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TA'LIMI & INNOVATSIYALARI

O'ZBEKISTON RESPUBLIKASI
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- 14.00.02 - Morfologiya;
- 14.00.03 - Endokrinologiya;
- 14.00.04 - Otorinolaringologiya;
- 14.00.05 - Ichki kasalliklar;
- 14.00.06 - Kardiologiya;
- 14.00.07 - Gigiena;
- 14.00.08 - Oftal'mologiya;
- 14.00.09 - Pediatriya;
- 14.00.10 - Yuqumli kasalliklar;
- 14.00.11 - Dermatologiya va venerologiya;
- 14.00.12 - Tibbiy reabilitologiya;
- 14.00.13 - Nevrologiya;
- 14.00.14 - Onkologiya;
- 14.00.15 - Patologik anatomiya;
- 14.00.16 - Normal va patologik fiziologiya;
- 14.00.17 - Farmakologiya va klinik farmakologiya;
- 14.00.18 - Psixiatriya va narkologiya;
- 14.00.19 - Klinik radiologiya;
- 14.00.20 - Tibbiy genetika;
- 14.00.21 - Stomatologiya;
- 14.00.22 - Travmatologiya va ortopediya;
- 14.00.23 - Hamshiralik ishini tashkil etish;
- 14.00.24 - Sud tibbiyoti;
- 14.00.27 - Xirurgiya;
- 14.00.28 - Neyroxirurgiya;
- 14.00.41 - Xalq tabobati;
- 14.00.35 - Bolalar xirurgiyasi;
- 14.00.34 - Yurak-qon tomir xirurgiyasi

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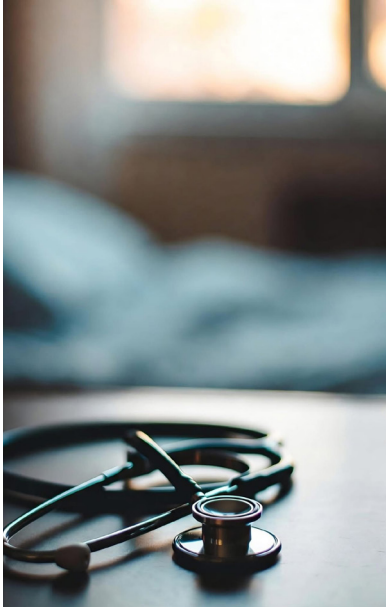
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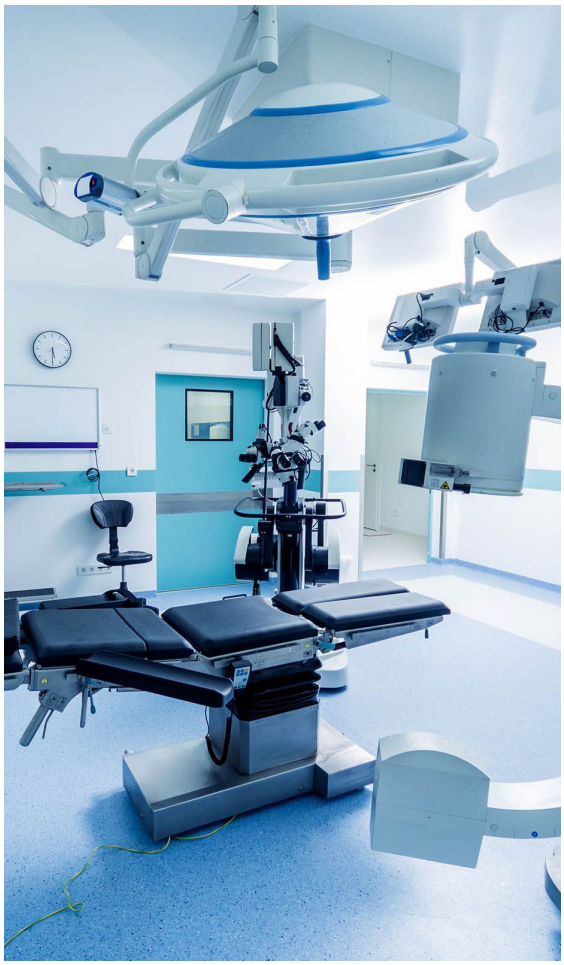
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“Tibbiyot ta'limi va innovasiyalari” ilmi elektron jurnali 29.04.2025-yildan O‘zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi Axborot va ommaviy kommunikatsiyalar agentligi tomonidan C-5669801 reyestr raqami tartibi bo‘yicha ro‘yxatdan o‘tkazilgan. Litsenziya raqami: №745444.

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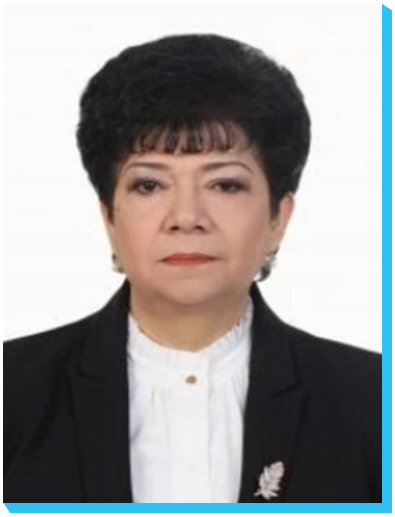
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CLINICAL AND PROGNOSTIC FACTORS OF FUNCTIONAL RECOVERY IN PATIENTS WITH HEMORRHAGIC STROKE





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Abstract: Spontaneous intracerebral hemorrhage (ICH) remains a leading cause of mortality and long-term disability worldwide. Accurate prediction of functional recovery is essential for optimizing treatment and rehabilitation strategies. The objective of this study was to evaluate clinical and prognostic factors associated with functional recovery at 30 and 90 days in patients with spontaneous ICH. The study included 180 patients whose clinical severity was assessed using the Glasgow Coma Scale (GCS) and the National Institutes of Health Stroke Scale (NIHSS). Functional outcomes were evaluated using the Barthel Index and the modified Rankin Scale (mRS) at 30 and 90 days. Early neurological status and functional assessment are key predictors of short- and mid-term functional recovery after ICH. Early assessment improves risk stratification and rehabilitation planning.

Key words: intracerebral hemorrhage, prognosis, functional recovery, modified Rankin Scale.

Annotatsiya: Gemorragik insult butun dunyo bo‘ylab o‘lim va uzoq muddatli nogironlikning asosiy sabablaridan biri bo‘lib qolmoqda. Davolash va reabilitatsiya strategiyalarini optimallashtirish uchun funksional tiklanishni aniq bashorat qilish juda muhimdir. Tadqiqotning maqsadi spontan intratserebral qon quyilishi bo‘lgan bemorlarda 30- va 90-kunlarda funksional tiklanish bilan bog‘liq klinik va prognostik omillarni baholashdan iborat edi. Tadqiqotga 180 nafar bemor kiritilib, klinik og‘irlik darajasi Glazgo koma shkalasi (GCS) va NIHSS yordamida baholandi. Funksional natijalar 30- va 90-kunlarda Bartel indeksi va modifikatsiyalangan Renkin shkalasi (mRS) yordamida baholandi. Nevrologik status va funksional holatni erta baholash intratserebral qon quyilishidan keyingi qisqa va o‘rta muddatli funksional tiklanishning asosiy prediktorlari hisoblanadi. Erta baholash xavflarni stratifikatsiya qilish va reabilitatsiyani rejalashtirishni yaxshilaydi.

Kalit so‘zlar: intratserebral qon quyilishi, prognoz, funksional tiklanish, modifikatsiyalangan Renkin shkalasi.

Аннотация: Спонтанное внутримозговое кровоизлияние является одной из ведущих причин смертности и долгосрочной инвалидизации во всём мире. Точное прогнозирование функционального восстановления имеет важное значение для оптимизации стратегий лечения и реабилитации. Цель исследования — оценить клинические и прогностические факторы, связанные с функциональным восстановлением через 30 и 90 дней у пациентов со спонтанным внутримозговым кровоизлиянием. В исследование включены 180 пациентов, клиническая тяжесть состояния которых оценивалась по шкале комы Глазго (GCS) и шкале инсульта Национальных институтов здоровья (NIHSS). Функциональные исходы оценивались с использованием индекса Бартел и модифицированной шкалы Рэнкина (mRS) через 30 и 90 дней. Ранняя оценка неврологического статуса и функционального состояния является ключевым предиктором краткосрочного и среднесрочного функционального восстановления после внутримозгового кровоизлияния. Ранняя оценка улучшает стратификацию рисков и планирование реабилитации.

Ключевые слова: внутримозговое кровоизлияние, прогноз, функциональное восстановление, модифицированная шкала Ранкина.

INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) remains one of the most severe and disabling forms of stroke, accounting for a substantial proportion of stroke-related mortality and long-term disability worldwide. Despite advances in acute stroke management and neurocritical care, the prognosis of patients with hemorrhagic stroke continues to be poor, with high rates of early mortality and significant functional dependence among survivors [1,10]. Functional recovery after hemorrhagic stroke is a complex, multifactorial process determined by the interaction of pathophysiological, demographic, clinical, and biochemical factors [2,5]. Among the most consistently reported predictors are initial neurological status, commonly assessed using the Glasgow Coma Scale (GCS) and the National Institutes of Health Stroke Scale (NIHSS), as well as hematoma characteristics such as volume, location, and the presence of intraventricular extension [4]. In addition, patient-related factors, including age and comorbid vascular conditions, may significantly modify recovery trajectories.

Early functional assessment using validated scales such as the Barthel Index and the modified Rankin Scale (mRS) plays a crucial role in predicting long-term outcomes and guiding rehabilitation strategies [6]. Previous studies have demonstrated that the first 30-90 days after hemorrhagic stroke represent a critical window for neurological recovery, during which most functional gains occur [7]. However, prognostic profiles may vary across different populations because of differences in healthcare systems, access to rehabilitation services, and demographic characteristics [3]. Understanding the relative contribution of different determinants of recovery is critically important for developing personalized rehabilitation approaches and predicting long-term outcomes [9,11]. In the present study, a comprehensive analysis of factors influencing functional recovery was conducted, with special emphasis on the role of biomarkers of neuroinflammation and neuroplasticity [8]. Aim of the study: To evaluate clinical and prognostic factors associated with functional recovery at 30 and 90 days in patients with spontaneous intracerebral hemorrhage.

RESEARCH METHODOLOGY

A total of 180 patients with hemorrhagic stroke, with a mean age of 59.9±0.79 years, were examined. Of these, 70% were men (n=126) and 30% were women (n=54). All patients were admitted for inpatient treatment to the intensive care unit of the Tashkent State Medical University Clinic. Inclusion criteria: acute hemorrhagic stroke of hypertensive or atherosclerotic etiology.

Exclusion criteria: ischemic stroke with hemorrhagic transformation, cerebral aneurysms, systemic diseases, and diabetes mellitus. The diagnosis of hemorrhagic stroke was confirmed using neuroimaging methods, including CT, MRI, and MSCT. Clinical and neurological examinations were performed, with quantitative assessment of disease severity using the Glasgow Coma Scale and the National Institutes of Health Stroke Scale (NIHSS). Functional recovery was assessed using the modified Rankin Scale (mRS) as the primary indicator of functional independence. A favorable outcome was defined as achieving an mRS score of ≤2 points by day 90, corresponding to functional independence in activities of daily living. Changes in the Barthel Index, the NIH Stroke Scale (NIHSS), and specialized scales assessing cognitive and motor function were also analyzed.

To identify independent predictors of recovery, a multistage approach was used, including univariate analysis, multivariate logistic regression, Kaplan-Meier survival analysis, and the development of prognostic models using machine learning. Statistical significance was set at $p<0.05$, with Bonferroni correction applied for multiple comparisons.

ANALYSIS AND RESULTS

Age was one of the most significant predictors of functional recovery. Analysis by age group revealed a pronounced inverse relationship between age and the probability of a favorable outcome. In the group of patients younger than 50 years (n=28), a favorable outcome was achieved in 21 patients (75.0%); among patients aged 50-60 years (n=42), in 26 patients (61.9%); among patients aged 60-70 years (n=58), in 25 patients (43.1%); and among patients older than 70 years (n=52), in only 12 patients (23.1%) (χ^2=18.7, p<0.001) (Table 1).

Table 1. Effect of Age on Favorable Outcome

Age group	Number of patients	Favorable outcome	Proportion (%)	χ^2	p-value
<50 years	28	21	75.0%	18.7	<0.001
50-60 years	42	26	61.9%		
60-70 years	58	25	43.1%		
>70 years	52	12	23.1%		
Total	180	84	46.7%		

Note: Differences were considered statistically significant at p<0.05.

Multivariate analysis showed that each decade of life reduced the odds of a favorable outcome by 32% (OR = 0.68, 95% CI 0.54-0.85, p<0.001). Age-related differences were especially pronounced in the recovery of cognitive functions and self-care ability, reflecting a decline in neuroplasticity and compensatory capacity with age. Sex showed a moderate influence on recovery. Women had somewhat worse outcomes compared with men: a favorable outcome was observed in 46.3% of women (25 of 54) versus 54.8% of men (69 of 126) (χ^2 = 1.12, p=0.29). However, after adjustment for age and stroke severity, the differences became nonsignificant (OR = 0.87, 95% CI 0.48-1.58, p=0.65) (Table 2).

Table 2. Effect of Sex on Functional Recovery

Sex	Number of patients	Favorable outcome	Proportion (%)	χ^2	p-value
Men	126	69	54.8%	1.12	0.29
Women	54	25	46.3%		
Total	180	94	52.2%		

Comorbidities had a significant effect on recovery. Arterial hypertension, present in 156 patients (86.7%), was associated with worse outcomes when uncontrolled, defined as a history of systolic blood pressure >160 mmHg: a favorable outcome occurred in 38.2% versus 58.7% in patients with controlled hypertension (p<0.01). A history of smoking (n=67, 37.2%) was paradoxically associated with better outcomes in patients younger than 60 years, the so-called “smoking paradox,” but worsened prognosis in older age groups, which may reflect different mechanisms of cerebrovascular injury.

Stroke severity according to NIHSS score at admission was the strongest predictor of outcomes. The mean NIHSS score in patients with a favorable outcome was 8.4 ± 4.2, compared with 18.7 ± 6.8 in patients with an unfavorable outcome (p<0.001). Each additional NIHSS point reduced the odds of a favorable outcome by 18% (OR = 0.82, 95% CI 0.76-0.88, p<0.001).

NIHSS threshold values for prognosis:

- ✓ NIHSS ≤8: favorable outcome in 78.3% of patients (47 of 60)
- ✓ NIHSS 9-15: favorable outcome in 52.1% of patients (25 of 48)
- ✓ NIHSS 16-20: favorable outcome in 22.9% of patients (11 of 48)
- ✓ NIHSS >20: favorable outcome in 8.7% of patients (2 of 23)

Level of consciousness according to the Glasgow Coma Scale (GCS) at admission was closely correlated with outcomes. Patients with a GCS score of 13-15 points (n=89) had a favorable outcome in 67.4% of cases; those with a GCS score of 9-12 points (n=67), in 35.8%; and those with a GCS score <9 points (n=24), in only 8.3% of cases (χ^2 = 28.4, p<0.001) (Table 3).

Table 3. Level of Consciousness by GCS and Outcomes

GCS range	Number of patients	Favorable outcome	Proportion (%)	χ^2	p-value
13-15 points	89	60	67.4%	28.4	<0.001
9-12 points	67	24	35.8%		
<9 points	24	2	8.3%		
Total	180	86	47.8%		

Note: Differences were considered statistically significant at p<0.05.

The anatomical characteristics of intracerebral hemorrhage, including location, hematoma volume, and the presence of an intraventricular component, have a critical influence on functional outcomes and require detailed analysis for accurate prediction of recovery. Hematoma location demonstrated marked heterogeneity in its effect on recovery potential, reflecting the functional specialization of different brain regions and their role in maintaining neurological functions. The best outcomes were observed in lobar hemorrhages, where a favorable outcome was achieved in 28 of 45 patients (62.2%). This finding may be associated with the greater compensatory capacity of the cerebral cortex and the potential for functional reorganization of cortical networks. Subcortical hemorrhages showed an intermediate prognosis, with a favorable outcome in 42 of 89 patients (47.2%), reflecting damage to white matter and subcortical structures while cortical regions remained preserved. The worst outcomes were observed with involvement of deep structures: thalamic hemorrhages were associated with a favorable outcome in only 4 of 23 patients (17.4%), and brainstem hemorrhages in 1 of 12 patients (8.3%). These findings may be explained by the critical role of these structures in maintaining vital functions and consciousness.

Multivariate analysis adjusted for hematoma volume confirmed the independent effect of location on outcomes. Using lobar hemorrhages as the reference group, subcortical locations showed a trend toward worse outcomes (OR = 0.58, 95% CI 0.28-1.21, p=0.15), although the differences did not reach statistical significance. Thalamic hemorrhages demonstrated a significantly worse prognosis (OR = 0.23, 95% CI 0.07-0.74, p<0.05), while brainstem locations were associated with the most unfavorable outcomes (OR = 0.11, 95% CI 0.01-0.89, p<0.05). Hematoma volume showed a pronounced nonlinear relationship with functional outcomes, demonstrating critical threshold values for prognosis. With a volume of less than 20 ml, a favorable outcome was achieved in 71.4% of patients (35 of 49), indicating high compensatory potential in small hemorrhages. An increase in volume to 20-40 ml reduced the frequency of favorable outcomes to 54.8% (34 of 62 patients), while a volume of 40-60 ml reduced it to 31.6% (18 of 57 patients). A critical threshold was a volume of 60 ml or more, at which a favorable outcome was observed in only 10.0% of patients (1 of 10). Logistic regression showed that each 10 ml increase in hematoma volume reduced the odds of a favorable outcome by 28% (OR = 0.72, 95% CI 0.61-0.85, p<0.001).

Intraventricular hemorrhage (IVH) represents a particularly unfavorable prognostic factor and was observed in 78 patients (43.3% of the total sample). Extension of blood into the ventricles significantly worsened the prognosis: a favorable outcome was achieved in only 19.2% of patients with IVH versus 67.0% of those without IVH, reflected in an extremely low odds ratio (OR = 0.12, 95% CI 0.06-0.24, p<0.001). The volume of the intraventricular component also had critical prognostic significance: with an IVH volume greater than 20 ml, no patient achieved a favorable outcome, indicating the severe adverse impact of massive intraventricular hemorrhage on functional recovery.

CONCLUSION

Multivariate analysis of recovery factors showed that age, hematoma volume, baseline NIHSS severity, and biomarker levels are independent predictors of functional outcomes. Each decade of age reduced the odds of a favorable outcome by 32%; each 10 ml increase in hematoma volume reduced the odds by 28%; and each additional NIHSS point reduced the odds by 18%. These data emphasize the critical importance of the anatomical characteristics of hemorrhage in predicting functional outcomes and planning therapeutic interventions. The combination of unfavorable factors — deep location, large hematoma volume, and the presence of massive IVH — is associated with an extremely low probability of functional recovery and requires a realistic assessment of prognosis when making clinical decisions.

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