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Health literacy program in the prevention of unplanned postoperative gastrostomy tube extubation in patients with esophageal cancer

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Statements and Declarations

Author contributions Jianhua Tang and Mingfeng Feng: Conceptualization, Methodology, Literature search, Formal analysis and Writing - Original Draft; Xin Liu, Chengcheng Li and An Shi: Investigation and Data Curation; Zheng Jia: Supervision ,Project administration and Writing - Review & Editing.

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Conflict of interest The authors declare that they have no conflict of interest.

Data availability The data of this study are available from the corresponding authors upon reasonable request.

Ethics The study protocol was approved by the Ethics Committee for Medical Research of Sichuan Cancer Hospital. all methods were carried out in accordance with relevant guidelines and regulations.

[Abstract]

Objective: To assess the impact of a health literacy program on preventing unplanned extubation of gastrointestinal tubes in esophageal cancer patients and to inform prevention strategies.

Methods: This quasi-experimental study involved 192 esophageal cancer patients who underwent surgery at Sichuan Cancer Hospital and were transferred to the ICU from May 2023 to September 2024. Patients were randomly assigned to an experimental group (Group B, n=96) or a control group (Group A, n=96) using convenience sampling. The experimental group received health education through a literacy program, while the control group received verbal education. We compared knowledge scores on postoperative gastrointestinal tube care and unplanned extubation rates between both groups post-intervention.

Results: Knowledge scores for postoperative gastrointestinal tube care were significantly higher in the experimental group (94.38 ± 4.96) than in the control group (81.30 ± 8.94), ($t = 9.76$, $P < 0.05$). The experimental group had no cases of unplanned extubation, while the control group's incidence rate was 1.60% (3/188), ($P < 0.05$).

Conclusions: The health literacy program can effectively improve patients' awareness of gastrointestinal tubes and their self-management abilities, thereby reducing the unplanned extubation rate. This study provides valuable insights for clinical health education to prevent such incidents.

[Keywords] Health education; health literacy program; esophageal cancer; gastrointestinal tube; unplanned extubation; prevention

Introduction

Esophageal cancer is a common malignant tumor that poses a serious health threat globally [1]. Postoperative complications in esophageal cancer patients can be reduced by using indwelling gastrointestinal tubes, which also promote early recovery [2]. Studies have shown that the rate of unplanned gastrointestinal tube removal in hospitalized patients is high, with an even higher rate observed in postoperative esophageal cancer patients [3]. Previous analyses suggest that most esophageal cancer patients have limited knowledge about gastrointestinal tubes, with cognitive biases and low self-management efficacy [4-5]. Current health education practices often rely on one-way information delivery without dynamic feedback assessment, which limits the effectiveness of educational outcomes [6]. The health literacy program is a comprehensive intervention designed to improve patients' knowledge of and engagement in managing their diseases and related treatments through education, counseling, and guidance [7]. This program aims to enhance patients' self-management skills and confidence, thereby improving their clinical outcomes and quality of life [8]. Health literacy programs generally include standardized guidelines, provision of standardized Visualization Tool, the teach-back method, and effective doctor-patient communication [9]. Herein, a health literacy program was applied to prevent unplanned gastrointestinal tube extubation in postoperative esophageal cancer patients. The objective was to reduce the unplanned extubation rate and provide a scientific basis for the prevention, control, and formulation of quality improvement goals related to unplanned extubation.

1 Patients and Methods

1.1 General Information. This study employed a quasi-experimental study. Using a convenience sampling method, 192 esophageal cancer patients who underwent surgical treatment and were transferred to the ICU at Sichuan Cancer Hospital between May 2023 and September 2024 were selected as study subjects. Grouping was conducted by drawing lots, with patients assigned to medical group B as the experimental group and to medical group A as the control group, with 96 patients in each group. The inclusion

criteria were as follows: age ≥18 years; preoperative surgical indications meeting the Chinese Society of Clinical Oncology Guidelines for the Diagnosis and Treatment of Esophageal Cancer [10]; indwelling of gastrointestinal tubes postoperatively; clear consciousness and normal verbal expression ability; and normal muscle strength. Exclusion criteria included that patients with blindness and hearing impairments, or inability to continue participation due to unforeseen factors during the study. The patients' knowledge score on postoperative gastrointestinal tube care was used as a primary evaluation index in this study. Based on the formula for comparing the sample sizes of two means [11] and a literature review, the gastrointestinal tube care knowledge score for patients receiving routine health education was estimated to be 82.70 ± 9.32. It was anticipated that the test group would achieve a 7.3-point increase in this score, with an estimated standard deviation of 10.2 points. With $\alpha = 0.05$ and a power of 90%, the required sample size for each group was calculated to be 38. Accounting for an approximate 10% dropout rate, the minimum sample size was adjusted to 42 per group. The study was approved by the Hospital Ethics Committee (SCCHEC-02-2023-020), and all participants in both groups signed an informed consent form. all methods were carried out in accordance with relevant guidelines and regulations

1.2 Methods. (1) Establishment of the intervention team: The team comprised two nursing specialists (one chief nurse and one deputy chief nurse), two nursing graduate students, and several charge nurses. The nursing specialists provided guidance and monitored the intervention. The nursing graduate students conducted the literature review, designed the postoperative gastrointestinal tube nursing knowledge rating scale for esophageal cancer patients, produced standardized guidelines, developed standardized Visualization Tools, and collected and analyzed data. The charge nurses were responsible for implementing the intervention, collecting data, and assisting the nursing graduate students with creating standardized guidelines. (2) Intervention group training: Firstly, Training content included knowledge related to the health literacy program, interpretation of the postoperative gastrointestinal tube nursing knowledge score sheet rules for esophageal cancer patients, understanding evaluation indicators and data collection methods, as well as communication methods and skills. Secondly,

Evaluation of training effectiveness was conducted through a combination of theoretical examinations and practical operations to ensure that all group members fully mastered the content. (3) The development of standardized guidelines and standardized Visualization Tools involved a brainstorming session within the intervention group, which established that the guidelines would be presented in a video format, referred to as the video guide. The standardized Visualization Tool chosen was a round mirror with a diameter of 15 cm. The video guide was produced by two postgraduate students and three senior nurses after considering the characteristics of postoperative indwelling gastrointestinal tubes in patients with esophageal cancer and the risk factors associated with unplanned tube removal. The video guide, lasting a total of 2 minutes and 40 seconds, was structured into six parts: Part 1 introduces the difference between gastric tubes and nutritional tubes; Part 2 explains the route of insertion for gastrointestinal tubes; Part 3 describes methods for securing gastrointestinal tubes; Part 4 discusses the role and importance of the gastrointestinal tube; Part 5 outlines methods for protecting the gastrointestinal tube; and Part 6 addresses the consequences and complications following unplanned extraction of the gastrointestinal tube. The video guide incorporated voiceover narration to enhance understanding and engagement. (4) Implementation of the intervention involved conducting two health education sessions for the experimental group. The first session was conducted after the patient was admitted to the ICU, fully conscious, and extubated from the tracheal tube, while the second session took place 6 hours after the first intervention. The trial group utilized a health literacy program for health education, consisting of three core components: a standardized guideline in the form of a video guide, a standardized Visualization Tool (a mirror), and the teach-back method. The implementation of the health literacy program consisted of two steps. In the first step, the interventionist showed the video guide to the patient, pausing the video as needed to address any questions the patient had during the viewing process. In the second step, after completing the video intervention, the interventionist provided the patient with the standardized Visualization Tool which was a mirror in the present study. The interventionist held the mirror for the patient, allowing them to observe the position and fixation of their gastrointestinal tubes.

This also enabled the patient to learn the method for wiping sputum and the precautions for daily tube protection. Throughout both steps of the intervention, the teach-back method was utilized. Timely, targeted questions were administered based on the patient's situation, allowing the patients to verbalize or demonstrate the health education content. This approach helped assess their understanding and mastery of the material. Any misconceptions were promptly clarified and corrected based on the patient's feedback, ensuring that the patient's understanding was effectively maintained. In the control group, two health education sessions were conducted using a face-to-face verbal mode, delivering the same content as the video guide provided to the experimental group. This included information on the types of gastrointestinal tubes, their importance and purpose, tube placement and fixation methods, risks associated with gastrointestinal tube dislodgment, potential consequences of tube removal, the method for wiping sputum, and precautions for daily tube protection.

1.3 Data collection. Four nurses carried out data collection. In cases where indicators were difficult to distinguish, a nursing specialist and a nursing graduate student made a joint judgment to ensure accurate assessment.

1.4 Evaluation indicators. (1) The gastrointestinal tube nursing knowledge score was assessed using a postoperative gastrointestinal tube nursing knowledge score sheet for esophageal cancer patients, as reported in previous studies. Notably, this scoring method demonstrated good reliability and validity, with a Cronbach's α coefficient of 0.76 and a retest reliability of 0.89 [12]. The scale comprised 10 items, including the purpose of gastrointestinal tube placement, tube placement method, importance of the gastrointestinal tube, fixation method, consequences of extubation, sputum wiping method, and precautions. Each item was worth 10 points, totaling 100 points, and a nursing knowledge score of 80 or above indicated mastery. In both groups, the patients' nursing knowledge scores regarding the gastrointestinal tube were assessed before health education and one hour after the first and second health education sessions. (2) The unplanned extraction rate of the gastrointestinal tube was calculated using the following formula: unplanned extraction rate of gastrointestinal tube = number of cases of unplanned extraction of gastrointestinal tube/total number of days of gastrointestinal

tube retention in the same period × 1000‰ [13].

1.5 Data processing. Statistical analysis was performed using SPSS 26.0 software, with data entered and verified through double-checking. Measured data conforming to a normal distribution were expressed as mean ± standard deviation (±s) and analyzed using a two independent samples t-test. Categorical data were expressed as frequency and percentage, and analyzed using the χ^2 test or Fisher's exact probability method. A difference was considered statistically significant at $P < 0.05$.

2. Results

2.1 In this study, data were collected from a total of 192 postoperative esophageal cancer patients, with 96 in the experimental group and 96 in the control group. A comparison of general information, including age, gender, education level, duration of the disease, and type of gastrointestinal tube, indicated no statistically significant differences between the two groups (all $P > 0.05$), as presented in Table 1.

Table 1 Comparison of general data of postoperative patients with esophageal cancer in 2 groups

Item / Group	Number of cases	Sex [cases (%)]		Age (year, $\bar{x} \pm s$)	Educational level [example (%)]			Duration of illness [cases (%)]		Type of gastrointestinal tube [cases (%)]	
		male	females		Elementary and below	Specialized and below	Bachelor's degree and above	< 6 months	≥6 months	Gastric tube	Gastric tube + Nutritional tube
Control group	96	68（70.8）	28（29.2）	63.00±8.74	48（50.0）	40（41.7）	8（8.3）	76（79.2）	20（20.8）	40（41.7）	56（58.3）
Experimental group	96	72（75.0）	24（25.0）	58.71±9.47	60（62.5）	24（25.0）	12（12.5）	68（70.8）	28（29.2）	24（25.0）	72（75.0）
χ^2/t		0.11		1.63	1.53			0.11		1.50	
P		0.745		0.110	0.465			0.745		0.221	

Note: Control group: given face-to-face verbal health education; experimental group: given health

education according to the health literacy program

2.2 The comparison of gastrointestinal tube nursing knowledge scores between the two groups of patients revealed no statistically significant difference before the intervention ($P > 0.05$). However, after the intervention, the experimental group demonstrated a higher gastrointestinal tube nursing knowledge score compared to the control group, with a statistically significant difference observed ($P < 0.05$). Detailed results are presented in Table 2.

Table 2 Comparison of postoperative gastrointestinal tube nursing knowledge scores between the two groups of postoperative esophageal cancer patients (score, ± s)

Group	Number of examples	Pre-intervention	1h after the 1st intervention	1h after the 2nd intervention
Control group	96	18.33±7.02	37.50±7.94	81.30±8.94
Experimental group	96	21.25±7.97	57.50±7.37	94.38±4.96
t		1.35	7.16	9.76
P		0.185	＜0.001	＜0.001

Note: Control group: face-to-face verbal health education was given; experimental group: health education was given according to the health literacy program

2.3 The comparison of the unplanned extraction rate of the gastrointestinal tube showed that the total number of days of gastrointestinal tube retention in the experimental group was 196 days, with no cases of unplanned extubation. In contrast, the control group had a total of 188 days of gastrointestinal tube retention and recorded three cases of unplanned extubation, leading to an unplanned extubation rate of 1.60% (3/188). The unplanned extubation rate in the experimental group was significantly lower than that in the control group, with statistical significance confirmed by Fisher's exact probability method ($P < 0.05$).

3. Discussion

3.1 The health literacy program significantly enhances the knowledge level regarding postoperative nasoenteric tube care among esophageal cancer patients. Many patients in this population exhibit a low level of understanding about the retention of

postoperative gastrointestinal tubes [14] and lack knowledge pertinent to gastrointestinal tube care. Although healthcare providers, including doctors and nurses, deliver relevant health education prior to surgery, these methods often rely on one-way information transfer, neglecting to assess the patients' mastery of the information given. Research indicates that following traditional health education, 40% to 80% of the information is often forgotten, and nearly 50% of the information is misunderstood [15~16].

3.2 The health literacy program implemented in this study centered on a video guide, a standardized Visualization Tool (a mirror), and the teach-back method. Together, this strategy significantly enhanced the knowledge of postoperative nasogastric tube care among esophageal cancer patients. The effectiveness of this program could be attributed to three main reasons. Firstly, video playback is one of the most common multimedia formats in daily life, effectively capturing patients' attention and stimulating their interest in learning more than traditional oral education. The fast-paced and intuitive nature of video-assisted instruction enables patients to deepen their understanding and retention of educational content, improving acceptance [17]. Thus, producing scientifically sound, well-structured, and high-quality videos as guides for health education can create a multiplier effect. Secondly, providing a standardized Visualization Tool, such as a mirror, allows patients to clearly visualize the position and fixation of the nasogastric tube through plane mirror imaging. This visual feedback enhances their understanding and impression of their own nasogastric tube, fostering a sense of ownership and responsibility in their care[18]. Thirdly, incorporating the teach-back method allows nursing staff to engage actively with patients during the health education process. Nursing staff can ensure patient understanding by promptly clarifying misconceptions, re-educating, and offering targeted guidance based on patient feedback. This approach emphasizes the patients' feelings, facilitates effective communication, and presents educational content in a gradual and orderly manner, underscoring the advantages of improved health literacy [19].

3.3 This study identified several reasons for the differences in gastrointestinal tube nursing knowledge scores between the two patient groups. First, both groups had some baseline knowledge of gastrointestinal tube nursing before the intervention. This was

partly due to health education provided by doctors and nurses before surgery and partly because patients accumulated relevant knowledge during their hospital stay through observation and experience. Second, the scores from the first health education session were low for both groups, primarily because the surgeries were performed under general anesthesia. Given that the metabolism of anesthesia drugs takes about six hours, many patients had not fully metabolized the drugs during this initial session, leading to a poor recovery of mental state and consequently less effective health education. Third, following the second health education session, both groups achieved gastrointestinal tube nursing knowledge scores above 80 points, indicating they had mastered the essential knowledge of postoperative nasoenteric tube care. However, differences remained in mastery levels. Notably, patients in the control group exhibited incorrect sputum wiping and nose cleaning techniques.

3.4 The health literacy program has been shown to effectively reduce the rate of unplanned postoperative nasoenteric tube extraction in esophageal cancer patients. Postoperative discomfort in these patients often exacerbates their ability to tolerate physiological pain, which can lead to self-removal of the tube. Moreover, incorrect techniques for wiping sputum after coughing can result in dislodgment of the nasoenteric tube. By addressing these issues through improved education and support, the program helps mitigate the factors contributing to unplanned extubation, ultimately enhancing patient safety and comfort during recovery [20]. The video guide developed for the health literacy program was meticulously crafted to address the common causes of unplanned extubation. It covered a range of critical topics, including the various types of nasoenteric tubes, their significance, the rationale behind tube placement, the correct methods for placement and fixation, potential risks and consequences associated with tube slippage, techniques for effective sputum wiping, and essential precautions for daily tube care. This comprehensive content was designed to equip patients with the necessary knowledge to protect their nasoenteric tubes effectively. In addition, the program incorporated a standardized Visualization Tool, specifically a mirror, allowing patients to observe their nasoenteric tube in real time. By performing actions such as sputum wiping while viewing themselves in the mirror, patients could clearly see how

improper techniques might inadvertently dislodge the tube. This visual feedback facilitated a better understanding of the correct practices and enabled patients to correct any errors they might make. Consequently, this approach not only enhanced patients' comprehension of the nasoenteric tube but also significantly improved their self-management abilities. The teach-back method increased patients' participation and allowed for timely confirmation and correction of any misconceptions they had. This process deepened their understanding of nursing knowledge and heightened their awareness regarding the protection of the nasoenteric tube during the postoperative period. Consequently, this improvement in understanding enhanced their self-management abilities and led to a reduction in the rate of unplanned extubation of the nasoenteric tube in these patients.

4. Limitations

The health education method used in this study effectively enhances the knowledge of postoperative gastrointestinal tube care among esophageal cancer patients, improves their self-management abilities, and reduces the rate of unplanned gastrointestinal tube extraction. Nevertheless, the study has certain limitations. Firstly, none of the participants were treated in the ICU for more than 36 hours after surgery and were quickly transferred back to the original general ward following a brief treatment period. As a result, this study only monitored the gastrointestinal tubes during the time spent in the ICU, without tracking the tubes of patients in the general ward. Therefore, the rate of unplanned extraction observed may not accurately reflect the actual rate among these patients. Secondly, the study was conducted in the same ward, and although the two medical groups were in separate, independent beds, the study could not completely control for the potential confounding effects this arrangement may have caused.

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