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Nursing Care for a Patient with Severe Traumatic Brain Injury: A Case Report

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Abstract

Introduction: Summarizing the intensive care experience and lessons learned in a patient with severe traumatic brain injury.

Case Report: This paper describes a 52-year-old female patient who presented as severe traumatic brain injury. The key points of nursing were early and rapid identification and opening of the green channel, giving mild hypothermia therapy, and Continuous Renal Replacement Therapy (CRRT) by the neurological care team during the critical period. In addition, it also incorporates enteral nutrition management under the intensive care ultrasound technology and integration of intensive rehabilitation care. During the whole nursing process, nurses paid attention to the changes in the physiological, psychological, social, and spiritual states of patients and their families, and implemented personalized intensive care humanistic care. Finally, the patient's vital signs gradually stabilized after comprehensive, refined, and personalized care, and she was transferred to the general ward after 24 days of treatment in the neurological intensive care unit (NICU), during which no secondary infection occurred and the patient was successfully discharged from the ventilator.

Conclusion: This case report outlines the clinical manifestations of patients with severe traumatic brain injury in different periods, and summarizes the treatment and nursing measures for patients with severe craniocerebral trauma.

***Keywords*:** Severe traumatic brain injury; Neurological emergency nursing; Mild hypothermia therapy; Intensive care ultrasound technology.

Introduction

Severe Traumatic Brain Injury (STBI) is one of the most important causes of death and disability for patients worldwide [1]. Because of the interlocking and complex brain tissue and nerve structures, patients with severe traumatic brain injury are more difficult to treat, plus the need for surgery as soon as possible, and their secondary organ failure and infection are also important causes of death, increasing the difficulty of nursing [2]. It has been shown that the main points of treatment and care for patients with sTBI in the intensive care unit are preventing secondary injury, reducing intracranial pressure, avoiding hypotension, hyperthermia or hypoxemia, maintaining normal electrolyte homeostasis and adequate nutrition [3]. In September 2021, a patient with severe traumatic brain injury was admitted to our hospital. Through a series of standardized, dynamic, and continuous treatment and care, the patient's vital signs gradually stabilized after 24 days in the neurological intensive care unit, during which no secondary infection occurred and she was successfully discharged from the ventilator and transferred to the general ward for further treatment.

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Case Presentation

General information

The patient was admitted to the Neurosurgical Intensive Care Unit (NICU) on September 17, 2021, due to being "found on the ground, unable respond to a call with respiratory distress, loss of consciousness for 1+ hours", with a body temperature of 36.2ºC, pulse of 58 beats/min, respiration of 20 breaths/min, blood pressure of 108/73 mmHg. The patient had a GCS score of 4. After the physician gave painful stimulation the patient reflected a state of decerebrate tonicity and moderate coma, with bilaterally dilated pupils of about 5 mm in diameter, loss of light response, high muscle tone, and tendon reflex (++). The cranial CT findings showed that the patient had a right frontotemporal top subdural hematoma with a midline shift of approximately 8 mm and an indistinct circumferential pool, a left frontotemporal subdural hemorrhage, a subarachnoid hemorrhage, a left occipital and posterior cranial fossa fracture, and a left parietooccipital scalp hematoma. Therefore, the patient was admitted with a diagnosis of hyperacute severe traumatic brain injury.

Treatment and clinical outcome

The patient was found on the ground and immediately brought to our emergency department. The emergency medical staff gave the patient oxygen and other basic life support, performed a physical examination and emergency cranial CT then gave a mannitol drip and furosemide drip and performed tracheal intubation at the same time. After the successful implementation of tracheal intubation, the patient's cranial CT was reexamined under ventilator-assisted breathing, and the results showed that there was a marked increase in the subdural hematoma on the right frontotemporal roof with a midline shift of about 15 mm, disappearance of the circumferential pool, subdural hemorrhage on the left frontotemporal region, subarachnoid hemorrhage, fracture of the left occipital bone and posterior cranial fossa, and scalp hematoma on the left parietooccipital region. The patient was immediately admitted to the NICU and underwent emergency subdural hematoma removal and debridement decompression surgery on the same day. After surgery, the patient was ventilated with the assistance of a ventilator (PSV, oxygen concentration 45%), ICP was slightly high fluctuating from 16 to 21 mmHg, and a repeat cranial CT showed that the right hematoma was mostly cleared, the cricoid pool was still heavily compressed, her consciousness was in a moderate to deep coma, pupil light reflex disappeared, and bilateral pupils were about 2 mm. On the first day after the emergency operation, the medical staff performed ultrasound-guided nasojejunal tube placement and mild hypothermia treatment, combined Continuous Renal Replacement Therapy (CRRT) on the fourth day, tracheotomy and ventilator-assisted breathing (SIMV, oxygen concentration 50%) on the fifth day, and gave dynamically adjusted therapeutic care regimens such as control of intracranial pressure, cerebral protection, control of infection, control of blood glucose and blood pressure, and monitoring of the internal environment during the stay of NICU. 24 days later, the patient was stabilized and successfully discharged from ventilator-assisted breathing and transferred to a general ward for continued treatment.

Nursing

Rapid identification and opening of green channels for emergency care.

Emergency pre-screening and triage is a process in which medical personnel quickly classify patients according to the severity of their condition to determine treatment or management priorities, which is critical to the implementation of emergency care and directly affects the quality of emergency medical and nursing [4]. As a comprehensive tertiary hospital featuring emergency care, our hospital has built up an emergency care specialty integrating clinical, scientific research, and teaching which is one of the earliest emergency care disciplines established in Chongqing, China. When the patient was sent to our emergency department, the emergency nursing staff immediately graded the severity of the patient's condition according to the Emergency Pre-examination Triage Criteria and gave the patient basic life support such as vital sign monitoring and oxygenation. After the implementation of the physical examination and emergency head CT examination, the patient was given intravenous mannitol and intravenous furosemide, and tracheal intubation was performed at the same time. A green channel was opened for the patient and her family at the first time, and important examinations and treatments were arranged for the patient as soon as possible to save time and energy and seize the golden time for disease diagnosis and treatment.

Nutrition management under intensive care ultrasound technology

Intensive care ultrasound technology combines ultrasound medicine and the nursing interdisciplinarily to qualitatively or (and) quantitatively assess nursing indicators that cannot be observed by the naked eye in a visualized view, which helps to solve nursing challenges in the clinic and the use of ultrasound technology for the transnasal placement of jejunal nutrition can reduce the incidence of reflux and aspiration and increase the patient's tolerance of enteral nutrition [5]. The neurosurgery medical staff invited the dietetic team to consult the patient on the 1st day after the emergency surgery and performed bedside jejunal tube placement under the intensive care ultrasound technology, which was safe, convenient, and non-invasive, with a small complication rate. In addition, NRS-2002 was used to assess the nutritional status of the patients, and the nutritional implementation plan was determined by the dietitian according to the nutritional indicators such as hemoglobin and albumin and personal tolerance, and finally decided to give the patient early postoperative parenteral nutrition as the mainstay and enteral nutrition as a supplement within 24 hours, and gradually increased enteral nutrition after 48 hours, giving Beprid 500 ml/d, 20-50 ml/h continuous infusion pump, and using a heater to control the temperature range of nutrition fluid at 38-40^{O}C, and gradually increasing the amount of nutrition fluid intake according to the patient's gastric motility and caloric demand. Before and after the infusion of nutrient solution, the nursing staff washed the lumen with warm boiled water through the feeding needle. During the infusion, the nursing staff monitored the vital signs and blood glucose fluctuations of the patients in real time and observed whether the patients had adverse reactions such as bucking, vomiting, and diarrhea. In addition, nurses also regularly monitored gastric residual volume for patients, accurately assessed gastric motility and timely adjusted nutritional management strategies, strengthened oral care measures, and dynamically observed and recorded changes in nutritional indicators, so that the patient's albumin and total protein nutritional indicators always fluctuated within normal values during the stay of NICU.

Mild hypothermia treatment and CRRT were performed in series

Studies have shown that craniocerebral injury can result in histological and functional changes, such as damage to the blood-brain barrier and cellular edema, which can aggravate brain tissue ischemia and hypoxia, and mild hypothermia treatment, as an important measure for brain protection, can control brain metabolism, reduce brain tissue oxygen consumption, and effectively control intracranial pressure levels [6]. The patient was treated with mild hypothermia treatment on the 1st postoperative day, and the patient's head and body were continuously cooled with a mild hypothermia apparatus, and chlorpromazine 20 mg and acepromazine 20 mg were administered by intravenous pumping at 3 ml/h for artificial hibernation. During the hypothermia induction period, the body temperature was lowered to the target temperature within 2 to 3 h. During this period, blood volume deficiency and cardiac arrhythmia were likely to occur, causing a drop in blood pressure and chills, so the nursing staff strengthened dynamic cardiac and respiratory monitoring during this period, observed and prevented the occurrence of chills, and monitored and recorded the patient's body temperature and skin condition every 0.5 h. The Bed-Side Shivering Assessment Scale (BSAS) was used to assess the chilling response and to ensure that the target temperature was safely reached within the specified time. During the hypothermia maintenance period, the patient's body temperature was maintained at 34-35^{O}C. During this period, the nursing staff monitored the vital signs and strengthened the monitoring of intracranial pressure, skincare, and the observation and prevention of deep vein thrombosis in the lower extremities, and also observed and recorded every 0.5 h interval. During the rewarming period, to avoid the rebound hyperthermia and intracranial pressure increase due to the rapid rewarming rate, the rewarming rate was adjusted to ≤0.25^{O}C/h, so that the patient's body temperature gradually increased to 36.5~37.3^{O}C, during which the nursing care focused on reasonable control of the rewarming rate and increased management of intracranial pressure level control.

On the 4th day after the operation, the index values of blood sodium, blood chloride, and osmotic pressure of the patient were abnormal, indicating a disorder of water and electrolyte balance. After a discussion of difficult cases by the medical and nursing team, it was decided to add CRRT in tandem with mild hypothermia treatment, on the one hand, heat dissipation using thermal radiation and thermodilution through the peripheral line of CRRT supplemented by mild hypothermia treatment for temperature control, and on the other hand, ultrafiltration was used to remove excess water from the body and remove inflammatory mediators by adsorption to regulate the water and electrolyte balance of the body environment, facilitate intracerebral blood circulation and reduce cerebral edema [7]. The patient's blood sodium and blood chloride fluctuation levels were normal, the osmolality control was slightly higher than normal, and the intracranial pressure was controlled at 7-10 mmHg after the implementation of CRRT. The tandem treatment was discontinued after 2 days, and the purpose of dehydration and cranial pressure reduction, stable maintenance of intracranial pressure, control of fluctuating levels of body temperature, and water-electrolyte balance treatment care were achieved.

Humanistic care

With the innovation of medical concepts and technology, the nursing model is also constantly updated and developed, and while focusing on the treatment of the disease itself, it advocates the implementation of a person-centered care model, respecting the value of patients' lives and human dignity, applying humanistic care in the process of intensive nursing management, helping patients and their families to improve compliance and enhancing the quality of critical care [8]. After patients were transferred to NICU for treatment, the nursing team implemented humanistic care:

1. The responsible nurse know more about the patient's condition, family, and social situation through effective communication and made an evaluation, formulated a personalized humanistic care plan and the nurse regularly conducted offline interviews with family members to know the changes in their psychological condition and treatment attitude, adjusted the humanistic care plan, and gave targeted health education, psychological consultation, and other support measures.

2. Meeting the needs of family members to provide visits based on the network platform, and advocate for family members to actively participate in the decision-making process of patient treatment. On the one hand, this will promote family members' understanding of the patient's situation, facilitate two-way communication and decision-making, and promote the relationship between medical staff and patient. On the other hand, encouragement and other emotional support from family members can promote the stability of the patient's psychological condition and facilitate disease treatment and recovery.

3. Create a quiet and comfortable ward environment, adjust the temperature of the ward, control it between 22 and 25^{o}C, with humidity around 55%, adjust the ambient light according to the changes of the indoor and outdoor environment; reasonably adjust and fix the placement of monitoring instruments and tubes, adjust the instrument alarm parameters according to the changes of the disease, reduce the external stimulation of the patient and the occurrence of adverse events.

4. Dynamically assess the patient's consciousness, pain, and irritability, and give medication and non-pharmacological nursing interventions as prescribed by the doctor, such as hot and cold compresses, massage, moving limbs, playing soothing music, etc.

5. Strengthen the management of position and restraint, adopt appropriate positions and place soft pillows and cushions according to the patient's condition and ergonomics, and change positions regularly; Patients should avoid non-essential restraint during treatment, and if there is restraint, it should be gentle, and the width and tightness of the restraint belt should be appropriate, and the restraint area should be loosened and massaged regularly.

Intensive rehabilitation care

Studies have shown that although the survival rate of NICU patients is higher than before, due to long-term bed rest and neurological impairment, patients are prone to intensive care unit acquired weakness (ICUAW) for a long time in the braking state which seriously affects disease recovery and quality of life. However, early implementation of scientific and systematic rehabilitation care for patients with severe neurological disorders can, to a certain extent, reduce the complication and disability rate, shorten the number of hospitalization days, reduce the burden on families and society, maximize the maintenance and improvement of physical function, and enhance the long-

term quality of life [9,10]. After the patient was transferred to the NICU, the department immediately set up an early rehabilitation team consisting of rehabilitation therapists, doctors, nurses, and caregiver, with the attending physician and rehabilitation therapist taking the lead in formulating an early rehabilitation plan for the patient and conducting rehabilitation training after the patient's vital signs stabilized after surgery.

Respiratory function rehabilitation

(1) Maintenance of effective position: Maintenance and change of effective position is the key measure to keep the patient's airway unobstructed and prevent aspiration. A qualified caregiver should change the patient's position and turn and pat the back every 2 hours, and keep the head and neck in the mid-axis of the body with the help of a turning mat and/or soft pillow to prevent the neck from bending and causing airway obstruction and breathing difficulty.

(2) Continuous airway humidification combined with closed suction: For critically ill patients in neurosurgery, due to their low immunity, the establishment of an artificial airway also provides conditions for the growth of bacteria, which very easy to cause respiratory tract infection and other adverse consequences. Therefore, after this patient had established an artificial airway, nursing staff performed continuous airway humidification, using a warm humidification device at the patient's air intake while the ventilator was being applied, humidifying with sterilized water, and performing closed suction as needed.

(3) Dynamic monitoring of respiratory function: After successful weaning from the ventilator through dynamic respiratory function evaluation and intermittent weaning training, the patient's respiratory treatment plan was changed to mask oxygen inhalation and warm humidification to achieve the best warm humidification effect, and nebulization treatment was given twice a day.

Progressive limb function rehabilitation

The patient's muscle strength was assessed by the early rehabilitation team to be at 0 to 2 levels, and a combination of physical therapy and passive exercise was advocated for progressive functional rehabilitation.

(1) Bedside passive training: Rehabilitation therapists helped patients to perform joint and limb function training in the supine position, and the active parts included the hand, wrist, ankle, knee, and other joints. The activities included wrist extension, finger extension, limb elevation, joint flexion, extension, adduction, external rotation, etc. The early rehabilitation training time was 5min/time and gradually increased to 10, 15, and 20min/time, 2 times/day.

(2) Skin cleansing massage: The nursing staff cleaned the patient's whole body with warm water and applied a little moisturizer for a soothing massage. The massage time was generally 10min/ time, 1 time/day.

(3) Acupuncture and neuromuscular electrical stimulation were used for auxiliary training: During the implementation period, the vital signs of patients were closely monitored. When the heart rate or blood pressure increases, and the blood oxygen saturation was lower than 90%, the time and frequency of rehabilitation treatment should be appropriately reduced, or the training should be paused to reformulate the rehabilitation plan.

Conclusion

The condition of patients with severe traumatic brain injury is critical and changes rapidly, with high mortality, and nursing is difficult and risky. It is necessary to monitor all aspects of indicators through various monitoring instruments and tools, so as to reflect the patient's condition in time and provide refined and systematic nursing support. In clinical practice, the critical and difficult period of the treatment and nursing of patients with severe traumatic brain injury is the peak period of brain edema in the perioperative period. How to effectively prevent dehydration and reduce intracranial pressure while avoiding hypotension and maintaining homeostasis of the internal environment is particularly important. In this case, the degree of craniocerebral injury was serious and urgent, which extremely tested the emergency response and intensive care level of trauma first aid. In our hospital, the rapid emergency triage and timely opening of the green channel ensured the timeliness of the follow-up treatment of the patient. The early mild hypothermia treatment, CRRT, enteral nutrition under intensive care ultrasound technology, multidisciplinary team cooperation, and other measures of the neurological intensive care team responded to the abnormal changes of the condition in time, prepared for a rescue, and provided comprehensive nursing, ensuring the timeliness of treatment and fine nursing, and finally made the patient's vital signs gradually stable. The patient was transferred from the NICU to the general ward for continued treatment, with no secondary infection occurring during this period, and was successfully discharged from the ventilator.

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