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PROGNOSTIC IMPACT OF AGE ON SURGICAL OUTCOMES OF ACUTE TRAUMATIC BRAIN INJURY IN ELDERLY AND SENILE PATIENTS

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Abstract.
Background. Traumatic brain injury (TBI) in elderly and senile patients is characterized by specific pathomorphological features, atypical clinical presentation, and poor outcomes due to age-related brain involution and high comorbidity burden.
Objective. To assess the prognostic significance of age in the surgical treatment of acute TBI.
Materials and Methods. A retrospective analysis of 1,557 patients surgically treated for acute TBI was performed. The study group included 252 patients aged ≥60 years, and the control group consisted of 1,305 patients aged 18–59 years. Clinical, neuroimaging, and neurological parameters, Injury Severity Score (ISS), Glasgow Coma Scale (GCS), and Glasgow Outcome Scale (GOS) were analyzed.
Results. Falls from standing height, subdural hematomas, and multiple intracranial injuries predominated in elderly patients. Age ≥60 years was associated with significantly higher postoperative mortality, particularly in the presence of arterial hypotension, severe basal cistern compression, pupillary abnormalities, and postoperative infectious complications. Basal cistern compression showed the highest prognostic value in elderly patients.
Conclusion. Advanced age is an independent adverse prognostic factor in surgical outcomes of severe TBI and should be considered in treatment planning and outcome prediction.
Keywords: traumatic brain injury; elderly patients; prognosis; neurosurgery; subdural hematoma; mortality.

ПРОГНОСТИЧЕСКОЕ ЗНАЧЕНИЕ ВОЗРАСТА ПРИ ХИРУРГИЧЕСКОМ ЛЕЧЕНИИ ОСТРОЙ ЧЕРЕПНО-МОЗГОВОЙ ТРАВМЫ У ЛИЦ ПОЖИЛОГО И СТАРЧЕСКОГО ВОЗРАСТА

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Аннотация.
Актуальность. Черепно-мозговая травма (ЧМТ) у лиц пожилого и старческого возраста характеризуется особенностями патоморфологии, клинического течения и неблагоприятными исходами, что обусловлено инволютивными изменениями головного мозга и высокой коморбидностью.
Цель. Оценить прогностическое значение возраста при хирургическом лечении острой ЧМТ.
Материалы и методы. Проведен ретроспективный анализ результатов хирургического лечения 1557 пациентов с острой ЧМТ. Основную группу составили 252 пациента в возрасте ≥60 лет, контрольную — 1305 пациентов 18–59 лет. Оценивались клинические, нейровизуализационные показатели, выраженность дислокационного синдрома, уровень сознания по ШКГ, тяжесть сочетанной травмы (ISS), а также исходы лечения по шкале исходов Глазго (GOS).

Результаты. У пожилых пациентов преобладали падения с высоты собственного роста, субдуральные и множественные внутричерепные гематомы. Возраст ≥60 лет ассоциировался с более высокой послеоперационной летальностью, особенно при наличии артериальной гипотензии, выраженной компрессии базальных цистерн, нарушений зрачковых реакций и инфекционных осложнений. Компрессия базальных цистерн имела наибольшее прогностическое значение у пожилых пациентов.
Заключение. Возраст является независимым неблагоприятным прогностическим фактором исходов хирургического лечения тяжелой ЧМТ и должен учитываться при выборе тактики лечения и оценке прогноза.
Ключевые слова: черепно-мозговая травма; пожилой возраст; прогноз; хирургическое лечение; субдуральная гематома; летальность.

KEKSA VA QARILIK YOSHIDAGI BEMORLARDA O‘TKIR BOSH MIYA JAROHATIDA YOSH OMILINING JARROHLIK DAVOLASH NATIJALARIGA TA’SIRI

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Annotatsiya.
Dolzarbligi. Keksa va qarilik yoshidagi bemorlarda bosh miya jarohati (BMJ) miya involyutsiyasi va ko‘p hamroh kasalliklar tufayli o‘ziga xos klinik kechish va noxush natijalar bilan tavsiflanadi.
Maqsad. O‘tkir BMJda jarrohlik davolash natijalariga yosh omilining prognostik ahamiyatini aniqlash.
Material va usullar. O‘tkir BMJ bilan jarrohlik yo‘li bilan davolangan 1557 bemorning retrospektiv tahlili o‘tkazildi. Asosiy guruhga 60 yosh va undan katta 252 bemor, nazorat guruhiga esa 18–59 yoshdagi 1305 bemor kiritildi. Klinik, KT/MRT ma’lumotlari, ShKG, ISS va Glasgow natija shkalasi (GOS) tahlil qilindi.
Natijalar. Keksa bemorlarda ko‘proq o‘z bo‘yi balandligidan yiqilishlar, subdural va ko‘p o‘choqli gematomalar kuzatildi. 60 yoshdan katta yosh jarrohlikdan keyingi yuqori o‘lim ko‘rsatkichi bilan bog‘liq bo‘lib, ayniqsa arterial gipotenziya, bazal sisternalarning siqilishi va infeksion asoratlar mavjud bo‘lganda yomonlashdi.
Xulosa. Keksa yosh og‘ir BMJda jarrohlik davolash natijalarini yomonlashtiruvchi mustaqil prognostik omil hisoblanadi.
Kalit so‘zlar: bosh miya jarohati; keksa yosh; prognoz; jarrohlik davolash; subdural gematoma; o‘lim

Relevance of the problem. According to WHO criteria, elderly people are considered to be over 60 years of age, and senile people are considered to be over 70 years of age. In old age and senility, involutional changes occur in the human brain, which determine the specific pathomorphology, traumatic reactions, clinical manifestations, and course of traumatic brain injury (TBI) in the elderly and senile individuals *1, 10, 15+. With age, the number of comorbidities increases, which adversely affects the outcomes of TBI. The relevance of the problem of TBI in the elderly and senile individuals is due to the increasing number of citizens in the older age group, as well as the specific course of TBI in such victims *2, 10]. The development of prognostic criteria for surgical treatment of elderly patients is necessary for determining the extent of surgical intervention, timely prevention of complications, and assessment of treatment outcome. In elderly patients, both the identification of risk factors and the assessment of the degree of influence of each of them on the treatment outcome are of great importance *1-15].

The aim of the study. The aim was to determine the prognostic significance of the age factor in TBI.

Materials and methods. The work is based on a retrospective analysis of the results of clinical and instrumental examination and surgical treatment of 1,557 patients with acute TBI, treated in the Neurosurgery Clinic of the National Hospital of the Ministry of Health of the Kyrgyz Republic for 5 years. Patients with chronic intracranial hematomas were excluded from the study. The main group included 252 patients aged 60 years and older, who accounted for 16.2% of all operated patients. There were 52 women (20.6%), 200 men (79.4%). The median age was 67 * 63; 72+ years. Patients aged 18 to 59 years made up the control group (1,305 victims - 83.8%), 185 women (14.2%) and 1,120 men (85.8%), the median age was 36 * 27; 47+ years. All patients underwent a dynamic clinical neurological examination. The level of consciousness of the victims was assessed using the Glasgow Coma Scale (GCS). The main method of neuroimaging was computed tomography (CT) (and/or magnetic resonance imaging - MRI) of the brain. Clinical assessment of dislocation syndrome was performed using the classification of F. Plum and JB Posner (1986). The degree of axial dislocation was assessed based on the severity of compression of the basal cisterns (according to S.B. Vavilov et al., 1986), the severity of the condition of patients with extracranial injuries was determined according to the Injury Severity Score (ISS) classification. The outcome of surgical treatment in victims with severe TBI was assessed using the Glasgow Outcome Scale (GOS). Osteoplastic craniotomy (OPC) was performed in 135 of 252 patients in the study group (53.6%) and in 652 of 1,305 patients in the control group (50%). Decompressive craniotomy (DC) was performed in 89 elderly patients (35.3%) and in 504 young and middle-aged patients (38.6%).

Results and their discussion. A relationship was found between age and the mechanism of TBI. Elderly patients were more likely to be injured by falling from standing height — 87 people (34.5%) — mainly in the winter-spring period (among young victims, this mechanism of injury was observed in 204 patients (15.6%). In young patients, criminal trauma (a blow to the head) was most often noted, mainly in the summer period — 359 patients (27.5%) (in the main group, a similar mechanism was observed in 23 victims (9.1%). Road traffic accidents (RTA) were the cause of injury in both groups with equal frequency: in the main group, in 34 (13.5%) victims, in the control group — in 219 (16.8%). In 99 patients (39.3%) of the older age group and in 406 patients (31.1%) of the control group, the mechanism of injury remained unknown. Type of injury. Subdural hemorrhages were significantly more common in elderly patients: acute subdural hematomas (ASDH) — in 91 (36.1%), subacute subdural hematomas (SADH) — in 43 (17.1%). In the group of young patients, ASDH was observed in 346 (26.5%), and SADH — in 132 (10.1%). Epidural hematomas were significantly less common in elderly victims — in 8 (3.2%) patients in the main group, while in the control group they were found in 213 (16.3%) patients. Multiple intracranial injuries (mTBI) were more common in the main group — in 64 (25.4%) patients, in the control group — in 239 (18.3%) victims. Intracerebral hematomas (ICH) were present in 32 (12.7%) and 140 (10.7%) patients, respectively ($p<0.05$).

Multiple brain injuries (combinations of OSDH and VMG or subdural hematoma and contusion focus) were predominantly diagnosed in the study group – in 55 victims (70.3%), while in the control group – in 162 patients (50.9%). Hematomas located in both hemispheres of the brain were detected in 9% of patients in the study group and in 5% of young victims. Probably, the noted differences in the structure of intracranial injuries (high frequency of subdural and low number of epidural hematomas) were due to the anatomical and physiological features of the brain and its membranes in elderly patients (calcification of the dura mater, its fusion with the bones of the skull, brain atrophy and a decrease in its volume, as well as changes in the viscoelastic properties of the brain) *8, 12+.

Associated injury. Associated TBI was slightly more common in younger patients, occurring in 290 (22.2%), compared to 43 (17.1%) in the study group. Among elderly victims, the most common associated extracranial injuries were limb fractures and uncomplicated rib fractures. In the control group, where the main mechanisms of injury were road traffic accidents and criminal trauma, the most common were tubular bone fractures and multiple and complicated rib fractures. The severity of the condition of victims with associated TBI according to the ISS scale in the study group ranged from 29 to 68 points (average 32±7.3 points), while in the control group it ranged from 33

to 86 points (average 38.6±8.4 points). In the presence of associated extracranial injuries, surgical outcomes were worse among elderly victims than in the control group. Postoperative mortality among patients with combined TBI was 58.1% in the study group and 42.7% in the control group. With a combined injury severity of over 50 points on the ISS scale, postoperative mortality exceeded 80% in the study group and 60% in the control group. Level of consciousness. Significant differences were noted in the structure of consciousness disturbances in young and elderly patients. Among hospitalized patients, the level of consciousness was not impaired (GCS 14 points) in 23.4% of elderly patients and in 21% of young patients. Depression of the level of consciousness to the point of obtundation (13-14 points on the GCS) was noted in 33.8% of elderly patients and in 27.5% of young patients. Depression of the level of consciousness to the point of coma was registered in 27.4% of elderly patients and in 38.1% of young patients. As a factor worsening the outcome of surgical treatment, the degree of patient wakefulness was more significant for elderly patients. In the group of younger patients, a strong relationship was found between the degree of wakefulness suppression before surgery and the outcome of surgical treatment ($R=0.74$; $p<0.05$). The median degree of wakefulness according to the GCS with a good outcome of surgical treatment corresponded to 14 points, with moderate disability - 12 points, with profound disability - 9 points, with a vegetative state and a death outcome - 6 points. Among elderly patients, the relationship between the signs was less pronounced ($R=0.62$; $p<0.05$). A good and satisfactory outcome was possible only with a decrease in the degree of wakefulness no deeper than stupor, which corresponds to 13 points on the GCS. The median decrease in the degree of wakefulness in a death outcome was significantly greater and amounted to 8 points on the GCS. Disorders of the oculomotor nerve function. Impaired oculomotor nerve function is one of the most important and common clinical symptoms of dislocation syndrome—brain displacement into the tentorium cerebelli. Anisocoria with preserved or impaired light reactions has been noted by many authors as a highly significant prognostic indicator of TBI outcome [11,13-15]. Pupil dilation occurs due to compression of the oculomotor nerve by the uncus of the hippocampus.Wedging under the tentorium cerebelli. Anisocoria and oculomotor nerve dysfunction were equally common in both groups. In the presence of anisocoria, the postoperative mortality rate in elderly patients was 79.7%, compared to 66.5% in the control group. In the presence of photoreaction disorders, the postoperative mortality rate reached 90% in older patients, compared to 75% in younger patients.

Arterial hypotension.A relationship was found between the presence of unstable hemodynamic episodes and the age of the victims. In our study, arterial hypotension (a decrease in systolic blood pressure of less than 100 mm Hg) was observed in 56 (23.6%) patients in the main group of victims and in 218 (16.1%) patients in the control group. Episodes of arterial hypotension were recorded significantly more often in older victims ($p < 0.05$, $R = 0.42$). The age of most patients with arterial hypotension exceeded 50 years. The age factor significantly influenced the outcome of surgical treatment of TBI complicated by the development of arterial hypotension. Mortality among patients with arterial hypotension in the main group was significantly higher than in the control group - 92.1 and 73.5%, respectively. Data of the CT scan of the brain. The prognostic value of such CT data of the brain as the volume of the intracranial lesion, the magnitude of transverse dislocation, and the degree of compression of the basal cisterns has been noted by many authors *4, 7, 11, 13-15+. In elderly patients, the volume of all types of intracranial hemorrhages was 10-20% higher than that of young patients. Thus, the average volume of acute subdural hematomas in the study group was 100±20 cm3, poDSH — 97.5±10 cm3, EDH — 85±30 cm3, VMG — 60±25 cm3, multiple TBI — 100±25 cm3. In the control group, the average volume of OSDG was 85+25 cm3, poOSDG — 80+20 cm3, EDG — 60+20 cm3, VMG — 45+15 cm3, multiple TBI — 80+25 cm3. The volume of intracranial hematoma, as a factor in unfavorable outcome of surgical treatment, was the same for both groups of patients - the median hematoma volume for a good outcome was 50 cm3, for a lethal outcome - 80 cm3. The displacement of midline structures with the same hematoma volume was less in patients of the main group. Thus, the displacement of midline structures with a subdural hematoma volume from 90 to 100 cm3 in elderly patients was 8 mm, while in young patients it was 12 mm. Displacement of midline structures, according to brain CT data, was a significant risk factor for the outcome of surgical treatment of patients with TBI. In the group of young patients, we found

a significant relationship between the outcome of surgical treatment and the magnitude of lateral dislocation (R=0.45; p<0.05). The median of good outcome was 6 mm, satisfactory outcome was 7 mm, and lethal outcome was 12 mm. Among elderly patients, no significant relationship was found between the magnitude of midline structure displacement and outcome. The median of good and satisfactory outcome was 6 mm, and lethal outcome was 7 mm. One of the highly significant prognostic factors for the outcome of surgical treatment in patients with TBI was the degree of compression of the basal cisterns according to CT data. In the group of elderly patients, this factor played a much greater role in the development of an unfavorable outcome than in young patients. All elderly patients with a severe degree of compression of the basal cisterns died (according to S.B. Vavilov et al., 1986).whereas among young patients, mortality with this type of compression ranged from 75% with multiple foci of injury to 83.3% with epidural hematomas. It should be noted that in elderly patients, compression of the basal cisterns with multiple hematomas was an extremely unfavorable prognostic factor. Postoperative mortality with a severe degree of cistern compression was 96%, with a gross degree - 97%. In younger patients, mortality was 42 and 68%, respectively. The causes of intraoperative cerebral heaving with prolapse into the trepanation defect in TBI are increased ICP due to cerebral edema or as a result of reperfusion (overperfusion syndrome) during decompression and removal of supratentorial foci of injury *4, 6, 19+. Intraoperative cerebral swelling was significantly more common in young patients — 22 (8.3%) in the main group and 210 (16.1%) in young victims (Mann-Whitney test, p=0.008, n=150). With the development of intraoperative edema, the outcomes of surgical treatment in elderly victims were significantly worse, postoperative mortality reached 93.5%, and in young patients — 74.3% (Mann-Whitney test, p=0.007, n=150). Postoperative complications. A significant risk factor for an unfavorable outcome of severe TBI are postoperative complications. The development of pneumonia in victims with severe TBI leads to disruption of external respiration function and the occurrence of secondary ischemic brain damage [3, 5, 6, 9, 11, 13, 15]. According to our study, pneumonia developed in 71 (28.2%) elderly and senile patients and in 271 (20.8%) young patients. Infectious complications such as meningitis and meningoencephalitis were observed with equal frequency in the study and control groups — 9.1 and 8.1% of patients, respectively. However, the development of infectious complications significantly worsened the prognosis of the surgical outcome in elderly patients. Postoperative mortality among victims with pneumonia in the study group reached 78%, in young victims — 61.8%, with the development of meningitis — 73.9 and 55.7%, respectively. Another formidable complication with a high risk of death is pulmonary embolism (PE). Risk factors for PE in neurosurgical patients include: advanced age, prolonged bed rest, and a history of thromboembolic diseases. Pulmonary embolism was the cause of death in 3.2% of patients in the main group and in 0.6% of patients in the control group.In younger patients, the mortality rate was 42 and 68%, respectively. The causes of intraoperative cerebral heaving with prolapse into the trepanation defect in TBI are increased ICP due to cerebral edema or reperfusion (overperfusion syndrome) during decompression and removal of supratentorial foci of injury *4, 6, 19+. 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Conclusion. Age 60 years and older is a significant risk factor for poor outcomes in severe TBI. The predominant mechanism of TBI in elderly patients is a fall from standing height, most often in the winter and spring. Subdural hematomas and multiple brain injuries, as well as bilateral

hematomas, are most common in elderly patients with severe TBI. Epidural hematomas are rare in elderly patients. Intracranial pressure (ICP) is significantly lower in elderly patients, even with large hematomas. The following factors influence surgical outcomes in elderly patients with severe TBI: level of alertness, degree of basal cistern compression, abnormal pupillary responses, ICP, and arterial hypotension.

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