.2 ± 26.0	14.7 ± 15.3	<0.0001

Note : GCS : Glasgow Coma Scale, IVDU : Intravenous drug usage,
PPA : phenyl propanolamine.Some clinical data were missing, thus the denominators of each parameter varied.

(e.g., GCS, haematoma volume and duration of hospitalization). For qualitative variables, Pearson's Chi-square test was employed. Multivariable analysis using multiple logistic regression models was performed to determine the effect of each predictor on developing grave outcome after adjusting for other predictors. Adjusted odds ratio (OR) with a 95% confidence interval (CI) and parameter estimates of the logistic model were applied.

From multiple logistic regression analysis, the prognostic assessment score for each patient was determined using statistically significant prognostic variables and their weights based on the parameter estimation. To predict further the probability of having grave outcome, the probability curve based on the logistic model was constructed. The validity of predicted probability against true outcome was assessed using sensitivity and specificity. A statistically significant difference was considered if the p-value was less than or equal to 0.05. All statistical analyses were performed using SAS software version 8.0.

Results

Of 1,082 patients who presented with ICH between May 2000 and April, 2002 in the enrolled centers, 87 patients were excluded because of incomplete data. Therefore, the remaining 995 patients from 14 hospitals in Hong Kong (N=81), Korea (N=83), Pakistan (N=60), The Philippines (N=359), Singapore (N=71), Taiwan (N=112), and Thailand (N=229) were analyzed. The mean age of patients was 59.5$\pm$14.3 years and 540 (54.27%) patients were male. 402 patients (40.40%) were in the grave outcome group (MRS 5-6) and 593 patients (59.60%) were in the survivor outcome group (MRS 0-4). The mean duration of hospitalization was 14.45$\pm$20.6 days. Nearly seventy percent of patients (69.55%) had a history of hypertension. Comparison of baseline characteristics; clinical, laboratory and neuroimaging parameters between the two outcome groups is shown in Table 1. The majority of haematomas were located in the supratentorial region (86.90%) and the most common site of bleeding was the basal ganglia (28.74%).

Four hundred and ten patients (41.54%) had intraventricular haemorrhage (IVH) and the majority (65.61%) was in the grave outcome group. Hydrocephalus was demonstrated in 263 patients (26.92%). Approximately one-quarter (25.20%) of patients had surgical intervention. Mannitol was the most commonly used medication (50.06%) especially in the grave outcome group (Table 1). The mortality rate in our study was 25.73% and brain herniation (60.94%) was the most common cause of death followed by sepsis (10.94%) (Table 2).

Table 2. Causes of death

Causes of death	Number of patient
Brain herniation	156 (60.94%)
Sepsis	28 (10.94%)
Heart failure	24 (9.38%)
Respiratory failure	14 (5.47%)
Multi-organs failure	11 (4.30%)
Pneumonia	5 (1.95%)
Others	18 (7.00%)
Total	256 (100%)

From univariate analysis, only alcohol consumption, antithrombotic medication, furosemide treatment, dexamethasone treatment, BT, blood pressure, GCS, location of bleeding, size of haematoma, IVH, obstructive hydrocephalus and serum glucose > 11.10 mmol/L variables were independent, significant prognostic factors which were then selected for the multivariate analyses using a multiple logistic regression model. The purpose here was to obtain a parsimonious model for further predicting the probability of grave outcome. In Table 3 the four statistically significant predictors emerging from the multivariate analyses are displayed i.e. fever (BT $\geq$ 37.8°C), GCS on admission, large haematoma volume (size $\geq$ 30 mL) and IVH. Intraventricular haemorrhage was the strongest risk factor (OR 2.53) followed by size of haematoma (OR 2.46) and fever (OR 2.37). For GCS on arrival, one point of reduction in GCS resulted in a 1.44 increase risk of having grave outcome (95% CI: 0.65-0.70).

The ICH Score

The prognostic score for discharge outcome was developed using the results of multiple logistic model. To obtain the ICH score, each patient must have all predictors present (shown in Table 3). The score was then calculated by summing all predictive values and their coefficients as shown in equation (1). To simplify, rounded coefficients are used (equation 2). The higher the coefficient, the greater the weight of prediction for grave outcome.

After the GP on STAGE score is obtained using the simplified equation (2), it is transformed to the probability of developing grave outcome (p) using equation (3) according to the logistic model.

Table 3. Results of multiple logistic regression of grave outcome

Independent factors	Parameter estimate	Odds ratio (OR)	95% CI for OR	p-value
Constant	2.791			
Fever (BT $\geq$ 37.8^{O}C)	0.863	2.372	1.521-3.699	0.0001
GCS on arrival	-0.365	0.694	0.657-0.733	<0.0001
Haematoma volume $\geq$ 30 mL	0.899	2.458	1.675-3.607	<0.0001
Intraventricular haemorrhage	0.929	2.533	1.738-3.692	<0.0001

Note : BP: body temperature; OR: odds ratio; GCS; Glasgow coma scale.

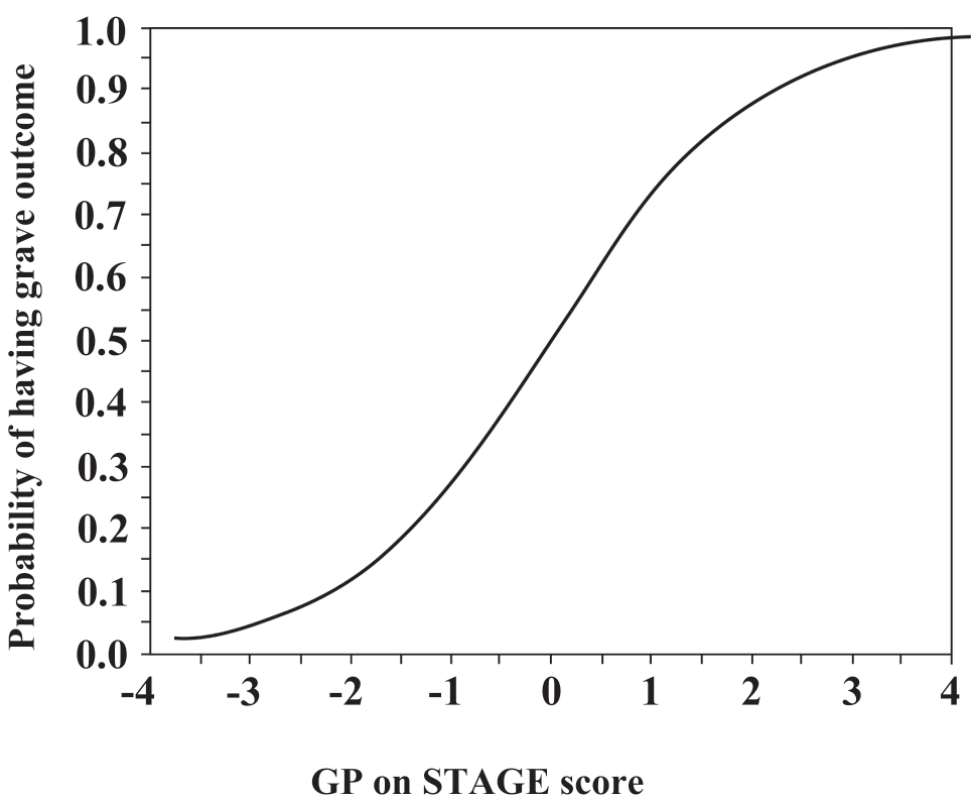

Fig. 1 The probability of the GP on STAGE score to determine the prognosis of patient with intracerebral haemorrhage

Original model:

GP on STAGE score (z) = 2.7915 + 0.8637(Fever) + 0.8992 (Haematoma volume) + 0.9294(IVH) – 0.3653(GCS) .....(1)

Simplified model:

GP on STAGE score (z) = 3 + Fever + Haematoma volume + IVH – 0.35(GCS) .....(2)

Probability of grave outcome (p) = exp (z) / [1 + exp (z)] .....(3)

Where, fever: body temperature (BT) if ≥ 37.8°C = 1; if BT < 37.8°C = 0.

GCS (Glasgow coma scale): determine on arrival, ranging from 3-15.

Haematoma volume: if ≥ 30 mL = 1; if < 30 mL = 0.

IVH (intraventricular haemorrhage): if YES = 1; if NO = 0.

The higher the GP on STAGE score, the higher the probability of grave outcome. The probability of the GP on STAGE score is also provided in the probability curve (Fig. 1). From the curve, a GP on STAGE score of less than -2 indicates the very low probability (11.92%) of having a grave outcome. On the other hand, a GP on STAGE score of more than 2 reflects the very high probability of a grave outcome (88%) and if the score is 0, the probability of having grave outcome is around 50%. For scores between -2 to 2, the use of the probability curve in Figure1 is recommended to predict more accurately the outcome.

To determine the accuracy of the GP on STAGE score in predicting the discharge outcome, patients with the calculated probability (p) of less than 0.5 are predicted as having a survivor outcome, whereas p of ≥ 0.5 is predicted as grave outcome. Cross-tabulation of the true outcome (survivor/grave) and the predicted outcome (survivor/grave) reveals a sensitivity of 82%, specificity of 82% and overall accuracy of 82%.

Discussion

The mean age of our patients was quite young (59.3 ± 14.3 years) but they had a high percentage of vascular risk factors such as hypertension (69.55%), smoking (33.75%), alcohol consumption (27.93%), and diabetes mellitus (16.01%). The mortality rate in our study was 25.73% mainly due to brain herniation (60.94%) and sepsis (10.94%). 402 patients (40.40%) were in the grave outcome group (MRS 5-6 ; death or vegetative state). There have been numerous attempts to identify outcome predictors for ICH[5,6,15-24,26]. Several clinical parameters had been identified for prognosis. Among these, the level of consciousness (GCS) and haematoma volume had been the most robust, while other factors, such as age, fever, present and amount of blood in the ventricles, location of haematoma and high blood pressure; have been reported in some models[15,18,19,24-26] . The main disadvantage of these models is the need for complex algebraic equations to determine the outcome; some required non-weighted parameters and score validations were not reliable[15,18,19]. Furthermore, all studies were conducted to identify clinical variables at 30-days or longer and most of them were retrospective analyses.

In our study with a large sample size (995 patients) from multicenters in Asia, four independent prognostic factors of ICH were identified. We also developed a simple equation using clinical and neuroimaging parameters at the time of admission to predict grave outcome. We found that IVH was the strongest risk factor for outcome (odd ratio 2.53). Other prognostic factors such as fever, low GCS on admission and large haematoma volume were similar to other studies[5,6,15-26,29]. In our study, we not only determined the mortality as a grave prognosis but also included vegetative state, which is considered "worse than death". Thus, we combined death and vegetative state (MRS 5 and 6) in the grave outcome in our prognostic score. We did not aim to validate any previous score of intracerebral haemorrhage. Thus, we selected the combination of MRS 5 and 6 at discharge as the grave prognosis.

IVH seems to be a very powerful predictor of grave outcome, both in our study and others[26], although the pathophysiologic mechanism by which intraventricular blood produces additional morbidity in ICH is still unascertained. One important finding was that haematoma volume over 30 ml was one of the predicting outcomes in our study (odd ratio 2.46). A large prospective observation study from the Stroke Data Bank demonstrated that the frequency of neurologic deterioration was greatest on the first hospital day and most of the patients had a larger haematoma volume (mean volume 45 mL versus 16 mL) on initial CT scan[25]. However, the powerful association between IVH and haematoma volume in our study suggests that the volume of haematoma was underestimated due to extension of blood in to the ventricles and subarachnoid spaces, thus making IVH the strongest predictor of poor outcome.

Evidence from animal and human models clearly showed that even small variations in brain

temperature caused a critical effect on the histopathologic and functional consequences of various types of neuronal injury[30-32]. Schwarz et al reported a high incidence of fever after supratentorial ICH and in association with IVH , particularly increased body temperature at presentation and during the first few days after the insult[28]. Both factors predicted a poor outcome. Several experimental studies have suggested that IVH mechanically affects the hypothalamic thermoregulatory centers and thus induces hyperthermia[30-32]. Analogous to ischemic infarction and head trauma, one may assume that hyperthermia exaggerates the development of brain edema after ICH, whereas decreasing the body temperature to normal or even hypothermia may decrease the extent of brain edema and secondary neuronal damage. Although, the possible benefit from therapeutic measures to decrease body temperature is not yet proved, the careful monitoring of body temperature and treating fever vigorously in patients with ICH seems to be justified[33].

The in-hospital mortality rate in our study was 25.73% which was similar to other studies[5, 6, 15-24, 26, 29]. Surgical intervention and medical treatment proved to be no better than conservative treatment in our study and as similar to other studies[8-14]. We found that mannitol was most commonly used (62.83%) in the grave outcome group whereas dexamethasone was less popular (21.15%) probably because of its well-established disadvantages[34].

In applying the prognostic factors in clinical practice for patients with ICH, several formulas have been identified. One retrospective study conducted by Lisk et al resulted in a complex formula with the sensitivity of 62%[18]. Later, Hemphill et al invented a simple well known clinical grading scale called the ICH score for predicting outcome at 1-month[15]. However, non-weighted parameters were used and the validation of the score is still uncertain for Caucasian and Asian populations[35, 36]. Recently, Cheung et al reported a modified and new ICH score to predicted outcome at 1-month[19]. Nevertheless, one independent prognostic parameter in this study applied a National Institutes of Health Stroke Scale that was not familial to non-neurologist and time consuming in the initial evaluation.

In practice, any clinical grading scale must be simple, reliable, easy to use, and need no special training. Half of stroke deaths occur in Asia and the majority of strokes are seen by nonstroke trained physicians. Hence, there is a real need for a simple and pragmatic score that can be universally applied. Therefore, our study is the first ever study in Asia to demonstrate independent prognostic factors with a practical score and probability curve for predicting grave prognosis in patients with ICH. This GP on STAGE score has high sensitivity and specificity.

The limitation of our study was that a validation study of this equation has not boon performed yet. We thus suggest validating our score in other centers worldwide.

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Appendix

The GP on STAGE score can be calculated using a simple hand calculator to predict whether any ICH patient will have a poor outcome.

Example 1: A 70-year old woman diagnosed as ICH, with BT 38^{o}C, GCS 9 at presentation, haematoma volume is 40 mL and presence of IVH

GP on STAGE score = 3 + BT + Haematoma volume + IVH – 0.35 (GCS)

Where BT: if $\geq$ 37.8^{o}C = 0, < 37.8^{o}C = 1
GCS : determined on arrival, ranging from 3-15
Haematoma volume : if $\geq$ 30 mL = 1, < 30 mL = 0
IVH : if YES = 1, NO = 0,

GP on STAGE score = 3 + 1 +1 + 1 – 3.15
= 2.85

Therefore, the probability of grave outcome in this patient is nearly 90%

Example 2: A 57-year old man diagnosed as ICH, with BT = 37^{o}C, GCS 15 at presentation, haematoma volume = 23 mL and absence of intraventricular bleeding.

GP on STAGE score = 3 + BT + Haematoma volume + IVH – 0.35 (GCS)

Where BT: if $\geq$ 37.8^{o}C = 0, < 37.8^{o}C = 1
GCS : determined on arrival, ranging from 3-15
Haematoma volume : if $\geq$ 30 mL = 1, < 30 mL = 0
IVH : if YES = 1, NO = 0

GP on STAGE score = 3 + 0 + 0 + 0 – 5.25
= - 2.25

Therefore, the probability of grave outcome in this patient is less than 10%

References

1 Caplan LR. Intracerebral haemorrhage. Lancet 1992; 339: 656-8.

2 Broderick JP, Brott T, Tomsick T, Miller R, Huster G. Intracerebral hemorrhage more than twice as common as subarachnoid hemorrhage. J Neurosurg 1993; 78: 188-91.

3 Jorgensen HS, Nakayama H, Raaschou HO, Olsen TS. Intracerebral hemorrhage versus infarction: stroke severity, risk factors, and prognosis. Ann Neurol 1995; 38: 45-50.

4 Qureshi AI, Tuhrim S, Broderick JP, Batjer HH, Hondo H, Hanley DF. Spontaneous intracerebral hemorrhage. N Engl J Med 2001; 344: 1450-60.

5 Nilsson OG, Lindgren A, Brandt L, Saveland H. Prediction of death in patients with primary intracerebral hemorrhage: a prospective study of a defined population. J Neurosurg 2002; 97: 531-6.

6 Poungvarin N, Viriyavejakul A. Spontaneous supratentorial intracerebral haemorrhage: a prognostic study. J Med Assoc Thai 1990; 73: 206-11.

7 Asian Acute Stroke Advisory Panel (AASAP). Stroke epidemiological data of nine Asian countries. J Med Assoc Thai 2000; 83: 1-7.

8 Mendelow AD, Gregson BA, Fernandes HM, Murray GD, Teasdale GM, Hope DT, et al. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. Lancet 2005; 365: 387-97.

9 Juvela S, Heiskanen O, Poranen A, Valtonen S, Kuurne T, Kaste M, et al. The treatment of spontaneous intracerebral hemorrhage. A prospective randomized trial of surgical and conservative treatment. J Neurosurg 1989; 70: 755-8.

10 Auer LM, Deinsberger W, Niederkorn K, Gell G, Kleinert R, Schneider G, et al. Endoscopic surgery versus medical treatment for spontaneous intracerebral hematoma: a randomized study. J Neurosurg 1989; 70: 530-5.

11 Hankey GJ, Hon C. Surgery for primary intracerebral hemorrhage: is it safe and effective? A systematic review of case series and randomized trials. Stroke 1997; 28: 2126-32.

12 Batjer HH, Reisch JS, Allen BC, Plaizier LJ, Su CJ. Failure of surgery to improve outcome in hypertensive putaminal hemorrhage. A prospective randomized trial. Arch Neurol 1990; 47: 1103-6.

13 Zuccarello M, Brott T, Derex L, Kothari R, Sauerbeck L, Tew J, et al. Early surgical treatment for supratentorial intracerebral hemorrhage: a randomized feasibility study. Stroke 1999; 30: 1833-9.

14 Fernandes HM, Gregson B, Siddique S, Mendelow AD. Surgery in intracerebral hemorrhage. The uncertainty continues. Stroke 2000; 31: 2511-6.

15 Hemphill JC 3rd, Bonovich DC, Besmertis L, Manley GT, Johnston SC. The ICH score: a simple, reliable grading scale for intracerebral hemorrhage. Stroke 2001; 32: 891-7.

16 Juvela S. Risk factors for impaired outcome after spontaneous intracerebral hemorrhage. Arch Neurol 1995; 52: 1193-200.

17 Lampl Y, Gilad R, Eshel Y, Sarova-Pinhas I. Neurological and functional outcome in patients with supratentorial hemorrhages. A prospective study. Stroke 1995; 26: 2249-53.

18 Lisk DR, Pasteur W, Rhoades H, Putnam RD, Grotta JC. Early presentation of hemispheric intracerebral hemorrhage: prediction of outcome and guidelines for treatment allocation. Neurology 1994; 44: 133-9.

19 Cheung RT, Zou LY. Use of the original, modified, or new intracerebral hemorrhage score to predict mortality and morbidity after intracerebral hemorrhage. Stroke 2003; 34: 1717-22.

20 Daverat P, Castel JP, Dartigues JF, Orgogozo JM. Death and functional outcome after spontaneous intracerebral hemorrhage. A prospective study of 166 cases using multivariate analysis. Stroke 1991; 22: 1-6.

21 Razzaq AA, Hussain R. Determinants of 30-day mortality of spontaneous intracerebral hemorrhage in Pakistan. Surg Neurol 1998; 50: 336-42.

22 Vermeer SE, Algra A, Franke CL, Koudstaal PJ, Rinkel GJ. Long-term prognosis after recovery from primary intracerebral hemorrhage. Neurology 2002; 59: 205-9.

23 Tuhrim S, Dambrosia JM, Price TR, Mohr JP, Wolf PA, Hier DB, et al. Intracerebral hemorrhage: external validation and extension of a model for prediction of 30-day survival. Ann Neurol 1991; 29: 658-63.

24 Broderick JP, Brott TG, Duldner JE, Tomsick T, Huster G. Volume of intracerebral hemorrhage. A powerful and easy-to-use predictor of 30-day mortality. Stroke 1993; 24: 987-93.

25 Mayer SA, Sacco RL, Shi T, Mohr JP. Neurologic deterioration in noncomatose patients with supratentorial intracerebral hemorrhage. Neurology 1994; 44: 1379-84.

26 Tuhrim S, Horowitz DR, Sacher M, Godbold JH.

Volume of ventricular blood is an important determinant of outcome in supratentorial intracerebral hemorrhage. Crit Care Med 1999; 27: 617-21.
27 Kothari RU, Brott T, Broderick JP, Barsan WG, Sauerbeck LR, Zuccarello M, et al. The ABCs of measuring intracerebral hemorrhage volumes. Stroke 1996; 27: 1304-5.
28 Schwarz S, Hafner K, Aschoff A, Schwab S. Incidence and prognostic significance of fever following intracerebral hemorrhage. Neurology 2000; 54: 354-61.
29 Qureshi AI, Bliwise DL, Bliwise NG, Akbar MS, Uzen G, Frankel MR. Rate of 24-hour blood pressure decline and mortality after spontaneous intracerebral hemorrhage: a retrospective analysis with a random effects regression model. Crit Care Med 1999; 27: 480-5.
30 Rudy TA, Westergaard JL, Yaksh TL. Hyperthermia produced by simulated intraventricular hemorrhage in the cat. Exp Neurol 1978; 58: 296-310.
31 Serlin S. Intraoperative hyperthermia associated with intraventricular hemorrhage. J Clin Anesth 1991; 3: 153-5.
32 Pomerance JJ, Richardson CJ. Hyperpyrexia as a sign of intraventricular hemorrhage in the neonate. Am J Dis Child 1973; 126: 854-5.
33 Broderick JP, Adams HP Jr, Barsan W, Feinberg W, Feldmann E, Grotta J, et al. Guidelines for the management of spontaneous intracerebral hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. Stroke 1999; 30: 905-15.
34 Poungvarin N, Bhoopat W, Viriyavejakul A, Rodprasert P, Buranasiri P, Sukondhabhant S, et al. Effects of dexamethasone in primary supratentorial intracerebral hemorrhage. N Engl J Med 1987; 316: 1229-33.
35 Fernandes H, Gregson BA, Siddique MS, Mendelow AD. Testing the ICH score. Stroke 2002; 33: 1455-6.
36 Jamora RD, Kishi-Generao EM Jr, Bitanga ES, Gan RN, Apaga NE, San Jose MC. The ICH score: predicting mortality and functional outcome in an Asian population. Stroke 2003; 34: 6-7.

การพยากรณ์โรคที่เลวในโรคเลือดออกในสมองโดยใช้ GP และ STAGE Score

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ความรู้พื้นฐานและวัตถุประสงค์: *โรคเลือดออกในสมองพบบ่อยในชาวเอเชียมากกว่าชาวตะวันตก และเป็นโรคที่มีอัตราตายสูง ในปัจจุบันยังไม่มีวิธีการคำนวณแต้มง่าย ๆ เพื่อบอกการพยากรณ์ที่เลวร้ายของโรคนี้ วัตถุประสงค์ของกลุ่มผู้วิจัยเพื่อสร้างวิธีการคำนวณแต้มง่าย ๆ และเชื่อถือได้เพื่อให้แพทย์ทั่วไปใช้ในการพยากรณ์โรคเลือดออกในสมอง*

วัสดุและวิธีการ: *รวบรวมผู้ป่วยโรคเลือดออกในสมองจาก 7 ประเทศในเอเชียที่เกิดขึ้นในช่วง 2 ปี ระหว่างเดือนพฤษภาคม พ.ศ. 2543 ถึง เมษายน พ.ศ. 2545 ลักษณะอาการทางคลินิกต่าง ๆ ได้แก่อาการปวดศีรษะ อาการอาเจียน ปัจจัยเสี่ยงโรคหลอดเลือดสมอง กลาสโกว์โคมาสเกล อุณหภูมิกาย ค่าความดันโลหิตขณะผู้ป่วยถึงโรงพยาบาล ขนาดก้อนเลือด ตำแหน่งก้อนเลือด การที่มีเลือดแตกเข้าโพรงสมอง โพรงสมองโต การผ่าตัดสมอง การรักษาโดยยาต่าง ๆ นำมาวิเคราะห์เพื่อประเมินผลการรักษาโดยใช้ค่าแรนกินสเกลที่ดัดแปลง ซึ่งกำหนดค่าพยากรณ์โรคที่เลวเมื่อมีค่าแรนกินสเกลที่ดัดแปลงที่ 5 และ 6 ในวันจำหน่ายผู้ป่วยออกจากโรงพยาบาล*

ผลการศึกษา: *ผู้ป่วยทั้งหมดมี 995 คน มีอายุเฉลี่ยที่ 59.5±14.3 ปี โดยคัดผู้ป่วยออกไป 87 ราย เพราะข้อมูลไม่ครบ ผู้ป่วยจำนวน 402 ราย (ร้อยละ 40.4) ถูกจัดอยู่ในกลุ่มที่มีการพยากรณ์โรคเลว (ค่าแรนกินสเกลที่ดัดแปลงแล้วที่ 5 และ 6) การวิเคราะห์ทางสถิติโดยใช้ univariate และ multivariate พบว่ามีปัจจัย 4 อย่างที่จะบอกถึงพยากรณ์โรคในทางที่เลว ได้แก่ อาการไข้ (อุณหภูมิกายสูงกว่า 37.8 องศาเซลเซียส) ค่ากลาสโกว์โคมาสเกลที่ต่ำ ขนาดก้อนเลือดที่โตและการมีเลือดแตกเข้าในโพรงสมอง จากนั้นได้สร้างวิธีการคำนวณแต้มที่เรียกว่า GP on STAGE score โดยอาศัยปัจจัยทั้ง 4 ชนิดดังกล่าวโดยวิธี multiple logistic model*

สรุป: *คณะผู้วิจัยได้สร้างวิธีการคำนวณแต้มง่ายๆ ขึ้นมาเพื่อพยากรณ์โรคที่เลวในผู้ป่วยโรคเลือดออกในสมอง โดยมีความไวสูงถึงร้อยละ 82 และความจำเพาะสูงร้อยละ 82 เช่นกัน วิธีนี้สามารถใช้ได้ง่ายโดยแพทย์ทั่วไป*