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Original Article

Comparison of Effectiveness and Complication Rate in Patients of Acute Ischemic Stroke Undergoing Early Vs Delayed Stent Retrieval Mechanical Thrombectomy

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ABSTRACT

Objective: To compare effectiveness and rate of complications in patients with acute ischemic stroke undergoing early (within 4.5 hours) vs delayed (4.5-12 hours) mechanical thrombectomy.
Study Design: Quasi-Experimental Study.
Place & Duration of Study: PEMH, Rawalpindi, Pakistan, from Jan to Sept 2025.
Methodology: 100 patients were selected from Neurology OPD / ER PEMH Rawalpindi who presented with Acute Ischemic Stroke. After written informed consent, they were divided into early (onset of CVA < 4.5 hours) or delayed (onset of CVA 4.5-12 hours) group. National Institute of Health Stroke Score (NIHSS) and modified Rankin Score (MRS) were calculated at this time, and basic bio data (age, gender, diabetes, hypertension, ischemic heart disease status, and previous CVA) were documented. Patients then underwent stent retrieval and mechanical thrombectomy and were prospectively observed for complications (Bleeding, Reperfusion Injury & stroke recurrence) and duration of hospital stay. NIHSS was calculated at discharge and MRS at discharge and at 03 months follow-up. All data were analyzed using SPSS Version 25.
Results: There was significant improvement in MRS at 03 months in the early vs. Delayed-Group (80% vs 43.3%) (*p*-value 0.0005), but not in NIHSS at discharge (*p*-value 0.615). Median (IQR) hospital stay was shorter in the early vs delayed group, 5 (3) days vs 6 (3) days, (*p*-value <0.001).
Conclusion: The early intervention group showed better MRS scores at 03 months and shorter hospital stay than the delayed group.

Keywords: Ischemic Stroke, Mechanical Thrombectomy, Modified Rankin Score, National Institute of Health Stroke Score.

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INTRODUCTION

Cerebrovascular accidents (CVAs) are the second leading cause of disability and morbidity worldwide, with an annual incidence of about 12 million new cases globally. Its incidence is highest in developing low socioeconomic countries.[1] Ischemic CVA has a much higher incidence than hemorrhagic CVA.[2] Small risk factors such as diabetes, hypertension, hyperlipidemia, smoking, obesity, and heart diseases like atrial fibrillation are major determinants of incidence in susceptible individuals.[3] CVA poses a massive burden on healthcare systems in terms of long-term costs of patient care and caregiver dependence.[4]

In Pakistan, the situation is also quite serious. Annual incidence is about 80 cases per 100,000 people, and overall prevalence is about 1.2% of the total population. This is higher than developed countries like the USA (78 per 100,000), the UK (56 per 100,000), and Australia (55 per 100,000).[5] The increase in morbidity and mortality is further aggravated by the lack of quality healthcare facilities for acute stroke management, including mechanical thrombectomy.[6] In this regard, Pakistan lags far behind the developed nations both in terms of mortality (133 per 100,000) as compared to global figures (80 per 100,000) as well as access to specialized Stroke Units (<2% vs >5%).[7]

Mechanical Thrombectomy (MT) has emerged as a revolutionary intervention in reversing the effects of Acute Stroke and limiting functional disability. It has become the standard of care in Acute Stroke Management in first-world countries.[8] Multiple landmark trials have established the efficacy of MT over conservative or medical management alone.[9] In Pakistan, however, MT is still considered a novel treatment due to the paucity of such facilities, leading to delayed presentation to these specialized stroke units. One study showed that only 16 out of 220 patients presenting to a tertiary care stroke unit were considered eligible for MT, whereas others had

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presented later than 5 hours. American Heart Association/ American Stroke Association guidelines recommend MT by stent retrieval device within 4.5 hours of symptom onset (1A), with possible benefit achieved as late as 12 hours after symptom onset.[10]

Our study is aimed at assessing the effectiveness or otherwise of delayed MT (within 4.5-12 hours) as compared to the standard of care (before 4.5 hours) in terms of improvement in symptoms and complication rate. If it is found to be effective and safe, delayed MT can be advocated for patients presenting late to tertiary care stroke units.

METHODOLOGY

This Quasi-experimental study was conducted in the Interventional Neurology Department, Pak Emirates Military Hospital, Rawalpindi, from Jan to Sept 2025. Sample size was calculated using the WHO sample size calculator, taking a confidence level of 95%, a margin of error of 5%, and a reported prevalence of ischemic stroke of 4.8%.[11] The estimated sample size came out to be 51 for each group. A total of 100 patients were included in the study. A consecutive, non-probability sampling technique was used in recruiting patients presenting with acute stroke to the emergency dept of PEMH Rawalpindi.

Inclusion Criteria: Both Male and Female patients presenting to PEMH ER / Neurology OPD and fulfilling the criteria for Mechanical thrombectomy (Early and delayed) were included in the study.

Exclusion Criteria: Patients unwilling to participate, those who were late for thrombectomy (presenting after 12 hours), and those not fulfilling the criteria for MT were excluded from the study.

Approval from the Hospital Ethical Committee was taken vide letter no. A/28/ERC/139/2025 dated 14/1/2025. After approval, patients were selected according to the sampling technique and Inclusion / Exclusion Criteria. Written informed consent was taken, and baseline levels of NIHSS and Modified Rankin Scale (mRS) were documented on a proforma along with personal data and previous co-morbidities. The patients were then assigned to either the Early-Group (presenting within 4.5 hours of symptom onset) or the Delayed-Group (presenting between 4.5 and 12 hours of symptom onset but meeting criteria for MT) according to their presentation. All patients underwent MT by stent retrieval technique without Intravenous Thrombolysis. After the procedure, all patients were observed for the incidence of complications, namely hemorrhage, reperfusion injury, or stroke recurrence, and duration of hospital stay. NIHSS score was calculated at discharge, and MRC score was calculated after 3 months of the procedure, and improvement or otherwise was documented Figure.

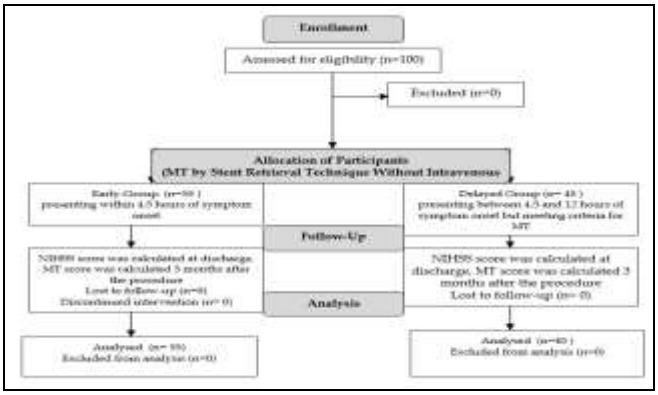

Figure: Patient Flow Diagram

Data was entered into Statistical Package for the Social Sciences (SPSS) version 25 for statistical analysis. Shapiro-Wilk test to check the normality of quantitative data, age and NIHSS were normally distributed, whereas duration of stay was not normally distributed. Normally distributed quantitative variables were presented as Mean±SD, and non-normal variables were presented as Median and IQR. The qualitative variables, like incidence of complications and improvement in MRS, were calculated in frequency and percentages. Chi-square test was applied to check the association of improvement in the MRC scale between the study groups. Independent samples t-test was done to compare means of normally distributed quantitative data, while the Mann-Whitney U test was done for non-normally distributed variables.

RESULTS

100 patients were included in the analysis, out of which 67(67%) were males and 33(33%) females. The mean age of all patients was 59.8±12.50 years. 55(45%) patients presented within the 4.5-hour window and were included in the EARLY intervention group. 45(45%) patients were presented after 4.5 hours but before 12 hours and were included in the Delayed group. Mean NIHSS at presentation in the Early-Group was 14.6±4.68, and at discharge was 10.05±4.25. Mean NIHSS at presentation in the Delayed-Group was 12.42±4.28 and at discharge was 9.77±4.26. (Table-I)

The primary objective was taken as improvement of NIHSS at discharge and improvement of functional status (calculated using Modified Rankin Scale) at 03 months post MT when compared between the early vs delayed group. Improvement in NIHSS at discharge was seen in 45 out of 55(81.8%) in the Early-Group and 35 out of 45(77.7%) in the delayed group; however, this was not statistically significant (*p*-value 0.615). Improvement in functional status / Modified Rankin Scale at 03 months was seen in 44 out of 55(80%) patients in the Early-Group and 21 out of 45(46.6%) patients in the delayed group. This was statistically significant (*p*-value 0.0005). Median (IQR) duration of stay in the Early-Group was 5(3) days in Early-Group as compared to 6(3) days in the delayed group. There was a statistically significant increase in duration of hospital stay in the Delayed-Group as compared to the Early-Group (*p*-value <0.001) (Table-II).

Table-I: Patient Characteristics in Both Early and Delayed Groups (n=100)

Parameter	EARLY-Group (<4.5 hours from symptom onset)	DELAYED-Group (4.5 – 12 hours of symptom onset)	Total
Sample size; n (%)	55 (55%)	45 (45%)	100
Mean Age±SD (years)	59.36±12.74	60.46±12.30	59.8±12.50
Male; n (%)	38(56.7%)	29 (43.3%)	67
Female; n (%)	17(51.5%)	16 (48.5%)	33
Diabetic; n (%)	27(57.4%)	20 (42.6%)	47
Hypertensive; n (%)	35(53.8%)	30 (46.2%)	65
Old CVA; n (%)	4(50%)	4 (50%)	8
Mean NIHSS±SD at presentation	14.60±4.68	12.42 ± 4.28	13.62±4.61
Mean NIHSS±SD at discharge	10.05±4.25	9.77±4.26	9.93±4.24
Median (IQR) Duration of Hospital Stay (days)	5 (3)	6 (3)	5 (4)

**CVA – Cardiovascular Attack, SD – Standard Deviation, NIHSS - National Institutes of Health Stroke Scale*

Table II: Association of Improvement of Functional Status at Discharge and at 3 Months

		EARLY-GROUP (n=55)	DELAYED-GROUP (n=45)	*p*-value
IMPROVEMENT IN NIHSS AT DISCHARGE	No	10(18.2%)	10 (22.2%)	0.615
	Yes	45(81.8%)	35(77.7%)	
IMPROVEMENT IN MRS AT 03 MONTHS	No	11(20%)	24(53.3%)	0.005
	Yes	44(80%)	21(46.7%)	
Median (IQR) Duration Of Hosp Stay (Days)		5.00(3.00)	6.00(3.00)	< 0.001*

**Mann-Whitney U Test for non-parametric variable*

There were 47 diabetics and 53 nondiabetics. Improvement in functional scale at 03 months was seen in 30 out of 47 diabetics and 35 out of 53 non-diabetics (*p*-value=0.817), showing no statistical difference in results with respect to the presence of DM. Similarly, there were 65 hypertensive patients and 35 normotensive patients. Improvement in functional scale at 03 months was seen in 39 out of 65 hypertensive and 26 out of 35 normotensive patients (*p*-value =0.15), again showing no statistical difference in outcome with respect to the presence of hypertension Table-lll.

Table-III: Association of Improvement of Functional Status in Diabetics vs non – Diabetics and Hypertensive vs Normotensive (n=100)

		Improvement In Modified Rankin Scale At 03 Months		Total	*p*-value
		No	Yes		
Diabetes Mellitus	No	18 (33.9%)	35(66.1%)	53	0.817
	Yes	17(36.1%)	30(63.9%)	47	
Hypertension	No	9 (25.7%)	26(74.3%)	35	0.153
	Yes	26 (40.0%)	39(60.0%)	65	

Finally, the frequency of complications was also compared between the two groups, which showed that there was a higher complication rate in the Delayed-Group as compared to the Early-Group (6 out of 55 vs 17 out of 45). Again, this was statistically significant (p-value 0.018). (Table-IV).

Table-IV: Association of complications in the Early vs Delayed-Group (n=100)

Groups	Complications				Total	*p*-value
	NONE	Stroke recurrence	Hemorrhage	Reperfusion injury		
EARLY GROUP	49(89.0%)	1(2.0%)	4 (7.0%)	1 (2.0%)	55	0.018
DELAYED GROUP	28(62.2%)	3 (6.6%)	11(24.6%)	3 (6.6%)	45	
Total	77(77.0%)	4(4.0%)	15(15.0%)	4(4.0%)	100	

DISCUSSION

In our study, we compared different parameters in patients with acute ischemic stroke who had been treated with stent-retrieval mechanical thrombectomy (MT) in an early (within 5 hours of symptoms) versus a delayed (5 to 12 hours after symptoms) scenario. Patients were compared for improvement in functional status as assessed by NIHSS at discharge and modified Rankin Scale (MODIFIED RANKIN SCALE) at 03 months as a primary objective. Duration of hospital stay and incidence of complications were secondary objectives. Additionally, improvement in the above MRC at 03 months was also compared with respect to the presence of comorbidities like Diabetes Mellitus and Hypertension. The rationale of our study was based on landmark trials like the DAWN trial and the DEFUSE-3 trial that showed a significant

improvement in functionality of patients who underwent MT even after the ideal window of 4.5 hours since onset of symptoms.[12] Both these trials showed that compared to medical or conservative therapy alone, a delayed MT up to 24 hours showed better 03 month MODIFIED RANKIN SCALE scores. When compared to our study results, there was an improvement in the delayed group; however, it was still statistically less than that in the early group. Also, we did not compare the early or Delayed-Group with the conservative management group.

Asdaghi *et al*., carried out a retrospective analysis of over 8000 patients and concluded that early intervention (within 6 hours) had better outcomes than delayed intervention (6-24 hours) in terms of independent ambulation (OR, 0.78 [0.67–0.90]) and discharge home (OR, 0.71 [0.63–0.80]). They also showed a lower complication rate in early than delayed group.[13] Our study also reached similar conclusions, albeit in a smaller prospective analysis. Another similar retrospective analysis of 573 patients was done by Barry *et al*., who compared results of early vs delayed MT in ischemic stroke patients. They also concluded that delayed MT offered a significant improvement in NIHSS and MODIFIED RANKIN SCALE scores in selected patients with delayed intervention. They had a larger sample size than ours, and their study showed a poorer result in diabetics and ischemic heart disease patients. Our study, in contrast, did not show a statistically significant difference in the primary outcome with respect to DM or Hypertension.[14]

In another study, Al-Mallouhi *et al*., compared early vs delayed MT in patients with low Alberta Stroke Program Early Computed Tomography Score (ASPECTS) and concluded that there was no significant difference in results between the two groups. Our study did not apply such limitations and considered results in all patients presenting with acute stroke.[15] In yet another study, Kwok *et al*., concluded that due to expanded time window criteria of MT in late presenters (up to 24 hours of symptoms), a larger number of patients underwent MT in the USA in the last 10 years; however, there was no significant improvement in mortality between pre-expanded and post-expanded timeline criteria. This also correlates with our study that delayed intervention, although beneficial, is still not as effective in preventing morbidity and mortality as early intervention.[16]

Results of delayed intervention are also influenced by patient selection, and not all delayed MT outcomes are equal. Many successful trials or studies rely on imaging studies with perfusion mismatch analysis to predict patient outcome in late presenters and select patients likely to improve in such circumstances. Whereas this seems like a prudent approach, the results are then skewed in favor of delayed intervention and do not reflect the true outcomes. Qureshi *et al*., did an extensive retrospective analysis comparing outcomes of MT in trial settings vs non-trial settings and observed that outcomes were better in trial settings due to careful patient selection. This also affected the results in many studies.[17]

When comparing secondary outcomes of our studies with international literature, Roy *et al*., identified age, DM, and incidence of complications as predictors/reasons of longer duration of stay, and not timing of intervention.[18] In comparison, our study showed a statistically significant decrease in the mean duration of hospital stay in the Early-Group as compared to the delayed group. With regards to complications, our study showed a higher incidence of hemorrhage, reperfusion injury, and recurrence in the Delayed-Group as compared to the early group. Krishnan et al conducted a systematic review of complications post MT and highlighted delay in reperfusion therapy as one of the factors leading to a higher complication rate, including intracerebral bleed and reperfusion injury.[19] These findings are aligned with our study findings.

Finally, Masilas *et al*., compared complication rate and early post procedure outcome in early vs late group and determined that there was no significant incidence of at least a single complication in early (<6 hours) vs Delayed-Group (6-24 hours) (16.2% vs 16.3%), but there was a significant difference in outcomes, with Early-Group showing better NIHSS after 72 hours post procedure.[20]

LIMITATIONS OF STUDY

This study was limited by its relatively small sample size and single-center design, which may reduce the generalizability of the findings. Patients were not randomized, and the study did not include a conservative management group for comparison. Longer follow-up with larger multicenter randomized studies is needed to better assess long-term functional outcomes and complication rates.

CONCLUSION

This study found that early mechanical thrombectomy, performed within 5 hours of symptom onset, was associated

with greater improvement in late functional status than delayed intervention performed between 5 and 24 hours. Improvement in early NIHSS scores did not differ significantly between the two groups. Patients in the delayed intervention group had a longer duration of hospital stay and a higher complication rate compared with those in the early intervention group. Because this study had a relatively small sample size compared with international datasets, larger multicenter studies with longer follow-up are needed before these findings can be generalized to broader patient populations.

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Discolure:

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MR & JL: Data acquisition, data analysis, critical review, approval of the final version to be published.

FR & UIM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AG: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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