Journal of Pioneering Medical Sciences
Received: July 03, 2025 | Accepted: October 18, 2025 | Published: January 05, 2026
Volume 14, Issue 12, Pages 79-85

DOI https://doi.org/10.47310/jpms2025141212

Impact of Thrombolytic Therapy on Stroke Severity, Complications, Disability and Quality of Life in Ischemic Stroke Patients

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Abstract **Objectives: Background:** Ischemic stroke is a major public health burden globally and in Iraq, often leading to long-term disability and poor quality of life. Thrombolytic therapy with recombinant tissue Plasminogen Activator (rtPA) has been shown to improve acute and long-term outcomes in eligible patients, yet its real-world impact remains underexplored in low-resource settings such as the Kurdistan Region. **Objective:** To evaluate the impact of thrombolytic therapy on stroke severity, in-hospital complications, functional disability and Quality of Life (QoL) in ischemic stroke patients compared to those receiving usual care. **Methods:** A comparative cross-sectional study was conducted among 60 ischemic stroke patients admitted to Shar Hospital in Sulaymaniyah. Thirty patients received intravenous thrombolysis with rtPA within the recommended time window, while 30 matched patients were managed with usual care. Stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS) at admission, discharge and three months post-stroke. Disability was evaluated using the modified Rankin Scale (mRS) at admission and three months post-stroke and quality of life was assessed with the Stroke-Specific Quality of Life Scale (SS-QoL) at three months post-stroke. Complications were documented during hospitalization. **Results:** There was no significant difference in initial NIHSS scores between groups ($p = 0.938$), confirming baseline comparability. However, thrombolysis significantly reduced stroke severity at discharge ($p = 0.001$) and at three months ($p = 0.004$). A greater proportion of patients in the thrombolysis group achieved favorable functional outcomes (mRS ≤2) and reported good QoL (66.7%) compared to the control group (16.7%, $p = 0.001$). Additionally, thrombolysis was associated with fewer in-hospital complications ($p = 0.018$). The thrombolysis group also scored significantly higher across multiple QoL domains, including mobility, self-care, mood and upper extremity function. **Conclusion:** Thrombolytic therapy significantly improves neurological recovery, functional independence and quality of life in ischemic stroke patients, while reducing complication rates. These findings highlight the urgent need to expand thrombolytic stroke care services in Iraq, particularly in underserved regions. Implementation of time-sensitive stroke pathways and public awareness campaigns may enhance treatment access and outcomes.

Key Words Thrombolysis, Ischemic Stroke, Stroke Severity, Quality of Life, Modified Rankin Scale, NIHSS, Iraq, Stroke Complications

INTRODUCTION

Stroke, defined as a cerebrovascular accident, occurs due to inadequate blood flow to the brain, resulting in varying degrees of neurological impairment [1]. It is not a singular disease but rather a clinical syndrome with multiple etiologies, risk factors and pathophysiological mechanisms [2]. Stroke affects individuals of all ages, although its incidence increases significantly with age [3]. Symptoms depend on the brain region affected and may include unilateral weakness, speech difficulties, vision problems, imbalance and sudden, severe headache [4]. Ischemic stroke-caused by arterial obstruction-is the most prevalent type, while hemorrhagic stroke results from intracranial bleeding, often leading to increased intracranial pressure and rapid deterioration [5,6].

Globally, the stroke burden has escalated, with a 70% rise in incidence and 44% increase in mortality from 1990 to 2021. Low- and middle-income countries, including Iraq, account for over 87% of stroke-related deaths and DALYs [7]. In Iraq, incidence ranges from 196.2 to 218.3 per 100,000,

exacerbated by an underdeveloped stroke care infrastructure, delayed access and regional instability [8].

Stroke risk factors are categorized as modifiable, such as hypertension, smoking, diabetes, obesity and physical inactivity and non-modifiable, including age, gender, ethnicity and family history [9]. The cornerstone of acute ischemic stroke management is timely revascularization to minimize neuronal damage [10]. Thrombolytic therapy with intravenous tissue Plasminogen Activator (IV tPA), ideally administered within 4.5 hours of symptom onset, catalyzes the conversion of plasminogen to plasmin, effectively dissolving clots and restoring cerebral blood flow [11]. Its high fibrin specificity and reduced risk of systemic bleeding make it the gold standard for thrombolysis [12].

Thrombolytic therapy not only reduces infarct volume but also preserves neurological function and significantly improves post-stroke outcomes, including physical independence and health-related quality of life [13,14]. It has proven cost-effective by reducing long-term disability and the burden on healthcare systems [15]. However, real-world outcomes vary based on regional factors such as healthcare accessibility and emergency response capacity.

This study, the first of its kind in Sulaymaniyah, aims to evaluate the association of thrombolytic therapy with stroke severity, disability, acute complications and post-stroke quality of life among ischemic stroke patients. By providing region-specific data, the findings are expected to inform clinical practice, optimize stroke care protocols and support public health strategies aimed at reducing the burden of stroke in the Kurdistan Region.

METHODS

Study Design and Timeline

A quantitative, descriptive-analytic design was employed to evaluate the effect of thrombolytic therapy on stroke severity, acute complications, disability and quality of life in ischemic stroke patients. The study was conducted in Sulaymaniyah City at Shar Teaching Hospital, which houses the region's only specialized Stroke Unit. Following approval from the Scientific Committee in November 2024, a pilot study was conducted from December 1 to December 20, 2024. The main data collection period extended over five months, from December 20, 2024, to May 2025. Final analyses and reporting were completed by September 2025.

Ethical Considerations

Ethical approval was obtained from the Scientific Committee of the Adult Nursing Branch at the College of Nursing, University of Sulaimani (Approval ID No. 2/24 on Sep 2024-UoS). Permissions were also secured from the Sulaymaniyah Directorate of Health and Shar Teaching Hospital. The study complied with the Declaration of Helsinki. Prior to participation, written informed consent was obtained from all patients or their caregivers. Participation was voluntary and individuals were informed of their right to withdraw at any stage. The researchers respected both the privacy and confidentiality of study participants.

Sampling and Participants

A non-probability, purposive sampling technique was used to recruit 60 patients diagnosed with ischemic stroke during the study period. Patients were categorized into two groups: Thrombolytic group (n = 30): Patients eligible and treated with intravenous thrombolysis. Non-thrombolytic group (Usual care) (n = 30): Patients ineligible for thrombolysis based on standard criteria. Eligibility for thrombolytic therapy was determined using NIHSS.

Instruments for Data Collection

Data were collected using a structured questionnaire composed of four primary components:

- **Patient Characteristics:** Sociodemographic variables included age, gender, education level, occupation and place of residence. Clinical characteristics captured prior stroke history, Transient Ischemic Attacks (TIAs), comorbid conditions and acute complications such as aspiration pneumonia, urinary tract infection, dysphagia, falls, incontinence and pressure sores
- **National Institutes of Health Stroke Scale (NIHSS):** Used to assess stroke severity. The tool includes 11 items assessing consciousness, gaze, motor and sensory function, language and other neurological domains. Scores range from 0 (no symptoms) to 42 (very severe stroke), categorized as mild (1-4), moderate (5-14), moderate-to-severe (15-24) and very severe (25-42) [16,17]
- **Modified Rankin Scale (mRS):** Used to evaluate the degree of disability. Scores range from 0 (no symptoms) to 6 (death), with increasing levels indicating greater disability. The tool is widely applied in stroke outcome research and clinical trials [18]
- **Stroke-Specific Quality of Life Scale (SS-QoL):** A validated 49-item scale covering 12 domains, including mobility, communication, cognition, self-care, emotional state and social participation [19]

Data Collection Procedures

Data collection was conducted in three phases:

- **At Admission:** Stroke severity was assessed using NIHSS upon patient arrival. Sociodemographic and clinical information were extracted from medical records. The researcher explained the study and formal consent was obtained before administering the mRS
- **During Hospitalization and at Discharge:** Patients were assessed for stroke-related complications throughout their hospital stay. Stroke severity was reassessed at discharge using NIHSS
- **Follow-up at Three Months:** Patients were followed up using NIHSS and mRS to reassess stroke severity and disability, while SS-QoL measured their quality of life

RESULTS

This study involved 60 ischemic stroke patients equally divided into a case group (thrombolytic therapy) and a

control group (usual care), with analyses conducted to compare sociodemographic, clinical, functional and quality of life outcomes.

Sociodemographic Characteristics

The distribution of age, gender, education level and occupation was similar between the two groups. The mean age of patients was 62.43±12.93 years in the case group and 65.67±12.91 years in the control group, with no statistically significant difference (p = 0.336). Age stratification showed a slight tendency toward younger patients (39-59 years) receiving thrombolytic therapy; this trend was not statistically significant (p = 0.629). In terms of gender, 63.3% of the case group and 53.3% of the control group were male (p = 0.432). Educational status was similarly distributed, with a high proportion of illiterate participants in both groups (63.3%), reflecting regional literacy patterns, particularly among the elderly in Iraqi Kurdistan. Occupational categories, which included paid employees, self-employed, housewives and jobless/retired individuals, showed no significant differences between the groups (p = 0.620). A statistically significant difference was observed in residential area distribution (p = 0.035). The case group had a significantly higher proportion of urban dwellers (73.4%) compared to the control group (43.3%). This may be due to better access to stroke care facilities offering thrombolytic therapy in urban settings (Table 1).

Clinical Characteristics

No significant differences were found in baseline clinical features between groups. Prior transient ischemic attacks were reported by 16.7% of the case group and 23.3% of the control group (p = 0.748). Previous stroke attacks were present in 40.0% of case participants and 50.0% of controls (p = 0.604). Comorbid conditions such as hypertension, heart disease and diabetes mellitus were prevalent in both groups but did not differ significantly. Hypertension was noted in 53.3% of the case group versus 66.6% of the control group (p = 0.29). Heart disease affected 43.3% of the case group and 33.3% of controls (p = 0.42), while diabetes mellitus was recorded in 23.3% of the case group and 33.3% of the control group (p = 0.39). Overall, 76.7% of case group patients and 86.7% of controls had at least one comorbidity (p = 0.506). These findings suggest a similar baseline clinical risk profile across both groups (Table 2).

Stroke Severity Assessment

At admission, stroke severity scores were comparable between groups. The mean NIHSS score was 15.93±7.49 in the case group and 17.97±8.98 in the control group (p = 0.345). Distribution across severity categories (minor, moderate, moderate-to-severe and severe) was statistically nonsignificant (p = 0.793), indicating a balanced neurological status at baseline.

At discharge, significant improvements were observed in the thrombolysis group. The mean stroke severity score dropped to 4.71±5.05, markedly lower than the control group's 12.88±9.83 (p = 0.001). Fourteen percent of case group patients were symptom-free at discharge, while another 42.9% had only minor symptoms. In contrast, the control group had fewer patients with minimal or no symptoms and included 19.2% with persistent severe stroke.

At the three-month follow-up, the benefit of thrombolytic therapy was sustained. Nearly 80% of the case group reported no residual symptoms, compared to 43.5% in the control group (p = 0.024). The mean NIHSS score in the case group was significantly lower (0.83±1.93 vs. 4.09±4.58; p = 0.004), indicating a continued advantage in neurological recovery for patients receiving thrombolytic therapy (Table 3).

Table 1: Distribution of Sociodemographic Characteristics of Ischemic Stroke Patients in the Case and Control Groups

Variable	Category	Case (n = 30)	Control (n = 30)	Total (n = 60)	p-value
Age (Years)	39-59	13 (43.3)	10 (33.3)	23 (38.3)	0.629*
	60-79	14 (46.7)	15 (50.0)	29 (48.3)	
	≥80	3 (10.0)	5 (16.7)	8 (13.3)	
	Mean± SD	62.43±12.93	65.67±12.91		0.336**
Gender	Male	19 (63.3)	16 (53.3)	35 (58.3)	0.432*
	Female	11 (36.7)	14 (46.7)	25 (41.7)	
Education Level	Illiterate	19 (63.3)	19 (63.3)	38 (63.3)	0.582*
	No informal education	4 (13.3)	1 (3.3)	5 (8.3)	
	Primary school	3 (10.0)	6 (20.0)	9 (15.0)	
	Secondary school	2 (6.7)	3 (10.0)	5 (8.3)	
	Institute or college	2 (6.7)	1 (3.3)	3 (5.0)	
Residential Area	Urban	22 (73.4)	13 (43.3)	35 (58.3)	0.035*
	Rural	8 (26.7)	17 (56.7)	25 (41.7)	
Occupation	Paid employee	2 (6.7)	1 (3.3)	3 (5.0)	0.620*
	Self-employed	8 (26.7)	6 (20.0)	14 (23.3)	
	Housewife	6 (20.0)	4 (13.3)	10 (16.7)	
	Jobless/Retired	14 (46.7)	19 (63.3)	33 (60.0)	

Table 2: Distribution of Clinical Characteristics of Ischemic Stroke Patients in the Case and Control Groups

Variable	Case (n = 30) F (%)	Control (n = 30) F (%)	Total (n = 60)	Chi-square (df)	p-value
Transient Ischemic Attack	5 (16.7)	7 (23.3)	12 (20.0)	0.417 (1)	0.748
Previous Stroke Attack	12 (40.0)	15 (50.0)	27 (45.0)	0.606 (1)	0.604
Comorbidities	23 (76.7)	26 (86.7)	49 (81.7)	1.002 (1)	0.506
Hypertension	16 (53.3)	20 (66.6)	36 (60.0)	1.11	0.29
Heart Disease	13 (43.3)	10 (33.3)	23 (38.0)	0.63	0.42
Diabetes Mellitus	7 (23.3)	10 (33.3)	17 (28.0)	0.73	0.39

Disability Assessment

At admission, both groups had similarly high levels of functional impairment. In the case group, 76.7% were classified as having severe disability and 23.3% as moderately severe. The control group had 70.0% with severe and 30.0% with moderately severe disability. This distribution showed no statistically significant difference ($p = 0.771$), confirming comparable baseline disability levels.

However, at the 3-month follow-up, functional outcomes diverged significantly ($p = 0.006$). In the case group, 13.3% had no symptoms and 50% had only mild disability. None of the patients in this group remained in the moderately severe or severe categories. By contrast, the control group had a higher proportion of moderate (20.0%) and moderately severe (23.3%) disability. Although mortality was similar in both groups (20.0% in case vs. 23.3% in control), the overall functional recovery was substantially better in those treated with thrombolysis (Table 4).

Quality of Life Assessment

The distribution of Quality of Life (QoL) levels among participants in both the case (thrombolytic therapy) and control (usual care) groups at the follow-up assessment showed a statistically significant advantage for patients who received thrombolytic therapy. In the case group, 63.3% of patients reported good QoL, compared to only 30% in the control group. Conversely, 70% of the control group rated their QoL as poor, significantly higher than the 36.7% in the case group ($p<0.05$).

Table 3: Comparison of Stroke Severity at Admission, Discharge and Follow-up between Case and Control Groups

Grade	Case n (%)	Control n (%)	Mean Difference	95% CI	p-value
Stroke Severity at Admission					
Minor Stroke	0 (0.0)	1 (3.3)	-2.03	-6.31, 2.24	0.793*
Moderate Stroke	15 (50.0)	14 (46.7)			
Moderate to Severe Stroke	4 (13.3)	4 (13.3)			
Severe Stroke	11 (36.7)	11 (36.7)			
Mean±SD	15.93±7.49	17.97±8.98			0.345†
Stroke Severity at Discharge					
No stroke symptoms	4 (14.3)	2 (7.7)			0.021
Minor Stroke	12 (42.9)	4 (15.4)			
Moderate Stroke	9 (32.1)	8 (30.8)			
Moderate to Severe Stroke	3 (10.7)	7 (26.9)			
Severe Stroke	0 (0.0)	5 (19.2)			
Mean±SD	4.71±5.05	12.88±9.83	-8.17	-12.53, -3.81	0.001†
Stroke Severity at Follow-up					
No stroke symptoms	19 (79.2)	10 (43.5)			0.024*
Minor Stroke	3 (12.5)	3 (13.0)			
Moderate Stroke	2 (8.3)	9 (39.1)			
Moderate to Severe Stroke	0 (0.0)	1 (4.3)			
Mean±SD	0.83±1.93	4.09±4.58	-3.25	-5.37, -1.14	0.004†

Table 4: Comparison of Disability between Groups at Admission and Follow-Up

Category	Case N (%)	Control N (%)	p-value
Levels of Disability at Admission			
4: Moderately Severe Disability	7 (23.3)	9 (30.0)	0.771*
5: Severe Disability	23 (76.7)	21 (70.0)	
Levels of Disability at Follow-Up (after 3 months)			
0: No Symptoms at All	4 (13.3)	1 (3.3)	0.006**
1: No Significant Disability	15 (50.0)	6 (20.0)	
2: Slight Disability	3 (10.0)	2 (6.7)	
3: Moderate Disability	2 (6.7)	6 (20.0)	
4: Moderately Severe Disability	0 (0.0)	7 (23.3)	
5: Severe Disability	0 (0.0)	1 (3.3)	
6: Dead	6 (20.0)	7 (23.3)	

Table 5: Comparison of Overall Quality of Life and Its Domain Scores Between Ischemic Strokes Patients Receiving Thrombolytic Therapy and Those Receiving Usual Treatment

Domains	Case Mean±SD	Control Mean±SD	Mean Difference	95% CI	p-Value*
Energy (3-15)	10.50±5.76	6.67±4.84	3.83	[1.37, 6.58]	0.007
Family Roles (3-15)	10.40±5.78	7.30±4.96	3.10	[0.32, 5.88]	0.030
Work/Productivity (3-15)	10.03±5.69	5.77±4.52	4.27	[1.61, 6.92]	0.002
Vision (3-15)	8.63±4.87	7.33±5.01	1.30	[-1.25, 3.85]	0.312
Personality (3-15)	9.43±5.56	6.83±4.65	2.60	[-0.05, 5.25]	0.054
Thinking (3-15)	9.77±5.59	6.63±4.69	3.13	[0.47, 5.80]	0.022
Mood (5-25)	15.90±9.29	11.03±7.69	4.87	[0.46, 9.27]	0.031
Self-Care (5-25)	16.27±9.59	10.87±7.95	5.40	[0.85, 9.95]	0.021
Social Roles (5-25)	15.13±8.61	11.77±7.97	3.37	[-0.92, 7.65]	0.121
Language (5-25)	17.70±9.90	12.17±8.43	5.53	[0.78, 10.28]	0.023
Upper Extremity Function (5-25)	16.63±9.35	11.40±8.02	5.23	[0.73, 9.74]	0.023
Mobility (6-30)	20.87±11.49	13.07±10.04	7.80	[2.22, 13.38]	0.007
Overall Quality of Life (49-245)	161.27±89.61	110.83±76.42	50.43	[7.39, 93.47]	0.022

The overall QoL score was significantly higher in the thrombolysis group (161.27±89.61) than in the control group (110.83±76.42), with a mean difference of 50.43 points ($p = 0.022$). Significant improvements were observed in multiple QoL domains, including energy ($p = 0.007$), family roles ($p = 0.030$) and work/productivity ($p = 0.002$), suggesting better reintegration into daily activities. Cognitive and emotional domains such as thinking ($p = 0.022$), mood ($p = 0.031$) and self-care ($p = 0.021$) also showed marked improvement in the case group. Physical domains like language ($p = 0.023$), upper extremity function ($p = 0.023$) and mobility ($p = 0.007$) reflected better physical rehabilitation among patients who underwent thrombolysis. While some domains-vision, personality and social roles-did not reach statistical significance, the mean scores remained higher in the case group, indicating a general trend toward better outcomes across all dimensions of recovery (Table 5).

DISCUSSION

This study assessed the impact of thrombolytic therapy on stroke severity, functional disability, acute complications and quality of life (QoL) among ischemic stroke patients in Iraqi Kurdistan, comparing outcomes between patients treated with thrombolysis and those who received usual care. The findings demonstrated that thrombolytic therapy significantly improved neurological recovery, reduced disability and enhanced QoL outcomes at three months post-stroke.

Despite no statistically significant differences in baseline sociodemographic or clinical parameters between the groups, a higher proportion of patients in the thrombolysis group resided in urban areas ($p = 0.035$), reflecting persistent inequities in access to acute stroke care between urban and rural regions. Delayed hospital arrival and lack of stroke-ready infrastructure in rural settings have been associated with suboptimal Door-To-Needle (DTN) times, impeding timely intervention [20]. Educational attainment and employment status were similar between groups, with high rates of illiteracy and unemployment, particularly among older patients-a pattern consistent with broader Eastern cultural contexts [21]. Stroke in younger adults is increasingly linked to lifestyle and behavioral risk factors, including substance use, oral contraceptives and sedentary behavior [22]. Both sexes exhibit a stronger correlation with the risk of any stroke or its subtypes in women than in males. Notwithstanding this, the prevalence of stroke continues to be elevated in men [23]. High comorbidity rates in both groups, especially hypertension, cardiovascular disease and diabetes, align with the global profile of ischemic stroke risk factors. Hypertension alone accounts for up to 60% of ischemic stroke risk worldwide [24].

Stroke severity, measured by the NIHSS, declined significantly more in the thrombolysis group at discharge ($p = 0.001$) and at the three-month follow-up ($p = 0.004$), despite similar admission scores. Notably, 79.2% of thrombolysis-treated patients had no residual stroke symptoms at follow-up, compared to 43.5% in the control group. These findings are consistent with prior studies showing that intravenous thrombolysis within the 4.5-hour window leads to significantly better short-term and long-term neurological recovery [25,26].

Functional outcomes, evaluated using the modified Rankin Scale (mRS), also favored the thrombolysis group. At three months, 50% of the case group had no substantial disability (mRS 1), with 13.3% achieving complete recovery (mRS 0). This contrasts sharply with the control group, where moderate to severe disability remained prevalent. These outcomes are in line with previous evidence highlighting the efficacy of rtPA in improving post-stroke functional status [27].

Regarding QoL, thrombolysis was associated with significantly higher SS-QoL scores (mean = 161.27) compared to controls (mean = 110.83), underscoring substantial gains in health-related quality of life. Approximately two-thirds of the thrombolysis group reported good QoL at follow-up, versus less than one-third in the control group, while poor QoL was reported by 70% of the control group [28].

Among QoL domains, mobility exhibited the greatest improvement (mean difference = 7.80, $p = 0.007$), followed by work/productivity, language, upper extremity function and self-care-all essential components for independent living. These results reflect the broad rehabilitative advantages of thrombolytic therapy, encompassing both gross and fine motor function as well as communication [29]. Enhanced emotional and cognitive function (mood, thinking and family roles) in the thrombolysis group further emphasizes the psychological and social recovery associated with early reperfusion.

Cultural factors may modulate these outcomes. In collectivist societies such as Iraqi Kurdistan, recovery in domains related to family roles, communication and self-care may be particularly valued and thus the benefits of thrombolytic therapy extend beyond biomedical improvement to include social reintegration. Although domains such as vision, personality and social roles did not reach statistical significance, the overall trend favored the thrombolysis group.

CONCLUSION

This study provides robust evidence supporting the effectiveness of thrombolytic therapy in improving stroke severity, functional disability and multiple domains of quality of life among ischemic stroke patients in Iraqi Kurdistan. Thrombolysis led to significantly better neurological and functional outcomes at discharge and three months post-stroke, with marked benefits in mobility, cognitive function and emotional well-being. The most important conclusion is that thrombolytic therapy not only improves clinical recovery but also enables more meaningful reintegration into daily, social and occupational life-a particularly critical consideration in the sociocultural context of Eastern societies. However, the urban-rural disparity in access to this life-saving intervention necessitates urgent health system reforms and targeted policy efforts to ensure equitable stroke care delivery across all regions of Iraq.

Acknowledgement

We would like to express our sincere gratitude to all the patients who participated in this study and to the staff of Shar Teaching Hospital for their valuable assistance in facilitating data collection.

Authors' Contributions

Both authors contributed equally to the conception, design, data collection, analysis and interpretation of the study. They jointly drafted and critically revised the manuscript. Both authors have read and approved the final version and agree to be accountable for all aspects of the work.

Funding

No funds, grants, or other support were received in relation to this paper.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data supporting the findings can be made available upon reasonable request.

Ethical Statement

Ethical approval to report this case was obtained from the University of Sulaimani, Sulaymaniyah, Iraq (Approval ID No. 2/24 on Sep 2024-UoS).

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