Original Article

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# Assessment of Treatment Outcomes for Traumatic Intracranial Hematomas During Early Traumatic Brain Injury

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## Abstract

The main objective of this research study was to examine the treatment outcomes of traumatic intracranial hematomas through the application of algorithms for complex diagnosis and differentiated tactics for treating various types of traumatic hematomas. Between 2014 and 2019, a total of 635 patients with traumatic intracranial hematomas were evaluated and treated at the Republican Specialized Scientific and Practical Medical Center of Neurosurgery. In addressing indications for surgical or conservative treatment, a unique approach was adopted based on the principles of urgency, complexity, and interconnection at all stages of treatment in the hospital. The results of the treatment of traumatic intracranial hematomas, both surgical and conservative, significantly varied not only in different periods and phases of the course of traumatic brain injury but also depending on the patient's age, type, location, and prevalence of the hematoma. The application of algorithms for complex diagnosis and differentiated treatment was found to be beneficial.

**Keywords:** Traumatic intracranial hematomas, epidural hematomas, subdural hematomas, intracerebral hematomas, multiple hematomas, chronic hematomas, complex diagnosis, treatment, outcomes.

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## Introduction

Traumatic brain injury (TBI) is a complex issue in modern medicine and one of the most significant challenges in healthcare and society.[1,2] The severity of complications and consequences with permanent or temporary disability makes it materially costly for families, society, and the state.[3,4,5,6] Among the causes of death due to all types of injuries, severe TBI accounts for 50% of all cases.[7] More than 10 million people suffer from traumatic brain injury annually.[8,9]

According to our study and data from foreign neurosurgical clinics, the overall mortality rate of traumatic intracranial hematomas (TICH) is around 4.0%, with postoperative mortality up to 20% of cases.[10,11] Mortality from TBI in neurosurgical clinics and hospitals is about 6-7%, and postoperative mortality after severe TBI is 28-32%.[6,8]

The healthcare system, including neurosurgeons, neuro-traumatologists, resuscitators, neurologists, psychiatrists, and rehabilitation specialists, are responsible for treating patients with traumatic intracranial hematomas and preventing its consequences and complications.[7,12,13] Qualified training in the treatment of traumatic brain injury in acute and long-term periods remains a complex and unresolved problem.[1,10]

This study aimed to investigate the outcomes of treating traumatic intracranial hematomas using complex diagnostic algorithms and differentiated tactics for treating different types of traumatic hematomas.

## Subjects and Methods

From 2014 to 2019, 635 patients with traumatic intracranial hematomas, including acute and subacute epidural and subdural hematomas, intracerebral hematomas, multiple hematomas, and chronic hematomas, were examined and treated at the Republican Specialized Scientific and Practical Medical Center for Neurosurgery. The patients were divided into two groups: group I, consisting of 245 patients (38.6%), who underwent surgical treatment, and group II, consisting of 390 patients (61.4%), who underwent conservative treatment.

The majority of patients (62.5%) experienced closed traumatic brain injury, while 12.1% of patients had an open injury. Among the clinical phases of the course of traumatic brain injury, 54.5% of patients were admitted to the hospital in the stage of clinical subcompensation, 18.1% in the stage of moderate clinical decompensation, and 27.4% in the stage of gross clinical decompensation.

The age of the patients ranged from 1 month to 92 years, with a mean age of 31.5 years. Men comprised 78.9% of the patients, while women accounted for 21.1%. Children made up 40.6% of the patients, and elderly and senile patients constituted 13.0% of the patients. A significant number of patients (47.9%) were between the ages of 18 and 60, with the largest age group being patients aged 30 to 44 years (17.9%). Among children aged 1 month to 18 years, this figure was 9.9%, while among elderly and senile patients, it was 11.0%. According to our data, the majority (two-thirds) of patients with HTCH were men of working age.

All patients underwent clinical and neurological examinations upon admission and in the course of treatment, with a focus on assessing the level of depression of consciousness, the severity of cerebral, focal.

## Results & Discussion

Acute epidural hematomas were observed in 174 patients (27.4%), predominantly in pediatric and adolescent patients - 101 (58.0%). The average age of the 106 (60.9%) operated patients with acute epidural hematoma was 22.1 years. Conservative therapy was performed in 68 (39.1%) patients. In 96 (15.1%) patients with subacute epidural hematomas, the average age was 17.4 years. The majority of them were pediatric and adolescent patients under the age of 18, which accounted for 63 patients (65.6%). More than half of the patients with subacute epidural hematoma (54 or 56.2%) underwent surgery, while the rest were treated conservatively.

According to our data, acute subdural hematomas were observed in 87 patients (13.7%), and were more common in elderly patients - 19 (21.8%). The average age of the 40 (46.0%) operated patients with acute subdural hematoma was 42.7 years. Conservative therapy was performed in 47 (54.0%) patients.

According to the conducted studies, 43 (6.8%) patients with subacute subdural hematomas had an average age of 36.9 years. The majority were patients over 30 years old, which accounted for 26 patients (60.5%). Of the total number of patients with subacute subdural hematoma, 23 (53.5%) underwent surgery, while the rest were treated conservatively.

The total number of patients with traumatic intracerebral hematomas was 58 (9.1%), and their average age was 40.6 years. Of these, 39 (67.2%) were acute hematomas and 19 (32.8%) were subacute. Conservative treatment was administered to 33 (56.9%) patients, while 25 (43.1%) underwent surgical treatment.

In the study of multiple traumatic intracranial hematomas, 111 (17.5%) patients were identified, while their average age was 40.0 years, and in the vast majority, they were observed among adults compared with children - 88 (79.3%). Of the total number of patients with multiple hematomas, 80 (72.1%) patients underwent surgery, and 31 (27.9%) underwent conservative tactics.

With chronic traumatic intracranial hematomas, 65 (10.2%) patients were identified, with an average age of 43.1 years and the vast majority at the age of 60-74 years. Of the total number of patients with multiple hematomas, 62 (95.4%) patients out of 65 underwent surgery.

The largest number of HTCH were patients with acute epidural hematomas - 174 (27.4%), the following types of hematomas were also recorded: multiple - in 111 (17.45%), subacute epidural - in 96 (15.1%), chronic - in 66 (10.4%), intracerebral - in 58 (9.1%), subacute subdural - in 43 (6.8%) patients.

According to the neurological examination, motor disorders (mono- or hemiparesis, paralysis) were distinguished from focal hemispheric neurological symptoms in 22.7%, sensory disorders (with a moderate head injury) in 15.4%, aphasic disorders, epileptic seizures in 9.6%, meningeal symptoms in 47.9%, as well as psychomotor agitation in 20%, visual disturbances in 57.6%, pathological reflexes in 30%, cerebral symptoms in 86%, etc. Violation of sensitivity, visual disturbances, as well as some cerebral symptoms to identify in some patients with a severe and terminal conditions, was not possible, due to the deep depression of the level of consciousness and the lack of contact.

Conservative treatment was carried out in the absence of gross focal symptoms, small hematomas that did not cause compression of the brain.

Surgical treatment was provided to patients: with acute and subacute epidurals - 107 (27.4%) and 54 (13.8%), respectively, acute and subacute subdural - 39 (10.0%) and 23 (5.9%), and also with intracerebral 25 (6.4%), multiple - 80 (20.5%) and chronic - 62 (15.9%) hematomas.

Questions of indications for surgical or conservative treatment in a hospital required a special approach and were based on the principle of urgency, complexity and interconnection at all stages of treatment.

Differentiated surgical treatment of patients with traumatic intracranial hematomas was carried out by choosing osteoplastic and decompressive craniotomy, as well as by performing minimally invasive operations.

The criteria for choosing conservative treatment of patients with traumatic intracranial hematomas were the severity of the patient's condition, the level of consciousness upon admission, and the volume, type, localization and prevalence of the hematoma.

Round-the-clock monitoring of the clinical and neurological picture of the patient by a neurosurgeon and MSCT / MRI, ultrasound and neurophysiological control were one of the mandatory conditions for conservative treatment. In addition, therapy was carried out using the methods of neurophysiological monitoring, cerebral, focal and stem symptoms, cardiovascular and respiratory activity, body temperature, and homeostasis. Conservative therapy also included the prevention of convulsive syndrome, psychomotor agitation and hyperthermia.

We analyzed the studied patients depending on the level of consciousness (according to the GCS) and its depression, as a result of which it was found:

In 174 (27.4%) patients with acute epidural hematoma, surgery was performed in 107 (61.5%) patients, and conservative therapy was performed in 67 (38.5%) patients. With a GCS level of consciousness of 14-15 points, the number of patients with conservative treatment was almost one-third (32.8%), and with surgical treatment – one-quarter (25.9%). Thirty-three (9.2-9.8%) patients underwent surgical treatment with a GCS level of consciousness of 11-13 points, and 29 (1.7-6.9%) patients had less than 11 GCS points.

In 96 (15.1%) patients with subacute epidural hematoma, patients with conservative and surgical treatment with a GCS level of consciousness of 14-15 points were divided equally,

amounting to 39 (40.6%) patients. It was noted that with a GCS level of consciousness of 11-13 points, patients underwent surgery in 15 (7.3-8.3%) cases. It should be noted that among patients with subacute epidural hematoma, there were no patients with a GCS level of consciousness below 9 points.

Among 87 (13.7%) patients with acute subdural hematoma without impairment of consciousness according to GCS score 14-15, 31 (35.6%) patients received conservative treatment, and only 2 (2.3%) received surgical treatment. 10 (5.7%) patients with GCS level of consciousness 11-13 underwent surgical treatment, and 12 (6.9%) – were conservative. Patients with a GCS level of consciousness of 5-10 points underwent surgical treatment in 27 (7-13.8%).

Among 43 (6.8%) patients with subacute subdural hematoma without impairment of consciousness according to GCS 14-15 points, conservative therapy was mainly carried out, which amounted to 19 (44.2%), and surgical - 11 (25.6%). With a level of consciousness on GCS less than 13 points, surgical treatment was mainly performed - 12 (2.3-9.3%).

Among 58 (9.1%) patients with intracerebral hematomas and depression of consciousness of 14-15 GCS points, 18 (31.0%) patients underwent conservative treatment, and 9 (15.5%) surgically, with a level of consciousness of 11-13 points 6 (10.3%) received surgical treatment, and 3 (5.2%) received conservative treatment. With a GCS level of consciousness of fewer than 11 points, surgical treatment was mainly performed, amounting to 6 (1.7-5.2%) patients.

Among 111 (17.5%) patients with multiple hematomas, 80 (72.1%) were operated on, while the number of patients with a consciousness level of 14-15 points according to the GCS was 20 (18.0%) and the same number were treated conservatively. In all other cases, with varying degrees of depression of consciousness, the number of patients with surgical treatment significantly prevailed over the number of patients treated conservatively.

In 66 (10.4%) patients with chronic hematomas, the vast majority - 62 (93.9%) were operated on, while the largest part was patients with a level of depression of consciousness of 14-15 points on the GCS - 52 (78.8%).

In our study, various methods of surgical treatment of traumatic intracranial hematomas were used, a total of 390 patients were operated on and 406 surgical interventions were performed, including decompressive craniotomy - 218 (53.7%) cases, osteoplastic craniotomy - 85 (20, 9%) and minimally invasive surgeries 103 (25.4%). Due to the severity of the injury and depending on the location, prevalence, and recurrence of traumatic intracranial hematomas, 15 patients underwent surgery on both sides or repeatedly.

Among 218 operations performed by decompressive craniotomy, the overwhelming majority were cases with subacute subdural, multiple, intracerebral and acute epidural hematomas - more than 65.7%, and the remaining cases were other traumatic intracranial hematomas - 38.9-45.8%.

Among 85 cases of osteoplastic craniotomy, the largest number of operated patients - 20.3-35.2% - were subacute epidural, intracerebral, acute epidural, chronic hematomas, and 10-3-14.1% were acute subdural and multiple hematomas.

Among 103 cases of minimally invasive surgery (removal of hematomas in the enlarged burr hole), the vast majority, 79.7%, were chronic hematomas, and 25.9-33.3% were subacute epi- and subdural hematomas.

It should be noted that we used, along with various types of surgical treatment, removal under microscopic assistance in 38 cases of traumatic intracerebral hematomas.

Treatment outcomes were assessed using the Glasgow Outcome Scale, and it was found that good recovery was registered in 426 (67.1%) patients, moderate disability in 80 (12.6%) patients, and severe disability in 50 patients (7.9% patients). ), vegetative state - in 2 (0.3%), 77 (12.1%) died.

In the group of surgical treatment of patients (390 patients, 61.4%) with traumatic intracranial hematomas, good recovery was recorded in 221 (56.7%) patients, moderate disability - in 65 (16.7%), severe disability - in 34 ( 8.7%), vegetative state - in 1 (0.3%), died - 69 (17.7%).

In the group of conservative treatment (245 patients, 38.6%) patients with traumatic intracranial hematomas, good recovery was registered in 205 (83.7%), moderate disability - in 15 (6.1%), severe disability - in 16 (6 .5%), vegetative state - in 1 (0.4%), died - 8 (3.3%).

The total number of patients with an unfavorable outcome was 79 (12.4%).

During the entire period of application of the scale for predicting outcomes and algorithms for diagnosing and treating patients with traumatic intracranial hematomas, it led to a decrease in mortality rates, a decrease in disability and an improvement in the recovery of patients.

Thus, the mortality rate of the studied patients, both in the group with surgical and conservative treatment, in general, had a downward difference, while the average mortality rates in patients with conservative treatment were single - 1.3%. And in the group of patients with surgical treatment, the mortality rates changed in waves from year to year, while its highest value was in 2017 - 32.3%, and by 2019 it had halved - to 16.2%.

Of those treated conservatively (245 patients, 38.6%), the number of patients with good recovery generally increased from 6.5% to 13.5%, as did moderate disability from 0.4% to 2.0%. Gross disability and death also tended to decrease from 2.0% to 0.4% and from 1.2% to 0.4%. The total number of patients with a vegetative state was insignificant and single and amounted to -0.4%.

Of those treated surgically (390 patients, 61.4%), the number of patients with good recovery generally increased from 5.15% to 13.6%, as did moderate disability from 1.3% to 4.9%. The percentage of patients with a severe disabilities had an undulating course, reaching a peak value of 2.6 in 2016, and then decreasing to 0.8%. Mortality rates were similar, 5.4%, and then dropped to 2.8%. The total number of patients with a vegetative state was insignificant and single -0.3%.

Thus, the proportion of favorable outcomes in patients with traumatic intracranial hematomas in our study increased by an average of 2-5%.

The outcome of treatment largely depends on the period of TBI and the timing of the surgical intervention, as well as the severity of compression, concomitant bruising, crushing of the brain in traumatic intracranial hematomas.

Of the total number of 160 operated on with epidural hematoma, good recovery in the acute period of TBI was observed in 225 (57.7%) patients operated on in the subacute period of TBI - 103 (26.4%), in patients with chronic hematomas over time.

Among 160 (41.0%) operated patients with epidural hematoma, good recovery was recorded in 119 (74.4%), of which in the acute period - in 74 (69.8%) and in the subacute - in 45 (83.3%), moderate disability was noted in 10 (9.4%) and 8 (14.8%), severe disability - in 9 (8.5%) and 1 (1.9%), respectively. Mortality was noted only in the acute period in 13 (12.3%) patients, no vegetative state was recorded.

Among 63 (16.1%) operated patients with subdural hematoma, good recovery was recorded in 24 (38.1%), of which in the acute period - in 12 (30.0%) and in the subacute - in 12 (52.2%), moderate disability was noted in 6 (15.0%) and 5 (21.7%), severe disability - in 5 (12.5%) and 2 (8.7%), respectively. Vegetative state - in 1 (2.5%) in the acute period. Mortality was observed in the acute period in 16 (40.0%) patients and in the subacute period in 4 (17.4%) patients.

Among 25 (6.4%) operated patients with intracerebral hematomas, good recovery was recorded in 13 (52.0%), of which in the acute period - in 6 (35.3%) and in the subacute - in 7 (87.5%), moderate disability was noted - in 7 (41.2%) only in the acute period, severe disability - in 1 (5.95%) also in the acute period. Mortality was noted in the acute period in 3 (17.6%) and in the subacute period in 1 (12.5%) patients, and no vegetative outcome was recorded.

Among 80 (20.5%) operated patients with multiple hematomas, good recovery was recorded in 27 (33.8%), of which in the acute period - in 17 (27.0%) and in the subacute - in 10 (58.8%), moderate disability was noted in 6 (9.5%) in the acute period and in 5 (29.4%) in the subacute period, severe disability in 9 (14.3%) in the acute period and in 1 (5.9%) %) - in the subacute. Mortality was noted in the acute period in 31 (49.2%) and in the subacute period in 1 (5.9%) patients, and no vegetative outcome was recorded.

Among 62 (15.9%) operated patients with chronic hematomas, good recovery was recorded in 38 (61.3%) patients, moderate disability was noted in 18 (29.0%) and severe disability in 6 (9.7%) patients. Vegetative state and lethality were not observed.

The highest percentage of favorable outcome (good recovery and moderate disability) was recorded among patients with traumatic intracranial hematomas admitted in the subacute period, amounting to 90.1% in general, and in the acute period the proportion of good outcomes was 61.0%.

Mortality in the acute period of TBI was 27.9%, which is explained by the severity of TBI in decompensated patients, the presence of a large volume of intracranial hematomas, including multiple ones, and concomitant severe somatic pathology in the group of elderly and senile patients. Mortality in the subacute period was significantly less - 5.9%.

In the group of patients with chronic hematomas, a favorable outcome was noted in 90.3% of cases, severe disability in 9.7%, and no mortality was recorded. This was due to the stable condition of patients in the stage of compensation and subcompensation.

Lethal outcomes were most often recorded in the group of patients with multiple hematomas, when 32.4% of 111 patients died, while the overall mortality among all the patients studied by us (635) was 12.1%, and good recovery was in 67.1%.

Thus, the mortality rate of the studied patients, both in the group with surgical and conservative treatment, in general, had a downward difference, while the average mortality rates in patients with conservative treatment were single - 1.3%. And in the group of patients with surgical treatment, the mortality rates changed in waves from year to year, while its highest value was in 2017 - 32.3%, and by 2019 it had halved - to 16.2%.

The analysis showed that the age of patients with traumatic intracranial hematomas had a significant impact on the outcome of surgical treatment. The worst results of treatment were in patients of elderly and senile age, while the highest mortality rate - up to 24.3% was registered in patients aged 60 years and older, which is explained by the presence of concomitant somatic pathologies and complications and the formation, as a rule, of larger hematomas. volume.

Among patients with good recovery after treatment, the best rates were at the age of 1-7 years, amounting to 87.3-93.1%, with moderate disability - the highest rates were at the age of 15-18 years (21.4%), and with severe disability - in the elderly and senile age - up to 22.2%.

## Conclusion

It is worth noting that the treatment of traumatic intracranial hematomas has shown variable outcomes, and this variability can be attributed to several factors including but not limited to the temporal stages of the phases of traumatic brain injury, the patient's age, the type of hematoma, its localization and prevalence. However, the use of advanced algorithms for complex diagnostics and differentiated treatment has played a pivotal role in improving the overall outcomes of treatment of patients with traumatic intracranial hematomas, and has also proven effective in reducing postoperative mortality rates. Therefore, the use of sophisticated techniques and algorithms in the management of these complex cases is crucial for enhancing the efficacy of the therapeutic interventions and ultimately improving patient outcomes.

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