ORIGINAL ARTICLE

Application of improved Beck oral score in oral care of burn patients with mechanical ventilation

Yan Wang[1], Rui Guo*[2], Shu-jie Wang[1], Xiu-mei Zhou[1]

[1] *Department of Burn Surgery, Baogang Hospital, Baotou, Inner Mongolia, China*
[2] *Ordos Institute of Technology, Ordos, Inner Mongolia, China*

Received: September 13, 2023 **Accepted:** December 10, 2023 **Online Published:** January 2, 2024
DOI: 10.5430/dcc.v10n2p15 **URL:** https://doi.org/10.5430/dcc.v10n2p15

ABSTRACT

Objective: To explore the application effect of improved Beck oral score in oral care of burn patients with mechanical ventilation, to provide practical basis for oral care of such patients.

Methods: A total of 42 patients with tracheotomy and mechanical ventilation in the Department of Burn Surgery of Baogang Hospital in Inner Mongolia from January 2021 to December 2022 were selected as the study objects, and the patients were randomly divided into observation group and control group, with 21 cases in each group. The control group was given routine oral care, and the observation group was given oral care according to improved Beck oral score. The following were compared between the two groups: Age, total burn area, third-degree burn area, acute physiological and chronic health assessment scores, as well as improved Beck oral scores; the incidence of oral odor, plaque index, mouth ulcer and ventilator-associated pneumonia (VAP) after 7 days; the detection of microorganism in oral secretions.

Results: After 7 days, the oral condition of patients in observation group was effectively improved, and the oral comfort level was significantly improved. The incidence of oral odor (2.57±1.59), dental plaque index (2.62±1.47), oral ulcer evaluation (2.24±1.09), VAP incidence (9.52%) and improved Beck oral score (8.09±1.92) in observation group were all lower than those in control group, which was (3.95±1.82), (3.57±1.21), (3.14±1.24), (38.09%), and (9.90±2.21) respectively. The difference was statistically significant ($p < .05$). The oral normal flora in observation group (71.43%) was higher than that in control group (28.57%), and the difference was statistically significant ($p < .05$). The oral gram-positive bacteria (19.05%) and Gram-negative bacteria (23.81%) in observation group were lower than those in control group, which was 52.38% and 57.14% respectively, and the difference was statistically significant ($p < .05$).

Conclusions: The application of the improved Beck oral assessment method in dynamic oral care can effectively reduce the content of oral pathogens, lower the incidence of pulmonary infection, and improve the quality of life of patients.

Key Words: Improved Beck oral score, Tracheotomy, Burns, Oral care

1. INTRODUCTION

Tracheotomy mechanical ventilation is an effective therapy to improve hypoxia in patients with deep facial and neck burns as well as inhalation injuries. Due to the impaired normal oral function and the combined influence of ventilator pipes, patients are limited in communication and eating.[1,2] The long-term open state of the patients' mouth, severe edema around the mouth, reduced saliva secretion and oral self-purification function lead to a large number of bacterial growth in the mouth and an increased risk of

*Correspondence: Rui Guo; Email: 280490555@qq.com; Address: Ordos Institute of Technology, Ordos 017000, Inner Mongolia, China.

related infections, thus, comprehensive and systematic oral care is needed.[3,4] The traditional way of oral care is to wipe the mouth with a wet cotton ball soaked with normal saline, which cannot effectively remove dental plaque in the gums and crevices. If the operation is not proper, the flushing fluid is easy to enter the tracheal tube air bag, and when patients turn over or the air bag pressure decreases, it will also enter the lower respiratory tract and cause lung infection. At present, evidence-based medicine based oral care program for burn patients with mechanical ventilation after tracheotomy has not been established. In this study, the improved Beck oral score system was applied to evaluate the oral status of patients, aiming to provide effective practical basis for oral care of such patients.

2. OBJECT AND METHOD

2.1 General data

A total of 42 hospitalized patients in the Department of Burn Surgery of Baogang Hospital in Inner Mongolia from January 1^{st} 2021 to December 31^{st} 2022 were selected and divided into observation group (n = 21) and control group (n = 21) according to random number table method. Inclusion criteria: (1) Age 18-60 years old; (2) Burn patients with tracheotomy and mechanical ventilation; (3) Hospital admission within 24 hours after injury. Exclusion criteria: (1) A definite lung infection before admission; (2) Pregnant women and parturient; (3) Patients with previous mental illness; (4) Malignant tumors, diseases of the blood system, pneumonia caused by acquired immunodeficiency virus infection, autoimmune diseases, and other systemic infections. General information of the patients was recorded, including age, gender, burn site, total burn area and third-degree burn area. Acute physiology and chronic health evaluation II (APACHE II) score[5] and improved Beck oral score[6] were calculated. There were no statistically significant differences in age, total burn area, third-degree burn area, APACHE II score and improved Beck oral score between the two groups ($p > .05$), as shown in Table 1.

Table 1. Comparison of the general situation of patients in observation group and control group at admission

Group	Age	Total burn area	Third-degree burn area	APACHE II score	Improved Beck oral score
Observation group (n = 21)	36.52±8.857	35.76±16.70	20.47±7.15	24.48±8.03	10.29±2.63
Control group (n = 21)	35.90±11.91	41.57±22.15	19.57±11.07	24.86±7.58	10.38±2.92
t	0.191	0.960	0.315	0.158	0.111
p	.849	.343	.755	.875	.912

Table 2. Types of oral care solution and methods and frequency of oral care

improved Beck oral score	Types of oral care solution	Methods and frequency of oral care
1-5	2% sodium bicarbonate or 0.12% chlorhexidine	Oral rinse + negative pressure suction + oral wipe 2 times/d; Partially moisten the lips and mouth, qd
6-10	2% sodium bicarbonate or 0.12% chlorhexidine	Oral rinse + negative pressure suction + oral wipe 4 times/d; Partially moisten the lips and mouth, q8h
11-15	2% sodium bicarbonate or 0.12% chlorhexidine	Oral rinse + negative pressure suction + oral wipe 6 times/d; Partially moisten the lips and mouth, q6h
16-20	2% sodium bicarbonate or 0.12% chlorhexidine	Oral rinse + negative pressure suction + oral wipe ≥8 times/d; Partially moisten the lips and mouth, q4h

2.2 Methods

Oral care for observation group: The frequency of care, the type of care solution and the way of oral care were determined according to the improved Beck oral score (see Table 2). Brushing method for oral care was used. The toothbrush soaked with chlorhexidine or sodium bicarbonate solution was used to brush the teeth at 45°, and the cheek and tongue were brushed gently from inside to outside, the inner and outer sides were brushed longitudinally, and the occlusal surfaces were brushed horizontally. All parts were brushed more than 5 times, chlorhexidine mouthwash was injected slowly into the mouth with a syringe to rinse and a negative pressure suction toothbrush was used to attract the mouth at a low level, and a sputum suction tube was used to attract the airway and oropharynx if necessary to avoid aspiration. After the end, a lip balm was used to protect the lip and the tracheal tube was fixed, ensuring that the air bag pressure is in the range of 25-30 cm H_2O.

Oral care for control group: Traditional oral care was adopted, the head of the bed was raised 30°-45°, the head

was tilted to one side, one nurse was responsible for airway fixation, the other nurse was responsible for cleaning operation, sterile gloves were worn, and the saline cotton ball was held by cured clamp to wipe the teeth, cheeks, lingual surface, hypogloeeis and other parts of patients in turn. At the same time, the changes in the patient's vital signs were closely paid to avoid coughing and vomiting.

Both groups received oral care for 7 consecutive days. Patients were treated and cared by medical staff of burn surgery in accordance with burn treatment guidelines and advanced trauma life support guidelines.[7,8] Patients were given fluid resuscitation and vital signs monitoring, sensitive antibiotics were selected according to the results of bacterial culture in secretions, and transfusions of blood products, enteral and external nutrition were given if necessary.

2.3 Outcome measures

Oral odors, dental plaque index, evaluation of oral ulcers, incidence of ventilator-associated pneumonia (VAP) and improved Beck oral score were compared between the observation group and control group. Oral normal flora, gram-positive bacteria, gram-negative bacteria, and fungal spores' mycelium were compared between the two groups.

2.4 Evaluation index

2.4.1 *Improved Beck score[6]*

The total score of Beck oral care was 5-20 points, and each evaluation index was 1-4 points. The score was calculated through systematic evaluation of the mouth, saliva, gums and oral mucosa, teeth, and tongue. Oral status assessment was carried out at 8:00 am every day. After patients were fully exposed to the mouth, the nursing staff filled in the score sheet after assessment.

2.4.2 *Odor score[9]*

Visual simulation score was used to evaluate the degree of odor in the patient about 10 cm away from the patient: 0 was classified as no odor, 1-3 as mild odor, 4-6 as moderate odor, 7-9 as severe odor, and 10 as strong odor.

2.4.3 *Determination of dental plaque index[10]*

A cotton swab dipped in 2% basic fuchsin was applied on the tooth surface, after patients rinsed mouth, the stained red area was identified as dental plaque. The plaque index was measured before oral care using Turesky modified scoring method.

2.4.4 *Evaluation of oral ulcers[11]*

The status of oral ulcers in patients was observed in the early morning of every day. Oral ulcers were evaluated according to the World Health Organization oral ulcer scale, with grades 0-IV corresponding to 1-5 points.

2.4.5 *Collection of oral secretions*

Patients' secretions from posterior pharyngeal wall was collected by a cotton swab dipped in a small amount of normal saline, and oral microorganisms were identified and cultured and sent to the laboratory of our hospital. The secretions were cultured continuously at 37°C under aerobic conditions for 5 days, and the bacterial staining characteristics and colony morphology were analyzed after Gram staining, and the secretions were identified by an automatic bacterial identification instrument. Oral secretions were collected for primary fungal screening and microbial culture on the 1^{st}, 4^{th} and 7^{th} days after mechanical ventilation, any 1 time in 3 days of sampling is positive can be judged as a positive result.

2.5 Statistical treatment

The experimental data were analyzed by SPSS 20.0 statistical software, and the counting data were analyzed by Fisher's exact probability method or Chi-square test; Measurement data were expressed as $\bar{x}\pm$s, and independent sample T-test was used to compare the results, and the difference was statistically significant if $p < .05$.

3. RESULTS

3.1 Comparison of oral status after 7 days between the two groups

The incidence of oral odor, plaque index, oral ulcer evaluation, VAP incidence and improved Beck oral score in the observation group were all lower than those in the control group, with statistical differences ($p < .05$), as shown in Table 3.

Table 3. Comparison of oral status between observation group and control group after 7 days

Group	Odor score	Plaque index	Oral ulcer evaluation	VAP	Improved Beck oral score
Observation group (n = 21)	2.57±1.59	2.62±1.47	2.24±1.09	2 (9.52)	8.09±1.92
Control group (n = 21)	3.95±1.82	3.57±1.21	3.14±1.24	8 (38.09)	9.90±2.21
t/χ^2	2.604	2.299	2.514	4.725	2.831
p	.013	.027	.016	.030	.007

Note. VAP: ventilator-associated pneumonia

3.2 Comparison of microbial detection in oral secretions between the two groups

The oral normal flora in observation group was higher than that in control group, the difference was statistically significant ($p < .05$). The oral gram-positive bacteria and gram-negative bacteria in observation group were lower than those in control group, with statistical difference ($p < .05$). There was no statistical difference in the detection of oral fungal spores and mycelia between the two groups ($p > .05$) (see Table 4).

Table 4. Comparison of microbial detection in oral secretions in observation group and control group (example [%])

Group	Normal flora	Fungal spores mycelium	Gram-positive bacteria	Gram-negative bacteria
Observation group (n = 21)	15 (71.43)	3 (14.29)	4 (19.05)	5 (23.81)
Control group (n = 21)	6 (28.57)	8 (38.10)	11 (52.38)	12 (57.14)
χ^2	7.714	3.079	5.081	4.842
p	.005	.079	.024	.028

4. DISCUSSION

Traditional oral care uses wet cotton balls soaked with normal saline to wipe the mouth, which is suitable for postoperative, comatous and critically ill patients who are unable to clean themselves or take care of themselves.[12] The mouth of burn patients with tracheotomy mechanical ventilation remains open, saliva secretion decreases, amylase and other components in saliva are prone to change, the natural antibacterial effect of oral cavity is decreased, and the colonized bacteria in the oropharynx are constantly increasing, which easily leads to the occurrence of VAP. Therefore, such patients have more obvious oral care needs.[13] Su Lijuan et al.'s study showed that:[14] After dynamic oral assessment, the nursing satisfaction and operation evaluation were higher than those of conventional oral care group; Other studies have found[15] that the incidence of pulmonary infection is closely related to oral hygiene, and effective oral care can reduce the incidence of VAP in critically ill patients with mechanical ventilation. There are no clinical guidelines or norms for oral care of burn patients with tracheotomy mechanical ventilation, and it is urgent to prevent oral complications and VAP through oral care, which is identified as a convenient and safe measure.

In this study, by comparing the occurrence of oral odor, plaque index and oral ulcer of patients in the observation group and the control group, it was found that improving Beck oral score to guide oral care can effectively improve oral health and oral comfort of patients. Huang Caimei et al.[16] evaluated the oral condition through the oral assessment program, formed an organic whole of oral care assessment and intervention, and achieved good nursing effects. Other studies have shown that:[17] Dynamic implementation of oral care mode can significantly improve oral cleanliness of severe patients and shorten the mechanical ventilation time of tracheal intubation patients. For patients in the control group in the study, the oral care was done with cotton balls with normal saline, the removal of dental plaque and tartar was not complete, and the oral pathogens could not be effectively removed either. For patients in observation group, the oral care was done with children's soft-bristle toothbrush and washed with chlorhexidine or sodium bicarbonate solution, which could effectively remove dental plaque and phlegm scabs in the mouth, it was beneficial to keep the mouth clean and moist, and patients' comfort was significantly improved.

Tracheotomy artificial airway mechanical ventilation treatment is one of the key factors for the successful treatment of critically injured patients, and airway management of such patients is the focus and difficulty of the work.[18] In this study, there are increased rates of gastric reflux and aspiration in patients with tracheotomy, in addition, oral secretions accumulate and pathogens multiply, which could lead to lung infection easily. The effect of oral management in these patients is closely related to the prognosis. Lin Yuejuan et al.[19] applied the improved cluster oral care strategy to patients with mechanical ventilation in ICU and found that the incidence of VAP was significantly reduced. The results of Qin Lili et al.[20] showed that oral bacterial colonization was closely related to the occurrence of tracheal intubation-related stress injuries and could prolong the healing time of oral mucosal stress injuries. The incidence of gram-positive bacteria, gram-negative bacteria and VAP were significantly reduced in patients in the observation group, indicating that the implementation of oral care through the improvement of Beck oral score dynamic may significantly decrease the respiratory complication by reducing the number of pathogenic bacteria in the oral cavity of patients.

In summary, the improved Beck scoring system was simple and easy to implement in this study. The oral conditions of patients could be comprehensively mastered in a short period of time through quantitative evaluation of patients' oral conditions. Oral pathogens and dental plaque could be effectively removed by oral irrigation, wiping and negative

pressure suction, it could significantly reduce lung complications, which is worthy of application and promotion.

ACKNOWLEDGEMENTS

The authors sincerely thank reviewers and editors for their constructive comments and suggestions.

AUTHORS CONTRIBUTIONS

Yan Wang: Writing – review & editing, Conceptualization; Rui Guo: Conceptualization, Writing – original draft; Shu-jie Wang: Writing – review & editing; Xiu-mei Zhou: Writing – original draft.

FUNDING

The research was funded by Inner Mongolia Health Science and Technology Plan Project [project number 202201515].

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

INFORMED CONSENT

Obtained.

ETHICS APPROVAL

The Publication Ethics Committee of the Sciedu Press. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

PROVENANCE AND PEER REVIEW

Not commissioned; externally double-blind peer reviewed.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

DATA SHARING STATEMENT

No additional data are available.

REFERENCES

[1] Li S, Zhou Q, Gou J, et al. Early prognosis assessment of patients with extensive burn combined with inhalation injury. Chinese Journal of Emergency Resuscitation and Disaster Medicine. 2022; 17(9): 1186-1189.

[2] Xie Z, Guo G, Yang Z, et al. Comparative study of three scores in predicting the risk of death in severe burn patients. Chinese Journal of Burn and Wound Repair. 2022; 38(2): 184-189.

[3] Yang F, Fang Y, Han Z. Effect of improved oral care on oral health status and incidence of ventilator-associated pneumonia in patients with mechanical ventilation. Journal of the Third Military Medical University. 2020; 42(02): 215-219.

[4] Wang S, Ma C, Lu H, et al. Construction and application of cluster management scheme for lung care of batch burn patients. Chinese Journal of Burn. 2020; 36(8): 665-670.

[5] Ma X, Xiao Y, Chen T, et al. Prediction value of anatomical score combined with physiological score for multiple organ dysfunction syndrome in patients with severe trauma. Chinese Journal of Burn. 2016; 32(2): 105-108.

[6] Man M, Gan M. Effect of quality control circle nursing model based on Beck score on oral health status, self-efficacy and self-care ability of patients with nasopharyngeal carcinoma. International Journal of Nursing. 2022; 41(23): 4342-4346.

[7] Wang H, Fan L, Liu W, et al. Interpretation of the 2016 ISBI Burn Management Practice Guidelines. Nursing Research. 2019; 33(5): 729-733.

[8] Cheng Y, Meng M, Chen L, et al. Summary of the best evidence for tracheotomy management in burn patients with inhalation injury. Chinese Journal of Nursing. 2020; 55(7): 1084-1090.

[9] Zhu Q, Lu Y, Wang Z. Effect of quality control circle nursing based on Beck score on oral health status of patients with nasopharyngeal carcinoma. Journal of Practical Stomatology. 2018; 34(6): 774-777.

[10] Song S, Lu Y. Effect of cognitive behavioral therapy on the loss rate of adhesive points of orthodontic brackets and oral hygiene in adolescents. Medical Theory and Practice. 2002; 35(15): 2675-2678.

[11] Tang J, Dong L, Wang Y. Effect of calcium folinate solution at 2-8°C on prevention of oral ulcer caused by high-dose methotrexate chemotherapy in patients with central malignant lymphoma. Journal of Military Medicine. 2019; 43(9): 719-720.

[12] Xiao D. Comparative analysis of different oral nursing methods in patients with oral catheterization. Clinical Nursing Research. 2022; 31(22): 137-139.

[13] Yan Y, Ding J, Liu C, et al. Summary of best evidence for airway management in critically ill adults. Journal of Nursing. 2021; 28(3): 39-45.

[14] Su L, Yan J, Zhang L, et al. Application of dynamic nursing strategy based on improved Beck oral score combined with HC visual laryngoscope in oral nursing of coma patients in EICU. Journal of North Sichuan Medical College. 2018; 33(5):799-802.

[15] Gong S, Liao C, Liu J, et al. Interpretation of expert Consensus on oral care in adult intensive care unit. Journal of Nursing Research. 2023; 37(3): 388-391.

[16] Huang C, Lu L, Lu Y, et al. Application of improved flushing toothbrush in oral care of patients with oral tube intubation. Heilongjiang Medical Journal. 2022; 46(5): 622-626.

[17] Pang Y, Ye S. Application of cluster nursing model in ventilator support patients in ICU. Clinical Medical Engineering. 2022; 29(12): 1737-1738.

[18] Jiang Y, Wang K, Wang B, et al. Epidemiological characteristics and outcome analysis of 266 patients with inhalation injury with combined burn area less than 30% of total body surface area. Chinese Journal of Burn. 2021; 37(4): 340-349.

[19] Lin Y, Gan Z, Lin Y, et al. Application of improved cluster intervention strategy in the prevention of ventilator-associated pneumonia in patients with mechanical ventilation in ICU. Fujian Journal of Medicine. 2022; 44(06): 132-134.

[20] Qin L, Yun W, Hang Z. Risk factors analysis of tracheal intubation-related stress injury in ICU patients. Journal of Advanced Nursing. 2020; 35(12): 1105-1108.