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ORIGINAL RESEARCH

Correlation Analysis of Activity Levels and Risk Factors in Patients with Stroke: Variations in Cardiac Function According to the Longshi Scale

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Objective: This study examined the link between physical activity levels, as measured by the Longshi Scale, and cardiac function and N-terminal pro-brain natriuretic peptide (NT-proBNP) levels in stroke patients, aiming to find correlations with stroke risk factors.
Methods: The study involved 123 apoplexy patients divided into four groups based on the Longshi Scale: bedridden (31), domestic (32), community (30), and health (30). Clinical data was collected, and hemodynamic assessments were performed using impedance cardiography.
Results: Cardiac output time index (CTI) and estimated ejection fraction (EF est) were significantly reduced in both the domestic and community groups compared to the health group ($P < 0.05$), while diastolic arterial blood pressure (DABP) and systemic vascular resistance index (SVRi) were increased. In the bedridden group, stroke volume (SV), cardiac output (CO), CTI, left cardiac work index (LCWi), and EF est were all lower compared to the health group ($P < 0.05$), with SVRI and NT-proBNP levels being higher. Additionally, the bedridden group exhibited lower SV, CO, DABP, LCWi, CTI, and EF est when compared to the domestic and community groups ($P < 0.05$), but higher end-diastolic filling rate (EDFR) and NT-proBNP levels. The Longshi Scale grading positively correlated with SV ($r = 0.536$, $P < 0.01$), and NT-proBNP, EF, and cognitive dysfunction were found to be associated with activity levels in stroke patients.
Conclusion: The Longshi Scale correlates with cardiac function indicators like NT-proBNP and EF, and can help identify stroke patients at risk of cardiac dysfunction. Moreover, cognitive dysfunction was identified as a significant factor influencing the range of activity in patients with stroke.
Keywords: assessment, hemodynamic, Longshi Scale, stroke

Introduction

Stroke represents a clinical syndrome arising from a group of vascular risk factors and is the second leading cause of mortality worldwide. Prevalence rates are particularly pronounced in developing nations, constituting the primary cause of disability.[1] Studies reveal that a substantial proportion, ranging from 60% to 80%, of stroke survivors experience varying degrees of functional impairment post-event, with approximately 75% encountering a loss of occupational capacity and 40% facing severe disability, rendering them unable to perform daily living activities.[2] Prolonged physical inactivity following stroke exacerbates the decline in cardiac functional adaptability and imposes limitations on daily activities, thereby heightening the susceptibility to cardiovascular diseases.[3,4] Given the shared risk factors—like hypertension, hyperlipidemia, smoking, sedentary lifestyle, obesity, and diabetes—between stroke and coronary heart disease, most patients with stroke concurrently suffer from cardiovascular disease. Notably, patients with stroke and

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concomitant cardiovascular disease exhibit a more pronounced decline in cardiac function.[5] Also, research indicates abnormal changes in hemodynamics concurrent with vascular lesions, underscoring the significance of hemodynamic indicators as prognostic factors for stroke risk and pivotal contributors to cerebrovascular disease progression.[6] Thus, the assessment of cardiac hemodynamics in patients having stroke assumes significant importance in comprehensive stroke care assessments.

The Longshi Scale, endorsed as the sole Chinese rating scale under GB/T37103 national standards within the industry, offers precise scale support for rehabilitation assessors without any medical background.[7] Recognizing the positive correlation between human activity capability and its range, the Longshi Scale categorizes patients into distinct activity tiers—bedridden, domestic, and community-based—based on their activity spectrum.[8] Differences in activity ranges of patients correspond to differing levels of activity. Existing studies indicate a notable association between increased Metabolic Equivalent Tasks (METs) and a consequent 12% reduction in adjusted mortality risk among patients concurrently afflicted with stroke and coronary heart disease.[9] It is thus hypothesized that enhancements in the exercise capacity of patients will expand their activity range, subsequently improving their aerobic metabolic capacity and cardiac function, thereby reducing the risk of cardiovascular and cerebrovascular complications.

Currently, scholarly research and analysis on the cardiac function of patients with different activity ranges (bedridden, domestic, and community) remain scarce, with existing studies predominantly focusing on assessing the disability levels of patients and verifying the reliability, validity, and feasibility of the Longshi Scale.[8,10] At present, there is no investigation into the use of the Longshi Scale for assessing cardiac function in patients with stroke. Hence, this study endeavors to compare the difference in cardiac function among patients with stroke having varying levels of activity—bedridden, domestic, and community-dwelling patients—by comparing their hemodynamic indexes. Also, it seeks to determine whether the Longshi Scale can assess the cardiac function of patients with the objective to provide clinicians with a more precise means of assessing cardiac function in stroke patients across diverse functional states.

Methods

Inclusion and Exclusion Criteria

The implementation of this study was approved by the medical ethics committee of our hospital. Patients with stroke admitted to our hospital between October 2019 and March 2021 were retrospectively selected for the study. Head CT or MRI examinations were performed on all patients, and they were diagnosed with their first stroke based on the stroke diagnostic criteria outlined in the "Chinese guidelines for the diagnosis and treatment of acute ischemic stroke 2010". Additionally, all patients with stroke met the following inclusion criteria: ① informed consent and willingness to actively cooperate, and ② 35years≤age≤85years. Exclusion criteria included: ① the presence of a cardiac pacemaker; ② significant dysfunction of liver, kidney, or other vital organs; ③ a history of malignant progressive hypertension; and ④ respiratory failure or acute infectious diseases.⑤ Patients with atrial fibrillation.

Research methods

Use of Longshi Scale

The Longshi Scale is an assessment tool for assessing ADL ability, by using situational diagrams for display. Patients are categorized into three groups based on their distinct activity ranges: Bedridden patients: Those confined to movement within the bed. Domestic patients: Patients capable of self-initiated movement onto the ground or wheelchair, engaging in independent activities within the home environment (including wheelchair use), but unable to initiate outdoor activities independently. Community patients: Patients capable of self-initiated movement onto the ground or wheelchair, and capable of independently initiating outdoor activities (including wheelchair use). The activity capacity of these groups escalates with the broadening of their activity scope. Using the criteria of "ability to get out of bed" and "ability to venture outdoors" as pivotal indicators, the assessment process delineates the disabled the self-care abilities of patients into six grades: Grade 1: Complete inability to perform self-care activities. Grade 2: Predominantly unable to perform self-care activities. Grade 3: Partial ability to perform self-care activities. Grade 4: Substantial ability to perform self-care activities. Grade 5: Fundamental ability to perform self-care activities. Grade 6: Full independence in self-care activities.[7]

Barthel Index

The Barthel Index is an assessment tool used to measure an individual's independence in activities of daily living, including basic activities such as eating, bathing, dressing, and toileting. Each activity is scored based on the degree of independence achieved, with a total score ranging from 0 points (complete dependence) to 100 points (complete independence). The higher the score, the better the individual's independence in daily life.[11]

Use of Impedance Cardiography

Inspection instrument: Impedance cardiography: Physioflow (model: Enduro) produced by Manatec, France.

Skin preparation and electrode placement involved several steps. Initially, the skin was cleaned using alcohol to reduce impedance between the skin and electrode. For impedance cardiography, gel electrodes (FS-50 ECG electrodes) were used. The specific placement sites were as follows: Blue electrode: Positioned at the posterior margin of the lower one-third of the sternocleidomastoid muscle. White electrode: Placed at the upper margin level of the sternocleidomastoid muscle, posterior to the blue electrode. Red electrode: Positioned along the anterior midline, at the upper margin level of the sternal angle. Orange electrode: Located at the site of apex pulsation. Green electrode: Positioned along the anterior median line, at the level of the flat xiphoid process. Black electrode: Placed at the lower right edge of the green electrode.

Impedance cardiography inspection and data recording were conducted while the patient remained in a quiet and supine position to ensure accurate measurement of hemodynamic calibration parameters.

Observation Indexes

Observation indexes: ①Myocardial systolic function: contractility index (CTI), left cardiac work index (LCWI). ② Left ventricular blood output: cardiac output (CO), stroke volume (SV) and ejection fraction (EF est). ③Cardiac preload: early diastolic filling ratio (EDFR). ④ Cardiac afterload: systemic vascular resistance index (SVRI). ⑤Blood pressure: systolic arterial blood pressure (SABP) and diastolic arterial blood pressure (DABP). ⑥Heart rate (HR). ⑦Ventricular ejection time (VET). ⑧N-terminal pro-brain natriuretic peptide (NT-proBNP): NT-proBNP is a cardiac-secreted biomarker used to assess cardiac function, playing a crucial role in the diagnosis, risk stratification, prognostic evaluation, and therapeutic monitoring of heart failure. It is an inactive fragment derived from the cleavage of proBNP by ventricular myocardial cells in response to increased pressure or volume load, with plasma levels rising as the severity of heart failure increases.[12] We collected 2 mL of venous blood from all subjects and allowed the blood samples to stand at room temperature until coagulation. The blood samples were then centrifuged at 3900 revolutions per minute for 15 minutes, and the concentration of NT-proBNP in the serum was measured using a fully automated chemiluminescence analyzer (PUMEN, eCL8000, China).

Statistical Analysis

Data was processed using SPSS 23.0 statistical software. For measurement data (denoted as "S"), single-factor analysis of variance (ANOVA) and LSD post-hoc testing were used to compare data among multiple groups. Counting data were expressed as percentages, and differences were assessed using the χ^2 test, with statistical significance set at $P < 0.05$. Spearman correlation coefficient was computed to assess the relationship between Longshi Scale classification and other measurement parameters. Also, risk factors were analyzed using ordered logistic regression.

Results

Comparison of General Data of Four Groups of Patients

Based on variations in the activity levels of patients, the 123 patients with stroke who conformed to both the inclusion and exclusion criteria were divided into different groups: 31 patients in the bedridden group, 32 in the domestic group, 30 in the community group, and 30 in the healthy control group. No statistically significant differences in age, gender, height, weight, and underlying etiology among the four groups ($P > 0.05$), indicating comparable baseline characteristics, as delineated in Table 1 were revealed by the analysis.

Table 1 General Data About the Four Groups (Mean ± SD)

Group	Case(n)	Height(cm)	Weight(kg)	Age(years)	Sex(n)		Pathogenesis(n)	
					Male	Female	Cerebral infarction	Cerebral hemorrhage
Control group								
Health group	30	162.93±7.15	64.23±10.75	61.57±12.44	20	10		
Stroke group								
Bedridden group	31	165±5.84	60.06±8.81	66.23±8.61	18	13	19	12
Domestic group	32	164.53±8.47	65.53±11.48	64.41±10.63	20	12	21	11
Community group	30	162.43±7.11	64.9±9.04	60.77±10.88	17	13	21	9

Comparison of Hemodynamics, NT-proBNP and Barthel Index Between Bedridden Group and Health Group

When compared to the healthy group, patients with stroke within the bedridden group exhibited significant reductions in SV, CO, CTI, LCWi, and estimated EF ($P < 0.05$). However, SVRI and levels of NT-proBNP were significantly elevated in the bedridden group ($p < 0.05$). Besides, patients with stroke within the bedridden group exhibited significant reductions in the Barthel index ($P < 0.05$), as illustrated in Table 2.

Comparison of Hemodynamics, NT-proBNP and Barthel Index Between Domestic Group and Health Group

When compared to the healthy group, the domestic group exhibited significant reductions in CTI and estimated EF est ($P < 0.05$). Conversely, DABP and SVRI were significantly increased in the domestic group ($p < 0.05$). In addition, the domestic group exhibited significant reductions in the Barthel index ($P < 0.05$), as indicated in Table 2.

Table 2 Comparison of Hemodynamic Indexes, NT-proBNP and Barthel Index in the Four Groups (Mean ± SD)

Parameters	Health group (n=30)	Stroke group		
		Bedridden group (n=31)	Domestic group (n=32)	Community group (n=30)
SV (mL)	79.83±13.22	63.66±13.92^{a}	74.92±14.21^{b}	75.79±16.38^{b}
HR (bpm)	70.5±9.06	72.16±10.95	75.34±15.5	73.63±7.51
CO (l/min)	5.6±1	4.6±1.16^{a}	5.55±1.06^{b}	5.56±1.23^{b}
SABP (mmHg)	117.03±18.6	119.39±13.52	122.31±11.83	126.67±10.47
DABP (mmHg)	75.5±8.26	75.03±8.31	81.06±9.75^{ab}	84.6±9.72^{ab}
CTI	199±79.79	106.7±35.6^{a}	143.46±68.02^{ab}	145.91±66.87^{ab}
VET (ms)	338±76.54	342.46±99.76	322.51±80.38	337.81±63.03
EDFR (%)	62.75±15.92	68.38±30.43	58.47±11.96^{b}	53.11±15.25^{b}
LCWi (kg.m/m²)	4.21±1.21	3.46±1.06^{a}	4.18±1.04^{b}	4.39±1.1^{b}
SVRi (dyn.s/cm^{5}.m²)	2065.53±328.32	2603.52±527.16^{a}	2371.09±485.03^{a}	2490.73±643.34^{a}
EF est (%)	68.72±10.48	49.46±17.43^{a}	58.1±12.15^{ab}	60.16±13.55^{ab}
NT-proBNP (ng/L)	69.03±38.51	332.09±261.46^{a}	140.04±151.78^{b}	97.37±86.15^{b}
Longshi Scale grading, grade(n)	9(30)	1(16), 2(15)	3(15), 4(17)	5(11), 6(19)
Barthel index	100.00±0.00	2.74±7.28^{a}	39.06±10.43^{ab}	74.83±12.35^{abc}

Notes: [a]Compared with health group, $P < 0.05$; [b]Compared with bedridden group, $P < 0.05$; [c]Compared with domestic group, $P < 0.05$.

Comparison of Hemodynamics, NT-proBNP and Barthel Index Between Community Group and Health Group

When compared to the healthy group, the community group displayed significant reductions in CTI and estimated EF est ($P < 0.05$). While DABP and SVRI were significantly increased in the community group ($p < 0.05$). Besides, the community group displayed significant reductions in the Barthel index ($P < 0.05$), as delineated in Table 2.

Comparison of Hemodynamics, NT-proBNP and Barthel Index of Bedridden, Domestic and Community Group

When compared to the bedridden group, the domestic and community groups exhibited significant increases in SV, CO, DABP, LCWi, CTI, estimated EF est and the Barthel index ($P < 0.05$). Also, EDFR and NT-proBNP were significantly decreased in both the domestic and community groups when compared to the bedridden group ($P < 0.05$). Notably, the Barthel index of community groups was higher than of domestic groups ($P < 0.05$), as presented in Table 2.

Univariate Analysis of Complications in Bedridden Group, Domestic Group, and Community Group in Patients with Stroke (Table 3)

Results of Logistic Multi-Factor Regression Analysis

Following single-factor analysis, 11 potential influencing factors suspected to contribute to variations in the activity levels of patients were identified. These factors encompassed NTproBNP, SV, CO, EF, BMI, MABP, EDFR, SVR, cognitive impairment, coronary heart disease, and hypertension. A subsequent multi-factor study was conducted on these variables, by using ordered logistic regression as the statistical analysis method.

Based on the results of the multi-factor analysis (presented in Table 4), NTproBNP, EF, and cognitive impairment emerged as independent influencing factors affecting activity range in patients with stroke, having statistical significance observed at $P < 0.05$. Conversely, SV, CO, BMI, MABP, EDFR, SVR, coronary heart disease, and hypertension did not demonstrate independent significance as factors influencing the activity range of patients with stroke, as indicated by $P > 0.05$.

Correlation Analysis of Longshi Scale Grading and SV in Patients with Stroke

The Longshi Scale grading revealed a positive correlation with SV ($P<0.01$), as revealed in Figure 1.

Prediction accuracy analysis of three groups (Table 5).

Table 3 Univariate Analysis of Complications in Bedridden, Domestic, and Community Group in Patients with Stroke

		Bedridden group	Domestic group	Community group	X^2/t	P
Pathogenesis	Cerebral hemorrhage	12(37.5%)	11(34.38%)	9(28.13%)	−0.712	0.476
	Cerebral infarction	19(31.15%)	21(34.43%)	21(34.43%)		
Smoking	None	27(37.5%)	23(31.94%)	22(30.56%)	−1.291	0.197
	Exist	4(19.05%)	9(42.86%)	8(38.1%)		
Drinking	None	24(36.36%)	18(27.27%)	24(36.36%)	−0.189	0.85
	Exist	7(25.93%)	14(51.85%)	6(22.22%)		
Cognitive impairment	None	4(6.9%)	24(41.38%)	30(51.72%)	−7.007	<0.001
	Exist	27(77.14%)	8(22.86%)	0(0%)		
Coronary heart disease	None	17(22.97%)	30(40.54%)	27(36.49%)	−3.421	0.001
	Exist	14(73.68%)	2(10.53%)	3(15.79%)		
Hypertension	None	6(20%)	10(33.33%)	14(46.67%)	−2.267	0.023
	Exist	25(39.68%)	22(34.92%)	16(25.4%)		
Diabetes	None	18(30.51%)	23(38.98%)	18(30.51%)	−0.173	0.862
	Exist	13(38.24%)	9(26.47%)	12(35.29%)		
Hyperlipemia	None	25(32.89%)	25(32.89%)	26(34.21%)	−0.596	0.551
	Exist	6(35.29%)	7(41.18%)	4(23.53%)		
BMI(kg/m^2)		22.09±3.27	24.19±3.76	24.60±3.14	4.792	0.011

Table 4 Multivariate Analysis of Patients with Stroke Performing Various Levels of Activity

		Regression coefficient	P	OR	OR of 95% CI	
					Lower Bound	Upper Bound
Threshold	[Ranges of activity = 1.00]	13.676	0.054			
	[Ranges of activity = 2.00]	16.888	0.019			
Location	NTproBNP	−0.004	0.036	0.996	0.991	1.000
	SV	0.026	0.304	1.026	0.976	1.080
	CO	0.743	0.383	2.102	0.396	11.167
	EF	0.069	0.047	1.071	1.001	1.146
	BMI	0.094	0.303	1.099	0.919	1.313
	MABP	−0.027	0.588	0.973	0.884	1.071
	EDFR	−0.03	0.127	0.970	0.934	1.008
	SVR	0.004	0.161	1.004	0.998	1.010
	[cognitive impairment=none]	3.658	<0.001	38.784	8.793	171.058
	[cognitive impairment=exist]	0				
	[CHD=none]	−0.082	0.918	0.921	0.194	4.375
	[CHD=exist]	0				
	[Hypertension=none]	0.238	0.66	1.269	0.440	3.662
	[Hypertension=exist]	0				

Discussion

Stroke is a significant global public health concern characterized by increased morbidity, mortality, and disability rates, with a discernible trend that affects younger demographics.[13] Hemiplegia emerges as a particularly severe complication,

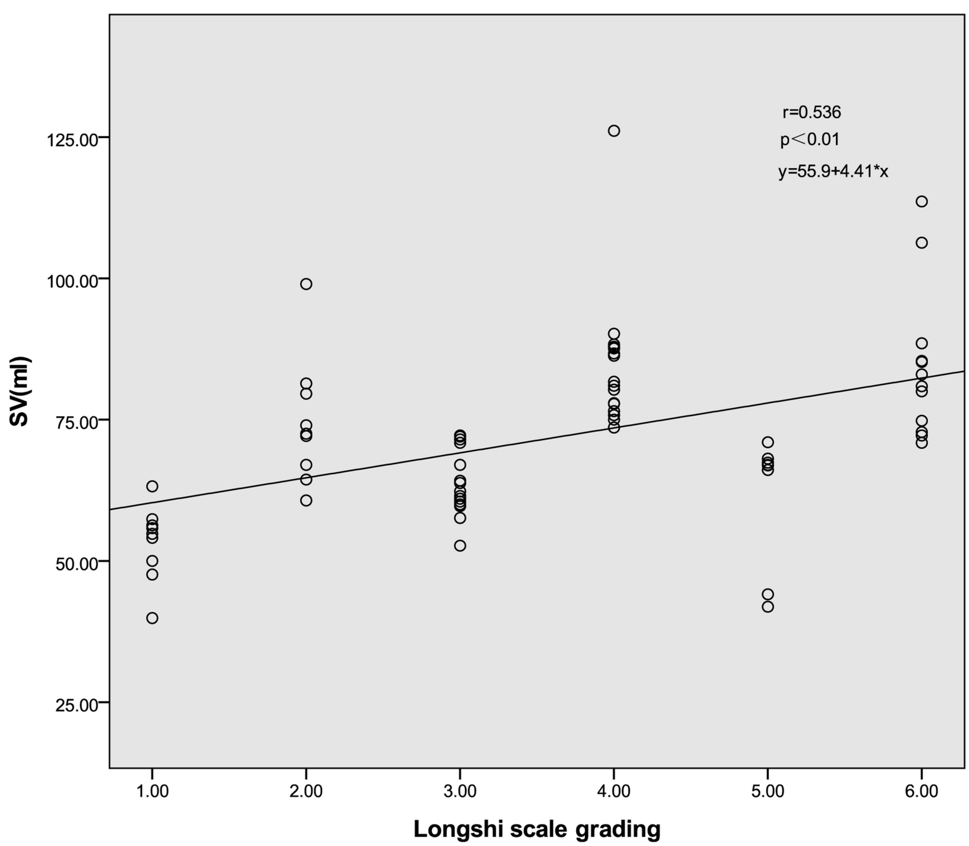

Figure 1 Correlation between the Longshi Scale grading and SV.

Table 5 Prediction Accuracy Analysis

Groups Predictive Response Category Crosstab					
Count					
		Predictive response category			Total
		Bedridden group	Domestic group	Community group	
Groups	Bedridden group	27	2	2	31
	Domestic group	6	18	8	32
	Community group	0	8	22	30
Total		33	28	32	93

imposing substantial burdens on the daily lives of patients.[14] Hypertension, diabetes, coronary heart disease, atrial fibrillation, and cardiac disorders persist as prominent risk factors for stroke, with hypertension notably ranking as the primary risk factor. The persistent disharmony between cardiac output and peripheral vascular resistance leads to hemodynamic changes, underscoring the importance of vigilant hemodynamic monitoring throughout the natural history of hypertension.[15]

Impedance cardiography is a valuable tool in using the hemodynamic perturbations accompanying elevated blood pressure, providing insights into cardiovascular event occurrence and prognosticating outcomes.[15] Based off an examination of hemodynamic profiles across different activity levels in patients with stroke, this study helps to predict cardiac function within these distinct patient groups. Currently, research efforts concerning the Longshi Scale predominantly center on assessing the disability levels of patients and validating the reliability, validity, and feasibility of the scale. However, the application of the Longshi Scale in assessing cardiac function patients with stroke remains largely unassessed.[8,10] Given the documented positive correlation between human activity levels and cardiovascular function, it is conjectured that enhancements in cardiopulmonary function may be observed alongside increased activity ranges.[8] Also, the simplicity and efficiency of the Longshi Scale makes it conducive to widespread use. Thus, this study seeks to divide patients with stroke into bedridden, domestic, and community groups using the Longshi Scale, and subsequently assess their cardiac function via impedance cardiography.[8] This pioneering investigation is the first endeavor to employ the Longshi Scale in assessing cardiac function among patients with stroke, with the overarching goal of facilitating rapid and straightforward cardiac assessments in this patient group.

Hemodynamic Differences Between Stroke Patients and Healthy People

The findings revealed significant decreases in CTI and estimated EF est among domestic and patients with stroke compared to healthy patients ($P < 0.05$). Additionally, DABP was significantly increased in patients with domestic and community stroke ($P < 0.05$), with SVRI revealing a significant increase in patients with community stroke ($P < 0.05$). Similarly, patients who were bedridden with stroke exhibited notable reductions in SV, CO, CTI, and EF est ($P < 0.05$), accompanied by a significant increase in SVRI ($P < 0.05$). These findings indicate that the cardiac function of patients with stroke across different activity levels in a resting state is inferior to that of healthy patients, indicating an overall lower cardiac function in stroke patients compared to their healthy counterparts.

Subsequently, this paper intends to scrutinize potential factors contributing to the compromised hemodynamic performance observed in patients with stroke when compared to healthy patients. First, the decrease in cardiac function correlates with stroke incidence, particularly in cases of ischemic stroke originating from atherosclerosis. Atherosclerosis, characterized by increased blood lipid levels, arterial intimal lipid deposition, and platelet aggregation, underpins the pathogenesis of ischemic stroke. Patients with stroke often present with a hypercoagulable state and heightened blood viscosity, making them susceptible to cerebral vascular stenosis or occlusion.[16,17] Consequently, cerebral ischemia and necrosis ensue, precipitating apoptosis of corresponding nerve cells and consequent damage to neural pathways.

Post-stroke, brain edema and increased intracranial pressure stimulate the sympathetic nerve center, inducing sympathetic hyperactivity and increasing catecholamine synthesis via the sympathetic-adrenal axis. Excessive catecholamine release can induce coronary artery constriction or spasm, leading to myocardial damage.[18] Some scholars propose that lesions within the frontal orbital gyrus (area 13), limbic system, hypothalamus, and brainstem can disrupt or stimulate the integrity of the thoracolumbar sympathetic pathway, exacerbating sympathetic excitation. Also, secondary factors post-stroke can precipitate changes in blood volume and vascular resistance, further compromising heart function.[18] Second, changes in cardiac hemodynamics may predispose patients to stroke occurrence, thereby contributing to lower cardiac function observed in patients with stroke compared to healthy patients. Hemodynamics plays a key role in atherosclerosis progression and arterial disease management, with strokes representing a significant arterial disorder. Hemodynamic changes like reflux and low wall shear stress may foster atherosclerosis and stroke, thereby exacerbating cardiac dysfunction in affected patients.[19] Third, a linear correlation exists between cerebral perfusion volume and pressure post-stroke. Even slight decreases in perfusion pressure may precipitate the demise of surviving brain cells within the penumbra, particularly in patients with small pulse pressure differentials. Ischemic penumbra represents not only an anatomical region but also a hemodynamic process. Diminished cardiac function exacerbates hemodynamic changes, increasing the cerebral perfusion deficits and exacerbating patient injuries. This phenomenon may elucidate the exacerbated cardiac dysfunction observed in bedridden patients with compromised functional status. Consequently, emphasizing systemic arterial blood supply emerges as a critical strategy in future stroke prevention and treatment endeavors.[20]

Hemodynamic Differences Among Bedridden, Domestic and Community Group of Patients with Stroke

The study findings indicated a notable difference in SV, CO, DABP, LCWI, and estimated EF est between patients with stroke in the bedridden group and those in the domestic and community groups ($P < 0.05$), corroborating the findings of Bleecker MW et al.[21] This indicates a superior cardiac function among domestic and community-dwelling patients with stroke compared to their bedridden counterparts. Subsequently, the discussion will explain the underlying factors contributing to the inferior cardiac function observed in bedridden patients with stroke, considering perspectives from bedridden, domestic, and community patients. Analysis from the angle of bedridden people should be considered above all. The immobility experienced by bedridden stroke leads to a series of pathological transformations within both the cardiovascular system and muscle tissue. A reduction in blood volume and left ventricular end-diastolic volume by 6–11%, along with a decrease in stroke volume and cardiac output by 6–13% among stroke patients confined to bed was revealed by extensive studies.[21]

This decline in cardiac contractility, coupled with diminished left ventricular function and cardiac output, contributes to sluggish blood rheology, heightened blood viscosity, exacerbated dysfunction in cerebral microcirculation, and the facilitation of cerebral thrombosis. The resultant increase in blood viscosity impedes coronary blood flow, culminating in insufficient myocardial blood supply and eventual damage to cardiac systolic function, thereby initiating a self-perpetuating and detrimental cycle. Also, from the perspective of community and domestic groups of patients with stroke, who typically maintain a sitting or standing position, the influence of gravity triggers sequential changes in blood flow rate, oxygen uptake, cardiac preload, cardiac perfusion, and cardiac output.[22] These modifications stimulate the sympathetic nervous system, thereby enhancing the stroke volume to accommodate external stressors.[23] At the same time, we also noted that the prevalence of coronary artery disease varied among stroke patients with different mobility levels, which was significantly higher in the bedridden group (73.68%) than in the domestic group (10.53%) and the community group (15.79%).Patients with coronary artery disease itself has limited activity function, studies have reported that 10–24% of stroke patients with heart failure,[24] stroke with heart failure patients daily activity ability is worse, and low physical activity and long-term bed will aggravate the deterioration of cardiac function,[25] the mutual influence lead to a vicious circle.

Therefore, compared with the domestic, community group, the bedridden group with coronary artery disease incidence significantly increased. Also, repetitive positional changes enhance the adaptability of cardiopulmonary function and contribute to enhanced stroke patient prognosis.[26,27] Notably, the importance of changing the body position is underscored in enhancing cardiac function among bedridden patients. Also, the superior limb function and increased activity levels observed among community and domestic patients with stroke when compared to their bedridden counterparts further contribute to the enhanced cardiac function observed in these groups.[28]

The analysis also revealed no significant difference in hemodynamics between the domestic and community groups, indicating comparable cardiac function between patients residing at home and those within the community. Subsequent interpretation of potential factors supports this finding. First, despite differences in the activity scope of domestic and community-dwelling groups of stroke patients, their daily routines predominantly feature sedentary activities, thereby minimizing discrepancies in daily physical exertion. Second, empirical studies have indicated that for stroke patients exhibiting relatively preserved motor function, the impact of less strenuous physical activity on cardiac function may be inconspicuous.[29] Consequently, the marginally higher levels of physical activity among patients with stroke in the community setting compared to those at home are unlikely to exert a significant influence on cardiac function.

Limitations of Study

This study only examined the cardiac hemodynamics of patients with stroke categorized into bedridden, domestic, and community groups based on Longshi Scale classifications, without further delving into the variations in cardiac function among patients with stroke having different Longshi Scale scores. Also, hemodynamic monitoring was limited to the supine position, precluding comparisons across different patient positions or during physical activity, thereby providing an incomplete representation of cardiac function. Also, the categorization of stroke patient dysfunction was relatively rough, diminishing the specificity of the study, and the sample size was modest. Therefore, it is imperative for future studies to expand upon these findings by assessing the use of Longshi Scale scores in assessing both static and dynamic cardiac function among patients with stroke.

Conclusion

The Longshi Scale classifications demonstrated associations with cardiac function indicators like NT-proBNP and EF, with Longshi Scale grading exhibiting a positive correlation with SV. Thus, the Longshi Scale serves as a potential tool for assessing the cardiac function status of patients with stroke, enabling clinicians to efficiently identify high-risk groups with compromised cardiac function and facilitate prompt and tailored interventions. Also, cognitive dysfunction emerged as a significant factor influencing the activity range of patients with stroke.

Data Sharing Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Shenzhen Second People's Hospital (Approval number:20180926006). This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

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Disclosure

Yao Wang and Huilan Lv contributed equally as co-first authors. The authors declare that they have no competing interests.

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