Int J Clin Exp Med 2017;10(9):13790-13795
www.ijcem.com /ISSN:1940-5901/IJCEM0061365

*Original Article*

# Observation of clinical effects of care bundle on patients with traumatic brain injury during nasal feeding

Zhiyue Yan[1*], Hong Chen[2*], Ying Ni[1], Jingwen Gu[2], Wenxia Yu[1], Jie Gao[1]

*Departments of [1]Nursing, [2]Worldwide Medical Center, Huashan Hospital, Fudan University, Shanghai City, China. [*]Equal contributors and co-first authors.*

Received July 12, 2017; Accepted August 16, 2017; Epub September 15, 2017; Published September 30, 2017

**Abstract:** Objective: To evaluate the effects of care bundle on relevant complications and postoperative recovery in patients with traumatic brain injury during nasal feeding. Methods: One hundred and sixty patients with traumatic brain injury were randomly divided into intervention group (I Group) and control group (C group) with 80 cases in each one. The I Group patients were treated with some care bundle measures: adjusting patients' position before nasal feeding, increasing the supply step by step and performing moderate massage after nasal feeding, while the C Group adopted the routine care. The incidence of complications, conditions of clinical recovery, nutritional status and satisfaction degree of care during nasal feeding were observed and compared between the two groups. Results: The overall incidence of complications during nasal feeding, such as vomiting, diarrhea, food reflux, constipation, gastric retention and tube slippage, in I Group was lower than that in C Group (P<0.001). The number of cured patients in I Group was more than that in C Group, and the number of patients that did not response to the care in I Group was less than that in C Group. The overall effective rate of clinical recovery in I Group was 96.25%, which was better than that in C Group (P=0.004). The nutritional status of patients in I Group was better than that in the C Group after the care (P<0.001). The overall satisfaction degree of care in I Group was 87.50%, which was higher than that in C Group (60%, P<0.001). Conclusion: By applying care bundle to patients with traumatic brain injury, incidence of complications of nasal feeding can be decreased, recovery ability of patients can be strengthened, nutritional status of patients can be improved and the satisfaction degree of patients can be increased.

**Keywords:** Care bundle, traumatic brain injury, nasal feeding, clinical effects

## Introduction

Traumatic brain injury is caused by the direct or indirect impacts from external force on the heads of patients, which is one of the most major causes of death and severe disability among young people [1]. Its incidence increases gradually in the elder population and there is a marked increase in developing countries [2]. Patients with traumatic brain injury often suffer from malnutrition at different levels due to their difficulty in eating. Nasal feeding is often adopted to provide these patients with nutrients and energy that their bodies are needed. And in the course of nasal feeding, it is easy to develop a series of complications that aggravate patients' pain, affect the treatment, and have a great negative impact on the prognostic rehabilitation of patients [3]. Therefore, it is worth studying effective methods to reduce the incidence of complications during the period of nasal feeding and improve the nutritional level and recovery ability of patients with traumatic brain injury. Care bundle is based on the evidence-based medicine theory and it is a clinical care mode which integrates many effective and scientific care methods and implements jointly [4, 5]. In this study, the clinical effects of care bundle on patients with traumatic brain injury during nasal feeding were observed.

## Materials and methods

### *General information*

One hundred and sixty patients with traumatic brain injury who were treated with nasal feeding from October 2014 to October 2016 in our hospital were selected. And they were divided randomly into control group (C Group) and intervention group (I Group) with 80 cases in each.

Inclusion criteria: Patients aged 18-80 years old and diagnosed as traumatic brain injury but without other external injuries; patients whose periods of nasal feeding were more than 72 h; patients with stable state of consciousness and without restlessness; patients' families signed the informed consent to let the patients participatein this study.

Exclusion criteria: Patients who were women during pregnancy and lactation; patients with coagulation disorders, severe hypertension, dia betes or digestive tract diseases.

This study has been approved by the Ethics Committee of our hospital.

*Methods*

*Care methods:* The C Group patients were treated with the routine care while the I Group patients were given care bundle on the basis of the routine care. All the patients in two groups were given nasal feeding within 24 h after operation.

*Routine care methods:* Postoperative routine care for nasal feeding was conducted.

*Care bundle:* An evidence-based care team was set up to further observe the possible complications of patients with traumatic brain injury and to pay close attention to physical and psychological conditions of patients during nasal feeding. According to the specific conditions of patients, the true and effective care data were collected by searching literature. These contents were filed into a care book by evidence-based care group after their study and discussion. After the handbook was assessed and verified by care specialists, the care group which would implement the care bundle were trained.

Measures of care bundle: 1) Care before nasal feeding: The head of the bed was elevated 30 to 40 degrees; the gastric residual volume of every patient was evaluated and the residual gastric juice was pumped; every appropriate nasal feeding tube was selected according to the nasal feeding time of the patient; appropriate intubation method was adopted and the nasal feeding tube was fixed on the cheek or nasal alae of the patient [3, 6]. 2) Care during nasal feeding: Nasal feeding tubes were ensured to be stable and unblocked to avoid slippage and dislocation; appropriate rate, temperature and concentration of nasal feeding were selected according to assessment results of gastric residual volume of patients; the principle of increasing the supply step by step was followed (low concentration of nutrient solution was adopted at the beginning of care bundle, the amount of nasal feeding was controlled at 500 ml/d according to physical function status of patients, and when patients had no abnormal reactions, the amount of nasal feeding could be increased to 1000 ml/d to 1500 ml/d, the speed of nasal feeding and the concentration of nutrient solution could also be increased properly); the airway cleanliness status of patients was observed closely to avoid aspiration or obstruction [7]. 3) Care after nasal feeding: Abdominal massage was performed on patients, and the nasal feeding tubes were rinsed with warm water in time to prevent food retention after nasal feeding.

*Observation indexes and evaluation criteria of clinical effects*

*Observation indexes:* The incidence of complications such as vomiting, diarrhea, food reflux, constipation, gastric retention, tube slippage, etc. and conditions of clinical recovery of patients with traumatic brain injury were compared between I Group and C Group during nasal feeding. At the same time, two groups of patients' nutritional status and degree of care satisfaction after care were analyzed.

*Evaluation criteria:* Evaluation criteria for clinical recovery status of patients: 1) Well-healed: when patients' brain examination presented normal, symptoms disappeared, and vital functions returned to normal; 2) Effective: when patients' symptoms were controlled, or symptoms and signs were improved. 3) Ineffective: when patients' clinical symptoms and conditions of patients failed to be improved markedly or even deteriorated. The sum of well-healed rate and effective rate was total effective rate.

Evaluation criteria for nutritional status of patients: 1) Obese: when patients' body mass index (BMI) ≥23; 2) Normal: when patients' BMI were 18.5 to 22.9; 3) Mild malnutrition: when patients' BMI were 17.0 to 18.4; 4) Moderate malnutrition: when patients' BMI were 16.0 to 16.9; 5) Severe malnutrition: when patients' BMI <16.0. Considering the nutritional stability of the patients, the nutritional status of I group

**Table 1.** Comparison of general information between two groups of patients

| Project | I Group | C Group | $t/X^2$ | P |
|---|---|---|---|---|
| Case | 80 | 80 | | |
| Gender (male/female) | 52/28 | 50/30 | 0.74 | 0.108 |
| Age ($\bar{x}$±s/year) | 47.5±7.8 | 48±9.1 | 1.21 | 0.651 |
| Time from injury to treatment ($\bar{x}$±s/h) | 7.3±1.4 | 6.9±1.3 | 0.45 | 0.193 |
| Nasal feeding time ($\bar{x}$±s) | 48.6±2.2 | 49.3±2.5 | 1.06 | 0.458 |
| Cerebral contusion and laceration | 18 | 16 | 0.69 | 0.149 |
| Subarachnoid hemorrhage | 16 | 14 | 0.69 | 0.164 |
| Brain stem injury | 10 | 11 | 0.81 | 0.055 |
| Intracranial hematoma | 6 | 8 | 0.57 | 0.315 |
| Subdural hematoma | 8 | 9 | 0.79 | 0.066 |
| Epidural hematoma | 9 | 10 | 0.81 | 0.060 |
| Moderate, severe malnutrition | 68 | 66 | 0.18 | 0.668 |

and the C group was evaluated as the final BMI score using the average of four time points: the end of the nasal feeding, at discharge, one month after discharge, and three months after discharge.

Evaluation criteria for satisfaction degree of patients after care: Staff in departments of hospital designed questionnaires by themselves for satisfaction degree evaluation and gave out questionnaires to patients to investigate their satisfaction degree when they were discharged. Total scores were 100. The scores more than 85 meant patients were strongly satisfied. The scores of 75-85, 60-75 and <60 meant they were appreciated, generally satisfied and unsatisfied respectively. The total satisfaction degree was the sum of degree of strong satisfaction and appreciation.

*Statistical methods*

SPSS 17.0 software was used for statistical data processing. Measurement data were expressed by mean ± standard deviation ($\bar{x}$±s). T test was adopted in comparison between groups. Enumeration data were expressed by ratio and detected using chi-square test. When P<0.05, the difference was statistically significant.

## Results

*Comparison of general information between two groups of patients*

The gender, age, time from injury to treatment and nasal feeding time and damage conditions of traumatic brain injury of patients in two groups were similar (P>0.05), which were comparable. As shown in **Table 1**.

*Comparison of conditions of complications between two groups of patients during nasal feeding*

The incidence of complications like vomiting, diarrhea, food reflux, constipation, gastric retention and tube slippage during nasal feeding in I Group was lower than that in C Group. The total incidence of complications in I Group (10%) was significantly lower than that in C Group (97.5%). As shown in **Table 2**.

*Comparison of clinical conditions between two groups of patients*

The total effective rate after care was 96.25% in I Group and 82.50% in C Group. The difference between two groups was statistically significant (P=0.004), and the conditions of clinical recovery in I Group were better than those in C Group. As shown in **Table 3**.

*Comparison of nutritional status after care between two groups of patients*

Before care, I group and C group had balanced moderate and severe malnutrition, the difference was not statistically significant (P=0.668). Compared with C Group, patients with mild malnutrition increased significantly and patients with severe malnutrition decreased obviously after care in I Group. Patients with malnutrition were reduced obviously (P<0.001). As shown in **Table 4**.

*Comparison of satisfaction degree of care between two groups of patients*

The overall satisfaction rate after care of I Group was 87.50% while it was 60.00% in C Group. The care satisfaction degree of I Group was significantly higher than that of C Group and the difference between two groups was statistically significant (P<0.001). As shown in **Table 5**.

**Table 2.** Comparison of conditions of complicationsafter care between two groups of patients (n, %)

| Group | Case | Vom | Dia | FR | Con | GR | TS | Total |
|---|---|---|---|---|---|---|---|---|
| I Group | 80 | 1 (1.25) | 2 (2.50) | 2 (2.50) | 0 (0.00) | 1 (1.25) | 2 (2.50) | 8 (10.00) |
| C Group | 80 | 16 (20.00) | 12 (15.00) | 18 (22.50) | 9 (11.25) | 12 (15.00) | 11 (13.75) | 78 (97.50) |
| $X^2$ | - | 14.81 | 7.83 | 14.63 | 9.54 | 10.13 | 6.78 | 123.19 |
| P | - | <0.001 | 0.005 | <0.001 | 0.002 | 0.002 | 0.009 | <0.001 |

Note: Vom: Vomiting; Dia: Diarrhea; FR: Food reflux; Con: Constipation; GR: Gastric retention; TS: Tube slippage.

**Table 3.** Comparison of recovery effects after care between two groups of patients (n, %)

| Project | Case | Total effective rate | | Ineffective rate | UC value | P |
|---|---|---|---|---|---|---|
| | | Well-healed rate | Effective rate | | | |
| I Group | 80 | 18 (22.50) | 59 (73.75) | 3 (3.75) | 10.972 | 0.004 |
| C Group | 80 | 8 (10.00) | 58 (72.50) | 14 (17.50) | | |

**Table 4.** Comparison of nutritional status after care between two groups of patients (n, %)

| Group | Case | Normal nutrition | Mild malnutrition | Moderate, severe malnutrition | |
|---|---|---|---|---|---|
| | | | | Moderate | Severe |
| I Group | 80 | 4 (5.00) | 64 (80.00) | 12 (15.00) | 0 (0.00) |
| C Group | 80 | 0 (0.00) | 41 (51.25) | 26 (32.50) | 13 (16.25) |
| $X^2$ | - | - | - | 20.98 | |
| P | - | - | - | <0.001 | |

**Table 5.** Comparison of satisfaction degree between two groups of patients (n)

| Group | Case | S | A | GenS | UnS | TotS (%) | $X^2$ | P |
|---|---|---|---|---|---|---|---|---|
| I Group | 80 | 39 | 31 | 8 | 2 | 87.50 | 15.63 | <0.001 |
| C Group | 80 | 20 | 28 | 22 | 10 | 60.00 | | |

Note: S: Strongly satisfied; A: Appreciated; GenS: Generally satisfied; UnS: Unsatisfied; TotS: Total satisfaction rate.

## Discussion

Traumatic brain injury can result in drag or laceration of nerves, blood vessels and other tissues in the brain, which will cause damage in cerebral neural pathways and then will induce intracranial hemorrhage, edema, etc. [8]. Without enough attention, mild traumatic brain injury may cause severe or secondary traumatic brain injury and it is accompanied by many complications [9, 10]. Therefore, patients with traumatic brain injury need not only timely and appropriate treatment, but also careful and effective nursing strategies [11, 12]. In recent years, care bundle has been widely used in the treatment of critically ill patients, which is a care program based on a series of combined evidence-based and interrelated nursing measures. Under normal circumstances, the program consists of 3 to 5 evidence-based nursing measures [13]. All the included nursing measures have strong operability, and joint implementation is more conducive to the recovery of patients than the individual implementation [14-16]. As care bundle has important practical significance in the care field, this study focused on the clinical application and effects observation of care bundle in patients with traumatic brain injury during nasal feeding [17-22].

Patients with traumatic brain injury usually suffer from nausea and vomiting due to intubation and other operations during nasal feeding. And diarrhea, food reflux or gastric retention, even slippage of nasal feeding tube, etc. occur due to unreasonable supply of nasal feeding fluid [23]. In this study, the care group which was mentioned in the above method part analyzed and determined inducements of vomiting, diarrhea, constipation, food reflux, gastric retention, tube slippage and other complications of patients with traumatic brain injury during nasal feeding based on relevant literature and then took corresponding measures of care bundle: adjusting patients' position before nasal feeding, selecting appropriate nasal feeding tubes and intubation methods, properly fixing nasal feeding tubes, controlling the speeds and amounts of nasal feeding, paying attention to hygiene and cleaning of nasal feeding equipment, etc. [24, 25]. The results showed that the incidence of complications in I Group was significantly lower

than that in C Group, which indicated that care bundle had an obvious effect on the control of complications in patients with traumatic brain injury. This was similar to the study results that Catherine Le et al. concluded, which was about the control of complications such as infection of surgical site and wound dehiscence of cranioplasty after craniectomy. They found that perioperative technical care could effectively reduce the incidence of surgical complications and second cranioplasty [26].

The study also found that clinical recovery rate was increased and nutritional status was better in I Group, which was similar to results of research for patients treated with cardiac surgery that made by IO Fleming et al. [27]. They found that perioperative care bundle could effectively decrease the postoperative morbidity as well as the recovery rate of patients and reduce the incidence of postoperative complications. In addition, the overall satisfaction degree of patients in observation group (87.50%) was significantly higher than that in C Group (60%), and the difference was statistically significant (P<0.001), which indicated that care bundle could achieve more acceptance than routine care from patients.

However, there might be incomplete program of care bundle due to the limited number of cases of this research. For example, if there was a patient had nausea, vomiting or food refulx because he was allergic to the materials of nasal feeding tube, the comparison results of the research might be interfered. Therefore, the clinical effects of care bundle in patients with traumatic brain injury need to be further studied on clinic.

In conclusion, care bundle can effectively reduce related complications in patients with traumatic brain injury, increase their effective rate of treatment and improve nutritional status and overall satisfaction degree of patients during nasal feeding.

## Disclosure of conflict of interest

None.

**Address correspondence to:** Ying Ni, Department of Nursing, Huashan Hospital, Fudan University, No.12 Urumqi Middle Road, Shanghai City, 200040, China. Tel: +86-021-52887300; E-mail: ycngyg710@163.com; Jingwen Gu, Department of Worldwide Medical Center, Huashan Hospital, Fudan University, No.12 Urumqi Middle Road, Shanghai City, 200040, China. Tel: +86-021-52887255; E-mail: jwg8725@163.com

## References

[1] Valente SM and Fisher D. Traumatic brain injury. Journal for Nurse Practitioners 2011; 7: 863-870.

[2] Hawryluk GW and Bullock MR. Past, present, and future of traumatic brain injury research. Neurosurg Clin N Am 2016; 27: 375-396.

[3] Brugnolli A, Ambrosi E, Canzan F and Saiani L. Securing of naso-gastric tubes in adult patients: a review. Int J Nurs Stud 2014; 51: 943-950.

[4] Damkliang J, Considine J, Kent B and Street M. Initial emergency nursing management of patients with severe traumatic brain injury: development of an evidence-based care bundle for the Thai emergency department context. Australas Emerg Nurs J 2014; 17: 152-160.

[5] Okgun Alcan A, Demir Korkmaz F and Uyar M. Prevention of ventilator-associated pneumonia: use of the care bundle approach. Am J Infect Control 2016; 44: e173-e176.

[6] Kavakli AS, Kavrut Ozturk N, Karaveli A, Onuk AA, Ozyurek L and Inanoglu K. Comparison of different methods of nasogastric tube insertion in anesthetized and intubated patients. Rev Bras Anestesiol 2017; [Epub ahead of print].

[7] Chan EY, Ng IH, Tan SL, Jabin K, Lee LN and Ang CC. Nasogastric feeding practices: a survey using clinical scenarios. Int J Nurs Stud 2012; 49: 310-319.

[8] Semenova NA, Akhadov TA, Petryaykin AV, Sidorin SS, Lukovenkov AV and Varfolomeev SD. Metabolic dysfunction and relationship in human frontoparietal cortex in severe traumatic brain injury: single-voxel (1) H magnetic resonance spectroscopy study. Biochemistry (Mosc) 2012; 77: 388-394.

[9] Mustafa AG and Alshboul OA. Pathophysiology of traumatic brain injury. Neurosciences (Riyadh) 2013; 18: 222-234.

[10] Salentijn EG, Collin JD, Boffano P and Forouzanfar T. A ten year analysis of the traumatic maxillofacial and brain injury patient in Amsterdam: complications and treatment. J Craniomaxillofac Surg 2014; 42: 1717-1722.

[11] Lafferty B. Traumatic brain injury: a factor in the causal pathway to homelessness? Journal for Nurse Practitioners 2010; 6: 358-362.

[12] Lee JC, Rittenhouse K, Bupp K, Gross B, Rogers A, Rogers FB, Horst M, Estrella L and Thur-

mond J. An analysis of brain trauma foundation traumatic brain injury guideline compliance and patient outcome. Injury 2015; 46: 854-858.
[13] Resar R, Fa G, Haraden C and Tw N. Using care bundles to improve health care quality. 2012; (26): 1-14.
[14] McCarron and Kim. Understanding care bundles. Nursing Made Incredibly Easy 2011; 9: 30-33.
[15] Damkliang J, Considine J, Kent B and Street M. Using an evidence-based care bundle to improve Thai emergency nurses' knowledge of care for patients with severe traumatic brain injury. Nurse Educ Pract 2015; 15: 284-292.
[16] Damkliang J, Considine J, Kent B and Street M. Nurses' perceptions of using an evidence-based care bundle for initial emergency nursing management of patients with severe traumatic brain injury: a qualitative study. Int Emerg Nurs 2015; 23: 299-305.
[17] Tanner J, Padley W, Assadian O, Leaper D, Kiernan M and Edmiston C. Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery 2015; 158: 66-77.
[18] Anthony T, Murray BW, Sum-Ping JT, Lenkovsky F, Vornik VD, Parker BJ, McFarlin JE, Hartless K and Huerta S. Evaluating an evidence-based bundle for preventing surgical site infection: a randomized trial. Arch Surg 2011; 146: 263-269.
[19] Crolla RM, van der Laan L, Veen EJ, Hendriks Y, van Schendel C and Kluytmans J. Reduction of surgical site infections after implementation of a bundle of care. PLoS One 2012; 7: e44599.
[20] Rello J, Afonso E, Lisboa T, Ricart M, Balsera B, Rovira A, Valles J and Diaz E. A care bundle approach for prevention of ventilator-associated pneumonia. Clin Microbiol Infect 2013; 19: 363-369.
[21] Righi E, Aggazzotti G, Ferrari E, Giovanardi C, Busani S, Rinaldi L and Girardis M. Trends in ventilator-associated pneumonia: impact of a ventilator care bundle in an Italian tertiary care hospital intensive care unit. Am J Infect Control 2014; 42: 1312-1316.
[22] Tayyib N, Coyer F and Lewis PA. Implementing a pressure ulcer prevention bundle in an adult intensive care. Intensive Crit Care Nurs 2016; 37: 27-36.
[23] Avitzur Y, Heerden PVV, Dayan L, Pintel O, Skopek J, Siman-Tov Y, Mcclave S, Bassi GL, Torres A and Singer P. Development of a device to reduce gastro-esophageal reflux in critically ill patients. Clinical Nutrition Experimental 2016; 7: 1-8.
[24] Lavi R, Katznelson R, Cheng D, Minkovich L, Klein A, Carroll J, Karski J and Djaiani G. The effect of nasogastric tube application during cardiac surgery on postoperative nausea and vomiting--a randomized trial. J Cardiothorac Vasc Anesth 2011; 25: 105-109.
[25] Huang HH, Chang SJ, Hsu CW, Chang TM, Kang SP and Liu MY. Severity of illness influences the efficacy of enteral feeding route on clinical outcomes in patients with critical illness. J Acad Nutr Diet 2012; 112: 1138-1146.
[26] Le C, Guppy KH, Axelrod YV, Hawk MW, Silverthorn J, Inacio MC and Akins PT. Lower complication rates for cranioplasty with peri-operative bundle. Clin Neurol Neurosurg 2014; 120: 41-44.
[27] Fleming IO, Garratt C, Guha R, Desai J, Chaubey S, Wang Y, Leonard S and Kunst G. Aggregation of marginal gains in cardiac surgery: feasibility of a perioperative care bundle for enhanced recovery in cardiac surgical patients. J Cardiothorac Vasc Anesth 2016; 30: 665-670.