

Introduction

- Stroke is a leading cause of disability, significantly impacting mobility. Effective rehabilitation depends on accurate predictors of recovery. Recent studies suggest that both cognitive function and certain initial laboratory biomarkers, such as aminotransferase (ALT), could be crucial for predicting recovery outcomes. This study investigates how cognitive function and ALT levels can predict functional ambulation in survivors of middle cerebral artery (MCA) stroke.

Method

- This retrospective study analyzed 87 patients who experienced a first-time middle cerebral artery (MCA) stroke and began rehabilitation within 30 days of their stroke, between June 2016 and June 2023 at a university hospital. Key covariates such as age, sex, National Institutes of Health Stroke Scale (NIHSS), Berg Balance Scale (BBS), Mini-Mental State Examination (MMSE), and low alanine aminotransferase (ALT) levels were considered.
- Participants** : The study included MCA stroke patients who were initially non-ambulatory and excluded those with conditions that could affect gait, such as musculoskeletal disorders, quadriplegia, or other brain region strokes. The total study population was 87 individuals.
- Outcome Variable** : The primary outcome was whether the patient achieved functional ambulation, measured using the Functional Ambulation Categories (FAC) scale, after short-term rehabilitation. A FAC score of 3 or higher indicated functional ambulation.
- Data Analysis** : To identify predictors of ambulation recovery, multivariate binary logistic regression was used. Covariates like comorbidities, stroke type, lesion size, balance, and cognitive function were factored into the model.

Results

● Comparison of General Characteristics and Group Outcomes (Table 1)

The study found that individuals who did not achieve functional ambulation were older (69.4 vs. 61.2 years, p = 0.004) and had lower initial BBS and MMSE scores compared to those who regained ambulation (p < 0.001). Men were more likely to regain walking function than women (p = 0.035). Extremely low ALT levels were associated with poor ambulation outcomes (p = 0.014). Among 32 participants with aphasia, all had left-hemisphere lesions, but aphasia incidence showed no significant difference between groups.

Table 1. General Characteristics and Functional Ambulation After Subacute Rehabilitation.

Functional ambulation (FAC 3,4,5) after subacute rehabilitation	No (n=52)	Yes (n=35)	p-value
Sex			0.035*
- Female	28 (53.8%)	10 (28.6%)	
- Male	24 (46.2%)	25 (71.4%)	
Age	69.4 ± 13.2	61.2 ± 11.5	0.004*
Initial NIHSS	15.0 ± 7.1	12.1 ± 6.8	0.062
Stroke type			0.776
- Hemorrhagic	18 (34.6%)	14 (40.0%)	
- Ischemic	34 (65.4%)	21 (60.0%)	
Side of brain lesion			0.727
- Lt.	25 (48.1%)	19 (54.3%)	
- Rt.	27 (51.9%)	16 (45.7%)	
ASPECTS	6.0 [3.5; 8.0]	4.0 [3.0; 7.0]	0.126
CCI	6.0 [5.0; 7.0]	5.0 [4.0; 6.0]	0.009*
Albumin	4.2 [3.9; 4.4]	4.3 [4.0; 4.4]	0.074
ALT	18.0 [11.0; 23.0]	23.0 [16.0; 28.0]	0.059
Group by ALT level			0.014*
- Extremely low-level	13 (25.0%)	1 (2.9%)	
- Reference range	39 (75.0%)	34 (97.1%)	
Creatinine	0.7 [0.6; 0.9]	0.7 [0.6; 0.9]	0.585
Hemoglobin	13.4 ± 1.7	14.7 ± 1.8	0.002*
Onset to rehabilitation (days)	9.5 [6.0; 17.5]	6.0 [4.0; 9.5]	0.010*
Aphasia	16 (30.8%)	16 (45.7%)	0.156
Receptive aphasia	12 (23.1%)	12 (34.3%)	0.251
initial MMSE	14.5 [1.0; 21.0]	22.0 [15.5; 26.0]	<0.001*
initial BBS	2.0 [0.0; 4.0]	5.0 [1.5; 22.0]	<0.001*
initial FAC			0.001*
- 0	47 (90.4%)	22 (62.9%)	
- 1	4 (7.7%)	3 (8.6%)	
- 2	1 (1.9%)	10 (28.6%)	
Onset to discharge (days)	40.0 [36.5;49.5]	37.0 [31.0;42.0]	0.016*
BBS at discharge	8.6 ± 9.3	38.6 ± 10.6	<0.001*
FAC at discharge			<0.001*
- 0	33 (63.5%)	0 (0.0%)	
- 1	14 (26.9%)	0 (0.0%)	
- 2	5 (9.6%)	0 (0.0%)	
- 3	0 (0.0%)	17 (48.6%)	
- 4	0 (0.0%)	15 (42.9%)	
- 5	0 (0.0%)	3 (8.6%)	

*p<0.05, ALT (Alanine Aminotransferase), ASPECTS (Alberta Stroke Program Early CT Score), BBS (Berg Balance Scale), CCI (Charlson Comorbidity Index), FAC (Functional Ambulation Category), MMSE (Mini-Mental State Examination), NIHSS (National Institutes of Health Stroke Scale)

● Binary logistic regression (Table 2)

The binary logistic regression identified several key predictors of functional ambulation. Male sex, higher initial MMSE (≥20), and BBS (≥20) scores were associated with increased odds of achieving functional ambulation, while older age, higher Charlson Comorbidity Index (CCI), and extremely low ALT levels (≤10 U/L) negatively impacted recovery. Serum albumin and hemoglobin levels were positive predictors. In the multivariate analysis, male sex, MMSE, BBS scores, and low ALT levels remained significant predictors. These findings highlight the importance of cognitive function, balance, and biochemical markers in post-stroke ambulation recovery.

Table 2. Binary Logistic Regression for Predicting Functional Ambulation

Predictors of Functional Ambulation (Binary logistic regression)	Univariate			Multivariate		
	B	Exp(B)	p-value	B	Exp(B)	p-value
Sex (ref: male)	-1.070	0.343	0.022*	-1.190	0.304	0.046*
Age	-0.051	0.950	0.006*			
initial NIHSS	-0.061	0.941	0.065			
Stroke type (ref: Hemorrhagic)	-0.231	0.794	0.610			
Side of brain lesion (ref: Lt.)	-0.249	0.780	0.570			
ASPECTS	-0.124	0.884	0.133	-0.202	0.817	0.062
CCI	-0.379	0.684	0.010*	-0.349	0.705	0.069
serum albumin	1.457	4.293	0.028*			
serum creatinine	-0.240	0.787	0.582			
serum hemoglobin	0.418	1.519	0.003*			
serum ALT level group (ref: 10 and below 10 U/L)	2.428	11.333	0.022*	2.324	10.218	0.045*
initial MMSE group (ref: below 20 group)	1.160	3.375	0.008*	1.295	3.650	0.038*
initial BBS group (ref: 20 and below group)	3.016	20.400	0.005*	3.980	53.517	0.017*
Aphasia group	-0.639	0.528	0.159			
Receptive aphasia group	-0.553	0.575	0.254			

Conclusion

- Extremely low ALT levels, indicative of frailty, significantly predict poor recovery in MCA stroke patients. This study underscores the importance of routine biomarkers and cognitive assessments in enhancing prognostic accuracy and tailoring rehabilitation strategies to improve patient outcomes.

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