Assessment of the Functional Status of Patients after Ischemic Stroke Treated with Thrombolytic Therapy

Ocena stanu funkcjonalnego chorych po udarze niedokrwiennym mózgu leczonych trombolitycznie

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Abstract

Introduction. One of the most effective methods for treating acute ischemic stroke is thrombolytic therapy, which involves intravenous administration of recombinant tissue plasminogen activator (rtPA) within a narrow therapeutic window of up to 4.5 hours from symptom onset.
Aim. The aim of this study was to assess the functional status of patients with ischemic stroke treated with thrombolytic therapy.
Material and Methods. The study was conducted in the Neurological Department with a Stroke Subunit on a group of 90 patients hospitalized due to ischemic stroke and eligible for thrombolytic treatment. Functional status was assessed using the modified Rankin Scale, the National Institutes of Health Stroke Scale (NIHSS), and the Barthel Index on admission and at discharge from the hospital.
Results. The mean scores on the modified Rankin Scale, NIHSS, and Barthel Index on admission were 4.3, 13.1, and 14.2, respectively. At discharge, the scores were 2.4, 6.0, and 59.5, respectively.
Conclusions. Based on the conducted research, it was observed that thrombolytic therapy contributed to the improvement of functional status. **(JNNN 2024;13(2):47–53)**
Key Words: functional capacity, intravenous thrombolysis, stroke

Streszczenie

Wstęp. Jedną z najskuteczniejszych metod leczenia świeżego udaru niedokrwiennego mózgu jest leczenie trombolityczne czyli dożylne podanie rekombinowanego tkankowego aktywatora plazminogenu, które stosuje się w wąskim oknie terapeutycznym do 4,5 godziny od wystąpienia objawów.
Cel. Celem niniejszej pracy była ocena stanu funkcjonalnego pacjentów z udarem niedokrwiennym mózgu leczonych trombolitycznie.
Materiał i metody. Badania przeprowadzono w Oddziale Neurologicznym z Pododdziałem Udarowym na grupie 90 pacjentów, hospitalizowanych z powodu udaru niedokrwiennego mózgu i zakwalifikowanych do leczenia trombolitycznego. Stan funkcjonalny oceniono na podstawie zmodyfikowanej skali Rankina, Skali Udarów Narodowego Instytutu Zdrowia oraz skali Barthel, w dniu przyjęcia oraz w dniu wypisu ze szpitala.
Wyniki. Średnia suma punktacji w zmodyfikowanej skali Rankina w dniu przyjęcia do szpitala wynosiła 4,3 pkt, w skali NIHSS 13,1 pkt, w skali Barthel 14,2 pkt. W dniu wypisu punktacja wynosiła kolejno 2,4 pkt, 6,0 pkt, 59,5 pkt.
Wnioski. Na postawie przeprowadzonych badań stwierdza się, że zastosowane leczenie trombolityczne wpłynęło na poprawę stanu funkcjonalnego. **(PNN 2024;13(2):47–53)**
Słowa kluczowe: wydolność funkcjonalna, dożylna tromboliza, udar mózgu

Introduction

Vascular diseases of the central nervous system pose a serious health problem in contemporary society. The most commonly diagnosed disease in this field is stroke, which despite extensive educational campaigns, is increasingly affecting younger individuals. Stroke is associated with numerous difficulties, both medically, socially, and economically. Currently, stroke is the second leading cause of death worldwide, after ischemic heart diseases, and a major cause of permanent disability among adults [1]. It is estimated that the annual incidence of stroke is 17 million among the general population, with 10–15% of patients being under 45 years old. According to data from the National Health Fund in 2022, there were 73.9 thousand cases of ischemic stroke, of which 89.1% were first-time strokes [2].

Stroke is a condition of immediate threat to life and health. Currently, the most effective method for treating acute ischemic stroke is thrombolytic therapy, which involves intravenous administration of recombinant tissue plasminogen activator (rt-PA, alteplase), within a narrow therapeutic window of up to 4.5 hours from symptom onset, and mechanical thrombectomy (within a therapeutic window of up to 6 hours) [1]. The action of alteplase treatment involves dissolving blood clots formed in the blood vessels. Functional status refers to the ability to perform daily tasks and duties independently and safely, without excessive effort. The assessment of a patient's functional status after stroke is particularly used to check the function of the nervous system, conduct rehabilitation exercises, and achieve the best possible patient performance [3]. Specialized scales are used to assess the neurological and functional status of patients [4]. Nursing care, due to the narrow therapeutic window, must be characterized by efficient organization of the undertaken actions, maximally coordinated care, while maintaining all safety principles towards the patient [5]. According to NFZ recommendations, hospitalization in a stroke unit after thrombolytic treatment should last a minimum of 8 days [6,7].

The aim of the study was to assess the functional status of patients with ischemic stroke after intravenous thrombolytic treatment. The specific objectives were to compare the patient's health status at admission to the ward and after thrombolysis, analyze the impact of disability and stroke severity on the performance of daily activities, and determine whether the time elapsed from symptom onset to the start of treatment affects the patient's subsequent functioning.

Material and Methods

The study was conducted from May 8 to July 16, 2021. Permission to conduct the research and access to the medical documentation of patients were obtained from the Management of the Provincial Hospital in Bielsko-Biała. The basis of the study was the medical documentation of 90 patients from the Neurological Department with a Stroke Subunit. The inclusion criteria for the study were the administration of fibrinolytic treatment (Actilyse) within a 4.5-hour time window. Patients who did not qualify for fibrinolytic treatment, those who underwent mechanical thrombectomy after alteplase administration, and patients who tested positive for SARS-CoV-2 during alteplase absorption and were subsequently transferred to infectious disease departments were excluded from the study.

A retrospective analysis of medical documentation was performed to collect sociodemographic and clinical patient data, as well as functional assessment (on admission and at discharge or death). The patient's condition was assessed based on the degree of disability (modified Rankin Scale), stroke severity assessment (NIHSS scale), and functional efficiency in performing daily activities (Barthel scale). The analysis was conducted using the Statistica 12 package. Statistical significance was set at p<0.05.

The study group predominantly consisted of women, accounting for 54.4% of the participants, while men comprised 45.6%. The average age of the participants was 73.5 (±14.0) years. More than half (58.9%) of the participants were married, 28.9% were widowed, 8.9% were divorced, and 3.3% were single. Nearly half (44.4%) of the participants lived in rural areas. Half of the participants (50%) did not use substances, 33.3% smoked cigarettes, 11.1% reported alcohol consumption, 8.9% drank coffee, and 1.1% used psychoactive substances. The highest percentage of participants reported low or very low levels of physical activity (55.6%). 74.4% of participants had hypertension, 27.8% had diabetes, and 25.6% had atrial fibrillation. Nearly one-fifth of the participants were obese, overweight, or had coronary artery disease (18.9%).

Results

Upon admission to the hospital, the mean score on the Rankin Scale was 4.3, indicating moderate disability, while at discharge, the mean score was 2.4 points, indicating slight disability (Table 1). Due to the lack of normal distribution of the differences in measurements before and after treatment, the significance of differences was verified using the non-parametric Wilcoxon signed-rank test. A statistically significant difference (p=0.000)

Table 1. Descriptive statistics of the Rankin, NIHSS, and Barthel scales on admission and on discharge day (N=90)

Descriptive statistics	M	Me	SD
Rankin Scale			
Admission	4.3	5.0	0.8
Discharge	2.4	3.0	1.8
Change	−1.9	−2.0	1.4
NIHSS Scale			
Admission	13.1	11.0	8.8
Discharge	6.0	3.0	8.4
Change	−7.1	−7.0	10.4
Barthel Scale			
Admission	14.3	0.0	16.8
Discharge	59.5	62.5	39.3
Change	45.2	52.5	28.5

M — mean; Me — median; SD — standard deviation

was observed between the level of disability expressed by the Rankin Scale at admission and at discharge.

Upon admission to the hospital, the mean score on the NIHSS scale was 13.1, while at discharge, the mean score was 6.0 points — indicating a moderately severe stroke (Table 1). Due to the lack of normal distribution of the differences in measurements before and after treatment, the significance of differences was verified using the non-parametric Wilcoxon signed-rank test. A statistically significant difference (p=0.000) was observed between the level of neurological status expressed by the NIHSS scale at admission and at discharge.

At admission, the most commonly diagnosed stroke was moderately severe — 67 patients (74.4%), while at discharge, the patients' condition significantly improved, leading to the classification of the stroke as mild — 56 patients (62.2%). The percentage of patients with severe stroke at admission accounted for nearly one-fourth (24.4%) of the participants, which was significantly higher (p=0.001) than the percentage of patients with such a degree of stroke at discharge, which was 6.7% — 6 patients.

The Barthel Scale, which assesses the independence of patients in daily activities, allows the determination of the patient's independence — the more points obtained, the better the level of patient independence. Upon admission to the hospital, the mean score on the Barthel scale was 14.3 points, indicating a completely dependent patient, while at discharge, the mean score was 59.4 points — indicating a partially dependent patient who needed assistance with some activities of daily living (Table 1). Due to the lack of normal distribution of the differences in measurements before and after treatment, the significance of differences was verified using the

non-parametric Wilcoxon signed-rank test. A statistically significant difference (p=0.000) was observed in the total independence in activities of daily living according to the Barthel scale at admission and at discharge.

The percentage of independent patients in performing activities of daily living upon admission (42.2%) was significantly lower (p=0.000) than the percentage of individuals with such independence at discharge, accounting for 81.1% of the participants. The number of individuals who were dependent, requiring care throughout the day for all activities of daily living upon admission, constituted over half (54.4%) of the participants and was significantly higher (p=0.000) than the percentage of individuals with such dependence at discharge (12.2%). The above data indicate that over 80% of admitted patients regained independence or required minimal assistance, such as supervision by another person when climbing stairs, after thrombolytic treatment. However, less than 20% of patients remained completely or partially dependent on the care of another person at discharge (Table 2).

Table 2. Detailed descriptive statistics of the Barthel scale upon admission and on the day of discharge (N=90)

Descriptive statistics	M	Me	SD
1	2	3	6
Eating			
Admission	1.9	0.0	2.4
Discharge	7.1	10.0	3.7
Mobility			
Admission	2.0	0.0	2.8
Discharge	9.6	10.0	5.9
Personal hygiene maintenance			
Admission	0.0	0.0	0.0
Discharge	1.9	5.0	2.6
Toileting			
Admission	1.1	0.0	2.1
Discharge	5.0	5.0	4.7
Bathing			
Admission	0.1	0.0	0.5
Discharge	2.3	0.0	2.8
Ambulation on flat surfaces			
Admission	0.1	0.0	1.1
Discharge	9.5	10.0	6.2
Stairs			
Admission	0.1	0.0	0.7
Discharge	5.3	5.0	4.4

Table 2. Continued

	1	2	3	6
Dressing and undressing				
Admission		1.4	0.0	2.3
Discharge		6.3	5.0	3.7
Bowel control				
Admission		4.0	0.0	4.9
Discharge		6.4	10.0	4.7
Bladder control				
Admission		3.7	0.0	4.7
Discharge		6.3	10.0	4.7

M — mean; Me — median; SD — standard deviation

Next, we analyzed whether the degree of disability expressed by the Rankin scale and the severity of stroke according to the NIHSS scale influenced the independence in performing activities of daily living assessed by the Barthel scale. A statistically significant and very high negative correlation (R=−0.835; p=0.000) was observed between the degree of disability expressed by the Rankin scale and the performance of activities of daily living assessed by the Barthel scale upon admission. A higher level of one variable significantly correlated with a decrease in the level of the other variable. This means that the higher the number of points obtained on the Rankin scale, the fewer points we would achieve on the Barthel scale. The degree of disability according to the Rankin scale directly affects the level of performance of activities of daily living (the higher the degree of disability, the poorer the functional capacity expressed by the Barthel scale) (Table 3).

A statistically significant and high negative correlation (R=−0.591; p=0.000) was also observed between the severity of stroke expressed by the NIHSS scale and the performance of activities of daily living assessed by the Barthel scale upon admission. A higher level of one variable significantly correlated with a decrease in the level of the other variable. This means that the higher the number of points obtained on the NIHSS scale, the fewer points we would achieve on the Barthel scale. The type of stroke determined according to the NIHSS scale directly affects the level of performance of activities of daily living (the more severe the stroke, the poorer the functional capacity expressed by the Barthel scale) (Table 3).

Between the degree of disability expressed by the Rankin scale and the performance of activities of daily living assessed by the Barthel scale at discharge, a statistically significant and very high negative correlation was also observed (R=−0.881; p=0.000). A higher level of one variable significantly correlated with a decrease in the level of the other variable. This means that the

lower the number of points obtained on the Rankin scale, the more points we would achieve on the Barthel scale. The degree of disability according to the Rankin scale directly affects the level of performance of activities of daily living (the lower the degree of disability, the better the functional capacity expressed by the Barthel scale) (Table 3).

Table 3. Spearman's rank correlation of the influence of disability level and stroke severity on performing activities of daily living on admission and at discharge (N=90)

Spearman's rank correlation	r_S	p
Amission		
Rankina scale — Barthel scale	−0.835	0.000
NIHSS scale — Barthel scale	−0.591	0.000
Discharge		
Rankina scale — Barthel scale	−0.881	0.000
NIHSS scale — Barthel scale	−0.847	0.000

r_S — Spearman's rank correlation coefficient; p — level of statistical significance

Regarding the severity of stroke expressed by the NIHSS scale and the performance of activities of daily living assessed by the Barthel scale at discharge, a statistically significant and very high negative correlation was also observed (R=−0.847; p=0.000). A higher level of one variable significantly correlated with a decrease in the level of the other variable. This means that the lower the number of points obtained on the NIHSS scale, the more points we would achieve on the Barthel scale. The type of stroke determined according to the NIHSS scale directly affects the level of performance of activities of daily living (the milder the stroke, the better the functional capacity expressed by the Barthel scale).

Another factor analyzed was the impact of the time elapsed from symptom onset to the start of treatment on the subsequent functioning of the patient. The average time from symptom onset to the start of thrombolytic treatment was 172.5 (±53.7) minutes.

Table 4. Spearman's rank correlation of the time from symptom onset to initiation of thrombolytic treatment (N=90)

Spearman's rank correlation	r_S	p
Time — Rankin Scale discharge	0.901	0.00
Time — NIHSS Scale discharge	0.857	0.00
Time — Barthel Scale discharge	−0.923	0.00

r_S — Spearman's rank correlation coefficient; p — level of statistical significance

In Table 4, the influence of the time elapsed from symptom onset to the start of treatment on the final results of the scales used in the study was compared.

A statistically significant positive correlation was observed between the time of starting thrombolytic treatment from symptom onset and the Rankin scale results at discharge (R=0.901; p=0.000), as well as a high negative correlation with the Barthel scale results at discharge (R=−0.923; p=0.000). Additionally, the time from symptom onset, when thrombolytic treatment was initiated, significantly and highly positively correlated with the NIHSS scale results at discharge (R=0.857; p=0.000). The timing of treatment initiation significantly affects the treatment outcomes expressed by the scales at discharge. This means that the earlier thrombolytic treatment is initiated, the better functional status outcomes will be achieved at discharge. This applies to both the severity of stroke, degree of disability, and ability to perform activities of daily living.

Discussion

According to the WHO, stroke is the second most common cause of death worldwide and the leading cause of disability among adults. In recent years, numerous studies have been conducted regarding the functional status of patients after a stroke. Unfortunately, scientific data on the functional capacity of patients undergoing thrombolytic treatment are not as extensive. The modified Rankin scale was used to assess the degree of disability. Upon admission to the ward, the average score was 4.3 points, indicating moderate to severe disability, while at discharge, the average score was 2.4 points, indicating mild disability. The differences primarily stem from the improvement in neurological status due to the treatment administered. However, it should be emphasized that each patient admitted to the neurology ward and eligible for thrombolytic treatment is treated as a person in immediate life-threatening condition and is placed under a bed rest regimen. Therefore, despite maintaining independence in basic hygiene and physiological activities, a significant number of patients required constant presence and assistance from nursing staff, and their functional capacity was assessed as moderate to moderately severe. After the first day of hospitalization and a follow-up computed tomography scan of the head, if the neurological status allowed, the patient could independently perform basic care activities, and their Rankin scale assessment improved. The average difference in the mRS scale was 1.9 points. In studies assessing the functional status of patients with ischemic stroke treated with thrombolysis by Hebel et al. [8], the modified Rankin scale [9–11] was also used. The study included 109 hospitalized patients with ischemic stroke eligible for thrombolytic treatment. The average score upon admission was 2.88 points, and at discharge, it was 2.05 points, also indicating an improvement in the patient's functional status. In the presented studies, on admission according to the NIHSS scale [12], the average score was 13.1 points, indicating a moderately severe stroke. At discharge, the average score was 6 points, also indicating a moderately severe stroke. However, in the presented studies, out of 90 admitted patients, 89 experienced a moderately severe or severe stroke, while at discharge, only 34 patients were classified as having these types of strokes. The remaining patients — 56 (62.2%) — left the ward with a score of 0–4 points on the NIHSS scale, indicating significant improvement in neurological status and a mild stroke. Comparing our own analysis with the work of Hebel et al. [8], where the average score upon qualification for thrombolytic treatment was 10.11 points, and on the last day of hospitalization, it was 5.81 points, an improvement in the neurological status of patients can also be observed. In 2015, a publication by Rosińczuk et al. [13] examined 91 patients diagnosed with ischemic stroke treated with thrombolysis and hospitalized at the Lower Silesian Specialist Hospital in Wrocław. The authors demonstrated a significant improvement in the assessed functional status according to the NIHSS scale by performing a double measurement of neurological status — before and 24 hours after fibrinolytic therapy. Additionally, in the Polish publication by Wawrzyńczyk et al. [14], the assessment of functional status according to the National Institute of Health Stroke Scale improved, with an improvement of at least 4 points on the NIHSS scale observed after 24 hours of treatment. Independence in activities of daily living was assessed based on the Barthel scale. Upon admission to the hospital, the average score was 14.3 points (completely dependent patient), while at discharge, the average score was 59.5 points (patient partially requiring assistance with some activities of daily living).

According to the authors' research, upon admission, patients experienced the greatest difficulty in mobility, such as moving on flat surfaces, climbing stairs, and maintaining personal hygiene. At the time of discharge, the deficit in functionality most commonly involved washing and bathing the whole body, as well as maintaining personal hygiene. In the final examination, patients achieved the highest level of independence in moving on flat surfaces, transferring from bed to chair, and eating meals. Similar conclusions were drawn by Grochulska and Jastrzębska [7] in their publication. The study involved 75 respondents. In the Barthel scale, the average score upon admission was 18.12 points, and at discharge, it was 59.25 points, allowing the patient's condition to be assessed as moderately severe. Respondents regained functionality most quickly in eating meals and mobility, while regaining independence in washing and bathing the whole body was the most challenging. In their study, Przychodzka et al. [15] examined 102 patients treated for ischemic stroke at the Neurology Clinic.

Using the Barthel scale for assessment, the average score at discharge was 46.19 points, indicating a moderately severe condition regarding activities of daily living. Patients demonstrated the greatest dependence regarding washing and bathing the whole body and moving on flat surfaces. They most easily regained independence in eating meals and controlling urination and defecation. In our own studies, the average time from symptom onset to the initiation of thrombolytic treatment was 172.5 minutes (the treatment started earliest at 65 minutes and latest at 265 minutes). A similar average time (182 minutes) was obtained in studies conducted in Słupsk by Hebel et al. [8], while a better average time (130 minutes) was achieved in the published studies by Wawrzyńczyk et al. [14]. The differences likely stemmed from the locations of the centers and the organization of work in the departments.

Conclusions

1. The implementation of thrombolytic treatment improved the functional status of patients after ischemic stroke.
2. Both the degree of disability and the type of stroke influenced the patient's independence in performing activities of daily living.
3. Patients achieved the highest level of independence in walking on flat terrain, transferring from bed to chair and back, and eating meals, while the lowest level concerned washing and bathing the whole body and maintaining personal hygiene.
4. The earlier the initiation of thrombolytic treatment, the better the results in assessing the functional status achieved at the time of discharge.

Implications for Nursing Practice

The conducted research is significant because it demonstrates the effectiveness of intravenous thrombolytic treatment and contributes to a deeper understanding of the risk factors associated with its use. Undoubtedly, attention must be paid to the need for adhering to principles during the implementation of treatment, and it must be remembered that time plays a crucial role in the health and life of the patient. Every medical professional who comes into contact with a patient eligible for thrombolytic treatment must strive to perform their tasks as efficiently as possible to avoid delays in the procedure and initiate fibrinolytic therapy as quickly as possible. The results of our own research can be used to prepare and conduct training aimed at improving the quality of care for neurological patients, especially those affected by ischemic stroke potentially treated with alteplase. Personnel should be made aware that efficient organization of work, and consequently faster initiation of thrombolytic therapy, significantly contributes to better treatment outcomes by markedly improving the patient's functional status, enabling a faster recovery, reducing subsequent patient disability, and promoting greater independence in activities of daily living.

References

[1] Postępowanie w ostrej fazie udaru mózgu. W: Członkowska A., Niewada M. (Red.), Wytyczne postępowania w udarze mózgu. *Pol Przegl Neurol.* 2019;15(Supl. A):A29–A92.

[2] Kruk M., Pawlewicz A. *NFZ o zdrowiu. Udar niedokrwienny mózgu.* NFZ, Warszawa 2022, https://ezdrowie.gov.pl/portal/home/badania-i-dane/zdrowe-dane/raporty/nfz-o-zdrowiu-udar-niedokrwienny-mozgu [dostęp: 31.01.2023].

[3] Grabowska-Fudala B., Jaracz K. Obciążenie osób sprawujących opiekę nad chorymi po przebytym udarze mózgu. *Udar Mózgu.* 2006;8(1):42–47.

[4] Filipska K., Skrzypek-Czerko M., Cwiekala-Lewis K., Ślusarz R. Clinimetric Evaluation of Functional Capacity and Quality of Life of Stroke Patients — Study Review. *J Neurol Neurosurg Nurs.* 2019;8(2):86–90.

[5] Smelkowska A., Pniewska J., Grabowska-Fudala B., Jaracz K. Rola pielęgniarki w leczeniu trombolitycznym w udarze niedokrwiennym mózgu — opis przypadku. *Pielęg Chir Angiol.* 2012;2:78–82.

[6] Zych J., Korzekwa P. Involvement of the Nurse in the Treatment of Ischemic Stroke — Knowledge of Nurses from the Stroke Unit. *J Neurol Neurosurg Nurs.* 2017;6(4):150–156.

[7] Grochulska A., Jastrzębska M. Poprawa stanu funkcjonalnego osób po przebytym udarze mózgu — rola pielęgniarki. *Probl Pieleg.* 2012;20(3):300–309.

[8] Hebel K., Kowiański P., Rogoza K. Assessment of the Functional Status of Patients with Ischaemic Stroke Receiving Thrombolytic Treatment. *J Neurol Neurosurg Nurs.* 2020;9(1):12–19.

[9] Rankin J. Cerebral vascular accidents in patients over the age of 60. II. Prognosis. *Scott Med J.* 1957;2(5):200–215.

[10] Książkiewicz B., Nowaczewska M., Wicherska B. i wsp. Kliniczne monitorowanie udaru mózgu. *Udar Mózgu.* 2007;9(2):89–96.

[11] Bamford J.M., Sandercock P.A., Warlow C.P., Slattery J. Interobserver agreement for the assessment of handicap in stroke patients. *Stroke.* 1989;20(6):828.

[12] Meyer B.C., Hemmen T.M., Jackson C.M., Lyden P.D. Modified National Institutes of Health Stroke Scale for use in stroke clinical trials: prospective reliability and validity. *Stroke.* 2002;33(5):1261–1266.

[13] Rosińczuk J., Bonk K., Kołtuniuk A. Analysis of thrombolytic therapy in ischemic stroke treatment. *Ann Acad Med Siles.* 2015;69:125–131.

[14] Wawrzyńczyk M., Pierzchała K., Łabuz-Roszak B. Tromboliza w udarze niedokrwiennym mózgu — 8 lat doświadczeń. *Ann Acad Med Siles*. 2012;66(6):37–44.

[15] Przychodzka E., Grudzień A., Celej-Szuster J., Turowski K. Ocena wydolności funkcjonalnej chorych po udarze mózgu. *Gerontol Pol*. 2019;27(4):272–279.

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