

Applied Research on Feedforward Control Nursing Intervention to Improve Patient Satisfaction in the Post-Anesthesia Care Unit

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Abstract: *Objective:* To explore and analyze the effectiveness of implementing feedforward control nursing interventions in patients undergoing general anesthesia surgery. *Methods:* A total of 100 patients who underwent general anesthesia surgery in our hospital were selected as the study subjects. The reference group received routine nursing care, while the study group received feedforward control nursing interventions. The nursing effects were observed. *Results:* The nursing effects and related indicators in the study group were better than those in the reference group ($P < 0.05$). *Conclusion:* Implementing feedforward control nursing interventions in patients undergoing surgery can effectively accelerate their postoperative recovery, help them recover from the effects of anesthesia more quickly, improve their prognosis, and significantly increase their satisfaction.

Keywords: General anesthesia surgery; Feedforward control nursing; Anesthesia recovery; Satisfaction

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1. Introduction

The Post-Anesthesia Care Unit (PACU) is a critical location for patients undergoing general anesthesia surgery to recover from anesthesia, monitor vital signs, and prevent complications. During the postoperative anesthesia recovery period, patients are prone to adverse reactions such as respiratory depression, agitation, pain, and hypothermia. Additionally, anxiety and fear due to uncertainty about the surgical outcome and recovery process not only affect the quality of anesthesia recovery but also reduce patient satisfaction with nursing care ^[1]. Currently, clinical PACU nursing often adopts an empirical routine nursing model, primarily responding passively to problems that arise in patients, lacking proactive and targeted preventive measures, and struggling to meet patients' individualized recovery needs fully, thus necessitating further improvement in nursing quality ^[2]. Feedforward control is a proactive management model that focuses on identifying potential problems in advance, formulating targeted preventive measures, and intervening before problems occur to prevent adverse events ^[3]. Applying the concept of feedforward control to PACU nursing work can

improve patients' recovery experiences and increase nursing satisfaction by proactively identifying potential risks during anesthesia recovery and developing personalized intervention plans to achieve proactive prevention and precise intervention in nursing work^[4]. Therefore, this article aims to explore and analyze the effectiveness of implementing feedforward control nursing interventions in patients undergoing surgery.

2. Materials and methods

2.1. General information

A total of 100 patients who underwent general anesthesia surgery in our hospital from September 2024 to August 2025 were selected as the study subjects. They were evenly divided into two groups using a random number table method, with 50 cases in each group. The male-to-female ratio in the study group was 27:23, with ages ranging from 32 to 58 years and an average age of (45.62 ± 6.42) years. The male-to-female ratio in the control group was also 27:23, with ages ranging from 31 to 59 years and an average age of (45.35 ± 6.55) years. The differences in baseline data between the two groups were small ($p > 0.05$).

2.2. Methods

The control group received routine nursing care: After the patient was transferred to the PACU, vital signs (body temperature, blood pressure, heart rate, and blood oxygen saturation) were monitored every 5 minutes. Close observation was made of the incision drainage, intravenous infusion, and urine output. Medication reactions were recorded, and any abnormalities were promptly reported to the doctor and handled. Routine position care and catheter care were performed, and patients were informed of postoperative precautions to meet their basic nursing needs.

The study group received feedforward control nursing interventions in addition to routine nursing care:

(1) Preoperative psychological intervention and health education

Patients were visited before anesthesia, and a one-on-one communication method was used to introduce the anesthesia method, surgical process, and PACU recovery process to the patients, answer their questions about surgery and anesthesia, and alleviate their tension. A PACU promotional video was played to allow patients to visually understand the nursing operations, precautions, and possible discomfort during the recovery period, eliminating their fear of the unknown and improving their cooperation.

(2) Precise monitoring of anesthesia depth

For patients with longer surgical times or poorer physical conditions, the bispectral index (BIS) was continuously monitored to observe the patient's anesthesia depth dynamically. Based on changes in the BIS value and the patient's respiratory status, the respiratory mode was adjusted, and the timing of extubation was accurately judged to avoid adverse reactions caused by premature or delayed extubation.

(3) Precise pain intervention

After the patient was transferred to the PACU, the pain numerical rating scale (NRS) was used to assess the patient's pain level every 30 minutes continuously. When the NRS score was ≥ 4 , sedative and analgesic drugs were promptly administered according to the doctor's advice. After medication, the patient's response was closely observed, and the dosage and plan were adjusted according to the pain score to ensure that the pain was controlled within a reasonable range and reduce the impact of pain on the patient's recovery.

(4) Temperature protection intervention

The risk of hypothermia was assessed in advance. For elderly, frail patients or those with surgical times

exceeding 1 hour, a fluid warmer and warming blanket were used for insulation. Patients were routinely covered with cotton quilts, and their body temperature was monitored every 30 minutes to promptly detect hypothermia and take intervention measures to avoid complications such as shivering and arrhythmia caused by hypothermia.

(5) Agitation prevention and catheter care

The patient's limbs were reasonably restrained, and various catheters and drainage tubes were properly fixed to avoid tube dislodgement. The PACU environment was kept quiet, and noise and strong light stimulation were controlled. For patients with a clear tendency toward agitation, psychological comfort was promptly provided. When extubation indications were met, extubation was performed in a timely manner to avoid agitation caused by adverse stimuli.

(6) Humanistic care and position care

After the patient regained consciousness, humanistic care was strengthened. Active communication was initiated with the patient to inform them that the surgery was completed and to alleviate their anxiety. Reasonable demands of the patient were met as much as possible. When the patient's condition allowed, the head of the bed was elevated by 15–30 degrees to promote smooth breathing and prevent pulmonary infections.

2.3. Observation indicators

2.3.1. Time consumed for anesthesia recovery

Record the time for the recovery of spontaneous breathing, eye-opening, tracheal tube removal, and the duration of stay in the Post-Anesthesia Care Unit (PACU) for both groups.

2.3.2. Patient satisfaction

Utilize the Anesthesia Department's postoperative & PACU patient satisfaction questionnaire, administered on the first postoperative day. The satisfaction dimensions are categorized as very satisfied, satisfied, neutral, and dissatisfied. The overall satisfaction rate among hospitalized patients is calculated as (very satisfied + satisfied) / number of cases $\times$ 100%.

2.4. Statistical analysis

All data generated from this experiment were analyzed using SPSS 26.0 software. Measurement data and count data are presented as " $\bar{x} \pm s$ " and "%", respectively. Comparisons between groups were conducted using *t*-tests and chi-square tests (χ^2). Statistical significance is considered when $p < 0.05$.

3. Results

3.1. Comparison of time consumed for anesthesia recovery

The time consumed for anesthesia recovery in the study group was shorter than that in the reference group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of time consumed for anesthesia recovery ($\bar{x} \pm s$)

Group	n	Spontaneous breathing recovery time (minutes)	Eye-opening time (minutes)	Tracheal tube extubation time (minutes)	PACU stay time (minutes)
Study group	50	8.04 ± 1.75	10.35 ± 2.06	15.23 ± 2.18	68.15 ± 9.67
Reference group	50	12.15 ± 2.39	15.34 ± 2.51	25.26 ± 3.26	85.64 ± 11.26
<i>t</i>	/	9.810	10.866	18.084	8.332
<i>p</i>	/	0.000	0.000	0.000	0.000

3.2. Comparison of nursing satisfaction

The nursing satisfaction in the study group was higher than that in the reference group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of nursing satisfaction [n/(%)]

Group	n	Very satisfied	Satisfied	General	Dissatisfied	Total satisfaction rate
Study group	50	32 (64.00)	16 (32.00)	2 (4.00)	0 (0.00)	48 (96.00)
Control group	50	21 (42.00)	18 (36.00)	7 (14.00)	4 (8.00)	39 (78.00)
χ^2	/	/	/	/	/	7.161
<i>p</i>	/	/	/	/	/	0.007

4. Discussion

The anesthesia recovery phase in patients undergoing general anesthesia surgery is a period of high nursing risk. During this stage, as patients' physiological functions such as consciousness, respiration, and circulation have not fully recovered, they are prone to a series of issues including restlessness, hypothermia, unplanned extubation, and inadequate pain control. These problems not only affect the postoperative recovery process but also easily trigger various complications, increasing patient suffering and healthcare burdens^[5]. Conventional nursing primarily adopts a “reactive response” approach, intervening only after problems arise, making it difficult to avoid risks fundamentally. In contrast, feedforward control nursing intervention, as a “proactive prevention and early intervention” nursing model, is guided by patients' potential nursing risks. By identifying risk factors in advance, formulating targeted prevention and control plans, and standardizing nursing procedures, it achieves comprehensive control over the nursing process. This approach demonstrates significant advantages in the nursing of patients undergoing general anesthesia surgery, effectively compensating for the deficiencies of conventional nursing and providing solid guarantees for patients' safe recovery^[6].

The core advantage of feedforward control nursing intervention lies in its ability to identify nursing risks in advance and achieve front-end risk prevention and control, thereby reducing the incidence of adverse events at their source. The nursing risks in patients undergoing general anesthesia surgery are characterized by concealment and suddenness. In conventional nursing, nurses often focus on monitoring patients' postoperative vital signs and lack systematic identification and anticipation of potential risks. They typically address risk events only after they occur, which has already impacted patients' recovery to some extent. In contrast, feedforward control nursing intervention emphasizes “prevention first”. Before patients enter the anesthesia recovery room, nurses comprehensively review potential nursing risk points based on individual

patient factors such as age, constitution, surgical type, and anesthesia method. These risk points include delayed anesthesia recovery, respiratory depression, restlessness, catheter dislodgement, hypothermia, and increased pain. They analyze the causes of risk occurrence, such as a weak constitution leading to delayed recovery, prolonged surgery time contributing to hypothermia, and insecure catheter fixation resulting in unplanned extubation. Based on this analysis, personalized prevention plans are formulated for various potential risks, and early intervention measures are taken to nip risks in the bud, preventing adverse events and maximizing patient safety ^[7].

Feedforward control nursing intervention establishes a comprehensive nursing procedure system, standardizing various nursing operations during anesthesia recovery. It clarifies operational procedures, standards, and responsibilities, formulating detailed operational guidelines for every aspect, from patient admission assessment, vital sign monitoring, catheter care, and positioning care to psychological nursing, pain nursing, and temperature protection. This ensures that every nursing measure is carried out with clear rules and evidence-based practices ^[8]. Simultaneously, through systematic training for nurses, their mastery of nursing procedures and operational standards is enhanced, improving the proficiency and accuracy of nursing operations and reducing nursing errors. Additionally, feedforward control nursing intervention emphasizes control over nursing details. For example, in catheter care, nurses not only focus on catheter fixation but also assess patients' restlessness risk in advance and take reasonable restraint measures to prevent catheter dislodgement due to patient agitation. In temperature protection, based on patients' constitution and surgical conditions, nurses take proactive insulation measures to prevent hypothermia, making nursing services more targeted and refined and comprehensively improving nursing quality.

Patients undergoing general anesthesia surgery often experience varying degrees of anxiety and fear before surgery, worrying about surgical outcomes, anesthesia safety, and postoperative pain. During the anesthesia recovery phase after surgery, patients may exhibit negative emotions such as restlessness and anxiety due to factors like unclear consciousness, physical discomfort, and unfamiliar environments. These emotions not only affect patients' recovery mindset but may also lead to non-cooperation with nursing operations, increasing nursing difficulty ^[9]. Feedforward control nursing intervention fully considers patients' psychological states and integrates psychological nursing throughout the entire nursing process. Before anesthesia, nurses visit patients, providing detailed information about anesthesia methods, procedures, precautions, and postoperative recovery knowledge. They patiently answer patients' questions, alleviating preoperative anxiety and fear and gaining patients' trust and cooperation. After patients enter the anesthesia recovery room, nurses promptly communicate with them, informing them that the surgery has been completed, explaining the current recovery situation, and providing emotional comfort and humanistic care. They create a quiet and comfortable recovery environment for patients, avoiding adverse stimuli and alleviating restlessness. Simultaneously, nurses actively attend to patients' needs, fulfilling reasonable requests as much as possible, making patients feel respected and cared for, enhancing their healthcare experience, and increasing nursing compliance. This enables patients to actively cooperate with various nursing operations and promotes postoperative recovery ^[10].

By proactively preventing adverse events and reducing the incidence of complications, feedforward control nursing intervention decreases the nursing resources required to manage complications and reduces nursing workload. Simultaneously, by standardizing nursing procedures and clarifying responsibilities, it avoids redundant labor and ineffective operations in nursing work, improving nursing efficiency and

allowing nurses to devote more time and energy to personalized patient care. Moreover, through training and assessment of nurses, feedforward control nursing intervention enhances nurses' professional competence and emergency response capabilities, preventing nursing errors and reducing medical disputes and costs associated with nursing errors. Additionally, the accelerated recovery process shortens patients' stay in the anesthesia recovery room, improving bed utilization rates and achieving reasonable allocation and efficient utilization of nursing resources, promoting the scientific and standardized development of nursing work.

5. Conclusion

In summary, implementing feedforward control nursing intervention in patients undergoing surgical treatment can effectively accelerate their postoperative recovery, help them recover more quickly from the effects of anesthesia drugs, improve their prognosis, and significantly enhance their satisfaction.

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