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MORSE FALL SCALE AS CLINICAL PREDICTOR OF 3-MONTH NEUROLOGIC FUNCTION RECOVERY ON ISCHEMIC STROKE PATIENTS: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Stroke is a leading cause of death in developing countries. The Morse Fall Scale (MFS)'s use in predicting stroke clinical outcomes has not been extensively studied. This study aims to assess MFS's ability to predict neurological recovery in acute ischemic stroke patients within 3 months using the National Institutes of Health Stroke Scale (NIHSS).
Methods: This prospective cohort study enrolled all individuals with acute ischemic stroke between September and November 2021. Patients' baseline data included their MFS and NIHSS scores, as well as their age, gender, weight, stroke location, and comorbidities. The NIHSS score was reassessed three months later. To identify NIHSS predictors, all baseline data will be analyzed. SPSS 22 was used to analyze the data. The local ethics committee approved the study.
Results: Of the 164 patients who met the criteria, only 105 (mean age 59.09 [±11.65], male [58.1%], anterior location [88.6%]) reached the study end point. The average NIHSS score decreased from 9.14 (±1.70) to 6.27 (±1.92). Multiple linear regression showed only the MFS score (p = 0.000) accurately predicted the NIHSS by 0.059 (95% CI: 0.032–0.085, p = 0.000) at the study's conclusion.
Discussion: Our investigation revealed that the baseline MFS score accurately predicted neurological improvement in patients who had suffered an ischemic stroke over a three-month period. It is considered that the greater risk of falling results in a delay in the patient's rehabilitation. Investigation with larger sample sizes and longer monitoring intervals are required to corroborate our findings.

Keyword: ischemic stroke, rehabilitation, fall risk, morse fall scale, NIHSS

Introduction

Stroke affects 13.7 million people globally per year and is the second leading cause of death, with 5.5 million deaths per year. 2010, the incidence, mortality, disability and the ratio of mortality to the incidence of ischemic stroke continues to stagnate, especially in developing countries.2 Based on the pathophysiology, Stroke can be separated into ischemic stroke and hemorrhagic stroke. Ischemic stroke defined as brain, spinal cord or retinal infarction and represents ~71% of all strokes globally.3 Furthermore, ischemic stroke can be caused by thrombotic or embolic causing decreased blood flow to the brain. On the incident thrombotic, blood flow to the brain is blocked in the blood vessels due to dysfunction in the brain vessel itself, usually secondary to atherosclerotic disease, arterial dissection, dysplasia fibromuscular, or inflammatory conditions. In the development of stroke medical science, it has been developed a scoring system to assess neurological deficits due to stroke. Scoring system This is the *National Institutes of Health Stroke Scale* (NIHSS), which is useful in determining the severity of stroke.4,5

After occuring stroke, one of the common and potentially dangerous consequences is: balance disorders that cause the patient to fall. Interestingly, the relationship The relationship between the severity of the neurological deficit in stroke patients and the risk of falling is not linear According to one cohort, the relationship is inverted U-shaped. This matter showed a complex interaction between decreased mobility and the risk of falling, where individuals with moderate neurologic deficits, as is common in thrombotic strokes, are at greater risk for falls.6 Falls impact not only physical injury but also increase the patient's dependence, fear of falling, impaired physical activity level and bad mood. Therefore, it is very important to minimize the risk fell during hospitalization. Falls are

common in stroke patients, especially after enter the stroke unit. Consequently, in patient safety work, early identification of individuals at risk of falls is critical.[7]

At this time, several assessment systems have been developed to assess fall risk hospitalized patients, especially stroke patients. Quite popular scoring system method used is the *Morse Fall Scale* (MFS) system. However, not much literature that discusses the application of the Morse scoring system to the clinical outcomes of stroke patients, especially as a predictor of recovery from stroke itself. The purpose of this research to determine the predictive ability of MFS on the recovery of the patient's neurological status acute ischemic stroke within 3 months as assessed by the NIHSS.

Method

This research is a prospective cohort study at dr. Moewardi Surakarta Hospital, Indonesia. All patients presenting with a diagnosis of ischemic stroke based on CT-Scan results without contrast in September to November 2021 included in the study. Patients with a history of previous stroke, currently suffering from sepsis, and coma were excluded from the study. At the start of treatment, Patient data was collected using anamnesis and physical examination. The basic characteristic data collected included gender, age, weight, location ischemia, balance disorders, visual disturbances, use of lowering drugs consciousness, diabetes mellitus, hypertension, and heart disease. All ischemic stroke patients get curative and rehabilitative medical services in accordance with standard of care at the Hospital dr. Moewardi Surakarta. After discharge, all patients will be programmed to attend regular visits for at least 3 months after treatment. Patients who died, and lost to regular visits were excluded from the study.

The dependent variable of this study was the neurological deficit as assessed by the NIHSS.[8] Researchers will assess this variable at the beginning of the patient's admission to the treatment room, and 3 months after treatment care. The NIHSS scores will operate on a numerical scale. The independent variable in this study was the risk of falling as assessed by MFS[9] . This variable will only be assessed at the start of the patient's admission to treatment. The MFS score will operate on a numerical scale. Data obtained in the basic characteristics will then be operated as a variable confounders and included in statistical analysis according to the type of data.

Statistical analysis of independent and confounding variables on the dependent variable was carried out with multiple linear regression test. Independent and confounding variables were declared capable of predicting dependent variable when p value < 0.05. All data analysis was carried out using SPSS edition 22. This study was approved by the local ethics committee.

Result

From September to November 2021, there were 164 ischemic stroke patients, who meet the inclusion and exclusion criteria. During the 3 months return visiting period, there were 59 patients were excluded from the study, so that only 105 patients were included in the statistical analysis. The complete research sample selection process is shown in Figure 1.
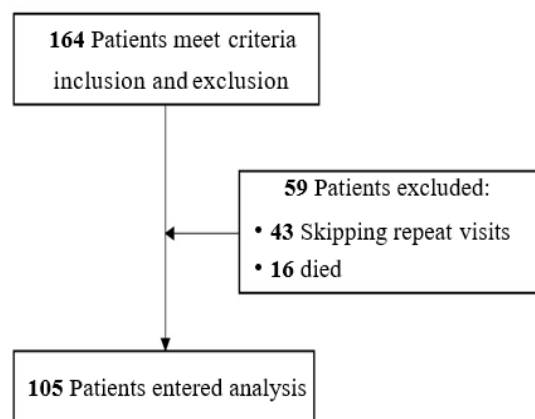

Figure 1. Research Sample Selection Process

From 105 samples, it is known that the majority are male (58.1%), with an average of The patient's age was 59.09 (±11.65) years, with an age range of 28-84 years. Ninety-three patients (88.6%) of all patients had an ischemic stroke located in the anterior. There was a decrease in the mean NIHSS from 9.14 (±1.70) at the start of treatment to 6.27 (±1.92) at a 3-month follow-up visit. Complete patient baseline characteristics are presented in Table 1.

Table 1. Basic characteristic of ischemic stroke patients

Basic Characteristics (n=105)	Total/Mean (%/±SD)
Age (years)	59.09 (±11.65)
Body weight (kg)	75.75 (±6.58)
Gender	
Man	61 (58,1)
Woman	44 (41.9)
Ischemic location	
Anterior	93 (88.6)
Posterior	12 (11,4)
Comorbid	
Balance Disorders	7 (6.7)
Visual disturbance	6 (5,7)
Use of consciousness-lowering drugs	2 (1.9)
Diabetes mellitus	22 (21)
Hypertension	73 (69.5)
Heart disease	33 (31.4)
NIHSS score	
T0	9.14 (±1.70)
T1	6.27 (±1.92)
MFS Score (T0)	57.71 (±13.00)

Description: NIHSS: *National Institutes of Health Stroke Scale,* MFS: *Morse Fall Scale,* T0: initial patient care, T1: 3 months return visiting

As a condition for linear regression testing, variables with a numerical scale will be tested for normality using the Shapiro-Wilk test. The p value> 0.05 indicates that the data in the variable it has a normal distribution, so that a linear regression test can be performed. Based on the normality test, the variables of age, weight, NIHSS score (T0-T1), and MFS . score (T0) has a normal distribution. The full normality test results are shown in Table 2.

Table 2. Numerical scale variable normality test

Variable	Shapiro- Wilk. Normality Test		
	Statistics	Df	*p*
Age	0.960	105	0.878
Weight	0.968	105	0.823
NIHSS scores			
T0	0.911	105	0.766
T1	0.893	105	0.788
MFS Score (T0)	0.967	105	0.877

Based on multiple linear regression test, only the MFS score is statistically significant (p = 0.000) was able to predict the NIHSS score at a follow-up visit 3 months after treatment. This predictive power can be expressed statistically as every increase in one score MFS at the beginning of treatment, will increase the NIHSS value at a 3-month follow-up visit after treatment was 0.059 (95%CI: 0.032 – 0.085, p = 0.000). Other variables are not has a statistically significant predictive ability to NIHSS scores at follow-up visits 3 months after treatment. Full analysis results shown in Table 3.

Table 3. Multiple linear regression test results on independent and confounding variables on the NIHSS score at a 3 months return visiting

Variable	Multiple Linear Regression Test		
	Total/ Mean (%/±SD)	B (95% CI)	*P*
MFS Score (T0)	7.71 (±13.00)	0.059 (0.032 – 0.085)	**0.000***
Age (years)	9.09 (±11.65)	0.004 (-0.027 – 0.036)	0.784
Body weight (kg)	5.75 (±6.58)	0.021 (-0.034 – 0.075)	0.450
Gender		0.622 (-1.358 – 0.115)	0.097
Man	61 (58.1)		
Woman	44 (41.9)		
Ischemic location		0.877 (-0.497 – 2.252)	0.208
Anterior	93 (88.6)		
Posterior	12 (11,4)		
Comorbid			
Balance disorders	7 (6.7)	1.413 (-3.309 – 0.483)	0.142
Visual disturbance	6 (5,7)	1,232 (-2,741 – 0.277)	0.108
Use of consciousness-lowering drugs	2 (1.9)	,107 (-0.503 – 4,718)	0.112
Diabetes mellitus	22 (21)	.323 (-0.527 – 1.173)	0.453
Hypertension	73 (69.5)	.072 (-0.712 – 0.856)	0.855
Heart disease	33 (31.4)	0.560 (-1.333 – 0.212)	0.153

Description: MFS: *Morse Fall Scale,* T0: initial patient care
*statistically significant (p<0.05)

stroke in the multiple linear regression. This shows that MFS can statistically reliable in predicting NIHSS, regardless of the location of the stroke experienced by the patient.

Discussion

Our study shows evidence of the utility of MFS in predicting clinical outcome ischemic stroke patients within 3 months after stroke. Based on the linear regression performed, MFS values at presentation were directly proportional to NIHSS values at 3 months after stroke. To the best of the researcher's knowledge, there are no other studies that specifically review predictive ability of MFS in predicting clinical outcome of ischemic stroke patients.

Fall risk assessed by MFS has not been widely discussed in the literature around its utility in predicting the clinical outcome of stroke patients, but there are few studies which could explain our findings. A scope review shows that in Southeast Asia, prevention of falls among stroke survivors has received little attention and is only considered an indirect goal in stroke rehabilitation.[10] Low effort prevention of falls in the patient care room will result in reduced knowledge will risk falling. Other research shows that individuals with higher levels of knowledge adequate fall risk, tend to have moderate to high level of fall prevention behavior.[11] A greater risk of falling will certainly hinder the rehabilitation process stroke patients, and this explains why MFS can predict progress stroke rehabilitation in our population. Factors thought to play a major role in this relationship seems to be reflected in the scope of care of the study population, which will affect the patient's knowledge and behavior in dealing with the risk of falling. Other factors that contributing to the risk of falling is the return of functional status. In a cohort retrospectively at (n=2255), there is an inverse U-shaped relationship between functional status and the incidence of falls in patients with stroke, where the highest risk of falling is in the group with moderate functional status.[6] This indicates a complex interaction between decreased mobility leading to decreased chance of falling and increased susceptibility to falls.

The NIHSS scoring system is a comprehensive scoring system widely used in neurovascular studies in assessing the severity of neurologic deficits in stroke patients. Both prevention, treatment, and rehabilitation studies use this scoring system as the gold standard.[12] The NIHSS score is also significantly related to location obstruction in ischemic stroke, particularly in predicting the location of circulatory obstruction anterior, but not in the posterior circulation. A study stated that the score NIHSS 9 and 7, at 3 hours and time >3 to 6 hours after symptom onset, had positive predictive values of 86.4% and 84.4%, respectively.[13] This scoring system is also useful. in predicting the clinical outcome of patients with stroke, which a study found that a score of 5 for the posterior circulation (sensitivity, 84%; specificity, 81%) and 8 for anterior circulation (sensitivity, 80%; specificity, 82%) was able to predict a good clinical outcome better. It should be remembered that the characteristics of the anterior and posterior strokes are different tended to lead to lower posterior stroke NIHSS scores (p <0.001), higher scores on ataxia (p < 0.001) and visual field (p = 0.043) components than anteriorstroke.14 In our analysis, MFS scores at baseline continued to have significant relationship to the NIHSS score, although there is a variable location of

As the first prospective cohort study to investigate predictive ability MFS on the clinical outcome of ischemic stroke patients, this study succeeded in showing its utility another of these commonly used fall risk assessment systems. Limitations of this study is a limited number of study samples with limited scope in hospitals tertiary, so it has not been able to determine whether MFS has predictive ability on general population. The follow-up monitoring period is only relatively short (3 months) was also another weakness of the study.

Conclusion

Our research shows that MFS has the ability to predict recovery of neurological function in the ischemic stroke patient population at Dr. Moewardi Surakarta. Similar studies with a wider population and timeframe longer monitoring is needed to confirm the results of our study before can be applied in clinical guidelines.

Research Ethic

This research has passed the ethical review of the Health Research Ethics Committee of RSUD Dr.Moewardi by letter number 287 / III / HREC / 2022

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The author declares that there is no conflict of interest in the search process data, data processing, and preparation of this research manuscript.

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