# Post-print: Nursing Care for Patients with Traumatic Brain Injury After Tracheotomy

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## Abstract

Objective: To summarize nursing care experience in patients with craniocerebral injury following tracheotomy to prevent complications. Methods: A series of meticulous nursing interventions and observations, including stoma care, airway suctioning, airway humidification, and decannulation, were performed in 30 patients with craniocerebral injury after tracheotomy. Results: All 30 patients successfully passed through the critical period without complications such as stoma infection, airway obstruction, asphyxia, or pulmonary infection. Conclusion: Proper nursing measures, including airway suctioning and airway humidification, are crucial for effectively preventing complications following tracheotomy.

## Full Text

### Nursing Care for Patients with Craniocerebral Injury After Tracheostomy

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#### Abstract

**Objective:** To summarize nursing experience in preventing complications following tracheostomy in patients with craniocerebral injury. **Methods:** A series of meticulous nursing interventions and observations were implemented in 30 patients with craniocerebral injury after tracheostomy, including wound care, sputum aspiration, airway humidification, and extubation. **Results:** All 30 patients successfully passed the critical period without complications such as

wound infection, airway obstruction, asphyxia, or pulmonary infection. **Conclusion:** Proper sputum aspiration and airway humidification are critical measures for effectively preventing complications after tracheostomy.

**Keywords:** craniocerebral injury; tracheostomy; airway; nursing care

Craniocerebral injury is a common critical condition in neurosurgery, often accompanied by disappearance of swallowing reflex, loss of cough reflex, dyspnea, tongue root retraction, and impaired secretion drainage [1]. Tracheostomy can ensure airway patency, improve blood oxygen saturation, and maintain normal vital signs [2]. This procedure involves incising the cervical trachea and inserting a metal cannula to relieve laryngeal dyspnea, respiratory dysfunction, or lower airway secretion retention. Our department performed tracheostomy on 30 patients with craniocerebral injury between July 2021 and February 2023. The postoperative nursing care is presented below.

## 1 Clinical Data

All 30 cases were admitted to our ICU, including 20 males and 10 females aged 20–79 years (mean 45 years). The diagnoses comprised 20 cases of craniocerebral injury, 5 cases of cerebral hemorrhage, and 5 cases of cerebral infarction. Metal cannulas were used in 25 cases and balloon cannulas in 5 cases. All patients presented with varying degrees of consciousness disturbance upon admission.

## 2 Nursing Care Measures

### 2.1 Consciousness Assessment

Most patients with craniocerebral injury have varying degrees of consciousness disturbance. Comatose patients exhibit weakened or absent swallowing and cough reflexes, leading to poor drainage of tracheal secretions. Combined with central respiratory insufficiency, prolonged bed rest, reduced vital capacity, and weakened gastrointestinal function under intracranial hypertension, gastric contents may reflux without protective reflexes. Decreased immunity creates favorable conditions for microbial growth and predisposes patients to pulmonary infection. Zhuo et al. [3] identified tracheostomy as an independent risk factor for pulmonary infection in craniocerebral injury because respiratory function is affected by the central nervous system. When respiratory secretions accumulate, tracheostomy becomes necessary, but this procedure alters the physiological anatomy of the airway, allowing direct contact between external air and the trachea. Additionally, the airway's humidifying and filtering functions gradually diminish, and sputum aspiration procedures can irritate the respiratory mucosa, reducing pulmonary mucosal protection and increasing infection risk. Qi et al. [4] identified several causes of pulmonary infection in craniocerebral injury: first, pathogens directly enter the lungs after tracheostomy while immune dysfunction reduces pulmonary defense; second, improper nursing operations irritate airway mucosa and damage barrier function, introducing oral and nasal

bacteria into the lungs; third, prolonged bed rest decreases vital capacity and causes secretion reflux, leading to aspiration pneumonia; and finally, fluid loss during treatment makes pulmonary secretions difficult to expectorate.

### 2.2 Psychological Nursing

Tracheostomy affects patients' ability to speak and communicate, increasing psychological and physiological stress. Nursing staff should employ physical touch, soothing music, and other methods to alleviate anxiety and improve treatment confidence [5]. Preoperative education about tracheostomy basics and surgical necessity should be provided to patients and families to maintain optimism and eliminate tension, fear, and anxiety. Prognosis and recovery outcomes should be discussed, including successful cases of similar conditions. Simple hand gestures should be taught for common needs: thumb for defecation, little finger for urination, index finger for hunger, and middle finger for thirst. Paper and pen should also be available for expression. Humanistic nursing approaches are essential, as patients experience significant irritability during illness. Nurses must attend not only to physical conditions but also to psychological and mental states, being mindful of their own words and actions to avoid causing harm.

### 2.3 Dedicated Nursing Care

Continuous cardiac monitoring is required with close observation for dyspnea, cyanosis, subcutaneous hematoma, and wound bleeding. Any abnormalities must be immediately reported to physicians for prompt management. For metal cannulas, local bleeding can be controlled with petroleum jelly gauze compression for 24 hours before removal.

### 2.4 Positioning Nursing

Post-tracheostomy patients generally assume supine position. Semi-reclining position is permissible when condition allows or during irritable coughing, as this facilitates breathing and reduces cannula stimulation to the trachea. Supine patients should be turned every 2–3 hours with back percussion to promote sputum drainage and pulmonary function recovery. For comatose patients, the head and neck must remain level with the trunk during position changes to prevent tissue damage, bleeding, or perforation around the trachea from improper positioning.

### 2.5 Environmental Requirements

Patients should be placed in quiet, clean rooms with fresh air, maintaining temperature at 20–22°C and humidity at 60–70%. Ventilation should occur at least three times daily for 15–30 minutes each. Surfaces and floors should be wiped with 84 disinfectant solution twice daily, with ultraviolet disinfection for one hour twice daily with proper documentation. Visitation should be strictly

limited, with no smoking or littering in the room. Individuals with upper respiratory contamination should be prohibited from visiting, and protective isolation measures must be strictly implemented.

### 2.6 Wound Care

Tracheostomy site dressings must remain clean and dry, with daily povidone-iodine disinfection and dressing changes. During the first 1–2 postoperative days, the periwound skin should be frequently inspected for emphysema, infection, and eczema. The fixation bandage should be appropriately tight (allowing one finger passage). Overly loose bandages risk cannula dislodgement, while overly tight bandages impede jugular venous return. Overly long incisions may require 1–2 sutures at the upper end. Finally, two split gauze pieces should cover the incision beneath both sides of the cannula. The tie should be changed daily to prevent cannula dislodgement.

### 2.7 Sputum Aspiration Care

Strict aseptic technique must be observed, including hand washing and mask wearing before procedures. Suction catheters are for single use only, following an inside-out principle: tracheal secretions first, then oral and nasal secretions. Sterile saline should be used to flush the catheter. Meticulous cannula and balloon care with strict cleaning and disinfection are key to preventing complications. The outer cannula should be changed weekly, while the inner cannula requires cleaning, disinfection, and replacement every 6–8 hours. After removal, the inner cannula should be rinsed under running water, inspected against light for foreign bodies or secretions, then boiled for disinfection. Since prolonged separation may cause sputum crusting on the outer cannula wall and airway obstruction, separation should not exceed 30 minutes. A sterilized inner cannula of the same size should be readily available for immediate replacement, with sputum aspiration performed before inner cannula changes. The cannula opening should be covered with double-layer sterile saline gauze with appropriate moisture (no dripping). For balloon cannulas, deflation should occur every 2–4 hours for 2–5 minutes, with tracheal secretions aspirated before deflation. Balloon inflation should be appropriate (generally 5–6 ml), with cannula replacement every two weeks and immediate replacement if leakage occurs.

Before aspiration, patients should be instructed to take 3–5 deep breaths. For ventilated patients, high-flow oxygen should be administered for 1–2 minutes before and after aspiration to prevent hypoxemia. Aspiration should be gentle, rapid, and accurate, moving from bottom to top. Pressure should be controlled at 10.64–15.98 kPa for adults and 7.98–10.64 kPa for children, with each aspiration lasting no more than 15 seconds. For excessive secretions requiring continuous aspiration, high-flow oxygen can be administered between sessions, with no more than two consecutive aspirations. For thick secretions causing difficult aspiration, nebulization or direct instillation of humidification solution (100 ml 0.9% saline + 80,000 U gentamicin + 4,000 U $\alpha$-chymotrypsin) can

be administered via syringe (3–5 ml) into the tracheal cannula to dilute sputum before prompt aspiration. Turning and back percussion may also assist in loosening sputum plugs to facilitate drainage.

### 2.8 Airway Humidification Care

After tracheostomy, the upper airway loses its functions of warming, humidifying gases, and preventing bacterial invasion, leading to sputum retention. Combined with patient dehydration and viscous secretions, this predisposes to pulmonary infection.

Following evidence-based practice, 1.25% sodium bicarbonate solution, 0.45% sodium chloride solution, and distilled water are used for airway humidification, while sterile saline gauze covering the tracheostomy site further enhances humidification effectiveness [6]. For oxygen humidification, distilled water at 60–70°C should be added to the humidification bottle or maintained with a hot water bag, with water replenished as needed to warm and humidify the airway and dilute secretions.

### 2.9 Dietary Nursing

Seventy-five percent of craniocerebral injury patients have concurrent upper gastrointestinal injury. All 30 patients in this group routinely received nasogastric feeding tubes. During feeding, patients should be placed in lateral position with the head of bed elevated 15° to prevent gastric content reflux into the airway and aspiration pneumonia. Feeding speed should be controlled to avoid vomiting and hiccups. Suction should be avoided for one hour post-feeding to prevent reflex vomiting with massive gastric content expulsion that could cause asphyxiation. If massive gastric content expulsion occurs, immediate suction should be performed to clear airway, oral, and nasal secretions to prevent aspiration pneumonia. Daily oral care should be performed routinely.

### 2.10 Oral Care

Oral secretions entering the lower respiratory tract constitute an important infection source requiring enhanced oral care. Oral care solutions should be selected based on oral pH: 2%–3% boric acid solution for high pH, 2% sodium bicarbonate solution for low pH, and 1%–3% hydrogen peroxide or saline for neutral pH to reduce pulmonary infection risk.

### 2.11 Extubation Nursing

When conditions improve, extubation may be attempted. For cannulas with external balloons, the balloon should be deflated first before trial occlusion of the inner cannula opening, progressing from 1/3 to 1/2 to complete occlusion. The occluding plug must be secure to prevent aspiration. Respiration should be closely monitored during occlusion; any dyspnea requires immediate

plug removal. Generally, if the patient maintains stable breathing and normal phonation for 24–48 hours of complete occlusion, extubation can proceed. Post-extubation, periwound skin should be disinfected and approximated with butterfly adhesive tape without suturing, then covered with sterile gauze for 2–3 days until wound healing. Post-extubation monitoring should include respiration, swallowing, and phonation. Some patients develop dependence and cannot inhale through the nose post-extubation, requiring guidance and encouragement for proper inhalation and coughing. Patients should be instructed not to leave the ward for 48–72 hours post-extubation to prevent complications such as tracheal collapse, with a same-size tracheal cannula readily available at the bedside.

Tracheostomy ensures airway patency, improves blood oxygen saturation, and maintains normal vital signs. Post-tracheostomy, respiratory water loss increases while the airway's filtering, warming, and humidifying functions are reduced or eliminated. Prolonged inhalation of dry air can destroy pulmonary surfactant, decreasing lung compliance, worsening hypoxia, and causing airway obstruction. Maintaining airway patency is key to preventing complications. Through timely and effective sputum aspiration, airway humidification, strict cannula disinfection, aseptic technique, and wound observation and dressing changes, none of the 30 patients developed wound infection, asphyxiation, or pulmonary infection, and all were transferred to general wards for continued treatment.

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