European Review for Medical and Pharmacological Sciences 2023; 27: 4462-4470

Effects of comprehensive care measures based on the HAPA model on self-care, neurotransmitters and clinical outcomes in cerebral infarction patients

X.-H. TIAN[1], X. CHEN[2], G.-F. JIANG[1]

[1]Department of Neurology, The Second Affiliated Hospital of Hunan University of Traditional Chinese Medicine, Changsha, China
[2]Department of Gastroenterology, The Second Affiliated Hospital of Hunan University of Traditional Chinese Medicine, Changsha, China

Abstract. – OBJECTIVE: Cerebral infarction is induced by cerebral artery occlusion, resulting in ischemia, hypoxia, necrosis of brain cells in the corresponding blood supply area, and then dysfunction. Health action process approach (HAPA) model emphasizes the proposal and practice of health behavior as a whole and uses self-monitoring and encouraging ultimately developed health behavior. The present study explores the effects of comprehensive nursing measures of HAPA model on neurotransmitters, self-care ability and clinical outcomes of cerebral infarction patients.

PATIENTS AND METHODS: One hundred and ten patients with cerebral infarction diagnosed and treated in our hospital from July 2020 to February 2022 were included as the subjects. The subjects were randomly grouped as the control (55 patients) and the study group (55 patients) and received conventional nursing measures and additional comprehensive nursing measures of HAPA model, respectively. The patients were tested for changes in self-care ability, nerve damage [myelin basic protein (MBP), S100B, glial fibrillary acidic protein (GFAP), neuron-specific enolase (NSE)] and neurotransmitter indexes [acid-soluble protein (Asp), neuropeptide Y (NPY), substance P (SP), glutamate (Glu)], respectively. The patients were considered as the good prognosis group (47 cases) and poor prognosis group (63 cases) according to the prognosis after comprehensive care. The logistic regression model was used to analyze the risk factors affecting the poor prognosis of patients with cerebral infarction.

RESULTS: After nursing, China Stroke Scale (CSS) score, the Fugl Meyer Rating Scale (FMA) score and Barthel index were significantly higher in both groups than before nursing, and all indexes were significantly higher in the study group than in the control group ($p< 0.05$). The length of hospital stay was significantly shorter in the study group than in the control group ($p< 0.05$). Compared with before nursing, the health knowledge, self-care skills, self-responsibility and self-concept of two groups were strongly increased after nursing, and the study group had much higher indexes than the control group ($p< 0.05$). After nursing, the levels of MBP, S100B, GFAP, NSE, Asp, NPY, SP and Glu in both groups were largely decreased, and more significant decrease was found in the study group ($p< 0.05$). Age, body mass index (BMI), hypertension history, coronary heart disease history and National Institutes of Health Stroke Score (NIHSS) score after treatment were significantly different between the good and poor prognosis groups ($p< 0.05$). The prognosis of patients in the study group was 52.73%, which was significantly higher than 32.73% in the control group ($p< 0.05$). Age, hypertension history, and post-treatment NIHSS score were independent risk factors related to poor prognosis by logistic multiple regression analysis ($p< 0.05$).

CONCLUSIONS: Comprehensive care measures of HAPA model may be used with advantage to improve the self-care ability, reduce the degree of neurological damage, and improve neurological function in cerebral infarction patients. Age, hypertension history, and NIHSS score after treatment were all risk factors related to poor prognosis.

Key Words:
HAPA model, Comprehensive care measures, Cerebral infarction, Self-care ability, Neurotransmitters, Clinical outcomes.

Introduction

Cerebral infarction is a common lethal and disabling disease with high incidence rate, disability rate and recurrence rate due to cerebral ischemia and hypoxia caused by interruption of blood flow

Corresponding Authors: X. Chen, MD; e-mail: chenxudr@21cn.com
G.-F. Jiang, MD; e-mail: sfegwph@163.com

in local blood supply area[1]. The morbidity of cerebral infarction is increasing year by year with the improved living standards. Once a patient has cerebral infarction, with the extension of the ischemic time, the ischemic injury area gradually expands until it develops into irreversible injury, which not only brings serious impact to the patient and his family, but also brings huge burden to the society[2,3]. Thus, timely detection and effective treatment count for much to reduce the degree of neurological impairment and improve the prognosis of patients.

Health action process approach (HAPA) model is a health action theory proposed by German psychologists[4,5], which believe that different intervention methods need to be adopted to implement different measures to promote different health behaviors. There are many influencing factors of cerebral infarction, and the rehabilitation of patients is a long process. In the past, the treatment of cerebral infarction was conducted based on drug combined nursing, but it failed to achieve ideal results, and even caused poor self-care ability of patients[5,6]. Comprehensive nursing measures are a new type of nursing intervention measures, which can effectively improve patients' bad mood and achieve the purpose of auxiliary treatment of diseases to a certain extent[7].

In this study, the effects of comprehensive nursing measures of HAPA model on neurotransmitters, self-care ability and clinical outcomes were explored in cerebral infarction patients. It provides relevant references for clinical nursing staff to improve the self-care ability of patients with cerebral infarction, enhance clinical outcomes, and promote early rehabilitation.

Patients and Methods

General Material

One hundred and ten cerebral infarction patients diagnosed and treated in our hospital during July 2020 to February 2022 were randomly selected as the subjects. Among them, 71 male and 39 female patients were included and the average age of them was (43.27±8.16) years. Inclusion criteria: (1) All subjects conformed to relevant diagnostic criteria for cerebral infarction[8] and were confirmed by head imaging. (2) All the patients had their first onset, and the onset time was less than 2 days. (3) All the subjects and their families signed the informed consent and actively cooperated with the study. (4) The patients had normal mental symptoms and no previous cerebral hemorrhage. Exclusion criteria: (1) patients with central nervous system infectious diseases history. (2) patients with severe liver and kidney function or cardiac dysfunction; (3) pregnant or lactating patients; (4) patients received major surgery 2 months before participating in the study. According to the principle of the random number table, these 110 subjects were grouped as the study group (55 cases) and the control group (55 cases). This study was authorized by the Ethics Committee of our hospital.

Methods

Control group: patients received routine nursing measures. Health education was given to patients on admission. The patients were informed of relevant precautions about the disease once a week during hospitalization. Patients followed the doctor's instructions. Patients' condition was closely observed. Patients were informed of regular follow-up at discharge.

Study Group: patients adopted additional comprehensive nursing measures of HAPA model[9]. A nursing intervention team including attending doctors, nursing staff and cerebral infarction experts was established. The basic data of the patients were collected, and the health education manual of cerebral infarction was distributed to the patients and their families to explain the relevant knowledge and precautions of the disease in detail. The health manual was compiled based on the HAPA model, including the causes and hazards of diseases. Patients were encouraged according to their cognition and attitude towards the disease to stimulate their self-confidence against the disease. Assisting patients to develop a long-term functional exercise plan, enhance patients' self-efficacy, guide patients to carry out rehabilitation training, and encourage patients to exercise every day. Psychological intervention should be given to patients to help them adjust themselves, make patients realize the severity of the disease, reduce their bad emotions, and strive to cooperate with the treatment of the disease to promote the recovery of patients.

Outcome Measures

Analysis of recovery of patients with cerebral infarction: the recovery of patients was evaluated by the China Stroke Scale (CSS) score[10], the Fugl Meyer Rating Scale (FMA) score[11], the Barthel index[12] and length of hospital stay. The CSS score included 8 items such as consciousness, horizontal gaze function and facial mus-

cles, each of which varied from a total score of 45 points. The higher the score, the more serious the patient's condition. The FMA score included 15 items such as upper limb/lower limb reflex activity and flexor joint movement. Each score varied with a total score of 100 points. The higher the score, the higher the patient's neurological function. The Barthel index rating scale included 10 items such as eating, transfer, and grooming, each with different scores, with a total score of 100 points. The lower the score, the more serious the patient's condition.

Detection of self-care ability: the changes in self-care ability before and after treatment were accessed using the self-care ability assessment scale[13], including health knowledge level, self-care skills, self-responsibility and self-concept. A total of 43 items were included, and each item was divided into 0-4 points. Among them, "very different from me", "some different from me", "No comments", "some like me" and "very similar to me" were considered as 0, 1, 2, 3 and 4 score respectively, with a total score of 172. Higher score indicated stronger self-care ability.

Nerve injury and neurotransmitter detection: 4 ml of fasting venous blood was gathered from each patient before and after nursing and centrifuged at the 4,500 r/min to obtain the supernatant. Changes in the level of nerve injury indexes [Myelin basic protein (MBP), S100B, Glial fibrillary acidic protein (GFAP), Neuron specific enolase (NSE)] and neurotransmitter indexes [Acid soluble protein (Asp), Neuropeptide Y (NPY), Substance P (SP) and glutamate (Glu)] were evaluated by radioimmunoassay and enzyme-linked immunosorbent assay, respectively. Radioimmunoassay: NSB, S0, S1-S6, and U0 were labeled in polystyrene test tubes (U tubes), and different concentrations (300 μL, 200 μL, 100 μL) buffers were added to NSB, S0 and U0 tubes, respectively. 200 μL of standard solution was added to S1-S6 tubes, 200 μL samples were counted in U tubes and U0 tubes, and 100 μL of antiserum were added to S0, S1-S6 and U tubes. Then, the reagents were mixed and placed at 4°C for 48 h. 100 μL of labeled samples were added into each tube and mixed well, and then a separating agent was added, mixed thoroughly, stood, centrifuged, taken the precipitate, and used a fully automatic γ radio-immunometer (Zhuhai Beso Biotechnology Co., Ltd., Xiangzhou District, Zhuhai City, Guangdong Province, China, model: BSJ-PT104) for detection. The radioimmunoassay kit was purchased from Shanghai Xinyu Biotechnology Co., Ltd. (Xinqiao Town, Songjiang District, Shanghai, China). Enzyme-linked immunosorbent method: the standards were first prepared, and 100 μL of standards and samples of different concentrations were added in blank wells, standard wells and sample wells to be tested. The mixtures were incubated for 30 min at 37°C, and then were added with 100 μL of primary antibody and enzyme-coated avidin with the incubation at 37°C in the dark for about 15 min. An Enzyme-Linked Immunosorbent Assay (BIOBASE8001, Jinan Noobao Medical Device Co., Ltd. of Lixia District, Jinan City, Shandong Province, China) was used. The assay program was set, 100 μL chromogenizer was added, and then incubated in the dark for 15 min. The reaction was stopped by adding 100 μL stop solution. Enzyme-Linked Immunoassay kits were purchased from Wuhan Merck Biotechnology Co., Ltd (East Lake New Technology Development Zone, Wuhan, Hubei Province, China).

The prognosis of patients was evaluated by Grasse prognosis, with a score of 1-5 points. 1 point indicated recovery, 2-3 point indicated improvement, 4 points indicated aggravation, and 5 points indicated disease and death. The good rate was calculated with the following formula: (recovery + improvement)/number of cases × 100%.

Analysis of influencing factors: according to the prognosis after comprehensive nursing, the patients were considered as the good prognosis group (47 cases) and poor prognosis group (63 cases). The basic clinical data of patients were gathered and poor prognosis of patients with cerebral infarction related factors were analyzed by Univariate analysis. The screening process of the study subjects of cerebral infarction patients was shown in Figure 1.

Statistical Analysis

SPSS 22.0 (IBM Corp., Armonk, NY, USA) was used to calculate different observation indicators and data. Enumeration data such as age and gender of patients with different prognosis outcomes were expressed in cases (%) and compared using χ^2 test. The self-protection ability, neurotransmitters, nerve injury indexes and some other measurement data were all tested by normal distribution, and they all conformed to normal distribution. The measurement data were shown in the form of (±s) and compared using *t*-test between groups. Logistic regression model was used to analyze the factors related to poor prognosis of cerebral infarction patients. $p< 0.05$ was statistically significant.

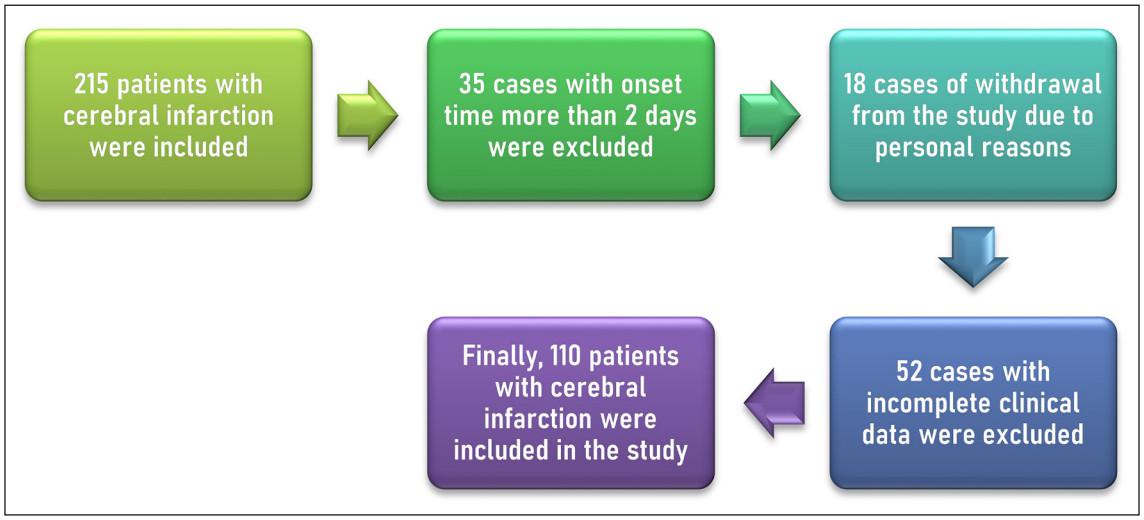

Figure 1. The screening process of the study subjects of cerebral infarction patients.

Results

Effect of Comprehensive Nursing Measures on Recovery of Cerebral Infarction

Before nursing, CSS score, FMA score and Barthel index between the study group and the control group had no significant difference ($p > 0.05$). After nursing, the CSS score, FMA score and Barthel index of the two groups were all obviously elevated, and the study group had much higher indexes than the control group ($p < 0.05$). The study group had sharply shorter hospitalization time than the control group ($p < 0.05$, Table I).

Effect of Comprehensive Nursing Measures on Self-Care Ability of Patients with Cerebral Infarction

Before nursing, the health knowledge level, self-care skills, self-responsibility and self-concept between two groups had no significant difference ($p > 0.05$). After nursing, health knowledge, self-care skills, self-responsibility and self-concept of the two groups were strongly enhanced, and a more obvious increase was found in the study group ($p < 0.05$, Table II).

Effect of Comprehensive Nursing Measures on Nerve Injury and Neurotransmitter in Patients with Cerebral Infarction

Before nursing, the levels of MBP, S100B, GFAP, NSE, Asp, NPY, SP and Glu in serum of patients with cerebral infarction between two groups had no significant difference ($p > 0.05$). After nursing, the levels of MBP, S100B, GFAP, NSE, Asp, NPY, SP and Glu were largely decreased, and the study group had more significant decrease ($p < 0.05$, Table III).

Table I. Effect of comprehensive nursing measures on recovery of cerebral infarction ($\bar{x} \pm s$).

Index	Time	The study group (n=55)	The control group (n=55)	*t*	*p*
CSS score	Before nursing	35.12±8.77	36.18±9.13	0.621	0.536
	After nursing	18.46±4.25	23.45±6.28	4.880	< 0.001
FMA score	Before nursing	38.56±10.42	39.42±10.18	0.438	0.662
	After nursing	58.85±12.25	50.21±12.13	3.717	< 0.001
Barthel index	Before nursing	62.25±12.13	61.98±12.74	0.114	0.910
	After nursing	78.72±10.26	71.52±11.33	3.493	0.001
Hospitalization time	Before nursing	—	—		
	After nursing	17.25±2.18	23.87±3.26	12.519	< 0.001

China Stroke Scale (CSS) score, Fugl Meyer Rating Scale (FMA) score.

Table II. Effect of comprehensive nursing measures on self-care ability of patients with cerebral infarction ($\bar{x}$ ±s) (score).

Index	Time	The study group (n=55)	The control group (n=55)	t	p
Health knowledge level	Before nursing	31.16±4.38	30.70±4.42	0.548	0.585
	After nursing	54.28±4.70	47.35±4.36	8.017	< 0.001
Self-care skills	Before nursing	24.19±4.08	24.27±4.14	0.102	0.919
	After nursing	41.11±2.69	29.19±2.92	22.266	< 0.001
Self-responsibility	Before nursing	11.27±2.16	11.52±3.18	0.482	0.631
	After nursing	21.52±2.30	15.15±3.42	11.462	< 0.001
Self-concept	Before nursing	16.18±4.15	16.41±4.18	0.290	0.773
	After nursing	26.27±3.95	20.39±3.24	8.536	< 0.001

Effect of Comprehensive Nursing Measures on Prognosis of Patients with Cerebral Infarction

The good prognosis rate of the study group and the control group was 52.73% and 32.73%, respectively ($p< 0.05$, Table IV).

Univariate Analysis on Prognosis of Patients with Cerebral Infarction

The good prognosis group and poor prognosis group were judged according to the clinical outcome after treatment. Age, body mass index (BMI), hypertension history, coronary heart disease history and National Institutes of Health Stroke Score (NIHSS) score after treatment were markedly different between two groups ($p< 0.05$). There was no significant difference in gender, smoking history, drinking history, diabetes history and NIHSS score before treatment ($p> 0.05$, Table V).

Multivariate Analysis of Poor Prognosis in Patients with Cerebral Infarction

Age, hypertension history, and post-treatment NIHSS score were independent risk factors related to poor prognosis by logistic multiple regression analysis ($p< 0.05$), and comprehensive nursing measures were protective factors ($p< 0.05$, Table VI).

Table III. Effect of comprehensive nursing measures on nerve injury and neurotransmitter in patients with cerebral infarction ($\bar{x}$ ±s).

Index	Time	The study group (n=55)	The control group (n=55)	t	p
MBP (μg/L)	Before nursing	7.45±0.73	7.40±0.75	0.354	0.724
	After nursing	2.10±0.24	4.02±0.50	25.674	< 0.001
S100B (μg/L)	Before nursing	1.52±0.19	1.47±0.20	1.344	0.182
	After nursing	0.69±0.09	1.07±0.14	16.933	< 0.001
GFAP (ng/L)	Before nursing	23.50±2.10	23.48±3.09	0.040	0.968
	After nursing	7.27±0.76	14.37±2.16	22.995	< 0.001
NSE (μg/L)	Before nursing	49.64±5.18	50.18±5.07	0.553	0.582
	After nursing	14.81±2.09	28.95±3.52	25.616	< 0.001
Asp (μmol/L)	Before nursing	40.96±3.88	41.18±4.09	0.289	0.773
	After nursing	9.69±2.06	22.57±2.15	32.080	< 0.001
NPY (μg/L)	Before nursing	262.58±30.64	255.29±29.28	1.276	0.205
	After nursing	92.46±9.28	149.27±20.39	18.807	< 0.001
SP (μg/mL)	Before nursing	6.42±0.69	6.39±0.80	0.211	0.834
	After nursing	2.10±0.22	4.02±0.64	21.040	< 0.001
Glu (μmol/L)	Before nursing	90.59±8.65	90.45±9.29	0.082	0.935
	After nursing	25.57±2.52	43.05±4.72	24.228	< 0.001

Myelin basic protein (MBP), S100B, glial fibrillary acidic protein (GFAP), neuron-specific enolase (NSE), acid-soluble protein (Asp), neuropeptide Y (NPY), substance P (SP), glutamate (Glu).

Table IV. Effect of comprehensive nursing measures on prognosis of patients with cerebral infarction [cases (%)].

Groups	Cases	Recovery	Improvement	Aggravation	Death	Good recovery rate
The study group	55	14 (25.45)	15 (27.27)	15 (27.27)	11 (20.00)	29 (52.73)
The control group	55	8 (14.55)	10 (18.18)	19 (34.55)	18 (32.73)	18 (32.73)
χ^2						4.495
p						0.034

CRP: C-reactive protein, WBC: White blood cell, NEU: Neutrophil, LYMPH: Lymphocyte.

Table V. Univariate analysis on prognosis of patients with cerebral infarction ($\bar{x} \pm s$).

Groups		Good prognosis group (n=47)	Poor prognosis group (n=63)	χ^2/t	*p*
Age (years, %)				18.055	< 0.001
	< 70	44 (93.62)	36 (57.14)		
	≥ 70	3 (6.38)	27 (42.86)		
Gender (%)				0.449	0.503
	Male	32 (68.09)	39 (61.90)		
	Female	15 (31.91)	24 (38.10)		
BMI (kg/m^2)				5.960	0.015
	< 30	34 (72.34)	31 (49.21)		
	≥ 30	13 (27.66)	32 (50.79)		
Smoking history (%)				0.639	0.424
	Yes	26 (55.32)	30 (47.62)		
	No	21 (44.68)	33 (52.38)		
Drinking history (%)				0.565	0.452
	Yes	15 (31.91)	16 (25.40)		
	No	32 (68.09)	47 (74.60)		
Hypertension history (%)				10.402	0.001
	Yes	4 (8.51)	22 (34.92)		
	No	43 (91.49)	41 (65.08)		
Diabetes history (%)				0.053	0.808
	Yes	6 (12.77)	9 (14.29)		
	No	41 (87.23)	54 (85.71)		
Coronary heart disease history (%)				6.811	0.009
	Yes	3 (6.38)	16 (25.40)		
	No	44 (93.62)	47 (74.60)		
NIHSS score (score)					
	Before treatment	14.05±3.46	15.24±3.78	1.693	0.093
	After treatment	7.35±2.14	10.85±2.03	8.740	< 0.001
Nursing method				4.495	0.034
	comprehensive nursing	29 (64.44)	26 (47.27)		
	routine nursing	18 (32.73)	37 (67.27)		

Table VI. Multivariate analysis of poor prognosis in patients with cerebral infarction

Index	B value	Wald	Standard error	Odds ratio	*p*-value	95% CI	
						Upper limit	Lower limit
Age	0.568	7.415	0.745	1.836	0.023	1.394	2.319
BMI	0.212	1.637	0.311	1.016	0.238	0.806	1.538
Hypertension history	1.478	10.417	0.831	4.042	0.013	2.631	5.452
Coronary heart disease history	0.313	1.518	0.274	1.838	0.113	1.312	1.624
Post-treatment NIHSS score	1.163	8.526	0.742	2.972	0.005	1.730	4.117
Comprehensive nursing	-1.915	10.546	0.375	0.146	0.001	0.058	1.268

Discussion

Acute cerebral infarction (ACI) is a common clinical syndrome of cerebral functional impairment. If not treated in time, it may even cause aphasia, hemiplegia, cognitive impairment, etc. In the past, thrombolytic therapy was mainly used for acute cerebral infarction treatment. The thrombolytic therapy accelerates the recovery of cerebral blood flow in the ischemic area by saving the remaining brain cells, thereby reducing the cerebral infarction area and improving the prognosis. However, the patients' requirements for service quality are constantly improving with the change of social medical model, and the clinical nursing methods are gradually changing to "patient-centered[14]". HAPA model considers that the interaction between affective factors and cognitive behavior plays an important role in maintaining and changing individual behavior. At the same time, corresponding intervention measures should be taken for individuals at different behavioral stages, so as to promote the generation of healthy behaviors. Comprehensive nursing measures are a new type of nursing intervention measures, which can effectively help patients to perfectly combine various nursing measures with medical personnel during treatment[15]. In this study, the patients were given comprehensive nursing measures based on HAPA model to explore its impact on the treatment effect.

Self-care behavior promotes the health and comfort of patients[16]. In the case that the body itself cannot effectively carry out self-care, it is necessary to give full play to the inherent potential of patients' self-care. The self-care ability assessment scale includes health knowledge level, self-care skills, self-responsibility and self-concept. In the research related to chronic diseases of the elderly, some scholars[17] found that medical care combined with continuous and comfort nursing intervention were beneficial to improve the self-care ability and nursing effect of the elderly patients with chronic diseases, and significantly improved the life quality and psychological state. The results of this study showed that the self-care ability of the patients in two groups was largely increased after nursing, and the study group had much higher self-care ability. These results indicated that appropriate nursing intervention could effectively improve the self-care ability of patients.

Cerebral infarction is one of the important causes related to death. The study found that more than 80% of patients might have died within 48 h after onset[18]. Even if the patient could survive, the later stage would be accompanied by varying degrees of consciousness disturbance and nerve damage. MBP, S100B, GFAP and NSE are all related to nerve injury. Among them, MBP belongs to a basic protein, which is an indispensable protein for maintaining the structure and function of nerve fiber myelin sheath and can effectively maintain the stability and function of the central nervous system. Under normal conditions, MBP is mainly expressed in nerve tissues. In the study of ischemic stroke, it was found[19] that the treatment group had much higher MBP mRNA level than the ischemic group. MBP can be used as an important index to evaluate the injury of central nervous system. S100B, GFAP, NSE, etc. are mainly distributed in nerve tissues, which can effectively maintain the blood-brain barrier and participate in regulating cell metabolism. In related animal studies[20], it was found that GFAP and NSE proteins of rats with cerebral ischemic stroke were significantly reduced after treatment, and the walking ability and nerve function damage of rats were rapidly recovered. In addition, studies[21] have shown that brain biomarkers such as MBP, S100B, GFAP, NSE and microtubule associated protein are largely elevated in patients with subarachnoid hemorrhage, which may have a direct relationship with neurological prognosis and is similar to the results of this study. In addition, studies[22] have shown that the neurological function is closely related to the level of neurotransmitters. Neurotransmitters are chemical components secreted by nerve endings and Asp, NPY, SP and Glu are all central neurotransmitters. Once the patient has cerebral hemorrhage, the levels of neurotransmitters such as Asp, NPY, SP and Glu are obviously abnormal[23]. The results of this study showed that the level of neurotransmitters was sharply reduced after the comprehensive nursing intervention. The above results indicated that certain nursing intervention could effectively regulate the level of neurotransmitters and further improve the patient's neurological function.

In addition, this study found that age, BMI, hypertension history, coronary heart disease history and NIHSS score were all factors related to poor prognosis. Logistic multivariate analysis showed that age, history of hypertension and NIHSS score after treatment were independent risk factors related to poor prognosis of cerebral infarction patients. Patients' basic diseases increase and their immune function decreases with the increase of age. BMI has been considered as one of the important predictors of cardiovascular and cerebrovascular diseases. It has also been confirmed by previous studies[24] that BMI is a risk factor for increasing hypertension, diabetes, metabolic syndrome and other dis-

eases, and is also one of the main risk factors for cerebral infarction. Hypertension is an important inducement of cerebral infarction. It is generally believed[25] that brain edema caused by ischemia may cause compensatory reactions in other tissues or even the whole body, including increasing the local blood flow of brain tissue at the cost of blood pressure rise, thereby improving the hypoperfusion of brain tissue. In addition, the neuroendocrine and sympathetic nervous system are activated in the acute phase when the patient is subjected to stress response, resulting in an increase in blood pressure and a vicious cycle. At the same time, elevated blood pressure is one of the main risk factors for coronary heart disease, which can cause arteriosclerosis and lead to coronary artery stenosis to form coronary heart disease[26,27]. The NIHSS score is one of the most commonly used scoring methods in clinic to evaluate the nerve function of patients. In a previous study[28], by evaluating the neurological function of patients with cerebral hemorrhage, it was found that after treatment, the NIHSS score of patients was significantly reduced, the ability of daily living was significantly improved, and the psychological state was significantly improved. NIHSS plays an important role in assessing neurological function in patients, and higher NIHSS score means higher nerve function defect degree.

In general, comprehensive care measures of HAPA model effectively improved the self-care ability, reduced the degree of neurological damage, and enhanced neurological function in cerebral infarction patients. Age, hypertension history, and NIHSS score after treatment were all risk factors related to poor prognosis in cerebral infarction patients. Through the changes of self-care ability and nerve injury of patients with cerebral infarction, the impact of comprehensive care based on HAPA model on patients with cerebral infarction was further clarified, which was conducive to the early recovery of patients. However, due to the lack of psychological knowledge of medical staff at present and the lack of certain experience during psychological nursing intervention, medical staff will be further trained in the following stage to improve their psychological knowledge.

Conclusions

Comprehensive nursing measures based on HAPA model can effectively promote the neurological rehabilitation and self-care ability of patients with cerebral infarction and improve the physical function of patients. Some patients did not receive timely and effective treatment but can recover well with integrated care measures based on the HAPA model. The factors affecting the poor prognosis of patients with cerebral infarction were analyzed, and the comprehensive nursing measures based on the HAPA model were the protective factors for the poor prognosis of patients with cerebral infarction, which can effectively improve the prognosis of patients and is worthy of clinical application.

Acknowledgements
None.

Funding
This study was supported by the General Project of Education Department of Hunan Province (Project No.: 21C0244).

Data Availability
The data analyzed and used during the current study are available from the corresponding author on reasonable request.

Ethics Approval
This study was conformed to the requirements of the Ethics Committee of The Second Affiliated Hospital of Hunan University of Chinese Medicine (Number: ChiCTR2200057808).

Informed Consent
All the subjects and their families signed informed consent and actively cooperated with the study.

Conflict of Interest
The authors declare that there is no conflict of interests.

ORCID ID
X. Chen: 0000-0002-4576-3197

References

1) Chen G, Leak RK, Sun Q, Zhang JH, Chen J. Neurobiology of stroke: Research progress and perspectives. Prog Neurobiol 2018; 163-164: 1-4.
2) Ng YS, Stein J, Ning M, Black-Schaffer RM. Comparison of clinical characteristics and functional outcomes of ischemic stroke in different vascular territories. Stroke 2007; 38: 2309-2314.
3) Paul S, Candelario-Jalil E. Emerging neuroprotective strategies for the treatment of ischemic stroke: An overview of clinical and preclinical studies. Exp Neurol 2021; 335: 113518.

4) Xu F, Bu K, Chen F, Jin S, Zhang H, Zhang D, Sun C, Wang N, Han M, Wang L. Structural equation modeling test of the pre-intentional phase of the health action process approach (HAPA) model on condom use intention among senior high school students in Tianjin, China. Medicine (Baltimore) 2020; 99: e22776.
5) Tian Y, Su G, Liu JF, Liu XY, Zhou JP, Chen DY, Zhang ZC. Rodent models for intravascular ischemic cerebral infarction: a review of influencing factors and method optimization. Neuroreport 2020; 31: 1154-1160.
6) Matsumoto K, Sato S, Okumura M, Niwa H, Hida Y, Kaga K, Date H, Nakajima J, Usuda J, Suzuki M, Souma T, Tsuchida M, Miyata Y, Takeshi N. Left upper lobectomy is a risk factor for cerebral infarction after pulmonary resection: a multicentre, retrospective, case-control study in Japan. Surg Today 2020; 50: 1383-1392.
7) Fu J, Song L, Wang R, Ping F, Dong S. Effect of comprehensive rehabilitation nursing intervention on hemiplegia patients in sequela stage of stroke. J Pak Med Assoc 2020; 70: 38-44.
8) Rabinstein AA. Update on Treatment of Acute Ischemic Stroke. Continuum (Minneap Minn) 2020; 26: 268-286.
9) Cao D, Chu N, Yu H, Sun M. Role of comprehensive nursing care in improving the prognosis and mood of patients with secondary cerebral infarction after craniocerebral injury. Am J Transl Res 2021; 13: 7342-7348.
10) Zhao XJ, Li QX, Liu TJ, Wang DL, An YC, Zhang J, Peng YB, Chen RY, Chang LS, Wang Y, Zhang L, Fan HY, Wang XJ, Zheng FX. Predictive values of CSS and NIHSS in the prognosis of patients with acute cerebral infarction: A comparative analysis. Medicine (Baltimore) 2018; 97: e12419.
11) Wang Q, Hu M, Ye P. Effect of a modern stroke unit combined with recombinant human tissue-type plasminogen activator intravenous thrombolysis on ischemic cerebral infarction and its influence on limb motor function and activity of daily living. Am J Transl Res 2021; 13: 9708-9714.
12) Li QX, Zhao XJ, Wang Y, Wang DL, Zhang J, Liu TJ, Peng YB, Fan HY, Zheng FX. Value of the Barthel scale in prognostic prediction for patients with cerebral infarction. BMC Cardiovasc Disord 2020; 20: 14.
13) Maeda N, Tsutsumi Y, Niwa S. Development of a self-assessment behavioral and psychological symptoms of dementia competency scale for care teams at long-term geriatric care facilities. Geriatr Nurs 2021; 42: 628-634.
14) Gu YH, Wang X, Sun SS. Benefits of multidisciplinary collaborative care team-based nursing services in treating pressure injury wounds in cerebral infarction patients. World J Clin Cases 2022; 10: 43-50.
15) Liu J, Xun Z. Evaluation of the Effect of Comprehensive Nursing in Psychotherapy of Patients with Depression. Comput Math Methods Med 2021; 2021: 2112523.
16) Li L, Ma Z, Wang W. Influence of transitional care on the self-care ability of kidney transplant recipients after discharge. Ann Palliat Med 2020; 9: 1958-1964.
17) Xie YE, Huang WC, Li YP, Deng JH, Huang JT. Dynamic interaction nursing intervention on functional rehabilitation and self-care ability of patients after aneurysm surgery. World J Clin Cases 2022; 10: 4827-4835.
18) Herpich F, Rincon F. Management of Acute Ischemic Stroke. Crit Care Med 2020; 48: 1654-1663.
19) Kuryata OV, Kushnir YS, Nedzvetsky VS, Korsa VV, Tykhomyrov AA. Serum Levels of the Biomarkers Associated with Astrocytosis, Neurodegeneration, and Demyelination: Neurological Benefits of Citicoline Treatment of Patients with Ischemic Stroke and Atrial Fibrillation. Neurophysiology 2021; 53: 2-12.
20) Xue WS, Wang N, Wang NY, Ying YF, Xu GH. miR-145 protects the function of neuronal stem cells through targeting MAPK pathway in the treatment of cerebral ischemic stroke rat. Brain Res Bull 2019; 144: 28-38.
21) Kedziora J, Burzynska M, Gozdzik W, Kübler A, Kobylinska K, Adamik B. Biomarkers of Neurological Outcome After Aneurysmal Subarachnoid Hemorrhage as Early Predictors at Discharge from an Intensive Care Unit. Neurocrit Care 2021; 34: 856-866.
22) Xin H, Cui Y, An Z, Yang Q, Zou X, Yu N. Attenuated glutamate induced ROS production by antioxidative compounds in neural cell lines. RSC Adv 2019; 9: 34735-34743.
23) Rajdev K, Siddiqui EM, Jadaun KS, Mehan S. Neuroprotective potential of solanesol in a combined model of intracerebral and intraventricular hemorrhage in rats. IBRO Rep 2020; 8: 101-114.
24) Chen SH, McCarthy D, Saini V, Brunet MC, Peterson EC, Yavagal D, Starke RM. Effect of Body Mass Index on Outcomes of Mechanical Thrombectomy in Acute Ischemic Stroke. World Neurosurg 2020; 143: e503-e515.
25) Wu, S., Yuan, R., Wang, Y., Wei, C., Zhang, S., Yang, X., Wu, B., & Liu, M. Early Prediction of Malignant Brain Edema After Ischemic Stroke. Stroke 2018; 49: 2918-2927.
26) Yang K, Zhu X, Feng Y, Shen F, Chen J, Fu N, Sun J, Fu Y. Abnormal blood pressure circadian rhythms are relevant to cerebral infarction and Leukoaraiosis in hypertensive patients. BMC Neurol 2020; 20: 36.
27) Li W, Jin C, Vaidya A, Wu Y, Rexrode K, Zheng X, Gurol ME, Ma C, Wu S, Gao X. Blood Pressure Trajectories and the Risk of Intracerebral Hemorrhage and Cerebral Infarction: A Prospective Study. Hypertension 2017; 70: 508-514.
28) Zheng G, Cai X, Zhu R, Yang L, Liu T. Effect of holistic rehabilitation nursing on postoperative neurological function recovery and limb function improvement in patients with intraintracerebral hemorrhage. Am J Transl Res 2021; 13: 7256-7262.