THE USA JOURNALS
THE AMERICAN JOURNAL OF MEDICAL SCIENCES AND PHARMACEUTICAL RESEARCH
(ISSN – 2689-1026)
VOLUME 06 ISSUE04

PUBLISHED DATE: - 28-04-2024
DOI: - https://doi.org/10.37547/TAJMSPR/Volume06Issue04-05 **PAGE NO.: - 31-39**

RESEARCH ARTICLE **Open Access**

CLINICAL AND NEUROLOGICAL FEATURES DEPENDING ON THE SIDE OF LOCALIZATION IN PATIENTS WITH ISCHEMIC STROKE

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Abstract
In recent years, research into functional interhemispheric asymmetry has been intensively carried out in our country and abroad. An analysis of publications related to this topic shows that the problem of interhemispheric asymmetry is associated with some fundamental properties of living matter and is present at almost all stages of the evolutionary ladder. In the 30-40s of the 20th century, the study of functional asymmetry in healthy people began. The identified asymmetries were divided into three main types: mental, motor and sensory.

Keywords Interhemispheric, "specialization", "dominance", "brain-psyche", disinhibition.

INTRODUCTION

The distribution of higher nervous functions between the hemispheres (thinking, consciousness, emotions, perception of space and time, speech) is defined as mental asymmetry. Relationships: in this case, they are built on the principle of "specialization" and not "dominance" [2]. It is advisable to analyze the "brain-psyche" relationships with a separate characteristic of each link. The brain is a paired material organ. In the implementation of right-handedness and left-handedness of the hemispheres in the living brain, such a fundamental factor as time is important, acting only in the living brain [10]. The psyche is impossible without the brain, but it differs fundamentally from it in its intangibility. In most people, the left hemisphere is dominant in speech and verbal thinking and memory based on it, motor functions (the psychomotor sphere of the holistic psyche), and the right hemisphere is dominant in the perception, experience of the world and oneself in this world (the psychosensory sphere of the holistic psyche). A left-hander is different from a right-hander to the extent that the asymmetry of his brain is different. Asymmetries of the brain and

psyche are mediated by spatiotemporal factors [24]. These asymmetries apparently mean the opposite of the spatio-temporal organization of the paired work of the hemispheres of the brain and the two main spheres of the integral psyche. There is an assumption about the special role of space and time in the implementation of asymmetries of the human brain and psyche [22]. It is currently assumed that changes in mood are associated with changes in the activity of the structures of the left hemisphere with simultaneous inhibition or disinhibition of the structures of the right hemisphere [28].

The existence of functional asymmetry of the telencephalon hemispheres in relation to speech functions has been established. However, the left hemisphere dominates linguistic operations, including speech, syntactic analysis and phonetic representation. However, the results of many years of work have shown that although the left hemisphere plays a decisive role in speech operations, its speech activity is modulated by the right hemisphere [5]. A manifestation of speech asymmetry is the anatomical asymmetry of certain paired areas of the brain. The magnitude of some fields predominates in the left hemisphere, others - in the right. In the frontal and temporal regions, the coefficient of asymmetry of the fields that are part of the motor and sensory speech zones is greater than in other fields of the same regions [5]. It has been established that the connection between the cortical part of the brain and the brainstem is different. In right-handed people, the right hemisphere is more closely connected with the diencephalic region, which is responsible for autonomic, humoral, and endocrine regulation [1]. Paired brain structures are in close interaction, which determines the heterogeneity of functional asymmetry in individuals. Most authors recognize that in the integrative activity of the brain, which provides the adaptive capabilities of the body, the decisive role belongs to the processes of dynamic interaction of the hemispheres [2]. These processes are carried out according to three types: reciprocal interaction, interaction according to the type of complementarity (each hemisphere makes its own complementary contribution to the implementation of a particular function) and the most complex type of interaction - according to the type of superposition (damping), or correction of distortions [2]. It is believed that functional asymmetry is based on differences in the biochemical activity of cells originating from the same embryonic rudiment [22], and, accordingly, an asymmetric distribution of receptors: if there are more ligands for certain receptors in any of the structures, then there should be more receptors themselves in this same structure than in the contralateral formation.

Thus, at the moment, the existence of a functional asymmetry of the central nervous system has been established, the basis for the formation of which is biochemical asymmetry. The long and varied history of studying functional asymmetry has established, first of all, its extreme mobility and variability in various situations, including pathology.

The study of functional asymmetry of the cerebral hemispheres began in the mid-19th century in patients with focal brain lesions caused by hemorrhages and traumatic brain injuries. It was found that damage to the left hemisphere cortex leads to speech impairment in 85% of cases, which was first established by Broca [10]. Subsequently, results were obtained on speech representation in the right and left hemispheres. In right-handed people with damage to the right hemisphere, olfactory hallucinations, disturbances in imaginative thinking, and topographic memory were detected. When the left hemisphere was damaged, disturbances in speech, consciousness, and verbal memory were observed. In left-handed people, the clinical picture did not depend on the side of the brain injury. However, there are syndromes that appear only in left-handed people due to brain damage [2]. An example is the state of twilight consciousness, specularity, skin-optical sense, sleep disturbance, with the subsequent development of endogenous depression, which is especially pronounced in patients with epilepsy with concomitant mental disorders. Violation of spatio-temporal characteristics in a cerebral catastrophe is manifested by left-sided spatial

agnosia and Korsakov's syndrome, which arise, as a rule, with focal damage to the right hemisphere of the brain, often combined with left-sided "hemi": hemihypesthesia, hemianopsia and hemiparesis. It has been noted that memories are also based on the mechanisms of temporary interaction between the two hemispheres and that disruption of this leads to mnestic disorders [12].

Stroke is one of the most common forms of focal brain damage. Functional asymmetries underlie the formation of certain clinical manifestations of the disease. A large number of studies on brain damage have shown that a motor defect in the limb ipsilateral to unilateral hemispheric damage is more characteristic of left- rather than right-hemisphere damage [14]. Limb apraxia is the best clinical example of this asymmetry [30]. Neuroimaging experiments and studies using transcranial magnetic stimulation have also shown that the left hemisphere is specialized in controlling a variety of motor skills, and some studies have also identified a role for the right hemisphere [4]. The relative importance of each hemisphere has been examined and is likely to vary depending on the demands of a given movement [3]. This is illustrated by a study of goal-directed movements and grasping, which showed greater performance deficits when more planning was required after left hemisphere damage, as well as when tracking or not tracking a target in brain-damaged patients, depending on the behavioral task assigned [25].

There is a rather attractive hypothesis in the literature about the control of goal-directed movements, according to which the left hemisphere is more specialized for ballistic movements, more dependent on the planning and implementation of a motor program and to a lesser extent on direct sensory feedback [25]. This hypothesis associates the right hemisphere with the control of non-ballistic movements, which are more dependent on sensory feedback and less dependent on motor programs [22]. However, this difference was not confirmed unequivocally. It should be noted that the described effects were demonstrated either separately in the group with right or left hemisphere damage, but not in both. The use of kinematic analysis makes it possible to distinguish in the initial component of the movement an acceleration phase and a deceleration phase, which ensures the approach of the hand to the target and is associated with the open loop process.

A fairly in-depth development of the problem of interhemispheric asymmetry in the theory of goal-directed movements has shown that the influence of the functional specialization of the hemispheres on changes in posture in patients who have suffered an ischemic stroke remains poorly understood.

We have not found a single study characterizing the influence of structural asymmetries in humans on the formation of a motor defect after a stroke.

All this aims at finding reserves aimed at optimizing the provision of medical care to patients with vascular diseases of the brain, which serves the purpose of the study: to justify the method of differentiated rehabilitation in patients with hemispheric ischemic stroke, taking into account the localization of the lesion.

METHODS

A retrospective analysis of 1354 medical records of patients admitted to City Clinical Hospital No. 1 with a diagnosis of "Acute cerebrovascular accident" for 2013-2023 was carried out. When analyzing case histories, we studied the annual prevalence, structure of MI, clinical manifestations depending on the location of the lesion, outcomes, as well as the gender and age of the patients.

Inclusion criteria for the study were patients with diagnoses corresponding to ICD-10 codes I60–I64. We considered the structure of patients according to the pathogenetic type of stroke:

1) ischemic stroke caused by acute focal cerebral ischemia leading to infarction (area of ischemic necrosis) of the brain (cerebral infarction, I63.0–9);

2) hemorrhagic stroke caused by rupture of an intracerebral vessel and penetration of blood into

the brain parenchyma or rupture of an arterial aneurysm with subarachnoid hemorrhage (non-traumatic intracerebral hemorrhage (I61.0–9) and subarachnoid hemorrhage (I60.0–9)).

The diagnosis of cerebral stroke (MI) was verified based on the results of magnetic resonance imaging and (or) computed tomography of the brain. Assessment of the neurological status included determining the degree of impairment of consciousness, the severity of impairment of motor and sensory functions, statodynamic, coordination and cognitive impairments. In our study, data on the neurological status and indicators of clinical rating scales were analyzed: NIHSS - to identify the severity of stroke, Gusev and Skvortsova - to determine the severity of neurological disorders; Barthel - to assess the state of functional daily life activities (6).

Statistical processing of the results was carried out using the Microsoft Excel and Statistica 7.0 for Windows application package. Quantitative data are presented in the form of arithmetic mean (M), representativeness error (m), and relative frequencies. The significance of differences in mean values was determined using Student's test (t). For comparison based on a qualitative binary criterion, the $\chi 2$ criterion was used; for comparison of percentages, the Fisher angular transformation (φ-transform) was used. The correlation dependence was determined using the nonparametric Spearman test (ρ).

RESULTS AND DISCUSSION

In City Clinical Hospital No. 1 during 2009–2019. 1354 cases of cerebral stroke (CS) were registered. Of these, men account for 42.9% and 52.1% of cases were detected among women. In the city, 608 cases of CS (44.9%) were recorded, of which 21.9% were in men and 49.6% in women (Table 1). 746 (55.1%) cases of CS were reported from the Tashkent region, of which 38.1% were in men and 61.9% in women. As can be seen from the presented data, the largest number of CS occurred in the Tashkent region, and the largest number of strokes occurred among women in all groups. There are significant differences in CS rates among women in rural areas and among women among all studied patients. (diagram 1).

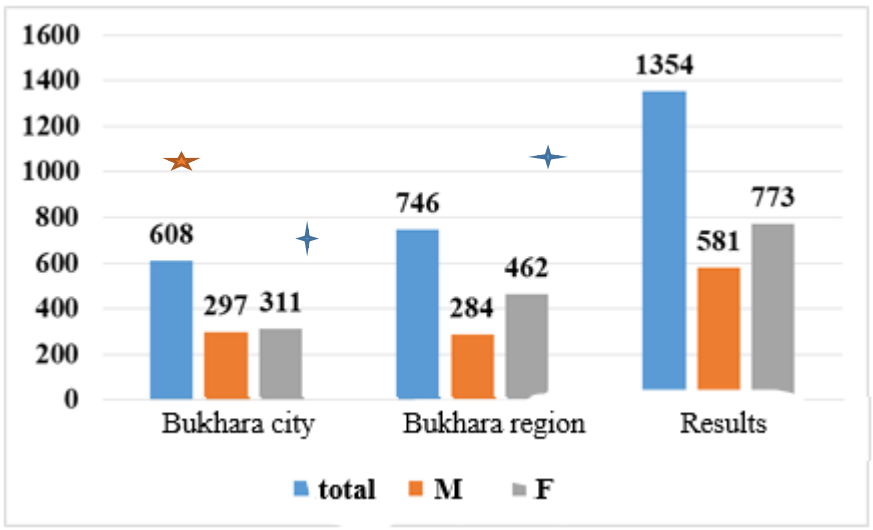
Table.1.

Number of cases of cerebral stroke

		Total	M	F
Total	**abs**	1354	581	773
	%	100,0%	42,9%	57,1% *
Tashkent city	**abs**	608	297	311
	%	44,9%	48,8%	51,2%
Tashkent region	**abs**	746	284	462
	%	55,1% #	38,1%	61,9%**

*- significance of the difference between , $p < 0.05$

**-*- significance of difference, $p < 0.01$



- significance of the difference between , p < 0.05
- significance of difference, p < 0.01

Diagram 1. Number of cases of cerebral stroke in the city of Bukhara and Bukhara region

Starting from the age group of 25-44 years, on average, there is a gradual increase in the number of strokes with age for both men and women (Table 2). The largest number of strokes occurs in the age group 60-75 years. At the same time, the number of CS among women is greater in the age groups 44-60 years and 60-75 years. But in the age category of 25-44 years, CS is more common in men than in women - 5.0%, versus 2.3%, respectively. This pattern can be seen in both IS and HS. Statistical data in this age category are consistent with both the Russian average and international research data (). And in the age categories of 44-60 years and 60-75 years, in our study there is a significantly larger percentage of women both in the CS category, and in IS and HS.

The largest number of cases of cerebral strokes is ischemic stroke. For the period 2009–2019 the proportion of ischemic strokes was 83.3% (Figure 2), which is higher than the world average (80.7%).

Table.2.
Total number of stroke cases among men and women
by age and depending on the type of CS

	Age, years		**25-44**	**44-60**	**60-75**	**Total**
ACA n=1354	M	abs	29	238	314	581
		%	5,0%	41,0%	54,0%	42,9%
	F	abs	18	212	543	773
		%	2,3%*	27,4%*	70,2%*	57,1%*
HS n=226 16,7%	M	abs	17	49	26	92
		%	18,5%	53,3%	28,3%	40,7%
	F	abs	14	46	74	134

		%	10,4%*	34,3%*	55,2%*	59,3%*
IS	M	abs	5	223	261	489
n=1128		%	1,0%	45,6%	53,4%	43,4%
83,3%	F	abs	2	198	439	639
		%	0,3%	31,0%*	68,7%*	56,6%*

*- reliability of differences between men and women within groups, p < 0,05

The share of hemorrhagic stroke, including intracerebral hemorrhage and subarachnoid hemorrhage, accounted for 16.7%, which is higher than the Russian average (13.5%). Thus, the ratio of ischemic and hemorrhagic strokes in the city and region was 4.9:1, while the same figure for the same period in Russia on average was 5.0:1.

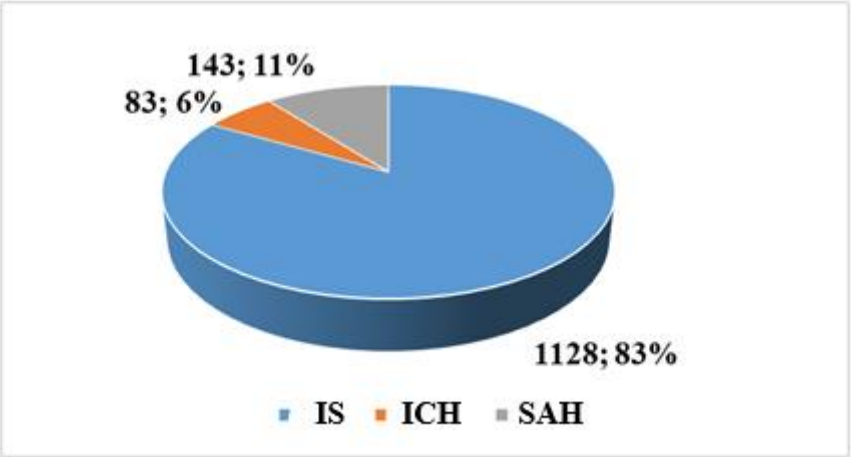


Diagram 2. – Percentage of different types of cerebral stroke

The high percentage of hemorrhagic stroke is probably associated with a poorly established system for correcting arterial hypertension in residents of the region. Table 3 also shows that the proportion of intracerebral hemorrhages among hemorrhagic strokes is lower than the proportion of SAH - 6.1% versus 10.6%, respectively. It should also be noted that among patients with both IS and HS, females predominate. As for the average age, Table 3 shows that in patients with SAH this indicator is lower compared to patients with ICH and IS - 61.8 + 5.7; 64+5.3 and 66.8+5.2 years, respectively.

Table 3.

Number of CScases among men and women,
types of CS stroke and average age of patients

CS	gender	number of patients	% of all IS cases	Average age (M+m)
IS	M	489	36,1%	65,3±6,9
	F	639	47,2%	68,3±3,4
	Total	1128	83,3%	66,8±5,2

ICH	M	33	2,4%	62,8±4,8
	F	50	3,7%	65,9±2,7
	Total	83	6,1%	64±5,3
SAH	M	59	4,4%	58,8±6,1
	F	84	6,2%	64,7±4,5
	Total	143	10,6%	61,8±5,7

Note: ICH intracerebral hemorrhage

SAH subarachnoid hemorrhage

As can be seen from table. 4, in all patients with IS in the acute period, severe stroke was detected on the NIHSS scale, moderate neurological impairment was detected on the Gusev-Skvortsova scale, and moderate disability in functional daily life was detected on the Barthel scale. Moreover, it should be noted that in female patients with all forms of IS, the indicators are worse compared to male patients.

Table 4.

Indicators of clinical rating scales (in points) in the acute period of IS, depending on gender and lateralization of the lesion (M+m)

Pool IS, n=1158	gender	number of patients	% of all IS cases	NIHSS scale (points)	Gusev-Skvortsova scale	Barthel index
carotid swimming pool - LH 47,2%	муж	234	20,7%	15,3±5,8*#	29,8±6,1*	58,9±11,9
	жен	298	26,4%	14,8±6,2*#	28,9±7,3*	57,7±8,7*#
	всего	532	47,2%	15,1 ± 7,5*	29,3 ± 9,5*#	58,6 ± 5,9*#
carotid swimming pool -RH 37,4%	муж	186	16,5%	16±5,6	30,1±6,3	58,6±12,1
	жен	236	20,9%	14,9±3,2	27,6±6,1	52,4±9,5
	всего	422	37,4%	15,8±9,4	28,7±4,9	56,3±11,8
VBB 15,4%	муж	69	6,1%	15,8±4,4	29,4±6,8	57,8±9,3
	жен	105	9,3%	15,6±8,2	28,2±7,9	53,3±13,1
	всего	174	15,4%	15,4±5,1	28,6±5,2	55,8±10,7

Note: *RH - right hemisphere, LH- left hemisphere, IS - ischemic stroke, VBB - vertebrobasilar, * - significance of the difference between patients with RH and LH, p < 0.05.*

 # - significance of the difference between patients with RH, LH and VBB, p < 0.05.

The totality of the identified indicators depending on the hemispheric lateralization of the lesion showed that the overall severity of the neurological and functional defect according to the established scales significantly prevails in the case of right-sided localization of the lesion. The Barthel index turned out to be significantly higher in the group of patients with damage to the left hemisphere (Table 4).

Thus, the results of our research show that in the structure of hospitalizations, the largest number of patients with CS lived in rural areas, and females predominated among them. The ratio of ischemic and hemorrhagic strokes in the city and region was

4.9:1. Among patients with both IS and HI, females predominated. The set of identified indicators depending on the hemispheric lateralization of the lesion showed that the overall severity of the neurological and functional defect according to the NIHSS, Gusev-Skvortsova and Barthel scales significantly prevails in the right-sided localization of the lesion. Moreover, it should be noted that in females with all forms of IS the indicators on the stated scales worse compared to male patients.

CONCLUSION

So, the results of our studies make it possible to reflect the characteristics of clinical neurological manifestations in patients in the acute period of CS. The results obtained should be used in the development of specific rehabilitation programs in the acute and acute periods of IS, taking into account the lateralization of the lesion.

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