The impact of selected cardiovascular factors on the safety and efficacy of intravenous thrombolysis for acute ischemic stroke in routine practice in a rural hospital

Wpływ wybranych czynników sercowo-naczyniowych na bezpieczeństwo i skuteczność dożylnego leczenia trombolitycznego u chorych z niedokrwiennym udarem mózgu w codziennej praktyce w szpitalu w rejonie wiejskim

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Słowa kluczowe: czynniki sercowo-naczyniowe, znaleziska echokardiografii, udar niedokrwienny mózgu, rt-PA, dożylna tromboliza.

Abstract

Introduction: Cardiac and electrocardiography (ECG) abnormalities are common in acute ischemic stroke (AIS) patients.
Aim of the research: To evaluate the relationship between selected cardiovascular factors and the long-term outcome, the presence of hemorrhagic transformation (HT), symptomatic intracerebral hemorrhage (SICH) and mortality in Caucasian patients with AIS treated with intravenous thrombolysis (*i.v.* thrombolysis) in routine practice.
Material and methods: We prospectively evaluated 286 stroke patients in terms of the impact of cardiovascular factors and changes in the transthoracic echocardiogram (TTE) on the safety and effectiveness of intravenous (*i.v.*) thrombolysis.
Results: In the analyzed group we found atrial fibrillation (AF) in 35.3% of patients and cardiogenic stroke in 31.5% of patients. The first abnormal ECG ($p = 0.02$) and the presence of AF ($p = 0.002$) were higher in patients with an unfavorable outcome (modified Rankin Scale, 3–6 points) and in patients who died within 3 months' follow-up ($p = 0.02$, $p = 0.004$ respectively). Only median NIHSS score at the time of admission was associated with cardiogenic stroke ($p = 0.01$). There was no impact of TTE findings on safety and efficacy of *i.v.* thrombolysis. No significant differences in the long-term outcome, HT and SICH rates and mortality between the subgroups of patients with cardiogenic stroke and patients with other types of strokes were observed. Multivariate analysis showed the impact of AF on the long-term unfavorable outcome ($p = 0.02$) and mortality rate ($p = 0.04$).
Conclusions: Atrial fibrillation is a strong predictor of unfavorable long-term outcome and death in patients with AIS treated with *i.v.* thrombolysis in routine practice. Further studies assessing cardiac function in patients undergoing *i.v.* thrombolysis are needed.

Streszczenie

Wprowadzenie: Nieprawidłowości w badaniu kardiologicznym i elektrokardiograficznym (EKG) często występują u pacjentów z ostrym udarem niedokrwiennym mózgu (AIS).
Cel pracy: Ocena zależności między wybranymi czynnikami sercowo-naczyniowymi a odległym wynikiem leczenia, obecnością zmian krwotocznych (HT), objawowych krwotoków śródmózgowych (SICH) i umieralnością pacjentów rasy kaukaskiej z AIS leczonych trombolizą dożylną (*i.v.*) w rutynowej praktyce klinicznej.
Materiał i metody: Prospektywnie oceniano dane 286 pacjentów pod względem wpływu czynników sercowo-naczyniowych i zmian w echokardiografii przezklatkowej (TTE) na bezpieczeństwo i skuteczność trombolizy *i.v.*
Wyniki: W analizowanej grupie migotanie przedsionków (AF) występowało u 35,3%, a udar kardiogenny u 31,5% pacjentów. Nieprawidłowy pierwszy zapis EKG ($p = 0,02$) i obecność AF ($p = 0,002$) częściej stwierdzano u pacjentów z niekorzystnym wynikiem leczenia (zmodyfikowana skala Rankina, mRS 3–6 pkt) oraz u pacjentów, którzy zmarli w ciągu 3 miesięcy obserwacji (odpowiednio $p = 0,02$, $p = 0,004$). Jedynie mediana skali NIHSS w momencie przyjęcia była związana z udarem kardiogennym ($p = 0,01$). Nie zaobserwowano istotnych różnic w odległym wyniku leczenia, częstości występowania SICH

oraz śmiertelności między podgrupami pacjentów z udarem kardiogennym i udarami o innej etiologii. Analiza wieloczynnikowa wykazała wpływ AF na długoterminowy niekorzystny wynik leczenia ($p = 0,02$) i śmiertelność ($p = 0,04$).
Wnioski: Migotanie przedsionków jest silnym predyktorem niekorzystnego odległego wyniku leczenia oraz zgonu u pacjentów z AIS leczonych za pomocą trombolizy *i.v.* w rutynowej praktyce lekarskiej. Konieczne są dalsze badania oceniające funkcję serca u pacjentów z udarem poddawanych trombolizie *i.v.*

Introduction

The co-occurrence of heart and cerebrovascular diseases is very common. This is related to common risk factors and in many cases similar etiopathogenesis and therapeutic decisions that are mutually dependent on each other. According to previous studies, cardiogenic etiology occurs in 22–39% of ischemic strokes [1]. Studies using prolonged cardiac monitoring indicate higher incidence of serious arrhythmias, which leads to the conclusion that cardiogenic stroke occurs in a greater proportion.

Cardiac and electrocardiogram (ECG) abnormalities are common in acute stroke patients, especially if the insular cortex is involved [2, 3]. Cardiac dysfunction in stroke patients may be particularly damaging. Within the territory of tissue affected by an acute ischemic stroke (AIS) intrinsic autoregulation of the vasculature is lost, rendering cerebral blood flow directly dependent only on cardiac function [4]. An admission ECG, cardiac biomarkers and cardiovascular monitoring should be conducted routinely after an acute cerebrovascular event to screen for serious cardiac arrhythmias [5]. Holter monitoring is superior to routine ECG for the detection of atrial fibrillation (AF) in patients anticipated to have thromboembolic stroke [6]. Transthoracic echocardiography (TTE) and especially transesophageal echocardiography (TEE) can detect a potential cardiac source of embolism [7, 8].

Systemic thrombolysis (*i.v.* thrombolysis) with recombinant tissue plasminogen activator (rt-PA), initiated within 4.5 h of the onset of symptoms, is an effective medical therapy for acute ischemic stroke, but is associated with a number of hemorrhagic complications and is contraindicated in patients with severe hemostatic disorders [5, 9].

Aim of the research

Our study aimed to evaluate the relationship between selected cardiovascular factors, TTE and TEE findings and the long-term functional outcome, the presence of hemorrhagic complications and mortality in Caucasian patients with AIS treated with *i.v.* thrombolysis in routine practice.

Material and methods

Study design and patients

We prospectively evaluated the clinical and epidemiological data of 286 Caucasian patients with AIS who were consecutively treated with *i.v.* thrombolysis from January 2008 to December 2012 in the Department of Neurology and Stroke Unit of the Holy Spirit Specialist Hospital in Sandomierz. Our study center was recognized as a stroke unit according to the Polish national criteria and was equipped with the proper monitoring and diagnostic facilities [10]. Our unit provided a 24-h stroke service 7 days a week. All patients were examined at the time of admission by a stroke physician, and the severity of stroke symptoms was assessed using the National Institutes of Health Stroke Scale (NIHSS) [11]. Stroke was diagnosed on the basis of the ICD 10 criteria and was confirmed on discharge by clinical evaluation and using neuroimaging findings. All biochemical samples were routinely taken at the time of admission and the results of biochemical analyses were obtained before starting *i.v.* thrombolysis. Computed tomography (CT) scans were performed in all patients upon admission to hospital and between 22 and 36 h after *i.v.* thrombolysis. In selected cases, especially in case of hemorrhagic complications, additional CT scans were performed according to the patient's status and clinical indications. Magnetic resonance imaging (MRI) was not routinely performed.

Clinical cardiovascular evaluation was performed through a general physical examination, ECG on admission, 3-day monitoring of heart rate and blood pressure, the Holter-ECG test, chest X-ray and TTE and in selected cases TEE performed according to the current echocardiography guidelines and standards [12]. Assessment of cardiovascular risk factors was also performed. In the evaluation of congestive heart failure (CHF) the following variables were registered: history of heart failure, New York Heart Association functional classification (NYHA) dichotomized as < stage II and ≥ stage II, left ventricular ejection fraction (dichotomized as ≤ 44% and > 44%, left atrium diameter (dichotomized as ≤ 38 mm and > 38 mm for women and ≤ 46 mm and > 46 mm for men) and end-diastolic left ventricular diameter (dichotomized as ≤ 57 mm and > 57 mm for women and ≤ 63 mm and > 63 mm for men). The adopted values of TTE corresponded to moderately and severely abnormal (in accordance with the American Society of Echocardiography Guidelines and Standards) [12].

Cases related to AF, valvular disease, congestive heart failure, patent foramen ovale and aortic embolism were defined as cardiogenic stroke.

Cerebral thrombolysis with the intravenous infusion of rt-PA was administered according to the current guidelines [5, 12]. Patients treated > 4.5 h from the stroke onset and patients treated with combina-

tion therapy (intravenous and intraarterial thrombolysis) were excluded from the study.

The 90-day stroke outcomes were measured with the modified Rankin scale (mRS) [13]. A favorable outcome was defined as an mRS score ≤ 2 points, while an unfavorable outcome was defined as an mRS of 3–6 points. Hemorrhagic transformation (HT) and symptomatic intracerebral hemorrhage (SICH) rates were assessed according to the European Cooperative Acute Stroke Study (ECASS) II criteria [14].

The ethics committee approved all data analyses.

Statistical analysis

This study was based on a prospective data analysis. A statistical analysis was performed with Statistica v. 9.1 All continuous variables were tested for normal distribution and equality of variance. Because of the non-normality of the variables, the non-parametric Mann-Whitney *U* test was used to perform the univariate analysis of the continuous variables. Categorical data were compared using the χ^2 test. The multivariate analysis was performed using multiple logistic regression. For logistic regression those variables which showed discrimination power $p < 0.1$ in univariate analysis were selected. The results of the logistic regression models were presented as odds ratios (ORs) and the corresponding 95% confidence intervals (CIs). *P*-values < 0.05 were considered statistically significant.

Results

In the analyzed group a favorable outcome was found in 56.6% of patients and an unfavorable outcome was identified in 43.4% of patients; 17.8% of patients died within 90 days of the stroke onset. The HT was found in 15.7% of patients, and SICH was found in 4.2% of patients. We found AF in 35.3% and con-

Table 1. Clinical characteristics of subgroups of stroke patients with a favorable and an unfavorable outcome after *i.v.* thrombolysis

Variables	Favorable outcome (mRS 0-2) *n* (%)	Unfavorable outcome (mRS 3-6) *n* (%)	*P*-value
N = 286	162 (56.6)	124 (43.4)	–
Hypertension	105 (64.8)	81 (65.3)	0.93
Coronary heart disease	112 (69.6)	91 (73.4)	0.48
Previous heart infarct	24 (14.8)	21 (16.9)	0.63
Heart infarct on admission	1 (0.6)	3 (2.4)	0.20
First abnormal ECG	89 (54.9)	85 (68.6)	0.02
Atrial fibrillation	45 (27.8)	56 (45.2)	0.002
History of atrial fibrillation with anticoagulant therapy	17 (10.5)	15 (12.1)	0.67
PSVT	39 (24.1)	20 (16.1)	0.10
Antiplatelet therapy before stroke	92 (56.8)	77 (62.1)	0.37
Anticoagulant therapy before stroke	18 (11.1)	18 (14.5)	0.39
Congestive heart failure	12 (7.4)	12 (9.7)	0.49
N = 233	153 (65.7)	80 (34.3)	
Enlarged left atrium	71 (47.6)	35 (43.8)	0.57
Enlarged left ventricle	30 (19.6)	21 (26.3)	0.24
Patent foramen ovale	3 (2.0)	1 (1.3)	0.69
Left ventricular wall dyskinesia	66 (43.1)	39 (48.8)	0.53
Calcification and/or thickening of mitral valve	49 (32.0)	25 (31.3)	0.90
Calcification and/or thickening of aortic valve	88 (57.5)	46 (57.5)	0.99
Mitral stenosis	4 (2.6)	0	0.15
Aortic stenosis	11 (7.2)	2 (2.5)	0.14
Reduced ejection fraction ≤ 35%	9 (5.9)	9 (11.3)	0.15

mRS – modified Rankin Scale, PSVT – paroxysmal supraventricular tachycardia, ECG – electrocardiography.

gestive heart failure in 8.4% of patients, but we recognized cardiogenic stroke in 31.5% of patients.

The first abnormal ECG and the presence of AF were more frequent in patients with an unfavorable outcome than in patients with a favorable outcome. There were no differences between groups according to vascular risk factors or TTE and TEE parameters (Table 1). There were also no differences between groups of patients with and without HT according to vascular risk factors or TTE parameters. The presence of an enlarged left ventricle was more frequent in patients with a HT than in those without a HT, but the difference was not significant (Table 2).

The first abnormal ECG and the presence of AF were more frequent in patients who died within 3 months' follow-up than in those who survived (Table 3). Only median NIHSS score at the time of admission, beyond the presence of AF, and pre-stroke coagulant use, was associated with cardiogenic stroke when compared to patients with other types of strokes. Significant differences in the long-term outcome, HT and SICH rates and mortality between the subgroups of patients with cardiogenic and other types of strokes were not observed (Table 4).

Multivariate analysis showed the impact of AF on the long-term unfavorable outcome and mortality rate. Only the presence of AF was associated with cardiogenic stroke (Table 5).

Discussion

The etiology of stroke is undoubtedly multifactorial. It determines the future management of the patients. If cerebral ischemia is associated with cardiac thrombi, oral anticoagulation is the treatment of choice. Therefore, for the detection of both serious cardiac arrhythmias and subclinical disorders, changes in TTE and TEE are essential.

About 15% of strokes are attributable to documented AF [15]. Epidemiologic studies indicate that many patients with AF on screening ECGs had not previous-

Table 2. Clinical characteristics of subgroups of stroke patients with and without hemorrhagic transformation after *i.v.* thrombolysis

Variables	With hemorrhagic transformation *n* (%)	Without hemorrhagic transformation *n* (%)	*P*-value
N = 286	45 (15.7)	241 (84.3)	–
Hypertension	32 (7.1)	154 (63.9)	0.35
Coronary heart disease	33 (73.3)	170 (70.8)	0.73
Previous heart infarct	6 (13.3)	39 (16.2)	0.63
Heart infarct on admission	0	4 (1.7)	0.38
First abnormal ECG	31 (68.9)	143 (59.3)	0.23
Atrial fibrillation	19 (42.2)	82 (34.0)	0.29
History of atrial fibrillation with anticoagulant therapy	5 (11.1)	27 (11.2)	0.99
PSVT	12 (26.7)	47 (19.5)	0.28
Antiplatelet therapy before stroke	27 (60.0)	142 (58.9)	0.89
Anticoagulant therapy before stroke	5 (11.1)	31 (12.9)	0.75
Heart failure	4 (8.9)	20 (8.3)	0.87
N = 233	29 (12.5)	204 (87.6)	
Enlarged left atrium	14 (48.3)	92 (45.1)	0.75
Enlarged left ventricle	10 (34.5)	41 (20.1)	0.08
Patent foramen ovale	1 (3.5)	3 (1.5)	0.44
Left ventricular wall dyskinesia	15 (51.7)	90 (44.1)	0.44
Calcification and/or thickening of mitral valve	6 (20.7)	68 (33.3)	0.17
Calcification and/or thickening of aortic valve	16 (55.2)	118 (57.8)	0.79
Mitral stenosis	0	4 (2.0)	0.45
Aortic stenosis	1 (3.5)	12 (5.9)	0.59
Reduced ejection fraction ≤ 35%	3 (10.3)	15 (7.4)	0.57

PSVT – paroxysmal supraventricular tachycardia, ECG – electrocardiography.

Table 3. Clinical characteristics of subgroups of stroke patients who survived or died after *i.v.* thrombolysis

Variables	Dead *n* (%)	Alive *n* (%)	*P*-value
N = 286	51 (17.8)	235 (82.2)	
Hypertension	33 (64.7)	153 (65.1)	0.96
Coronary heart disease	40 (78.4)	163 (69.7)	0.21
Previous heart infarct	7 (13.7)	38 (16.2)	0.66
Heart infarct on admission	0	4 (1.7)	0.35
First abnormal ECG	39 (76.5)	135 (57.5)	0.02
Atrial fibrillation	27 (52.9)	74 (31.5)	0.004
History of atrial fibrillation with anticoagulant therapy	6 (11.8)	26 (11.1)	0.89
PSVT	7 (13.7)	52 (22.1)	0.18
Antiplatelet therapy before stroke	36 (70.6)	133 (56.6)	0.07
Anticoagulant therapy before stroke	6 (11.8)	30 (12.8)	0.85
Heart failure	3 (5.9)	21 (8.9)	0.66
N = 233	14 (6.0)	219 (94.0)	
Enlarged left atrium	3 (21.4)	104 (47.5)	0.06
Enlarged left ventricle	2 (14.3)	49 (22.4)	0.48
Patent foramen ovale	1 (7.1)	3 (1.4)	0.11
Left ventricular wall dyskinesia	6 (46.2)	99 (45.2)	0.86
Calcification and/or thickening of mitral valve	6 (42.9)	68 (31.1)	0.36
Calcification and/or thickening of aortic valve	8 (57.1)	126 (57.5)	0.98
Mitral stenosis	0	4 (1.8)	0.45
Aortic stenosis	0	13 (5.9)	0.61
Reduced ejection fraction ≤ 35%	1 (7.1)	25 (11.4)	0.62

PSVT – paroxysmal supraventricular tachycardia, ECG – electrocardiography.

ly received a diagnosis of AF. One quarter of AIS are of unknown cause. Subclinical AF is often suspected to be the cause in patients with AIS and without an etiologic factor identified [16, 17]. On the other hand, in 50% to 60% of patients with AF cerebral ischemic incidents were documented [15].

Approximately 1% to 2% of all adults in developed countries have CHF; its prevalence increases steeply with age [18]. Major risk factors for CHF are arterial hypertension, myocardial infarction (MI), valvular heart disease, diabetes and AF [19]. The 1-year survival rate is 55% in CHF patients associated with limitation of moderate activity (NYHA class III) and the 1-year survival rate as low as 5% to 15% in patients with symptoms occurring at rest (NYHA class IV) was found [20]. The prevalence of accompanying AF in CHF patients is 10% to 17%. This is relevant, because AF is associated with increased stroke risk and mortality in patients with CHF [21]. The CHF is a common cause of ischemic stroke [19, 22]. The most frequently recognized reasons for cardioembolic stroke in patients with CHF are thrombus formation due to AF and left ventricular hypokinesia [22]. Patients with CHF are at risk for stroke of large-artery atherosclerosis and small-vessel occlusion [23]. In addition, hypotension in CHF patients is also a risk factor for stroke [24].

In the previous trials evaluating the safety and effectiveness of *i.v.* thrombolysis with use of alteplase, AF was found with different rates. In the NINDS study, there were 18–20% with AF [25]; in ECASS 1 – 17.5% [26], ECASS 2 – 21.8% [27], ECASS 3 – 12.7% [28] and IST-3 – 31% [29]. In these trials, the incidence and the impact of the CHF on the long-term outcome were not studied.

In the Safe Implementation of Thrombolysis in Stroke-Monitoring Study (SITS-MOST) AF occurred in 23.2% of patients and was a predictor of symptomatic intracerebral hemorrhage (SICH) (independently from the definition), unfavorable outcome and death, and CHF occurred in 7.3% of patients and was a predictor of unfavorable outcome and death [30]. The previously published paper by Palumbo *et al.* revealed that clinical diagnosis of CHF, with estimation of the left ventricu-

Table 4. Clinical characteristics of subgroups of thrombolytic patients with cardiogenic and other subtypes of stroke

Variables	Cardiogenic strokes *n* (%)	Other strokes *n* (%)	*P*-value
N (%)	90 (31.5)	196 (68.5)	–
Demographic data:			
Age ± SD, mean	69.3 (11.4)	70.3 (11.0)	0.55
Male gender, *n* (%)	51 (56.7)	104 (53.1)	0.57
Age > 80, *n* (%)	14 (15.6)	35 (17.9)	0.63
Risk factors, *n* (%):			
Hypertension	58 (64.4)	128 (65.3)	0.89
Coronary heart disease	57 (63.3)	104 (53.1)	0.10
Atrial fibrillation	51 (56.67)	50 (25.5)	< 0.0001
Diabetes mellitus	14 (15.6)	28 (14.3)	0.78
Dyslipidemia	64 (71.1)	158 (80.6)	0.07
Smoking	19 (21.1)	40 (20.4)	0.89
Prior stroke	15 (16.7)	29 (14.8)	0.68
Pre-stroke antiplatelets	58 (64.4)	111 (56.6)	0.21
Pre-stroke anticoagulants	18 (20.0)	18 (9.2)	0.01
Congestive heart failure	17 (18.9)	7 (3.6)	< 0.001
Stroke severity:			
Median NIHSS (IQR)	12.0 (10.0–17.0)	10.0 (7.0–16.0)	0.01
NIHSS > 14 points, *n* (%)	34 (37.8)	57 (29.1)	0.14
Radiological findings before thrombolysis in CT scans, *n* (%):			
Old ischemic changes	32 (35.6)	73 (37.2)	0.78
Early ischemic changes	20 (22.2)	43 (21.9)	0.96
Logistic times and factors:			
Onset to door time (IQR) [min]	90.0 (65.0–120.0)	85.0 (55.0–120.0)	0.30
Onset to door time > 60 min, *n* (%)	72 (80.0)	143 (72.9)	0.20
Door to treatment time (IQR) [min]	62.0 (45.0–85.0)	65.0 (50.0–88.5)	0.61
Onset to treatment time (IQR) [min]	157.5 (135.0–180.0)	155.0 (130.0–180.0)	0.49
mRS 0–2 at 3 months, *n* (%)	45 (50.0)	117 (59.7)	0.12
Hemorrhagic transformation (HT)†, *n* (%)	15 (16.7)	30 (15.3)	0.77
SICH†, *n* (%)	6 (6.7)	6 (3.1)	0.16
Mortality, *n* (%)	17 (18.9)	34 (17.4)	0.75

†*According to the ECASS 2 criteria, NIHSS – National Institutes of Health Stroke Scale, CT – computed tomography, mRS – modified Rankin Scale, ECASS – European Cooperative Acute Stroke Study, SICH – symptomatic intra-cerebral hemorrhage, SD – standard deviation, IQR – interquartile range (Q_1–Q_3).*

lar ejection fraction, predicts mortality, but not disability, in AIS patients undergoing *i.v.* thrombolysis [31]. In our sample, we found AF in 35.5% and CHF in 8.4% of patients. Only AF was associated with unfavorable long-term outcome and mortality rate.

In our sample we found 2 cases of patients with AIS after percutaneous coronary intervention (PCI) [32]. Although the overall rate of stroke after PCI is low, ranging from 0.2% to 0.4% [33, 34], it is a complication associated with a high rate of morbidity and mortality [35, 36]. Dukkipati *et al.* found that the occurrence of stroke was more frequently associated with diabetes mellitus, hypertension, prior stroke, and renal failure and was associated with in-hospital death

Table 5. Multivariate logistic regression analysis showing pathological changes in circulatory system associated with an unfavorable outcome, hemorrhagic transformation and death (analysis includes variables that showed discriminating power $p \leq 0.1$ in the corresponding univariate model)

Variables	Unfavorable outcome		Hemorrhagic transformation		Death	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Atrial fibrillation	**1.89 (1.11–3.19)**	**0.02**	–		**1.99 (1.04–3.85)**	**0.04**
First abnormal ECG	1.44 (0.85–2.44)	0.17	–		1.88 (0.89–3.96)	0.10
PSVT	0.47 (0.15–1.45)	0.19	–		–	
Enlarged left ventricular	0.53 (0.18–1.57)	0.25	–		–	

*PSVT – paroxysmal supraventricular tachycardia, ECG – electrocardiography, OR – odds ratio, CI – confidence interval (significant associations are shown in **bold**).*

[33]. De Marco *et al*. reported 6 cases of periprocedural ischemic stroke complicating cardiac interventions in which immediate cerebral angiography followed by local thrombolysis was the key factor in their successful management [37]. Other authors indicate the possibility of treating such patients using alteplase [38].

Four patients with AIS and concomitant MI on admission were also treated. In half of these cases good long-term outcome was found. The MI is a frequent complication in the acute phase of stroke. On the one hand, brain and myocardial damage may be related to endogenous catecholamine release [39]. On the other hand, in MI left ventricular thrombi occur, appearing mainly in anterior MI. The factors associated with the formation of post-infarction left ventricular thrombus are: apical akinesia, aneurysm, and poor myocardial contractility, especially with an ejection fraction below 35% [40].

A limitation of our study was the lack of echocardiography and ECG-Holter tests in all patients (81.5%). We did not perform these examination in patients who died within the first days of hospitalization or in disturbed patients in whom Holter-ECG monitoring was difficult to perform. Echocardiography at the time of admission was impossible, because of the extension of onset to treatment times, which would be adverse to the outcome of treatment. In the group of patients without echocardiography, there were 72% of all patients who died within 90 days' follow-up.

Conclusions

It was found that AF is a strong predictor of unfavorable long-term outcome and death in patients with AIS treated with IV thrombolysis in routine practice. Echocardiographic findings which determined long-term outcome, HT and mortality rate were not found. All patients with AIS should undergo complete cardiologic diagnostic tests, including prolonged cardiac monitoring and TTE and TEE.

Conflict of interest

The authors declare no conflict of interest.

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