

# Diagnostic Accuracy of Recognition of Stroke in Emergency Room Score in Patients with Ischemic Stroke

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**Abstract: Objective:** To determine the diagnostic accuracy of ROSIER scale in patients with ischemic stroke taking non-enhanced CT scan brain as gold standard.

**Materials and Methods:** Cross-sectional study conducted at tertiary care hospital in Gujrat from October 2019 to December 2020. Patients of both sex groups aged 30- 75 years presented in emergency within 24 hours of onset of focal neurological deficit which is objectively present and suspected of ischemic stroke. 289 patients were included. Patient history and neurological examination done calculating ROSIER scale and ischemic stroke diagnosed after CT scan brain done 24 hours after onset of symptoms. Sensitivity, specificity, PPV, NPV and diagnostic accuracy of ROSIER scale were calculated. Data analysis was done using SPSS 20.0.

**Results:** In this study group 141(48.8%) were male while 148(51.2%) were female. Mean age was 62.1+11.02 years. 49(17%) patients were aged <50 years while 240(83%) were aged >50 years. 215(74.4%) presented within 12 hours while 74(25.6%) after 12 hours of symptoms onset. Sensitivity of ROSIER scale for diagnosing ischemic stroke was 98.86%(95%CI;95.96%-99.86%), specificity 5.31%(95%CI;1.97%-11.20%), PPV 61.92%(95% CI;60.82%-63.01%) and NPV was 75%(95%CI;38.13%-93.59%). LR+ was 1.04(95%CI; 1.00-1.09) while LR- was 0.21(95%CI; 0.04-1.04).

**Conclusion:** ROSIER score can be used as initial screening test in patients with stroke. It has high sensitivity but low specificity and is a good test to rule in and rule out stroke patients.

**Keywords:** ROSIER scale, Stroke, Ischemic stroke, Stroke mimics, Emergency service, Decision support techniques.

## INTRODUCTION

Stroke is 3<sup>rd</sup> common etiology of death and leading source of disability in developing and developed world [1]. Pakistan ranks seventh in population size approximately 196 million individuals [2]. Non-communicable diseases attribute 41% of disease burden of Pakistan including stroke [3]. There are no large scale epidemiological studies available to calculate prevalence of stroke in Pakistan. The estimated incidence of stroke in Pakistan when adjusted to age and sex is 95 per 100,000 persons per year during 2000 to 2016. Most cases were old age; aged 75 to 85 years being 584,000 of 650,000 [4]. The available studies show prevalence of 19.1% in urban population of Karachi [5].

There are multiple risk factors associated with stroke. One local study showed that hypertension, sedentary lifestyle, diabetes mellitus, smoking and family history are major risk factors associated with stroke [6]. Another study showed hypertension as most common risk factor with others including diabetes mellitus, heart failure, valvular heart disease, previous stroke, smoking, dyslipidemia, ischemic heart

disease and atrial fibrillation. Most common cause of ischemic stroke was cardio embolic disease due to atrial fibrillation [7].

In case of acute stroke, immediate intervention increases benefits of treatment. The first point of contact of stroke patients is with emergency room medical staff. However, rates of misdiagnosis for patients with suspicion of stroke are high. Recent meta analysis shows that almost 9% of stroke patients are misdiagnosed at emergency [8]. The common risk factors associated with stroke misdiagnosis include patients with non-specific symptoms and those having posterior circulation strokes [9]. There are several stroke recognition tools to increase the early diagnosis of stroke patients and triage for health providers' use. The most commonly used is Face Arm Speech Test (FAST), however American Stroke Association and the United States Centers for Disease Control and Prevention recommend its use for improving awareness of symptoms and signs of stroke [10, 11].

Nor AM, *et al.* designed and validated the Recognition of Stroke in the Emergency Room (ROSIER) scale and found out that it has sensitivity 92% and specificity of 86%. It also helped to differentiate stroke from stroke mimics and was

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effective in early referral of patients to stroke team [12]. One recent study compared ROSIER scale of Cincinnati Pre-hospital Stroke scale and found out that both are equally effective in diagnosis of stroke at primary care settings [13]. Another recent study determined that ROSIER scale has high sensitivity for diagnosis of acute stroke [14, 15]. Another study showed that nurses achieved diagnostic sensitivity of 98% using ROSIER scale compared to doctors who had diagnostic sensitivity of 94% using standard neurological assessment [16].

Pakistan is under-developing country. The facility of CT scan is not available at primary and secondary care centers and staff is not well trained in diagnosing and early referral of stroke. There are no studies conducted in Pakistan for early assessment of stroke. ROSIER scale is easy to perform, is cost effective and can be used not only by doctors but also by hospital staff for early triage and referral of stroke patients meanwhile saving many lives. The objective of study was to determine the diagnostic accuracy of ROSIER scale in patients with ischemic stroke taking non-enhanced CT scan of brain as gold standard.

## MATERIALS AND METHODS

This cross-sectional study was conducted at Medicine Department, Aziz Bhatti Shaheed Teaching Hospital Gujrat from October 2019 to December 2020 after ethical committee approval. Patients of both sex groups aged >30 years who present in emergency within 24 hours of onset of focal neurological deficit which is objectively present on examination and suspected of ischemic stroke were included. Patients who have previous history of ischemic stroke or having previous focal neurological deficit were excluded from study. Non-probability consecutive sampling was used to enroll study participants.

Patients who present in emergency within 24 hours of onset of focal neurological deficit which is objectively present showing power <5/5 in one or more limbs unilaterally on examination were considered to be suspected case of ischemic stroke. CT scan brain plain showing loss of grey-white differentiation and presence of hypo dense lesion after 24 hours of symptoms onset were considered to have ischemic stroke.

Eight points ROSIER scale [12] was used for labeling the patient as suspected stroke. It included one point for each of speech disturbance for example stammering, incoordination or aphasia; visual field defect found out by hemianopia by confrontation method or decreased visual acuity <6/18 on Snellen Chart; unilateral face weakness; unilateral arm weakness having power <5/5 assessed clinically; unilateral leg weakness having power <5/5 assessed clinically and unilateral grip weakness having power <5/5 assessed clinically. One

point was deducted for each of seizure and loss of consciousness or syncope having Glasgow Coma Scale < 10/15. If final score was >0 then patient was considered to have an ischemic stroke.

Sample size of 289 cases was calculated with 95% CI and 7% margin of error, prevalence of stroke as 19.1% [5], sensitivity at 92% with 6% margin of error and specificity of 86% [12] with 7% margin of error. Patients who presented in emergency department of hospital and fulfilled the above mentioned criteria were included after verbal informed consent. Detailed history was taken from each patient and neurological examination was done in emergency and ROSIER scale was calculated. All patients with focal neurological deficit underwent plain CT scan brain after 24 hours onset of stroke and findings were noted after reporting of radiologist. Final diagnosis of patient was also noted. All data was entered into the proforma.

## STATISTICAL ANALYSIS

Data analysis was done using SPSS version 20.0. Numerical variables such as age were expressed as median and interquartile range. Categorical data such as gender, score on ROSIER Scale and patient outcome were presented as frequency and percentage. Data was stratified for age (<50 years or > 50 years) and duration of symptoms (<12 hours or >12 hours) to address effect modifiers and post-stratification 2x2 table was computed to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ROSIER scale by using positive likelihood ratio and negative likelihood ratio.

## RESULTS

Total of 289 patients were included in study out of which 141 (48.8%) were male while 148 (51.2%) were female. Overall mean age was  $62.1 \pm 11.02$  years. Median age among male patients was 54 (IQR 42-64) years while median age among females was 52 (IQR 41-63) years. 49 (17%) patients were aged <50 years while 240 (83%) were aged > 50 years. 215 (74.4%) presented within 12 hours of onset of symptoms while 74 (25.6%) presented after 12 hours of symptoms onset. The median score of ROSIER scale was 2 (IQR= 0-4) in male patients while in female patients it was  $2.2 \pm 1.1$ .

Table 1 shows the comparison of Rosier scale with CT-scan findings. Overall sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio and negative likelihood ratio of ROSIER scale in diagnosis of ischemic stroke are depicted in Table 2. Diagnostic accuracy parameters according to the stratification of age and symptoms duration were determined in and shown in Table 2.

**Table 1.** Comparing ROSIER Scale with CT scan Findings.

Stroke on ROSIER Scale	Group	Infarction present on CT Scan Brain		Total N (%)
		Yes N (%)	No N (%)	
	Yes	174(61.9)	107(38.1)	281(100)
	No	2(25)	6(75)	8(100)

**Table 2.** Overall Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Positive Likelihood Ratio (LR+) and Negative Likelihood Ratio (LR-), according to Age and Duration of Symptoms.

Parameter		Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	LR+ (95% CI)	LR- (95% CI)
<b>Overall</b>		98.86% (95.96% to 99.86%)	5.31% (1.97% to 11.20%)	61.92% (60.82% to 63.01%)	75% (38.13% to 93.59%)	1.04 (1.00 to 1.09)	0.21 (0.04 to 1.04)
<b>According to Age</b>	< 50 years	100% (91.19% to 100%)	0% (0.0% to 33.63%)	81.63% (81.63% to 81.63%)	-	1.00 (1.00 to 1.00)	-
	> 50 years	98.53% (94.79% to 99.82%)	5.77% (2.15% to 12.13%)	57.76% (56.49% to 59.02%)	75% (8.2% to 93.57%)	1.05 (0.99 to 1.10)	0.25 (0.05 to 1.24)
<b>According to Duration of Symptoms</b>	<12 hours	98.47% (94.59% to 99.81%)	1.19% (0.03% to 6.46%)	60.85% (60.09% to 61.60%)	33.33% (4.40% to 84.44%)	1.0 (0.97 to 1.03)	1.28 (0.12 to 13.92)
	> 12 hours	100% (92.13% to 100.00%)	17.24% (5.85% to 35.77%)	65.22% (61.36% to 68.88%)	100.00% (92.13% to 100.00%)	1.21 (1.02 to 1.43)	0

## DISCUSSION

Results of this study show that ROSIER scale is highly sensitive in diagnosis of ischemic stroke. However, it has more negative predictive value and negative likelihood ratio of <0.5 indicating that it's more diagnostically accurate in ruling out the ischemic stroke rather than ruling in. When stratified for age, gender and duration of symptoms results remain almost same.

Results of study are comparable to Nor AM, *et al.* who designed and validated The Recognition of Stroke in the Emergency Room (ROSIER) scale in terms of sensitivity (92% vs 98.86%) however the specificity is very low in this study compared to Nor AM *et al.* (86%) [12]. The possible reason for this may be they included both ischemic and hemorrhagic stroke while calculating the sensitivity and specificity however this study included only ischemic stroke patients.

One recent meta-analysis determined that that ROSIER scale has sensitivity of 89% in diagnosing acute stroke [14]. It approve the results of this study. However, the higher sensitivity maybe due to small sample size as compared to meta-analysis. Another study in China showed the sensitivity of ROSIER scale to be 83.13% in pre-hospital setting when performed by GPs [13]. The difference in sensitivity maybe due to fact that our study was conducted in a tertiary care hospital and scale was performed by consultant physicians.

Thus there maybe difference in results when scale is applied by people with different level of experience.

Another systemic review determined the sensitivity of ROSIER scale to be 88% which support the results of this study [16]. It shows the ROSIER scale can be applied in pre-hospital settings for early triage of patients and make the arrangements for receiving patients at other end. Another review comparing different pre-hospital stroke scale showed that ROSIER scale has sensitivity of 79%, specificity 76%, PPV 61% and NPV 88% [17]. It showed lower sensitivity but higher specificity as compared to this study. However PPV and NPV were comparable to this study. A 2020 systematic review and meta-analysis identified 15 datasets that evaluated the ROSIER scale and found that the combined sensitivity and specificity were 88 and 66 percent, respectively [18].

National Institute of Health Stroke Scale is most widely used and studied scale for diagnosis of stroke and accessing its severity. Studies show that there is a significant association of NIHSS scores and the presence and location of a vessel occlusion. With an NIHSS score  $\geq 10$ , a vessel occlusion will likely be seen on arteriography, and with a score  $\geq 12$ , its location will probably be central [19]. It is also predictor of mortality however ROSIER scale lacks these characteristics or they need to be defined in future.

This is a single center study and is performed by physicians. Its sensitivity or specificity in hospital conditions of Pakistan

needs to be further evaluated. ROSIER score is designed to be used by health care professionals due to its complexity [16] but it is helpful in excluding stroke mimics [20]. Further validation is required in pre-hospital setting when performed by nurses, ambulance staff or other health care professionals. Further studies are required to access whether ROSIER scale has any role in prediction of disability or mortality in patients with stroke. It is however, a sensitive tool to access the ischemic stroke in pre-hospital settings but diagnosis should be made on radiological basis.

## CONCLUSION

ROSIER score can be used as initial screening test in patients with stroke. It is a good test to rule in and rule out stroke patients. It has good probability of initially diagnosing stroke. However, the final test should be non-enhanced CT.

## AUTHORS' CONTRIBUTION

**Syed Muhammad Ali Shah:** Study design, Data analysis, Manuscript writing.

**Zamir Butt:** Data Collection, Data Entry, Literature Review.

**Muhammad Afzal:** Data Collection, Data Entry, Critical review of manuscript.

**Shahida Husain Tarar:** Manuscript writing, Critical review of manuscript, Data Entry.

**Syed Usama Talat:** Data Collection, Data Entry, Literature Review.

## CONFLICT OF INTEREST

Declared none.

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