Original Article
The effect of a three-dimensional structure evaluation system on the continuing care of patients having liver cancer surgery

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Abstract: Objective: To explore the effect of a three-dimensional structure evaluation system in the continuing care of patients having liver cancer surgery. Methods: A total of 198 patients with liver cancer who underwent a surgical resection were randomly divided into two groups, with 99 patients in each group. The first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group). There were no differences in the baseline conditions between the two groups. Nursing satisfaction, the SF-36 quality-of-life Instrument score, the medication possession ratio (MPR), the self-rating anxiety scale (SAS) score, and the postsurgical complications were compared between the two groups at 3, 6, and 12 months after the nursing intervention. Results: The MPR of both the CC group and the TH group gradually decreased over time, but the MPR of the TH group was higher than the MPR of the CC group at all time points (all $P < 0.05$). The SAS scores of both groups decreased after the nursing intervention, but the SAS score of the CC group was higher than the SAS score of the TH group at all time points (all $P < 0.05$). Moreover, the SF-36 score of the TH group was significantly higher than the SF-36 score of the CC group at 3 months after surgery ($P < 0.05$). The nursing satisfaction rate of the TH group was 80.81%, which is significantly higher than the 69.70% of the CC group ($P < 0.05$). At 6 months after surgery, the Child-Pugh classifications of the two groups were significantly different ($P < 0.05$); there were 72 class A and 27 class B patients in the CC group, and there were 83 class A and 16 class B patients in the TH group. Conclusion: The three-dimensional structure evaluation system improved the outcome of the continuing care, alleviated anxiety, and reduced postsurgical complications in patients who underwent liver cancer surgery.

Keywords: Continuing care, liver cancer, three-dimensional structure, evaluation system

Introduction

Liver cancer is a common malignant tumor of the digestive system, and its mortality rate ranks third in the world [1]. China is a country with a high incidence of liver cancer, accounting for more than half of the world's morbidity and death each year, which seriously threatens the lives of Chinese citizens [2]. Many factors are believed to be involved in the etiology of liver cancer, such as viral infections, diet, and environmental pollution, etc. [3]. The early diagnosis of liver cancer is difficult, and the rate of surgical resection remains very low after diagnosis. Although surgical resection is the main means of treating liver cancer, many patients with liver cancer have missed the best timing for surgery when diagnosed [4]. Therefore, the overall therapeutic effect of liver cancer is not satisfactory [5]. In the course of treatment, patients not only have to suffer from the pain of surgery, but they also endure tremendous psychological pressure and even lose hope, such that their quality of life is greatly reduced [6]. Studies have confirmed that the psychological and physiological conditions of patients will have a certain impact on their therapeutic effects, and research in related fields has gradually become a research hotspot [7].

Continuing care is a new type of nursing mode based on scientific theory, which extends the inpatient care service to outside the hospital. Continuing care provides quality nursing care in

the hospital, and it also offers guidance for a series of problems such as the patient's psychological and daily life problems after discharge, so as to help the patients better achieve rehabilitation [8, 9]. Previous studies have found that after continuing care, patients' body functions and quality of life were significantly improved. Furthermore, continuing care effectively improves the postoperative viability and reduces the incidence of complications in patients who have undergone tumor surgery [10]. With the development of China's medical industry, the overall level of continuing care has been greatly improved [11].

Avedis et al. have proposed using a structure-process-outcome evaluation system to analyze and evaluate the effects of medical care [12]. The structure-process-outcome evaluation system is referred to as the three-dimensional structure evaluation system [13]. The "structure" mainly refers to various implementation elements, which are configured by manpower and material resources. The "process" refers to applying various elements of the structure to practice. The "outcome" refers to the final result achieved by the implementation process, which is the key to the evaluation of nursing care [14]. Previous studies have used a three-dimensional evaluation system to evaluate the quality of nursing care and achieved satisfactory results [15]. Therefore, we explored the effects of the three-dimensional structure evaluation system on the continuing care of patients with liver cancer surgery, hoping to provide a theoretical basis for the improvement of the quality of continuing care.

Materials and methods

Patients

A total of 198 patients who underwent liver cancer surgery at The 3rd Affiliated Teaching Hospital of Xinjiang Medical University (Affiliated Cancer Hospital) from January 2017 to May 2019 were enrolled in this study. The patients were randomly divided into two groups at discharge, with 99 patients in each group. The first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group). This study

was approved by the ethics committee of The 3rd Affiliated Teaching Hospital of Xinjiang Medical University (Affiliated Cancer Hospital), and all patients provided an informed consent.

Inclusion criteria: patients who were diagnosed with liver cancer and received their initial treatment at The 3rd Affiliated Teaching Hospital of Xinjiang Medical University (Affiliated Cancer Hospital) [16]; patients whose Child-Pugh classification was A or B at discharge; patients who were between 18 and 70 years old; patients who had no post-surgical complications; patients who had no major organ dysfunction.

Exclusion criteria: patients who had a recurrence of liver cancer; patients who had mental illness; patients who had other malignant tumors.

Continuing care

Continuing care is long-term care. After a patient is discharged, the medical staff continues to perform daily care that is similar to the care in the hospital. Through the telephone or internet video chat, the continuing care was carried out as follows.

Dietary guidance: a recipe was created by a professional dietitian and adjusted according to the condition of the liver cancer patient. The recipe was sent to the patient via the internet. The patients could also inform the dietitian about their diet habits and requirements via SMS or Internet, and they could give feedback about the use of the recipe.

Exercise guidance: the patients performed outdoor aerobic exercise for 40-60 min daily; in the meantime, the patients were asked to record videos during their exercising, which was shared in the communication group of our social media software. Exercise professionals would guide the way the patients exercised at home. At the same time, scientific guidance was provided on the time, precautions, and methods that should be noted during exercise.

Psychological guidance: each patient's rehabilitation progress and mental health were monitored every week. Patients with depression or emotional stress were encouraged to listen to cheerful music and communicate with the medical staff or other patients during the patient
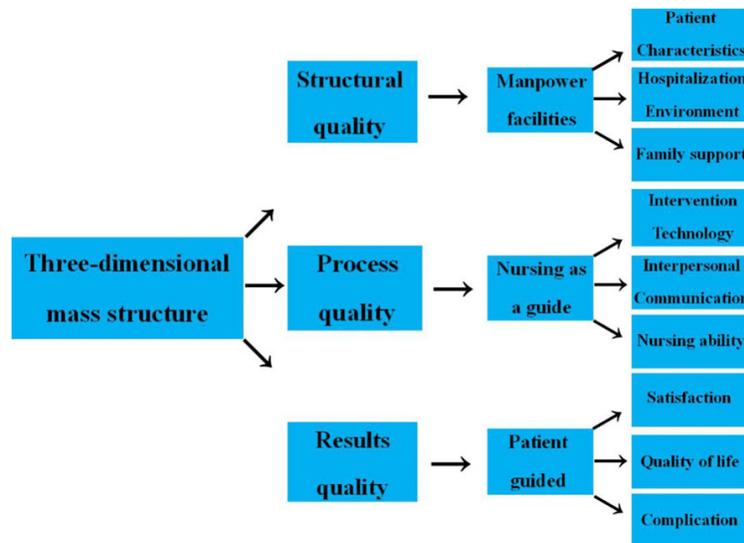
Figure 1. The three-dimensional structure evaluation system.

support meetings. Disease knowledge was delivered to the patients through the social media software to increase the self-confidence of liver cancer patients.

Sleeping guidance: the patients were instructed to avoid unhealthy sleeping habits. Sleeping intervention was used for patients with sleeping problems. Relaxing music was sent to the patients through social media software, so the patients could enjoy the music before going to sleep.

Patient follow-up: follow-up was carried out via telephone or internet video chat according to a pre-established schedule. At 1 week after discharge, the patients were asked about any adverse reactions to the treatment. At 2 weeks after discharge, the patients were asked about their exercising and sleeping quality. At 3 weeks after discharge, the patients were asked about their psychological conditions, and detailed records were kept for each patient.

Continuing care combined with a three-dimensional structure evaluation system

The TH group received continuing care combined with a three-dimensional structure evaluation system. The continuing care quality was evaluated in three aspects: structure quality, process quality, and outcome quality. Structure quality includes the quality of manpower, material resources, family support, etc., which are the fundamental elements of continuing care. Process quality means the quality of the intervention management, interpersonal communication, nursing skills, etc. Outcome quality was accessed based on the nursing satisfaction, quality of life, and postsurgical complications, which are the main indices for evaluating the quality of continuing care. Before the continuing care was implemented, a cancer care team was set up and workflow rules and regulations were established. Each department was centered on the cancer care team and required to give full cooperation. The head nurse was selected as the leader of the cancer care team and was responsible for the reporting implementation problems every week. The workflow rules and regulations were amended when necessary based on the reported problems by team members, so as to provide the patients with the best healthcare experience (**Figure 1**).

Observational indices

Medication possession ratio (MPR): The MPR of each group was compared before and at 3, 6, 12 months after discharge. The higher the MPR, the better the compliance. MPR = number of days covered by medications/total number of days of treatment *100%.

Self-rating anxiety scale (SAS) score: The SAS scores were compared between the two groups before and at 3, 6, and 12 months after discharge. The higher the SAS score, the more severe the anxiety. SAS has 20 items, with 10 items representing positive statements and 10 items representing negative statements. Each item is scored on a scale of 1-4, and the standardized cut-off score is 50 points. 51-59 points: mild anxiety; 60-69 points: moderate anxiety; ≥70 points: severe anxiety.

SF-36 quality-of-life instrument score: The SF-36 scores were compared between the two groups at 3 months after discharge. The SF-36 quality-of-life instrument has 8 dimensions including physical function, role-physical, bodily

Table 1. Comparisons of the baseline conditions (n)

Groups	CC group	TH group	χ^2	P
Gender			0.187	0.665
Male	38	41		
Female	61	58		
Age			0.721	0.395
<50	48	54		
≥50	51	45		
Child-Pugh classification			0.153	0.695
Class A	31	28		
Class B	68	71		

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group).

Table 2. Comparison of the medication possession ratios (mean ± sd)

	MPR (%)		
	At 3 months	At 6 months	At 12 months
CC group (n=99)	85.67±7.45	82.24±5.38	79.26±5.79
TH group (n=99)	96.24±8.35	93.46±7.35	90.32±6.54
t	9.442	12.327	12.591
P	<0.001	<0.001	<0.001

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group). MPR, Medication Possession Ratio.

Table 3. Comparison of the SAS scores (mean ± sd)

	SAS score			
	Before	At 3 months	At 6 months	At 12 months
CC group (n=99)	61.58±5.04	54.57±4.67	50.82±4.13	45.72±4.62
TH group (n=99)	62.35±5.12	46.93±4.82	37.94±3.90	30.65±3.04
t	1.068	11.387	22.673	27.252
P	0.281	<0.001	<0.001	<0.001

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group); SAS, self-rating anxiety scale.

pain, general health, validity, social function, role-emotional, and mental health. The total score is 100, and the higher the score, the better the quality of life.

Nursing satisfaction

At 3 months after discharge, the patients were asked to rate their nursing satisfaction on a scale of 1-3 as follows: satisfied, neutral, and unsatisfied. Nursing satisfaction rate = (satisfied + neutral)/ total *100%.

Child-Pugh classification

The Pugh-Child score is determined by scoring 5 clinical measures of liver disease. The 5 clinical measures include total bilirubin, serum albumin, prothrombin time, ascites, and hepatic encephalopathy. A score of 1, 2, or 3 is given to each measure, with 3 being the most severe. The total score ranges from 5 to 15 points. Liver function is classified as class A, B, or C based on the total Pugh-Child score. Class A: 5-6 points; class B: 7-9 points; class C: ≥10 points. The Child-Pugh classification was compared between the two groups at 6 months after discharge.

Statistical analysis

All data were analyzed using the SPSS 22.0 statistical package. Quantitative values were expressed as the mean ± sd and the differences between groups were evaluated using an independent *t*-test.; the enumeration data were expressed as number/percentage (n/%) and differences between groups were compared using χ^2 tests. A P value less than 0.05 was considered significant.

Results

Comparison of the baseline conditions

There were no differences regarding gender, age, and Child-Pugh classification between the two groups (all P<0.05). See **Table 1**.

Comparison of MPR

The MPR of patients in both groups gradually decreased over time, but the MPR in the TH

Table 4. Comparison of the SF-36 scores (mean ± sd)

	Physical function	Bodily pain	Validity	Social function	Role-emotional	Mental health	General health	Role-physical
CC group (n=99)	75.12±5.85	74.72±6.07	73.29±7.13	70.25±5.44	77.29±6.52	71.69±5.83	70.23±7.69	74.92±5.69
TH group (n=99)	88.39±6.89	85.33±7.32	82.07±8.13	79.47±7.62	82.34±6.03	82.77±7.41	82.05±7.19	85.23±6.59
t	8.041	6.101	4.447	5.367	3.091	6.656	6.151	6.486
P	<0.001	<0.001	0.004	0.002	0.031	<0.001	<0.001	<0.001

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group).

Table 5. Comparison of the nursing satisfaction

	Satisfied (n)	Neutral (n)	Unsatisfied (n)	Nursing satisfaction rate (%)
CC group (n=99)	27	42	30	69.70
TH group (n=99)	48	32	19	80.81
T				9.701
P				0.007

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group).

Table 6. Comparison of the postsurgical complications

	n	Class A	Class B	χ^2	P
CC group (n=99)	99	63 (63.64)	36 (36.36)	10.432	0.001
TH group (n=99)	99	83 (83.84)	16 (16.16)*		

Note: the first group received continuing care after undergoing liver cancer surgery (the CC group); the second group received continuing care combined with a three-dimensional structure evaluation system after undergoing liver cancer surgery (the TH group). *P<0.05, compared with the CC group.

group was significantly higher than it was in the CC group at all time points (all P<0.05), as shown in **Table 2**.

Comparison of the SAS scores

There was no significant difference in the SAS scores between the two groups before continuing care (P>0.05). However, the mental status of both groups improved over time. The SAS score (30.65±3.04) of the TH group was significantly lower than it was in the CC group (45.72±4.62) (P<0.05). See **Table 3**.

Comparison of the SF-36 score

The SF-36 scores of the TH group were significantly higher than those of the CC group at all dimensions (all P<0.05), as shown in **Table 4**.

Comparison of nursing satisfaction

Sixty nine patients in the CC group rated nursing satisfaction as satisfied or neutral, with a nursing satisfaction rate of 69.70%. In contrast, 80 patients in the TH group rated nursing satisfaction as satisfied or neutral; their nursing satisfaction rate was 80.81%, which is significantly higher than the rate in the CC group (P<0.05), as shown in **Table 5**.

Comparison of the Child-Pugh classification

At 6 months after discharge, there were 63 class A and 36 class B patients in the CC group;

there were 83 class A and 16 class B patients in the TH group. The difference between the two groups was statistically significant (P<0.05), as shown in **Table 6**.

Discussion

Liver cancer is one of the most common malignancies in the world [17]. With the development of social economy and lifestyle changes, the prevalence of liver cancer has increased significantly in China, which is seriously threatening the physical and mental health of Chinese citizens [18]. Although surgical resection is the best treatment for liver cancer, most patients have already passed the optimal timing for surgery at the time of their initial diagnosis. In recent years, with the continuous advancement of medical science, the treatment of liver cancer has shown a diversified trend, which effectively prolongs the survival time of liver cancer patients. However, determining how to improve their quality of life, relieve the patients' negative moods and reduce postoperative complications still remains an urgent problem for nursing staff [19]. The three-dimensional structure evaluation system clarifies the responsibilities of medical personnel and sets up workflow rules to regulate the operation procedures in continuing care, which is a prerequisite for the quality improvement of continuing care [20, 21].

Our study showed that the MPR of both the CC group and the TH group gradually decreased over time; however, the MPR of the TH group was significantly higher than it was in the CC group. With the prolongation of continuing care, the anxiety status of both groups improved, but the TH group had a significantly lower SAS score than the CC group. In addition, the SF-36 scores of the TH group were higher than those of the CC group, and the nursing satisfaction rate of the TH group was also higher than that of the CC group. Continuing care is a novel nursing care mode to ensure that patients continue to receive similar health care guidance from the hospital to improve their cognitive and self-management abilities. Previous research showed that continuing care could be implemented through the telephone, social media so-

ftware, internet video chat, etc. Patients could receive dietary, psychological, sleeping, and daily life guidance from medical professionals to help them cope with health-related problems. As a result, the patients had better sleeping and emotional statuses after receiving continuing care; at the same time, postsurgical complications were reduced and medication compliance was increased, which is conducive to the improved quality of life and better prognosis [22]. Multiple clinical studies have demonstrated the use of a three-dimensional structure evaluation system to evaluate the quality of nursing care and have achieved satisfactory results. The mutual impact correlation between "structure", "process", and "outcome" has made the continuing care evaluation system more relevant to the actual clinical effect. Nursing personnel are more likely to use this system to construct a reasonable workflow to conduct continuing care and achieve better outcome. As shown in our study, a continuing care scheme based on the "structure-process-outcome" three-dimensional structure evaluation theory could significantly improve the quality of life and nursing satisfaction of liver cancer patients after discharge [23].

In summary, continuing care combined with the three-dimensional structure evaluation system could more effectively reduce the anxiety and postsurgical complications in liver cancer patients. However, the single-center, small sample size is a limitation of this study. The conclusions of this study are to be confirmed by the results of a multi-center randomized controlled trial with a larger sample size.

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Disclosure of conflict of interest

None.

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