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In-Hospital Stroke in a Multidisciplinary Hospital

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INTRODUCTION Acute cerebrovascular event (ACVE) is the leading cause of persistent disability and death in the world. Due to the high medical and social significance, much attention is paid to the problem of out-of-hospital stroke, and the issues of diagnostics and treatment of in-hospital stroke are practically not studied.

RELEVANCE In-hospital stroke is defined as a stroke that develops in a patient hospitalized for other reasons. It is known that the incidence of in-hospital stroke ranges from 2 to 19% of all acute cerebrovascular accidents recorded in the hospital, 0.04–0.06% of all hospital admissions. It was found that patients with in-hospital stroke had significant restrictions on thrombolytic therapy, mortality can reach 60%, and the diagnosis is often made with long delays and deviations in examination protocols. The most common pathogenetic subtype of in-hospital ischemic stroke is the cardioembolic subtype. The explanation for this is that in most cases, in-hospital ischemic strokes develop in patients after open cardiac surgery with prosthetics of one or more valves, bypass surgery in conditions of artificial circulation, carotid endarterectomy. In the overwhelming majority of patients, the first symptoms of in-hospital stroke are observed not by doctors, but by nurses, patients or their relatives. Mortality in in-hospital stroke is significantly higher than in non-hospital stroke, which is due to the high incidence of extracerebral complications in this cohort of patients, as well as initially more severe stroke.

AIM OF STUDY To analyze the incidence of in-hospital stroke and the tactics of its treatment in a multidisciplinary hospital.

MATERIAL AND METHODS The study included 975 patients with ACVE hospitalized at the N.V. Sklifosovsky Research Institute for Emergency Medicine from January 1, 2018 to January 1, 2019. The inclusion criterion was any case of CVE - out-of-hospital or in-hospital. The study did not include patients with subarachnoid hemorrhage (SAH) where secondary cerebral ischemia developed against the background of vasospasm. Also, we did not include patients with stroke, transferred from other hospitals for neurosurgical treatment.

RESULTS In total, in 2018 at the N.V. Sklifosovsky Institute ACVE were diagnosed in 975 patients, of which in-hospital and out-of-hospital strokes were diagnosed in 109 (11.2%) and 866 patients (88.8%), respectively. The proportion of in-hospital stroke was 0.03% of the total number of patients treated at the institute in 2018. Systemic thrombolytic therapy (sTLT) is the main method of treating patients with IS. However, patients with in-hospital stroke may have a large number of contraindications to this type of therapy. Systemic TLT was performed in 1 patient (1%) with in-hospital stroke, while in out-of-hospital stroke, thrombolysis was performed in 36 patients (4.7%). After analyzing the reasons for refusing to perform sLT in patients with in-hospital and out-of-hospital IS. The leading reason for the impossibility of sTLT in patients with in-hospital stroke was the unspecified time of disease development - 44 (43.2%). In 35 patients (34.3%) with in-hospital stroke, refusal to perform sLTT was associated with late IS diagnosis, despite the fact that the stroke developed in the hospital.

CONCLUSION Thus, an in-hospital stroke aggravates the course of the underlying disease and, as a consequence, the outcome of the disease, leads to an increase in social and medical and economic costs. In this regard, there is a need to study the prevalence, risk factors, clinical features of in-hospital stroke, as well as the development of diagnostic and therapeutic algorithms in order to improve the efficiency of care for patients with in-hospital stroke.

Keywords: in-hospital stroke, emergency care, risk factors, examination protocol

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BP - blood pressure
IHS - in-hospital stroke
ALV - artificial lung ventilation
IS - ischemic stroke
RMI - Rivermead mobility index
MRS - modified Rankin scale
ADCC - acute disturbance of cerebral circulation

SAH - subarachnoid hemorrhage
sTLT - systemic thrombolytic therapy
TIA - transient ischemic attack
TE - thromboembolic extraction
PATE - pulmonary artery thrombembolia
GCS - Glasgow coma scale
ECG – electrocardiography
Echo-CG - transthoracic echocardiography
NIHSS - National Institutes of Health Stroke Scale - a scale for assessing the severity of ischemic stroke in the acute period

INTRODUCTION

Acute disturbance of cerebral circulation (ADCC) is the leading cause of persistent disability and death in the world [1]. Due to the high medical and social significance, much attention is paid to the problem of out-of-hospital ADCC, and the issues of diagnosis and treatment of in-hospital stroke have not been practically studied [2, 3].

It is known that from 2 to 19% of ADCC develop in the hospital in patients who were initially hospitalized for other reasons [4–6]. In the literature, in-hospital stroke (IHS) is defined as ADCC, which has developed in a patient hospitalized for other reasons [2-4]. It was found that patients with IHS have significant limitations for thrombolytic therapy [2, 7, 8], mortality can reach 60% [9-11], and the diagnosis is often made with long delays and deviations in examination protocols [12, 13]. Despite the opicality of the IHS problem, currently in the literature, studies devoted to this problem are rare. In this regard, the purpose of this work is to analyze the incidence rate and treatment tactics of IHS in a multidisciplinary hospital.

MATERIAL AND METHODS

From January 1, 2018 to January 1, 2019 at the N.V. Sklifosovsky Research Institute for Emergency Medicine, 975 patients with ADCC were treated. The inclusion criterion was any case of ADCC - out-of-hospital or in-hospital. The study did not include patients with subarachnoid hemorrhage (SAH), who developed secondary cerebral ischemia against the background of vasospasm. We also did not include in the study patients with ADCC, transferred from other hospitals for neurosurgical treatment. The average age of the patients was 64.5 ± 15.3 years. There were 479 (49.1%) men and 496 (50.9%) women.

The character of ADCC was established using computed tomography of the brain. Stroke severity and wakefulness level disorder were assessed using the National Institutes of Health Stroke Scale (NIHSS) and Glasgow Coma Scale (GCS). To assess the degree of the disablement, the ability to self-care and the need for medical care, the modified Rankin scale (MRS) and the Rivermead mobility index (RMI) were used.

Pathogenetic variants of ischemic stroke (IS) were established according to the TOAST criteria. All patients underwent the following instrumental and laboratory diagnostic methods: duplex scanning of the brachiocephalic arteries, transthoracic echocardiography (Echo-CG), electrocardiography (ECG), 24-hour blood pressure monitoring, continued 24-hour ECG monitoring, chest X-ray, clinical and biochemical analyzes blood, coagulogram, clinical urinalysis, blood test for lipidogram. Swallowing function was assessed using a three-pharyngeal test, video fluoroscopy, and laryngoscopy. During the entire period of hospitalization, we recorded all extracerebral complications in patients with in-hospital and out-of-hospital ADCC. The diagnosis of sepsis was established according to international recommendations for the diagnosis and treatment of sepsis and septic shock (2016) [14].

RESULTS

In total, in 2018 at the N.V. Sklifosovsky Research Institute for Emergency Medicine ADCC were diagnosed in 975 patients, of which IHS and out-of-hospital strokes were diagnosed in 109 (11.2%) and 866 patients (88.8%), respectively. The share of in-hospital stroke was 0.03% of the total number of patients treated at the institute in 2018. The average age of patients with IHS and out-of-hospital stroke was 70.5 ± 13.5 versus 63.8 ± 15.3 years, respectively. Intrahospital ADCC was diagnosed more often in women than in men (56.9% and 43.1%, respectively). The prevalence of IS over hemorrhagic stroke was also found in patients with IHS (94.5% and 5.5%, respectively). When analyzing the clinical structure of extramural ADCC , it was found that in 87.9% of patients was diagnosed with IS, in 9.9% - hemorrhagic stroke, 1.4% - transient ischemic attack (TIA), 0.8% - intracranial thrombosis venous system.

The ADCC severity was more pronounced in patients with IHS compared with out-of-hospital strokes (13.1 ± 11.03 versus 6.9 ± 7.9 points, $p < 0.05$). The mean GCS score at the onset of the disease in patients with IHS was significantly lower than in patients with out-of-hospital ADCC (12.8 ± 3.5 versus 14.3 ± 2.4, $p < 0.05$).

In 79 patients (72.5%), IHS was diagnosed after performing various surgical procedures. It was revealed that 75% of in-hospital ADCC have developed during the first 7 days of the patient's stay in the hospital. IHS was more often diagnosed in cardiovascular departments - in 59 patients (54.1%). Out of 109 in-hospital ADCC, 34 (31.2%) developed in the department of vascular surgery, in the cardiology department - in 19 patients (17.4%), in cardiac surgery - in 14 (12.8%), in traumatology - in 15 (13 , 8%), in thoracoabdominal surgery - in 16 (14.7%), in the toxicology department - in 7 (6.4%), in the neurological department - in 2 (1.8%), in the psychosomatic department - in 1 (0.9%), in the burn department - in 1 patient (0.9%).

Establishment of the pathogenetic variant of IS is the basis for the secondary prevention of ADCC. It was revealed that the leading pathogenetic mechanism in patients with in-hospital IS was cardioembolism (Table 1).

Table 1

Pathogenetic variants of ischemic stroke in patients with in-hospital and out-of-hospital ischemic strokes

Pathogenetic option by TOAST	Stroke type		Reliability of differences, p
	Intrahospital stroke, n (%)	Out-of-hospital stroke, n (%)	
Atherothrombotic	18 (17,6)	51 (6,7)	<0,05

Cardioembolic	45 (43,7)	159 (20,9)	<0,05
Lacunar	4 (3,9)	362 (47,6)	<0,05
Other etiology	2 (1,8)	6 (0,8)	<0,05
Unspecified rank	10 (9,7)	67 (8,8)	>0,05
Unknown etiology	24 (23,3)	116 (15,2)	<0,05

Systemic thrombolytic therapy (sTLT) is the main treatment for patients with IS. However, patients with IHS may have a large number of contraindications to this type of therapy. Systemic sTLT was performed in 1 patient (1%) with in-hospital IS, while in out-of-hospital IS, thrombolysis was performed in 36 patients (4.7%). Taking into account such a significant difference, we analyzed the reasons for refusing to perform sTLT in patients with in-hospital and out-of-hospital IS. The leading reason for the impossibility of sTLT in patients with IHS was the unspecified time of disease development - in 44 (43.2%) patients (Table 2). It should be noted that in 35 patients (34.3%) with IHS, refusal to perform sTLT was associated with late diagnosis of IS, despite the fact that the stroke has developed in the hospital.

Table 2

Reasons for failure to perform thrombolytic therapy in the examined patients

Reason for not performing TLT	Stroke type		Reliability of differences, p
	Intrahospital stroke, n (%)	Out-of-hospital stroke, n (%)	
Unspecified time of stroke	44 (43,2)	108 (14,8)	<0,05
More than 4.5 hours from the onset of symptoms	35 (34,3)	477 (64,6)	<0,05
Application anticoagulants	5 (4,9)	7 (0,9)	<0,05
Severe stroke (NIHSS> 25 points)	8 (7,8)	4 (0,5)	<0,05
Mild stroke (NIHSS <2 points)	1 (1)	129 (17,5)	<0,05
Previous operative measure	8 (7,8)	12 (1,6)	<0,05
BP > 185/100 mm Hg	1 (1)	1 (0,1)	<0,05

Notes: BP — blood pressure; TLT — thrombolytic therapy; NIHSS — a scale for assessing the severity of ischemic stroke in the acute period

Considering the large number of limitations for sTLT in patients with IHS, thromboembolic extraction (TE) in these patients is an alternative method of treatment. Of 93 patients with in-hospital IS, TE was performed in 10 patients (9.3%), while in patients with out-of-hospital IS, this method of treatment was used only in 28 people (3.6%). The overwhelming majority of patients (80%) with IHS who underwent TE were initially on beds of cardiac surgery or cardiology.

Quite often, the immediate cause of patients death with ADCC are such extracerebral complications as pneumonia and thromboembolia of the pulmonary artery (PATE). It was found that extracerebral complications are much more likely to develop in patients with IHS compared to patients with out-of-hospital ADCC. The most common extracerebral complications in patients with IHS were deep vein thrombosis of the lower extremities and pneumonia (Table 3).

Table 3

Extracerebral complications in patients with in-hospital and out-of-hospital acute cerebrovascular events

Complication	Stroke type		Reliability of differences, p
	Intrahospital stroke, n (%)	Out-of-hospital stroke, n (%)	
Deep vein thrombosis of the lower extremities	71 (65,1)	148 (17,1)	<0,05
Pulmonary embolism	24 (22)	56 (6,5)	<0,05
Tracheobronchitis	57 (52,3)	150 (17,3)	<0,05

Pneumonia	65 (59,6)	147 (17)	<0,05
Gastrointestinal bleeding	18 (16,5)	27 (3,1)	<0,05
Bedsores	50 (45,9%)	93 (10,7%)	<0,05
Hydrothorax	51 (46,8%)	92 (10,6%)	<0,05
Sepsis	27 (24,8%)	40 (4,6%)	<0,05

Taking into account the principle of the "therapeutic window", which is 4.5 and 6 hours at IS for STLT and emboloxtraction, respectively, early IHS diagnosis is important. The analysis has showed that most often the symptoms of stroke in the hospital were first diagnosed by nurses - 43.1%, doctors - 29.4%, patients - 22% and relatives of patients - 5.5%.

By the 30th day of the disease, good functional outcomes (0–2 points according to the MSR) were authentically more often observed in patients with out-of-hospital ADCC than in patients with IHS (50% versus 12%, $p < 0.05$), and the index of motor activity was RMI by the 30th day was 4.53 ± 5.3 versus 9.9 ± 5.61 points ($p < 0.05$), respectively.

The need for mechanical ventilation (ALV) in patients with IHS was higher than in patients with out-of-hospital strokes (59.6% versus 17.7%). Mortality in the IHS group was 44%, while in patients with out-of-hospital ADCC this indicator was 15.8%. It was also found that the average duration of hospitalization in patients with IHS was significantly higher than in out-of-hospital stroke (24.6 ± 17.2 versus 12.3 ± 12.8 days, $p < 0.05$).

DISCUSSION

In the conditions of a modern multidisciplinary hospital, IHS is one of the most severe complications of major diseases and is associated with a large number of unfavorable outcomes in comparison with out-of-hospital ADCC. It should be noted that the most common pathogenetic subtype of in-hospital IS is the cardioembolic subtype. According to the literature, about 50% of patients with in-hospital ADCC have a proven fact that they have a source of high-risk cardioembolism [15, 16]. The explanation for this is that in most cases, in-hospital IS are developed in patients with cardiological and / or cardiac surgery profiles [17, 18].

According to the data of various studies, it has been established that the transferred surgery should be considered as an additional risk factor for the development of IHS [19, 20]. It should be noted that in 34.3% of patients with IS, the reason for not performing reperfusion therapy was a deferred call of the neurologist. Studies in patients with IHS have shown that awareness raising, education and training of medical personnel is fundamental for the timely recognition of stroke symptoms, especially in patients with a high risk of ADCC development [21]. According to M.J. Alberts et al. (1993), in the vast majority of patients, the first symptoms of a stroke that developed in a hospital were observed by nurses (63%), patients (16%), doctors (10%), and 8% visitors [22]. In our study, similar results were obtained - in the overwhelming majority of patients (70.6%), the first symptoms of a stroke that developed in the hospital were observed not by doctors, but by nurses, patients or their relatives. Thus, training doctors, nurses, patients themselves and their relatives to the principles of early clinical diagnosis and emergency care for ADCC is an important component that will increase the percentage of reperfusion therapy in patients with in-hospital IS.

Mortality in IHS is significantly higher than in out-of-hospital strokes, which is due to the high incidence of extracerebral complications in this cohort of patients, as well as initially more severe stroke [23]. Y. Moradiya et al. (2013) found that higher mortality was observed in patients with IHS compared with out-of-hospital ADCC (15.7% versus 9.6%, respectively) [9]. According to N. Aly et al. (2000), in patients with in-hospital ADCC , mortality was also higher and have amounted 60% versus 28% in out-of-hospital strokes [10]. In a study by K. Schurmann et al. (2016) the frequency of deaths in the group of patients with nosocomial ADCC compared with out-of-hospital ADCC was 31.4% versus 8.0%, respectively [8]. In this regard, the training of cardiological and cardiac surgery personnel to the principles of prevention of venothrombotic and purulent-septic complications in patients with IHS is an important task.

It should be noted that in the literature available to us, there are no unified approaches to the systematization of etiological factors and the protocol for examining patients with in-hospital ADCC. The high incidence rate of IHS, significant heterogeneity of etiopathogenetic mechanisms, the need for differentiated approaches to secondary prevention of this type of ADCC make the further researchs in this direction actual.

FINDINGS

1. The incidence rate of in-hospital stroke in a large multidisciplinary hospital in the structure of acute cerebrovascular accident was 7.8%. Ischemic stroke was diagnosed in 94.5% of patients with in-hospital stroke, and hemorrhagic stroke in 5.5%. In patients with in-hospital ischemic strokes, cardioembolic stroke predominates in comparison with out-of-hospital strokes (40.3% versus 18.4%, respectively).

2. In 54.1% of patients, in-hospital strokes develop after open cardiac surgery with prosthetics of one or more valves, shunting operations under artificial circulation, carotid endarterectomy.

3. The frequency of systemic thrombolytic therapy in patients with in-hospital ischemic stroke was 0.9% versus 4.2% in patients with out-of-hospital ischemic stroke, and thromboembolic extraction was 9.3% versus 3.6%, respectively.

4. Intrahospital stroke is much more often accompanied by the development of complications, and mortality in it is almost 3 times higher than in patients with out-of-hospital stroke (44% and 15.8%, respectively).

5. Nurses most often recognize in-hospital stroke. Thus, teaching nurses the principles of diagnostics and emergency care for patients with acute cerebrovascular accident is a key point in increasing the proportion of patients who can undergo reperfusion therapy, since in most cases it is nurses who are the first that observe the symptoms of acute cerebrovascular accident.

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