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Original Article

Efficacy evaluation of comprehensive airway management in postoperative nursing and management on the patients with hypertension and encephalorrhagia

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Abstract: Objective: To evaluate postoperative nursing and management of patients with hypertension and encephalorrhagia, comprehensive airway management was employed in this study. Methods: Ninety-eight patients with tracheotomy, hypertension, and encephalorrhagia were enrolled in The Affiliated Hospital of Shandong University of Traditional Chinese Medicine from January 2016 to August 2017. The patients were randomly divided into a comprehensive management group (49 cases) and a control group (49 cases) by random number table. The routine nursing was employed in the control group, whereas in the comprehensive management group, routine nursing and comprehensive airway management were used. The baseline data, arterial blood gas analysis, abnormal blood pressure, hospital indexes, nursing satisfaction, incidences of pulmonary infection, and adverse events were recorded and compared. Results: There was no significant difference on baseline data, including gender, age, education level, and bleeding parts ($P>0.05$). The arterial oxygen saturation (SaO_2) and partial pressure of oxygen (PO_2) in the comprehensive management group was significantly higher than that in control group (both $P<0.05$). The incidence of abnormal blood pressure in the comprehensive management group was significantly lower than that in the control group ($P<0.05$). After nursing, acute physiology and chronic health evaluation II (APACHE II) scores in both groups were improved compared with before the nursing. Moreover, the APACHE II score in the comprehensive management group was significantly lower than that in control group ($P<0.05$). Also, there was a significantly higher airway nursing score in comprehensive management group than that in control group ($P<0.05$). The tube intubation and opening times and length of stay in the comprehensive management group were significantly shorter than that in control group (all $P<0.05$). The risk and complaint rate of nursing in the comprehensive management group were all significantly lower than that in the control group (both $P<0.05$). There was significantly higher nursing satisfaction in the comprehensive management group than in the control group ($P<0.05$). The incidence of adverse reaction in the comprehensive management group was significantly lower than that in the control group ($P<0.05$). Conclusion: Comprehensive airway management helps to improve patients with hypertension and encephalorrhagia, decrease the incidence of pulmonary infection, avoid adverse events, reduce the length of treatment, increase the nursing satisfaction, and improve the prognosis.

Keywords: Hypertension and encephalorrhagia, comprehensive airway management, tracheotomy

Introduction

As a high incidence disease in the clinic, hypertension and encephalorrhagia are induced by abnormal intracerebral arteriole bleeding caused by long-term cerebral arteriosclerosis and hypertension. Furthermore, the incidence of disease is getting more prevalent in younger patients in the recent years [1]. The clinical symptoms of hypertension and encephalorrhagia are dizziness, acroparalysis, and aphasia, etc. Also, the disease progression was relatively fast. Based on the common symptoms including the damage in the central nervous system and disturbance of consciousness, the disturbance of the respiratory center function emerges and then the function of maintaining airway open is decreased [2, 3]. Meanwhile, the distur-

bance of consciousness also leads to glossocoma which blocks the airway. The autonomous abilities of coughing and expectorating are also reduced accordingly. If timely intervention was not performed, the airway obstruction could be triggered at any time, and then result in disturbance of ventilation and oxygenated function, oxygen deficit on patients, and aggravation of encephalorrhagia and encephaledema [4, 5]. In recent years, with wide application of the mechanical ventilator on critical patients, the risk of postoperative respiratory insufficiency has decreased greatly, while treatment efficacy has improved [6, 7]. However, owing to the more severe conditions of the patients with hypertension and encephalorrhagia, long-term invasive ventilation was needed. This treatment easily results in respiratory tract infection, and can induce ventilator-associated pneumonia, thus affecting prognosis [8, 9]. Therefore, strict, meticulous, and effective airway management is an essential part for assurance of the effects of mechanical ventilation by ventilator, and also could decrease the incidence of respiratory tract infection, and improve the efficacy for the patients with hypertension and encephalorrhagia [10].

Accordingly, based on the urgent needs for clinical application, 98 patients with hypertension and encephalorrhagia were recruited in The Affiliated Hospital of Shandong University of Traditional Chinese Medicine to evaluate the comprehensive airway management on postoperative nursing. These data provide scientific practical guidelines and evidence-based support for clinical applications.

Materials and methods

Patient information

Ninety-eight patients with tracheotomy, hypertension, and encephalorrhagia were enrolled in The Affiliated Hospital of Shandong University of Traditional Chinese Medicine from January 2016 to August 2017. There were 53 males, and 45 females in this study. The patients were aged from 43 to 81 years old, with the average age of 56.91±4.69 years old. The Glasgow Coma scale (GCS) ranged from 4 to 9, with the average scale of 6.58±2.17. For the bleeding parts, there were 11 cases on lobes, 80 cases on basal ganglia region, and 7 cases on epencephal. The inclusion criteria consisted of (A) meeting the diagnosis of hypertension and encephalorrhagia on "various types of cerebrovascular disease diagnosis guideline", or confirmed by magnetic resonance imaging (MRI) or cranial computed tomography (CT) scan, (B) course of hypertension more than 5 years, (C) GCS ranging from 3 to 12, volume of hematoma above 30 mL after admission, (D) no pulmonary infection at admission, (E) delivered in The Affiliated Hospital of Shandong University of Traditional Chinese Medicine in 24 h after onset of illness, and performed mechanical ventilation after admission, the length of mechanical ventilation ≥ 48 h. The exclusion criteria consisted of (A) the patients with coagulopathy, severe liver and kidney dysfunction, pulmonary infection, and limb dysfunction, (B) combination of consciousness, perception, and behavior disorders, (C) occurrence of traumatic encephalorrhagia, spontaneous subarachnoid hemorrhage, or others which unsuitable for tracheotomy, (D) aggravation of disease or even death, transferring to another hospital, or giving up during the treatment. This study was approved from the local ethical committee. The patients or family members understood and signed the informed consent. The patients were randomly divided into a comprehensive management group (49 cases) and a control group (49 cases) by random number table.

Treatment program

Routine nursing was performed in control group as follows [11]. The ward temperature was maintained from 20 to 24°C. The ward humidity was also maintained from 45 to 60%. According to the specific situation of individual patients, the temperature and humidity were adjusted properly. The ward windows were opened at a regular time (twice per day) for ventilation and air exchange. The sterile operation was used strictly during nursing. Disinfection by ultraviolet light was performed for 30 min once per day. If the patients could not leave the bed, the ultraviolet lightning was delayed. Then the ward was cleared by cloth with disinfectant, twice per day. The position of the head was elevated properly with continuous oxygen inhalation under low flow. Oral cavity nursing was performed twice per day. Disease progression was monitored strictly. The times of the visits for patients were limited for only one guest in the ward for 30 min in each visit.

Comprehensive airway management was used in a comprehensive management group as follows. First, the airway management committee was built by one head nurse, one specialist charge group leader, and two charge nurses. Three months of rotary training proceeded for all members in the intensive care unit (ICU). Moreover, the members had abundant airway management experiences. Based on the clinical condition, the treatment program was scheduled following the requirements of airway management and nursing. Knowledge and skills training was performed for the group members. The quality of nursing on the patients with artificial airway (including airway humidification, aspiration of sputum, expectoration by turning and patting on the back, artificial airway and mechanical ventilation nursing, prevention and treatment of ventilator-associated pneumonia, non-invasive ventilator nursing, etc.) in our department was assessed each week by group members. According to the quality standard of airway management, the summative evaluation was conducted by charge of the group leader. General seminar was held every Tuesday, and the inspection results were analyzed and concluded. A written report was produced, and rectifying comments were proposed. Each item in the airway management operation procedure and routine nursing was improved. Issues with solutions were traced continuously in the following seminar. The inspection results were involved in the assessment by the department. The assessment of nursing quality was performed once per month.

For the comprehensive airway management group, there were also several key points in the nursing program. First, the nursing of airway incision needed to be handled carefully. After the tracheotomy, maintaining a dry and clean incision was needed. Careful observation was also needed to find bleeding if present on the incision site. The bleeding on the airway incision site was normally in the early stage after tracheotomy due to incomplete hemostasis or wall airway injury induced by tube oppression, or violent aspiration of sputum, etc. If massive hemorrhage emerged, compression hemostasis was needed immediately. Timely reporting for the concerned doctor was also performed. The procedures for hemostasis and disinfection were used for the incision. The iodophor disinfectant solution was performed on the skin which surrounding the incision twice per day. Based on the amount of secreta, the dressing was changed properly in once or twice per day. Secondly, the tube in airway also should be taken carefully. The inside tube was cleared every day at regular time (once in every 2-4 h). Then the tube was dipped in 3% hydrogen peroxide for 25-30 min for the disinfection. The outside tube was fixed by bandage to avoid taking off and displacement.

Continuous humidification for the airway was still needed and operated as follows. Sterile distilled water was transferred into the empty 50 mL syringe, and fixed on the microinfusion pump. The scalp needle with flexible pipe was then inserted in the airway with a length from 5 to 7 cm. The water was dropped into the airway slowly (4-6 drops per minute). The amount of water was no less than 200 mL. In some cases, sticky secreta emerged making it difficult for suction on patients, along with a combination of dysphoria, dyspnea, cyanopathy, or decreasing of blood oxygen saturation (SpO_2). These symptoms indicated that there was sticky sputum and not enough humidification. Then the rate of humidification needed to be increased, so a combination of 500 mL humidification liquid with gentamicin ($1.2*10^5$ U), and Mucosolvan (30 mg) could dilute the sputum and control infection. If bloody sputum appeared, 1.35% sodium bicarbonate solution was used as humidification liquid to prevent the occurrence of pulmonary infection [12]. Then the nursing of sputum aspiration was performed as follows. The frequency of sputum aspiration was maintained at every 0.5-1 h during the next three days after surgery and the frequency of sputum aspiration was sustained at every 1-2 h. During the aspiration of sputum, the sucker was rotated around from deep to shallow site with lifting (no more than 15 s per aspiration). For the patients with much more sputum, an intermittent aspiration method for sputum was employed as follows. After the clearance of secreta in patient' oral cavity, the whole secreta in tube was aspirated and then ceased. The tube in airway and the aspiration tube for secreta was all pulled out. Then the sputum around the oropharynx was cleared until the tubes arrived. For the blocking and pulling out of the tube, proper nursing was used as follows. The blocking of the tube (24-48 h) could be done after the patients have stable

Table 1. Comparison of clinical baseline data between two groups

Item	Control group (n=49)	Comprehensive management group (n=49)	$t/\chi^2/H$	P
Gender			0.041	0.839
Male	27	26		
Female	22	23		
Age (years old)	57.39±4.25	56.86±4.12	0.627	0.532
Bleeding part			0.156	0.925
Lobe	5	6		
Basal ganglia region	40	40		
Epencephal	4	3		
Education level			0.300	0.772
Illiteracy	1	2		
Primary school	9	10		
Middle school	25	23		
Bachelor degree or above	14	14		

disease, improved breathing, and powerful sputum suction and significant bucking reflection. During the blocking of the tube, the patients were monitored for the oxygen deficit (cyanosis or anhelation, etc). The secreta in the respiratory tract was cleared in a timely manner. If there was no cough and dyspnea after blocking of the tube, the tube could be pulled out, and the incision also would be covered with oil sand which changed at any moment. The coalescence of the incision was then monitored and recorded. Finally, nursing for the oral cavity and nutrition was promoted. According to the situations of recovery on patients after surgery, fasting, or nasal feeding was used. The oral cavity nursing was maintained twice per day to avoid the growth and reproduction of bacterial in oral cavity.

Outcome measures

Main outcome measures: Arterial blood gas analysis and abnormal blood pressure was measured seven days after the tracheotomy for the PO_2 and SaO_2 of both groups during the treatment [13]. The changes of blood pressure on patients were recorded after the treatment of percussion on back and sputum elimination apparatus each day. If the increase of systolic pressure ≥ 20 mmHg was measured three times consecutively, the symptom was recorded as abnormal blood pressure. The APACHE II airway nursing score was measured to evaluate the physical condition of patients from 0-30 score. The lower score indicated better physical condition. The airway nursing scale table was employed to assess the airway nursing [14]. This scale table included eight items, such as underlying disease, arterial blood gas analysis, airway reactivity, oxygen index, consistency of sputum, auscultation of lungs, and airway resistance of medical ventilator, etc. There were 1-3 scale for each item, and 24 scores in total. The higher score indicated better nursing.

For the occurrences of pulmonary infection and adverse events (including trachea cannula, remaining needle and catheter pulling out, skin and airway damage, and also out of sync for breath between patient and ventilator) during nursing were recorded and analyzed. The sputum culture and drug sensitivity test were used when pulmonary infection appeared on patients. Then the sensitive anti-bacterial drugs were employed for the treatment. For the adverse events, the prevention approaches were more important. The depressant was given for the patients after anesthesia without consciousness to avoid the tube drawing by themselves after revival. Bound limbs were needed if necessary. The ventilator should be placed beside the bed to avoid the tube falling out by gravity. During the intubation of tube, the action should soft to avoid airway injury.

Secondary outcome measures: Hospital indexes (including time of opening tube, tube intubation time, and length of stay) were recorded for both groups [15]. The nursing satisfaction, risk of nursing, incidences of risk on nursing, and complaint nursing were also recorded. The risk on nursing included improper parameters setup, maintenance operations, clearance for the ventilator, unqualified airway management procedures, and all paper work. The incidence of risk on nursing = patients with the previous factors/all patients * 100%. The incidence of complaint nursing = patients with complaint for nursing/all patients * 100%. Then the incidences of risk and complaint on nursing were compared. The nursing satisfaction survey was assessed by patients and family members [16].

Table 2. Comparison of arterial blood gas analysis and abnormal blood pressure between two groups

Group	SaO_2 (%)	PO_2 (mmHg)	Abnormal blood pressure (n, %)
Control group (n=49)	92.65±3.92	79.26±6.57	40 (81.63)
Comprehensive management group (n=49)	97.72±4.31	89.49±6.73	5 (10.20)
t/χ^2	6.092	7.614	50.335
P	<0.001	<0.001	<0.001

Note: SaO_2: arterial oxygen saturation; PO_2: partial pressure of oxygen.

Table 3. Comparison of APACHE II and airway nursing score before and after nursing between two groups

Item	Control group (n=49)	Comprehensive management group (n=49)	t	P
APACHE II score				
Before nursing	20.36±4.18	21.07±4.96	0.766	0.445
After nursing	15.95±3.16	11.54±2.21	8.005	<0.001
t	5.891	12.285		
P	<0.001	<0.001		
Airway nursing score				
Before nursing	14.53±3.36	13.84±3.29	1.027	0.307
After nursing	17.54±3.92	21.51±2.27	6.135	<0.001
t	4.081	13.432		
P	<0.001	<0.001		

Note: APACHE II: acute physiology and chronic health evaluation II.

For this survey, the reliability and validity were measured by Cronbach's α coefficient (0.84) and remeasuring validity (0.86). There were 10 items with the total score of 40. The higher score indicated the higher satisfaction for the nursing by patients and family members.

Statistical analysis

SPSS 18.0 software was used for data analysis. The measurement data is expressed by mean ± standard deviation ($\bar{x}$ ± sd). The measurement data with normal distribution was conducted with t test. The measurement data without normal distribution was conducted with rank-sum test. The count data was expressed by percentage, and compared with χ^2 and Fisher's exact test. The ranked data was conducted with rank-sum test. P<0.05 indicated statistically significant difference.

Results

Comparison of baseline data between two groups

There was no significant difference on baseline data, including gender, age, education level, and bleeding parts (P>0.05, **Table 1**).

Comparison of arterial blood gas analysis and abnormal blood pressure during the treatment between two groups

The SaO_2 and PO_2 in comprehensive management group were significantly higher than that in control group (both P<0.05, **Table 2**). There was significantly lower incidence of abnormal blood pressure in comprehensive management group than that in control group (P<0.05, **Table 2**).

Comparison of APACHE II and airway nursing score between two groups

There was significantly lower APACHE II score after nursing than that before nursing in both groups (both P<0.05). The airway nursing score after nursing was significantly higher than that before nursing in both groups (both P<0.05). Moreover, the APACHE II score in the comprehensive management group was significantly lower than that in the control group after nursing (P<0.05). There was significantly higher airway nursing score in the comprehensive management group than that in the control group after nursing (P<0.05). The data is shown in **Table 3**.

Comparison of hospital indexes between two groups

The tube intubation time, length of stay, and time of opening tube on patients in comprehensive management group were significantly lower than that in control group (all P<0.05, **Table 4**).

Comparison of nursing satisfaction between two groups

There were significantly lower incidences of risk and complaint on nursing in comprehensive

Table 4. Comparison of hospital index between two groups

Group	Tube intubation time (d)	Length of stay (d)	Time of opening tube (d)
Control group (n=49)	19.47±6.19	21.68±3.18	14.75±2.12
Comprehensive management group (n=49)	13.41±6.21	18.44±3.02	9.54±1.98
t	4.833	5.172	12.572
P	<0.001	<0.001	<0.001

Table 5. Comparison of nursing index between two groups

Group	Nursing risk (n, %)	Nursing complaint (n, %)	Nursing satisfaction (score)
Control group (n=49)	7 (14.29)	8 (16.33)	24.65±8.65
Comprehensive management group (n=49)	1 (2.04)	1 (2.04)	33.11±6.43
t/χ^2	4.900	5.995	5.495
P	0.027	0.031	<0.001

Table 6. Comparison of adverse events between two groups (n, %)

Item	Control group (n=49)	Comprehensive management group (n=49)	χ^2	P
Endotracheal tube out	1 (2.04)	0 (0.00)		
Remaining needle out	3 (6.12)	1 (2.04)		
Catheter tube out	2 (4.08)	0 (0.00)		
Skin damage	1 (2.04)	0 (0.00)		
Airway damage	3 (6.12)	2 (4.08)		
Out of sync for breath between patient and ventilator	3 (6.12)	1 (2.04)		
Total	13 (26.53)	4 (8.16)	5.765	0.016

management group than that in control group (both P<0.05). The nursing satisfaction in comprehensive management group was significantly higher than that in the control group (P<0.05). The data is shown in **Table 5**.

Comparison of adverse events between two groups

The incidence of adverse events in the comprehensive management group (8.16%) was significantly lower than that in the control group (26.53%, P<0.05 by Fisher's exact test). The data is shown on **Table 6**.

Discussion

With the severe disease progression, rapid changing and normally combining with acute intracranial hypertension, vomiting often appeared on the patients with hypertension and encephalorrhagia. The high amount of hemorrhage in patients would induce the disturbance of consciousness and lower or even no swallowing reflex. Then it would lead to the inhalation of vomitus in respiratory tract, and induce the aspiration pneumonia. After the combination of shortness on expectoration, it would increase the difficulties of treatment and nursing, also effect the patient prognosis [17]. At the same time, the brain tissue would be redamaged by surgical stress during the operation. The levels of oxygen and blood deficiency would also aggravate the injury, and induce the impaired brain tissue. It would cause death for patients if there was no intervention timely [18, 19]. Therefore, at the early stage after the surgery, respiratory support was needed as early as possible to clear the abnormal secreta in respiratory tract, keep the airway open, correct the hypoxemia, improve the cure of brain tissue damage which caused by oxygen and blood deficiency, and promote the recovery of patients [20]. However, the respiratory tract was exposed to the environment directly during and after the tracheotomy [21, 22], and the respiratory tract was damaged through the pro-

cess of trachea cannula. The barrier function of airway was then decreased, and the risk of pulmonary infection was increased greatly [23, 24]. In addition, continuous aspiration of sputum under negative pressure would induce the respiratory tract damage, and then result in respiratory depression, affecting the recovery of patients [25]. Thus, proper respiratory tract nursing approaches play an important role on the treatment and prognosis for the patients with hypertension and encephalorrhagia.

Based on the priority principles on nursing, comprehensive airway management was a predictive nursing type, which including the strict monitoring and recorded the disease progression of patients, finding and raising problems initiative, then solving the problem in treatment and nursing [26]. According to the problems in nursing, targeted and persistent nursing was performed to improve the recovery of patients, decrease incidence and the risk of adverse events, promote the nursing quality [27]. Based on the priority principles on nursing, the airway management not only included the airway routine nursing, but also optimized each operation step in airway nursing to perform a comprehensive, normalized, and institutionalized airway management [28].

In this study, the comprehensive airway management was performed. The results show that, the APACHE II score, tube intubation time, length of stay, time of opening tube, risk and complaint for nursing in the comprehensive management group were all significantly lower than that in the control group. The airway nursing score and nursing satisfaction in comprehensive management group were significantly higher than that in the control group. Those results indicated that comprehensive airway management could effectively decrease the tube intubation time, accelerate the recovery of patients, decrease the risk and complaint for nursing, reduce the medical disputes and the length of stay. From the previous clinical study, based on the long-term resting on bed, decreasing of self-immunity and swallowing function, the risk of incidence of pulmonary infection was increased on the patients with hypertension and encephalorrhagia. In this study, the incidence of pulmonary infection in the comprehensive management group (8.16%) was significantly lower than that in the control group (26.53%). Moreover, the adverse events (such as disturbance in respiration and airway collapse, etc.) in the comprehensive management group was also significantly lower than that in the control group. The results indicated that, the comprehensive airway management could effectively decrease the complications such as pulmonary infection, and avoid the adverse events. After the tracheotomy, the airway in patients was affected by outside air. Then it induced the dry environment inside the airway, and easily led to airway mucosal tissue damage. Then the airway mucosal tissue would lose the normal clearance and filtration functions. The secreta in airway would scab together, then induce the blocking of respiratory tract and affect the ventilation function. However, continuous humidification of the airway could decrease the viscosity of sputum, dilute the secreta, improve the smooth and quick expectoration of sputum, decrease the times of smoking, and make sure the smooth aspiration flow of sputum. In addition, the clearance and fixation of cannula could decrease the incidence of taking off, displacement, and re-location. The clearance of secreta in oral cavity of patients at fixed period could prevent microorganism growth effectively. After orienting the comprehensive treatment and nursing, this study focused on the systematic and multimethodological medical management services. This management could not only meet the nursing requirement of humidification for the airway sufficiently, but also help to avoid the inducing factors of adverse events and complications. There was no long-term prognosis follow-up research in this study. Thus, the short-term observation limited the results and conclusion. An extended study was planned to evaluate the effects of long-term prognosis by comprehensive airway management.

In conclusion, comprehensive airway management could help to improve the respiratory function of patients with hypertension and encephalorrhagia after the tracheotomy. It also could decrease the incidence of intrapulmonary infection effectively, ensure the oxygen supply for brain tissue, decrease the length of stay, and increase the nursing quality.

Disclosure of conflict of interest

None.

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