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# Comparing the Incidence of Respiratory Aspiration between Two Tube Feeding Methods of Intermittent Bolus and Intermittent Drip Bag

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**Abstract**

**Purpose of the study:** Aspiration of stomach contents is a serious side effect in patients with a feeding tube which can be prevented otherwise may lead to death. There have been disputes over the safest feeding method. Therefore, this study seeks to identify the chance of occurrence of respiratory aspiration in two tube feeding methods of intermittent bolus and intermittent drip bag in patients of the ICU and trauma ward.

**Methods:** In this quasi-experimental study, investigating contextual variables and using gradual method, 72 patients in ICU and trauma ward who were fed through tubes were divided into two groups of intermittent bolus and intermittent drip bag method and both groups were independently fed for 3 days. After that, both groups were surveyed and compared based on the level of aspiration occurrence. To collect the data, personal information, nutrition, and respiration form as well as form of information about the two feeding methods in the studied units were utilized. The studied units were selected among Training and Treatment Centers in Rasht in 2010. To analyze the data, descriptive and inferential statistics and SPSS16 software were used.

**Results:** The findings showed that respiratory aspiration occurrence level in intermittent bolus tube feeding methods was 5.6% whereas this amount in intermittent drip bag method was zero. Fisher exact test revealed that there was no significant relationship between these two groups (P=0.47).

**Conclusion:** As there was no significant relationship in respiratory aspiration between the two groups, it was concluded that intermittent bolus method can still be mentioned in books as a standard method to decrease the risk of aspiration if it is used properly.

**Keywords:** Respiratory aspiration, Tube feeding, intermittent bolus method, intermittent drip bag method

## Introduction

Nutrition is one of fundamental and physiological needs of human being. When a person is hospitalized, this need changes and depending on the kind of the disease and the person's conditions, the change can be drastic.

Among patients who undergo major changes in their nutritional status, there are patients in special units, especially in the intensive care unit (ICU). Adequate and good nutrition is the basis for success in all treatments. Because of the stressful situation, many patients in special units need more energy. They cannot provide their nutritional needs through natural ways for different reasons, such as a decrease in level of consciousness, physical barriers for movement of food, ulcers, tumors, respiratory failure, lung infections, burns, etc. consequently, they are highly at risk of malnutrition (3,4,5).

According to surveys, level of malnutrition in patients of the ICU is between 30 and 55% which bring about several problems such as heart muscle weakness, immune system deficiency, respiratory muscle weakness, inability to separate patient from ventilator and thus an increase in duration of hospitalization and costs, and eventually death [3-6]. In a study conducted on patients in the ICU, 36% of patients received less than 90% of their needed energy (4).

Due to the patients' inability to provide their nutritional need, artificial feeding method is necessarily used including tube and intravenous feeding (5, 6). Studies and evidence suggest the use of intestine feeding in preference to intravenous one (7). In this regard, during a study in 2008, Scurlock et al stated that intestinal feeding was a preferred feeding method for the ICU patients (8).

There are four methods in this type of feeding including: intermittent drip, intermittent bolus, cyclic, and continuous. These methods are applied with a syringe, feeding pump, and food bags (9, 10). Although tube feeding has many advantages, it causes some side effects such as diarrhea, vomiting, dumping syndrome, hyperglycemia, electrolyte imbalance, and aspiration (11) that can be controlled by choosing the best feeding method. Aspiration of stomach contents is a serious side effect in patients with tube feeding which may even lead to death;

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however, it can be prevented (6, 10, 12). There is a lot of evidence that shows many patients in special care units who are fed through tubes and are mechanically ventilated have had at least one aspiration during their feeding days (13). Statistics show that the incidence of pneumonia caused by aspiration is from 7 to 62% in patients with tube feeding (14). Parish, in his study, discussed the kind of feeding method as a major risk factor in the incidence of pulmonary aspiration (15). In spite of the great number of research about feeding methods, there are still disputes over the safest feeding method for critically ill patients (16). The risk of aspiration reduces in drip method because feeding is done in a longer time and with less speed (17). In this regard, a study conducted by Lee et al (2009) in Hong Kong showed that although continuous drip feeding method is applied as a preferred method to reduce aspiration risk, its usefulness in preventing aspiration is not yet confirmed (16). Based on the researcher's experience in different hospital units, more feeding is done through intermittent bolus using a syringe and sometimes it is done through continuous method using a feeding pump. In order to use these pumps, a special nutritional formula is required which is available in the market in the form of a ready-made food (10). However, unfortunately, since there is no access to this formula, and because of the use of food prepared by the hospital kitchen, high sensitivity of these machines, and organizing them with ready-made food solution, it has been observed in many cases that the most common feeding method is using a syringe. It frequently happens that feeding by a syringe is done with poor speed and pressure which can lead to dangerous complications such as respiratory aspiration (18), while drip method is less likely to have complications because by using feeding bags, speed and pressure of food solution is steady (6). Therefore, according to the mentioned complications and advantages of food bags, the researcher conducted a study to compare the incidence of respiratory aspiration in two tube feeding methods of intermittent bolus and intermittent drip bag in patients of the ICU and trauma ward.

## Methods

This quasi-experimental study was carried out in 2010. The statistical population included all the patients in the Neuro ICU, general ICU and trauma ward in the selected Treatment and Training Centers in Rasht. The research sample consists of 72 patients that have been chosen through a gradual approach, and after consideration of variables such as age, sex, diagnosis, type of breathing tube, number of breathing tube, breathing tube cuff pressure, number of nasogastric tube, and amount of food by gavage. The samples then were randomly put into two groups. Inclusion criteria included: being hospitalized in the ICU and trauma ward, no history of allergy to methylene blue, not suffering from the risk of kidney failure, lack of G6PD enzyme deficiency (19-21), aged between 15 to 65 years, GCS 9 and less (6), having a breathing tube (tracheal and tracheostomy), being connected to a ventilator (22), ventilation with SIMV mode with PEEP three to seven and PS ten to fifteen, feeding through nasogastric tube. It was also necessary that the duration from the time of patients' admission into the hospital and nasogastric tube insertion for feeding until the beginning of the study was not more than four days (15). Moreover, it was required that all patients were in the same level of sedation according to the sedative drugs they took. Exclusion criteria consisted of discharge, transfer, change of diet and serious digestive complications such as intolerance, vomiting, diarrhea and gastrointestinal bleeding, pneumonia and any sensitivity due to methylene blue (nausea, vomiting, abdominal pain, headache, dizziness, chest pain, diarrhea, urine discoloration, hemolysis, increased blood pressure, sweating, and sensitivity to light) [21 - 23].

The following tools were used to collect the data:

1.The evaluation form which consists of two sections; the first section was related to demographic, nutritional and respiratory information which is completed by the researcher. Demographic information includes age, sex, diagnosis, date of admission and date of entry into the study.

Nutritional information investigates feeding methods, date of nasogastric tube insertion, tube number, and date of beginning of feeding. Respiratory information asks about the type of breathing tube and tube number. The second section included information about the two feeding methods in the studied units during three consecutive days in which they register the amount of solution by gavage, feeding duration, gastric residual volume in cc, appearance of color blue in secretions of patients' breathing tubes, and also its observation time.

2.Surgeon's feeding bag produced in Ghavami Productions, made in Iran.

To collect the data, after obtaining authorization for conducting the study from the Deputy of Research and Ethics Committee of Guilan University of Medical Sciences and registering it in IRCT under the number of 201009214787N1, the researcher went to the selected hospitals in Rasht for four months, from the late September to early January. Patients who had the inclusion criteria participated in the study after obtaining consent from their legal guardian. They were divided into two groups of intermittent bolus and intermittent drip; each was independently fed through a tube for three days. In the intermittent bolus method, 150 to 300 cc food solution was fed by gavage to the patients seven times a day at three-hour intervals. Every time it took 10 to 15 minutes, and it was injected with a 60-cc syringe without a plunger into at least twelve-inch-height above the patients' stomach with the help of gravity. In the intermittent drip method, the same amount of food entered the patients' stomach with the help of a feeding bag that was hung from the IV stand during 30 to 60 minutes. In both groups, before each feeding, breathing tube cuff pressure was measured and adjusted in the range of 25 mmHg. Also in all patients, the head position was observed to be 30 degrees high during gavage and one hour after that. In order to discover respiratory aspiration, low amount of methylene blue 1% was added to all food solutions which were prepared in the hospital kitchen. 0.5 cc of that was added to each 500 cc food solution. If patients needed suction, whenever blue color induced by blue methylene in pulmonary secretions of patients was seen during breathing tube suction, it was obvious that the patients had respiratory aspiration.

In the present study, to scientifically validate the questionnaires, content validity and to collect the data, two partners in the study were used. To investigate the reliability of the process in the two methods, in 20% of the samples, reliability was studied between the researcher and the participants; according to Kappa coefficient, these people's correlation was more than 99%.

The data was analyzed via statistical software SPSS16. It was described with the help of descriptive statistics (estimating frequency, percentage, calculating mean, standard deviation and median). To study the two groups being homogeneous based on contextual variables, chi square test, Fisher's exact test, independent t test, and Mann-Whitney U test were used. To study the process of changes in gavage duration and the gastric residual volume in the two groups in different repeated times, and also to study intragroup and intergroup interaction of gavage duration and the residual volume with gavage volume, feeding method, time of studying aspiration in three consecutive days, repeated measures ANOVA was used.

## Results

Research findings show that the mean of age in the intermittent bolus group was 50±12.41 years, and in intermittent drip group was 45±13.97 years. 61.1 % of intermittent bolus group and 52.8 % of intermittent drip group were female and 38.9 % of intermittent bolus group and 47.2% in the intermittent drip group were male. In the intermittent bolus group 86.1% and in the intermittent drip group 83.3% of patients had an endotracheal tube, and in the bolus group 13.9 % and in the drip group 16.7% of patients had tracheostomy. Independent t-test and chi square test showed no significant difference between the two groups based on the mentioned characteristics.

Moreover, regarding artificial airway size, the size of nasogastric tube, diagnosis, gavage volume in the first, second, and third 24

hours, it was found out that the two groups were homogeneous; statistical tests of chi square, Fisher's exact test and independent t-test showed no significant difference.

Considering gastric residual volume (GRV) in the first, second and third 24 hours of the studied cases, findings showed that the intermittent bolus group had about 6 cc more residual volume than the intermittent drip group. This amount was more in the third 24 hours; independent t-test showed a significant difference between the two groups ($p<0.0001$) (Table 1).

To determine the incidence of aspiration in the studied cases, the results revealed that this amount in the first 24 hours in the intermittent bolus group was 2.8 % and in the drip group was zero. In the second 24 hours, the incidence of respiratory aspiration in the intermittent bolus group was 2.9 % and in the drip group was zero. Fisher's exact test showed no statistically significant difference between the two groups $p>0.05$. In the third 24 hours of the study, the incidence of respiratory aspiration in both groups was zero. Comparing the incidence of respiratory aspiration in both groups during the study indicated that this amount in the bolus group was 5.6 % and in the drip group was zero. Fisher's exact test showed no significant difference between the two groups ($p<0.47$) (Table 2).

To examine the intragroup interactive effects of gavage duration with gavage volume, feeding method, and time of studying aspiration in three consecutive days, repeated measures ANOVA was used (Greene House Gayzer). Similarly, repeated measures ANOVA were used to examine the intragroup interactive effects of gavage duration with feeding method, and time of studying aspiration in three consecutive days. The results showed that there was no significant relationship between gavage duration and gavage volume at different times ($p<0.13$, $f=1.68$), time of studying aspiration in three consecutive days ($p=0.19$, $f=1.35$), feeding method and time of studying aspiration in three consecutive days ($p<0.27$, $f=1.21$). However, the relationship between gavage duration and feeding method was almost significant ($p<0.06$, $f=2.02$).

To examine the intergroup interactive effects of gavage duration with gavage volume, feeding method and time of studying aspiration in three consecutive days, repeated measures ANOVA was used. This was also used to examine the intergroup interactive effects of gavage duration with feeding method and time of studying aspiration in three consecutive days. The results showed that there was no significant relationship between gavage duration and gavage volume at different times ($p<0.12$, $f=2.40$), time of studying aspiration in three consecutive days ($p<0.36$, $f=1.01$) and feeding method and time of studying aspiration in three consecutive days ($p<0.95$, $f=0.04$). However, there was a meaningful relationship between gavage duration and feeding method ($p<0.0001$,

Table 1: Mean of gastric residual volume in the first, second and third 24 hours of the research in two intermittent bolus and intermittent drip groups

| Group | Intermittent bolus | Intermittent drip | Test and results |
|---|---|---|---|
| Residual volume (cc) | Mean and SD | Mean and SD | |
| In the first 24 hours | 12.55±5.85 | 6.94±4.20 | Independent t, df=69, t=4.64, p < 0.0001 |
| In the second 24 hours | 12.77±5.22 | 7.02±3.67 | Independent t, df=68, t=5.34, p < 0.0001 |
| In the third 24 hours | 12.41±5.71 | 6.66±3.69 | Independent t, df=68, t=5.02, p < 0.0001 |

Table 2: Incidence of respiratory aspiration in the entire period of the study in both intermittent bolus and intermittent drip groups

| Incidence of aspiration in the entire period of the study | Intermittent bolus | | Intermittent drip | | Test and results |
|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | |
| Yes | 2 | 5.6 | 0 | 0 | Fisher's exact test p<0.47 |
| No | 34 | 94.4 | 36 | 100 | |
| Total | 36 | 100 | 36 | 100 | |

F=8.69).

To examine the intragroup interactive effects of gastric residual volume with gavage volume, feeding method and time of studying aspiration in three consecutive days, repeated measures ANOVA was used (Greene House Gayzer). It was also used to examine the intragroup interactive effects of gastric residual volume with feeding and time of studying aspiration in three consecutive days. The results showed no significance relationship between gastric residual volume and gavage volume (P<0.55, F=0.8), feeding method (P<0.45, F=0.93), time of studying aspiration in three consecutive days (P<0.79, F=0.64), and feeding method and time of studying aspiration in three consecutive days (P<0.21, F=1.30).

To examine the intergroup interactive effects of gastric residual volume with gavage volume, feeding method, and time of studying aspiration in three consecutive days and also the intergroup interactive effects of gastric residual volume with feeding method and time of studying aspiration, ANOVA was applied. It was revealed that no significant relationship existed between gastric residual volume and gavage volume (p<0.32, f=0.96), time of studying aspiration in three consecutive days (p<0.9, f=0.09), and feeding method and time of studying aspiration in three consecutive days (p<0.0001,f=0.005). However, between gastric residual volume and feeding method a significant difference was observed (p<0.0001, f=75.47).

Intermittent bolus and intermittent drip

## Discussion

In the present study, findings showed that the mean of gastric residual volume in the intermittent bolus group was far more than that of intermittent drip group, so a slight aspiration in the intermittent bolus group compared with intermittent drip group can be a result of high GRV. Feeding intolerance indicates high gastric residual volume which is a risk factor for incidence of aspiration (15). On the other hand, these methods are still among the standard feeding methods and if conducted properly, they can reduce the risk of aspiration. The incidence of aspiration in different methods has been reported to be different in many studies.

In the present study, the results showed that the incidence of aspiration in the intermittent bolus group, in the first 24 hours was 2.8 %, and in the drip group was zero. In the second 24 hours, the incidence of respiratory aspiration in the intermittent bolus group was 2.9 % and in the drip group was zero. Fisher's exact test showed no significant difference between the two groups. In the third 24 hours of the study, the incidence of respiratory aspiration in both groups was zero. The incidence of respiratory aspiration in the entire period of the study in the bolus group was 5.6 % and in the drip group was zero. Fisher's exact test revealed no significant difference between the two groups. Serpa et al (2003) in their study compared the benefits and side effects of two tube feeding methods of continuous and bolus. The results showed that incidence of respiratory aspiration was similar in both tube feeding methods and there was no statistically significant difference between the two groups (p>0.05) (18). Bowling et al (2008) carried out a study about identifying the effect of continuous and bolus feeding on food return from stomach to gullet and gastric emptying on healthy people. The results indicated that there was no difference between gastric emptying duration and pulmonary aspiration in the two methods (p=0.19) (23). However, the results of the study conducted by Morshedi (1997) are in contrast with the above findings. In his study, he compared the gastrointestinal and respiratory aspiration complications between the two methods of intermittent bolus and intermittent drip feeding of patients in the ICU. The results showed that in the intermittent bolus group 60 % and in the intermittent drip group because of gravity only 6.7 % of patients got pulmonary aspiration; there was no significant relationship between the two groups according to the Fisher's exact test p=0.0001 (9).

Likewise, a study was done by Rooney et al (2002) to compare two gastric feeding methods of bolus and continuous in patients with brain damage. The results showed that the risk of feeding intolerance in bolus

method was more than the continuous method ($p<0.009$) (24). Considering different results in this area, it seems necessary to perform further studies to determine the safest feeding method.

## Conclusion

Despite insignificant difference of respiratory aspiration in the present study, the complication rate in the tube feeding method of intermittent bolus was more than intermittent drip method. Therefore, nursing service managers are provided to take necessary measures to choose a safe method in this regard. It seems crucial especially in care places where feeding pumps are not used yet. Furthermore, use of food bags can play an important role in decreasing the costs.

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