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Original Research Article

Functional Outcomes in Patients with Acute Ischemic Stroke Undergoing Different Treatment Modalities, Using NIHSS and mRS Scores

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Abstract

Background: Stroke, a major health concern in India, demands multidisciplinary management due to its high morbidity and mortality. Ischemic strokes, constituting 85%, require timely intervention to salvage the penumbra and minimize cerebral damage. Recent research supports intravenous rtPA administration within 4.5 hours. Endovascular interventions target large vessel strokes, expanding treatment eligibility. Rapid diagnostic tools like NIHSS and mRS aid severity assessment. This study seeks to compare functional outcomes in acute ischemic stroke patients undergoing various treatments based on NIHSS and mRS scores, contributing to the optimization of stroke care.

Methods: This prospective observational study, conducted at FMRI, Gurgaon, between June 2019 and August 2020, enrolled 150 diagnosed acute ischemic stroke patients. Inclusion criteria involved eligibility for IV rtPA, IV rtPA failure requiring bridging therapy, and recommendations based on DAWN TRIAL criteria. Data, including NIHSS and mRS scores, were collected, and patients received various interventions. Investigation results informed diagnostic tools, and statistical analysis utilized SPSS version 17.0. Categorical variables were expressed as numbers and percentages, assessed using the chi-square test, with $p<0.05$ signifying significance.

Results: In our study, the mean age of participants was determined to be 59.77 years.Regarding gender, the study cohort comprised 71.33% males and 28.67% females.Among the clinical features, weakness was the most prevalent, reported by 48.00% of participants. The majority of individuals underwent medical management, constituting 41.33% of the cohort.area-specific features such as involvement of the thalamus (8.00%), basal ganglia (4.67%), and corona radiata (14.67%). In our study, 14.00% underwent Intra venous thrombolysis plus mechanical thrombectomy, 28.57% showed improvement in NIHSS score of 8 or more, and 23.81% of participants showed good MRS outcome.

Conclusion: Notable improvements in NIHSS scores and favourable Modified Rankin Scale outcomes associated with medical management suggest its effectiveness in certain scenarios.

Keywords: Ischemic Stroke, Thalamus, weakness, NIHSS score, mRS score.

Introduction

Stroke is a leading cause of death and disability in India. Developing countries, like India, face a double burden of both communicable and non-communicable diseases [1,2,3].

Approximately 85% of strokes are ischemic, arising from arterial thrombotic or thromboembolic occlusions [4].

Stroke is a complex disorder requiring multidisciplinary management. Clinicians involved in emergency care, neurology, interventional radiology, neurointensive critical care, rehabilitation medicine, and possibly neurosurgery and cardiology must be aware of the patient from the initiation of therapy [4]. In ischemic stroke, an area of hypoperfused tissue with patent collateral vessels, known as the penumbra, remains salvageable, while a core area of tissue dies due to under perfusion. Timely revascularization can save the penumbra [5,6]. Recent studies show that intravenous administration of rtPA can be done up to 4.5 hours in selected patients [5,6,7].

The goal of acute ischemic stroke intervention is to minimize cerebral damage and reduce mortality by restoring blood flow to ischemic brain tissue through urgent recanalization before irreversible infarction occurs [7].

Endovascular stroke intervention aims to treat large vessel stroke, expanding the proportion of the acute ischemic stroke population eligible for treatment. Time is a crucial factor, emphasizing the need for complete and fast recanalization [8]. Emergency physicians and neurologists have developed rapid diagnostic and risk assessment systems to document the severity of a stroke. Popular systems

include the National Institute of Health Stroke Scale (NIHSS) and Modified Rankin Score (mRS) [9,10].

The NIHSS, focusing on cortical function, tends to give higher baseline scores for patients with cortical strokes. It has been found to be an excellent predictor of patient outcomes, with a baseline score greater than 16 indicating a strong probability of patient death. However, its correlation with functional recovery weakens when strokes are isolated to the cortex [9].

The mRS is a widely used scale for measuring disability or dependence in daily activities for people who have suffered a stroke [10]. This study aims to compare functional outcomes in patients with acute ischemic stroke undergoing different treatment modalities, using NIHSS and mRS scores.

Materials and Methods

Study Design and Area

This was a prospective observational study was conducted between June 2019 to august 2020at the Department of Neurology, FMRI, Gurgaon. FMRI is a tertiary care and teaching institute in a metropolitan city.

Study Participants

The study included diagnosed patients of acute ischemic stroke in the Emergency Medical Services (EMS), Intensive Care Unit (ICU), Ward, and Casualty at the Department of Emergency and Trauma, FMRI, Gurgaon.Subjects eligible for inclusion in this prospective observational study met the following criteria: 1) eligibility for intravenous recombinant tissue plasminogen activator (IV rtPA) within the designated window period; 2) failure of IV rtPA, necessitating mechanical thrombectomy under bridging therapy; 3) presentation beyond 6 hours, with subsequent medical management as per the hospital protocol; 4) recommendation for thrombectomy based on the DAWN TRIAL criteria, specifically for patients undergoing thrombectomy plus medical management when treatment is initiated within 6-24 hours after the last seen well; 5) age greater than or equal to 18; 6) baseline National Institute of Health Stroke Scale (NIHSS) score greater than or equal to 1; 7) absence of significant pre-stroke disability (pre-stroke modified Rankin Score must be 0 or 1); and 8) willingness and ability of the subject to return for protocol-required follow-up visits.Exclusion criteria for this study were as follows: 1) absence of informed consent for participation; 2) presence of coagulopathy in the patient; 3) diagnosis of intracranial hemorrhage in the patient; and 4) current participation in any other study. A total of 384 subjects displaying obvious signs of ischemic stroke (such as facial droop, arm drift, abnormal speech) to more subtle indications (including generalized weakness, lightheadedness, vague sensory changes, and altered mental status) were screened. 150 met the inclusion and exclusion criteria and were then enrolled in the study.

Data Collection

A pretested semiquantitative semistructured interview schedule/study Performa was utilized. The patients underwent interviews and various clinical examinations, along with laboratory investigations. Following these examinations, patients received treatment through various available modalities, including: 1. IV thrombolysis using recombinant tissue plasminogen activator (rtPA); 2. Endovascular treatment involving intra-arterial thrombolysis and mechanical clot extraction; 3. IV thrombolysis (rtPA) followed by endovascular treatment.; and 4. Non-thrombolytic medical management.All four intervention methods mentioned above are considered acceptable standards of care, recommended for early management of acute ischemic stroke by healthcare professionals from the Indian Stroke Association (ISA) [1].

Investigation results from NCCT HEAD and MR BRAIN STROKE PROTOCOL were collected. Using this information, NIHSS scores and mRS were calculated for each patient. It is important to note that the calculation of NIHSS and mRS scores serves as diagnostic tools, and this study is purely observational. There were no additional costs incurred by patients for their treatment.The NIHSS consists of a series of 11 items (Level of Consciousness (LOC), Best Gaze, Visual Field Testing, Facial Palsy, Motor Arm, Motor Leg, Limb Ataxia, Sensory, Best Language, Dysarthria, and Extinction/Inattention) that evaluate various aspects of neurological function. Each item is scored on a scale from 0 to a maximum severity level, with higher scores indicating more severe neurological impairment. The total possible score ranges from 0 to 42.The mRS is scored on a scale from 0 to 6, with 0 indicating no symptoms and 6 indicating death [10].The lower the score, the better the functional outcome, with scores of 0 or 1 indicating a Favourable outcome.

Statistical Analysis: The statistical analysis for the conducted study was executed using the SPSS program for Windows, version 17.0. Categorical variables were expressed as absolute numbers and percentages. Categorical variables were assessed using the chi-square test. Throughout all statistical tests, a p-value less than 0.05 was considered indicative of a significant difference.

Ethical Consideration: The conducted study adhered to rigorous ethical standards, commencing with the attainment of formal approval from the head of the institution and the Hospital Ethics and

Committee. Informed consent was diligently obtained from patients or their relatives through the distribution of a comprehensive Patient Information and Consent sheet, presented in both English and Hindi. To safeguard participant privacy, unique identification numbers were employed in lieu of patient names, with exclusive accessibility granted to the research team. Strident measures were implemented to prevent any information leakage, and all gathered data has been securely preserved for a period of 5 years, maintaining strict confidentiality and limited access solely to the research team. These ethical practices underscore the study's commitment to upholding the rights, well-being, and privacy of participants, ensuring the integrity and transparency of the research process.

Results

The distribution of age revealed a varied representation across different age groups, with the majority falling within the 61-70 years range (30.00%), followed by the 51-60 years group (21.33%).

Participants aged 41-50 years constituted 16.00% of the sample, while those aged 31-40 and 71-80 years accounted for 9.33% and 14.67%, respectively. A smaller proportion was observed in the age categories ≤30 years (2.00%) and ≥81 years (6.67%). In our study, the mean age of participants was determined to be 59.77 years. Regarding gender, the study cohort comprised 71.33% males and 28.67% females (Table 1).

Table 1: Age and sex distribution of study participants (N=150).

Variable	Number	%
Age in Years		
≤30	3	2.00
31 – 40	14	9.33
41-50	24	16.00
51 – 60	32	21.33
61 -70	45	30.00
71-80	22	14.67
≥81	10	6.67
Sex		
Male	107	71.33
Female	43	28.67

Among the clinical features, weakness was the most prevalent, reported by 48.00% of participants, followed by slurring speech (28.00%), and paralysis (14.00%). Aphasia was noted in 20.00% of cases, while deviation of the mouth and facial droop were observed in 12.67% and 6.67% of participants, respectively. Nausea/vomiting and headache were reported by 14.00% and 11.33%, respectively. Less frequently reported symptoms included vertigo (4.67%), gait ataxia (2.67%), blurring of vision (8.67%), and area-specific features such as involvement of the thalamus (8.00%), basal ganglia (4.67%), and corona radiata (14.67%)(Table 2).

Table 2: Clinical feature and involvement of brain area in study participants (N=150).

Variables	Number	%
Clinical Feature		
Weakness	72	48.00
Slurring speech	42	28.00
Paralysis	21	14.00
Aphasia	30	20.00
Deviation of mouth	19	12.67
Facial droop	10	6.67
Nausea/vomiting	21	14.00
Vertigo	7	4.67
Gait ataxia	4	2.67
Blurring of vision	13	8.67
Headache	17	11.33
Area of brain involved		
Thalamus	12	8.00
Basal ganglia	7	4.67
FP region	5	3.33
FT	4	2.67
Midbrain	4	2.67
Temporal	5	3.33
Occipital	9	6.00

Int. Capsule	12	8.00
PCA	2	1.33
Putamen	1	0.67
MCA	7	4.67
Corona radiate	22	14.67
Pons/brainstem	3	2.00

The majority of individuals underwent medical management, constituting 41.33% of the cohort. Intra Venous Recombinant Thrombolysis was administered to 27.33% of participants, while 17.33% underwent Mechanical Thrombectomy. A notable proportion, accounting for 14.00%, received Intra Venous Thrombolysis in combination with mechanical thrombectomy (Table 3).

Table 3: Therapy used for the treatment in study participants (N=150)

Therapy	Number	Percentage
Intra Venous Recombinant Thrombolysis	41	27.33
Intra venous thrombolysis plus mechanical thrombectomy	21	14.00
Mechanical Thrombectomy	26	17.33
Medical Management	62	41.33

Our study reports a median National Institutes of Health Stroke Scale (NIHSS) score of 10 for its participants. For the improvement in NIHSS score of 8 or more, the results indicate that 31.70% of individuals who underwent Intra Venous Recombinant Thrombolysis showed improvement, while 68.30% did not (P = 0.057). In the case of Intra Venous Thrombolysis plus Mechanical Thrombectomy, 28.57% demonstrated improvement, with 71.43% showing no improvement (P = 0.383). Similarly, for Mechanical Thrombectomy, 23.08% showed improvement, and 76.92% did not (P = 0.811). Notably, Medical Management exhibited a statistically significant difference, with 11.29% showing improvement and 88.71% showing no improvement (P = 0.012). In terms of a good MRS outcome, the percentages for improvement and no improvement were as follows: Intra Venous Recombinant Thrombolysis (24.39% vs. 75.61%, P = 0.575), Intra Venous Thrombolysis plus Mechanical Thrombectomy (23.81% vs. 76.19%, P = 0.765), Mechanical Thrombectomy (15.39% vs. 84.61%, P = 0.415), and Medical Management (11.29% vs. 88.71%, P = 0.012) (Table 4).

Table 4: Therapy wise improvement in NIHSS and MRS scores among study participants (N=150)

Therapy	YES Number (%)	NO Number (%)	P value
Improvement in NIHSS score of 8 or more			
Intra Venous Recombinant Thrombolysis	13(31.70)	28(68.30)	0.057
Intra venous thrombolysis plus mechanical thrombectomy	6(28.57)	15(71.43)	0.383
Mechanical Thrombectomy	6(23.08)	20(76.92)	0.811
Medical Management	7(11.29)	55(88.71)	0.012
Total	32(21.33)	118(78.67)	-
Good MRS outcome			
Intra Venous Recombinant Thrombolysis	10(24.39)	31(75.61)	0.575
Intra venous thrombolysis plus mechanical thrombectomy	5(23.81)	16(76.19)	0.765
Mechanical Thrombectomy	4(15.39)	22(84.61)	0.415
Medical Management	7(11.29)	55(88.71)	0.012
Total	32(21.33)	118(78.67)	-

Discussion

Regarding gender, the study cohort comprised 71.33% males and 28.67% females. In the study conducted by Huded V et al., a gender distribution of 32 (71.11%) male patients and 13 (28.89%) female patients was reported. Notably, the male-to-female ratio was calculated at 2.46:1. It is worth highlighting that this ratio was comparable to the gender distribution in our study [11].Furthermore, the study cohort predominantly comprises males, reflecting a gender-based disparity, with males constituting 71.33% of the participants.

The demographic profile of our study population reveals a diverse representation across different age groups, with the majority falling within the 61-70 years range, indicating that the elderly population is more susceptible to acute ischemic stroke. This observation aligns with existing literature, emphasizing the increased incidence of stroke with advancing age. In our study, the mean age of participants was determined to be 59.77 years. The

delZoppo et al., study reported a mean age of 66.5 years, while the Smith et al., study indicated a mean age of 67 years. In the Smith et al., study, participants had an average age of 68.1 years. The Saver et al., study documented a mean age of 67.1 years, and the Jansen et al., study reported a mean age of 65 years [12,13,14,15,16].

In our study, Intra Venous Recombinant Thrombolysis was administered to 27.33% of participants, and for the improvement in NIHSS score of 8 or more, 31.70% of individuals who underwent Intra Venous Recombinant Thrombolysis showed improvement; and 24.39% of participants showed good MRS outcome. A meta-analysis by Sandercook et al., incorporating data from 12 intravenous recombinant tissue plasminogen activator (IV rtPA) trials, involving a total of 7012 patients, affirmed the significant benefits of administering IV rtPA within 6 hours from symptom onset compared to placebo (odds ratio [OR] 1.17; 95% confidence interval [CI] 1.06-1.29; P=0.001). The analysis underscored the critical role of timely treatment, revealing the highest benefit in patients treated within the initial 3 hours from symptom onset (OR 1.53; 95% CI 1.26-1.86; P<0.0001) [17]. Similarly in a study by Cheng et al., initiating IV rtPA within 1.5 hours of symptom onset was associated with an OR of 2.81 (95% CI 1.75-4.50) for Favourable outcomes at 3 months compared to placebo. Furthermore, the OR for a positive outcome at 3 months diminished slightly with delayed initiation: 1.55 (95% CI 1.12-2.15) within 1.5 to 3 hours, and 1.40 (95% CI 1.05-1.85) within 3 to 4.5 hours [18]. These findings highlight the paramount importance of minimizing total ischemic time and promptly restoring blood flow to threatened, yet not infarcted, tissue.

In our study, 17.33% underwent Mechanical Thrombectomy, 23.08% showed improvement in NIHSS score of 8 or more, and 15.39% of participants showed good MRS outcome.In a meta-analysis by Badhiwala et al., encompassing eight trials with a total of 2423 patients, comparing endovascular thrombectomy to standard medical care with tissue plasminogen activator (tPA), significant benefits were observed. Endovascular therapy demonstrated a notable treatment advantage across modified Rankin scale (mRS) scores (OR 1.56; 95% CI 1.14–2.13; P=0.005). Achieving functional independence at 90 days (mRS score, 0-2) was notably higher in the endovascular therapy group (44.6%; 95% CI, 36.6%-52.8%) compared to the standard medical care group (31.8%; 95% CI, 24.6%-40.0%), with a risk difference of 12% (95% CI, 3.8%-20.3%; OR 1.71; 95% CI, 1.18-2.49; P=0.005) [19].The interim analysis of the Hughes et al., study revealed a substantial treatment benefit in favor of the thrombectomy group, with 48.6% of patients achieving a Favourable functional outcome (Modified Rankin Scale [MRS] 0–2 at 90 days) compared to 13.1% in the control group. This marked a treatment benefit of 35.5% (95% CI, 23.9–47.0). Notably, the thrombectomy group exhibited a significantly higher proportion of patients achieving a Favourable functional outcome in both the 6–12 hours and 12–24 hours groups, emphasizing the positive impact of thrombectomy across different time windows [20].In the study by Berkhemer et al., 146 patients (29%) presented with an additional extracranial internal carotid artery (ICA) occlusion, indicative of tandem pathology. The treatment effect favored thrombectomy, yielding an odds ratio (OR) of 1.43 (95% CI 0.78–2.64) [21]. In a comprehensive systematic review by Cohen et al., encompassing 32 studies and involving 1107 patients with intra and/or extracranial ICA occlusions, intra-arterial thrombolysis was compared with various mechanical treatment modalities and/or stent placement. Notably, acute stenting of extracranial ICA occlusions demonstrated superior outcomes, with a significantly higher recanalization rate (87% vs. 48%, p=0.001) and a markedly increased proportion of Favourable outcomes (68% vs. 15%, p<0.001) [22].

In our study, 14.00% underwent Intra venous thrombolysis plus mechanical thrombectomy, 28.57% showed improvement in NIHSS score of 8 or more, and 23.81% of participants showed good MRS outcome. The study by Zacharatos et al., enrolled patients aged 18-80 years with acute ischemic stroke and proximal cerebral artery occlusion. Participants were randomly assigned to receive either intravenous thrombolysis alone (IVT group) or intravenous thrombolysis plus mechanical thrombectomy (IVTMT group). Out of 414 patients, 208 were assigned to the IVT group, and 204 to the IVTMT group. At the 3-month follow-up, functional independence was achieved by 42% (85 out of 202) in the IVT group and 53% (106 out of 200) in the IVTMT group, resulting in an odds ratio of 1.55 (95% CI 1.05–2.30; p=0.028). There were no significant differences between the two groups in terms of mortality at 3 months (12% in the IVT group vs. 13% in the IVTMT group; p=0.70) or symptomatic intracranial hemorrhage at 24 hours [23].

In our study, 41.33% underwent Intra venous thrombolysis plus mechanical thrombectomy, 11.29% showed improvement in NIHSS score of 8 or more, and 11.29% of participants showed good MRS outcome. Similar findings were observed in the study by Kennedy et al., Adams et al., and Sacco et al., [24,25,26].

Our study reports a median National Institutes of Health Stroke Scale (NIHSS) score of 10 for its participants. The delZoppo et al., study

documented a higher median NIHSS score of 17, indicating potentially more severe neurological impairment in its participants. Similarly, the Smith et al., study reported a median NIHSS score of 20, suggesting a relatively higher level of stroke severity. The Smith et al.,study and the Saver et al., study both demonstrated median NIHSS scores of 19 and 17, respectively. In the Jansen et al., study, participants had a median NIHSS score of 18[12,13,14,15,16].

In the present study, 21.33% of participants achieved a favourable functional outcome, defined by a Modified Rankin Scale (MRS) score of 2 or lower. The delZoppo et al., study reported a percentage of 30.80%, while the Smith et al., study documented 27.70% of participants attaining an MRS score of 2 or lower. The Smith et al., study demonstrated a slightly higher percentage of 36.00% in this regard. Notably, the Saver et al., study reported a substantially higher percentage of 58.00%, indicating a higher proportion of participants with favourable functional outcomes. The Jansen et al., study, with 55.00%, also reported a notable percentage of participants achieving a Favourable MRS score[12,13,14,15,16].

Conclusion

In conclusion, our research sheds light on crucial aspects of acute ischemic stroke, offering insights into its demographic and clinical intricacies. The predominance of weakness as a prominent symptom, coupled with the variable involvement of specific brain regions, underscores the diverse nature of stroke presentations. The demographic emphasis on the elderly population highlights the need for tailored preventive measures. Therapeutically, our findings illuminate the prevalent use of medical management, with a discernible trend towards a multimodal approach. Notable improvements in NIHSS scores and favourable Modified Rankin Scale outcomes associated with medical management suggest its effectiveness in certain scenarios.

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