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THE ROLE OF IMAGING DIAGNOSIS IN ACUTE CEREBRAL CIRCULATORY FAILURE IN MULTIDISCIPLINARY HOSPITALS ALMATY

Gulzhan M. Adenova¹, <https://orcid.org/0000-0003-0887-432X>

Galina K. Kausova¹, <https://orcid.org/0000-0001-6857-9563>

Alexander V. Brukhanov², <https://orcid.org/0000-0001-7641-6801>

¹ Kazakhstan Medical University "KSPH", Almaty, Republic of Kazakhstan;

² Diagnostic Centre of Altai Krai, Barnaul, Russian Federation.

Abstract

Introduction. Acute cerebral circulatory failure (ACCF) remains one of the most serious medical problems of modern society. This condition requires immediate diagnosis and intervention to minimize its consequences and save patients' lives. This article discusses the important role of imaging diagnostics in the process of detection and evaluation of ACCF, in particular radial diagnostics, especially in multidisciplinary hospitals.

The study aims to analyze cases of acute cerebral circulation disorders and the experience of using radial diagnostics in multidisciplinary hospitals of Almaty.

Materials and methods: The type of research was chosen: quantitative, observational, cross-sectional, analytical, and descriptive. This retrospective study was conducted based on data analysis from "Implementation of the Roadmap for the Introduction of an Integrated Acute Stroke Management Model in Almaty in 2020." A total of 3291 patients with ischemic stroke and 748 patients with hemorrhagic stroke were diagnosed and hospitalized in the stroke units of multi-specialty hospitals - City Clinical Hospital No. 7, City Clinical Hospital No. 4, and the City Emergency Hospital in Almaty. The ethics committee of the Local Ethical Committee of the Kazakhstan Medical University "KSPH" approved this study (IRB –A161 24.03.2022). Research materials were obtained after receiving permission from the institution's management. The leaders were informed about the progress of the study and expressed no objections to its conduct and the publication of its results. Statistical methods included descriptive and analytical techniques. Data analysis was conducted using the MS Excel software package, and visualization was performed using the DataWrapper program.

Results. A study of acute cerebral circulatory disorders in Almaty showed that mortality from stroke increased in 2020 to 16.5% in the City Emergency Hospital and 14.1% in Municipal Clinical Hospital No. 7, driven by the COVID-19 pandemic and associated delays in seeking care. Radiological diagnostics, including MRI (83.0% of patients) and CT (94.0% of patients), proved to be key in treatment management, although access to such services was heterogeneous due to economic barriers. Measures to intensify prevention programs and improve the qualifications of medical personnel are proposed to reduce disability and mortality from stroke, including improved access to diagnosis and primary prevention.

Conclusions: Ischemic stroke is the main cause of mortality among patients with acute cerebral circulatory disorders in multidisciplinary hospitals of Almaty, which requires strengthening the role of primary prevention and improving dispensary practices in urban polyclinics. Radiological diagnostics, including MRI and CT of the brain, is an integral part of stroke diagnosis and treatment in Almaty and plays a key role in determining the type and extent of brain damage. However, despite the widespread availability of these diagnostic methods through budgetary funding, there is still a problem of insufficient coverage of dispensaries due to the redistribution of medical personnel in the context of the pandemic and the closure of medical institutions. This leads to delays in diagnosis and initiation of treatment, which aggravates disease outcomes and increases the risk of mortality among stroke patients. Thus, although radiotherapy is available, systemic healthcare problems limit its effectiveness in controlling stroke at the population level.

Keywords: acute cerebral circulatory disorders (ACCD), stroke, diagnosis, visualization, Almaty.

Резюме

РОЛЬ ВИЗУАЛЬНОЙ ДИАГНОСТИКИ ПРИ ОСТРОМ НАРУШЕНИИ МОЗГОВОГО КРОВООБРАЩЕНИЯ В МНОГОПРОФИЛЬНЫХ БОЛЬНИЦАХ ГОРОДА АЛМАТЫ

Гулъжан М. Аденова¹, <https://orcid.org/0000-0003-0887-432X>

Галина К. Каусова¹, <https://orcid.org/0000-0001-6857-9563>

Александр В. Брюханов², <https://orcid.org/0000-0001-7641-6801>

¹ Казахстанский медицинский университет «ВШОЗ», г. Алматы, Республика Казахстан;

² Диагностический центр Алтайского края, г. Барнаул, Российская Федерация.

Введение. Острое нарушение мозгового кровообращения (ОНМК) остается одной из наиболее серьезных медицинских проблем современного общества. Это состояние требует немедленной диагностики и вмешательства

для минимизации его последствий и спасения жизни пациентов. В статье рассматривается важная роль визуальной диагностики в процессе выявления и оценки ОНМК, в частности лучевой диагностики, особенно в многопрофильных больницах.

Целью исследования является анализ случаев острого нарушения мозгового кровообращения и опыта использования лучевой диагностики в многопрофильных больницах г.Алматы.

Материалы и методы: Выбран тип исследования: количественный, обсервационный, поперечный, аналитический, описательный. Данное ретроспективное исследование проводилось на основе анализа данных "Информация по исполнению Дорожной карты по внедрению интегрированной модели управления острыми инсультами по г. Алматы в 2020 году". Всего было диагностировано и госпитализировано 3291 пациентов с ишемическим инсультом и 748 пациентов с геморрагическим инсультом в отделениях для инсультных больных многопрофильных больниц — Городская клиническая больница № 7, Городская клиническая больница № 4 и Городская больница скорой неотложной помощи в городе Алматы. Исследование одобрено Локальным Этическим комитетом Казахстанского медицинского университета "ВШОЗ" (IRB-A161 24.03.2022). Исследовательские материалы были получены после получения разрешения от руководства учреждений. Руководители были проинформированы о прогрессе исследования и не выразили возражений против его проведения и публикации результатов. Статистические методы включали описательные и аналитические методы. Анализ данных проводился с использованием программного пакета MS Excel, а визуализация выполнялась с помощью программы DataWrapper.

Результаты исследования. Исследование острого нарушения мозгового кровообращения в Алматы показало, что летальность от инсультов увеличилась в 2020 году до 16,5% в Городской больнице скорой медицинской помощи и 14,1% в ГКБ №7, что было вызвано пандемией COVID-19 и связанными с ней задержками в обращении за медицинской помощью. Лучевая диагностика, включая МРТ (83,0% пациентов) и КТ (94,0% пациентов), оказалась ключевой в управлении лечением, хотя доступ к таким услугам был неоднороден из-за экономических барьеров. Предложены меры по активизации профилактических программ и улучшению квалификации медицинского персонала для снижения инвалидности и смертности от инсультов, включая улучшение доступа к диагностике и первичной профилактике.

Выводы: Ишемический инсульт является основной причиной смертности среди пациентов с острыми нарушениями мозгового кровообращения в многопрофильных больницах г. Алматы, что требует усиления роли первичной профилактики и улучшения практики диспансеризации в городских поликлиниках. Лучевая диагностика, включая МРТ и КТ головного мозга, является неотъемлемой частью диагностики и лечения инсультов в Алматы и играет ключевую роль в определении типа и степени поражения мозга. Однако, несмотря на широкую доступность этих методов диагностики за счёт бюджетного финансирования, сохраняется проблема недостаточного охвата диспансеризацией, связанная с перераспределением медицинского персонала в условиях пандемии и закрытием медицинских учреждений. Это приводит к задержкам в диагностике и инициации лечения, что усугубляет исходы заболевания и повышает риск летальных исходов среди пациентов с инсультом. Таким образом, хотя лучевая диагностика и доступна, системные проблемы здравоохранения ограничивают её эффективность в борьбе с инсультами на популяционном уровне.

Ключевые слова: острые нарушения мозгового кровообращения (ОНМК), инсульт, диагностика, визуализация, Алматы

Түйіндеме

АЛМАТЫ Қ. КӨП САЛАЛЫ АУРУХАНАЛАРЫНДА МИ ҚАН АЙНАЛЫМЫНЫҢ ЖЕДЕЛ БҰЗЫЛУЫНДАҒЫ ВИЗУАЛДЫ ДИАГНОСТИКАНЫҢ РӨЛІ

Гульжан М. Аденова¹, <https://orcid.org/0000-0003-0887-432X>

Галина К. Каусова¹, <https://orcid.org/0000-0001-6857-9563>

Александр В. Брюханов², <https://orcid.org/0000-0001-7641-6801>

¹ ҚДСЖМ Қазақстандық медициналық университеті, Алматы қ., Қазақстан Республикасы;

² Алтай өлкесінің диагностикалық орталығы, Барнаул қ., Ресей Федерациясы.

Кіріспе. Ми қан айналымының жедел бұзылуы (ОНМК) қазіргі қоғамның ең маңызды медициналық мәселелерінің бірі болып қала береді. Бұл жағдай оның салдарын азайту және пациенттердің өмірін сақтау үшін дереу диагностика мен араласуды қажет етеді. Мақалада ОНМК-ны анықтау және бағалау процесінде, әсіресе сәулелік диагностикада, әсіресе көп салалы ауруханаларда визуалды диагностиканың маңызды рөлі қарастырылады.

Зерттеудің мақсаты Алматы қаласындағы көпсалалы ауруханаларда ми қан айналымының жіті бұзылу жағдайларын және сәулелік диагностиканы қолдану тәжірибесін талдау болып табылады.

Материалдар мен әдістері: Тандалған зерттеу түрі: сандық, бақылау, көлденең бақылау, аналитикалық, сипаттама. Бұл ретроспективті зерттеу «2020 жылы Алматы қаласында жедел инсультті басқарудың интеграцияланған моделін енгізу бойынша жол картасын іске асыру» деректерін талдау негізінде жүргізілді. Көп бейінді стационарлардың инсульт бөлімшелерінде 3291 науқас және геморрагиялық инсультпен ауыратын және

748 науқас анықталды – №4 қалалық клиникалық ауруханада ишемиялық инсультпен ауыратын. №7 қалалық клиникалық аурухана 4 және Алматы қаласындағы қалалық жедел жәрдем ауруханасы. «KSPH» Қазақстан медицина университетінің жергілікті этикалық комитеті бұл зерттеуді мақұлданды (IRB –A161 24.03.2022). Зерттеу материалдары мекеме басшылығынан рұқсат алғаннан кейін алынды. Басшылар зерттеу барысы туралы хабардар болып, оның жүргізілуіне және нәтижелерінің жариялануына қарсылық білдірмеді. Статистикалық әдістерге сипаттамалық және аналитикалық әдістер кірді. Деректерді талдау MS Excel бағдарламалық пакеті арқылы жүргізілді, ал визуализация DataWrapper бағдарламасы арқылы орындалды.

Нәтижелер. Алматы қаласында ми қан айналымының жіті бұзылуын зерттеу 2020 жылы Қалалық жедел медициналық жәрдем ауруханасында инсульттан өлім-жітім 16,5% - ға дейін және №7 Қалалық клиникалық ауруханасында 14,1% - ға дейін өскенін көрсетті, бұл COVID-19 пандемиясынан және соған байланысты медициналық көмекке жүгінудің кешігуінен туындады. Сәулелік диагностика, соның ішінде МРТ (пациенттердің 83,0%) және КТ (пациенттердің 94,0%) емдеуді басқаруда маңызды болды, дегенмен мұндай қызметтерге қол жеткізу экономикалық кедергілерге байланысты біркелкі болмады. Диагностика мен бастапқы профилактикаға қолжетімділікті жақсартуды қоса алғанда, инсульттан болатын мүгедектік пен өлімді азайту үшін профилактикалық бағдарламаларды жандандыру және медициналық персоналдың біліктілігін арттыру бойынша шаралар ұсынылды.

Қорытынды: ишемиялық инсульт Алматы қаласының көпсалалы ауруханаларында ми қан айналымы жіті бұзылған пациенттер арасында өлім-жітімнің негізгі себебі болып табылады, бұл қалалық емханаларда диспансерлеудің алғашқы профилактикасы мен тәжірибесін жақсартудың рөлін күшейтуді талап етеді. Мидың МРТ және КТ қоса алғанда, сәулелік диагностика Алматы қаласында инсульт диагностикасы мен емдеудің ажырамас бөлігі болып табылады және мидың зақымдану түрі мен дәрежесін анықтауда шешуші рөл атқарады. Алайда, бюджеттік қаржыландыру есебінен диагностиканың осы әдістерінің кең қолжетімділігіне қарамастан, пандемия жағдайында медициналық персоналды қайта бөлумен және медициналық мекемелердің жабылуымен байланысты диспансерлеумен жеткіліксіз қамту мәселесі сақталуда. Бұл аурудың нәтижелерін нашарлататын және инсультпен ауыратын науқастар арасында өлім қаупін арттыратын диагностика мен емдеуді бастаудың кешігуіне әкеледі. Осылайша, сәулелік диагностика қол жетімді болғанымен, денсаулық сақтаудың жүйелі мәселелері оның популяция деңгейіндегі инсультпен күресудегі тиімділігін шектейді.

Түйінді сөздер: ми қан айналымының жіті бұзылыстары (МҚЖБ), инсульт, диагностика, визуализация, Алматы

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Introduction

According to the data from the Global Stroke Bulletin, stroke is the leading cause of disability worldwide and the second most significant cause of death. Global statistics show that in 2022, the incidence of stroke increased by 70%, mortality from this disease increased by 43%, and its prevalence increased by 102%. The number of disability-adjusted life years increased by 143%, and the lifetime risk of having a stroke is 50% [18]. Ischemic stroke remains the most prevalent type of stroke. Numerous modifiable risk factors have been identified, such as smoking, sedentary lifestyle, as well as treatable comorbidities like hypertension, hyperlipidemia, and atrial fibrillation, which influence the development of acute cerebrovascular events [13].

The prognosis of stroke depends on the affected area and prompt treatment. In treating stroke patients, the timing of assistance is crucial, as estimates suggest that approximately 1.9 million neurons, 14 billion synapses, and

12 kilometers of myelinated nerve fibers are lost per minute. Hence, early diagnosis and prompt treatment are essential [20]. The primary goal of imaging in acute stroke is to diagnose the underlying cause, assess the extent of damage, predict the response to thrombolytic therapy, and rule out conditions that mimic stroke. Thanks to advancements in radiology, various imaging modalities are available for diagnosis and prognosis. However, none of them are considered ideal on their own [1].

The alignment between primary medical care organizations (PMCOs) and rehabilitation services can be assessed through patient routing analysis and interviews, enabling the development of measures to improve the condition of patients after experiencing a stroke [2].

In modern conditions, the choice of suitable methods for multimodal visualization depends on the diagnosis and financial accessibility for the population. Magnetic resonance imaging (MRI) is currently considered the most effective for early diagnosis, planning interventional

treatment, and predicting the response to it. However, it has limitations due to its high cost and lack of access in remote regions of the country [21].

Recent studies have shown that early detection, urgent interventional treatment of acute ischemic stroke, and treatment at specialized stroke centers can significantly reduce the incidence and mortality associated with stroke-related outcomes [9].

Almost every patient hospitalized with symptoms of acute stroke undergoes some form of examination, including emergency imaging. Thus, visualization plays a crucial role in early diagnosis and management of patients at risk of developing stroke-related complications [12].

Neuroimaging is essential for differentiating ischemic stroke from intracerebral hemorrhage and for diagnosing conditions other than stroke. The choice of neuroimaging depends on the availability of the method, the patient's condition for thrombolysis, and the presence of contraindications [19]. Stroke visualization is crucial for assessing the extent of tissue damage and selecting treatment strategies [8].

In recent years, a wide range of tools have been developed to assess the clinical condition of patients with acute stroke. However, the diagnostic effectiveness of available clinical instruments for detecting acute ischemic and hemorrhagic strokes, as well as other stroke-related conditions, is insufficiently documented in scientific literature. Further prehospital research is necessary to improve diagnostic accuracy [3].

Multimodal MRI visualization provides valuable prognostic information for physicians managing patients with acute ischemic stroke, especially those with severe consequences. MRI visualization offers the most valid data for diagnosing brain ischemia and is invaluable for differentiating true strokes from stroke mimics [17]. Visualization supports the clinical diagnosis and enables treatment decisions in acute cases, providing information about prognosis [11]. Visualization of the brain and its supplying blood vessels using modern tools and techniques is a crucial step in understanding the pathophysiology of acute stroke and making appropriate and timely clinical decisions [14].

Visualization of the brain is essential for the clinical assessment of stroke patients. While advanced neuroimaging methods offer opportunities to facilitate the treatment of acute stroke, several factors, including time delays in medical care, variability in physician training, and the lack of systematic collection of clinical information, hinder their maximum utility. Recent advancements in artificial intelligence offer new strategies for using computer analysis of medical images to make informed decisions in acute stroke. However, without specialist involvement, this approach carries the risk of errors [5].

In the modern world, artificial intelligence has become relevant, allowing for the prediction of outcomes after a stroke. These approaches take into account demographic, clinical, and electrophysiological data, as well as data obtained from various visualization methods and their combinations [4]. The direct and indirect costs of stroke treatment in the United States exceed \$100 billion annually. Timely identification of acute neurological deficits with appropriate history-taking during physical

examination and glucose level testing can aid in diagnosing stroke. The National Institutes of Health Stroke Scale (NIHSS) should be used to determine stroke severity and monitor evolving clinical changes. Primary neuroimaging is used to differentiate ischemic/hemorrhagic stroke or other pathological processes. Additional assessment with specialized MRI studies helps decide whether to include recombinant tissue plasminogen activator within a specific time frame in the treatment strategy. Severe headache may suggest subarachnoid hemorrhage. In cases of delayed stroke risk but negative X-ray imaging, lumbar puncture may be considered to refine the diagnosis [6].

Multidisciplinary teams providing stroke care in five different centers participated in moderated sessions to develop an algorithm for the acute stroke diagnostic process and identify shortcomings in existing precautionary measures. It was found that screening according to the utilized scales shows the highest predictive results for stroke during the early stages of vessel occlusion progression. The research findings underscore the critical importance of all stages of the acute stroke diagnostic process, particularly existing tools for identifying stroke patients, considering the time of assistance [15].

In real-world settings with limited healthcare resources and experience in providing emergency stroke care, the use of simple three-item stroke assessment tools, providing a high level of specificity, can be highly significant. Although the low sensitivity of this tool ensures that a greater number of stroke cases may not be detected, the three-item assessment will expedite patient triage during inter-hospital transfers and medical care regionalization [22]. Brain imaging plays a central role in diagnosing and determining the mechanism of stroke, which is relevant to operative treatment, prognosis, and secondary prevention. The primary potential methods are computed tomography (CT) and magnetic resonance imaging (MRI). Most procedures are performed in hospitals, but mobile stroke units have expanded the capabilities of brain CT imaging in the prehospital setting [7].

The protocolled acquisition of images using CT, combined with the intervention of an interdisciplinary stroke team, allows for rapid diagnosis and operative revascularization. Supportive treatment recommendations within 24 hours of the onset of stroke symptoms were published between 2014 and 2015, based on initial evidence supporting endovascular therapy for occlusion of large vessels. Neuroimaging remains a central component of acute stroke diagnosis and potentially excludes patients with misdiagnoses, as described in this article [10].

An increasing number of complex physiological visualization methods offer unique advantages and find application in the assessment, diagnosis, and treatment decision-making for acute ischemic stroke. In the conducted review, the strengths and weaknesses, as well as potential indications and contraindications, of various stroke visualization methods were highlighted. As a result, visualization in each case was used to forecast functional outcomes. [16].

This study aims to analyze cases of acute cerebrovascular accidents and the use of radiological diagnostics in multidisciplinary hospitals in Almaty.

Materials and Methods: This retrospective study was conducted based on data analysis from "Implementation of the Roadmap for the Introduction of an Integrated Acute Stroke Management Model in Almaty in 2020". A total of 3291 patients with ischemic stroke and 748 patients with hemorrhagic stroke were diagnosed and hospitalized in the stroke units of multi-specialty hospitals - City Clinical Hospital No. 7 (CCH No. 7), City Clinical Hospital No. 4 (CCH No. 4), and the City Emergency Hospital (CEH) in Almaty. Written consent was obtained from all participants. The ethics committee of the Local Ethical Committee of the Kazakhstan Medical University "KSPH" approved this study (IRB –A161 24.03.2022).

Research materials were obtained after receiving permission from the institution's management. The leaders were informed about the progress of the study and expressed no objections to its conduct and the publication of its results.

Statistical methods included descriptive and analytical techniques. Data analysis was conducted using the MS Excel software package, and visualization was performed using the DataWrapper program.

Results

According to the study, the majority of patients with ischemic stroke - 81.6% (n=1681) and hemorrhagic stroke - 18.4% (n=359) were treated at City Clinical Hospital No. 7 (CCH No. 7). At City Clinical Hospital No. 4 (CCH No. 4), 80.6% (n=852) of patients had ischemic stroke, and 19.3% (n=193) had hemorrhagic stroke. In the City Emergency Hospital (CEH), 80.0% (n=460) of patients had ischemic stroke, and 20.0% (n=108) had hemorrhagic stroke. Data on admitted patients to stroke departments in multidisciplinary hospitals in Almaty are presented in Figure 1.

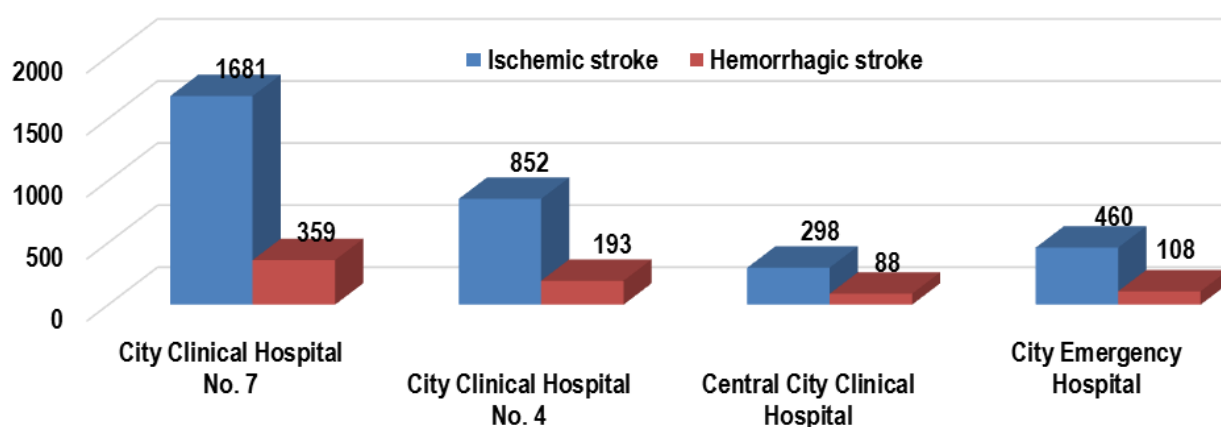


Figure 1. Nosological forms of treated patients in multidisciplinary hospitals in Almaty.

The highest mortality in hospitals from stroke in 2020 was observed at the City Emergency Hospital (CEH) – 16.5% and at City Clinical Hospital No. 7 (CCH No. 7) – 14.1%. In 2020, in-hospital mortality increased for several reasons: due to the epidemiological situation in the country and the closure of two multidisciplinary hospitals in Almaty, resulting in 75.0% of patients being delivered to CCH No. 7 and 25.0% to CCH No. 4. Patients did not seek medical help promptly due to fear of contracting COVID-19 within hospital premises. Upon admission to the hospital, patients were in extremely severe and critical condition with prolonged index events, as evidenced by mortality within one to three days, reflecting an increase in advanced cases and a decrease in treated patients by -12.1%. The daily mortality rate in 2020 was 265 (46.6%) individuals, compared to 209 (39.2%) in 2019, representing a 15.8% increase.

The daily mortality rate within 3 days reaches 71.1%, which serves as a criterion for the increase in the number of patients with severe strokes incompatible with life and severe comorbid conditions. This primarily affects elderly patients, accounting for 76.5% of cases, who present in a coma and have decompensated cardiovascular and respiratory systems. As a result, all therapeutic measures undertaken cannot yield positive results due to the

advanced stage of the pathological process. These patients are often elderly individuals living alone, lacking attention from relatives and adequate follow-up care from the outpatient clinic.

Patients with hemispheric strokes against the background of stenosis of the proximal segments of the brachiocephalic arteries develop cytotoxic and then vasogenic brain edema within 6-10 hours, leading to subsequent brainstem displacement and compression, resulting in fatal outcomes within 3-5 days. Additionally, patients with massive hemorrhages enter a comatose state with increasing brain edema within the first few hours of admission. The mortality rate from neurosurgical interventions was 5.8% (n=33) of patients. In this context, due to the epidemiological situation, alongside stroke, patients also had viral pneumonia during the COVID-19 period, leading to acute respiratory distress syndrome, subsequent multiorgan failure, and pulmonary artery thromboembolism (PE). This indicates an insufficient level of primary prevention and follow-up care from outpatient clinic staff.

Among acute cerebrovascular accidents, the cause of mortality was ischemic stroke in 57.1% of cases and hemorrhagic stroke in 42.9% of cases in patients. The results are presented in Figure 3.

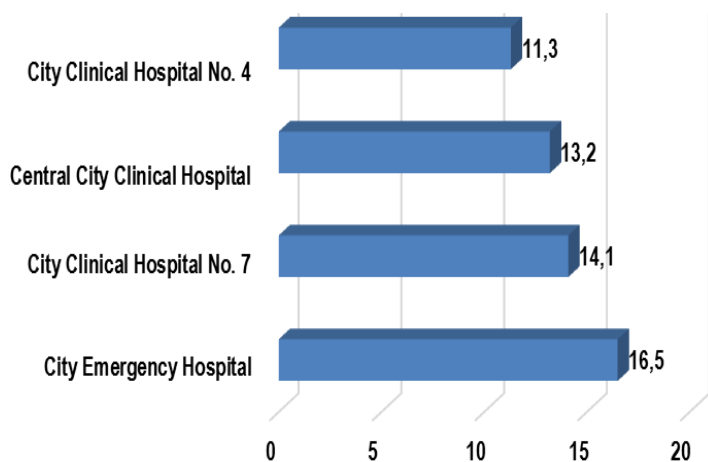


Figure 2. In-hospital mortality from stroke

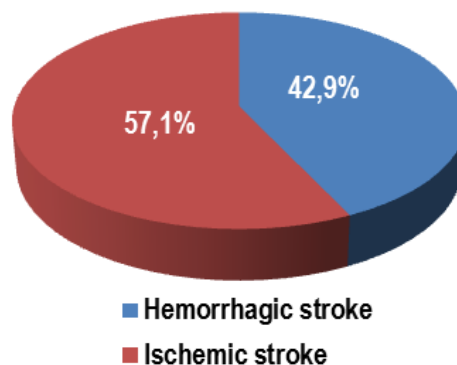


Figure 3. Mortality of patients by type of acute cerebrovascular accident

According to the budget plan, the majority - 83.0% (n=1400) - of patients underwent diagnostic MRI of the brain, while 17.0% (n=294) of patients paid for it

themselves. Brain CT scans were conducted for 94.0% (n=4673) of patients through the budget, while 6.0% (n=307) of patients paid for it privately (Figure 4).

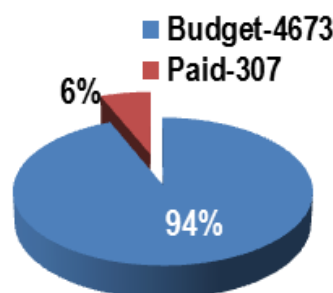
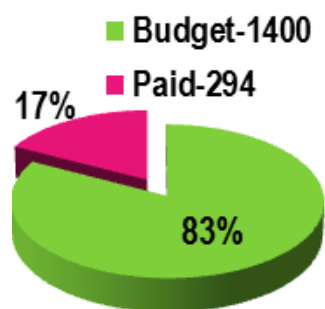


Figure 4. Number of patients undergoing magnetic resonance imaging (MRI) and computed tomography (CT).

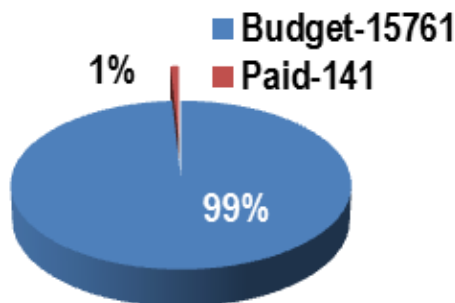
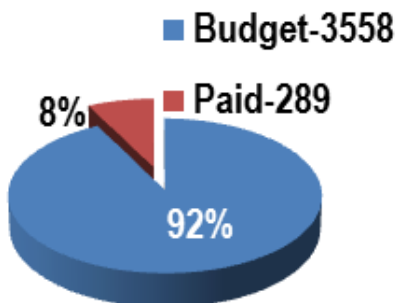


Figure 5. Number of patients undergoing stationery and emergency ultrasound examinations.

The majority of patients admitted to the stroke departments of multiprofile hospitals underwent ultrasound examinations (US) under the budget funding - 92.0% (n=3558), while only 8.0% (n=289) paid for it privately. Almost all, 99.0% (n=15761), of the urgently hospitalized patients underwent examinations through budget financing. The results regarding the number of patients undergoing ultrasound examinations are presented in Figure 5.

examinations in some urban clinics, which posed certain difficulties in dealing with patients evading medical examinations. It is recommended that the administrations of urban clinics strengthen monitoring of the Stroke Schools and Healthy Lifestyle (HLS) departments.

The analysis of the data revealed that the low coverage of medical examinations was attributed to several factors: the epidemiological situation (lack of personnel, as most staff were redirected to work in COVID-filtering and infectious-provisional hospitals, where COVID-infected healthcare workers were treated); constant turnover and shortage of general practitioners (GPs), neurologists, therapists, cardiologists, and low participation in medical

To strengthen primary stroke prevention and the quality of medical examinations, it is necessary to: Intensify the work in Healthy Lifestyle (HLS) departments and Stroke Schools at the level of primary healthcare (PHC); Increase the frequency of sessions with patients to twice a week. Display the schedule of Stroke Schools and inform the population about the first signs of stroke in the media (via videos). Administer appropriate antihypertensive therapy for arterial hypertension. Administer adequate anticoagulant therapy and, if necessary, surgical correction for atrial fibrillation. Address issues related to recurrent stroke, such

as timely enrollment in follow-up care and home care. Strengthen rehabilitation services at the PHC level. Enhance the training of personnel, including rehabilitation specialists, physiotherapists, and physical therapy instructors, as well as educate GPs, neurologists, and cardiologists on managing patients at risk of acute cerebrovascular events. Organize multidisciplinary teams (including a rehabilitation specialist, cardiologist, neurologist, and physical therapy instructor) at the PHC level to provide home visits aimed at reducing disability.

Discussion

The data from our study indicate that a significant proportion of stroke patients in Almaty received treatment primarily at City Clinical Hospital No. 7 and City Clinical Hospital No. 4, with ischemic stroke being more prevalent than hemorrhagic stroke. This pattern of distribution and hospitalization is critical for understanding resource allocation and the demand for healthcare facilities in the region.

The observed high mortality rates in 2020, particularly at the City Emergency Hospital and City Clinical Hospital No. 7, were influenced by several factors. The epidemiological situation, including the COVID-19 pandemic, directly impacted healthcare access and service delivery. Fear of contracting the virus, combined with the closure of medical facilities, significantly delayed emergency medical help for stroke patients. This delay often resulted in patients arriving at hospitals in severe or critical condition, as evidenced by the spike in mortality rates within the first few days of hospital admission.

Moreover, the increased mortality rate within the initial three days post-admission highlights the severity of strokes being treated and suggests a high prevalence of severe comorbid conditions. Elderly patients, often presenting in comatose states with decompensated systems, were particularly affected. These findings underline the crucial need for rapid medical intervention and the limitations in achieving positive outcomes when treatment is delayed.

Patients suffering from hemispheric strokes complicated by brain edema and subsequent brainstem compression faced particularly high risks of fatality, further exacerbated by the presence of severe comorbid conditions such as viral pneumonia during the pandemic. The substantial rate of mortality from neurosurgical interventions also emphasizes the challenges faced during acute management.

The study also reflected on the financial aspect of stroke management. A significant majority of diagnostic procedures, including MRI and CT scans, were covered under the budget, which shows a commitment to providing essential healthcare services. However, the need for some patients to pay out of pocket for these services indicates gaps in healthcare coverage that could potentially delay or limit access to necessary diagnostic tools.

In response to these findings, it is imperative to strengthen primary stroke prevention strategies. This includes enhancing the capabilities of Healthy Lifestyle departments and Stroke Schools, increasing public awareness programs, improving medical management protocols for conditions like hypertension and atrial fibrillation, and ensuring timely follow-up care. Strengthening rehabilitation services and organizing multidisciplinary teams for home care are also crucial steps

toward reducing disability and improving the overall management of stroke patients.

Ultimately, our study highlights the impact of external factors such as the COVID-19 pandemic on stroke management and outcomes. It calls for a concerted effort to improve both acute care and preventative strategies to better serve the population and mitigate the challenges faced during unprecedented health crises.

Conclusions

The scientific significance of this study is that it contributes to the improvement of diagnosis and treatment of acute cerebral circulatory disorders in multidisciplinary hospitals in Almaty. The study revealed specific problems such as untimeliness of patients' treatment during the 'therapeutic window' period, insufficient staffing of specialized physicians (neurologists, speech therapists, cardiologists) in the critical first hours after stroke, which directly affects the effectiveness of treatment and prognosis for the patient. The study emphasizes the role of modern diagnostic technology in improving the quality of care. Increased access to techniques such as angiography and the use of angiographic machines improves diagnostic accuracy and allows physicians to plan treatment more effectively. Requests for additional medical equipment and the opening of specialized departments (e.g. neurosurgery and neurorehabilitation) indicate a desire to improve medical services, which in turn contributes to reducing disability and improving the quality of life of patients. Challenges with the integration of medical information systems such as Damumed and Avicenna MIS, the study raises the need to unify information resources for better collection and analysis of data across the city, which will improve stroke treatment and management strategies.

Thus, the study not only identifies weaknesses in the current healthcare system, but also suggests concrete steps to address them, which makes a meaningful contribution to the advancement of medical science and practice in neuroscience and healthcare management. This makes it possible to build a more effective system of medical care for patients with acute cerebral circulatory disorders, thereby reducing the societal burden of disease and improving public health.

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Information about the authors:

¹ **Gulzhan M. Adenova** - doctoral candidate PhD, Kazakhstan Medical University "KSPH", Almaty, Kazakhstan, e-mail: gulzhanaden@mail.ru, <https://orcid.org/0000-0003-0887-432X>, Almaty city, Republic of Kazakhstan;

¹ **Galina K. Kausova** - doctor of medical sciences, professor Kazakhstan Medical University "KSPH", e-mail: kausovag50@gmail.com, <https://orcid.org/0000-0001-6857-9563>, Almaty city, Republic of Kazakhstan;

² **Alexander V. Brukhanov** - doctor of medical sciences, Deputy Chief Physician of the Regional State Budgetary Healthcare Institution "Diagnostic Center of the Altai Territory", e-mail: avb797@mail.ru, <https://orcid.org/0000-0001-7641-6801>, Russian Federation.

Corresponding author:

Gulzhan Adenova – doctoral candidate PhD, Kazakhstan Medical University "KSPH", Almaty, Kazakhstan

Address: Kazakhstan, 050000, Almaty, Republic of Kazakhstan.

Phone: +7(777) 361 03 88

E-mail: gulzhanaden@mail.ru