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2026 Volume 11, Issue 2
Advances in Precision Medicine
ISSN: 2424-9106 (Online)
ISSN: 2424-8592 (Print)

Observation on The Effect of Nursing Intervention on Preventing Pulmonary Infection in Patients with Cerebral Hemorrhage and Brain Trauma

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Abstract: *Objective:* To analyze the clinical effect of integrating postural management, airway humidification, nutritional support and early rehabilitation training into the care of patients with cerebral hemorrhage and brain trauma in preventing pulmonary infection. *Methods:* 160 patients with cerebral hemorrhage and brain trauma who were treated in our hospital from January 2023 to December 2024 were selected and divided into a control group (implementation of routine care) and an observation group (implementation of integrated nursing intervention) according to the principle of random allocation. The occurrence of pulmonary infection, length of hospitalization, complications and satisfaction with nursing work were compared between the two groups of patients. *Results:* The incidence of pulmonary infection in the observation group (7.50%) was significantly lower than that in the control group (28.75%), and the length of hospitalization (15.32 ± 3.12 days) was shorter than that in the control group (24.61 ± 4.57 days). In terms of complication rate (14.38% vs. 43.75%) and satisfaction (95.00% vs. 68.75%), the differences between the two groups were statistically significant ($p < 0.01$). *Conclusion:* Nursing intervention effectively reduces the risk of pulmonary infection and shortens the recovery cycle by systematically optimizing respiratory tract management and comprehensive support measures, demonstrating its clinical promotion value.

Keywords: Cerebral hemorrhage; Brain trauma; Nursing intervention; Pulmonary infection; Complications

Online publication: February 26, 2026

1. Introduction

Intracerebral Hemorrhage (ICH), as a primary non-traumatic intraparenchymal hemorrhage, accounts for 20–30% of the total number of cerebrovascular diseases, and its acute-stage mortality rate can reach 30–40% [1]. On the other hand, Traumatic Brain Injury (TBI) is caused by external violence, causing damage to the skull and brain tissue. It has become the second leading cause of death in men under the age of 35, and about half of the severe patients cannot survive [2]. Both of these diseases originate from the rupture or damage of intracranial blood vessels, which in turn causes bleeding. In severe cases, it can lead to neurological damage or even life-threatening [3]. Patients with cerebral hemorrhage and

brain trauma often suffer from impaired consciousness, decreased swallowing reflex, and long-term bed rest, which causes the pulmonary infection rate to rise to 20–40%, becoming a key complication affecting mortality and prognosis [4]. Although traditional nursing focuses on basic life support, there are deficiencies in comprehensive intervention in airway management, position adjustment and early rehabilitation, making the infection control effect unsatisfactory [5]. With the progress of research, multi-dimensional intervention measures such as combining airway humidification with vibration expectoration, and paying equal attention to postural management and nutritional support have been proposed, but systematic integration is still in the exploratory stage.

This study innovatively constructed a five-in-one comprehensive nursing strategy of "posture-airway-nutrition-infection-recovery" and verified its effect through randomized controlled trials, aiming to provide strong evidence-based support for clinical practice.

2. General information

2.1. Basic information

This study selected 160 patients with cerebral hemorrhage and brain trauma admitted to our hospital from January 2023 to December 2024 as the research subjects.

2.1.1. Inclusion criteria

(1) Meet the diagnostic standards of the "Chinese Guidelines for the Diagnosis and Treatment of Cerebral Hemorrhage" or "Clinical Diagnosis and Treatment Guidelines for Craniocerebral Trauma";
(2) The Glasgow Coma Scale (GCS) does not exceed 12 points;
(3) There is no history of pulmonary infection before admission;
(4) The patient's family members have signed an informed consent form.

2.1.2. Exclusion criteria

(1) Patients with multiple organ failure or immune deficiency;
(2) Patients with a history of chronic lung disease;
(3) Cases who dropped out or died during the study.

2.1.3. Study design

These 160 patients were randomly divided into the observation group (80 cases) and the control group (80 cases) using the random number table method. After comparison, there was no statistically significant difference in the baseline data of the two groups of patients (P>0.05). The specific data are shown in **Table 1**.

Table 1. Basic information

Group	n	Gender (n)		Age (years)	Disease type (n)		GCS score (points)
		Male	Female		Cerebral hemorrhage	Traumatic brain injury	
Observation group	80	39	41	52.62 ± 6.13	37	43	5.42 ± 0.84
Control group	80	40	40	52.91 ± 6.08	42	38	5.36 ± 0.79
χ^2/t		0.025		0.300	0.625		0.465
p		0.874		0.764	0.429		0.642

2.2. Research methods

2.2.1. Control group

Routine care: including continuous monitoring of vital signs, timely sputum suction treatment, rational application of antibiotics and basic nutritional support.

2.2.2. Observation group

Integrated nursing intervention

(1) Position management

Assist the patient to change to the lateral position or raise the head of the bed 30–45° every 2 hours, supplemented by intermittent prone position ventilation twice a day for 30 minutes each time to reduce the risk of aspiration and promote lung ventilation.

(2) Airway humidification and expectoration

Ultrasonic atomization treatment (using a mixture of physiological saline & acetylcysteine) was performed four times a day, and the number of atomization times was appropriately adjusted according to the viscosity of the sputum. At the same time, combined with a vibrating sputum device with a frequency of 30 Hz and manual back tapping of each lung lobe for 5 minutes, for patients with thicker sputum, a fiberoptic bronchoscope is additionally used for lavage.

(3) Nutritional support

The patient began to receive nasogastric enteral nutrition within 24 hours after admission, with an initial infusion rate of 20 mL/h, and was gradually increased to the target dose (≥ 25 kcal/kg/d) within 48 hours. A high-protein formula is used, with a protein content of 20% and a dosage of 1.5 g/kg/d. Continuously monitor serum albumin levels to ensure they are not less than 35 g/L, and assess gastric residual volume (< 200 mL) before each nasogastric feeding.

(4) Early rehabilitation

For conscious patients, abdominal breathing training is implemented three times a day for 10 minutes each time; for comatose patients, passive joint mobility training and postural drainage are performed. At the same time, transcranial direct current stimulation (tDCS) technology was applied, and the anode was placed in the motor area on the contralateral side of the injury. The stimulation intensity was set to 1.5 mA, and the treatment was performed for 20 minutes every day for 2 weeks. In addition, use an electric stand-up table for postural training with a starting angle of 30° and an increase of 10° every day to prevent the occurrence of orthostatic hypotension.

(5) Infection prevention and control measures

Ultraviolet disinfection is carried out twice a day in the ward. For high-touch surfaces (such as bed rails and pagers), chlorine-containing disinfectant with a concentration of 500 mg/L is used for wipe disinfection. Medical staff use hand-sensing sterilizers to disinfect before operating, and strictly implement the seven-step hand washing method before and after contact with patients. For patients infected with multidrug-resistant bacteria, they are placed in a single room for isolation, and the ventilator tubes are changed daily.

(6) Oral hygiene maintenance

① Cleaning and disinfection: Use chlorhexidine solution for oral cleaning, three times a day, and gargle for 30 seconds each time. If the oral pH value exceeds 7.0, switch to 2.5% sodium bicarbonate solution to effectively inhibit fungal colonization. ② Tongue coating and plaque management: Use a soft-bristled toothbrush combined with a tongue scraper to clean the base of the tongue and buccal mucosal folds, aiming to reduce the bacterial load in the oral cavity.

(7) Psychological support measures

① Cognitive behavioral therapy (CBT): Use behavioral experiments (such as simulating various tasks in daily life) and cognitive restructuring techniques (such as disease-related education) to improve patients' negative expectations

for recovery. ② Emotional regulation strategies: Use deep breathing exercises and progressive muscle relaxation training to reduce the level of sympathetic nerve excitement, and use mindfulness meditation techniques to reduce overactivation of the amygdala. ③ Family participatory intervention: Guide patients' families to actively participate in daily care (such as assisting patients to turn over, language training, etc.), and rebuild the family support network through regular family meetings, thereby reducing the patient's loneliness.

2.3. Observation indicators

(1) Pulmonary infection rate, complication rate (pressure ulcer, venous thrombosis, pulmonary embolism, urinary tract infection).
(2) Hospitalization time, mechanical ventilation time, and post-intervention GCS score.
(3) Nursing satisfaction: Likert 5-level rating.

2.4. Statistical processing

This study used SPSS version 26.0 statistical software for data analysis, and set the significance level at 0.05. If the p value was less than 0.05, the difference between the groups was considered to be statistically significant. Data description uses statistics such as mean, standard deviation and percentage, and comparison between groups uses independent sample t test and χ^2 test.

3. Results

3.1. Pulmonary infection rate and complication rate

It can be seen from the calculation results in **Table 2** that the pulmonary infection rate and complication rate of the observation group decreased ($p < 0.05$).

Table 2. Pulmonary infection rate, complication rate (n%)

Group	n	Pressure ulcer	Venous thrombosis	Pulmonary embolism	Urinary tract infection	Overall incidence	Overall incidence
Observation group	80	4 (5%)	4 (5%)	1 (1.25%)	2 (2.5%)	11 (13.75%)	6 (7.50%)
Control group	80	11 (13.75%)	10 (12.5%)	6 (7.5%)	8 (11.25%)	35 (43.75%)	23 (28.75%)
χ^2		-	-	-	-	17.574	12.172
p		-	-	-	-	0.000	0.000

3.2. Hospitalization, mechanical ventilation time, GCS score

The calculation results in **Table 3** show that compared with the control group, the observation group had shorter hospitalization and mechanical ventilation time ($p < 0.05$), and lower GCS score ($p < 0.05$).

Table 3. Hospitalization, mechanical ventilation time, GCS score ($\bar{x} \pm s$)

Group	n	Length of stay (d)	Mechanical ventilation time (h)	GCS score (points)
Observation group	80	15.32 ± 3.12	48.09 ± 9.52	9.12 ± 1.45
Control group	80	24.61 ± 4.57	72.23 ± 12.13	7.08 ± 1.32
t		15.016	14.003	9.305
p		0.000	0.000	0.000

3.3. Nursing satisfaction

From the results calculated in **Table 4**, it can be seen that compared with the control group, the nursing satisfaction of the observation group was improved ($p < 0.05$).

Table 4. Nursing satisfaction (n, %)

Group	n	Very satisfied	General satisfaction	Not satisfied	Overall satisfaction
Observation group	80	32 (40%)	44 (55%)	4 (5.00%)	76 (95.00%)
Control group	80	21 (26.25%)	34 (42.5%)	25 (31.25%)	55 (68.75%)
χ^2		-	-	-	18.573
p		-	-	-	0.000

4. Discussion

Cerebral hemorrhage and brain trauma are common critical illnesses of the nervous system, with rapid onset, high disability and high mortality rates [6]. Due to the patient's impaired consciousness and weakened swallowing reflex, sputum accumulates in the body, creating conditions for bacterial colonization [7]. In addition, long-term bed rest and the application of invasive treatments (such as endotracheal intubation, mechanical ventilation, etc.) further weaken the defense mechanism of the respiratory tract, significantly increasing the risk of infection by Gram-negative bacteria (such as Klebsiella pneumoniae) [8]. Furthermore, hypoalbuminemia and immunosuppression significantly reduce the body's ability to resist infection, thus forming a vicious cycle of "infection-malnutrition-low immunity". Relevant studies have shown that among patients with cerebral hemorrhage treated in ICU, the incidence of pulmonary infection is as high as 20–40%. This complication not only prolongs the patient's hospitalization time and increases medical expenses, but is also one of the important factors leading to patient death [9]. Although standard nursing measures (such as vital sign monitoring, basic sputum suctioning) are widely used in clinical practice, their insufficient integration of airway management, nutritional support, and early recovery results in limitations in the effectiveness of infection prevention and control. Although standard care focuses on life support, it lacks targeted measures. For example, it only uses supine positioning or simple turning without combining prone position ventilation to optimize the lung ventilation/blood flow ratio; it relies too much on sputum suction and ignores the synergistic effect of atomized inhalation and vibration sputum; the timing of starting enteral nutrition is not clear enough.

The results of this study showed that the incidence of pulmonary infection in the observation group was significantly lower than that in the control group, and the length of hospitalization was shorter than that in the control group. The difference in the incidence of complications between the two groups was statistically significant ($p < 0.01$). In recent years, domestic and foreign scholars have gradually paid attention to and studied the effect of multi-dimensional nursing intervention in preventing pulmonary infections [10]. For example, position management can effectively reduce the risk of aspiration by elevating the head of the bed to 30–45° or adopting a side-lying position; at the same time, this measure can also reduce the reflux of gastric contents and improve the ventilation/blood flow ratio, thereby reducing the risk of aspiration pneumonia. The combined application of airway humidification and vibration expectoration can dilute sputum and improve the efficiency of expectoration, and at the same time enhance ciliary movement, which is more efficient than a single suction operation. Early implementation of enteral nutritional support helps maintain the integrity of the intestinal barrier and immunoglobulin levels, thereby blocking the source of infection. Incorporating prone position ventilation into the care plan for patients with brain injury, combined with vibrating expectoration instruments and manual back tapping, can help reduce additional damage to patients caused by nursing operations. Oral care with chlorhexidine three times a day can inhibit the formation of biofilm, thereby reducing the number of oral colonies; daily replacement of ventilator

tubes can reduce the colonization rate of pathogenic bacteria. Adjusting the atomization frequency according to the sputum viscosity grade will help shorten the time for sputum clearance. A standardized process covering "enteral nutrition initiation timing, formula selection, and monitoring indicators" was established to reduce the arbitrariness of nutritional support programs in traditional care. The innovation of this study is reflected in the following two aspects:

(1) It systematically constructed a multi-dimensional nursing strategy that integrated elements such as position management, airway humidification, nutritional support, and early rehabilitation training to form a standardized intervention process;

(2) It introduced emerging technologies such as prone position ventilation and fiberoptic bronchoscope lavage, thereby improving the efficiency of airway management. Patients with cerebral hemorrhage and traumatic brain injury are prone to mental health problems such as anxiety, depression and post-traumatic stress disorder.

Psychological intervention measures, such as cognitive behavioral therapy (CBT) and mindfulness training, are designed to help patients establish positive thinking patterns, thereby reducing the impact of negative emotions on the recovery process. The value of integrated nursing intervention lies not only in the optimization of clinical indicators (such as the reduction of infection rates and the acceleration of functional recovery), but also in the rational allocation of medical resources through humanistic care and systematic management, in line with the patient-centered medical service concept.

In summary, the nursing intervention strategy significantly reduces the risk of pulmonary infection in patients with cerebral hemorrhage and brain trauma by optimizing multi-dimensional respiratory management, nutritional support, and infection control measures, while shortening the length of hospitalization and improving the quality of prognosis. It provides a practical nursing path for clinical practice and has both academic value and social benefit.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Sun D, Ren X, Ma L, et al., 2024, Application of Intervention Model Based on "Broken Window Effect" in Nutritional Support for Patients with Cerebral Hemorrhage in NICU. Hainan Medicine, 35(17): 2548–2552.

[2] Fan L, Guo M, Jin W, et al., 2024, Effects of Early Enteral Nutrition Supplemented with Bifidobacteria on Gastrointestinal Function in Patients with Severe Cerebral Hemorrhage. Modern Digestion and Interventional Diagnosis and Treatment, 29(6): 699–703.

[3] Qin X, 2024, Research on the Effect of Predictive Nursing Intervention on Pulmonary Infection and Recovery in ICU Patients with Hypertensive Cerebral Hemorrhage. Smart Health, 10(1): 207–210.

[4] Xu Y, Wang J, Zhao J, et al., 2023, Observation of the Effect of Dexmedetomidine in Patients After Traumatic Intracerebral Hemorrhage Under the Concept of Accelerated Recovery Surgery. Journal of Clinical Neurosurgery, 20(5): 569–574.

[5] Andre L, Bjrkelund A, Ekelund U, et al., 2024, The Prevalence of Clinically Relevant Delayed Intracranial Hemorrhage in Head Trauma Patients Treated with Oral Anticoagulants Is Very Low: A Retrospective Cohort Register Study. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 32(1): 9.

[6] Zhang Z, Shi Y, Liu J, et al., 2024, Multi-center Retrospective Study on the Predictive Value of New Coronavirus Infection

for Poor Short-term Prognosis in Patients with Cerebral Hemorrhage and Pulmonary Infection. Chinese Journal of Cerebrovascular Diseases, 21(4): 236–245.

[7] Li H, Li M, Li M, 2024, Analysis of the Clinical Efficacy of Acupuncture Combined with Modified Qingqi Huatan Decoction in the Treatment of Patients with Cerebral Hemorrhage Complicated by Pulmonary Infection. Chinese Journal of Antituberculosis, 46(S01): 73–75.

[8] Pessa R, Garcia G, Becker G, et al., 2024, Incidence and Risk Factors of Delayed Intracranial Hemorrhage in Anticoagulated Head Trauma Patients: A Systematic Review and Meta-analysis. World Neurosurgery, 192: 190–200.

[9] Huo J, Liu J, Ji R, et al., 2023, Effects of Different Early Airway Opening Methods on Pulmonary Infection and Tracheal Intubation in Patients with Severe Stroke. Chinese Journal of Stroke, 18(3): 295–300.

[10] Li Q, Chen X, Zou Y, 2023, The Impact of Predictive Nursing Intervention Under the Guidance of "5S" Management Model on the Rehabilitation Effect and Pulmonary Infection of Patients with Hypertensive Cerebral Hemorrhage. Chinese Journal of Integrated Traditional Chinese and Western Medicine First Aid, 30(5): 597–600.