Possibilities of verification of a short-term functional outcome prognosis in the acute period of spontaneous supratentorial intracerebral hemorrhage using modified variants of the Intracerebral Hemorrhage Scale

A. A. Kuznetsov

Zaporizhzhia State Medical University, Ukraine

The main purpose of the study was to analyze a diagnostic informative value of modified variants of the Intracerebral Hemorrhage Scale as techniques for detecting adverse functional outcome risk in the acute period of spontaneous supratentorial intracerebral hemorrhage (SSICH).

Materials and methods. A total of 122 conservatively treated patients (mean age was 64.7 ± 1.1 years old) in the acute period of SSICH were enrolled in a prospective study. Clinical and neuroimaging assessment of the patients’ condition severity was conducted on admission to hospital using the ICH Scale and its modified versions (mICH-A, mICH-B). The value >3 in accordance with the modified Rankin Scale on the 21st day of disease was considered as unfavourable functional outcome in SSICH. The ROC analysis was used for the comparative analysis of the scales’ informative value and for the criteria development.

Results. The unfavourable functional outcome in the acute period of SSICH was registered in 50 (41.0 %) patients. These patients at the disease onset had significantly higher values in accordance with the mICH-A Scale (4 (3; 5) versus 2 (1; 3), P < 0.0001) and the mICH-B Scale (3 (2; 4) versus 1 (0; 2), P < 0.0001). It was determined that modified versions of the ICH Scale was more accurate than the original ICH Scale as for a short-term functional prognosis verification (AUCmICH-A 0.81 ± 0.04 (0.73–0.88) versus AUCmICH-B 0.74 ± 0.04, P = 0.0104), whereas the mICH-A Scale scores >2 became the predictors of an unfavourable functional outcome in the acute period of disease (sensitivity = 76.0 %; specificity = 68.1 %; RR = 3.6 (3.1–4.1), P < 0.0001) as well as the mICH-B Scale scores >1 (sensitivity = 76.0 %; specificity = 68.1 %; RR = 3.2 (2.8–3.6), P < 0.0001).

Conclusions. Modified versions of the ICH Scale are informative tools for the verification of a short-term functional prognosis in patients with SSICH.

Key words: cerebral hemorrhage, prognosis.

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E-mail: titus3.05@gmail.com
The choice of optimal tactics for patient management with spontaneous supratentorial intracerebral hemorrhage (SSICH) is one of the most difficult and, unfortunately, still unsolved problems in modern neurology [1]. It is highly important from the medical and social point of view due to leading positions of this pathology in the cause-of-death and disability structure among the adult population in most countries of the world [2, 3].

One of the most effective ways of solving the problem is to develop a differentiated treatment strategy choice, taking into consideration an individual short-term prognosis [1, 4]. In this context, it is appropriate to use the tools of clinical neuroimaging assessment of the severity at the disease onset. The “gold standard” in this area is the original Intracerebral Hemorrhage (oICH) Scale, which demonstrated a high informative value when used to detect the risk for a lethal outcome of acute hemorrhagic stroke [5, 6].

At the same time, the results of our previous study showed a significantly lower informative value of the oICH Scale when used to evaluate a short-term functional prognosis in this cohort of patients [7]. All of the above justifies the search for alternative tools for clinical neuroimaging scoring. In view of these facts, our attention was drawn to modified versions of the oICH Scale [8]. Available research literature did not reveal any information on the studies related to the development of criteria for the short-term functional outcome after SSICH in the acute period using modified oICH Scale variants.

The aim
The aim of the study was to analyze a diagnostic informative value of modified variants of the Intracerebral Hemorrhage Scale as techniques for detecting adverse functional outcome risk in the acute period of SSICH.

Materials and methods
The study included 122 patients with SSICH (65 men and 57 women, the mean age was 64.7 ± 1.1 years old) who were admitted to the Brain Circulation Disorders Department of the Municipal Institution “Zaporizhzhia City Clinical Hospital No 6” within the first 24 hours from the disease onset and underwent conservative therapy.

Results
The unfavourable functional outcome in the acute period of SSICH was registered in 50 (41 %) patients. The frequency of the unfavourable outcome in the acute period of SSICH in patients with different values of the mICH-A Scale score and mICH-B Scale score is presented in Tables 1 and 2.

Based on comparison analysis, it was found that patients with unfavourable outcome in the acute period of SSICH had statistically higher values of the mICH-A Scale score (4 (3; 5) versus 2 (1; 3), P < 0.0001), the mICH-B Scale score (3 (2; 4) versus 1 (0; 2), P < 0.0001) and the oICH Scale score (1 (1; 2) versus 0 (0; 1), P < 0.0001) at the disease onset.

The gradations distribution of the mICH-A Scale and mICH-B Scale subtest values in comparison with the func-
The frequency of the unfavourable outcome in the acute period of SSICH in patients with different values of mICH-A Scale score

| mICH-A Scale score | Total number of patients (n) | Unfavourable functional outcome (%) |
|--------------------|-----------------------------|-------------------------------------|
| 0                  | 4                           | 25.0                                |
| 1                  | 22                          | 4.5                                 |
| 2                  | 36                          | 27.8                                |
| 3                  | 26                          | 42.3                                |
| 4                  | 18                          | 61.1                                |
| 5                  | 10                          | 100.0                               |
| 6                  | 3                           | 100.0                               |
| 7                  | 2                           | 100.0                               |
| 8                  | 1                           | 100.0                               |

The frequency of the unfavourable outcome in the acute period of SSICH in patients with different values of mICH-B Scale score

| mICH-B Scale score | Total number of patients (n) | Unfavourable functional outcome (%) |
|--------------------|-----------------------------|-------------------------------------|
| 0                  | 21                          | 9.5                                 |
| 1                  | 40                          | 25.0                                |
| 2                  | 23                          | 34.8                                |
| 3                  | 21                          | 71.4                                |
| 4                  | 11                          | 81.8                                |
| 5                  | 2                           | 100.0                               |
| 6                  | 3                           | 100.0                               |
| 7                  | 1                           | 100.0                               |

The gradations distribution of the mICH-A Scale subtest values in comparison with the functional outcome in the acute period of SSICH

| Subtest | Favourable functional outcome (n=72) | Unfavourable functional outcome (n=50) | Pearson’s chi-squared test statistic | P   |
|---------|--------------------------------------|---------------------------------------|-------------------------------------|-----|
| Age, years |                                     |                                       |                                     |     |
| <50     | 9 (12.5 %)                          | 1 (2.0 %)                             |                                     | 17.0 | 0.0002 |
| ≥50     | 35 (48.6 %)                         | 11 (22.0 %)                           |                                     |      |       |
| Glasgow Coma Scale score |                          |                                       |                                     |     |
| 14–15   | 55 (76.4 %)                         | 32 (64.0 %)                           |                                     | 6.6  | 0.0851 |
| 9–13    | 17 (23.6 %)                         | 14 (28.0 %)                           |                                     |      |       |
| 6–8     | 0 (0.0 %)                           | 2 (4.0 %)                             |                                     |      |       |
| 3–5     | 0 (0.0 %)                           | 2 (4.0 %)                             |                                     |      |       |

Intracerebral hemorrhage volume, mL

| Intracerebral hemorrhage volume, mL | Favourable functional outcome (n=72) | Unfavourable functional outcome (n=50) | Pearson’s chi-squared test statistic | P   |
|------------------------------------|--------------------------------------|---------------------------------------|-------------------------------------|-----|
| <30                               | 64 (88.9 %)                         | 37 (74.0 %)                           |                                     | 4.7  | 0.0959 |
| ≥30                               | 5 (0.9 %)                           | 9 (18.0 %)                            |                                     |      |       |
| Glaeb Scale score |                          |                                       |                                     |     |
| 0                                 | 49 (68.1 %)                         | 16 (32.0 %)                           |                                     |      |       |
| 1–4                               | 22 (30.8 %)                         | 14 (28.0 %)                           |                                     |      |       |
| 5–8                               | 1 (1.3 %)                           | 18 (36.0 %)                           |                                     |      |       |
| ≥9                                | 0 (0.0 %)                           | 2 (4.0 %)                             |                                     |      |       |

The gradations distribution of the mICH-B Scale subtest values in comparison with the functional outcome of SSICH acute period

| Subtest | Favourable functional outcome (n=72) | Unfavourable functional outcome (n=50) | Pearson’s chi-squared test statistic | P   |
|---------|--------------------------------------|---------------------------------------|-------------------------------------|-----|
| Age, years |                                     |                                       |                                     |     |
| <55     | 44 (61.1 %)                          | 12 (24.0 %)                           |                                     | 15.0 | <0.0001 |
| ≥55     | 28 (38.9 %)                          | 38 (76.0 %)                           |                                     |      |       |
| Glasgow Coma Scale score |                          |                                       |                                     |     |
| 14–15   | 55 (76.4 %)                         | 32 (64.0 %)                           |                                     | 6.6  | 0.0851 |
| 9–13    | 17 (23.6 %)                         | 14 (28.0 %)                           |                                     |      |       |
| 6–8     | 0 (0.0 %)                           | 2 (4.0 %)                             |                                     |      |       |
| 3–5     | 0 (0.0 %)                           | 2 (4.0 %)                             |                                     |      |       |
| Intracerebral hemorrhage volume, mL |                          |                                       |                                     |     |
| <30     | 64 (88.9 %)                         | 37 (74.0 %)                           |                                     | 4.7  | 0.0959 |
| ≥30     | 5 (0.9 %)                           | 9 (18.0 %)                            |                                     |      |       |
| Glaeb Scale score |                          |                                       |                                     |     |
| 0                                 | 49 (68.1 %)                         | 16 (32.0 %)                           |                                     |      |       |
| 1–3                              | 19 (26.4 %)                         | 9 (18.0 %)                            |                                     |      |       |
| >3                               | 4 (5.5 %)                           | 25 (50.0 %)                           |                                     |      |       |

It was determined that the ICH Scale were less informative than the mICH-A Scale (AUC ± SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.81 ± 0.04 (0.73–0.88), P = 0.0062) and the mICH-B Scale (AUC±SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.80 ± 0.04 (0.72–0.87), P = 0.0104) as a technique for detecting adverse functional outcome risk in the acute period of SSICH. At the same time, patients with different variants of the functional outcome of SSICH in the acute period were not only of different ages and the Graeb Scale score at the disease onset, but also they had different the Glasgow Coma Scale score and intracerebral hemorrhage volume (Table 5).

It was determined that the mICH Scale were less informative than the mICH-A Scale (AUC ± SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.81 ± 0.04 (0.73–0.88), P = 0.0062) and the mICH-B Scale (AUC±SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.80 ± 0.04 (0.72–0.87), P = 0.0104) as a technique for detecting adverse functional outcome risk in the acute period of SSICH, whereas the accuracy of a short-term functional prognosis verification using the mICH-A and mICH-B Scales accounted for 75.1 % and 77.1 %, respectively, (Pearson’s chi-squared test statistic = 32.8 for the mICH-A Scale, P < 0.0001; Pearson’s chi-squared test statistic = 32.8 for the mICH-B Scale, P < 0.0001) as well as the ICH Scale were less informative than the mICH-A Scale (AUC ± SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.81 ± 0.04 (0.73–0.88), P < 0.0001) as a technique for detecting adverse functional outcome risk in the acute period of SSICH.

The ROC-analysis showed, that mICH-A Scale score >2 and mICH-B Scale score >1 were the predictors of unfavourable functional outcome in the acute period of SSICH, whereas the accuracy of a short-term functional prognosis verification using the mICH-A and mICH-B Scales accounted for 75.1 % and 77.1 %, respectively, (Pearson’s chi-squared test statistic = 1.01, P = 0.2945).

It was determined that the mICH-A Scale score >2 and mICH-B Scale score >1 were associated with the risk of an unfavourable functional outcome of SSICH in the acute period, multiplied by 3.6 (RR 95 % CI 3.1–4.1, P < 0.0001) and 3.2, respectively, (RR 95 % CI 3.1–4.1, P < 0.0001) and the mICH-B Scale (AUC ± SE (95 % CI) 0.74 ± 0.04 (0.65–0.81) versus 0.80 ± 0.04 (0.72–0.87), P = 0.0104) as a technique for detecting adverse functional outcome risk in the acute period of SSICH.

The gradations distribution of the mICH-A Scale subtest values in comparison with the functional outcome in the acute period of SSICH

**Discussion**

In the course of the study, it was determined that the modified versions of the oICH Scale were informative tools to detect an individual risk for an unfavourable functional outcome in the acute period of SSICH.
outcome of SSICH in the acute period. The AUC values of the specified scales (≥0.80) corresponded to the gradation “very good” in accordance with the International Expert Scale for the quality of binary classifiers assessment (1993) [9]. In our opinion, a high informative value of these scales was supported by the integral assessment of clinical and neuroimaging data, which was associated with the outcome of disease in the acute period. The obtained data are consistent with the results of other studies, which demonstrated the negative effect of SIVH severity on the SSICH outcome [11,12].

All of the above justifies the expediency of using the modified versions of the oICH Scale in order to make a short-term functional prognosis of SSICH outcome in the acute period.

Conclusions

1. Modified variants of the ICH Scale are informative tools for the verification of a short-term functional prognosis in patients with SSICH and are more accurate than the ICH Scale to detect an individual risk for an unfavourable functional outcome of disease in the acute period (AUC_{mICH_A} 0.81 ± 0.04 (0.73–0.88) versus AUC_{oICH} 0.74 ± 0.04, P = 0.0062; AUC_{mICH_B} 0.80 ± 0.04 (0.72–0.87) versus AUC_{oICH} 0.74 ± 0.04, P = 0.0104).

2. Predictors of the mRS score >3 on the 21st day of SSICH are the mICH-A Scale score >2 (Se = 76.0 %; Sp = 68.1 %; RR 95 % CI = 3.6 (3.1–4.1), P < 0.0001) and the mICH-B Scale score >1 (Se = 76.0 %; Sp = 68.1 %; RR 95 % CI = 3.2 (2.8–3.6), P < 0.0001).

The perspective for the further scientific research is to assess the informative value of modified versions of the ICH Scale for a short-term vital prognosis determination in patients with SSICH.

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Information about author: Kuznietsov A. A., MD, PhD, Associate Professor of the Department of Nervous Diseases, Zaporizhzhia State Medical University, Ukraine.
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