



SURGICAL STRATEGIES AND TREATMENT OUTCOMES OF MULTIPLE TRAUMATIC INTRACRANIAL HEMATOMAS IN SEVERE TRAUMATIC BRAIN INJURY

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Abstract.

Background. Multiple traumatic intracranial hematomas represent one of the most severe complications of traumatic brain injury and are associated with extremely high mortality rates. Despite advances in neuroimaging and neurosurgical techniques, optimal surgical management remains controversial.

Objective. To evaluate surgical strategies and treatment outcomes in patients with severe traumatic brain injury complicated by multiple traumatic intracranial hematomas.

Materials and Methods. A retrospective analysis of 103 patients with multiple intracranial hematomas was performed. Clinical presentation, neuroimaging findings, surgical approaches, and postoperative outcomes were analyzed.

Results. Postoperative mortality reached 62.1%. Favorable outcomes were predominantly associated with wide craniotomy techniques. The depth of impaired consciousness was identified as the most significant prognostic factor.

Conclusion. Early, adequate, and radical surgical decompression tailored to hematoma localization and neurological status is critical for improving survival and functional outcomes in patients with multiple traumatic intracranial hematomas.

Keywords: traumatic brain injury; multiple intracranial hematomas; bilateral hematomas; craniotomy; neurosurgical treatment; mortality

ХИРУРГИЧЕСКАЯ ТАКТИКА И ИСХОДЫ ЛЕЧЕНИЯ МНОЖЕСТВЕННЫХ ТРАВМАТИЧЕСКИХ ВНУТРИЧЕРЕПНЫХ ГЕМАТОМ ПРИ ТЯЖЕЛОЙ ЧЕРЕПНО-МОЗГОВОЙ ТРАВМЕ

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Аннотация.

Актуальность. Множественные травматические внутричерепные гематомы представляют собой одну из наиболее тяжелых форм осложнений черепно-мозговой травмы и характеризуются высокой летальностью. Несмотря на развитие нейровизуализации и хирургических технологий, вопросы оптимальной тактики хирургического лечения данной патологии остаются дискуссионными.

Цель. Проанализировать исходы хирургического лечения больных с тяжелой черепно-мозговой травмой, осложненной множественными травматическими внутричерепными гематомами.

Материалы и методы. Проведен ретроспективный анализ 103 пациентов с множественными внутричерепными гематомами, которым выполнялись различные виды хирургических вмешательств. Оценивались клинические, нейровизуализационные и операционные факторы, влияющие на исход лечения.

Результаты. Послеоперационная летальность составила 62,1%. Наиболее благоприятные исходы отмечены при применении широкой трепанации черепа. Уровень угнетения сознания являлся ключевым прогностическим фактором.

Заклучение. Своевременное и радикальное хирургическое вмешательство с учетом клинико-топографических особенностей повреждения является определяющим фактором выживаемости пациентов с множественными внутричерепными гематомами.

Ключевые слова: черепно-мозговая травма; множественные внутричерепные гематомы; двусторонние гематомы; трепанация черепа; нейрохирургия; летальность

OG'IR BOSH MIYA JAROHATLARIDA KO'P O'CHOQLI TRAVMATIK INTRAKRANIAL GEMATOMALARNI JARROHLIK YO'LI BILAN DAVOLASH TAKTIKASI VA NATIJALARI

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Annotatsiya.

Dolzarbli. Ko'p o'choqli travmatik intrakranial gematomalar bosh miya jarohatlarining eng og'ir asoratlardan biri bo'lib, yuqori o'lim ko'rsatkichlari bilan tavsiflanadi. Zamonaviy neyroxirurgik texnologiyalariga qaramay, jarrohlik davolash taktikasi bo'yicha yagona yondashuv mavjud emas.

Maqsad. Og'ir bosh miya jarohati bilan kechuvchi ko'p o'choqli travmatik intrakranial gematomalarda jarrohlik davolash natijalarini baholash.

Materiallar va usullar. 103 nafar bemor retrospektiv tahlil qilindi. Klinik holat, KT/MRT natijalari, jarrohlik usullari va davolash natijalari o'rganildi.

Natijalar. Operatsiyadan keyingi o'lim darajasi 62,1% ni tashkil etdi. Eng yaxshi natijalar keng trepanatsiya qo'llanilganda kuzatildi. Ong darajasining pasayishi asosiy prognostik omil bo'ldi.

Xulosa. Jarohatning klinik va anatomik xususiyatlarini hisobga olgan holda o'z vaqtida va yetarli jarrohlik dekompressiyasi bemorlarning omon qolishi uchun hal qiluvchi ahamiyatga ega.

Kalit so'zlar: bosh miya jarohati; intrakranial gematoma; ikki tomonlama gematoma; trepanatsiya; neyroxirurgiya; o'lim ko'rsatkichi

Introduction. The steady increase in the incidence of traumatic brain injury (TBI), leading to damage of the brain as the principal integrator of physiological functions, positions neurotrauma as one of the most significant scientific and practical challenges in contemporary neurosurgery. Over recent decades, the diagnosis and management of TBI have gained even greater relevance within traumatology and neurosurgery due to rising injury severity and complexity (1–10). According to data from the World Health Organization, mortality associated with TBI among individuals of the most economically active age group (under 45 years) occupies a leading position in the overall mortality structure (4–7). Moreover, epidemiological analyses indicate a persistent annual increase in TBI incidence of approximately 2%, reflecting global trends related to urbanization, motorization, and high-energy trauma mechanisms (7–10).

Modern neurotraumatology is characterized not only by a quantitative rise in TBI cases, but also by qualitative changes, notably an increasing frequency of multiple traumatic intracranial lesions. Among these, bilateral traumatic intracranial hematomas represent a particularly severe and prognostically unfavorable subgroup. Despite a considerable number of clinical reports, surgical techniques and operative strategies for multiple intracranial hematomas remain insufficiently systematized in the literature, and there is a lack of comprehensive data regarding optimal surgical tactics for this complex pathology. In daily clinical practice, especially in the context of road traffic injuries, neurosurgeons are increasingly confronted with bilateral and multiloculated intracranial hematomas, necessitating rapid decision-making under conditions of critical neurological deterioration.

The aim of the present study was to analyze treatment outcomes in patients with severe TBI caused by multiple traumatic intracranial hematomas, with particular emphasis on the influence of surgical strategy, clinical status, and lesion characteristics on postoperative mortality and functional outcomes.

Materials and Methods. This study is based on a retrospective analysis of clinical syndromes and neurosurgical treatment outcomes in 103 patients diagnosed with multiple traumatic intracranial hematomas. Multiple traumatic intracranial hematomas were defined as the simultaneous presence of two or more subdural, epidural, or intracerebral hematomas, located unilaterally or bilaterally. Taking into account topographic localization and mutual spatial relationships, the hematomas were classified as bilateral or “multilevel” bilateral (“tiered”) hematomas. The latter category included epidural, subdural, and intracerebral hematomas positioned one above another within the same cranial region but affecting both cerebral hemispheres (23 cases). The group of bilateral hematomas comprised cases in which epidural, subdural, or intracerebral hematomas were located over both hemispheres without a strict vertical arrangement (80 patients).

The most frequent combinations were subdural plus subdural hematomas (40.8%) and subdural plus epidural hematomas (22.3%). Less common were intracerebral plus intracerebral hematomas (9.7%), while other combinations of bilateral intracranial hematomas were observed sporadically. Comprehensive in-hospital diagnostic evaluation included detailed somatic and neurological examinations, neuro-ophthalmological assessment, skull radiography, lumbar puncture, echoencephalography, electroencephalography, computed tomography and magnetic resonance imaging of the brain, as well as diagnostic exploratory burr-hole trepanation in selected cases.

Age distribution analysis demonstrated that bilateral traumatic intracranial hematomas occurred most frequently in patients younger than 40 years (57 cases), followed by individuals aged 40–59 years (29 cases), and patients aged 60 years and older (17 cases). The predominance of male patients was noted across all age groups, reflecting general epidemiological patterns of severe TBI.

Surgical Treatment. Surgical intervention constituted the final stage of diagnosis and the initial stage of definitive treatment for patients with intracranial hematomas. In the management of multiple traumatic intracranial hematomas, paramount importance was attributed to the timeliness and radicality of surgical decompression. The primary surgical techniques employed were decompressive craniectomy with resectional trepanation of the skull, osteoplastic craniotomy, and evacuation of hematomas through enlarged burr holes.

In the acute phase of severe TBI, the critical condition of patients often necessitated rapid surgical decompression, prompting the use of resectional trepanation and hematoma evacuation through enlarged burr holes. In cases of extremely severe neurological compromise, evacuation via expanded burr holes represented the only feasible surgical option.

Results. An important objective of this study was to assess the influence of neurological status, injury localization, skull fracture morphology, hematoma volume, and other factors on the choice of surgical access, as well as to elucidate postoperative course characteristics depending on the selected treatment strategy. During surgical management of multiple traumatic intracranial hematomas, three classical neurosurgical approaches were utilized: osteoplastic craniotomy, resectional trepanation, and burr-hole evacuation.

Resectional trepanation predominated among surgical methods, largely due to the fact that most patients were admitted in the acute stage of TBI with severe or extremely severe neurological impairment. This technique was most frequently applied in young and middle-aged patients, whereas in individuals older than 60 years it was used less often. Conversely, osteoplastic craniotomy was performed more frequently in younger patients, while enlarged burr-hole techniques were more commonly applied in elderly and senile patients. As a rule, osteoplastic craniotomy was indicated in patients without pronounced brainstem dysfunction and in cases where hematoma localization had been accurately determined by CT or MRI.

Clinical experience demonstrated that osteoplastic craniotomy is particularly effective for multilevel bilateral hematomas, especially epidural hematomas, which in the early post-traumatic period often contain dense coagulated blood and are prone to rebleeding during evacuation. This method was used both as a primary definitive procedure and as a subsequent stage following partial hematoma evacuation through burr holes. Its application was more frequent in younger patients, as it provides favorable anatomical and physiological conditions for early and complete neurological recovery and

prevents the development of the “trephined skull syndrome.” In patients with moderate or relatively stable clinical status, osteoplastic craniotomy was considered absolutely indicated.

Of the 103 patients, 98 (95.1%) underwent resectional trepanation. This method was employed in cases of severe clinical condition, pronounced cerebral and brainstem symptoms, comminuted depressed skull fractures, and progressive cerebral edema with brain displacement. In 12 patients with signs of incipient transtentorial herniation, bilateral subtemporal decompression was performed, allowing preservation not only of life but also of mental integrity. Resectional trepanation was carried out in 54 young and middle-aged patients and in 34 elderly patients. Although technically simpler than osteoplastic craniotomy, this method enabled effective revision of epidural and subdural spaces, albeit with certain limitations.

Evacuation of multiple traumatic intracranial hematomas through enlarged burr holes was performed in 30 cases (29.1%), predominantly in patients in extremely critical condition. This technique involved the creation of two burr holes expanded up to 5 cm in diameter, allowing aspiration of epidural hematomas and irrigation of clot remnants. In most cases, burr-hole evacuation served as the initial stage preceding a more radical surgical procedure. The method has notable limitations, including insufficient removal of large basal hematomas, difficulty in addressing contusion-laceration foci, limited identification of bleeding sources, and suboptimal decompressive effect. However, its advantages include rapid execution, minimal invasiveness, and high diagnostic value.

Outcomes. Among the 103 operated patients, 39 (37.9%) were discharged from the hospital, while 64 patients died, resulting in a postoperative mortality rate of 62.1%. Analysis of fatal outcomes revealed that the primary causes of death were brain injuries incompatible with life, severe cerebral contusion and laceration, incomplete hematoma removal, and secondary brainstem hemorrhages. Cumulative mortality rates varied by age: 54.7% in patients younger than 40 years, 25.0% in those aged 40–59 years, and 20.3% in patients older than 60 years.

The most favorable outcomes were observed following wide craniotomy procedures, whereas less satisfactory results were associated with burr-hole techniques, reflecting the extreme severity of patients’ conditions that precluded more extensive surgical intervention. Mortality increased progressively with the depth of consciousness impairment, from obtundation to sopor and coma, while the probability of favorable neurological recovery decreased accordingly. Thus, the level of consciousness depression emerged as a decisive prognostic factor determining both favorable and unfavorable outcomes in patients with multiple traumatic intracranial hematomas.

Conclusion. Multiple traumatic intracranial hematomas constitute a distinct and extremely severe form of traumatic brain injury, characterized by complex pathophysiology, rapid neurological deterioration, and high postoperative mortality. The findings of the present study demonstrate that treatment outcomes are determined primarily by the depth of consciousness impairment at admission, the extent of brain contusion and dislocation, and the timeliness and adequacy of surgical intervention. Wide decompressive craniotomy provides superior conditions for effective hematoma evacuation and cerebral decompression, particularly in younger patients and in cases of multilevel bilateral hematomas. Limited procedures, such as enlarged burr-hole evacuation, should be reserved for critically ill patients as a life-saving or diagnostic measure. An individualized surgical strategy based on clinical status, neuroimaging data, and intraoperative findings remains essential for improving survival and functional recovery in this challenging patient population.

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