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Acute Traumatic Intracranial Hematoma Index and its Significance for Objectifying Indications for Their Surgical Treatment

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THE AIM OF THE STUDY was an index creation for both single and multiple acute traumatic intracranial hematomas (ATIH) for objectification of the surgical treatment indications and using multispiral computed tomography (MSCT) and based on up-to-date clinical recommendations.

MATERIAL AND METHODS We performed a retrospective study of 3 groups of patients with ATIH. Group 1 included 19 patients who were treated conservatively and discharged from the hospital without complications (group of conservative treatment). Group 2 included 9 patients who were observed after hospitalization and were treated in a delayed manner surgically due to growth of the intracranial hematoma volume or the patient condition deterioration (group of observation). Group 3 included 18 patients who were operated due urgent indications (group of surgical treatment). For each patient, the acute traumatic hematoma index (ATHI) was calculated by our original formula. It took the ATIH location, volume in millilitres according to the first MSCT, and risk factors significant for poor outcomes into account. After a preliminary assessment of the significance of differences between the studied characters of groups, a discriminant analysis was carried out with determination of the ATHI values in each group.

RESULTS AND CONCLUSIONS The suggested ATHI index has been shown to be effective in assessing single and multiple ATIHs of any location in accordance with current recommendations. The index is an objective (digital) and easy-to-use for determining ATIH surgical treatment indications and statistical treatment. If ATHI is less than 3 points, there are no indications for surgery and the repeated MSCT of the brain is indicated at least 12 hours after the first checkup or if the suspicious clinical sings appear; if ATHI is 3–4, the indications for surgery are relative and the repeated MSCT of the brain is required 6 hours later even if the patient condition is unaltered; the surgery is indicated if ATHI is more than 4 points.

Keywords: traumatic intracranial hematoma, intracranial hematomas, volume measurement

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ATHI – index of acute traumatic hematoma

ATIH – acute traumatic intracranial hematoma

ICP – intracranial pressure

MATIHs – multiple acute traumatic intracranial hematomas

MCF – middle cranial fossa

MS – midline shift

MSCT – multispriral computed tomography

PCF – posterior cranial fossa

RF – risk factors

SATIHs – single acute traumatic intracranial hematomas

INTRODUCTION

Over the past 20 years, views on the surgical tactics of treating acute traumatic intracranial hematomas (ATIHs) have evolved from "... the presence of intracranial rank in TBI surgery" (TBI - traumatic brain injury) [2]. In the "pre-tomographic era", the postulate of 20 years ago was an example of optimization, when an effective standard for hospitals of different levels of equipment and staff was approved, despite the side effects of overdiagnosis and the risk of complications. Today, after the widespread introduction of multispiral computed tomography (MSCT) for deciding on surgery for ATIH, the leading signs in decreasing order of importance are recognized: hematoma volume, intracranial pressure (ICP), lateral dislocation in mm, hematoma thickness in mm, degree of compression of basal cisterns, Glasgow coma scale (GCS), as well as some other neurological symptoms [2]. Nevertheless, all issues cannot be considered resolved. As a rule, invasive intracranial pressure measurement is not performed before surgical treatment of ATIH, which immediately excludes the second most important criterion of "hierarchy". An increase in the number of evidence criteria is accompanied by an increase in the number of their combinations with each other. The size of the hematoma, midline shift (MS), the level of consciousness according to GCS, etc., can be combined in rather unexpected cases. Each new criterion introduced multiplies the number of such combinations. The question is complicated with multiple foci of hemorrhage and hematomas. Detailing of indications may become more detailed as new knowledge accumulates, and presenting them in the form of descriptions will take more than one sheet of printed text, which will complicate implementation in urgent medicine.

Any surgical diseases require a choice of tactics: 1 - you need to operate, 2 - you do not need to operate, 3 - observation is required. When deciding on surgery for ATIH today, MSCT signs of head injury are of key importance [3–7], which is also reflected in the Recommended Protocol for the Surgical Treatment of Severe Head injury (2014). Conservative treatment of ATIH always involves observation and repeated MSCT studies, the time and frequency of which are often determined empirically. The recommendations are more relevant for single ATIH (SATIH), but the search continues for the possibility of applying similar criteria in relation to multiple ATIH (MATIH) [8], which is about 40% of all OATIH [9]. In the cranium, several ATIHs may be located simultaneously: 1) in one "compartment" (that is, supratentorial to the right or left, or subtentorial), being different types of hematomas (epidural, subdural, intracerebral), 2) in the same "compartments" of the same type of hematomas , 3) different types of hematomas in different "compartments" [10]. Their total volume is important for MATIH, while, as a rule, removal of one dominant hematoma is required [11]. Today, it is recommended to remove ATIH with a volume of more than 35 ml in the frontal region, more than 20 ml in the temporal region, lateral dislocation - more than 3 mm, the first degree of compression of the basal cisterns of the brain [2]. Thus, it is important to improve methods for assessing the volume of ATIH, the which surgical value for SATIH and MATIH may be different. For convenience in practice, the systematization of "descriptive indications" into a compact digital algorithm is required, which contains the principle of decision making in such a way that the parameters "loaded" into it would lead to an answer for different combinations of evaluated attributes.

Aim of study: to develop a single score index for single and multiple ATIH, objectifying indications for their surgical treatment. Research objectives: 1) based on modern recommendations, using the capabilities of MSCT, create a formula for calculating the score index of traumatic acute hematoma (ATHI); 2) to perform a retroprospective analysis of ATHI values (upon admission) in patients with ATIH treated conservatively and surgically; 3) to determine the possibility of using the ATHI in making indications for surgical treatment of patients with ATIH.

MATERIAL AND METHODS

The retrospective analysis was made of the outcome of treatment of patients with ATIH in the Irkutsk City Clinical Hospital No. 3 (ICCH No. 3) in 2015–2017. When formulating the indications for surgical intervention, the criteria recommended by V.V. Krylov et al. were used [6]. A total of 187 patients underwent surgical treatment, among which MATIH occurred in 29 (15.5%). The results of surgical treatment of ATIH showed sufficient effectiveness of the applied recommendations and, accordingly, the validity of the use of the presented clinical material (Table 1).

Table 1

Postoperative mortality of 187 patients with ATIH in the City Clinical Hospital No. 3 (2015–2017)

Location	Patients operated	Died	Mortality rate (%)
Single ATIH			
Subdural	90	32	35.6
Epidural	44	2	4.5
Intracerebral	24	5	20.8
Total single ATIH	158	39	24.7
Multiple ATIH			
Subdural + intracerebral	12	6	50.0
Subdural + subdural	6	2	33.4
Subdural + epidural	5	3	60.0
Epidural + intracerebral	2	0	0.0
Epidural + epidural	2	0	0.0
Intracerebral + intracerebral	2	0	0.0
Total multiple ATIH	29	11	37.9
TOTAL	187	50	26.7

When determining surgical tactics, not only the volume of ATIH was taken into account, but also its location. Today, 40–50 ml is considered to be critical volume for convexital ATIH (epidural and subdural) regardless of the clinical condition of the patient, and 20–25 ml for basal hematomas of the middle cranial fossa (MCF) and posterior cranial fossa (PCF) [12] (the difference is exactly 2 times). To create a scoring ATHI, it was proposed to distinguish 5 risk areas for location of ATIH in the cranial cavity. These areas are divided into two categories - α and β .

Areas α are high-risk areas in which small amounts of ATIH are life-threatening to the patient. These include the right and left

MCF within known anatomical boundaries [13], as well as the entire PCF, that is, all 3 areas.

Areas β are the regions of the right and left hemispheres of the cerebrum, respectively (2 areas) with the exception of the MCF.

We considered 15 ml as a safe maximum volume of adherent hypertension, since already at 20 ml it is recommended to remove it [12] (Fig. 1).

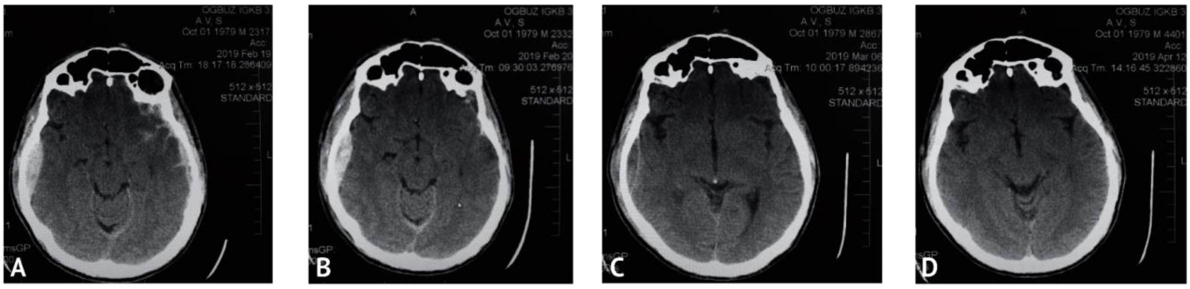

Fig. 1. Patient S., MSCT of the brain, regress of convexity epidural hematoma volume without surgical treatment: A — on the day of injury (18 ml); B — in 12 hours (15 ml); C — 15 days later (11 ml); D — 52 days later (<3 ml)

The difference between the areas α and β is realized with the formula through the coefficient of the risk area *k* taking into account the maximum safe volume of ATIH (Table 2).

Table 2

ATIH risk area coefficient for calculation of ATHI

Area of ATIH	Volume of ATIH (ml)	Coefficient
Area α	> 15	0.2
Area β	> 15	0.1
Any	≤ 15	0

In each risk area, several ATIHs can be formed (for example, meningeal and intracerebral), and in only 5 risk areas - at least 58 combinations of single and multiple ATIH. If there are several hematomas in one of the five zones (for example, in one MCF), their volumes are summed. In cases where one ATIH with a volume of more than 15 ml is located simultaneously in areas α and β , for example, in the basal part of MCF and convexitally, it is necessary to divide the ATIH into parts using MSCT and apply the corresponding area coefficients for each of them regardless of their volume (Fig. 2).

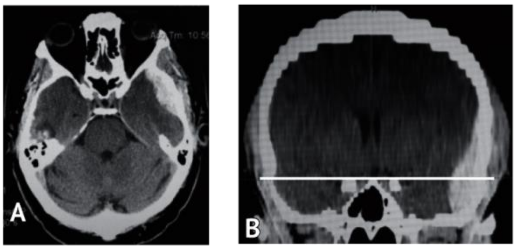

Fig. 2. Convexity MCF ATIH on the left: A — axial scan, B — frontal reconstruction (line shows the upper limit of MCF)

In addition, based on the Recommended Protocol for Surgical Treatment of TBI (2014), five groups of risk factors (RF) for the adverse outcome of ATIH were identified to create the formula. The task was to rank (classify) RF according to severity in points, since based on the recommendations, it is obvious that they have different severity when choosing treatment tactics. In this case, it was necessary to take into account the likely combinations of these factors and the possible results of their summation. Each factor was evaluated in terms of its independent surgical significance - whether it can be an indication for surgical treatment alone or only in combination with intracranial hematoma of a surgically insignificant (subcritical or small) volume or other factors. The greater the independent surgical significance of the RF was, the more difficult it was to be evaluated and the higher score was assigned to it (Table 3).

Table 3

Scoring of risk factors for poor outcomes of ATIH

Severity group	No	Risk factors	Severity in points
I	1	The presence of foci of contusion and (or) subarachnoid hemorrhage, and (or) sopor, coma upon admission	1
	2	The 2-point decrease in GCS after admission	2
II	3	The displacement of the middle structures more than 5 mm	3
	4	The brain base cisterns are compressed or absent; lateral dislocation of the IV ventricle	4
III	5	Increasing obstructive hydrocephalus	5

Group I: the factors are minimal, do not have independent surgical significance, that is, they do not require surgery without a hematoma of subcritical volume and other more severe factors; factors of subgroup 1 (1 point) are significant only in the presence of a hematoma of subcritical volume in combination with several other heavier factors, and factor of subgroup 2 (2 points) in the presence of a hematoma of significant volume in combination with only one RF from the more “heavy” group. For example, foci of contusion and / or sopor, coma upon admission (subgroup 1) are not indications for surgical treatment, unless intracranial hematomas of subcritical volume and several RFs from more “heavy” groups are present, such as midline shift more than by 5 mm, compression of basal cisterns or their absence, lateral dislocation of the IV ventricle and increasing occlusive hydrocephalus. A decrease in GCS consciousness by 2 points after admission is of surgical significance in the presence of a hematoma of insignificant volume in combination with only one of the following more severe RFs: midline shift by more than 5 mm, or compression of basal cisterns (or their absence), or lateral dislocation of the IV ventricle, or increasing occlusive hydrocephalus.

Group II: factors have independent significance without other RF in the presence of intracranial hematomas of subcritical volume. For example, midline shift more than 5 mm (factor 3), even with acute intracranial hematoma of a small (subcritical) volume and without foci of injury (which is rare) will be an indication for surgical treatment. The same applies to the deformation of the basal cerebrospinal liquor cisterns and the lateral dislocation of the IV ventricle (factor 4). Due to the fact that factor 3 refers only to supratentorial damage, it is relatively "lighter" than factor 4, taking into account supra- and subtentorial changes.

Group III includes the most severe factor 5 (occlusive hydrocephalus), since it is an indication for surgical treatment even without intracranial hematoma and other factors.

To convert the volume of hematomas from milliliters to points and calculate the ATHI, the formula is applied:

$$ATHI = V_{\alpha} \cdot k_{\alpha} + V_{\beta} \cdot k_{\beta} + F,$$

Where ATHI is the index of traumatic acute intracranial hematoma in points, V is the hematoma volume of the corresponding risk area for MSCT in ml, k is the coefficient of the corresponding risk area; F is the sum of RF points for an adverse outcome.

The proposed methodology (formula) is a mathematical description of the recommendations available today. To assess the effectiveness of the outcome, a random selection of 46 patients with ATIH who underwent both **surgical** and **conservative** treatment was performed. Inclusion criteria: 1) compliance of the diagnosis with the Russian classification of head injury; 2) reliable information on the presence of head injury; 3) primary brain MSCT no later than 72 hours after injury; 4) primary MSCT with signs of ATIH of any volume and location. Exclusion criteria: 1) children; 2) patients with subacute and chronic traumatic intracranial hematomas.

All the patients upon admission underwent brain MSCT (*GE Bright Speed* -16), and the volume of ATIH in milliliters determined by using postprocessing program *Volume Measurement* (Fig. 3.)

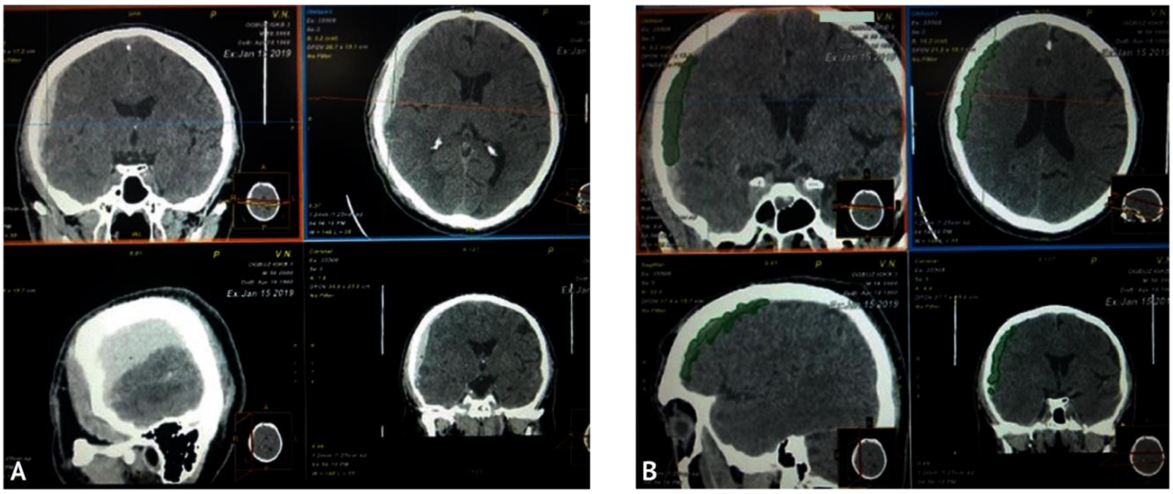

Fig. 3. MSCT measurement of intracranial hematoma volume (GE Bright Speed tomograph 16): A — native image, B — post-processing in Volume Measurement

The results were converted into ATHI according to the formula described above. Using the statistical package “*STATISTICA* 10”, the following digital signs were analyzed: age, level of consciousness at admission according to GCS, volume of adrenal hypertrophy in ml (V_{hem}), RF in points (see table 3), ATHI, MS according to MSCT in mm.

To build a forecasting model, a discriminant analysis of the results of diagnosis and treatment of three groups of patients with ATIH was performed [14]. We used the “Discriminant Analysis” module of the “*STATISTICA* 10” statistical package, and analyzed data from all 46 patients. Group 1: 19 patients, treated conservatively and discharged with improvement (conservative treatment group). Group 2: 9 patients who were under observation, but operated on with a delay due to an increase in hematoma volume and / or worsening of condition. Group 3: 18 patients with ATIH who underwent surgical treatment immediately after admission (surgical treatment group).

RESULTS AND DISCUSSION

The initial analysis of the source data was aimed at identifying intergroup differences in the characteristics or tendency to it. For this purpose, the values of the characteristics in the groups were compared by nonparametric and parametric methods.

When checking the statistical significance of differences in the studied traits according to the Mann – Whitney criterion between groups 1 and 2, they were revealed for all selected characters, except for RF and MS. The most significant differences were in the ATHI, V_{hem}, as well as GCS and age. With the same comparison of groups 2 and 3, differences were revealed for all selected characters, of which the most significant were ATHI, age, MS and $V_{hem.}$ Also, the statistical significance of the differences between groups 1 and 2 was revealed by *T-test* (table 4).

Table 4
The significance of differences of parameters between Groups 1 and 2 according to t-test

Variable	*T*-test; comparison of Group 1 and Group 2										
	Group mean 1	Group mean 2	*t*	cc	*p*	*N* gr. 1	*N* gr. 2	St. Dev. 1	St. Dev. 2	*F*-rel. dispers.	*p* dispers.
Age	**37.450**	**63.10**	**-4.875**	**28**	**0.00004**	**20**	**10**	**13.843**	**13.016**	**1.1309**	**0.888**
GCS	13.950	12.80	1.7293	28	0.09476	20	10	1.7614	1.6193	1.1832	0.828
$V_{hem.}$	**13.725**	**38.80**	**-7.981**	**28**	**0.00000**	**20**	**10**	**8.7742**	**6.4944**	**1.8252**	**0.356**
RF	0.6500	1.000	-1.472	28	0.15211	20	10	0.4893	0.8165	2.7838	0.057
ATHI	**1.5550**	**4.680**	**-6.967**	**28**	**0.00000**	**20**	**10**	**1.2634**	**0.8954**	**1.9909**	**0.290**
MS	**0.2000**	**1.730**	**-2.573**	**28**	**0.01564**	**20**	**10**	**0.8944**	**2.3748**	**7.0501**	**0.000**

Notes: statistically significant differences are highlighted in bold. ATHI — acute traumatic hematoma index; GCS — Glasgow Coma Scale; MS — midline shift; RF — risk factors; V_{hem} — volume of acute brain hematomas

Table 4 shows that according to *T-test*, the differences between groups 1 and 2 are statistically significant in all parameters, except for the level of consciousness according to GCS and RF. They are especially expressed by ATHI, V_{hem} and level of consciousness according to GCS. Between groups 2 and 3, the differences according to T-test are also statistically significant in all parameters, but especially in age, ATHI and GCS (Table 5).

Table 5
Reliability of differences of signs between groups 2 and 3 according to t-test

Variable	*T*-критерии; сравнение групп 2 и 3										
	Group mean 2	Group mean 3	*t*	cc	*p*	*N* gr. 2	*N* gr. 3	St. dev. 2	St. dev. 3	*F*-rel. dispers.	*p* dispers.
Age	**63.100**	**40.600**	**5.2629**	**28**	**0.00001**	**10**	**20**	**13.016**	**9.9652**	**1.7061**	**0.312**
GCS	**12.800**	**7.8000**	**4.2300**	**28**	**0.00022**	**10**	**20**	**1.6193**	**3.5333**	**4.7609**	**0.021**
$V_{hem.}$	**38.800**	**93.000**	**-3.584**	**28**	**0.00126**	**10**	**20**	**6.4944**	**47.183**	**52.784**	**0.000**
RF	**1.0000**	**5.0000**	**-4.119**	**28**	**0.00030**	**10**	**20**	**0.8165**	**2.9912**	**13.421**	**0.000**
ATHI	**4.6800**	**14.540**	**-4.582**	**28**	**0.00008**	**10**	**20**	**0.8954**	**6.7159**	**56.254**	**0.000**
MS	**1.7300**	**13.040**	**-3.597**	**28**	**0.00122**	**10**	**20**	**2.3748**	**9.7164**	**16.739**	**0.000**

Notes: statistically significant differences are highlighted in bold. ATHI — acute traumatic hematoma index; GCS — Glasgow Coma Scale; MS — midline shift; RF — risk factors; V_{hem} — volume of acute brain hematomas

Thus, according to the criterion *T*, the largest differences in the three groups were found in ATHI, age and V_{hem} (fig. 4).

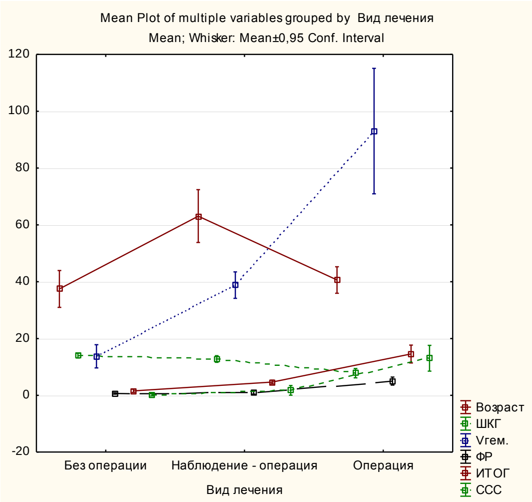

Fig. 4. The range of averages of the studied parameters in groups
Notes: ATHI — acute traumatic hematoma index; GCS — Glasgow Coma Scale; MS — midline shift; RF — risk factors; V_{hem} — volume of acute brain hematomas

The analysis of the initial data showed that the most informative features used to build the model were the ATIH and age of the patients. The assessment of the information content of the characteristics selected for analysis is presented in table. 6.

Table 6

Evaluation of the information capacity of parameters included in linear discriminant functions

N=46	Results of the analysis of discriminant functions (three groups) Variables in the model: 2; gr.: numb. gr. without 4 (3 gr.) Wilks'lambda: ,11209 appr. *F* (4.84)=41.723 *p*<0.0000					
	Wilks'lambda	Private lambda	*F*-excl. (2,42)	*p*-val.	Toler.	1-toler.(R-sq.)
Age	**0.257847**	**0.434732**	**27.30560**	**0.000000**	**0.994467**	**0.005533**
ATHI	**0.436047**	**0.257070**	**60.68994**	**0.000000**	**0.994467**	**0.005533**

Notes: statistically significant differences are highlighted in bold. ATHI — acute traumatic hematoma index

Table 6 shows that the variables presented in it are informative parameters with significance levels of 0.000000 (see *p*-value). Both signs turned out to be informative (F = 27.3 and 60.7, respectively), however, ATHI appeared to be even more informative. The coefficients of linear discriminant functions are presented in table 7.

Table 7

Coefficients of linear discriminant functions

Variable	Classification Functions		
	Group 1 (p = 0.41304)	Group 2 (p = 0.19565)	Group 3 (p = 0.39130)
Age	0.34451	0.6365	0.3845
ATHI	0.03968	0.1777	0.9349
Constant	-6.9999	-22.9066	-16.3419

Using the obtained coefficients, linear classification formulas are as follows:

$F1 = -6.99 + 0.34 \cdot X1 + 0.04 \cdot X2$

$F2 = -22.91 + 0.64 \cdot X1 + 0.178 \cdot X2$

$F3 = -16.34 + 0.3845 \cdot X1 + 0.935 \cdot X2$

where $X1$ - age (years); $X2$ - ATHI.

The quality of developed rules was assessed by the comparison of classification results with the original classification of objects. When checking the preliminary devision of patients into three groups by linear classification functions, the accuracy of grouping was 91.3% (Table 8).

Table 8

Sensitivity assessment of informative values

Group	Classification matrix Lines: observable classes (groups) Columns: predicted classes			
	Accuracy	1 (p = 0.41304)	2 (p = 0.19565)	3 (p = 0.3913)
1	100.000	19	0	0
2	88.8889	1	8	0
3	83.3333	3	0	15
Total	**91.3043**	23	8	15

Notes: Group 1 — conservative treatment, Group 2 — observation; Group 3 - surgical treatment

Four objects of observation were incorrectly spaced (1 from group 2, and 3 from group 3). When considering the matrix of subsequent probabilities, 4 transition points (or observations) were identified under numbers 28 (ATHI = 3.5, age = 48), 32 (ATHI = 4.6, age = 47), 41 (ATHI = 7, age = 18), 49 (ATHI = 8, age + 48). The presence of patients with "transitional" ATHI values, which can be assigned to neighboring groups with equal chances, predetermined the boundaries between the groups (Fig. 5).

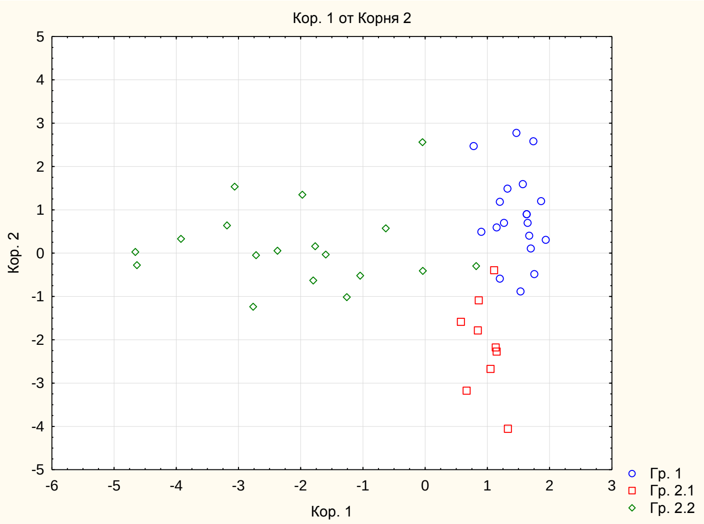

Fig. 5. The distribution of the three groups according to ATHI

Thus, the proposed ATHI, which is the mathematical description of modern recommendations for surgical treatment of ATIH allows one to allocate three groups of patients with ATIH: 1 - conservative treatment, 2 - observation, 3 - surgical treatment. The average ATHI were 1.555 ± 1.26 points in group 1 (conservative treatment), 4.68 ± 0.89 in group 2 (observations) and 14.54 ± 6.7 in group 3 (surgical treatment). The observation tactics in group 2 were ineffective, and the patients were operated on with a delay, taking into account contraindications. Therefore, the ATHI value of 4.5 points exceeds the threshold in favor of the operation. Based on our statistical comparison of three groups of patients with ATIH and current recommendations, indications for surgical treatment of ATIH correspond to a certain ATHI: less than 3 points - conservative treatment, 3-4 points - monitoring, more than 4 points - surgical treatment. In case of observation of patients with low-risk (subcritical) volumetric hypertension, the probability of secondary brain damage in the form of cerebral edema or delayed hemorrhage carries additional risks. Given the known time interval for the occurrence of delayed traumatic intracranial hemorrhages 6–8 hours after the injury [15], as well as the possibility of progression of foci of brain contusion in the first 24–72 hours [2], it is advisable to perform a repeated MSCT of the brain ATHI of 3-4 points in 6 hours of observation, and in 12 hours in patients with ATHI less than 3 points, even if they are in good condition (Table 9).

Table 9

ATHI and indications for surgical treatment

Indications for surgery	Absent (repeated MSCT of the brain in 12 hours)	Relative (repeated MSCT of the brain in 6 hours)	Absolute
ATHI score	<3	3 to 4	> 4

Notes: ATHI — acute traumatic hematoma index; MSCT — multispiral computedtomography

The advantage of the proposed digital ATHI algorithm is the possibility of its use in MATIH. The number and sequence of operations for MATIH should be determined individually, taking into account the volume of hematomas and the RF described above. The proposed method for determining the indications for surgical treatment of patients with ATIH is illustrated by examples of specific performance (table. 10).

Table 10

Examples of determining indications for surgical treatment for different variants of single and multiple ATIH

Clinical variant of ATIH (volume in milliliters)	ATHI calculation by the formula	ATHI score	Indications for surgery
Solitary subdural hematoma (50) (risk area β) without risk factors	50 x 0.1 + 0	5	absolute
Subdural hematoma (40) and epidural basal hematoma of MCF (18) (risk areas β and α, respectively) without risk factors	40 x 0.1 + + 18 x 0.2 + 0	7.6	absolute
Intracerebral hemispheric hematoma (40) and epidural basal hematoma of PCF (15), respectively (areas β and α), displacement of median structures less than 5 mm	40 x 0.1 + + 15 x 0 + 0	4	relative
Solitary epidural hematoma of MCF (18), displacement of median structures more than 5 mm	18 x 0.2 + 3	6.6	absolute
Epidural hematoma of MCF (18) on the right and epidural hematoma of MCF (15) on the left (2 risk areas α)	18 x 0.2 + + 15 x 0	3.6	relative

Notes: ATHI — acute traumatic hematoma index; ATIH — acute traumatic intracranial hematomas; MS — midline shift; MCF — middle cranial fossa; PCF — posterior cranial fossa; RF — risk factors;

CONCLUSIONS

1. The presented formula for the index of traumatic acute hematoma is unified for single and multiple acute traumatic intracranial hematomas of any location in accordance with modern recommendations. The index is objective (digital).

2. A retrospective study of the distribution of the index of traumatic acute hematoma among patients with acute traumatic intracranial hematomas showed the reasonability of its use in determining surgical tactics, as well as conducting statistical studies.

3. When the index of traumatic acute hematoma is less than 3 points, surgical treatment is not shown, it is necessary to observe patients in a neurosurgical hospital, repeated magnetic spiral computed tomography of the brain is advisable 12 hours after hospitalization or if the patient worsens clinically; with an index of 3-4 points, the indications are relative, observation is required in a neurosurgical hospital, repeated magnetic spiral computed tomography of the brain is required 6 hours after the initial magnetic spiral computed tomographic examination, even if the patient is clinically in good condition; with an index of traumatic acute hematoma more than 4 points, surgical treatment is indicated.

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