Benha Journal of Applied Sciences (BJAS) **print: ISSN 2356–9751**
Vol. (7) Issue (11) (2022), (67-73) **online: ISSN 2356–976x**
http://bjas.journals.ekb.eg

Comparative Retrospective study of NIHSS score before and after thrombolytic therapy in stroke patients

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Abstract

A stroke is "acute neurologic dysfunction of vascular origin with abrupt (within seconds) or at least fast (within hours) onset of symptoms and signs correlating to the involvement of specific regions in the brain." Strokes may be either ischemic or hemorrhagic. This research set out to compare NIHSS scores before and after rTPA, as well as to look at other variables that could have an effect on the result of rTPA. Methods: Fifty patients who had had an acute cerebrovascular stroke and been treated with RTPA were included in this retrospective analysis. Electrocardiogram (ECG), Echocardiogram (Echo), and Doppler ultrasound of the carotid arteries will be performed on all patients. Standard blood tests include a complete blood count (CBC), a lipid profile, a random blood sugar and glycosylated haemoglobin, and a hematocrit measurement (Hba1c). Early neurological progress; the results. AKA: high blood pressure. Ratio normalised on a global scale; abbreviated INR. Interquartile range (IQR) The M-RS is the modified Rankin scale. What we call the "stroke scale" at the National Institutes of Health. On bivariate analysis, hemorrhagic transformation was linked to factors such as a prior history of hypertension (8(88.9%)/1(11.1%), p= 0.034*), a higher NIHSS at presentation (16(13.5-21.5) against 13(11-16), p=0.025*), and a higher NIHSS after 24 hours (20(15-25) versus 10(7-15), p=0.000**). Initial National Institutes of Health Stroke Scale (NIHSS) was an independent predictor, with an increased risk of hemorrhagic transformation of 1.223% (95% CI 1.030% to 1.451%) (p=0.021) for each additional unit, and hypertensive patients tended to experience hemorrhagic transformation (AOR= 9.529% (95% CI 0.936% to 97.56%), p=0.058). When patients are properly chosen, intravenous rtPA is effective. There is no significant difference in the results in the first 3 hours versus extra 1.5 hour. It works just as well in the frontal as it does in the backal circulation. The National Institute of Health Stroke Scale (NIHSS) is an excellent clinical instrument for predicting the severity, speed of recovery, hemorrhagic transformation, and death of stroke.

Keywords: NIHSS Score; Thrombolytic Therapy; Stroke Patients.

1. Introduction

According to the American Heart Association, a stroke is "an acute neurologic malfunction of vascular origin characterised by the fast onset of symptoms and indications that reflect the involvement of specific brain regions." Ischemic stroke and hemorrhagic stroke are the two most common forms of stroke. [1]

A stroke is the second leading cause of mortality and the third leading cause of disability globally. [1]

Common after-effects of stroke include epilepsy, depression, and cognitive loss. [2]

The severity of a stroke may be quantified with the use of the National Institutes of Health Stroke Scale (NIHSS), a 15-item impairment scale. Its usage as an outcome metric in the recombinant tissue plasminogen activator stroke studies dates back to its creation in 19891. 2 The National Institutes of Health Stroke Scale (NIHSS) is suggested as a viable method to measure stroke severity in emergency departments, according to the most recent recommendations from the National Stroke Foundation.

Consciousness, eye and facial movement, visual field integrity, muscular strength in arms and legs, sensation, coordination, language, speech, and neglect are all measured by the NIHSS. Each disability is assigned a score on an ordinal scale from 0 to 2, 0 to 3, or 0 to 5. The sum of your item scores is your final score, which may be anywhere from 0 to 42. (the higher the score, the more severe the stroke). Intravenous thrombolysis (IVT) is the current standard of therapy for individuals with moderate but debilitating symptoms of acute ischemic stroke [3, 4]. 1 Some individuals with large vascular occlusion (LVO) appear with minor impairments, most likely because of excellent collaterals, despite the fact that LVO normally results in severe symptoms. [4]

This research set out to compare NIHSS scores before and after rTPA, as well as to look at other variables that could have an effect on the result of rTPA.

2. Patients and methods

This retrospective study included 50 patients developed acute cerebrovascular stroke, treated with RTPA from Ain shams University Hospitals who were admitted at neurology department

The study was done after being approved by the institutional ethical committee, Faculty of Medicine, Ain Shams University. A written informed consent will be obtained from all participants.

Inclusion criteria were age≥18 years old, both sex are included in the study, Diagnosis of ischemic stroke with measurable disabling neurologic deficit (regardless of the severity), symptom onset within 4.5 hours and eligible for RTPA, wake up stroke with diffusion-weighted imaging-Flair mismatch on MRI, and computed tomography (CT)brain reveals no hemorrhage.

Exclusion criteria were history of stroke within 3 months, History of cerebral amyloid angiopathy, or significant head trauma within 3 months, prior intracranial haemorrhage and brain imaging study (any CT scan or MRI) with one of the following: contusion, subdural/epidural hematoma, subarachnoid haemorrhage, neoplastic lesion, infectious/ inflammatory lesion, or hydrocephalus and intracerebral haemorrhage

Procedure: NIHSS will performed in the first few hours then performed again after rTPA

Every patient will perform: Brain CT scan or MRI if available, Electrocardiography ECG& Echocardiogram, Doppler on carotids. Routine labs as white, red blood cell count, Platelets count (CBC) lipid profile, random blood sugar test & glycosylated hemoglobin (Hba1c). levels of electrolytes, such as sodium and potassium, PT, PTT and INR, liver function tests (LFTs): as Alanine transaminase (ALT) Aspartate transaminase (AST), Kidney function tests (KFTs): as Blood Urea Serum Creatinine, Thrombophilia and collagen screening in special cases.

The study comprised 68 patients with median age 60.5 years (IQR= 50.3-73-7) and male to female ratio 36.8%: 63.2%. vascular risk factors included Hyperlipidemia (73.5%), HTN (58.8%), AF (50%), DM (32.4%). Most acute ischemic vascular accidents were in the anterior circulation (86%) with initial NIHSS median=13 (IQR=11-16.7). All the patients were presented in the 4.5 hours window with 67% treated in the first 3 hours. The score of NIHSS decreased to a median of 10.5 (8-16) after 24 hours. And further to a median of 8(3-15) after 3 months. Of the study population 30 patients (44.4%) achieved a good functional outcome, 9 (13.8%) suffered hemorrhagic transformation and 6 were dead at 3 months. **Table 1**

3. Results

Table (1) shows the descriptive results of the study group including Demographics, Vascular risk factors, Initial neurological assessment, Initial clinical assessment, Initial lab. Investigation, Imaging, Treatment window, Etiology (TOAST classification) and Follow-up.

Descriptive statistics of the study population Variable	
Demographics	
Age	61.34 (± 14.4)
Gender (Male/ female) n (%)	25 (36.8%)/43 (63.2%)
Residence (rural/urban) n (%)	20 (29.4%)/48 (70.6%)
Vascular risk factors	
HTN vs no HTN n (%)	40 (58.8%)/28 (41.2%)
DM vs no DM n (%)	22 (32.4%)/ 46(67.6%)
HYPERLIPIDEMIA vs no hyperlipidemia n (%)	50(73.5%)/18(26.5%)
Smoking VS non-smokers n (%)	10(14.7%)/51(75.0%)
Ex-smokers n (%)	7(10.3%)
AF n (%)	34(50.0%)/34(50.0%)
Initial neurological assessment	
NIHSS-0	13.65 (±5.4)
Initial clinical assessment	
Initial systolic BP (mmHg)	139.1(±21.8)
Initial diastolic BP (mmHg)	87.8 (±11.6)
Initial lab. Investigation	
Initial RBS (mg/dl)	135.2 (±31.6)
Initial INR	1.16 (±0.62)
Initial WBCs (1000/dl)	9.87(±25)
Initial platelets (1000/dl)	242.74 (±78.2)
Triglycerides (mg/dl)	147 (±100.7)
Cholesterol (mg/dl)	228.6 (±63.9)
Imaging	
ASPECT score	9.8 (±0.68
Territory (Anterior vs posterior circulation) n (%)	59 (86.8%) 9 (13.2%)
Treatment window	
Late vs early (first 3 hours/ additional 1.5 hr)	46(67.6%)/22(32.4%)
Etiology (TOAST classification)	
LA atherosclerosis n (%)	18 (26.5%)
cardioembolic n (%)	28 (41.2%)
Small vessel disease n (%)	2 (2.9%)
Other determined n (%)	4 (5.9%)
cryptogenic n (%)	16 (23.5%)
Follow up	
NIHSS-24 hour	12.2 (±6.9)
Hospital-stay (days)	7.7(±5.1)
NIHSS-3m	9.2(±6.8)

m-RS 3m	3.3(±1.5)
Any Haemorrhagic transformation	9(13.2%)
m-RS 0-2 / m-RS 3-6 n (%)	30 (44.1%)/38(55.9%)
Mortality vs survival n (%)	6 (8.8%)/ 62(91.2%)

There were statistically significant differences between m-RS (0-2) and RS (3-6) as regards age and gender. RS (3-6) group had the older age. Also, there were statistically significant differences between both groups as regards (Initial NIHSS, 24h NIHSS, Hospital stay, and hemorrhagic transformation). The latter group showed the worse values. **Table 2**

Table (2) Comparison between m-RS (0-2) group versus m-RS (3-6) group as regards age, gender, initial assessment (NIHSS, NIHSS 24h), cholesterol, hospital stay and haemorrhagic territory

	m-RS 0-2 vs m-RS 3-6		
	m-RS 0-2 (N=30)	**m-RS 3-6 (N=38)**	**P**
Age [median (IQR)]	51(46.5-60)	65(60-76)	0.000**
Gender m/f [n(%)]	16(53.3%)/14 (46.7%)	9(23.7%)/29(76.3%)	0.022*
Initial NIHSS [median (IQR)]	11 (5.7-13)	16(13-18)	0.000**
NIHSS 24 hrs [median (IQR)]	8(3-10)	15(12-20)	0.000**
cholesterol [median (IQR)]	199(164.5-247)	254.5(212-300)	0.000**
HOSPITAL STAY (days) [median (IQR)]	4.5(3-7)	7(6-10)	0.000**
Haemorrhagic transformation	0(0%)/30(100%)	9(23.7%)/29(76.3%)	0.001**

There were statistically significant differences between both groups as regards haemorrhagic transformation. ENI did not show haemorrhagic transformation while 18% of the other group showed haemorrhagic transformation. Also, none of the 1st group showed post circulation territory while 18% of 2nd group showed post circulation territory. **Table 3**

Table (3) Comparison between group of early neurological improvement (N=18) versus group with no early neurological improvement (N=50) as regards haemorrhagic Territory

	Early neurological improvement (NIHSS decreased by >4 in 1st 24 hrs)		
	ENI (N=18)	**NO ENI** (N=50)	
cholesterol	207.5(157-257)	230(198.75-285.25)	0.095
Haemorrhage	0(0%)/18(100%)	9(18%)/41(82%)	0.014*
Ant versus Post	18(100 %)/0(0%)	41(82%)/9(18%)	0.014*

The group of mortality had the older age, had more risk factors as regards DM and HTN, expressed worse values in the initial clinical assessment. Moreover, this group also had the higher rate of haemorrhagic transformation. **Table 4**

Table (4) Comparison between the group with mortality (N=6) and survival group (N =62) as regards age, risk factors, initial clinical assessment, imagining score and haemorrhagic territory

	Mortality vs survival		
	Mortality (N=6)	**Survival (N=62)**	**P**
Age [median (IQR)]	76(60-78.25)	60(50-67)	0.041*
HTN	6(100%)/0(0%)	34(54.8%)/28(45.2%)	0.009**
DM	5(83.3%)/1(16.7%)	17(27.4%)/45(72.6%)	0.007**
Initial NIHSS [median (IQR)]	19(15.5-24.25)	13(11-16)	0.012*
NIHSS 24 hrs [median (IQR)]	25(21-27)	10(7.75-15)	0.001**
ASPECT [median (IQR)]	10(7.75-10)	10(10-10)	0.025*
haemorrhagic transformation	5(83.3%)/1(16.7%)	4(6.5%)/58(93.5%)	0.000**

AF; atrial fibrillation. DM; diabetes mellitus. ENI; early neurological improvement. HTN; hypertension. INR; international normalized ratio. IQR; interquartile range. LAA; large artery atherosclerosis. M-RS; modified Rankin scale. NIHSS; national institute of health stroke scale. SD; Standard deviation. There were statistically significant differences between these 2 groups as regards AF, the group with longer stay had the higher percentage of AF. There were statistically significant differences between both groups as regards (initial NIHSS score and NIHSS 24h), the latter group expressed the worse values. **Table 5**

Table (5)comparison between group of short hospital stay and group of long hospital stay:

	Hospital Stay		
	Short stay (N=46)	**Long stay (N=22)**	**P**
Risk factors			
HTN	27(58.7%)/19(41.3%)	13(59.1%)/9(40.9%)	0.975
DM	15(32.6%)/31(67.4%)	7(31.8%)/15(68.2%)	0.948
Hyperlipidemia	34(73.9%)/12(26.1%)	16(72.7%)/6(27.3%)	0.918
AF	15(32.6%)/31(67.4%)	13(59%)/9(41%.)	0.036
SMOKING	7(15.2%)/32(69.6%)	3(13.6%)/19(86.4%)	0.140
Initial clinical			
Initial NIHSS [median (IQR)]	13(10.8-18)	17(15.8-18)	0.000
NIHSS 24 hrs [median (IQR)]	8.5(6.8-15)	16(11.5-23)	0.000

ENI; early neurological improvement. HTN; hypertension. INR; international normalized ratio. IQR; interquartile range. M-RS; modified Rankin scale. NIHSS; national institute of health stroke scale. Regarding haemorrhagic transformation, it was associated on bivariate analysis with history of HTN [8(88.9%)/1(11.1%), p= 0.034*], more initial NIHSS [16(13.5-21.5) vs 13(11-16), p=0.025*], more NIHSS after 24 hours [20(15-25) vs. 10(7-15), p=0.000**]. Independent predictors were initial NIHSS with every additional unit increasing the odds of haemorrhagic transformation by 1.223(1.030-1.451), p=0.021 with a trend towards haemorrhagic transformation in hypertensive patients, AOR= 9.529(0.93-97.65), p=0.058. **Table 6**

Table (6) Predictors of haemorrhagic transformation

variable	**Haemorrhagic transformation N=9**	**No haemorrhagic transformation N=59**	P
Risk factors			
HTN	8(88.9%)/1(11.1%)	32(54.2%)/27(45.8%)	0.034*
Initial clinical			
Initial NIHSS [median (IQR)]	16(13.5-21.5)	13(11-16)	0.025*
NIHSS 24 hrs [median (IQR)]	20(15-25)	10(7-15)	0.000**
OUTCOMES			
ENI	0(0%)/9(100%)	18(30.5%)/41(69.5%)	0.014*
NIHSS-3M	18(15.25-20)	6.5(3-13)	0.010*
MRS-3M	6(5-6)	3(2-4)	0.000**
MRS-3M (0-2)	0(0%)/9(100%)	30(50.8%)/29(49.2%)	0.001**
MORTALITY	5(55.6%)/4(44.4%)	1(1.7%)/58(98.3%)	0.000**

4. Discussion

This was a look back at the NIHSS results of individuals who had been IV thrombolysed. In this research we showed that NIHSS is a very robust predictors of all predicted outcomes of IV thrombolysis. Patients with a lower initial NIHSS had a better chance of a favourable functional result at 3 months, a shorter hospital stay, earlier neurological recovery, survival, and a non-hemorrhagic transformation [5].

Three months of functional independence was also predicted by characteristics such as younger age and a lower baseline NIHSS after 24 hours of therapy. Also indicative of a positive functional result was early neurological improvement. In addition to an initial lower NIHSS, the lack of a history of AF was a predictor of a shorter hospital stay [5].

Lower cholesterol, no hemorrhagic change, and no involvement of the posterior circulation were all related with early neurological recovery. While initial and 24-hour NIHSS, ICH, and a prior diagnosis of diabetes were all linked to deaths [6], the 24-hour NIHSS was the strongest predictor.

A significant factor in determining NIHSS is the time to reperfusion [7].

Patients with a history of hypertension (HTN) had a higher risk of hemorrhagic transition, and the initial NIHSS was also a significant predictor[7].

The Initial National Institute of Health Stroke Scale is a measure created to evaluate the severity of an acute ischemic stroke. It is also indirectly suggestive of the extent of the infarction (either core or penumbra) (either core or penumbra). More ischemic tissue or ischemia in a critical location (such as the motor area 4, the posterior limb of the internal capsule, or aphasia and its subtypes) corresponds to a higher NIHSS score. When carefully administered by a competent neurologist or nurse, NIHSS is a strong tool in diagnosing, follow up, monitoring

complications and predicting long term prognosis. Thrombolysis with clinical-diffusion mismatch may be employed in lieu of perfusion imaging with equivalent outcomes [8].

In our research, the best predictor of a positive functional result was age, with a positive outcome being linked to a younger age. Because of increased resistance to apoptosis, the process of death in the penumbra, and improved collaterals and ischemia resilience at a younger age, this may be the case. Neuroplasticity is higher in younger people, which suggests a more positive prognosis for recovery and reintegration into society [9].

The presence of ENI, or early neurological improvement, after 24 hours of therapy is also predictive of a positive result. ENI is defined as decline of NIHSS by 4 within the first 24 hours or reaching 0 (base line) (base line). The ENI suggests reperfusion of the ischemic penumbra and restoration of function. Reperfusion generally arises because of therapy with IV rtPA and/or endovascular treatment. In very unusual cases, it may occur on its own. Given its ability to obscure the effects of other predictors, this variable is more useful as an outcome than a predictive one [10].

The results of this investigation found that hemorrhagic transformation was linked to a more negative outcome. Improper cerebral perfusion, or ischemia, is caused by ICH's mass effect with herniation, increased intracranial tension, and lowered perfusion pressure. The production of neuroinflammatory mediators has been linked to a systemic inflammatory response and the activation of penumbra apoptotic pathways[11].

There was a bivariate relationship between early neurological recovery and the lack of hemorrhagic transformation, which may explain the correlation between the two outcomes[11].

Stroke originating in the posterior circulation was not linked to ENI. Strokes originating in the posterior circulation tend to be more severe in the outset, while being more resistant to hypoxia and hemorrhagic consequences. They are in charge of more critical processes, such as consciousness, cardiovascular, respiratory control, and swallowing, which may lead to complications including aspiration pneumonia and a systemic inflammatory response. Score of NIHSS is not tailored for posterior circulation and may underestimate severity of the stroke [12].

ENI was linked to lower cholesterol levels. Impairment of collateral circulation has been linked to hypercholesterolemia in SVD [13].

The COVID-19 pandemic highlighted the necessity for shorter hospital stays in the face of rising patient numbers and constrained resources. A lower baseline NIHSS and the lack of hemorrhagic complications were predictors of a shorter hospital stay [14].

Patients with atrial fibrillation tended to spend more time in the hospital. the necessity for a lengthier in-hospital stay (2-14 days) to initiate anticoagulation, the investigation of intracardiac thrombi using Echocardiography, and the monitoring of an individual's therapeutic range of INR may all contribute to this. There is some evidence that greater thrombus volumes linked with atrial fibrillation are related with more severe ischemic stroke. Initial severity may be higher in cases of cardioembolic sources because of the correlation between these causes and major artery blockage [15].

Even with careful patient screening, 7% of those who get IV rtPA will have hemorrhagic transformation, a potentially fatal event. We found a 13.8% incidence of hemorrhagic transformation in our investigation. On a bivariate basis, a greater baseline NIHSS was linked to this result. Higher NIHSS may be associated with more ischemic tissue, leading to a greater prevalence of blood brain barrier failure, basement membrane proteolysis by rtPA, and hemorrhagic transformation. The present investigation found that the prevalence of hemorrhagic transformation was higher in those with hypertension. In the basal ganglia, thalamus, cerebellum, and brain stem, ICH is a recognised risk due to hypertension's induction of lipohyalinosis of the penetrating arteries. More elderly individuals and more women tended to experience ICH. Weak blood arteries and impaired rtPA clearance may produce hemorrhagic transformation [11], and frailty may be linked to an increased risk of SVD, the presence of co-morbid illnesses such hypertension and diabetes, and an increased rate of renal impairment.

The later age of presentation in women compared to men may explain the link between female gender and ICH. Possible causes include the reduction of estrogen's protective action after menopause, for which there is very little evidence from animal research. A negative correlation was found between intracerebral haemorrhage and every positive functional outcome metric. Three-month decreases in m-RS 0-2 scores, three-month decreases in ENI, and three-month decreases in NIHSS all correlate with an increase in mortality. Initial NIHSS and a tendency in hypertensive individuals were independent predictors of ICH [16].

The ASPECT-measured magnitude of an infarct had no bearing on any measurable consequence. The more accurate NIHSS measure of AIS severity may be to blame for this misinterpretation. One possible reason is because CT imaging is routinely used in this research, and most patients are seen and cared for within the first three hours after presentation. Therefore, compared to the NIHSS, the CT tends to understate the extent of an infarction [17].

There was no noticeable difference between the results in the first three hours and the following one and a half hours. The expanded time window for IV thrombolysis may be safe with this assurance in place. There is no increased danger of hemorrhagic transformation.

Research findings were unaffected by participants' perceived risk factors for stroke or the underlying causes of stroke. Short-term results may be predicted by looking for a shared route into ischemia and reperfusion. Long-term recurrence may be connected to the initial aetiological diagnosis. A identification of the underlying

cause is more useful for long-term prevention than for immediate care [19].

Outcomes could not be predicted with certainty by laboratory data alone. Results and consequences are not related to INR, white blood cell count, or platelet count within normal ranges. A higher INR, up to 1.7, has been shown in certain studies to have a positive functional result. There have been additional studies that associate leucocytosis and a high neutrophil-to-lymphocyte ratio with a poor prognosis and a tendency for hemorrhagic transformation[19].

While neither blood pressure nor resting blood pressure had a role in the findings of our research, greater systolic BP is linked to worse outcomes, including a higher risk of hemorrhagic transformation and a poorer functional outcome. Increasing systolic pressure has long been believed to promote perfusion, but new study using MRI perfusion imaging shows the opposite to be true. A higher rate of RBS is associated with a higher rate of hemorrhagic transformation. Our study's lack of absentees may be due to the fact that all of the patients fell within a suitable range for IV rtPA, outside of which the result might have been different [19].

5. Conclusion

When given to carefully chosen individuals, rtPA administered intravenously has a high success rate. The consequences are the same after 3 hours as they are after an extra 1.5 hours. It works just as well in the frontal as it does in the backal circulation. The National Institute of Health Stroke Scale (NIHSS) is an excellent clinical instrument for predicting the severity, speed of recovery, hemorrhagic transformation, and death of stroke. If you have AIS of the brain stem, you should employ a variant of the normal NIHSS designed to assess the patient's posterior circulation.

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