Prediction of cerebral hemorrhagic supratentorial stroke acute period outcome on the basis of the assessment of secondary intraventricular hemorrhage severity in the onset of the disease

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Key words: cerebral hemorrhage, X-Ray tomography, prognosis.

Materials and methods. A complex clinical and paraclinical study was conducted in 70 patients (38 men and 32 women, aged 66 (58; 74) years) who have CHSS and secondary IVH confirmed by a clinical and neuroimaging examination, who were hospitalized within the first 24 hours since the onset of the disease and received conservative therapy. Intraventricular hemorrhage (IVH) severity was assessed in terms of Graeb Scale, IVH Scale and LeRoux Scale. To determine the prediction criteria, ROC analysis was used, calculating sensitivity (Se) and specificity (Sp) parameters.

Results. Lethal outcome was registered in 18.6 % cases, unfavorable functional outcome (modified Rankin Scale score (mRS) = 4–5 on the 21st day of the disease) – in 44.3 % patients. It was determined that IVH Scale (AUC = 0.94, P < 0.05) has a higher informative value than Graeb Scale (AUC = 0.89, P < 0.05) and LeRoux Scale (AUC = 0.88, P < 0.05) for a lethal prognosis of CHSS acute period outcome. It was detected that Graeb Scale, Intraventricular Hemorrhage Scale and LeRoux Scale are more informative for the determination of vital rather than functional prognosis of CHSS acute period outcome (AUC = 0.89 versus AUC = 0.74 for Graeb Scale, P < 0.05; AUC = 0.94 versus AUC = 0.79 for IVH Scale, P < 0.05; AUC = 0.88 versus AUC = 0.72 for LeRoux Scale, P < 0.05).

Conclusions. Predictors of the lethal outcome of CHSS acute period are Graeb Scale score >5 (Se = 84.6 %, Sp = 77.2 %), IVH Scale score >16 (Se = 84.6 %, Sp = 96.5 %) and LeRoux Scale score >9 (Se = 84.6 %, Sp = 86.0 %). Graeb Scale score ≤3 (Se = 69.2 %, Sp = 72.7 %), IVH Scale score <8 (Se = 69.2 %, Sp = 79.5 %) and LeRoux Scale score ≤3 Se = 69.2 %, Sp = 72.7 %) are the criteria for the favourable functional outcome of CHSS acute period (mRS score ≤3 on the 21st day).

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Цель работы — разработать критерии прогнозирования исхода остrego периода мГСИ на основании оценки выраженности вторичного внутрижелудочкового кровоизлияния в дебюте заболевания.

Материалы и методы. Проведено комплексное клинико-параклиническое исследование 70 пациентов (38 мужчин и 32 женщин, возраст — 66 (58; 74) лет) с подтвержденным по данным клинико-нейровизуализационного исследования мГСИ и вторичным ВЖК, которые были госпитализированы в первые 24 часа от дебюта заболевания и получали консерваторную терапию. Выраженность вторичного ВЖК оценивалась в баллах по Graeb Scale, Intraventricular hemorrhage (IVH) Scale и LeRoux Scale. Для определения критериев прогнозирования использовался ROC-анализ с расчетом параметров чувствительности (Se) и специфичности (Sp).

Результаты. Летальный исход был зарегистрирован в 18,6 % случаев, относительно неблагоприятный исход в форме 4–5 баллов по модифицированной шкале Рэнкина (мШР) и более на 21 сутки заболевания — у 44,3 % пациентов. Выявлено, что IVH Scale (AUC = 0,94, p < 0,05) превосходит по информативности Graeb Scale (AUC = 0,89, p < 0,05) и LeRoux Scale (AUC = 0,88, p < 0,05) для прогнозирования летального исхода остrego периода мГСИ. Установлено, что Graeb scale, IVH scale и LeRoux scale более информативны для определения витального, нежели функционального прогноза исхода остrego периода мГСИ (AUC = 0,89 против AUC = 0,74 для Graeb scale, p < 0,05; AUC = 0,94 против AUC = 0,79 для IVH scale, p < 0,05; AUC = 0,88 против AUC = 0,72 для LeRoux scale, p < 0,05).

Выводы. Предикторами летального исхода остrego периода мГСИ выступают значения >5 баллов по Graeb Scale (Se = 84,6 %, Sp = 77,2 %), >16 баллов по IVH Scale (Se = 84,6 %, Sp = 96,5 %) и >9 баллов по LeRoux Scale (Se = 84,6 %, Sp = 86,0 %). Критериями благоприятного функционального исхода остrego периода мГСИ (≤3 балла по мШР на 21 сутки заболевания) являются значения по Graeb Scale ≤3 (Se = 69,2 %, Sp = 72,7 %), IVH Scale ≤8 (Se = 69,2 %, Sp = 79,5 %) и LeRoux Scale ≤3 (Se = 69,2 %, Sp = 72,7 %).

Introduction
Cerebral hemorrhagic stroke (CHS) is the most destructive type of acute cerebrovascular accidents, which is at leading positions in the list of causes of death and disability in young and middle-aged people in most countries of the world [1,2]. The 30-day mortality rate from CHS constitutes 35–52 %, and about 80 % among survived patients, have severe consequences in the form of pronounced neurological deficit, which causes permanent disability and need for physical assistance in everyday life [3,8].

30-45 % of cases of spontaneous intracerebral hemorrhage (SICH) are complicated by intraventricular hemorrhage (IVH) [5,6]. In accordance with the numerous studies, the presence of secondary IVH is an independent predictor of early clinical deterioration and poor outcome in patients with SICH [4,9,10], which suggests the presence of secondary IVH in the spectrum of parameters associated with the acute period outcome of the disease [11].

The aim
Criteria for a short-term vital and functional prognosis for cerebral hemorrhagic supratentorial stroke (CHSS) acute period, that would take into account the secondary IVH severity in the onset of the disease, are currently lacking, and the aim of this study was to develop criteria for the prediction of cerebral hemorrhagic supratentorial stroke (CHSS) acute period outcome on the basis of the assessment of secondary intraventricular hemorrhage severity in the onset of the disease.
The results of the analysis of interrelation between the severity of secondary IVH and clinical and neurological data in patients on the basis of Spearman’s rank correlation coefficient (R)

<table>
<thead>
<tr>
<th>Scales</th>
<th>NIHSS score on the 1st day</th>
<th>Glasgow Coma Scale score on the 1st day</th>
<th>Modified Rankin Scale score on the 21st day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graeb Scale score</td>
<td>+0.44*</td>
<td>-0.40*</td>
<td>+0.54*</td>
</tr>
<tr>
<td>IVH Scale score</td>
<td>+0.54*</td>
<td>-0.50*</td>
<td>+0.64*</td>
</tr>
<tr>
<td>LeRoux Scale score</td>
<td>+0.43*</td>
<td>-0.39*</td>
<td>+0.51*</td>
</tr>
</tbody>
</table>

*: P < 0.05.

Analysis of differences of Graeb Scale score, IVH Scale score and LeRoux Scale score in groups of patients with lethal and non-lethal outcome of CHSS acute period, Me (Q1; Q3)

<table>
<thead>
<tr>
<th>Scales</th>
<th>Lethal outcome (n = 13)</th>
<th>Non-lethal outcome (n = 57)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graeb Scale score</td>
<td>9 (8; 10)</td>
<td>4 (2; 5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>IVH Scale score</td>
<td>20 (17; 20)</td>
<td>9 (3; 13)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LeRoux Scale score</td>
<td>13 (10; 14)</td>
<td>4 (2; 7)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Results of research and discussion

In the onset of the disease, the following indexes were registered in patients: NIHSS score = 12 (8; 15), GCS score = 14 (12; 15), Graeb Scale score = 4 (2; 7), IVH Scale score = 10 (6; 14) and LeRoux Scale score = 4.5 (2; 10).

A correlation analysis was made to determine the level of correlation between the severity of secondary IVH in patients with CHSS and clinical and neurological data in the acute period of the disease. The results of the analysis are presented in Table 1.

Direct relation between the severity of secondary IVH and the baseline level of neurological deficit, as well as the disability status on the 21st day of the disease were moderate, which suggests the presence of Graeb Scale score, the IVH Scale score and the LeRoux Scale score in the spectrum of predictors of acute CHSS period outcome.

The following outcomes of the acute period of the disease were registered in patients: lethal outcome (18.6 %), unfavorable functional outcome in the form of ≤3 points value in accordance with mRS (44.3 %) and favorable functional outcome in the form of ≥3 points value in accordance with mRS (37.1 %).

The Graeb Scale score, IVH Scale score and LeRoux Scale score in the onset of the disease were significantly higher in patients with CHSS who had a lethal outcome in the acute period in comparison with patients with non-lethal outcome (Table 2).

On the basis of ROC-analysis it was determined that predictors of the acute period lethal outcome of the disease are: Graeb Scale score >5 (Se = 84.6 %, Sp = 77.2 %), IVH Scale score >16 (Se = 84.6 %, Sp = 96.5 %) and LeRoux Scale score >9 (Se = 84.6 %, Sp = 86.0 %).

It was determined that IVH Scale (AUC = 0.94) has a higher informative value than Graeb Scale (AUC = 0.89, P < 0.05) and LeRoux Scale (AUC = 0.88, P < 0.05) for CHSS acute period lethal outcome prediction.

It was detected that Graeb Scale score, IVH Scale score and LeRoux Scale score in the onset of the disease were significantly higher in patients with CHSS who had an unfavorable functional outcome in the acute period in comparison with patients with favorable functional outcome (Table 3).

It was determined that criteria for a favorable functional outcome of CHSS acute period are Graeb Scale score ≤3 (Se = 69.2 %, Sp = 72.7 %), IVH Scale score <8 (Se = 69.2 %, Sp = 79.5 %) and LeRoux Scale score ≤3 (Se = 69.2 %, Sp = 72.7 %), while the Graeb Scale score = 4–5, IVH Scale score = 9–16 and LeRoux Scale score = 4–9 are associated with an unfavorable functional outcome.

It was found out that the predictive value of Le-Roux scale (AUC = 0.72) is inferior to that of IVH scale (AUC = 0.79, P < 0.05) and Graeb scale (AUC = 0.74, P < 0.05) as for the determination of the functional recovery level on the 21st day since the onset of the disease.

On the basis of a comparative analysis of AUC indexes, it was determined that Graeb Scale, Intracerebral Hemorrhage Scale and LeRoux Scale are more informative for the determination of vital rather than functional prognosis of CHSS acute period outcome (AUC = 0.89 versus AUC = 0.74 for Graeb Scale, P < 0.05; AUC = 0.94 versus AUC = 0.79 for IVH Scale, P < 0.05; AUC = 0.88 versus AUC = 0.72 for LeRoux Scale, P < 0.05).

The obtained results are adjusted with the research conducted by B.Y. Hwang et al. 2012 in which the connection between higher Graeb Scale score, IVH Scale score, LeRoux Scale score and poor functional outcome was displayed, but any differences between informative values of IVH Scale, Graeb Scale and LeRoux Scales for a prediction of CHSS acute period functional outcome were not found there – areas under the receiver operating characteristic curve were similar among the IVH, Graeb, and LeRoux scores (0.745, 0.743, and 0.744, respectively) [7]. In our research it was claimed that IVH Scale is characterized by the highest informative value for prediction of CHSS with a secondary IVH acute period lethal outcome (AUC = 0.94 versus AUC = 0.89 for Graeb Scale and AUC = 0.88 for LeRoux Scale) and for prediction functional recovery on the 21st day of the disease (AUC = 0.79 versus AUC = 0.74 for Graeb Scale and AUC = 0.72 for LeRoux Scale).

In our opinion, the results are due to the fact that IVH Scale was adjusted.
allows a more differentiated assessment of the severity of IVH, as it takes into consideration the difference between the sizes of lateral cerebral ventricles and other ventricles.

Thus, the study made it possible to justify the use of assessment scales of the severity of secondary IVH in the onset of CHSS to predict the acute period outcome of the disease and to determine the values of the Graeb Scale, Intraventricular Hemorrhage Scale and LeRoux Scale by optimal sensitivity and specificity ratio. However, further research is needed to obtain more informative criteria for the prediction of the functional outcome of CHSS acute period along with a secondary IVH.

Conclusions

1. Predictors of the lethal outcome of CHSS acute period are Graeb Scale score >9 (Se = 84.6 %, Sp = 77.2 %), IVH Scale score >16 (Se = 84.6 %, Sp = 96.5 %) and LeRoux Scale score >9 (Se = 84.6 %, Sp = 86.0 %).
2. Graeb Scale score ≤3 (Se = 69.2 %, Sp = 72.7 %), IVH Scale score ≤8 (Se = 69.2 %, Sp = 79.5 %) and LeRoux Scale score ≤3 (Se = 69.2 %, Sp = 72.7 %) are the criteria for the favourable functional outcome of CHSS acute period (mRS score ≤3 on the 21st day).
3. The predictive value of Intraventricular Hemorrhage Scale (AUC = 0.94) is superior to Graeb Scale (AUC = 0.89, P < 0.05) and LeRoux Scale (AUC = 0.88, P < 0.05) as for the definition of the vital prognosis of CHSS acute period outcome.
4. LeRoux Scale (AUC = 0.72) is less informative than IVH Scale (AUC = 0.79, P < 0.05) and Graeb Scale (AUC = 0.74, P < 0.05) as for the prediction of the functional outcome of CHSS acute period.
5. Graeb Scale, Intraventricular Hemorrhage Scale and LeRoux Scale are more informative as for the determination of vital, rather than functional outcome of CHSS acute period.

The perspective for the further scientific research is the elaboration of the differential approach for the optimal treatment choice in patients with CHSS and secondary IVH on the ground of individual acute period outcome prognosis.

References


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Conflicts of Interest: author has no conflict of interest to declare.

Конфлікт інтересів: відсутній.