Hang Chen[1], Ping Xu[1], Jia Hu[1], Hong Li[2], Yuan Yan[2], Yu Cai[2]

[1] Fengxian District Central Hospital, Department of Nursing, Shanghai, China

[2] The Affiliated Suzhou Hospital of Nanjing University Medical School Suzhou Science & Technology Towns Hospital, Suzhou, Jiangsu, China

Individualized Nutritional Support Improves Cardiac Function and Nutritional Status of Elderly Heart Failure Patients

Background The quality of life of the patient is diminished by chronic heart failure (CHF), which also costs the healthcare system. This study examined the benefits of individualized nutritional support provided by a specialized nursing team on the nutritional status and cardiac function of elderly patients with CHF.

Material and methods This study included 102 elderly, hospitalized CHF patients. The patients were randomly assigned to two groups of 51 each. During the study protocol, the control group received regular nursing care, while the experimental group received individualized nutritional support by a specialized nursing team. Nutritional-related and cardiac function indicators, inflammatory factors, and life quality scores measured before and after the protocol were compared.

Results There was a significant increase in total albumin, hemoglobin, and protein in both groups during the protocol, but the final concentrations were significantly higher in the experimental group ($p<0.05$). In both groups, the left ventricular ejection fraction was increased after the protocol, while the left ventricular end-systolic dimension and the left ventricular end-diastolic dimension significantly decreased. The improvements in these variables were greater in the experimental group ($p<0.05$). The experimental group also exhibited significantly reduced tumor necrosis factor-α, interleukin-6, and high sensitivity C-reactive protein ($p<0.05$), and the experimental group reported higher quality of life ($p<0.05$) and nursing satisfaction ($p<0.05$).

Conclusion Nutritional support of elderly CHF patients administered by a specialized nursing team improved nutrition, cardiac function, inflammatory status, and quality of life compared to standard nutrition and regular nursing care.

Keywords Individualized nutritional support; specialty nursing team; chronic heart failure; cardiac function; nutritional status

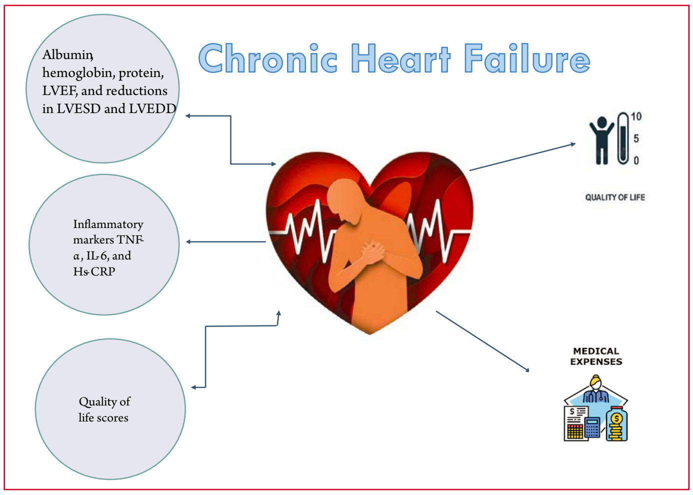
For citations Hang Chen, Ping Xu, Jia Hu, Hong Li, Yuan Yan, Yu Cai. Individualized Nutritional Support Improves Cardiac Function and Nutritional Status of Elderly Heart Failure Patients. Kardiologiia. 2025;65(2):48–56. [Russian: Хан Чэнь, Пин Сюй, Цзя Ху, Хун Ли, Юань Янь, Юй Цай. Индивидуальная нутритивная поддержка улучшает сердечную функцию и нутритивный статус пожилых пациентов с сердечной недостаточностью. Кардиология. 2025;65(2):48–56].

Corresponding authors Jia Hu. E-mail: hj12531116@163.com; Yuan Yan. E-mail: yuan444133@outlook.com

Introduction

Chronic heart failure (CHF) is a persistent, complex syndrome, primarily resulting from functional or structural heart disease. CHF results in impaired ventricular filling, lower cardiac output, and higher intracardiac pressures at rest or under stress [1]. Common CHF etiologies include endocardial diseases, valvular heart diseases, myocardial disorders, pericarditis or effusion, other vascular-related diseases, and metabolic disturbances [2]. Chronic heart failure is commonly associated with impaired left ventricular function and systemic inflammation, contributing to symptoms such as dyspnea, exercise intolerance, and fluid retention. Elderly patients with CHF often present with comorbidities like hypertension, coronary artery disease, and malnutrition, which negatively impact prognosis. Given the rising incidence of CHF in aging populations, addressing

Central illustration. Individualized Nutritional Support Improves Cardiac Function and Nutritional Status of Elderly Heart Failure Patients



ISSN 0022-9040. Кардиология. 2024;65(2). DOI: 10.18087/cardio.2025.2.n2764

nutritional deficiencies is crucial for improving patient outcomes [3].

In clinical settings, older patients diagnosed with CHF exhibit a heightened vulnerability to malnutrition, a factor intricately linked to the advancement of CHF. This progression results in a marked decline in the standard of living and a noteworthy escalation in mortality [4]. The susceptibility to malnutrition may be associated with the diminishing physical activity of elderly individuals and their frequently diminished and monotonous dietary intake [5]. Elderly CHF patients often have systemic or pulmonary congestion, a protracted disease trajectory, compromised nutritional status, and substantial weight loss [6].

In CHF patients, intestinal congestion and accumulation of abdominal fluids frequently result in diminished hunger, culminating in reduced food intake. In some cases, there may even be an aversion to eating, further intensifying the complications and challenges associated with poor nutritional status and substantial weight loss [7]. The resulting malnutrition may be present in 20% to 70% of CHF patients, with a cachexia incidence of 15% [7].

Once CHF patients develop cachexia, the condition becomes difficult to reverse, and malnutrition plays a crucial role in its further development. Therefore, initiating nutritional protocol for malnourished patients early in their hospitalization is of significant value for their prognosis. Hence, for newly diagnosed, elderly CHF patients with concomitant malnutrition, nutritional support is an essential component of their comprehensive treatment [8].

Recently, nutritional support measures have been implemented in CHF patients with the aim of improving their prognosis [9]. However, in China, nutritional therapy is still in its early stages, and limited by a scarcity of relevant research reports. The application value of this nutritional intervention requires further validation. Thus, this study examined the impact of individualized nutritional support provided by a specialized nursing team on the nutritional state and cardiac function of elderly CHF patients.

Material and methods

General information. 102 elderly CHF patients in our hospital between May 2022 and May 2023 were enrolled in this study. 51 patients each were randomly assigned to a treatment group or to a control group. Routine nursing care was provided to the control group, while individualized nutritional support was provided to the treatment group by a specialized nursing team. Both patient groups received standard medical treatment for heart failure. The hospital's medical ethics committee approved this investigation.

The age range of the 27 male and 24 female members of the treatment group was 65–85 yrs, with an average of 78.2±2.3 yrs. Their body mass index (BMI) ranged from 17.5 to 27.9 kg/m^2, with an average of 23.2±2.5 kg/m^2. 25 patients had primary or junior high school education, 15 had high school or vocational school education, and 11 had college or other higher education. 28 patients had New York Heart Association Class III heart failure [10], while 23 had Class IV failure.

The age range of the 31 male and 20 female members of the control group was 66–85 yrs, with an average of 78.6±2.3 yrs. Their BMI varied from 17.6 to 27.9 kg/m^2, with an average of 23.3±2.5 kg/m^2. 23 patients had primary or junior high school education, 16 had high school or vocational school education, and 12 had college or other higher education. 25 had Class III heart failure, while 26 had Class IV heart failure. There were no significant, discernible differences in heart function classification, gender, and age between the groups (p>0.05).

Inclusion criteria (Figure 1):

1. Diagnosis of CHF as outlined in the "Guidelines for the Primary Care of Chronic Heart Failure (2019)" constituted by the Chinese Medical Association [11].
2. Class II or Class III heart failure.
3. Age ≥ 60 yrs.
4. Complete clinical data available.
5. Voluntary written, informed consent.

Exclusion criteria:

1. Severe hepatorenal dysfunction.
2. Inability to adhere to treatment.
3. Severe psychological dysfunction.
4. Personal reason of the patient.

Figure 1 provides a schematic diagram of the patient screening.

The sample size (n) was estimated by:

$$n = 2\times\left[\frac{(u_\alpha + u_\beta)\times\sigma}{\delta}\right]^2$$

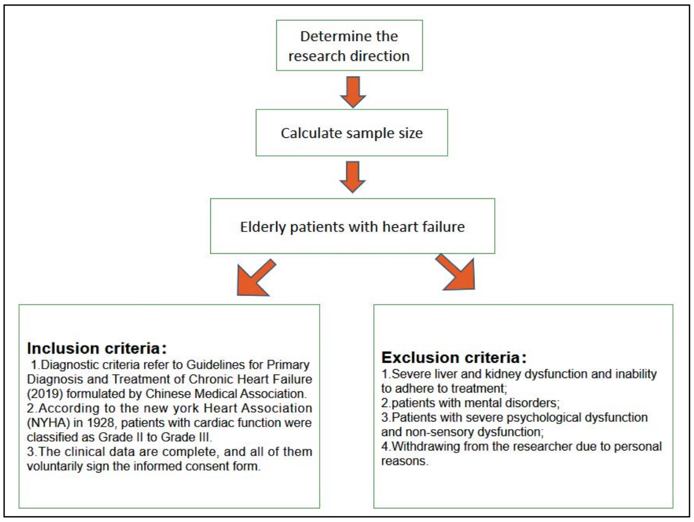
Where uα (1.96) is the value corresponding to a two-tailed α of 0.05; uβ (1.282) is the value corresponding to a β-II error probability of 0.1; δ (3.44) represents the expected difference in LVEF improvement between the two groups, hypothesized based on previous studies and clinical observations; σ (4.19) is the pooled standard deviation, estimated from preliminary data of LVEF measurements in similar patient populations.

Based on these parameters, the calculated sample size for each group was 46 cases. To account for a 10% dropout rate, we included 51 participants per group.

Nutrition

The control group was provided with traditional nutritional support, including routine dietary guidance combined with enteral nutrition. Oral enteral nutrition supplements, including peptide-based enteral nutrition such

Figure 1. Schematic diagram of the investigation including criteria for subject inclusion and exclusion



as Peptisorb, were administered to individuals capable of tolerating oral intake. For those unable or unwilling to receive oral administration, enteral nutrition was delivered through a nasogastric or nasoenteric tube, with dosage adjustments made according to tolerance. The goal was to maintain a daily energy intake of approximately 2000 kcal. The experimental group received individualized nutritional support.

Individualized nutritional support

The following scales and algorithms were used to guide the development and adjustment of the nutritional support plan.

1) Nutritional Risk Screening 2002 (NRS-2002). This tool was used for the initial assessment of the nutritional risk of the patients. It considered factors such as BMI, recent weight changes, and food intake, along with an age-adjusted score [12]. Patients with an NRS-2002 score of three or higher were classified as being at risk for malnutrition and received individualized nutrition. Patients with a score less than three received a standard nutritional support plan, similar to that in the control group. All patients in the experimental group were assessed using the NRS-2002 tool. Out of 51 patients in the experimental group, 35 patients (68.6%) were classified as at risk for malnutrition (NRS-2002 score ≥ 3) and received individualized nutritional support. The remaining 16 patients (31.4%) with a score <3 followed the standard nutritional support plan, similar to the control group. Subgroup analysis revealed that patients receiving individualized nutritional support demonstrated greater improvements in nutritional markers (e.g., serum albumin, hemoglobin, and total protein), cardiac function, and inflammatory status compared to those receiving standard nutrition. These findings highlight the importance of targeted nutritional interventions based on nutritional risk stratification.

2) Mini-Nutritional Assessment Short Form (MNA-SF). The MNA-SF includes evaluations of psychological status, health condition, and other aspects of the patient. It is the most used nutritional assessment tool for CHF patients. It assists in identifying CHF patients with malnutrition early and in providing timely intervention to improve their nutritional status and enhance their prognosis [13]. In addition to NRS-2002, the MNA-SF was employed to provide a more detailed assessment of nutritional status. This scale covers multiple domains such as health condition, psychological status, and dietary patterns, and was used to detect malnutrition early and guide the personalized nutritional support strategy.

Calculation of energy requirements

The daily energy requirement was calculated based on the patient's BMI, age, and disease status using standard algorithms [14]. These calculations determined the appropriate proportions of macronutrients, such as carbohydrates, proteins, and fats. Regular adjustments were made according to ongoing evaluations of the patients' nutritional and clinical status.

Biochemical monitoring

Regular measurements of serum albumin (ALB) and total protein (TP) were used as key indicators to adjust the nutritional support plan, thus ensuring personalized and effective support for each patient. Other indicators were: Hb, CRP, IL-6 and TNF-α.

Individualized nutritional support

An individualized nutritional support specialty nursing team was organized, made up of one head nurse and three specialized nurses. The head nurse was responsible for developing nursing protocols and overall quality assessment, while the specialized nurses were responsible for implementing nursing procedures. The initial assessment of patients' nutritional risk utilized the NRS2002 system [12]. This system involved evaluating measurements such as patients' body mass at admission, changes in food intake within the past week, recent fluctuations in body weight, and an age score. Based on the results of the NRS2002 nutritional screening, communication between physicians, patients, and patients' families was enhanced and expanded. This increased understanding of any nutritional issues that the patients were facing and the potential reasons behind these issues. Along with results of biochemical monitoring, this process enabled the development or improvement of a personalized nutritional support plan for the patient.

Patients with BMI <18.5 kg/m^2 were assigned three NRS-2002 points, and those with TP <30 g/l were also assigned three points. For patients with more normal BMI and TP resulting in a NRS2002 score of less than three points, the same routine nutritional support plan as the

ISSN 0022-9040. Кардиология. 2024;65(2). DOI: 10.18087/cardio.2025.2.n2764

control group was used to supplement their daily nutritional needs. These patients were screened every two days to allow for timely adjustments to their nutritional plan.

Patients with an NRS2002 score of three or more points required precise calculation of energy requirements based on factors such as age, BMI, and disease status. Specialized dietitians created personalized nutritional support plans for these patients, adjusting the proportion of carbohydrates, proteins, and fats to ensure adequate energy intake. Additionally, dietitians proscribed timely supplementation of various vitamins, electrolytes, and trace elements. Regular assessments of various nutritional indicators were conducted, and the nutritional intake plans were adjusted as needed.

In cases where the nutritional risk assessment did not indicate improvement after three screenings, a meeting was convened with members of the relevant healthcare professional team. The purpose of the meeting was to analyze the reasons for the insufficient nutritional intervention and to formulate a more tailored nutritional intervention plan for the patient. These interventions were sustained until the patient's discharge (1 month). After discharge, patients were followed up by telephone to monitor their progress, provide guidance, and remind them to return for regular check-ups.

Observation Index

Inflammatory Markers

The levels of TNF-α, IL-6 and CRP were measured to evaluate systemic inflammation. Blood samples (4 mL) were collected from fasting venous blood in the morning, centrifuged at 3500 rpm for 10 minutes, and the serum was analyzed. IL-6 and TNF-α were measured using an enzyme-linked immunosorbent assay (ELISA) kit according to the manufacturer's instructions. CRP levels were quantified using a high-sensitivity immunoturbidimetric method.

Nutritional status

Fasting venous blood samples (4 ml) were taken in the morning. The specimens were centrifuged at 3500 rpm for 10 min, and the supernatant was collected. The biuret colorimetric method was used to measure hemoglobin (HGB), serum ALB, and TP concentrations. Measurements were taken both prior to the protocol (upon admission) and following the protocol (on regular basis upto one month after the discharge).

Cardiac function

The Philips EPIQ7 color Doppler ultrasound system [15] was used to measure the left ventricular end-systolic dimension (LVESD), the left ventricular end-diastolic dimension (LVEDD), and the left ventricular ejection fraction (LVEF). These measurements were taken before the protocol (upon admission) and following the protocol at one month after discharge.

Inflammatory Markers

TNF-α, IL-6 and hs-CRP were measured both before the protocol (upon admission) and following the protocol upto one month after discharge.

Standard of Living

The Minnesota Living with Heart Failure Questionnaire [16] was used to evaluate the patients' standard of living. The questionnaire consists of 21 items, resulting in one total score with three dimensions: overall quality of life, physical domain, emotional domain. The maximum score on the scale was 105 points, and a higher scores corresponds to a lower standard of living. Assessment using this questionnaire were made prior to the protocol (upon admission) and following the protocol (one month after discharge).

Monitoring adverse reactions

Typical negative outcomes included diarrhea, abdominal distension, abdominal pain, vomiting, and nausea. The rate of overall adverse reaction was determined as the sum of all cases with adverse reactions divided by the total number of instances, multiplied by 100%. Adverse reactions were assessed for both groups.

Abdominal distension was evaluated by measuring the patient's abdominal circumference with a soft ruler. An increase in abdominal circumference after enteral feeding, along with increased hardness and tension detected during abdominal palpation by the doctor, was considered abdominal distension.

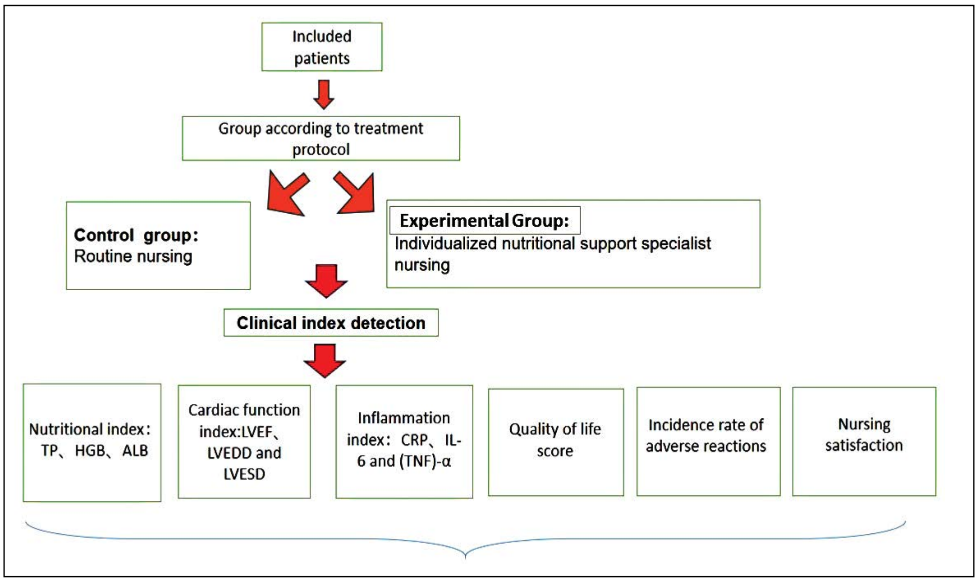
Nursing satisfaction

Upon the patient's discharge, their contentment with the nurses was assessed using a satisfaction survey questionnaire from our hospital. The evaluation results were categorized as very satisfied, satisfied, and dissatisfied. The overall satisfaction rate was calculated as the sum of the cases categorized as very satisfied and satisfied, divided by the total quantity of instances, multiplied by 100%. Figure 2 shows a flowchart of the investigation.

Statistical analysis

The data were processed using the statistical program, SPSS 22.0. Data with uniform variance and a normal distribution are presented as mean ± standard deviation (SD). Independent sample t-tests were used for between group comparisons, and paired t-tests were used for intra-group comparisons. Numerical data are reported as number (%), and χ^2 tests were used to compare these values. If $p<0.05$, a difference was considered statistically significant.

Figure 2. Flowchart of the study



Results

Comparison of nutrition-related indexes in the two groups before and after the protocol (Table 1). There were no statistically significant differences in the HGB, serum concentrations of ALB, and TP between the two groups before the protocol ($p<0.05$). Following the protocol, the concentrations of ALB, TP and HGB in both groups increased, but all the indexes were higher in the experimental group ($p<0.05$).

Comparison of cardiac function indices between the two groups before and after the protocol (Table 2). Before the protocol, there were no significant differences in LVEF, LVESD and LVEDD between the two groups ($p>0.05$). Following the protocol, the LVEF of both groups increased ($p>0.05$), and the LVESD and LVEDD decreased ($p>0.05$). The improvement of these indexes in the experimental group tended to be greater than in the control.

Comparison of inflammatory index indices between the two groups both before and after the protocol (Table 3).

Table 1. The nutrition-related indexes in the two groups before and after the protocol (n=51 in each group)

Group	TP (g/l)		Hb (g/l)		ALB (g/l)	
	Before protocol	After protocol	Before protocol	After protocol	Before protocol	After protocol
Experimental group	59.7±5.4	65.7±7.0a	123±9	134±12a	33.7±2.5	38.4±4.7a
Control group	60.4±5.1	62.0±6.4a	124±10	128±10a	32.8±6.4	34.5±3.9a
t	0.645	2.739	0.288	2.619	0.915	4.821
p	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Data are mean±SD. t and p, between group comparisons. awithin group comparisons, p<0.05. TP, total protein; Hb, hemoglobin; ALB, albumin.

Table 2. The cardiac function indexes in the two groups before and after the protocol (n=51 in each group)

Group	LVEF (%)		LVESD (mm)		LVEDD (mm)	
	Before protocol	After protocol	Before protocol	After protocol	Before protocol	After protocol
Experimental group	34.6±2.7	44.0±5.1a	45.6±5.2	37.9±4.2a	54.4±5.7	50.3±4.2a
Control group	35.2±2.8	37.7±4.3a	44.9±5.1	40.5±4.6a	54.8±5.0	53.3±4.0a
t	1.162	6.683	0.745	3.011	0.396	3.674
p	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Data are mean±SD. t and p, between group comparisons. awithin group comparisons, p<0.05.
LVEF, left ventricular ejection fraction; LVESD, left ventricular end systolic diameter; left ventricular end diastolic diameter.

Table 3. The inflammatory indexes in the two groups before to and after the protocol (n=51 in each group)

Group	hs-CRP (mg/l)		IL-6 (pg/ml)		TNF-α	
	Before protocol	After protocol	Before protocol	After protocol	Before protocol	After protocol
Experimental group	35.1±5.2	16.5±4.2a	386±75	264±43a	54.6±12.7	43.7±8.7a
Control group	35.3±5.2	27.7±5.2a	385±75	325±51a	55.1±11.9	49.7±10.1a
t	0.116	11.816	0.073	6.549	0.193	3.209
p	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Data are mean±SD. t and p, between group comparisons. awithin group comparisons, p<0.05.
hs-CRP, C-reactive protein; IL-6, interleukin-6; TNF-α, tumor necrosis factor-α.

ISSN 0022-9040. Кардиология. 2024;65(2). DOI: 10.18087/cardio.2025.2.n2764

Table 4. The quality of life ratings in the two groups before to and after the protocol (n=51 in each group)

Group	Somatic domain		Emotional field		Other areas		Total quality-of-life scores	
	Before protocol	After protocol	Before protocol	After protocol	Before protocol	After protocol	Before protocol	After protocol
Experimental group	22.4±3.1	13.2±3.7a	10.2±2.6	8.0±2.6a	16.7±4.2	12.2±3.6a	48.6±6.4	35.4±7.2a
Control group	22.0±3.25	16.6±5.09a	10.4±2.9	9.6±2.7a	16.2±4.51	14.2±4.6a	48.3±7.8	40.7±6.7a
t	0.585	3.778	0.256	3.142	0.104	2.558	0.247	3.829
p	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Data are mean±SD. t and p, between group comparisons. awithin group comparisons, p<0.05.

Table 5. The adverse reactions of the two groups during the protocol (n=51 in each group)

Group	Nausea and vomiting	Abdominal pain and distension	Diarrhea	Total incidence rate
Experimental group	1 (2.0)	0 (0.0)	1 (2.0)	2 (3.9)
Control group	3 (5.9)	5 (9.8)	2 (3.9)	10 (19.1)

Data are number (percentage).

Table 6. Comparison of nursing satisfaction between the two groups

Group	Very satisfied	Satisfied	Not satisfied	Overall satisfied
Experimental group	36 (70.6)	14 (27.4)	1 (2.0)	50 (98.0)
Control group	29 (56.9)	12 (23.5)	10 (19.6)	41 (80.4)
χ^2				8.254
p				<0.05

Data are number (percentage).
Overall satisfaction = Very satisfied + Satisfied.

Before the protocol, there were no significant differences in the inflammatory indexes between the two groups (p>0.05), but after the protocol, these indexes were significantly lower (p<0.05). The improvement of these indexes in the experimental group tended to be greater than in the control.

Comparison of the quality-of-life ratings between the two groups before and after the protocol (Table 4). Before the protocol, there were no significant differences in the qualityof life scores in the physical, emotional, and other areas between the two groups (p>0.05). Following the protocol, the quality-of-life scores in all areas increased significantly in both groups, but these scores were greater in the experimental group (p<0.05).

Comparison of the adverse reactions between the two groups during the protocol (Table 5). The incidence of adverse reactions in the experimental group (3.92%) was significantly less than in the control group. (19.61%, p<0.05).

Comparison of the nursing satisfaction of the two groups following the protocol (n=51 in each group). The nursing satisfaction of the experimental group was 98.0%, which was significantly higher than in the control group (p<0.05) (Table 6).

Discussion

According to an epidemiological investigation [16], the frequency of malnutrition in elderly people with CHF is as high as 50% to 60%, and malnutrition increases the mortality and complication rate of elderly CHF patients [17]. It has been confirmed that good nutritional support can considerably improve the standard of living of elderly individuals with CHF [18], decrease the chance of malnourishment, and ensure more normal operation of various body functions.

Traditional nutrition support lacks standardized, repetitive, and systematic processes, and it is not targeted, making it prone to overlooking patients' comprehensive needs and resulting in a limited clinical application effect [19, 20]. Individualized nutritional support, tailored to the individual conditions and gastrointestinal digestive function of patients, involves implementing targeted nutritional supply to ensure a balanced intake of nutrients, maintain water and electrolyte balance, and enhance the overall nutritional status of the body. This approach aims to increase levels of prealbumin, transferrin, hemoglobin, and total albumin, as well as to enhance body mass, boost immunity, and facilitate the rehabilitation of the patients [21, 22]. Providing effective nutritional support during the rehabilitation process can expedite the prognosis and improve patients' general quality of life.

The individualized nutritional support program employed in this study was specifically tailored to different individuals. It adjusted the nutritional plan in a timely manner based on the daily changes in illness and nutritional requirements. It included the daily replenishment of trace elements and electrolytes according to the results of biochemical ion assessments to meet the body's needs. This case nursing model, grounded in nutritional risk screening, assesses the daily energy requirements of patients by considering their actual situation and nutritional status. It then adjusts the dietary structure and energy ratio according to the evaluation's findings. The goal is to establish positive habits, enhance the patients' dietary condition, and elevate the overall prognosis level.

This approach falls under dynamic nutritional support therapy [23], which places high demands on the daily fluid intake and output of the body. The ultimate daily fluid infusion is determined, based on the severity of cardiac insufficiency and the extent of liver and kidney damage, and, thus, aims to reduce the cardiac load and metabolic pressure on the liver and kidneys [24, 25]. Although, this investigation revealed that the concentrations of serum TP, HGB and ALB in both the control and the experimental groups significantly increased during the protocol, but all of these indexes were higher in the experimental group. Thus, it is proposed that individualized nutritional support provided by a specialized nursing should be included in the treatment plan of patients hospitalized for CHF.

Alterations of cardiac function are often caused by various organic cardiac diseases, and nutritional support has been shown to improve myocardial function and overall health in patients with heart failure [26, 27]. The results of this study showed that LVEF in the experimental group was significantly higher, while LVEDD and LVESD were significantly lower in the experimental group, thus indicating that the specialized nursing model based on nutritional risk screening and supplementation could improve myocardial contraction function and overall cardiac function in patients with CHF. LVEF directly reflects the myocardial systolic function, and an increase in LVEF reflects enhancement of myocardial contractility. This indicates that the myocardial contractile function of the patients was improved by nutritional risk screening and supplementation [7]. The increased Left Ventricular End-Diastolic Dimension (LVEDD) and Left Ventricular End-Systolic Dimension (LVESD) in CHF patients reflect an increase in ventricular volume, which can elevate ventricular wall tension and potentially depress cardiac systolic function. While an infarcted or dyskinetic area is one possible cause of these changes, this study did not explicitly assess the presence of infarcted areas. Prior to the nutritional intervention, no significant differences in LVEF, LVESD, or LVEDD were observed between the control and experimental groups. Following the intervention, these indices showed improvement in both groups, with the experimental group demonstrating more pronounced enhancements [28]. This further demonstrates the benefits of the individualized nutritional support provided to the patients in the experimental group.

Since malnutrition in elderly CHF patients often contributes to ventricular systolic dysfunction, timely improvement of the nutritional status in these patients is crucial. Enhancing cardiac function and the rehabilitation outcomes of CHF patients requires prompt attention to their nutritional needs. As noted above, the individualized nursing model, grounded in nutritional risk screening, proved to be more effective in improving cardiac function as it enabled a more targeted improvement in the nutritional status of the patients.

It has been reported that inflammatory reactions are the main pathological basis of cardiac failure. Alleviating the response of inflammation would help to slow down the progress of the disease [29]. Inflammatory reactions, driven by inflammatory factors, play a major role in the pathogenesis of various heart failure phenotypes, and the regulation of these factors is a potential therapeutic target in the management of heart failure [30, 31]. Therefore, the concentrations of inflammatory factors in patients' serum were also measured in this study. The results revealed lower concentrations of CRP, IL-6 and TNF-α in the experimental group. Thus, personalized nutrition support was effective in reducing the hyperinflammatory state of CHF patients. This contributed to the improvement of cardiac function and enhanced the patients' quality of life and overall clinical condition.

In this research, the quality-of-life scores in the experimental group after the protocol were higher. This shows that the individualized nutritional support provided specialized nursing is more helpful in enhancing the mental condition and standard of living for elderly patients with CHF.

Adverse reactions such as abdominal pain, abdominal distension, diarrhea, nausea, and vomiting occurred in both groups, but unfavorable responses were less common in the experimental group. Thus, this further supports the use of individualized nutrition protocol since it was more beneficial in mitigating adverse reactions among patients. Furthermore, the nursing satisfaction of the patients in the experimental group was considerably higher. Patients in the experimental group had fewer negative effects and a greater rate of recovery, which significantly improved their nursing satisfaction.

Adverse reactions such as abdominal pain, abdominal distension, diarrhea, nausea, and vomiting occurred in both groups, but unfavorable responses were significantly less common in the experimental group (3.92% vs. 19.61%). This indicates better tolerance of the intervention in the experimental group. Furthermore, patients in the experimental group demonstrated significantly greater improvements in cardiac function indices (LVEF, LVESD, LVEDD), nutritional status (ALB, HGB, TP), and quality-of-life scores compared to the control group. These outcomes suggest a faster and more comprehensive recovery in the experimental group. The higher nursing satisfaction (98% vs. 80.4%) further supports the conclusion that

ISSN 0022-9040. Кардиология. 2024;65(2). DOI: 10.18087/cardio.2025.2.n2764

individualized nutritional support improved patient recovery and overall outcomes.

However, it is critical to recognize the study's limitations, notably its small sample size, lack of regional diversity, and absence of patients feedback from patients and healthcare providers on the implementation and outcomes of the individualized nutritional program.

Conclusion

Individualized, nutritional support of elderly CHF patients administered by a specialized nursing team improved nutritional status, cardiac function, inflammatory status, and quality of life compared to standard nutrition and regular nursing care. This nutritional support protocol resulted in fewer adverse reactions and higher patient satisfaction. It merits broader study and implementation.

Funding

Key medical support disciplines in Suzhou, Funding Number: SZFCXK202109.

No conflicts of interest are reported.

The article was received on 17/09/2024

REFERENCES

1. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. European Heart Journal. 2021;42(36):3599–726. DOI: 10.1093/eurheartj/ehab368
2. Heidenreich PA, Bozkurt B, Aguilar D, Allen LA, Byun JJ, Colvin MM et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022;145(18):e876–94. DOI: 10.1161/CIR.0000000000001062
3. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). With the special contribution of the Heart Failure Association (HFA) of the ESC. European Journal of Heart Failure. 2022;24(1):4–131. DOI: 10.1002/ejhf.2333
4. Arrigo M, Jessup M, Mullens W, Reza N, Shah AM, Sliwa K et al. Acute heart failure. Nature Reviews Disease Primers. 2020;6(1):16. DOI: 10.1038/s41572-020-0151-7
5. Pontremoli R, Borghi C, Perrone Filardi P. Renal protection in chronic heart failure: focus on sacubitril/valsartan. European Heart Journal - Cardiovascular Pharmacotherapy. 2021;7(5):445–52. DOI: 10.1093/ehjcvp/pvab030
6. Alvarez P, Sianis A, Brown J, Ali A, Briasoulis A. Chronic disease management in heart failure: focus on telemedicine and remote monitoring. Reviews in Cardiovascular Medicine. 2021;22(2):403–13. DOI: 10.31083/j.rcm2202046
7. Heidenreich PA, Bozkurt B, Aguilar D, Allen LA, Byun JJ, Colvin MM et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure. Journal of the American College of Cardiology. 2022;79(17):e263–421. DOI: 10.1016/j.jacc.2021.12.012
8. Heidenreich PA, Bozkurt B, Aguilar D, Allen LA, Byun JJ, Colvin MM et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: Executive Summary. Journal of the American College of Cardiology. 2022;79(17):1757–80. DOI: 10.1016/j.jacc.2021.12.011
9. Haynes R, Zhu D, Judge PK, Herrington WG, Kalra PA, Baigent C. Chronic kidney disease, heart failure and neprilysin inhibition. Nephrology Dialysis Transplantation. 2020;35(4):558–64. DOI: 10.1093/ndt/gfz058
10. Bredy C, Ministeri M, Kempny A, Alonso-Gonzalez R, Swan L, Uebing A et al. New York Heart Association (NYHA) classification in adults with congenital heart disease: relation to objective measures of exercise and outcome. European Heart Journal - Quality of Care and Clinical Outcomes. 2018;4(1):51–8. DOI: 10.1093/ehjqcco/qcx031
11. Chinese Medical Association. Guideline for primary care of chronic heart failure (2019). Chinese Journal of General Practitioners. 2019;18(10):936–47. DOI: 10.3760/cma.j.issn.1671-7368.2019.10.008
12. Alikiaii B, Heidari Z, Fazeli A, Rahimi Varposhti M, Moradi Farsani D, Fattahpour S et al. Evaluation of the effectiveness of the Nutritional Risk Screening System 2002 (NRS-2002) in COVID-19 patients admitted to the intensive care unit. International Journal of Clinical Practice. 2021;75(12):e14934. DOI: 10.1111/ijcp.14934
13. Sysal P, Veronese N, Arik F, Kalan U, Smith L, Isik AT. Mini Nutritional Assessment Scale-Short Form can be useful for frailty screening in older adults. Clinical Interventions in Aging. 2019;14:693–9. DOI: 10.2147/CIA.S196770
14. Ndahimana D, Kim E-K. Energy Requirements in Critically Ill Patients. Clinical Nutrition Research. 2018;7(2):81–90. DOI: 10.7762/cnr.2018.7.2.81
15. Philips. EPIQ 7 Ultrasound System User Manual. © 2013 Koninklijke Philips. All rights reserved. Published in USA. Av. at: https://usme.com/wp-content/uploads/2022/06/epiq_7.pdf.
16. Garin O, Herdman M, Vilagut G, Ferrer M, Ribera A, Rajmil L et al. Assessing health-related quality of life in patients with heart failure: a systematic, standardized comparison of available measures. Heart Failure Reviews. 2014;19(3):359–67. DOI: 10.1007/s10741-013-9394-7
17. Hersberger L, Dietz A, Bürgler H, Bargetzi A, Bargetzi L, Kägi-Braun N et al. Individualized Nutritional Support for Hospitalized Patients With Chronic Heart Failure. Journal of the American College of Cardiology. 2021;77(18):2307–19. DOI: 10.1016/j.jacc.2021.03.232
18. Fernández-Pombo A, Rodríguez-Carnero G, Castro AI, Cantón-Blanco A, Seoane LM, Casanueva FF et al. Relevance of nutritional assessment and treatment to counteract cardiac cachexia and sarcopenia in chronic heart failure. Clinical Nutrition. 2021;40(9):5141–55. DOI: 10.1016/j.clnu.2021.07.027
19. Schuetz P, Sulo S, Walzer S, Krenberger S, Stagna Z, Gomes F et al. Economic Evaluation of Individualized Nutritional Support for Hospitalized Patients with Chronic Heart Failure. Nutrients. 2022;14(9):1703. DOI: 10.3390/nu14091703
20. Yasuhara S, Maekawa M, Bamba S, Kurihara M, Nakanishi N, Yamamoto T et al. Energy Metabolism and Nutritional Status in Hospitalized Patients with Chronic Heart Failure. Annals of Nutrition and Metabolism. 2020;76(2):129–39. DOI: 10.1159/000507355
21. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) With the special contribution of the Heart Failure Association (HFA) of the ESC. Revista Española de Cardiología (English Edition). 2022;75(6):523. DOI: 10.1016/j.rec.2022.05.005
22. Bozkurt B, Fonarow GC, Goldberg LR, Guglin M, Josephson RA, Forman DE et al. Cardiac Rehabilitation for Patients With Heart Failure. Journal of the American College of Cardiology. 2021;77(11):1454–69. DOI: 10.1016/j.jacc.2021.01.030
23. Uysal H, Öz Alkan H, Enç N, Yiğit Z. Assessment of Dietary Habits in Patients With Chronic Heart Failure. Journal of Nursing Research. 2020;28(1):e65. DOI: 10.1097/jnr.0000000000000329

24. Matsumura K, Teranaka W, Taniichi M, Otagaki M, Takahashi H, Fujii K et al. Differential effect of malnutrition between patients hospitalized with new-onset heart failure and worsening of chronic heart failure. ESC Heart Failure. 2021;8(3):1819–26. DOI: 10.1002/ehf2.13279
25. McGrath R, Lee D-C, Kraemer WJ, Vincent BM, Shaughnessy KA, Terbizan DJ. Weakness is Associated with Time to Incident Chronic Heart Failure in Aging Americans. The Journal of nutrition, health and aging. 2020;24(1):16–9. DOI: 10.1007/s12603-019-1266-y
26. Emmons-Bell S, Johnson C, Roth G. Prevalence, incidence and survival of heart failure: a systematic review. Heart. 2022;108(17):1351–60. DOI: 10.1136/heartjnl-2021-320131
27. Rusli C, Bukhari A, A. Taslim N, As'Ad S, Rasyid H. Nutrition Therapy in Critically Ill Overweight Elderly Patient with Heart Failure, Myocardial Infarction, Pneumonia, and Chronic Kidney Disease. Journal of Nutritional Science and Vitaminology. 2020;66(Suppl):S25–31. DOI: 10.3177/jnsv.66.S25
28. Manceau H, Ausseil J, Masson D, Feugeas J-P, Sablonniere B, Guieu R et al. Neglected Comorbidity of Chronic Heart Failure: Iron Deficiency. Nutrients. 2022;14(15):3214. DOI: 10.3390/nu14153214
29. Hotta K, Taniguchi R, Nakayama H, Yamaguchi F, Sato Y. The Effects of an Oral Nutritional Supplement with Whey Peptides and Branched-Chain Amino Acids for Cardiac Rehabilitation of Patients with Chronic Heart Failure: A Randomized, Pilot Study. International Heart Journal. 2021;62(6):1342–7. DOI: 10.1536/ihj.21-102
30. Guerra-Sánchez L, Fresno-Flores M, Martínez-Rincón C. Effect of a double nutritional intervention on the nutritional status, functional capacity, and quality of life of patients with chronic heart failure: 12-month results from a randomized clinical trial. Nutrición Hospitalaria. 2020;34(3):422–31. DOI: 10.20960/nh.02820
31. Lisco G, Giagulli VA, Iovino M, Zupo R, Guastamacchia E, De Pergola G et al. Endocrine system dysfunction and chronic heart failure: a clinical perspective. Endocrine. 2022;75(2):360–76. DOI: 10.1007/s12020-021-02912-w

ISSN 0022-9040. Кардиология. 2024;65(2). DOI: 10.18087/cardio.2025.2.n2764