Research on the Correlation between NSE Level and Activities of Daily Living in Parkinson's Disease

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Abstract

Objective: To establish a prediction model of activities of daily living (ADL) as an auxiliary evaluation scheme of hospitalized Parkinson's disease patients. **Methods**: The hospitalization data of Parkinson's disease in patients in the Department of Neurology, Affiliated Brain Hospital of Guangzhou Medical University were collected. Firstly the NSE values and each BI item were analyzed by Pearson correlation analysis. Secondly, The NSE, Age, Body weight and Education level related to the total score of Barthel index were obtained by correlation analysis. At last, a multiple linear regression model was established with NSE, Age, Body weight and Education level as independent variables and BI as dependent variables. **Results**: A total of 95 patients with PD were enrolled in this study, including 53 males (55.8%) and 42 females (44.2%). The effects of the four independent variables incorporated in the model on the total score of Barthel index were statistically significant, as well as the regression model (F = 9.531, P < 0.001). **Conclusion**: The prediction model established in this research can effectively predict the activities of daily living of Parkinson's patients and can be used as an auxiliary evaluation scheme of the hospitalized PD patients.

Keywords

Parkinson's Disease, Activities of Daily Living, Neuron-Specific Enolase, Nursing

1. Introduction

Parkinson's disease (PD) is a degenerative disease mainly characterized by degeneration of substantia nigra dopamine neurons and Lewy microbody shape

[1]. By 2030, the number of Parkinson's disease patients in China is expected to reach 5 million [2]. Although the available therapeutic drugs are increasing year by year and the related treatment methods are being updated day by day, a radical cure has not been found, and the bradykinesia, rigidity and tremor of Parkinson's disease will gradually progress, seriously affecting the patients' Activities of Daily Living (ADL) [3] [4]. At present, nurses often use the scale to evaluate the ADL of Parkinson's patients, such as Barthel Index (BI), which is widely used to evaluate the ADL of Parkinson's disease because of its simple operation and high reliability [5]. However, this method often has certain subjectivities, and also has a certain "ceiling effect", which cannot evaluate the ADL ability of patients with high functional level. In recent years, more and more studies have begun to combine some objective indicators to evaluate the ADL ability of patients, such as the course of disease, number of diagnosis, age, education level and so on [6] [7]. There are also studies on the use of hematological indicators to predict ADL ability [8]. Recently some studies have found that neuron-specific enolase (NSE) is closely related to the progression and symptom severity of neurodegenerative diseases such as Parkinson's disease [9] [10]. Meanwhile the symptoms and condition of Parkinson's disease directly affect the patients' activities of daily living [11].

At present, some scholars have found that the level of NSE decreases and the ability of ADL improve in patients with brain injury, and there is a negative correlation between the level of NSE and their ability of ADL [12]. However, there is no study on the relationship between NSE and ADL in Parkinson's patients. Thus our purpose of this study is to explore the relationship between NSE and ADL of Parkinson's patients, and to construct a multiple linear regression model of ADL by using NSE combined with patients' sex, age, height and weight, in order to better judge the ADL ability of Parkinson's patients through hematological indexes and simple physiological data, and bring a more objective and simple auxiliary evaluation method for evaluating the ADL ability of Parkinson's patients.

2. Patients and Methods

2.1. Patients

We included PD patients hospitalized in the Department of Neurology, an affiliated brain Hospital of Guangzhou Medical University from 2019 to 2022. Inclusion criteria: 1) Meet the diagnostic criteria of PD of the Chinese Diagnostic criteria of Parkinson's Disease (2016 Edition) [13]. 2) Complete hematological index test (NSE) after admission. 3) Complete the BI index to evaluate their activities of daily living on the day of admission. 4) The general data of sex, age, height, weight and education level were collected routinely after admission. Exclusion criteria: 1) Secondary Parkinson's syndrome caused by drugs, head trauma and vascular, Parkinson's superposition syndrome such as multi-system atrophy, progressive supranuclear paralysis and cortical basal ganglia degenera-

tion. 2) Diseases that cause impaired ADL activity unrelated to Parkinson's disease, such as stroke, fracture, non-Parkinson's dementia, severe vision loss, etc. 3) parkinsonians with severe neuropsychiatric diseases, severe cardiovascular diseases, tumors and other diseases.

2.2. Methods

1) General data: The PD patients who were hospitalized in the Department of Neurology of the affiliated brain Hospital of Guangzhou Medical University from 2019 to 2022 and met the criteria of this study were selected from the medical record system by professionals who did not know about this study, as well as diagnosis, general data, NSE value and BI index at admission were collected.

2) Relevant clinical data: NSE is a cytoplasmic enzyme, and its isomers can be found in neurons and neuroendocrine cells. Because NSE is not physiologically secreted, its elevated levels in human serum and cerebrospinal fluid are considered to be a sign of neuronal injury [14] [15] [16]. Previous studies have shown that there is a significant association between NSE and Parkinson's dementia, and that Parkinson's dementia is significantly related to the ADL of patients [17]. The scale for clinical evaluation of ADL is the Barthel Index rating scale (BI Index), which includes 10 assessment items: bowels, bladder, grooming, toilet use, feeding, transfer, mobility, dressing, stairs, and bathing. Because of its simple operation, cost-effective and practical characteristics, it has high sensitivity and specificity for the evaluation of activities of daily living. The National Health Commission of China recommended BI index as one of the bases for nursing grading of inpatients [18]. The grading criteria of the BI index are: 0 - 20 (complete dependency), 25 - 45 (severe dependency), 50 - 70 (moderate dependency), 75 - 95 (mild dependency), 100 (no dependency).

3. Statistical Analysis

An analysis of the data was conducted using SPSS 26.0 software (IBM SPSS 26.0, SPSS Inc.). The enumeration data are presented in numerical and percentage form, while the measurement data are presented as the mean ± standard deviation ($\bar{x} \pm s$). 1) Pearson correlation analysis was performed between NSE and each item of BI. 2) The variables between NSE, age, height, weight (measurement data) and BI total score were analyzed by Pearson correlation analysis, while the variables of gender, education level (enumeration data) and BI total score were analyzed by Kendall'stau-b correlation analysis. Finally, meaningful variables are obtained as independent variables and incorporated into the multivariate linear regression equation with BI as dependent variable for statistical processing. A P-value < 0.05 (P < 0.05) was statistically significant.

4. Results

4.1. General Data

A total of 95 PD patients were included in this study, including 53 males (55.8%)

and 42 females (44.2%) with a mean age of 70.05 ± 0.87 years.

4.2. Univariate Analysis

The variables NSE and BI index (bowels, bladder, grooming, toilet use, feeding, transfer, mobility, dressing, stairs, and bathing) are all of normal distribution by drawing the P-P plot. Furtherly Pearson correlation analysis showed that NSE was linearly correlated with feeding, dressing and toilet use (Table 1).

4.3. Multiple Linear Regression Model

1) Univariate correlations. NSE (r = −0.180, P = 0.041), age (r = −0.434, P< 0.001) and weight (r = 0.192, P = 0.031) were respectively linearly correlated with BI total score, while there is no correlation between height and BI total score (r = 0.032, P = 0.380). On the other hand, education level is related to the total score of BI (Kendall's tau-b = −0.2, P = 0.011), and no significant correlation was found between gender and the total score of BI (Kendall's tau-b = −0.02, P = 0.818).

2) Multiple linear regression analysis. A multivariate linear regression model was established by using NSE value, age, body weight and culture as independent variables and BI as dependent variables. The assessment of the linear association between the independent variable and dependent variable is determined through the creation of partial regression scatter plots, as well as scatter plots depicting the biochemical residual and predicted value. Besides it has been verified that the research observations are independent of each other, and the Durbin-Watson test value is 1.902 (Table 2). Meanwhile, by drawing the scatter diagram between the biochemical residual and the unstandardized predicted value, it is proved that the variance of the residual is homogeneous. It is also found that the regression tolerance is greater than 0.1 and there is no multicollinearity. In addition, the standardized residual P-P plot indicates that the residual is approximately

Table 1. Univariate analysis.

Item	r	P
feeding	−0.205	0.047*
dressing	−0.224	0.029*
toilet use	−0.246	0.016*
bathing	−0.185	0.072
grooming	−0.183	0.077
bowels	0.055	0.594
bladder	0.011	0.918
transfer	−0.195	0.058
mobility	−0.083	0.424
stairs	−0.063	0.542

*Statistically significant (P < 0.05).

Table 2. Model summary.

model	R	R^2	Adjusted R^2	SE [a]	D-W [b]	F	P
prediction model	0.545	0.298	0.266	25.281	1.902	9.531	0.000

[a]standard error. [b]Durbin-Watson test value.

Table 3. Multiple linear regression.

variable	coefficient	SE	Standardized Coefficients	t	P	95%CI
constant	141.561	25.697		5.509	0.000	90.510 - 192.613
NSE	−1.113	0.591	−0.253	−4.885	0.031	−2.287 - 0.060
age	−1.167	0.241	−0.430	−4.839	0.000	−1.647 - −0.688
weight	0.477	0.272	0.336	3.754	0.010	−0.063 - 1.017
Education level	−5.162	2.102	−0.219	−2.456	0.016	−9.338 - −0.986

*$P < 0.05$.

normal. At last, we considered the regression model is statistically significant ($F = 9.531$, $P < 0.001$, adjusted $R2 = 0.266$). As well as the effects of the four independent variables included in the model on BI index with statistically significant ($P < 0.05$) (Table 3).

5. Discussion

Bradykinesia, rigidity and tremor is typical symptoms of patients with Parkinson's disease. These motor symptoms can also lead to impairment of activities of daily living. With age and progression of the disease, the ADL ability of patients will also be seriously impaired [19]. The simple and feasible BI index is used to evaluate the activities of daily living of inpatients with Parkinson's disease, which is convenient to evaluate the nursing effect of patients in hospital, and can guide the implementation of nursing program and nursing skills of patients' daily life [20]. However, the BI index often takes a certain amount of time to evaluate, and has a certain subjectivity. Because of the complexity of nursing work, patients' nursing follow-up process often changes different nurses to evaluate the BI index, and the results may be inconsistent.

In this study, by using the correlation analysis of the patient's test index NSE and BI index, it is found that NSE is related to skillful activities such as feeding, dressing, toilet use. Bezdicek *et al.* [21] found that the increase of NSE often represents a greater degree of brain damage and aggravation of symptoms in patients with Parkinson's disease, while the aggravation of central nervous system damage is often closely related to skilled activity, which is consistent with our results. Secondly, our clinical prediction model shows that there is a linear correlation between NSE and the patient's BI index, which means every additional unit of NSE in this model reduces the BI index by 1.113 points. Given this information, it is possible to develop a calculation program that can efficiently

calculate and display patients' activities of daily living (ADL) scores based on their NSE levels and physiological indexes. This will enable prompt assessment of patients' current ADL status, allowing clinical nurses to promptly and conveniently implement nursing programs and monitor ADL progress.

The recuperation of patients' condition is indissociable from the meticulous nursing plan implemented by nursing personnel and the provision of comprehensive health education [22], which is derived from the enhancement of nursing assessment techniques. The diverse range of symptoms associated with Parkinson's disease necessitates a consistent and regular nursing assessment of patients throughout their hospitalization and discharge process. By employing a convenient and objective assessment of activities of daily living (ADL), nurses can develop effective interventions and provide support that fosters patients' confidence in disease rehabilitation, ultimately leading to more efficient disease management [23]. However, even if this study conducts ADL assessment for individuals with Parkinson's disease within their homes, it remains imperative to visit a hospital for the collection of hematological samples in order to detect neuron-specific enolase (NSE). This requirement may introduce inconveniences to the process of continuous monitoring.

Furthermore, it is important to acknowledge the limitations present in our research. Firstly, the sample size utilized in our study is relatively small, which may impact the generalizability of our findings. Additionally, the selection of variables solely derived from existing medical records lacks a comprehensive theoretical foundation. Moreover, it is worth noting that we have not yet validated our model on an independent dataset; however, this validation process is planned for future investigations.

In conclusion, our multiple linear regression prediction model demonstrates efficacy in forecasting the activities of daily living (ADL) among individuals with Parkinson's disease. This model holds potential as a supplementary assessment tool for evaluating the ADL capabilities of hospitalized Parkinson's patients, thereby offering valuable insights for the implementation of subsequent nursing interventions.

Fund

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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