Research Paper

Effect of Early Airway Management on Postoperative Rehabilitation of Patients Undergoing Cervical Spine Surgery

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To explore the application of early airway management in accelerated rehabilitation of patients undergoing cervical spine surgery. A total of 76 anterior cervical spine surgery patients admitted to our hospital from May 2018 to June 2019 were selected and the patients were divided into a routine group and an intervention group with 38 cases each according to the random number table method. The conventional group received traditional nursing intervention during the perioperative period and the intervention group received early aerosolization based on traditional nursing during the perioperative period to strengthen airway management. The airway resistance and peak airway pressure of the two groups after intervention were compared and analyzed, work of breathing and other respiratory mechanics indicators, interleukin-8, C-reactive protein, procalcitonin levels and other respiratory tract infection related indicators, treatment satisfaction, complicates the situation and its infection rate and recovery progress. Before treatment, there was no significant difference between the two groups of airway resistance, peak airway pressure, work of breathing and serum interleukin-8, C-reactive protein, procalcitonin indicators; after treatment, the two groups of airway resistance, peak airway pressure, work of breathing indicators and serum interleukin-8, C-reactive protein, procalcitonin indicators were significantly lower than before treatment and the observation group was lower than the control group, the difference was statistically significant ($p<0.05$); the postoperative complication rate of patients in the intervention group was significantly lower than that of the conventional group and the difference was statistically significant ($p<0.05$) The observation group time to get out of bed and hospital stay were significantly shorter than those of the control group and their average hospitalization expenses were significantly lower than those of the control group. The difference was statistically significant ($p<0.05$); the total satisfaction rate of 94.7 % was significantly higher than the 78.9 % of the routine group and the difference was statistically significant ($p<0.05$). Carrying out early airway management after cervical spine surgery can effectively promote the recovery of patients, with fewer clinical complications, high nursing satisfaction, reducing the patient's family economic pressure and improving the prognostic quality of life, so it is worthy of clinical application.

Key words: Airway management, cervical spine surgery, postoperative rehabilitation, nursing

In recent years, the number and proportion of patients undergoing cervical spine surgery in bed are increasing year by year. Due to the particularity of anatomical location and physiological function of cervical spinal cord, patients are prone to respiratory dysfunction in varying degrees during perioperative period, which seriously affects the surgical effect and prognosis and even leads to death[1,2]. It is necessary to strengthen the nursing work of airway management in the operation process and after the operation. Therefore, the medical staff must properly implement the rehabilitation nursing operation of each link after the operation; especially pay attention to improving the level of airway nursing and corresponding medical management[3,4]. Early airway management refers to the perioperative use of evidence based medicine to optimize the patient's respiratory management measures, so that patients can recover quickly, reduce the incidence of complications, shorten the length of hospital stay and reduce the cost of hospitalization. In this study, the application effect of early airway management in postoperative rehabilitation of patients with cervical spine surgery was explored.

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MATERIALS AND METHODS

General information:

A total of 76 patients with cervical spine surgery in our hospital from May 2018 to June 2019 were selected as the research object, including 46 cases of anterior approach, 29 cases of posterior approach and 1 case of combined anterior and posterior approach. They were randomly divided into routine group and intervention group, 38 cases in each group. The routine group included 24 males and 14 females, with an average age of (58.10±5.43) y old from 36 to 73 y old; the intervention group included 18 males and 20 females, with an average age of (60.02±7.90) y old from 43 to 77 y old. There was no significant difference in gender, age and other general information between the two groups ($p>0.05$).

Inclusive criteria-Meeting the indications of cervical spine surgery; No mental disorder, cognitive disorder or communication disorder; Participating in the study with informed consent.

Exclusion criteria-Patients with heart, liver and kidney dysfunction who could not tolerate surgery; Patients with respiratory tract infection. The study was approved by the ethical society and all participants signed informed consent.

Methods:

The routine group was given traditional nursing intervention in perioperative period. Preoperative: diet was forbidden for 6-8 h, cleaning enema was given in the evening before operation and indwelling catheterization was given after entering the operating room on the day of operation. Intraoperative: the temperature and humidity in the operating room are appropriate, pay attention to keep warm and do a good job in general anesthesia intubation nursing. Postoperative: intravenous analgesia pump was used to relieve the pain and temporary medication was used to relieve the pain when the patient complained of aggravation of pain; 6 h after the operation, the patient was instructed to eat and gradually transferred from liquid food to normal diet. The catheter was removed 24 h after operation.

In the intervention group, the airway management and postoperative oxygen atomization inhalation were strengthened on the basis of the routine group:

Preoperative airway management-Assess the patient's respiratory system, cough and expectoration and smoking history; To guide the effective cough, expectoration and breathing training of patients and supervise the training of patients, so as to achieve the purpose of rapid recovery; Risk factor assessment: due to the high incidence of difficult airway in cervical spine surgery, the Department of Anesthesiology should improve the airway assessment before surgery[5]; Prevent upper respiratory tract infection, guide patients to drink more water and keep warm.

Postoperative airway management: Oxygen atomization inhalation: the patients were given atomization therapy immediately after returning to the ward[6]. Patients with sticky sputum were given glucocorticoid budesonide atomization suspension 1 mg plus inhalation and 0.3 g of acetylcysteine solution was used to dilute sputum, atomization frequency was 3 times/d. The patients without sputum were given 0.9 % normal saline 5 ml oxygen atomization inhalation to humidify the airway, atomization frequency 2 times/d. The evaluation of phlegm viscosity is based on: Grade I is thin phlegm, grade II is moderate sticky phlegm and grade III is severe sticky phlegm.

Other measures-Postoperative analgesia: personalized multimodal analgesia, analgesia pump+analgesic injection+topical patch and observe the effect of analgesic drugs on respiration; Posture Management: during the transport process, the patient uses the neck support fixed brake, where appropriate tightness, after lying in bed, remove the neck support and use sandbag brake to prevent torsion, hyperextension or hyperflexion, At least every 2 h to assist their coaxial small turn and closely observe the patient's breathing; To keep the respiratory tract smooth: the patients were given oxygen inhalation through nasal catheter (2-3 L/min) after operation and the blood oxygen saturation was closely monitored. Encourage patients to breathe deeply and cough and expectorate spontaneously in the early stage; Prepare tracheotomy bag beside the bed: when the patient complained of chest tightness, shortness of breath, asphyxia, neck thickening and obvious local swelling of incision, should immediately report to the doctor for treatment and assist in tracheotomy if necessary[7]; Nursing of incision drainage tube: properly fix the drainage tube to prevent folding, blocking and prolapse, closely observe the drainage volume, the nature and color of drainage fluid and observe whether there is blood and fluid seepage at the incision site and whether there is swelling[8]; Diet: from semi liquid food to normal diet, drink more water after operation, drink slowly, use

straw, so as not to cause discomfort such as aspiration, choking and cough.

Observation indexes:

Airway resistance, peak airway pressure (PIP) and work of breathing (WOB) were measured before and 3 d after treatment; The levels of interleukin-8 (IL-8), C-reactive protein (CRP) and procalcitonin (PCT) in peripheral blood were measured by enzyme-linked immunosorbent assay (ELISA) before and 3 d after treatment; The treatment satisfaction rate was evaluated by the self made "patient satisfaction questionnaire". There were 25 items in the questionnaire and each item was scored by 1-4 grades. Very satisfied: the total score of the questionnaire was more than 90 points; satisfied: the total score of the questionnaire was between 60-90 points; dissatisfied: the total score of the questionnaire was less than 60 points; The postoperative complications and infection rate of the two groups were compared; The recovery progress of the two groups were compared, including the first time out of bed, hospitalization time and hospitalization expenses.

Statistical analysis:

All data were processed by Statistical Package for the Social Sciences (SPSS) 20.0 statistical software. Chi square test was used to compare the count data, and t test was used to measure the data. $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Before treatment, there was no significant difference in airway resistance (raw), PIP and WOB between the two groups; after treatment, raw, PIP and WOB indexes of the two groups were significantly lower than before treatment and the observation group was lower than the control group ($p<0.05$), as shown in Table 1.

Before treatment, there was no significant difference in serum interleukin-8 (IL-8), CRP and PCT indexes between the two groups; after treatment, the serum IL-8, CRP and PCT indexes of the two groups were significantly lower than before treatment and the observation group was lower than the control group ($p<0.05$), as shown in Table 2.

The total satisfaction of patients in the intervention group was significantly higher than that in the conventional group ($p<0.05$), as shown in Table 3.

The incidence of postoperative complications in the intervention group was significantly lower than that in the conventional group ($p<0.05$), as shown in Table 4.

The time of getting out of bed for the first time and hospitalization time of the observation group were significantly shorter than those of the control group

TABLE 1: COMPARISON OF RESPIRATORY MECHANICS INDEXES BETWEEN THE TWO GROUPS BEFORE AND AFTER TREATMENT

Group	Time	RaW [$cmH_2O/(L·s)$]	PIP (cmH_2O)	WOB (J/L)
Control group	Before intervention	16.71±0.26	33.98±2.24	1.19±0.27
	After intervention	10.43±0.22[a]	23.09±3.77[a]	0.63±0.21[a]
Intervention group	Before intervention	16.82±0.33	34.55±2.12	1.11±0.26
	After intervention	7.28±0.32[ab]	15.62±3.14[ab]	0.22±0.09[ab]

Note: Compared with before intervention, [a]$p<0.05$; Compared with control group, [b]$p<0.05$

TABLE 2: COMPARISON OF INFLAMMATORY FACTORS BETWEEN THE TWO GROUPS BEFORE AND AFTER TREATMENT

Group	Time	IL-8 (ng/L)	CRP (mg/L)	PCT (ng/L)
Control group	Before intervention	2.33±0.54	78.81±9.02	27.11±4.13
	After intervention	1.22±0.38[a]	62.48±7.42[a]	20.79±2.28[a]
Intervention group	Before intervention	2.28±0.59	79.07±8.79	26.98±4.16
	After intervention	0.87±0.41[ab]	37.54±7.63[ab]	15.31±2.26[ab]

Note: Compared with before intervention, [a]$p<0.05$; Compared with control group, [b]$p<0.05$

TABLE 3: COMPARISON OF THE SATISFACTION OF TWO GROUPS OF PATIENTS WITH NURSING SATISFACTION

Group	Very satisfied	Satisfied	Dissatisfied	Degree of satisfaction
Intervention group	26 (68.4)	10 (26.3)	2 (5.3)	36 (94.7)
Control group	18 (47.4)	12 (31.6)	8 (21.1)	30 (78.9)
x^2		8.145		
p		<0.05		

TABLE 4: COMPARISON OF COMPLICATIONS BETWEEN THE TWO GROUPS

Group	Pulmonary infection	Collapse of trachea	Dyspnea	Low oxygen saturation	Incidence of adverse reactions
Intervention group	1 (2.63)	0 (0)	2 (5.26)	1 (2.63)	4 (10.52)
Control group	2 (5.26)	1 (2.63)	3 (7.89)	2 (5.26)	8 (21.04)
x^2	4.600	3.956	5.063	3.373	7.934
p	0.032	0.047	0.024	0.020	0.001

TABLE 5: COMPARISON OF RECOVERY AND PROGRESS BETWEEN THE TWO GROUPS

Group	First time out of bed (d)	Length of stay (d)	Hospitalization expenses (ten thousand)
Intervention group	2.81±0.72	12.10±2.49	6.42±1.27
Control group	4.65±1.32	14.91±3.34	7.98±2.44
x^2	5.941	4.733	3.128
p	0.001	0.001	0.003

and the average hospitalization cost of the observation group was also significantly lower than that of the control group ($p<0.05$), as shown in Table 5.

It is very important to carry out early airway management after cervical spine surgery, especially in the nursing process to ensure that the patient's airway remains unobstructed. Close observation of the patient's condition changes, the use of systematic and scientific measures for respiratory tract management, will help to reduce the incidence of respiratory complications, so that patients with pain relief, so that patients recover quickly. The use of oxygen atomization of drugs to form aerosol particles, through the way of natural inhalation into the respiratory tract, can achieve the purpose of humidifying the airway and treatment. Atomization inhalation plays an important role in eliminating the problem of patients undergoing anterior cervical surgery, improving lung ventilation function, diluting sputum and increasing patient comfort[9]. After oxygen atomization inhalation, the throat of patients can be kept moist for a long time, which plays an important role in relieving local distress symptoms. In addition, the patient's sputum is easier to cough up, which can relieve discomfort such as dry throat or pain[10]. Airway management, as one of the important links of eras, can reduce pulmonary complications, death risk, readmission rate and hospitalization expenses[11].

Raw, WOB and PIP are common respiratory mechanics indexes. Among them, raw can effectively reflect the airway obstruction, PIP can effectively reflect the ventilation of patients, WOB refers to the work done by respiratory muscles to overcome resistance and maintain ventilation and its level can effectively reflect the respiratory function of patients[12]. The main biological activity of IL-8 is to activate neutrophils. When its level is high, it can reflect the local inflammatory response of patients[4]. CRP is an acute phase protein, which is involved in the body's inflammatory response. Its level is often used to detect the degree of inflammatory response in patients. Under normal circumstances, the content of PCT in blood is very low, which reflects the active degree of systemic inflammatory response[13]. The results of this study showed that before treatment, there was no significant difference in raw, PIP and WOB between the two groups; after treatment, raw, PIP and WOB indexes of the two groups were significantly lower than before treatment and the observation group was lower than the control group, indicating that early airway management can effectively improve the respiratory function of patients, reduce the level of inflammatory factors and promote the rehabilitation of patients.

Clinically, patients undergoing cervical spine surgery are prone to dyspnea due to injury or surgical stress[14,15]. In addition, parasympathetic nerve excitation leads to increased respiratory secretions, tracheal smooth muscle contraction and alveolar vascular dilation and congestion, further reducing the ventilation function of patients[16,17] . Stress makes the patients have autonomic nerve dysfunction and causes diaphragmatic movement disorder, which makes the pulmonary alveolar ventilation, cough reflex and other respiratory functions dependent on diaphragm abnormal[18,19].

Most patients need to be forced to lie in bed after operation, which is prone to aspiration and respiratory secretions cannot be discharged in time, which is easy to cause pneumonia. The above reasons can make the respiratory function of patients abnormal, affect the effect of surgical treatment and postoperative recovery[2]. The results showed that compared with the control group, the incidence of respiratory complications was significantly reduced from 21.00 % to 10.00 %, the

average length of stay was shortened from (14.91±3.34) d to (12.10±2.49) and the patients' satisfaction with nursing was also significantly improved.

To sum up, early respiratory tract management after cervical spine surgery can effectively promote the rehabilitation of patients, reduce clinical complications, improve nursing satisfaction, reduce family economic pressure and improve prognosis quality of life, which is worthy of clinical application.

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Conflicts of interest:

The authors report no conflicts of interest.

REFERENCES

1. Joffe AM, Schroeder KM, Shepler JA, Galgon RE. Validation of the unassisted, gum-elastic bougie-guided, laryngeal mask airway-ProSeal™ placement technique in anaesthetized patients. Indian J Anaesth 2012;56(3):255-8.
2. Aziz M. Airway management in neuroanesthesiology. Anesthesiol Clin 2012;30(2):229-40.
3. Arslan ZI, Yildiz T, Baykara ZN, Solak M, Toker K. Tracheal intubation in patients with rigid collar immobilisation of the cervical spine: a comparison of Airtraq® and LMA CTrach™ devices. Anaesthesia 2009;64(12):1332-6.
4. Yeganeh N, Roshani B, Azizi B, Almasi A. Target-controlled infusion of remifentanil to provide analgesia for awake nasotracheal fiberoptic intubations in cervical trauma patients. J Trauma Acute Care Surg 2010;69(5):1185-90.
5. Goutcher CM, Lochhead V. Reduction in mouth opening with semi-rigid cervical collars. Br J Anaesth 2005;95(3):344-8.
6. Martyn JA, Richtsfeld M, Warner DO. Succinylcholine-induced hyperkalemia in acquired pathologic states: etiologic factors and molecular mechanisms. Anesthesiology 2006;104(1):158-69.
7. Stephens CT, Kahntroff S, Dutton RP. The success of emergency endotracheal intubation in trauma patients: a 10-year experience at a major adult trauma referral center. Anesth Analg 2009;109(3):866-72.
8. Kihara S, Watanabe S, Brimacombe J, Taguchi N, Yaguchi Y, Yamasaki Y. Segmental cervical spine movement with the intubating laryngeal mask during manual in-line stabilization in patients with cervical pathology undergoing cervical spine surgery. Anesth Analg 2000;91(1):195-200.
9. Keller C, Brimacombe J, Keller K. Pressures exerted against the cervical vertebrae by the standard and intubating laryngeal mask airways: a randomized, controlled, cross-over study in fresh cadavers. Anesth Analg 1999;89(5):1296-300.
10. Prasarn ML, Conrad B, Del Rossi G, Horodyski M, Rechtine GR. Motion generated in the unstable cervical spine during the application and removal of cervical immobilization collars. J Trauma Acute Care Surg 2012;72(6):1609-13.
11. Hadley MN, Walters BC, Grabb PA, Oyesiku NM, Przybylski GJ, Resnick DK, *et al.* Guidelines for the management of acute cervical spine and spinal cord injuries. Clin Neurosurg 2002;49:407-98.
12. Gerstein NS, Braude DA, Hung O, Sanders JC, Murphy MF. The Fastrach TM Intubating Laryngeal Mask Airway®: an overview and update. Can J Anaesth 2010;57(6):588-601.
13. Bathory I, Frascarolo P, Kern C, Schoettker P. Evaluation of the GlideScope® for tracheal intubation in patients with cervical spine immobilisation by a semi-rigid collar. Anaesthesia 2009;64(12):1337-41.
14. Bednar DA. Efficacy of orthotic immobilization of the unstable subaxial cervical spine of the elderly patient: investigation in a cadaver model. Can J Surg 2004;47(4):251-6.
15. Gerling MC, Davis DP, Hamilton RS, Morris GF, Vilke GM, Garfin SR, *et al*. Effects of cervical spine immobilization technique and laryngoscope blade selection on an unstable cervical spine in a cadaver model of intubation. Ann Emerg Med 2000;36(4):293-300.
16. Mosier JM, Stolz U, Chiu S, Sakles JC. Difficult airway management in the emergency department: GlideScope videolaryngoscopy compared to direct laryngoscopy. J Emerg Med 2012;42(6):629-34.
17. Avitsian R, Lin J, Lotto M, Ebrahim Z. Dexmedetomidine and awake fiberoptic intubation for possible cervical spine myelopathy: a clinical series. J Neurosurg Anesthesiol 2005;17(2):97-9.
18. Ong JR, Chong CF, Chen CC, Wang TL, Lin CM, Chang SC. Comparing the performance of traditional direct laryngoscope with three indirect laryngoscopes: A prospective manikin study in normal and difficult airway scenarios. Emerg Med Australas 2011;23(5):606-14.
19. Horodyski M, DiPaola CP, Conrad BP, Rechtine II GR. Cervical collars are insufficient for immobilizing an unstable cervical spine injury. J Emerg Med 2011;41(5):513-9.

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