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Effect of a Nursing Program on Anxiety, Depression, and Insomnia in Patients After Liver Transplantation: A Randomized Controlled Trial

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Study Design A
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Statistical Analysis C
Data Interpretation D
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Background: The incidence of anxiety, depression, and sleep disturbances is high among patients after liver transplantation, significantly impacting their quality of life. However, existing nursing programs often lack a comprehensive focus on psychological and physical health outcomes. This study aimed to evaluate the effectiveness of a targeted nursing program in reducing anxiety, depression, and sleep disturbances among liver transplantation patients through psychological care, lifestyle guidance, pain management, and rehabilitation training.

Material/Methods: A randomized controlled trial was conducted with 80 liver transplantation patients at Beijing Youan Hospital (2021-2023). Patients were randomly assigned to the control group (traditional nursing, n=40) or the intervention group (targeted nursing, n=40). The intervention included psychological care, lifestyle guidance, pain management, and rehabilitation training. Anxiety, depression, and sleep quality were assessed using the SDS, HAMA, and PSQI at 4 time points: 0-60, 61-120, 121-180, and 181-360 days after surgery.

Results: The incidence of anxiety, depression, and insomnia at 0-60, 61-120, 121-180, and 181-360 days after liver transplantation was 42.50%, 37.50%, 35.00%, and 30.00%; 14.50%, 9.40%, 3.20%, and 1.20%; and 15.80%, 12.10%, 7.30%, and 6.50%, respectively. After the care program, the depression, anxiety, and sleep scores were lower in the intervention group than in the control group and gradually decreased over time ($p<0.05$).

Conclusions: The nursing program after liver transplantation includes postoperative psychology, pain care, life strategies, and rehabilitation training, which can effectively reduce the depression, anxiety, and sleep scores of patients and is recommended for wide use.

Clinical trial: CHiCTR1900024561

Keywords: Anxiety • Incidence • Transplantation

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Introduction

Liver transplantation is an important and complex surgical procedure that is commonly used to treat various liver diseases, including cirrhosis, liver cancer, and acute liver failure [1]. Because liver transplantation is a highly stressful and risky process, both the operation itself and the postoperative recovery process can have a serious impact on the physical and mental health of patients, including the occurrence of anxiety and depressive symptoms [2]. Patients also often experience sleep problems after surgery, such as difficulty falling asleep, shallow sleep, and waking up at night [3]; such problems increase the risk of anxiety and depression. The study found high rates of anxiety, depression, and insomnia after liver transplantation, at 29%, 25%, and 28%, respectively. Psychological complications following liver transplantation are associated with many factors [4], such as the patient's age, gender, and education, surgical procedures, and postoperative care; they may also be associated with physical and psychological stress caused by surgery [5-7]. Factors such as uncertainty during recovery, pain, and medication adverse effects may also aggravate patient anxiety [8,9]. Anxiety and depression not only reduce the quality of life of patients but may also affect their rehabilitation process and the survival of transplanted organs.

In summary, healthcare professionals must pay close attention to the psychological and physical condition of patients and the support of their families and community, and should provide individualized care programs to help patients relieve anxiety and promote their physical recovery [10]. Previous studies have focused on psychological interventions in liver transplant patients [11,12], and few systematic nursing programs after liver transplantation have intervened in other aspects of patient care. One study [11] used mindfulness training to intervene in the anxiety and depression levels and sleep quality of patients after liver transplantation and found that it could reduce their anxiety and depression levels and improve sleep quality. However, the study was primarily psychological and did not involve other programs, and the number of interventions was small. Other nursing studies [13] have focused on the nursing period in the hospital and did not follow up on their psychological status after discharge to study their long-term effects.

While these previous studies have provided valuable insights into the psychological challenges faced by liver transplantation patients, they lack a comprehensive approach that integrates multiple facets of patient care. Postoperative recovery is a complex process involving not only psychological adjustment but also physical rehabilitation, pain management, and lifestyle modifications. Addressing these interconnected aspects is essential for achieving sustainable improvements in patients' quality of life. This highlights an unmet need for a systematic and multifaceted nursing program that goes beyond psychological interventions to encompass a broader spectrum of postoperative care.

Therefore, we performed the present randomized controlled trial to assess a nursing program after liver transplantation that includes training in psychology, pain management, life strategies, and rehabilitation, as a holistic intervention for patients and follow-up to observe its long-term effects. The aim was to investigate whether the nursing program can effectively reduce anxiety, depression, and sleep scores of patients after liver transplantation.

Material and Methods

Research Participants

This was a randomized controlled trial. A total of 80 patients who underwent liver transplantation at the surgery center of Beijing Youan Hospital between January 2021 and December 2023 were selected as the study participants using convenience sampling. All methods were carried out in accordance with relevant guidelines and regulations.

Randomization was performed according to the random number table method. A random number table was used to generate random numbers for each participant, and participants with odd numbers were assigned to the control group, which followed the traditional care protocol (n=40 patients). Participants with even numbers were assigned to the intervention group, which followed the post-liver transplantation care protocol (n=40 patients). This process was performed manually by a researcher to ensure the randomness of the allocation while maintaining balance between the groups. The inclusion criteria were as follows: (1) Adults aged 18-75 years who can independently complete self-reported psychological and sleep assessments; (2) first-time liver transplantation, as these patients experience higher levels of emotional and psychological stress related to the surgery and are thus more representative for studying post-transplant anxiety and depression; and postoperative consciousness with basic communication skills; and (3) able to perceive emotions linked to anxiety and depression and to describe sleeping conditions. The exclusion criteria were as follows: (1) suffering from other serious physical illnesses that may affect anxiety levels (eg, advanced cancer, heart disease); (2) a history of other mental disorders (eg, schizophrenia, bipolar disorder) or inability to understand and answer research questions; (3) prescribed and taking anti-anxiety or other medications during the study that may affect anxiety symptoms; (4) substance abuse (eg, alcohol, drugs) or a history/current symptoms of mental illness; or (5) unstable postoperative signs (eg, primary nonfunction, haemorrhage, vascular complications, biliary complications, metabolic complications,

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and renal insufficiency). The suspension criteria were as follows (consideration of participant safety; it was not deemed appropriate for the participant to continue the study): (1) voluntary withdrawal; (2) experiencing a serious adverse event during the study, such as a serious drug adverse effect or physical impairment; (3) loss of contact with the study team or unavailable for follow up; (4) severe illness deterioration during the study period, inability to continue participation in the study or inability to assess anxiety scores; and (5) ethical regulations or ethical requirements of the study protocol were violated by the participant during the study. The study was approved by the hospital's ethics committee (Ethics Archive Number: LL-2023-135-K) and all patients who participated in the study provided informed consent. The clinical study registration number is CHiCTR1900024561.

The R 4.2.1 (Beijing, China) package was used for sample estimation and power analysis and employed the following settings: target power=0.90; alpha=0.15; group allocation equal (N1=N2); experience difference δ=1; standard deviation σ=1.5; N1=N2=34; dropout rate=15%; N1'=N2'=40 and N'=80. Missing data were handled using simple imputation based on available values from the baseline and follow-up, which helped maximize data use while preserving result validity.

Intervention and Control

The intervention and control groups were treated by 2 nurses of the same age, with the same title and from traditional nursing programs. To ensure the competency of the nurses, all were trained on the intervention components (psychological care, pain management, postoperative care, rehabilitation) by senior specialists before the study began. Nurses were regularly assessed to ensure consistent implementation. Routine care practices, including nutritional therapy and skin care, followed standardized protocols to avoid any variations in care. The incidence of postoperative anxiety, depression, and sleep problems in patients after liver transplant in the control group and the intervention group were measured to assess the effectiveness of the nursing mode in the intervention group.

Control Group

Traditional care regimens were used, including routine monitoring of vital signs, attention to changes in condition, nutritional support, keeping the skin clean, preventing complications, and regular computed tomography (CT) examinations.

Electrocardiogram and oxygen saturation output were monitored postoperatively, and any changes in vital signs were closely observed to prevent critical symptoms. Body temperature was monitored closely, and a doctor was notified immediately if it exceeded 38°C, particularly if accompanied by chills, nausea, vomiting, diarrhea, or a rash. Concurrently, nursing staff paid attention to possible dangerous situations, such as excessive drainage flow, bleeding around the puncture point on the skin, and increased ecchymosis within 24-48 hours after the operation. Nutritional supportive therapy was given to the patients and their skin was kept clean, particularly where active and passive movement of the limbs occurred during bed rest, to prevent the occurrence of deep vein thrombosis, muscle atrophy, or joint contracture. Regular liver function review and abdominal CT examinations were performed to determine the status of postoperative recovery.

Intervention Group

1) Postoperative psychological strategy: Liver transplant patients often suffer from anxiety, nervousness, fear, depression, and other adverse emotions because of concerns regarding the financial burden caused by the surgery on their family and the pressures brought on by the surgery itself. Therefore, nursing staff encouraged and comforted patients after the operation and patiently reiterated relevant knowledge about the disease and the necessity for the transplantation to ensure that they had good understanding about the procedure as a whole.
2) Postoperative pain strategy: An air mattress was used to ensure cushioning of every type of bone protuberance. The nursing staff regularly wiped the patient's entire body with warm water and changed their clothes promptly to prevent pressure sores. The nursing staff properly fixed the drainage tube, ensuring that it was unobstructed and regularly observed the color, quantity, and character of the drained fluid, as well as the skin condition of the puncture site.
3) Postoperative life strategy: Patients consumed nutritious and easy-to-digest foods and were instructed to avoid greasy and spicy foods. According to the patient's liver function, the nursing staff adjusted the structure of their diet promptly to ensure that they received balanced nutrition. Patients needed adequate rest time to avoid overexertion. If their physical condition allowed, patients were encouraged to take part in appropriate activities, such as walking and tai chi to enhance their physical fitness and promote their recovery.
4) Rehabilitation training: Nursing staff instructed patients to perform breathing exercises, such as deep breathing and coughing, to enhance their lung function and prevent lung infections. Individualized limb function training programs were also developed based on the patient's specific situation. Blood circulation was promoted and muscle atrophy was prevented through massage and passive exercise. Psychological counselling was provided to patients through communication and experience sharing to relieve their anxiety, enhance their confidence, and promote psychological recovery.

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Data Collection

Patients who underwent liver transplantation were divided into 4 different time periods: 0-60, 61-120, 121-180, and 181-360 days. Follow-up staff collected questionnaires in 4 time periods through door-to-door calls, telephone, or WeChat in the home or the hospital. The duration of the continuous intervention was 1 year. During these periods, the researchers and nurses used the double-blind trial method to ensure the objectivity of this study. During the 1-year follow-up period for data collection, all study participants were highly cooperative, and all data were acquired after issuing the questionnaire.

Hamilton Anxiety Scale

The Hamilton Anxiety Scale (HAMA) was developed by Hamilton in 1959 and is mainly used to assess the severity of anxiety symptoms in patients [14]. It measures both mental anxiety and somatic anxiety. The scale ranges from 0 to 4, with 0 indicating no anxiety symptoms and 4 indicating a concentration of anxiety symptoms. The total score is divided into the following intervals: >29 points (considered severe anxiety); >21 points (definite significant anxiety); >14 points (definite anxiety); >7 points (considered anxiety); and <7 points (no anxiety symptoms). According to Tang Yuhua et al [15], HAMA has good reliability and validity, with a reliability coefficient r of 0.93 for the total score assessment, 0.83 to 1.00 for each single symptom score, and 0.36 for the validity coefficient.

Self-Rating Depression Scale

The Self-Rating Depression Scale was compiled by W.W. Zung to assess depression severity [16]. The scale contains 20 items divided into 4 factors: affective symptoms, somatic symptoms, psychomotor disorders, and psychological disorders. The answer options for each item are 'no or little time', 'a small part of the time', 'considerable time' and 'the vast majority of the time', which are recorded as 1-4 points, respectively. A total score of ≤52 is considered normal, 53-62 is considered mild depression, 63-72 is considered moderate depression, and ≥73 is considered severe depression. Correlation studies performed on SDS showed correlation coefficients >0.7 for all 20 items of the scale. The test-retest reliability of each item ranged from 0.730 to 1.000, and the Cronbach's α coefficient ranged from 0.782 to 0.784, indicating that the reliability and validity of this scale were good [17].

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index is used to evaluate sleep quality [18]. The scale has 7 factors: sleep quality, sleep onset time, sleep duration, sleep efficiency, sleep disturbance, hypnotic drugs used, and daytime dysfunction. Each factor is scored from 0 to 3. The total score on the scale is 0-21, and the score is negatively correlated with sleep quality. A score of 0-5 indicates good sleep quality, a score of 6-10 indicates average sleep quality, a score of 11-15 indicates fair sleep quality and a score of 16-21 indicates poor sleep quality. A study by Lu Taoying et al [19] showed that Cronbach's α of this scale was 0.845, with high intrinsic consistency. The confirmatory factor analysis showed that the fit index χ^2/df, square root of approximate error (RMSEA), non-norm fitting index (NNFI), comparative fitting index (CFI), and goodness-of-fit index (GFI) were 4.83, 0.09, 0.96, 0.98, and 0.97, respectively, indicating good validity [19].

The above questionnaires were translated into Chinese and administered by trained nurses during these follow-ups, with face-to-face interviews being prioritized. Telephone and WeChat interviews were used as alternatives when in-person visits were not possible, ensuring consistent application of the scale. The demographic and general clinical characteristics of the patients were also collected, including age, gender, marital status, education, place of residence, history of previous anxiety, history of previous depression, and type of liver disease.

Statistical Methods

The data analysis was performed using SPSS 26.0 (IBM, Armonk, NY, USA) statistical software. First, continuous data were statistically described by mean±standard deviation (M±SD), and qualitative data were described by case number or percentage (%). Then, the *t*-test was used to compare continuous variables (age), while the chi-squared (χ^2) test was adopted to compare nominal variables (gender, marital status, education, place of residence, proportion of patients with previous anxiety, previous depression and previous sleep disorders, and the proportion of patients with different types of liver disease) between the groups. Finally, repeated-measures of analysis of variance (ANOVA) were used to compare anxiety, depression, and sleep quality scores at each time point in the follow-up measures to analyze the time and intervention effects; a *p*-value of <0.05 was considered to indicate statistical significance.

Results

Baseline Characteristics of Participants

During the 1-year follow-up period, all study participants were highly cooperative, and no participants were lost or suspended. The mean age of patients was 56.79 years in the intervention group and 57.34 years in the control group. Previous histories of anxiety and depression were 17.5% and 7.5%, respectively, in the intervention group, and 22.5% and 5.0%, respectively, in the control group. Patients with previous sleep

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Table 1. Baseline characteristics of the patients.

Characteristic	Intervention group (N=40)	Control group (N=40)	t/χ^2	P
Age (M±SD)	56.79±1.31	57.34±1.28	0.382	0.545
Sex			0.202	0.653
Men	19	17		
Women	21	23		
Marital status			0.053	0.818
Spousal	24	25		
Non-spousal	16	15		
Education			1.186	0.172
Junior high school and below	29	34		
College and above	11	6		
Residence			0.228	0.633
Rural	26	28		
Urban	14	12		
Previous anxiety			0.376	0.54
Yes	7	9		
No	33	31		
Previous depression			3.222	0.136
Yes	3	2		
No	37	38		
Previous sleep disorders			1.829	0.176
Yes	6	7		
No	34	33		
Types of liver disease			0.300	0.861
Cirrhosis	13	11		
Liver failure	14	16		
Liver cancer	13	13		

disorders accounted for 15.0% in the intervention group and 17.5% in the control group. There were no significant differences in the baseline characteristics between the 2 groups ($p \geq 0.05$) (**Table 1**).

Incidence of Anxiety, Depression, and Sleep Disorders After Liver Transplantation

The incidence of anxiety at 0-60, 61-120, 121-180, and 181-360 days following liver transplantation was 42.50%, 37.50%, 35.00%, and 30.00%, respectively. The incidence of depression was 14.5%, 9.4%, 3.2%, and 1.2%, respectively. The incidence of sleep disorders was 15.8%, 12.1%, 7.3%, and 6.5%, respectively (**Table 2**).

Time and Intervention Effects on Anxiety, Depression, and Sleep Disorders

The results of the ANOVA for repeated-measures data showed that the anxiety and depression scores were lower in the intervention group than in the control group, and the difference was statistically significant (F_{group}=8.771, 16.821, p<0.001). Anxiety

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Table 2. Prevalence of anxiety, depression, and insomnia after liver transplantation.

Time	Anxiety score (M±SD)	Incidence rate (%)	Depression score (M±SD)	Incidence rate (%)	Sleep quality score (M±SD)	Incidence rate (%)
0-60 days	28.24±4.59	42.50	66.45±3.73	14.50	16.46±3.11	15.80
61-120 days	27.25±2.03	37.50	57.35±3.13	9.40	14.23±2.06	12.10
121-180 days	27.96±5.89	35.00	49.79±6.19	3.20	11.34±4.67	7.30
181-360 days	23.56±5.10	30.00	48.49±4.13	1.20	10.89±6.22	6.50

Table 3. Time effects and intervention effects on anxiety, depression, and insomnia.

	Time	Anxiety score (M±SD)	Depression score (M±SD)	Sleep quality score (M±SD)
Intervention group	0-60 days	24.14±3.51	61.51±4.23	14.34±2.12
	61-120 days	22.21±1.93	55.32±5.24	12.64±1.87
	121-180 days	20.69±4.31	42.82±4.17	10.68±2.32
	181-360 days	16.46±4.06	38.74±5.71	9.12±4.23
Control group	0-60 days	39.43±5.12	69.15±8.72	18.16±4.12
	61-120 days	33.12±4.21	65.28±6.13	17.13±3.82
	121-180 days	32.61±4.15	54.39±5.81	13.11±5.17
	181-360 days	26.67±5.63	50.22±7.33	11.82±4.23
F_{group}		8.771	16.821	8.166
P		<0.001	<0.001	<0.001
F_{time}		4.283	9.278	10.827
P		0.008	<0.001	<0.001
$F_{group*time}$		1.283	1.384	0.382
P		0.097	0.128	0.334

and depression scores gradually decreased in the intervention and control groups over time (F_{time}=4.283, 9.278, p<0.05). The quality of sleep scores was lower in the intervention compared with the control group, the difference was statistically significant (F_{group}=8.166, p<0.001) and the quality of sleep scores gradually decreased over time (F_{time}=10.827, p<0.001) (**Table 3**).

Discussion

The results of this study showed that the prevalence of anxiety at 0-60, 60-120, 120-180 and 180-360 days after liver transplantation was 42.50%, 37.50%, 35.00%, and 30.00%, respectively. Continuing psychological nursing combined with postoperative pain nursing, postoperative life nursing, and rehabilitation training can effectively reduce the incidence of anxiety and improve quality of life scores following liver transplantation. The results showed that the incidence of anxiety following liver transplantation was high; this was associated with several factors, including stress from the surgery, concern about the outcome of the surgery, fear of complications, and concerns about taking large amounts of immunosuppressive drugs [20,21]. Furthermore, patients may experience pain concurrently after a liver transplant, which can worsen anxiety.

The study showed that compared with the traditional care model, the personalized care program for patients after liver transplantation can effectively reduce the anxiety, depression, and sleep quality scores of patients, and the effect can be maintained for a long time. The possible reason for its effectiveness is that the nursing program contains 4 aspects – psychology, lifestyle, pain care, and rehabilitation training – which intervene in the psychological status of patients both psychologically and physically to enhance the improvement

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effect. Wang Xu et al [12] added psychological care based on traditional care, and the results showed that the application of psychological care in postoperative patient services could improve the patient's mental state, reduce pain perception, maintain a better quality of life, and have fewer complications and a better prognosis. This confirms the reliability and rational design of the study protocol. Increasing psychological care can help patients relieve emotional stress, improve psychological well-being, increase confidence and cooperation in their treatment, and correspondingly promote postoperative recovery.

Postoperative lifestyle care can help patients establish healthy habits, provide reasonable dietary advice, remind patients to exercise appropriately, and maintain a good rest schedule [22-24]. These habits will help to improve the physical fitness of patients and enhance their immunity while reducing the occurrence of negative emotions, thus improving their quality of life. Zhang [25] added a dietary nursing intervention to traditional nursing, showing that the implementation of dietary nursing intervention for liver transplantation patients could not only effectively shorten the rehabilitation time of patients but also promote wound healing of patients, which played an important role in improving the quality of life after surgery. Studies have also shown [26] that appropriate exercise can effectively reduce the incidence of negative emotions in patients with liver transplants.

Pain management is effective in improving sleep quality in patients, thereby relieving anxiety and depression. Studies have shown [27] that pain is an important factor for sleep disorders in patients after liver transplantation. Appropriate rehabilitation training can help patients gradually recover their physical abilities and improve various physiological functions of the body, which helps to prevent complications and enhance the patient's self-confidence and living ability, improving their quality of life. Rehabilitation training will also help patients to improve their physical state and promote good sleep [28-30].

In summary, the all-round post-liver transplantation care program used in this study can effectively reduce anxiety and depression and improve sleep quality scores of patients, and the effect is continuous in subsequent follow-up. This study provides a new nursing program, including psychological care, life care, pain management, and rehabilitation training. Compared with the traditional protocol, it is more complete and comprehensive and improves the psychological status of patients from multiple perspectives, and the effect is lasting. Therefore, we believe this approach has strong potential for widespread application in clinical practice.

Limitations

This study has several limitations. First, the small sample size may limit the generalizability of the results and affect subgroup analyses. Larger, multi-center studies are needed for further validation. Second, while the study compared nursing interventions, it did not explore the underlying mechanisms of anxiety and depression, which future research could address. Additionally, missing data or attrition during follow-up may have influenced the results, and we did not apply methods like sensitivity analysis. Lastly, the scales used only measure symptom severity, not clinical diagnoses, so the reported prevalence of anxiety and depression should be interpreted with caution.

Conclusions

Compared with traditional care programs, relevant nursing strategies can effectively reduce the occurrence of anxiety, depression, and sleep disorders in patients undergoing liver transplantation and improve their quality of life. Healthcare professionals should focus on the psychological and physical well-being of patients, provide personalized nursing care, and strengthen mental health education post-transplant. This can help improve patients' understanding of their condition, enhance coping abilities, reduce anxiety, and support physical recovery. Future research should explore the mechanisms of post-transplant anxiety, refine interventions, and consider strategies to address missing data and sample size limitations. Clinically, a comprehensive, patient-centered care model should be adopted to promote long-term well-being and recovery following liver transplantation.

Data and Code Availability

Data related to the study were not stored in a publicly available repository. Data will be made available on request.

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