PROGNOSTIC FACTORS OF MORTALITY IN PATIENTS WITH HEMORRHAGIC STROKE: A RETROSPECTIVE COHORT STUDY IN A MULTIDISCIPLINARY CLINIC IN ALMATY

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Abstract

Introduction. Hemorrhagic stroke is characterized by high mortality and severe outcomes. According to the World Health Organization, strokes rank second among the leading causes of death worldwide and are a leading cause of permanent disability among adults.

Aim. The aim of this study is to identify factors influencing the likelihood of mortality in patients with hemorrhagic stroke admitted to a multidisciplinary clinic.

Materials and methods. Data from 200 patients with hemorrhagic stroke admitted to City Clinical Hospital No. 7 in Almaty between January 2018 and December 2023 were analyzed. A retrospective cohort study was conducted, including an analysis of demographic data, clinical indicators, surgical interventions, and outcomes. Statistical analyses were performed using the χ^2 test, Student's t-test, Mann-Whitney test, and logistic regression.

Results. The mean age of patients in the mortality group was significantly higher compared to the discharge group (69 vs 58 years, p = 0.02). The presence of arterial hypertension nearly doubled the risk of death (OR = 1.717, p = 0.049), and low consciousness level at admission (GCS) significantly increased the risk of mortality (OR = 0.705, p < 0.001). Neurological deficit at admission was associated with a 3.6 times higher risk of death (OR = 3.595, p = 0.005). The volume of surgical intervention was also a significant factor, increasing the risk of mortality by 1.5% for each additional milliliter (OR = 1.015, p = 0.003). The length of hospital stay did not have a significant effect on outcomes (p = 0.221).

Conclusion. Age, presence of arterial hypertension, consciousness level at admission, neurological deficit, and the volume of surgical intervention are key factors influencing the likelihood of mortality in patients with hemorrhagic stroke. These findings can be used to improve prognosis and management of such patients.

Key words: hemorrhagic stroke, mortality, logistic regression, arterial hypertension, neurological deficit, surgical intervention.

Introduction. Hemorrhagic stroke is one of the most serious forms of cerebrovascular diseases, characterized by high mortality and disability rates [1-3]. According to the World Health Organization (WHO), strokes rank second among the leading causes of death worldwide and are a major cause of persistent disability in adults [4, 5]. Specifically, hemorrhagic stroke,

which includes subarachnoid and intracerebral hemorrhage, leads to severe neurological impairments and requires intensive treatment and rehabilitation [6].

Effective treatment of patients with hemorrhagic stroke directly depends on many factors, including age, the presence of comorbidities such as arterial hypertension, the level of consciousness at the time of admission, neurological impairments, and the extent of surgical interventions [7, 8]. Proper understanding of prognostic factors can significantly improve treatment outcomes and help develop strategies for early diagnosis and intensive therapy of patients [9, 10].

Despite numerous studies on hemorrhagic stroke, the problem of identifying key factors that can affect the prognosis and outcome of the disease remains relevant [11]. Existing studies often focus on the clinical characteristics of patients; however, additional data specific to various regions and medical institutions are needed, considering the local peculiarities of healthcare delivery [12, 13].

The aim of this study is to identify the key prognostic factors of mortality in patients with hemorrhagic stroke hospitalized at City Clinical Hospital No. 7 in Almaty. Thus, our study is focused on analyzing demographic characteristics, clinical data, and treatment features of patients for a deeper understanding of the factors influencing the outcome of the disease, with the goal of improving medical care and developing recommendations for the treatment of this patient group.

Materials and Methods

Ethical Considerations

All patient data were anonymized to protect confidentiality, and the study was conducted in accordance with ethical standards, including the principles of the Declaration of Helsinki. The study was approved by the local ethics committee of the Kazakhstan Medical University "KSPH" (IRB-A074/A 11/15/2018).

Study Design

This is a retrospective cohort study using patient medical records (form 003/y). The study was conducted at City Clinical Hospital No. 7 (CCH No. 7) in Almaty, the largest multi-profile clinic with a capacity of more than 1,000 beds. The study included patients admitted with a diagnosis of hemorrhagic stroke from January 2018 to December 2023. Patient inclusion was based on ICD-10 codes (I60.0–I62.9), corresponding to the following diagnoses: subarachnoid hemorrhage, intracerebral hemorrhage, and other non-traumatic hemorrhages.

Inclusion Criteria

Patients over 18 years old with a diagnosis of hemorrhagic stroke according to ICD-10 codes (I60.0–I62.9).

Exclusion Criteria

Patients under 18 years old, pregnant and breastfeeding women, and patients with other types of stroke.

Key Variables

The primary indicators used for evaluation were age, gender, comorbidities (e.g., arterial hypertension), level of consciousness at admission (based on the Glasgow Coma Scale), and neurological status.

Outcome Measures

Outcome assessment included the type and extent of surgical interventions, duration of hospital and ICU stay, use of neurosurgical care, and intensity of therapy. In addition, we evaluated the level of consciousness at discharge, the presence or absence of neurological deficits, and the overall outcome (discharge or death).

Data Collection Methods

Data were collected using an individual registration card developed by the study authors. The card included passport data, medical history, treatment details, and outcomes. Key parameters recorded included the level of consciousness, neurological deficit, outcome of hospitalization, duration of hospital stay, and surgical interventions. The level of consciousness was assessed using the Glasgow Coma Scale (GCS) [14].

Primary Outcomes

Level of consciousness at discharge, neurological deficit, and disease outcome (discharge or death).

Statistical Analysis. Data were processed using SPSS version 25.0. Descriptive statistics for quantitative data included median (Q1, Q3) for non-normally distributed data and mean (± standard deviation) for normally distributed data. Normality was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The patient groups were divided based on disease outcomes (discharge or death), allowing for a comparative analysis of various clinical factors and treatments. Statistical methods such as the χ^2 test for nominal data, Student's t-test for quantitative data, and non-parametric methods (Mann-Whitney test) for non-normally distributed data were used to assess differences between groups.

Results. In the study, which included 200 patients, 140 were discharged and 60 died. Significant differences were found (Table 1) in several demographic and clinical characteristics. The median age in the discharge group was 58 years (Q1: 45, Q3: 72), while in the death group it was 69 years (Q1: 55, Q3: 80), with a p-value of 0.02, indicating a statistically significant difference. The percentage of males among those discharged was 57% (n = 80), and in the death group, it was 67% (n = 40), but the difference did not reach statistical significance (p = 0.18).

Arterial hypertension was recorded in 68% (n = 95) of patients in the discharge group and in 80% (n = 48) in the death group, with a p-value of 0.11, which was not statistically significant. The level of consciousness at admission, as measured by the Glasgow Coma Scale, was significantly lower in patients with a fatal outcome (median 6, Q1: 4, Q3: 8) compared to those who were discharged (median 12, Q1: 8, Q3: 15), with a p-value <0.001. Neurological deficit at admission was noted in 32% (n = 45) of patients in the discharge group and in 83% (n = 50) in the death group, which also demonstrated a statistically significant difference (p < 0.001).

Table 1. Demographic and Clinical Characteristics of Patients (n = 200).

Parameters	Discharge (n = 140)	Death (n = 60)	P-value
Age, median (Q1, Q3)	58 (45, 72)	69 (55, 80)	0.02
Gender (male), %	80 (57%)	40 (67%)	0.18
Arterial hypertension, %	95 (68%)	48 (80%)	0.11
Level of consciousness at admission (GCS), median (Q1, Q3)	12 (8, 15)	6 (4, 8)	<0.001
Neurological deficit at admission, %	45 (32%)	50 (83%)	<0.0

Surgical intervention was performed in 64% (n = 90) of patients in the discharge group and 50% (n = 30) in the death group (Table 2), although this difference did not reach statistical significance (p = 0.08). The average volume of surgical intervention was significantly greater in patients with a fatal outcome — 180 ± 40 ml, compared to 150 ± 35 ml in the discharge group, with a p-value of 0.04, indicating a statistically significant difference. The median length

of hospital stay among discharged patients was 12 days (Q1: 8, Q3: 18), while in the death group it was only 6 days (Q1: 4, Q3: 10), with a p-value of <0.001.

The duration of stay in the ICU was longer for patients with a fatal outcome — 8 days (Q1: 6, Q3: 12) compared to 5 days (Q1: 3, Q3: 8) for discharged patients, with a p-value of 0.02. The level of consciousness at discharge, measured by the Glasgow Coma Scale, was significantly higher in the discharge group — median 14 (Q1: 12, Q3: 15), compared to 5 (Q1: 3, Q3: 7) in patients with a fatal outcome, with a p-value of <0.001. Neurological deficits at discharge were recorded in 21% (n = 30) of discharged patients and in 92% (n = 55) of patients who died, which also showed a statistically significant difference (p < 0.001).

Table 2. Therapeutic Interventions and Outcomes.

Parameters	Discharge (n = 140)	Death (n = 60)	P-value
Type of surgical intervention, %	90 (64%)	30 (50%)	0.08
Volume of surgical intervention (mean ± SD)	150 ± 35 ml	180 ± 40 ml	0.04
Length of hospital stay (days), median (Q1, Q3)	12 (8, 18)	6 (4, 10)	<0.001
Length of ICU stay (days), median (Q1, Q3)	5 (3, 8)	8 (6, 12)	0.02
Level of consciousness at discharge (GCS), median (Q1, Q3)	14 (12, 15)	5 (3, 7)	<0.001
Neurological deficit at discharge, %	30 (21%)	55 (92%)	<0.001

The level of consciousness at discharge, measured by the Glasgow Coma Scale (Table 3), had a median of 14 (Q1: 12, Q3: 15) in the discharge group, while in the death group, this indicator was significantly lower with a median of 5 (Q1: 3, Q3: 7), with a p-value of <0.001. Neurological deficits at discharge were recorded in 21% (n = 30) of patients in the discharge group and in 92% (n = 55) of patients in the death group, which also demonstrated a statistically significant difference (p < 0.001).

The overall outcome, reflecting the percentage of discharged and deceased patients, showed that 70% (n = 140) were discharged and 30% (n = 60) died, indicating the distribution of outcomes in the study sample.

Table 3. Evaluation of Treatment Outcomes.

Outcome	Discharge (n = 140)	Death (n = 60)	P-value
Level of consciousness at discharge (GCS)	14 (12, 15)	5 (3, 7)	<0.001
Neurological deficit at discharge, %	30 (21%)	55 (92%)	<0.001
Overall outcome (discharge/death)	140 (70%)	60 (30%)	-

The results of the logistic regression analysis (Table 4) showed that age has a significant impact on the likelihood of mortality in patients with hemorrhagic stroke. Each additional year

of life increases the risk of death by 4.6% (OR = 1.046, 95% CI 1.010 – 1.084, p = 0.014). Gender (male) was not a statistically significant factor, although males had a slightly higher chance of a fatal outcome (OR = 1.233, 95% CI 0.678 – 2.243, p = 0.523). The presence of arterial hypertension almost doubled the likelihood of a fatal outcome (OR = 1.717, 95% CI 1.001 – 2.947, p = 0.049), underscoring the importance of this factor in predicting outcomes.

The level of consciousness at admission, measured by the Glasgow Coma Scale (GCS), is a strong predictor of a favorable outcome. Each additional GCS point reduces the likelihood of death by 29.5% (OR = 0.705, 95% CI 0.574 – 0.866, p < 0.001). The presence of a neurological deficit at admission also significantly increases the risk of a fatal outcome. Patients with a neurological deficit were 3.6 times more likely to die (OR = 3.595, 95% CI 1.470 – 8.789, p = 0.005).

The length of hospital stay did not show a statistically significant effect on outcomes (OR = 0.98, 95% CI 0.950 – 1.011, p = 0.221). However, the volume of surgical intervention had a significant impact: each additional milliliter of intervention volume increased the risk of death by 1.5% (OR = 1.015, 95% CI 1.005 – 1.025, p = 0.003), suggesting that more aggressive surgical procedures may be associated with a poorer prognosis.

Table 4. Logistic Regression - Model of Factors Influencing Mortality.

Variable	Coefficient (β)	Standard Error (SE)	Odds Ratio (OR)	95% Confidence Interval (CI)	P-value
Age (years)	0.045	0.018	1.046	1.010 – 1.084	0.014
Gender (male)	0.21	0.32	1.233	0.678 – 2.243	0.523
Arterial hypertension	0.54	0.28	1.717	1.001 – 2.947	0.049
Level of consciousness at admission (GCS)	-0.35	0.09	0.705	0.574 – 0.866	<0.001
Neurological deficit at admission	1.28	0.45	3.595	1.470 – 8.789	0.005
Length of hospital stay (days)	-0.02	0.015	0.98	0.950 – 1.011	0.221
Volume of surgical intervention (ml)	0.015	0.005	1.015	1.005 – 1.025	0.003

Discussion. This study identified key prognostic factors affecting the likelihood of mortality in patients with hemorrhagic stroke who were hospitalized in a multi-profile clinic. The main significant variables determining the outcome of the disease were age, arterial hypertension, level of consciousness at admission, presence of neurological deficits, and the extent of surgical intervention. The results obtained are consistent with data from other studies, confirming the importance of these factors in predicting outcomes in hemorrhagic stroke [15].

Age was a significant factor, supporting the findings of numerous studies that older patients have a higher risk of unfavorable outcomes in stroke [16]. In our study, each additional

year of life increased the probability of death by 4.6%. This may be related to age-associated vascular changes, reduced compensatory mechanisms, and the presence of comorbidities.

Arterial hypertension also proved to be a significant predictor of mortality, increasing the risk of death by nearly two times (OR = 1.717, p = 0.049). This aligns with the literature, where hypertension is a major modifiable risk factor for hemorrhagic stroke, as it contributes to vascular wall damage and increases the likelihood of hemorrhage [17].

One of the most important outcome factors is the level of consciousness at admission, measured by the Glasgow Coma Scale (GCS) [18]. In our study, low GCS scores were closely associated with fatal outcomes (OR = 0.705, p < 0.001), a finding also supported by other studies [19]. This highlights the need for rapid diagnosis and intensive therapy in patients with low levels of consciousness to improve the chances of survival [20].

Neurological deficits at admission were found to be a significant prognostic factor, increasing the likelihood of death by 3.6 times. This emphasizes the importance of early detection of neurological impairments and the development of individualized therapeutic approaches for patients with severe deficits [21, 22].

An interesting result of the study was the significance of the extent of surgical intervention [23]. Patients who underwent more extensive surgical procedures had an increased risk of death (OR = 1.015, p = 0.003). This may be related to the fact that more aggressive surgical methods are applied in patients with more severe clinical cases, which in turn are associated with worse prognosis [24]. However, further research is needed to clarify these findings and the possible impact of the nature of surgical interventions on outcomes [25].

It is important to note that the length of hospital stay did not significantly affect disease outcomes (p = 0.221). This may indicate that the outcome of the disease is more determined by the severity of the patient's condition at admission rather than the duration of hospital treatment [26].

Our study has certain limitations. First, the retrospective design of the study does not allow for the complete exclusion of the influence of all possible confounding factors. Second, the study was conducted at a single medical center, which may limit its generalizability to other populations and medical institutions.

Nevertheless, the results of our study emphasize the importance of a multifactorial approach to the treatment of patients with hemorrhagic stroke. Age, arterial hypertension, level of consciousness at admission, presence of neurological deficits, and the extent of surgical intervention are key predictors of outcomes that should be considered when developing individualized treatment strategies.

Conclusion: This study confirms that age, arterial hypertension, level of consciousness, neurological deficits, and the extent of surgical intervention significantly influence the likelihood of mortality in patients with hemorrhagic stroke.

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ГЕМОРРАГИЯЛЫҚ ИНСУЛЬТПЕН АУЫРАТЫН НАУҚАСТАРДАҒЫ ӨЛІМ-ЖІТІМГЕ ӘКЕЛЕТІН ФАКТОРЛАР: АЛМАТЫ ҚАЛАСЫНДАҒЫ КӨПСАЛАЛЫ КЛИНИКАДА ӨТКІЗІЛГЕН РЕТРОСПЕКТИВТІ КОГОРТАЛЫҚ ЗЕРТТЕУ

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Түйіндеме

Кіріспе: Геморрагиялық инсульт жоғары өлім-жітіммен және ауыр салдарлармен сипатталады. Дүниежүзілік денсаулық сақтау ұйымының деректері бойынша, инсульттер әлемде өлім себептерінің арасында екінші орында және ересектер арасында тұрақты мүгедектіктің негізгі себебі болып табылады.

Мақсаты: Бұл зерттеудің мақсаты - көпсалалы клиникаға жатқызылған геморрагиялық инсультпен ауыратын науқастардың өлім ықтималдығына әсер ететін факторларды анықтау.

Материалдар мен әдістер: Зерттеуде 2018 жылдың қаңтарынан 2023 жылдың желтоқсанына дейін Алматы қаласындағы №7 Қалалық клиникалық ауруханаға түскен 200 геморрагиялық инсультпен ауыратын науқастардың деректері талданды. Демографиялық мәліметтерді, клиникалық көрсеткіштерді, хирургиялық араласулар мен нәтижелерді қамтитын ретроспективті когорттық зерттеу жүргізілді. Статистикалық өңдеу үшін χ^2-критерийі, Стьюденттің t-критерийі, Манн-Уитни критерийі және логистикалық регрессия қолданылды.

Нәтижелер: Өлім-жітім тобының орташа жасы шығу тобына қарағанда айтарлықтай жоғары болды (69 жас vs 58 жас, p = 0.02). Артериялық гипертензияның болуы өлім ықтималдығын шамамен 2 есе арттырды (OR = 1.717, p = 0.049), ал қабылдау кезіндегі сана деңгейінің төмендігі (GCS) өлім тәуекелін едәуір арттырды (OR = 0.705, p < 0.001). Қабылдау кезіндегі неврологиялық дефицит өлім тәуекелінің 3.6 есе жоғары болуымен байланысты болды (OR = 3.595, p = 0.005). Хирургиялық араласу көлемі де өлім-жітім қаупін әрбір миллилитрге 1.5%-ға арттыратын маңызды фактор болып саналды (OR = 1.015, p = 0.003). Ауруханада болу ұзақтығы нәтижелерге айтарлықтай әсер етпеді (p = 0.221).

Қорытынды: Жас мөлшері, артериялық гипертензияның болуы, қабылдау кезіндегі сана деңгейі, неврологиялық дефицит және хирургиялық араласу көлемі геморрагиялық инсультпен ауыратын науқастардың өлім ықтималдығына әсер ететін негізгі факторлар болып табылады. Бұл деректер осы науқастардың емін болжау мен басқаруды жақсарту үшін пайдаланылуы мүмкін.

Түйін сөздер: геморрагиялық инсульт, өлім-жітім, логистикалық регрессия, артериялық гипертензия, неврологиялық дефицит, хирургиялық араласу.

ПРОГНОСТИЧЕСКИЕ ФАКТОРЫ ЛЕТАЛЬНОГО ИСХОДА У ПАЦИЕНТОВ С ГЕМОРРАГИЧЕСКИМ ИНСУЛЬТОМ: РЕТРОСПЕКТИВНОЕ КОГОРТНОЕ ИССЛЕДОВАНИЕ В МНОГОПРОФИЛЬНОЙ КЛИНИКЕ АЛМАТЫ

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Аннотация

Введение: Геморрагический инсульт характеризуется высокой смертностью и тяжелыми исходами. По данным Всемирной организации здравоохранения, инсульты занимают второе место среди причин смертности в мире и являются ведущей причиной стойкой инвалидности среди взрослых людей.

Цель: Целью данного исследования является выявление факторов, влияющих на вероятность летального исхода у пациентов с геморрагическим инсультом, госпитализированных в многопрофильную клинику.

Методы: В исследовании были проанализированы данные 200 пациентов с геморрагическим инсультом, поступивших в Городскую клиническую больницу №7 в Алматы в период с января 2018 года по декабрь 2023 года. Проведено ретроспективное когортное исследование, включающее анализ демографических данных, клинических показателей, хирургических вмешательств и исходов. Для статистической обработки использовались χ^2-критерий, t-критерий Стьюдента, критерий Манна-Уитни и логистическая регрессия.

Результаты: Средний возраст пациентов в группе летального исхода был значительно выше по сравнению с группой выписки (69 vs 58 лет, p = 0.02). Наличие артериальной гипертензии увеличивало вероятность смерти почти в 2 раза (OR = 1.717, p = 0.049), а низкий уровень сознания при поступлении (GCS) значительно повышал риск летального исхода (OR = 0.705, p < 0.001). Неврологический дефицит при поступлении ассоциировался с в 3.6 раза более высоким риском смерти (OR = 3.595, p = 0.005). Объем хирургического вмешательства также был значимым фактором, увеличивающим риск смертности на 1.5% с увеличением каждого миллилитра (OR = 1.015, p = 0.003). Длительность пребывания в стационаре не оказала значимого влияния на исходы (p = 0.221).

Заключение: Возраст, наличие артериальной гипертензии, уровень сознания при поступлении, неврологический дефицит и объем хирургического вмешательства являются ключевыми факторами, влияющими на вероятность летального исхода у пациентов с геморрагическим инсультом. Эти данные могут быть использованы для улучшения прогнозирования и управления лечением данных пациентов.

Ключевые слова: геморрагический инсульт, смертность, логистическая регрессия, артериальная гипертензия, неврологический дефицит, хирургическое вмешательство.