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Optimal Times of Carrying Out of Operative Treatment of Patients with Hypertensive Hemorrhagic Stroke

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Abstract: Background: Until now, nobody has arrived at a general consensus on the timing of operative treatment intervention, depending on the hemorrhage nature, localization and volume and the severity of patient's condition. Objective: To assess the results of operative treatment of patients with hypertension-induced hemorrhagic stroke (HS) in order to determine the optimal times of surgical interventions, thereby improving the results of operative treatment. Methods: The treatment outcome analysis has been performed regarding the patients with hypertensive hemorrhagic stroke (HHS), who underwent surgery operation at the neurosurgery and neurotraumatology departments of the National Hospital of the MH KR. The age of patients ranged from 43 to 76 years. The main etiological factor in all cases was hypertensive disease. Results: The mean age of postoperative patients was 60 years old (the youngest patient was 43 years old and the oldest was 76 years old). Out of the 90 (100%) postoperative patients 74 (82.2%) patients were discharged with improvement, and 16 (17.8%) patients with fatal outcome. And also the fatality rate analysis has been performed depending on the HHS volume and the midline structure dislocation degree. Among the deceased postoperative patients, the distribution by HHS volume was as follows: up to 60 cm3 - 11.5% of cases, from 61 to 80 cm^3 - 9.52%, from 81 to 120 cm3 - 22.58% and above 121 cm3 - 33.3%. The deceased patient distribution by the midline structure dislocation degree was as follows: up to 2 mm - in 11.1% of cases, from 3 to 6 mm - in 21%, over 10 mm - in 40%. Also the fatality rate analysis has been performed, depending on the timing of operative treatment. Among the deceased postoperative patients, the distribution by operative treatment times was as follows: 1–3 days 23.7% of cases, 4–6 days 16.6%, 7–9 days 12.5%, 10 days and more - 11.1% (Table 6). Conclusions: The prognostic favorable times for operative treatment of patients having HHS with different localization and volumes (60 cm^3-80 cm^3), and with different dislocations of midlinebrain structures (from 2 to more than 6 mm) range from 3 days to 15-20 days. And the surgery operation is unjustified for the patients with supratentorial localization of than 120 cm^3 in volume with midline structure dislocation of more than 10 mm, and in this case the watchful waiting must be applied.

Keywords: Supratentorial Hemorrhage, Infratentorial Hemorrhage, Glasgow Coma Scale

1. Introduction

The first 72 hours are the favorable times for operative treatment of the patients with hypertensive hemorrhagic stroke (HHS) with subcortical localization of no less than 60 cm^3 in volume and with depression of consciousness no less than semicoma (more than 10 GCS scores (Glasgow coma scale)) and dislocation of midlinebrain structures up to 2 mm. The 6-7th days after hemorrhage are the favorable times for operative treatment of patients suffering from HHS with medial (basal ganglia) localization with the volume of less than 80 cm^3 and the depression of consciousness less than semicoma (less than 10 GCS scores) with the midline structure dislocation degree of more than 3 mm.

The 15-20th days after hemorrhage is the optimal time for operative treatment of patients suffering from HHS with the breakthrough into ventricular system or the supratentorial localization, with the volume of more than 80 cm^3 and the depression of consciousness less than deep somnolentia (less than 10 GCS scores) with the midline structure dislocation degree of more than 6mm. The operative treatment of patients suffering from HHS with the breakthrough into ventricular

system or the supratentorial localization with the volume of more than 120 cm^3 and with the depression of consciousness of less than 7 GCS scores, and with midline structure dislocation of more than 10 mm is unjustified and requires the watchful waiting that is not contrary to literature data.

In 2012, 6.8 million people died of stroke in the world, which accounted for 11.9% of all dead people. According to the World Health Organization, the strokes rank second among causes of death [1]. The hypertensive intracerebral hemorrhage rate (HICH) among all cerebrovascular disorders is up to 10-20% [2, 3].

The largest International Randomized Surgical Trail in Intracerebral Hemorrhage (STICH), which had included about 1000 patients, showed that the urgent craniotomy and hematoma evacuation during the first 72 hours are not associated with favorable outcomes as compared with conservative treatment methods [2, 16, 4]. At the next study (STICH II), performed in 2013, the moderate but clinically significant effect of surgical operations in patients suffering from subcortical HICH without intraventricular component [[5]] is recorded. Many specialists use the active tactics of HICH treatment and prefer surgical intervention, but just this group of patients records the largest mortality rates reaching 50%, and 60-80% [6, 3] in patients, who were under coma before surgery. 75% of operative survivors remain deeply disabled persons [7-10].

2. Materials and Methods of the Study

The analysis of surgical treatment results of 90 patients with hypertensive hemorrhagic stroke (HHS) has been performed. All patients underwent surgical operation at the neurosurgery and neurotraumatology departments of the National Hospital of the MH KR from 2010 to 2016. The age of patients ranged from 43 to 76 years. There were 57 men and 33 women. At admission, all patients underwent computer or magnetic resonance tomography. The main etiological factor was hypertension in all cases.

When developing a treatment and research methodology, treatment methods and studies of other clinics, which are described in open sources, were taken into account.

Surgical intervention was performed immediately after use of complex clinical methods for examining and determining the type of hemorrhages [11]. In the decompensated state of the patient, with a stunned state of consciousness, the absence of increasing brain compression, high blood pressure above 200 mm of mercury it was considered advisable to postpone the operation until the blood pressure decreases and stabilizes. In some cases, in the fresh period (5-7 hours) of the patient's admission, in our opinion, the hematoma kept growing and it was prone to relapse, then we did not try to operate the first 10 to 36 hours and later. In 18 cases, only puncture removal of the hematoma was performed. In other cases, hematomas were removed by an open method using a magnifying fiber-optic system as a minimally invasive method for the surgical treatment of hematoma [14, 17, 19]

In case of large cerebellar hematomas, hemispherical hematomas with dislocation of the median structures and occlusion of the IV ventricle, surgical treatment of hematomas was begun after preliminary external drainage of the ventricular system (12, 15, 18) [13, 16, 19].

3. Results and Discussion

The mean age of postoperative patients was 60 years old (the youngest patient was 43 years old and the oldest ones was 76 years old). Postoperative patients included 63.3% of men and 36.7% of women. 26.6% of postoperative patients had the wakefulness level of 14-15 GCS scores, 21.1% - from 11 to 13 GCS scores, 24.4% - from 8 to 10 GCS scores, 27.8% from 3 to 6 GCS scores. The mortality rate in patients with the wakefulness level of 14–15 GCS scores was not observed, and the mortality rate was 12% at 11–13 GCS; at 8–10 scores - 22%, at 3–6 scores - 33.3% (Table 1).

Table 1. *HHS surgical outcome depending on the consciousness level.*

Consciousness level	With improvement	Mortality rate	Total
Clear	17 (100%)	0	17 (100%)
Deferred	22 (88%)	3 (12%)	25 (100%)
Semicoma	21 (78%)	6 (22%)	27 (100%)
Coma	14 (66.7%)	7 (33.3%)	21 (100%)

The patients were divided into four groups depending on the type of surgical intervention.

The first group included 52 patients. These patients underwent the osteoplastic craniotomy with intracerebral hematoma extraction. The mortality rate was 19.2% at this surgical treatment method.

The second group included 28 patients. These patients underwent the resection craniotomy with intracerebral hematoma extraction, and the mortality rate was 14.28%.

The third group included 7 patients. These patients underwent freseotomy (bone cutting) with puncture intracerebral hematoma aspiration was performed in these patients, while the mortality rate was 28.57%.

The fourth group included 3 patients with cerebellar hemisphere hemorrhage. These patients underwent the decompression postcranial fossa trepanation with hematoma extraction, while the mortality rate was not observed; all 3 patients were discharged with improvement (Table 2).

Table 2. *HHS surgical outcome depending on surgery methods.*

Surgery method	With improvement	Mortality rate	Total
Osteoplastic craniotomy	42 (80.8%)	10 (19.2%)	52 (100%)
Resection craniotomy	24 (85.72%)	4 (14.28%)	28 (100%)
Freseotomy (bone cutting)	5 (71.43%)	2 (28.57%)	7 (100%)
Decompression postcranial fossa trepanation	3 (100%)	-	3 (100%)
Outcome of all postoperative patients	74 (82,2%)	16 (17,8%)	90 (100%)

Out of all 90 (100%) postoperative patients 74 (82,2%) patients were discharged with improvement, and 16 (17,8%) patients with fatal outcome.

Based on the brain-computed tomography, the patients were divided into two groups according to HHS location:

The first group included 81 patients with supratentorial hemorrhages, the mortality rate of which was 17.3%.

The second group included 9 patients with subtentorial hemorrhages, the mortality rate of which was 22.2%.

The first group patients were divided into subcortical (lobar) hemorrhages, which were diagnosed in 42 patients, where the mortality rate was the lowest 9.5%, and into medial hemorrhages (into basal ganglia) in 9 patients, where the mortality rate was 11.1% and into subcortical hemorrhage with breakthrough into the ventricular system (ventricular) in 30 patients, where the mortality rate was the highest 30% (Table 3).

Currently, there are no standard methods of treating patients with hypertensive strokes, the principles of treatment of patients are advisory in nature and are commonly determined by the traditions of medical institutions. This motivates the development of an algorithm for examination and treatment of patients with hypertensive strokes (10, 11, 16 [11, 12, 17]).

We investigated the need for surgical treatment, surgical tactics and methods of intervention and treatment outcomes. At the same time, the results of surgical treatment of similar groups of patients were evaluated depending on the volume and localization of intracranial hematomas, which caused varying degrees of brain dislocation and the timing of hematoma formation.

Table 3. *Surgical outcome depending on HHS localization.*

Localization	With improvement	Mortality rate	Total
Subcortical (lobar)	38 (90.48%)	4 (9.52%)	42 (100%)
Medial and basal ganglia	8 (88.89%)	1 (11.11%)	9 (100%)
With breakthrough into the ventricular system	21 (70%)	9 (30%)	30 (100%)
Supratentorial	7 (77.78%)	2 (22.22%)	9 (100%)

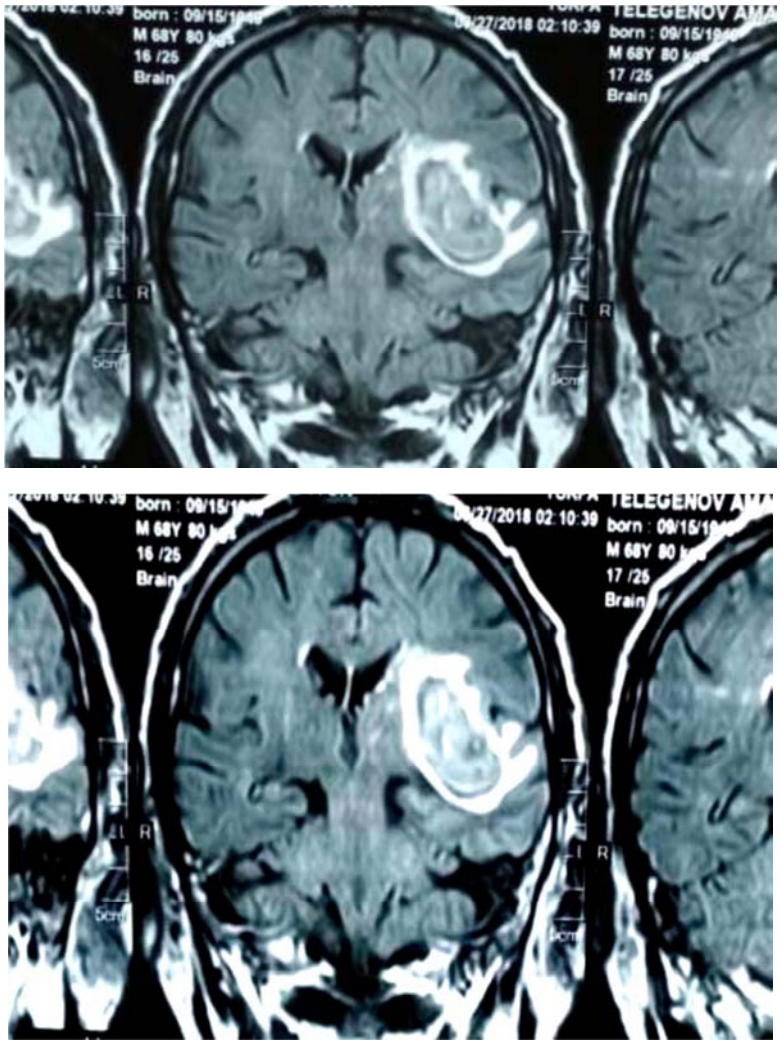

Figure 1. *MRI-type brain scan - intracerebral hematoma.*

Table 4. *Surgical outcome depending on HHS volume.*

Hematoma volume in cm^3	With improvement	Mortality rate	Total
Up to 60	23 (88.47%)	3 (11.53%)	26 (100%)
From 61 to 80	19 (90.48%)	2 (9.52%)	21 (100%)
From 81 to 120	24 (77.42%)	7 (22.58%)	31 (100%)
From 121 and more	8 (66.7%)	4 (33.3%)	12 (100%)

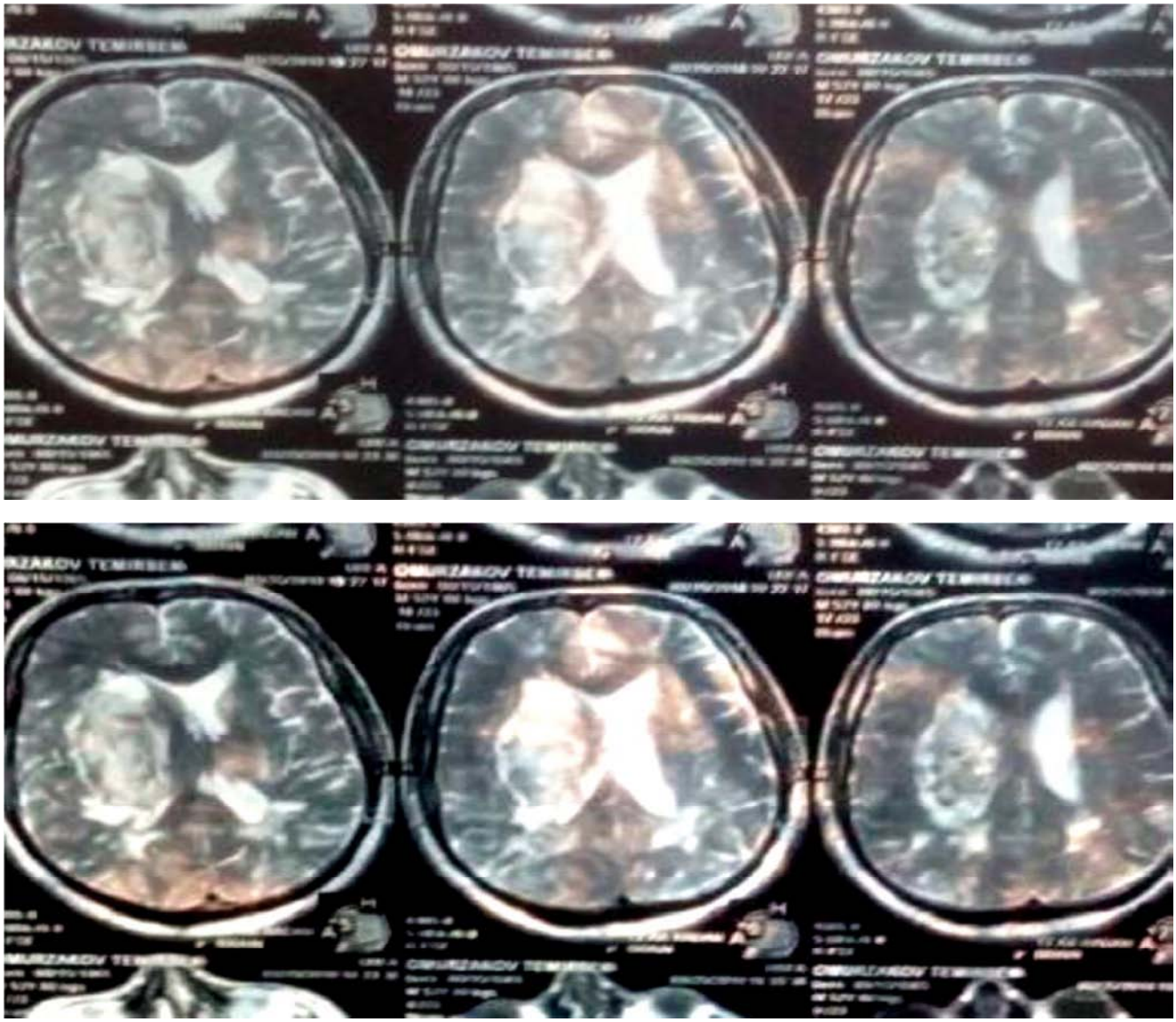

Figure 2. *MRI-type brain scan - intraventricular stroke hematoma.*

The distribution of deceased patients according to the midline structure dislocation degree was as follows: up to 2 mm - in 11.1% of cases, from 3 to 6 mm - in 21%, over 10 mm - in 40% (Table 5).

Table 5. *HHS surgical outcome depending on the midline structure dislocation degree.*

Midline structure dislocation degree	With improvement	Mortality rate	Total
up to 2 mm	8 (88.9%)	1 (11.1%)	9 (100%)
From 3 to 6 mm	8 (80%)	2 (20%)	10 (100%)
From 10 mm and more	3 (60%)	2 (40%)	5 (100%)
Outcome of all postoperative patients with midline structure dislocation	19 (79.17%	5 (20.83%)	24 (100%)

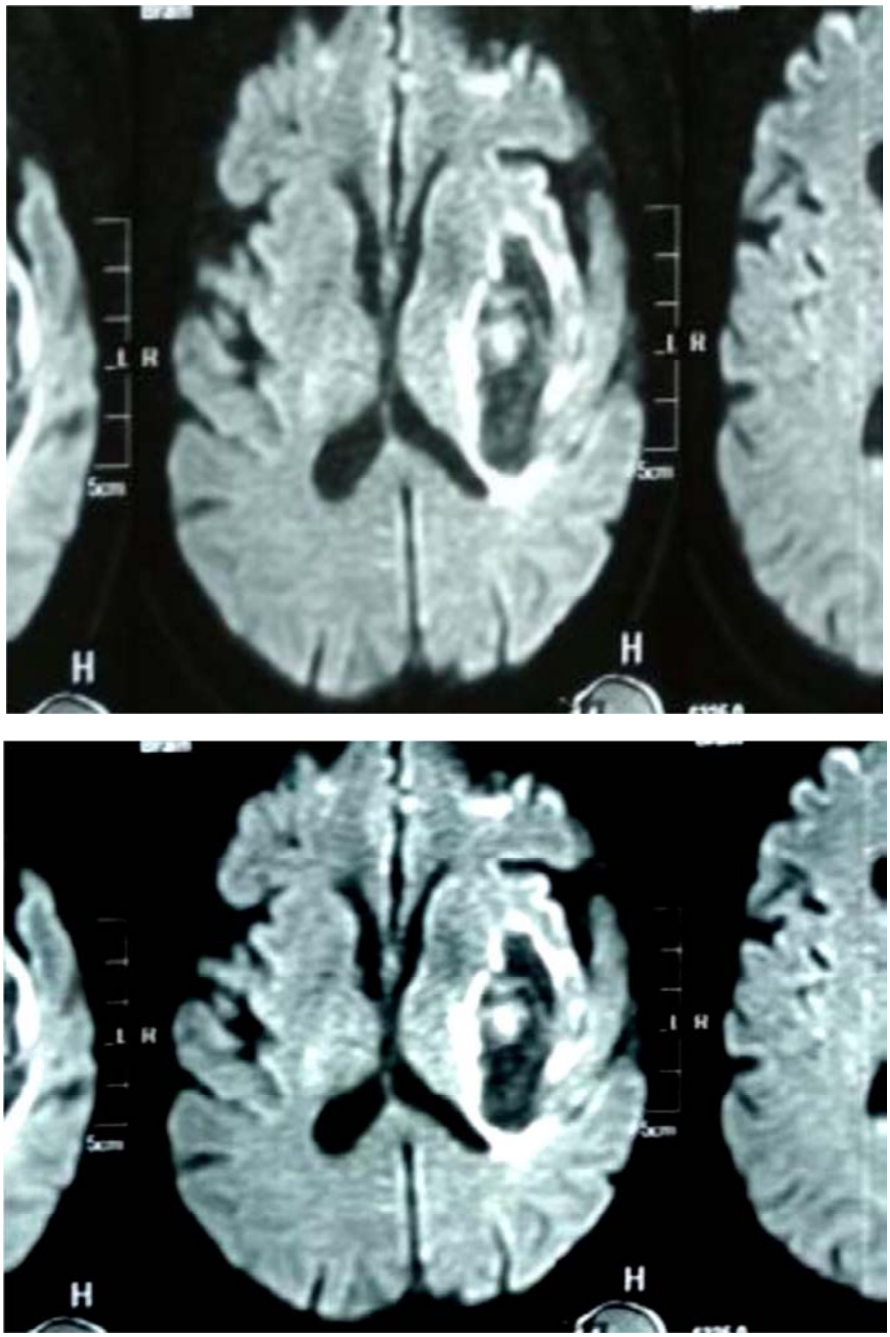

Figure 3. *MRI-type brain scan - intracerebral stroke hematoma.*

We conducted the fatality rate analysis depending on the times of operative treatment. Among the deceased postoperative patients, the distribution by the times of operative treatment was as follows: 1-3 days - 23.7% of cases, 4-6 days - 16.6%, 7-9 days - 12.5%, 10 days and more - 11.1% (Table 6).

Table 6. *HHS surgical outcome depending on the times of surgical operation.*

Times of surgical operation	With improvement	Mortality rate	Total
1-3 days	29 (76.3%)	9 (23.7%)	38 (100%)
4-6 days	15 (83.4%)	3 (16.6%)	18 (100%)
7-9 days	14 (87.5%)	2 (12.5%)	16 (100%)
10 days and more	16 (88.9%)	2 (11.1%)	18 (100%)

Table 7. *Criteria for timing of HHS surgical treatment.*

Times of surgical operation	Consciousness level under GCS	Hematoma localization	Hematoma volume	Dislocation degree
1-3 days	More than 10 scores	Subcortical	Less than 60 cm^3	Up to 2 mm
6-7 days	Less than 10 scores	Medial	Less than 80 cm^3	More than 3 mm
15-20 days	Less than 10 scores	With the breakthrough into ventricular system or supratentorial	More than 80 cm^3	More than 6 mm
Watchful waiting	Less than 7 scores	With the breakthrough into ventricular system or supratentorial	More than 120 cm^3	More than 10 mm

4. Conclusions

The first 72 hours are the favorable time for operative treatment of the patients suffering from HHS with the subcortical localization of no less than 60 cm^3 in volume and with the depression of consciousness no less than semicoma (more than 10 GCS scores) and with the dislocation of midline brain structures up to 2 mm.

The 6-7^{th} days after hemorrhage are the favorable time for operative treatment of patients suffering from HHS with medial (basal ganglia) localization with the volume of less than 80 cm^3 and the depression of consciousness less than semicoma (less than 10 GCS scores) with the midline structure dislocation degree of more than 3 mm.

The 15-20^{th} days after hemorrhage are the optimal time for operative treatment of patients suffering from HHS with the breakthrough into ventricular system or the supratentorial localization, with the volume of more than 80 cm^3 and the depression of consciousness less than deep somnolentia (less than 10 GCS scores) with the midline structure dislocation degree of more than 6 mm.

The operative treatment of patients suffering from HHS with the breakthrough into ventricular system or the supratentorial localization with the volume of more than 120 cm^3 and with the depression of consciousness of less than 7 GCS scores, and with the midline structure dislocation of more than 10 mm is unjustified; therefore in this case the watchful waiting must be applied.

Based on the study results, the Innovation Proposal "Procedure for timing of operative treatment of patients with hypertensive hemorrhagic stroke" Certificate No. 5/2018 and No. 4/2018 "Procedure for selection of patients with hypertensive hemorrhagic stroke for operative treatment" has been developed and put into practice.

Conflict of Interest

There are no conflicts of interest.

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