Outcomes of Utilizing Novel Versus Traditional Method of Length of Gastric Tube Insertion in Critically Ill Patients

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Abstract

Background: *Efficient positioning of the gastric tube in unconscious individuals in ICU remains difficult compared to its application in conscious patients. Therefore, innovative technique and procedure used for these patients to minimize complication and achieve better outcomes by measuring the distance from xiphisternum to earlobe to (nose/mouth) plus ten centimeters, as the tube containing a guidewire (as a stylet) reached around 20 cm, the nurse detects cricoid cartilage and pushed it outward and rightward in a guided manner could provide the best estimate of internal length of GT to be at an optimal position for feeding.* ***Objective:*** *To compare outcomes of utilizing novel versus the traditional method of the length of gastric tube insertion in critically ill patients.* ***Settings:*** *: at the ICUs of the Alexandria University Main Hospital (AUMH) in the General ICUs namely; General ICU (unit III) and continuous renal replacement therapy (CRRT) ICU.* ***Subjects*** *A Convenience sample of 60 adult unconscious critically ill patients from both genders, their ages ranged from 18 to 65 years constituted the subjects for this study. The sample was equally assigned into two equal groups (30 patients in each): group "A" the control group were subjected to the traditional method of insertion, Group B; patients were subjected to the novel method of insertion.* ***Tools:*** *Two tools were utilized to collect the data of this study. The tool I namely the "gastric tube insertion assessment tool". was utilized to collect the data of this study. This tool was developed by the researcher after reviewing the related literature. Tool II namely ' gastric tube insertion outcomes" This tool was adopted from (Santos et al.,2016).* ***Results:*** *Mean number of gastric tube insertion trials was 1.03±0.183 and 1.47±0.571 for the study and control group respectively with a significant difference between the two groups (P= 0.000). The mean time elapsed or required for insertion of GT was 5.27±1.437 and 12.30±2.521 for the study and control group respectively with a significant difference between the two groups (P= 0.000).* ***Conclusion:*** *The present study revealed that the novel method group had the shortest duration of GT insertion, which ranged from 4 to 6minutes. While the traditional group had a longer insertion time which ranged from 10-12 minutes. the novel method saves the nurse's time and effort during GT insertion, which decreases the patient's anxiety, trauma occurrence, and pain.* ***Recommendations:*** *A teaching program should be conducted to raise awareness of critical care nurses about a novel method of gastric tube insertion that may help in saving time, effort and prevent serious complications.*

Keywords: Novel method, Tube feeding, Length of a nasogastric tube, Insertion technique, Outcomes, Critically ill patients.

Introduction

A gastric tube (GT) is inserted into most patients in intensive care units (ICUs) to obtain a sample of gastric content for analysis, assess the presence of blood in the stomach, monitor the amount of bleeding, decompress gastric content after gastrointestinal surgery, instill medications and feeding and irrigate of the stomach (gastric lavage), as well as administer warm lavage fluid to correct hypothermia(Kim et al., 2016).

Insertion of the gastric tube is relatively safe; nevertheless, accidental misplacement of the gastric tubes into the respiratory tract is not rare and, if unrecognized, such misplacement may lead to serious consequences, including pneumonia, pneumothorax, atelectasis, bronchopleural fistula, emphysema, and even death(Blumenstein et al., 2014; Bolivar-Telleria et al., 2018; Numata et al., 2018).

The most common complication of GT insertion is the coiling in the pharynx or the esophagus. If the side holes are located within the esophagus, there is a risk of aspiration. The reported overall complication rates range widely from 0.3 percent to 8.0 percent. Several thoracic (bronchial and intravascular) and non-thoracic (enteral and intracranial) complications have also been identified(de Oliveira Santos et al., 2016; Lim et al., 2018; Rahimi et al., 2015).

Bronchial placement can lead to some complications such as atelectasis, pneumonia and lung abscess, bronchial perforation, pulmonary laceration, pulmonary hemorrhage, pleural cavity penetration, and its effects such as pneumothorax, empyema, and pleural knotting. Inadvertent insertion in the trachea or bronchial tree occurs in approximately 0.2 percent to 0.3 percent of patients. Rarely, pharyngeal and esophageal perforations may occur with severe consequences(Giantsou & Gunning, 2010; Gibson, 1984; Taylor et al., 2014).

Although the development of new methods, the healthcare providers depend mainly on the traditional methods for measuring gastric tube length which have some complications. However, no previous study was conducted among the Egyptian population regarding the new method. Few studies have been conducted to use novel methods to improve patient outcomes internationally. Therefore, this study was conducted to compare the novel and the traditional method of gastric tube length estimation in critically ill patients (Freeberg et al., 2010).

Aims of the Study

This study aims to compare outcomes of utilizing novel versus the traditional method of the length of gastric tube insertion in critically ill patients.

Research hypotheses

- Patients who are subjected to a novel method of the length of gastric tube insertion have better outcomes than those who are subjected to the traditional method.

Materials and Method

Materials

Design: A quasi-experimental research design was used to conduct this study.

Settings: This study was conducted At the ICUs of the Alexandria University Main Hospital (AUMH) in the General ICUs namely; General ICU (unit III) and continuous renal replacement therapy (CRRT) ICU

Subjects: A convenience sample of 60 newly admitted critically ill adult patients (18 to 60 years) constituted the subjects for this study. The sample was equally assigned into two equal groups (30 patients in each): group “A” the control group were subjected to the traditional method of insertion, Group B; patients were subjected to the novel method of insertion. The study sample size was calculated by power analysis using (Epi-Info program), Population size = 60,

expected frequency=50%, acceptable error=5%, design effect=1, confidence coefficient=98% and power=80%.

Tools: In order to collect the necessary data for the study two tools were used:

Tool one:''gastric tube insertion assessment tool''. was utilized to collect the data of this study. This tool is used to assess gastric tube insertion of patients who were newly admitted to the ICUs. Which was developed by the researcher after reviewing the related literature. This tool consists of three parts.

Part I ''Patients' Socio-Demographic and Clinical Data'' includes patient's socio-demographic characteristics as age, gender, and clinical characteristics as the date of admission, length of stay at ICU, past medical and surgical history, current diagnosis, history of old nasal and oropharyngeal trauma or surgery, history of previous gastric tube insertion, level of consciousness, number of days on MV, APACHE score was obtained**.**

Part II''Patients physiological parameters before insertion'' which includes the assessment of respiratory parameters as respiratory rate, mode of a mechanical ventilator, PEEP, peak pressure, Plateau, Minute volume, Peripheral oxygen saturation. Cardiovascular parameters as heart rate, heart rhythm, blood pressure, mean arterial blood pressure. Neurological parameter as the degree of pain using revised nonverbal pain score tool, degree of anxiety, level of consciousness, pupil size, pupil reaction, gage reflex.

Part III ''Factors affecting gastric tube insertion this part is used to assess the factors that might affect the patient's gastric tube insertion which includes Tracheal cuff pressure, tracheal tube size, oral mucous membrane condition, gastric tube size, manufactured material, and site of insertion (nasal, oral).

Tool II namely '' gastric tube insertion outcomes' This tool was utilized to collect the clinical and technical data of this study. This tool was adopted from (Santos et al.,2016) to assess gastric tube insertion outcomes. This tool consists of two parts: -

Part I '**'Patients' clinical outcomes after insertion'',** this part was used to assess the severity of outcomes for critically ill patients with a higher value reflecting the deterioration of patients' condition and vice versa. It consists of four items.

1-Respiratory parameters as respiratory rate, mode of a mechanical ventilator, PEEP, tidal volume, peak pressure, Plateau, Minute volume, Peripheral oxygen saturation, pulmonary aspiration, pneumothorax, atelectasis, pneumonia, empyema, and pleural knotted tube.

2-Cardiovascular parameters as heart rate, heart rhythm, blood pressure, mean arterial blood pressure.

3-Neurological parameter as the degree of pain using revised nonverbal pain score tool, degree of anxiety, level of consciousness, pupil size, pupil reaction, gage reflex.

4-Integumentary parameter as evidence of mucosal trauma and mucosal edema.

Part II 'Technical outcomes ''this part was used to assess the technical outcomes during and after insertion of a gastric tube. It includes a number of insertion trials, duration of insertion, kinked GT and clogging, number of a used gastric tube, improper position, mucosal bleeding.

Method

1- Approval of the ethics committee of the faculty of nursing was obtained.
2- An official letter from the Faculty of Nursing was sent to the appropriate authorities in Alexandria University Main Hospital (AUMH).

3- Permission to conduct the study with an explanation of the aim of the study1- was obtained.

4- The tool I developed by the researcher based on an extensive review of relevant and current literature .

5- The tool was tested for content validity by a jury of seven experts in the field of the study: one statistician, two experts from the critical care and emergency medicine department at the faculty of medicine staff2- members, four experts from the critical care and emergency nursing department at the faculty of nursing staff members.

6- The necessary modifications were done before data collection .

7- A pilot study was carried out on 10% of the studied patients (6 patients) to assess the clarity and applicability of the research tool. This number was excluded from the study sample. Based on the findings of the pilot study, these modifications were done.

8- The reliability of the tool was done using Cronbach's alpha test and the result was 0.98 which is acceptable. Data were collected from group "A" firstly and after its completion, data were collected from the group "B" to prevent the double contamination effect between the studied groups that might affect the study results.

The study was collected by the researcher over 5 consecutive months (from July to November 2020. This was done every day of the week in the morning, evening, and early at night.

Patients who met the inclusion criteria were assigned randomly to one of the two groups; group "A" patients were subjected to the traditional method of insertion (control group), Group "B" patients were subjected to the novel method of insertion (study group).

For both groups:

1- socio-demographic characteristics as age, sex, and clinical characteristics as the date of admission, length of stay at ICU, past medical and surgical history, current diagnosis, history of old nasal and oropharyngeal trauma or surgery, history of previous gastric tube insertion, level of consciousness, number of days on MV, APACHE score were obtained, calculated on the admission day and recorded using part I of the tool one.

2- Measurement of hemodynamic parameters: heart rate (beats/ min), respiratory rate (cycles/ min) was counted; mean arterial pressure (mmHg) was calculated, tidal volume, peak pressure, minute volume, SPO2, degree of pain, anxiety, level of consciousness, pupil size and reaction were measured and recorded using tool one part II .

3- 3- All the above values were recorded using part II of tool I and part one of tool II two times :

Time one (T1): the immediate time before the insertion of GT.

Time two (T2): the immediate time after the insertion of GT.

For the control group

•Patients were subjected to the traditional method of length and insertion of a gastric tube which includes: one of the following: -

1- measuring lengths of the gastric tube from the tip of the nose to the earlobe to xiphisternum in a semi setting or high fowler position.

2- tripling the distance from the earlobe to the tip of the nose/mouth and then mark the length of the tube to passed with tape.

3- Measuring the distance from the tip of the nose to the umbilicus in a flat position.

The routine care was performed by the researcher as the following .

•Explaining the procedure to a patient

•Putting a patient in a high flower's position or semi fowler's position with a pillow behind head and shoulder, Then about 6-10 cm of GT was lubricated from the distal end of the tube with water-soluble lubricant and inserted into more patent nostril.

For the study group

•The procedure was explained to the patient by the researcher .

•Patients were subjected to a novel method of insertion of GT which include measuring the length of GT from xiphisternum to earlobe to nose plus 10 cm using a stylet.
•The patient was positioned in a high flower's position or semi-flower's position with a pillow behind the head and shoulder.
•Then about 6-10 cm of gastric tube was lubricated from a distal end of the tube with water-soluble lubricant and inserted into more patent nostril with mild flexion of patient's neck.
•As the tube was entered around 20cm, cricoid cartilage was identified by the researcher and externally pulled outward and rightward in a controlled way.
•The gastric tube with the angiography catheter was pushed with the researcher's hand smoothly, after the insertion of a 50 cm angiography catheter was removed with gentle traction after releasing the outward cricoid pull. Moreover, the researcher chose this to be the preferred position, since this position would theoretically make it easier for nurses to achieve suction from the gastric tube.

For both groups:

1- An abdominal x-ray was done to confirm placement of GT, clinical and technical outcomes were monitored by the researcher twice; immediately and after 3days of insertion.
2- The clinical outcomes complications include pulmonary aspiration, atelectasis, pneumonia, lung abscess, bronchial perforation, pulmonary laceration, pulmonary hemorrhage, pneumothorax, empyema, a pleural knotted tube was assessed using x-ray. The pain was assessed using the revised non-verbal pain score tool. Tachycardia and tachypnea were observed by the researcher.
3- **A technical outcome** which includes tube clogging and kinked GT, coiling of GT in the pharynx or esophagus, the improper position was assessed using X-ray, mucosal bleeding, and several insertion trials were observed by the researcher.

Ethical considerations:

- Informed written consent was obtained from patients' witnesses (head nurses, nursing supervisors, and intensivists). After explaining the aim of the study.
- Patients' safety was ensured before the intervention by assessing hemodynamic readiness and during the intervention by stopping the intervention and physician notification if any hemodynamic intolerance sign occurs .
- Patients' privacy and confidentiality of the collected data were maintained during the implementation of the study.
- The ICU physician was consulted regarding the collaborative decision to consider Performing an abdominal x-ray after insertion of GT to confirm placement, clinical and technical outcomes.

Statistical Analysis

- Data were fed to the computer and analyzed using IBM SPSS software package version 25.0. (Armonk, NY: IBM Corp) Qualitative data were described using the number and percent.

Quantitative data were described using mean and standard deviation. The significance of the obtained results was judged at the 5% level. Frequency tables and cross-tabulations were used to illustrate the results of categorical data and tested by the Chi-Square for Friedman test or Fisher's Exact test or Monte Carlo correction. While Quantitative data were summarized by the arithmetic mean and standard deviation.

Results

Table 1 represents the distribution of the studied critically ill patient according to their demographic data. Sixty patients were recruited in the current study. Concerning

patients' age, this table shows that 33.3 % of the study group of patients aged from 40 to ≥ 50 years while 36.7 % of the control group of patients aged from 40 to 50 years. The mean age was 44.13±9.054 and 44.60±10.71 for the study and control group respectively with no statistical difference between the two groups (P= 0.989). Concerning gender, this table shows that 53.3% of the study group was males compared to 60 % in the control group of patients. That supported the homogeneity of the studied samples.

Table 2 Table (2) represents the distribution of the studied groups according to their clinical data. Concerning previous medical history, this table shows that (86.7%) of patients in the study group suffering from cardiovascular disorders compared to (46.7%) of patients in the control group. Whereas (53.3%) in the study group of patients suffering from respiratory disorders compared to 86.7% of patients in the control group with no statistical difference between the two groups (P= 0.068).

Table (3) shows the distribution of the baseline physiological respiratory parameters of the studied groups. In relation to the mode of a mechanical ventilator, it can be noted from this table that one-third of patients (33.30%) in the study group subjected to spontaneous mode. Whereas more than half of patients (56.7%) in the controlled group subjected to spontaneous mode with a statistically significant difference between the two groups (P= 0.044).

Table (4) shows a comparison between the studied group after gastric tube insertion. In relation to the mode of MV, it can be noted from this table that more than half of patients (53.3%) in the study group subjected to Supportive mode compared to nearly two-thirds of patients (60.0%) in the controlled group with a significant statistical difference between the two groups (P= 0.022).

Table (5) represents the distribution of the studied groups according to the respiratory complication after gastric tube insertion. In relation to pulmonary aspiration, it can be noted from this table that (3.33%) of patients in the study group suffering from this complication compared to nearly one-third of patients (30.0%) in the controlled group with a statistically significant difference between the two groups (P= 0.006).

Discussion

The current study findings revealed that using an angiography catheter as a stylet and manipulating the cricoid ring of the trachea while measuring the length from xiphisternum to earlobe to nose/mouth plus 10 cm are more successful in GT insertion compared to using traditional methods which are consist of measuring the length of GT from tip of the nose to earlobe to xiphisternum and inserting it in high fowler's position or semi-fowler's position with a pillow behind head and shoulder for comatose patients or left lateral position with head down.

Furthermore, following tracheal intubation, a GT is usually inserted to help gastric emptying, administer activated charcoal to a poisoned patient, and allow for intermittent enteric feeding. Negotiating the posterior nasopharyngeal angle and tube entry into the proximal esophageal orifice is a critical step to this procedure (Harvey & Cave, 2020).

The high success rate in the novel technique could be attributed to the use of a stylet and adequate length, which overcomes factors that affect GT insertion success. This stylet was used in the current study to reinforce the small-bore GT, reduce intraoral coiling of the GT in an intubated patient, and intraoral manipulation of the GT, which increased the chance of the tube entering the esophagus rather than the trachea and subsequently increasing the insertion success rate. This result is in line with Ghatak et al.,

(2013) who used this method in only thirty patients who underwent GT placement following orotracheal intubation in ICU settings. Therefore, successful GT insertion was achieved in all patients.

In the current research, the use of an angiography catheter to guide GT insertion has been more effective than the conventional method. Whereas this stylet will lead to an increase in GT's rigidity and then facilities GT insertion. In addition, the prevalence of negative events like trauma and bleeding was decreased by this technique. Three research papers that investigated the beneficial effects of rigidity imparted by cooling or freezing for the GT insertion without comparison to the conventional method were recorded up to the researcher's knowledge (Duk-Hee et al., 2009; Mandal et al., 2014; Mazlom et al., 2020).

The current study found that the novel method resulted in the least change in respiratory rate (RR), SPO2, mean arterial blood pressure (MAP), tidal volume (VT), minute volume (mv), and peak pressure when compared to the conventional method. Whereas a significant increase was found in the RR, VT, peak pressure, mv, SPO2, HR, and decrease in MAP on GT insertion by the traditional method. These findings may be attributed to the fact that the GT insertion process is a stressful event for a critically ill patient. That predisposed to an increase in catecholamine levels, which causes tachycardia. Furthermore, GT insertion stimulates the pharynx and esophagus, which may cause an autonomic reaction that is harmful to the heart (Mandal et al., 2018).

Conclusion

The current study aimed to determine the outcomes of utilizing novel versus the traditional method of the length of gastric tube insertion in critically ill patients. Based on the results of this study, it can be concluded that:

 The success rate of GT insertion can be increased by using an angiography catheter (as stylet) with the appropriate length which includes measuring the distance from the xiphisternum to nose to earlobe plus ten centimeters rather than the traditional methods.

 Gastric tube insertion is an acritical and stressful procedure that affects in physiological parameters of the patient especially (spo2, RR, HR, MAP) and pain .

 Using GT insertion with the novel method can decrease the number of insertion trial and complication as decreases trauma occurrence and pain which can occur by using the traditional method.

Recommendations

In line with the findings of the study, the following recommendations are made:

A teaching program should be conducted to raise awareness of critical care nurses about a novel method of gastric tube insertion that may help in saving time, effort and prevent serious complications.

A novel method of GT insertion should be included in the curricula of undergraduate nursing students in both theory and practice.

 Critical care nurses should use a novel method of GT insertion incorporated into daily practice.

 Critical care nurses should be oriented with significant differences between the novel and traditional method of GT insertion.

 Written guidelines for the application of the novel method of GT insertion.

Table (1) Distribution of the studied critically ill patients according to their demographic data.

Demographic data		Groups				Test of Significance
		Study (n=30)		Control (n=30)		
		No.	%	No.	%	
Age (years)	20-	3	10.0	3	10.0	X^2= 0.125 P= 0.989
	30-	7	23.3	6	20.0	
	40-	10	33.3	11	36.7	
	≥50	10	33.3	10	33.3	
	(Mean ± SD)	44.13±9.054		44.60±10.71		t= 0.033 P= 0.856
Gender	Male	16	53.3	18	60.0	X^2= 0.271 P= 0.602
	Female	14	46.7	12	40.0	

Table (2): Distribution of the studied critically ill patients according to clinical data

Clinical data		Groups				Test of Significance
		Study (n=30)		Control (n=30)		
		No.	%	No.	%	
Medical History#	Cardiovascular disorder	26	86.7	26	46.7	X^2= 11.745 P=0.068
	Respiratory disorder	16	53.3	14	86.7	
	Endocrine disorder	4	13.3	0	0.0	
	Gastrointestinal disorder	2	6.7	6	20.0	
	Renal disorder	16	53.3	18	60.0	
	others	5	16.7	0	0.0	
Surgical History	No previous surgery	21	70.0	17	56.7	X^2= 11.344 P=0.010*
	GIT	9	30.0	12	40.0	
	Cardiac	0	0.0	1	3.3	
Admission medical diagnosis#	Cardiovascular disorder	24	80.0	30	100.0	X^2= 9.416 P=0.094
	Respiratory disorder	18	60.0	14	46.7	
	Endocrine disorder	4	13.3	0	0.0	
APACHE II score	Mean ± SD Min.-Max	22.33±5.435 8.0-35		28.33±8.648 8.0-35		t=10.353 P=0.002*
Number of days on GT	Mean ± SD	1.270±3.016		1.000±0.000		t= 0.234 P= 0.630
Duration of mechanical ventilation (days)	Mean ± SD	1.67±2.928		1.000±0.000		t= 1.555 P= 0.217
ICU length of stay (days)	Mean ± SD	1.07±0.254		1.00±0.000		t=2.071 P=0.009*

Table (3): Comparison between the studied patients according to respiratory parameter after gastric tube insertion

Respiratory parameters after gastric tube insertion		Study (n=30)		Control (n=30)		Test of significance
		No.	%	No.	%	
Mode of MV	Controlled	4	13.3	2	6.7	X^2= 7.619 P=0.022*
	Assisted	10	33.3	10	33.3	
	Supportive	16	53.3	18	60.0	
Respiratory rate	Mean ± SD	18.60±2.943		25.83±4.284		t=58.107 P=0.000*
PEEP	Mean ± SD	5.370±1.033		5.470±0.860		t=0.166 P=0.685
Tidal volume	Mean ± SD	665.50±115.83		603.63±100.35		t=4.889 P=0.031*
Peak pressure	Mean ± SD	25.17±4.094		28.80±1.901		t=19.434 P=0.000*
Minute volume	Mean ± SD	11.86±2.680		13.71±3.189		t=5.921 P=0.018*
Spo_2 value	Mean ± SD	98.10±1.807		98.97±1.098		t=5.040 P=0.029*

Table (4): Distribution of the studied critically ill patients according to respiratory parameters at baseline.

Physiological parameter		Study (n=30)		Control (n=30)		Test of significance
		No.	%	No.	%	
Mode of MV	Controlled	9	30.0	2	6.7	X^2= 6.269 P=0.044*
	Assisted	11	36.7	11	36.7	
	Spontaneous	10	33.3	17	56.7	
Total respiratory rate	Mean ± SD	19.17±3.239		20.37±3.378		t=1.972 P=0.166
PEEP	Mean ± SD	5.370±1.033		5.400±0.814		t=0.019 P=0.890
Tidal volume	Mean ± SD	590.20±129.80		578.20±127.93		t=3.988 P=1.000
Peak pressure	Mean ± SD	27.17±4.662		28.37±1.564		t=6.006 P=1.017
Minute volume	Mean ± SD	12.20±2.815		11.21±3.027		t=1.718 P=0.195
SPO_2	Mean ± SD	97.27±2.449		97.57±1.305		t=0.351 P=0.556

Table (5) Comparison between the studied patients according to the respiratory complication after gastric tube insertion.

Respiratory complications after GT insertion		Study (n=30)		Control (n=30)		Test of significance
		No.	%	No.	%	
Pulmonary aspiration	**Yes**	1	3.33	9	30	X^2= 7.680 P= 0.006*
	No	29	96.6	21	70.0	
Pneumothorax	**Yes**	0	0.0	4	13.33	X^2= 4.286 P= 0.112
	No	30	100.0	26	86.67	
Atelectasis	**Yes**	0	0.0	0	0.0	X^2= ------ P= ------
	No	30	100.0	30	100.0	
Pneumonia	**Yes**	3	10.0	14	46.7	X^2= 9.932 P= 0.002*
	No	27	90.0	16	53.3	
Empyema	**Yes**	0	0.0	0	0.0	X^2= ------ P= ------
	No	30	100.0	30	100.0	
Pleural knotted tube	**Yes**	1	3.33	9	30.0	X^2= 7.680 P= 0.006*
	No	29	96.6	21	70.0	

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