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Two Novels Versus Traditional Methods Outcomes of Gastric Tube Insertion among Critically Ill Patients

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Abstract: **Gastric tube (GT) insertion is one of the most frequently performed procedures in critically ill patients with a wide range of diseases and critical conditions. It is used for nutritional support, decompression of the gastrointestinal tract (GIT), assessment, diagnosis, and medications administration. However, the insertion of GT can be a difficult and frustrating experience in the critically ill patients especially those who are intubated, sedated, and paralyzed. The insertion of GT can be very challenging even for an experienced nurse. Blind insertion of GT can be successful in approximately 40–58% of the insertion trials.**

Methods: A convenience sample of 90 adult critically ill patients, who were required a gastric tube (GT) insertion included in this study. Patients were assigned randomly to one of the following three groups (30 patients each). Group A: water-filled method of GT insertion; group B: tip burning method of GT insertion; and group C: the traditional method of GT insertion.

Results: The current study findings revealed that the tip burning method and the water-filled method are both effective methods of GT insertion. When compared the tip burning method with the water-filled method, the tip burning method is more successful to insert GT. Complication rates were higher in traditional method than two other group and the most common complications were mucosal trauma and Kinking of the GT.

Keywords: **Critical ill patient, gastric tube, gastric tube complication, insertion difficulties, tip burning method, water filled method.**

I. INTRODUCTION

Gastric tube (GT) insertion is one of the most frequently performed procedures in critically ill patients with a wide range of diseases and critical conditions. It is used for nutritional support, decompression of the gastrointestinal tract (GIT), assessment, diagnosis, and medications administration (Gomes & Andriolo, 2015; Makama, 2010; Pearce & Duncan, 2015). However, the insertion of GT can be a difficult and frustrating experience in the critically ill patients especially those who are intubated, sedated, and paralyzed.

The insertion of GT can be very challenging even for an experienced nurse. Blind insertion of GT can be successful in approximately 40–58% of the insertion trials (Harvey & Cave, 2010; Purngpipattrakul et al., 2020). This difficulty of GT insertion occurs due to the patient's inability to swallow and the presence of an inflated cuff in the proximal trachea which results in coiled GT in the pharynx (Blythe et al., 2015; Kayo & Kajita, 2015). It has been acknowledged that most difficulties in GT insertions are due to the impaction of GT (Kwon & Cho, 2015). The most common sites of impaction are the pyriform sinus, the arytenoids cartilage, and the esophagus. The gastric tube (GT) becomes compressed by the

inflated cuff of the tracheal tube (Ching et al., 2014). Moreover, the incidence of aspiration, mucosal bleeding, intracranial placement, and hemodynamic complications are increased due to the majority of attempts performed in a blinded fashion (Ghatak et al., 2013).

Previous studies have described different techniques to facilitate GT insertion such as the use of intubation stylet (Kavakli et al., 2017), endotracheal tube-assisted technique (Nanjegowda et al., 2013), endoscopic technique (Boston, 2015), use of frozen GT(Duk-Hee et al., 2009), use of "peel-away" split tracheal tube, angiography catheter guided technique (Blythe et al., 2015) and esophageal guide wire-assisted technique (Kayo & Kajita, 2015; Kirtania et al., 2012).

The mentioned methods require position change or instrument use (Ching et al., 2014). Placement of a silicone GT often fails due to the flexibility of the tube. This flexibility significantly affects the number of attempts made when inserting it. A rigid tube requiring fewer insertion attempts than a flexible tube (Hung & Lee, 2008; Vanek, 2014). Moreover, GT is inserted by the tube immersing method. The GT is immersed in an ice bath for 10 min. However, there is a problem with using this method because of the cooled GT is inserted into the nasal cavity, it quickly becomes heated up by the body's warmth and loses its rigidity. Therefore, if the initial insertion attempt fails, the GT cannot immediately be reused because it must be first put back in the iced water (Hung & Lee, 2008).

Other methods were developed to overcome these difficulties and to decrease the effort and the time of GT insertion. These methods include the water-fill method and the tip burning method. The water-fill method is a novel method to increase the rigidity of the GT to enhance the ease of insertion. This method involves filling the GT with distilled water at room temperature. The purpose of this technique is to change the density of GT. The density of water is higher than the density of air, the tube with water increases its density and make it rigid (Hung & Lee, 2008). The tip burning method is another one that produces a simple modification to the gastric tube and technique of insertion, which permits a degree of directional control of the tip of the tube. These modifications serves to overcome a number of the limitations of standard GT insertion (Harvey & Cave, 2010).

Critical care nurses spend more time at patients' bedside to assess and document all the data of the patients. They play a critical and significant role in identifying malnutrition in susceptible patients, assessing nutritional adequacy and management of GT feeding. The role of the critical care nurses is important in the GT insertion, GT feeding, and in the after care. Their proper performances in the GT insertion influence the patients' safety and clinical outcomes. The process of inserting the GT has its risks, but once the nurses gain experience in this area, they can do it without any level of difficulty. It is important for the nurses to know the reason that their patient has GT to avoid any pitfalls that can occur because of the procedure. Therefore, nurses should seek to master this nursing skill (Babapouret al., 2016; Robert Kaba et al., 2019).

Despite the traditional method of GT insertion has some complications the critical care nurses still use it (Dunn et al., 2019; Nascimento et al., 2018; Smith et al., 2018). Therefore, this study is conducted to compare between two novels versus the traditional method of gastric tube insertion among critically ill patients.

This study aims to:

Compare between two novels versus traditional methods of gastric tube insertion among critically ill patients.

Research Question:

What are the differences between two novel and traditional methods outcomes of the gastric tube insertion among critically ill patients?

Operational Definitions:

-**Novel methods** refer to water-filled and tip burning methods.

-**Traditional method** refers to a routine method used in the ICUs.

-**outcomes** in this study include:

-**patient clinical** outcomes that include vital signs, presence of pain, and evidence of mucosal trauma.

-**technical outcomes** include number of the trials, duration of insertion, and number of used GT.

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2. SUBJECTS & METHODS

2. Methodology

2.1. Research design: A descriptive comparative research design was used to conduct the current study.

2.2. Setting: This study was conducted in the intensive care units at the Alexandria Main University Hospital namely; unit I that includes 14 beds, unit II that includes 12 beds, and unit III that includes 15 beds. These units receive patients with different disorders in the acute stage of illness and patients with different types of injuries.

2.3. Subjects: A convenience sample of 90 adult critically ill patients, who were required a gastric tube (GT) insertion included in this study. Patients were assigned randomly to one of the following three groups (30 patients each). Group A: water-filled method of GT insertion; group B: tip burning method of GT insertion; and group C: the traditional method of GT insertion.

2.4. Exclusion criteria: Patients with severe midface trauma, recent nasal surgery, esophageal stenosis or varices, recent banding of esophageal varices, history of radiotherapy in head or neck region, coagulation abnormality, and fractured base of skull were excluded from this study.

2.5 Tool of Data Collection: Two tools were used to collect data in this study.

Tool one: Gastric tube insertion assessment:

Part I: Patients' socio-demographic and clinical data:

This part includes patients' demographic data such as age, sex, marital status, occupation, patient education. It also includes patients' clinical data as patients' diagnosis, date of admission, length of ICU stays, history of hospitalization, history of old nasal and oropharyngeal trauma or surgery, history of previous nasogastric or oro-gastric tube insertion, number of days on GT, number of days on MV and number of days on endotracheal /tracheostomy tube (ETT/ TT).

Part II: Physiological parameters:

This part includes respiratory parameters as mode of a mechanical ventilator, respiratory rate, PEEP (positive end-expiratory pressure), tidal volume, peak pressure, minute volume and saturation of peripheral oxygen (SPO2); cardiovascular parameters as heart rate, heart rhythm, blood pressure (mmHg) and mean arterial pressure (MAP). It also includes neurological parameters as a degree of pain, degree of anxiety, level of consciousness, pupil size, pupil reaction, gage reflex, and sedation.

Part III: Factors that may affect gastric tube insertion:

This part assesses the factors that may affect GT insertion. These factors include **the advanced airway related factors as the** type of the airway (ETT/TT); ETT/ TT cuff pressure; and ETT/ TT size; **the gastric tube (GT) related factors** as the site of insertion; and the GT size. In addition, the **patient-related factors** as **the** oral mucous membrane condition as well as the nasal mucous membrane condition.

Tool two: Gastric tube insertion outcomes.

Part I: Clinical outcomes:

This part assesses the respiratory outcomes as respiratory rate, tidal volume, peak pressure, and minute volume and SPO2; and assesses the cardiovascular outcomes as heart rate, heart rhythm, blood pressure (mmHg), and mean arterial pressure. Moreover, it assesses the neurological outcomes as the degree of pain, degree of anxiety and level of consciousness; and assesses the integumentary outcomes as evidenced by the mucosal trauma and mucosal edema.

Part II: Technical outcomes:

This part includes the number of trials, the site of each trial (nasal, oral), duration of insertion, the number of used GT, and the success, or failure of the GT insertion after trials.

- The study tools were developed by the researcher after reviewing the related literature.

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- A pilot study was carried out on nine critically ill patients to assess the clarity and applicability of the tools and the necessary modifications were done before data collection. They were excluded from the study sample.
- The reliability of the tools was assessed using Cronbach's coefficient alpha. The reliability of tool one and tool two were acceptable (0.876, 0.912 respectively).

2.6. Data collection:

Patients who met the inclusion criteria in the previously mentioned ICUs were assigned to the following three groups. Group A: the water filled method of GT insertion; group B: tip burning method of GT, and group C: the traditional method of GT insertion.

Before gastric tube insertion:

For the three groups, patients' demographic and clinical data were obtained and recorded using part I of tool one. Patients' physiological parameters as a baseline data were assessed and recorded using part II of tool one. For the factors that may affect the gastric tube insertion were assessed and recorded using part III of tool one. The same manufacture product of gastric tube was used in the three methods of the GT insertion to avoid failure of the insertion related to the type of the GT.

During gastric tube insertion:

For group A (The water-filled method)

1- After measuring the length of the tube that was inserted, the GT was filled with distilled water at room temperature and cold water alternatively. Then GT was immersed from the distal segment with its side holes in water (figure 1).

2-Water was sucked into the tube with a Tommy syringe. The Tommy syringe connected to the proximal end of the GT (figure 2). When inserting the GT, the patient's head was kept in a neutral position; the patient's head didn't elevate or depressed.

3- To confirm the placement of GT, the water was pulled by Tommy syringe before confirmation.

4-Then gastric tube placement was confirmed by: (Aspirate stomach contents into tommy syringe, or by auscultation of air insufflated through the feeding tube ('whoosh' test)).

Figure1: GT filled with distilled water.

Figure 2: Water sucked into the tube with a tommy syringe.

For group B (The tip burning method):

1- After measuring the length of the tube that was inserted, the GT was heated 1.5cm from the tip to form a 30° angle. (figure 3)

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2-Following lubrication, the gastric tube was inserted with the angle. The GT was advanced in the patient nose/ mouth until it reaches the nasopharynx/ oropharynx (figure 4).

3-Following entry into the oropharynx, the gastric tube was then rotated 180 ˚. Further advancement of the tube leads to entry into the esophagus (figure 5) (M. Harvey & G. Cave, 2010). When inserting the GT, the patient's head was kept in a neutral position; without elevating or depressing the patient's head.

4-Then gastric tube placement was confirmed by: (Aspirate stomach contents into tommy syringe or by auscultation of air insufflated through the feeding tube ('whoosh' test)).

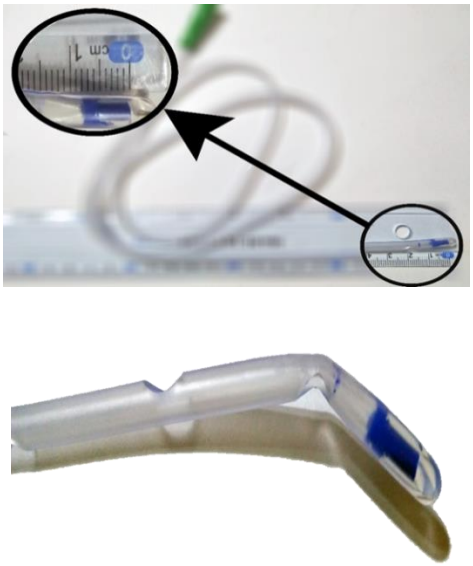

Figure 3: Gastric tube modification detailing distal angulation

Figure 4: Gastric tube inserted with the angle until it reaches the nasopharynx.

Figure 6: Gastric tube rotated 180 further advancement of the tube lead to entry into the esophagus.

For group C (The traditional method)

1- After measuring the length of the tube that was inserted. The oro-gastric tube was inserted into the oral cavity over the tongue, and the nasogastric tube was inserted into more patent nostril.

2-Then direct the tube downward toward the pharynx

3-When the tube hits the pharynx, have the patient flex the head forward or flex the unconscious patient's head.

4- Then continue to advance the tube until the marked position of the tube was reached.

5-Then gastric tube placement was confirmed by: (Aspirate stomach contents into tommy syringe or by auscultation of air insufflated through the feeding tube ('whoosh' test)).

For the three groups after gastric tube insertion:

Successful GT insertion was defined as the passage of the tube in no more than two attempts.

Patients were assessed for physiological parameters after GT insertion and recorded using part I of tool two.

Technical outcomes after GT were assessed a recorded using part II of tool two.

Statistical analysis of the data:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using the number and percent. Quantitative data were described using a range (minimum and maximum), mean, and standard deviation. The significance of the obtained results was judged at the 5% level.

3. RESULTS

Table I presents the characteristics of the patients in the studied three groups according to bio-demographic data.

Table I: Characteristics of studied patients according to bio-demographic data.

Bio-demographic data		Water filled method (n = 30)		Tip burning method (n = 30)		Traditional method (n = 30)		X^2	p
		NO	%	NO	%	NO	%		
Age	18-24	1	3.33	1	3.33	1	3.33	.868	.351
	25-34	0	0	2	6.66	1	3.33		
	35-44	10	33.3	5	16.66	6	20.0		
	45-54	9	30.0	16	53.33	11	36.66		
	55-60	10	33.3	6	20.0	11	36.66		
Sex	Male	15	50.0	15	50.0	21	70.0	2.146	.120
	Female	15	50.0	15	50.0	9	30.0		
Clinical data	Cardiovascular system	9	30.0	9	30.0	12	40.0	1.153	.283
	Respiratory system	10	33.3	11	36.6	5	16.6		
	Renal system	7	23.3	7	23.3	4	13.3		
	Neurological system	14	46.6	12	40.0	20	66.6		
	Gastrointestinal system	7	23.3	9	30.0	5	16.6		
	Sepsis	13	43.3	14	46.6	13	43.3		
	Trauma	1	3.33	0	0	1	3.3		

Table II shows physiological outcomes after GT insertion among the water-filled group.

Table III shows physiological outcomes after GT insertion among the tip-burning group.

Table IV demonstrate physiological outcomes after GT insertion among the traditional group**.**

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Table II: Physiological outcomes after GT insertion among water- filled group.

Physiological variables		Before insertion		After insertion (outcomes)		Test of sig.	p
respiratory	Respiratory rate	20.37 ± 6.88		21.63 ± 6.74		t=4.407	<0.001*
	Tidal volume	545.4 ± 170.1		534.7 ± 168.4		t=1.605	0.123
	Peak pressure	24.17 ± 5.80		23.96 ± 5.60		t=0.755	0.458
	Minute volume	10.62 ± 3.37		11.42 ± 3.65		t=1.264	0.220
	SPO_2	97.23 ± 2.42		96.60 ± 2.19		t=2.392	0.023*
Cardiovascular	Heart rate	88.37 ± 16.59		90.37 ± 15.41		t=3.319	0.002*
	MAP	86.17 ± 20.30		90.17 ± 15.58		t=1.038	0.308
Neurological	Degree of pain	0.77 ± 1.25		1.43 ± 1.76		t=2.763	0.010*
Psychological	Degree of anxiety						
	No	8	50.0	10	58.8	MH= 8.000	0.317
	Mild	7	43.8	5	29.4		
	Moderate	1	6.3	1	5.9		
	Sever	0	0.0	1	5.9		

Table III: Physiological outcomes after GT insertion among tip burning group.

Physiological variables		Before insertion		After insertion (Outcomes)		Test of sig.	p
Respiratory	Respiratory rate	19.47 ± 4.52		20.73 ± 4.94		t=4.535	<0.001*
	Tidal volume	576.3 ± 119.4		556.9 ± 119.9		t=1.030	0.315
	Peak pressure	24.18 ± 5.20		24.05 ± 5.13		t=0.646	0.525
	SPO_2	96.40 ± 2.14		96.73 ± 1.70		t=1.223	0.231
Cardiovascular	Heart rate	86.23 ± 17.80		89.63 ± 17.16		t=4.174	<0.001*
	MAP	96.25 ± 23.30		96.22 ± 23.65		t=0.290	0.774
Neurological	Degree of pain	0.38 ± 0.73		0.90 ± 0.98		t=3.360	0.002*
psychological	Degree of anxiety						
	No	11	73.3	9	56.3	MH= 13.500	0.132
	Mild	4	26.7	5	31.3		
	Moderate	0	0.0	2	12.5		
	Sever	0	0.0	0	0.0		

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Table IV: Physiological outcomes after GT insertion among traditional group.

Physiological variables		Before insertion		after insertion (outcomes)		Test of sig.	p
Respiratory	***Respiratory rate***	*21.07 ±4.72*		*24.30 ±5.09*		*t=5.003*	*<0.001**
	Tidal volume	548.5 ± 137.76		528.4 ± 137.5		t=1.103	0.284
	Peak pressure	22.0 ± 4.21		23.30 ± 4.47		t=2.110	0.048*
	Minute volume	10.94 ± 2.92		19.20 ± 31.26		t=1.227	0.235
	SPO_2	97.73 ± 2.24		96.67 ± 2.43		t=3.213	0.003*
Cardiovascular	**Heart rate**	93.83 ± 19.0		97.83 ± 19.38		t=3.564	0.001*
	MAP	91.09 ± 19.90		97.56 ± 21.15		t=3.390	0.002*
Neurological	**Degree of pain**	0.67 ± 1.06		2.07 ± 1.96		t=4.324	<0.001*
Psychological	**Degree of anxiety**					MH= 18.000	0.012*
	No	15	68.2	9	40.9		
	Mild	5	22.7	7	31.8		
	Moderate	2	9.1	6	27.3		
	Sever	0	0.0	0	0.0		

Table V presents comparison between the **three studied groups** according to the **percent of change in the outcomes** of the **physiological variables**.

Table V: Comparison between the three studied groups according to the percent of change in the outcomes of the physiological variables.

Percent of change of physiological variables		Water filled method (n = 30)	Tip burning method (n = 30)	Traditional method (n = 30)	H	P
		Median (Interquartile Range)	Median (Interquartile Range)	Median (Interquartile Range)		
Respiratory	Respiratory rate	-1.00(2.00)	-1.00(2.00)	-2.500(4.25)	8.865	0.012*
	Tidal volume	10.00(36.00)	3.00(38.5)	22.00(98.00)	0.363	0.834
	Peak pressure	0.00(0.00)	0.00(0.00)	-1.00(2.75)	10.581	0.005*
	Minute volume	-2.00(2.20)	0 .0850(0.85)	-1.2550(2.00)	7.376	0.025*
	SPO_2	.0000(1.00)	0.00 (2.00)	0.50 (2.25)	8.288	0.016*
Cardiovascular	Heart rate	-1.00(3.50)	-3.0000(4.25)	-3.0000(5.75)	1.996	0.369
	MAP	0.00(0.00)	0.00(0.30)	0.00(10.83)	9.859	0.007*
Neurological	Degree of pain	0.00(1.25)	0.00(1.00)	-1.00(2.00)	4.161	0.125

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Table VI shows trauma occurrence after GT insertion among the three groups

Table VI: Trauma occurrence after GT insertion among the three groups.

GT insertion groups	Trauma occurrence				χ^2	p
	Yes (n = 18)		No (n = 72)			
	No	%	No	%		
Water filled group (30)	6	20.0	24	80.0	0.417	.812
Tip burning group (30)	5	16.7	25	83.3		
Traditional group (30)	7	23.3	23	76.7		

Table VII represents mucous membrane condition and trauma occurrence after GT insertion among the three groups.

Table VII: Mucous membrane condition and trauma occurrence after GT insertion among the three groups.

Mucous membrane condition		Trauma occurrence (evidence of mucosal trauma)												χ^2	p
		Water filled method (n = 30)				Tip burning method (n = 30)				Traditional method (n = 30)					
		Yes		No		Yes		No		Yes		No			
		NO	%	NO	%	NO	%	NO	%	NO	%	NO	%		
Oral /nasal color	Pale	2	6.7	16	26.7	1	3.3	9	30.0	4	13.4	10	33.3	0.480	0.640
	Pink	4	13.3	8	53.3	4	13.3	16	53.3	3	10.0	13	43.3		
Oral / nasal condition	Dry	3	10.0	8	26.7	2	6.6	8	26.7	2	6.7	10	33.3	0.120	1.000
	Moist	3	10.0	16	53.3	3	10.0	17	56.7	5	16.7	13	43.3		

Table VIII shows technical outcomes after GT insertion among the three groups.

Table VIII: Technical outcomes after GT insertion among the three groups.

Technical outcomes		Gastric tube insertion methods						χ^2	p
		Water filled Group (n = 30)		Tip burning Group (n = 30)		Traditional Group (n = 30)			
		No	%	No	%	No	%		
Duration of insertion (minutes)	2-4	20	66.7	22	73.3	10	33.3	7.072	0.264
	4-	8	26.7	7	23.3	14	46.7		
	6-	2	6.7	1	3.3	5	16.7		
	≥8	0	0.0	0	0.0	1	3.3		
Number of used GT	1	27	90.0	28	93.3	24	80.0	2.446	0.366
	2	3	10.0	2	6.7	6	20.0		

Table IX represents comparison between the three groups in relation to the GT insertion success.

Table IX: Comparison between the three groups in relation to the GT insertion success.

GT insertion groups	Gastric tube insertion success (number of trial)								χ^2	^{MC}p
	Successes						Total failure			
	First attempt		Second attempt		Total successes					
	No	%	No	%	No	%	No	%		
Water filled group (30)	23	76.7	2	6.7	25	83.3	5	16.7	5.753	0.184
Tip burning group (30)	27	90.0	2	6.7	29	96.7	1	3.3		
Traditional group (30)	18	60.0	5	16.7	23	76.7	7	23.3		

4. DISCUSSION

Gastric tube (GT) insertion in critically ill patients can be challenging even for experienced critical care nurses. It is often difficult to place the GT in critically ill patients. The more insertion attempts the more complications occurred. Repeated attempts of GT insertion may injure the nasal mucosa, and pharynx that may cause nasal bleeding. Various techniques have been proposed to facilitate the GT insertion with variable success rate. The existence of several methods for proper placement of gastric tube (GT) and introduction of various novel methods day-by-day indicates that no method is perfect or universally accepted. However, the quest for the best is still on. (Siddhartha et al., 2017; Torsy et al., 2018). Hence, the present study was designed to compare between two novel versus traditional methods of gastric tube insertion among critically ill patients.

Gastric tube (GT) insertion success among the three groups:

The current study findings revealed that the tip burning method and the water-filled method are both more successful in GT insertion. When compared the tip burning method with the water-filled method, the tip burning method is more successful than the others are.

High success in the tip burning method may be due to induced curve, which overcomes factors that affect GT insertion success. This curve decreases the piriform sinuses and the arytenoid cartilage areas impaction; increase the chance of tube to enter esophagus rather than trachea, which increase its success rate. This result is in line with Harvey, et al (2010) who used the tip-burning method in only ten patients undergoing gastric tube placement following orotracheal intubation in the emergency department of Waikato hospital. Successful GT insertion is achieved in all patients (Harvey & Cave, 2010).

Water filled method was more successful than the traditional method in the current study. Success in the water-filled method may be due to the water filled especially cold water that increases the rigidity of GT and facilities its insertion. Moreover, this method showed less incidence of adverse events such as trauma and bleeding. It was documented only three reports, which have examined the beneficial effect of imparting rigidity by cooling or freezing for facilitation of the GT insertion without any comparison to the traditional method (Duk-Hee et al., 2009; Mandal et al., 2014; Mazlom et al., 2020).

The current study findings supported by Hung; et al (2008) who used the water-filled method in GT insertion and compared it with the traditional method. successful insertion rate was higher in the water-filled group (Hung & Lee, 2008). Moreover, Appukutty and Shroff (2009) reported that, when the GT was made more rigid using an esophageal guidewire, the procedure required a smaller number of attempts that decrease the incidence of adverse events such as trauma and bleeding.

Although, Chun et al (2009) reported that the frozen GT technique highly successful and with less complications when compared with the traditional method in intubated paralyzed patients (Appukutty & Shroff, 2009; Duk-Hee et al., 2009). Ratzlaff et al., (2010) found that the degree of GT flexibility significantly affects the easiness of GT insertion. They reported that the rigid tubes required fewer insertion attempts. However, as the GT rigidity increases, the incidence of trauma also increases, with a subsequent increase in the incidence of bleeding.

Changes in the physiological variables outcomes among the three studied groups:

The present study illustrated that the lowest change in the respiratory rate, SPO2, and mean arterial blood pressure (MAP) were in the water-filled method and tip burning method in comparison with the traditional method. A significant increase was found in the respiratory rate, heart rate, and MAP, and decrease in SPO2 on GT insertion by the traditional method. These results may be due to that the GT insertion procedure is a stressful event to the patient. This produces an increase in the levels of catecholamines and leads to tachycardia. Moreover, GT insertion leads to stimulation of the pharynx and esophagus that may induce an autonomic response, which is detrimental to the heart.

Tsai et al (2012) reported that after several unsuccessful GT insertions with any method, the incidences of unstable vital signs (hypertension, tachycardia, and arrhythmias) usually increase (Tsai et al., 2012). Moreover, the current results are in line with other studies as Mandal Met al., (2018) who found that the heart rate and MAP in the traditional method before and after the procedure were found comparable with other two groups the frozen GT technique and reverse Sellick's maneuver (Mandal et al., 2018). Moreover, Rowat A et al (2004) found that the traditional GT insertion method was associated with moderate hypoxemia.

On the other hand, the current result is contradictory with Fassoulaki, and Athanassiou (2013) who reported that regardless of techniques applied, the GT insertion resulted in a transient increase in SBP and HR (Fassoulaki & Athanassiou, 2013; Rowat et al., 2004). There are no studies documented the effects of two novel methods water filled method and tip burning method on hemodynamic changes in the ICU patients.

Pain and discomfort associated with the GT insertion procedure have long been recognized and reported as the single most painful routine procedure in the emergency department. Many patients experience oropharyngeal discomfort. However, pain control is often suboptimal, as many GT insertions are performed with ordinary lubricant jelly alone, without any additional pain-relieving supplements. Reasons for inadequate pain control measures include poor recognition of pain, inconvenience, unavailability, and insufficient research on alternative treatment options.

Results of the current study showed that pain has been increased after GT insertion in the three methods. When comparing between the three groups the tip burning method has the least pain in the three groups. Some studies have shown that GT insertion ranks as the second most painful procedure after arterial blood gas sampling (Fan et al., 2016; Lor et al., 2018; Morrison et al., 1998). Regardless of the techniques applied, the GT insertion causes pain but the degree of pain can differ from one technique to another.

The current study result was supported by Singer, et al (2017) who reported that the most painful procedures for emergency department patients were nasogastric intubation, incision and drainage of abscesses, fracture reduction, and urethral catheterization.

Trauma occurrence and technical outcomes after GT insertion among the three studied groups:

The present study revealed that the traditional group had the highest mucosal trauma (oral mucosa and nasal mucosa). Tip burning group and water-filled group had the least mucosal trauma. This suggests that the tip burning method and water-filled method are safer and less traumatic than the traditional method of GT insertion.

This result was in line with Hung and Lee (2008) who reported that although the water-fill method did not achieve a 100% success rate, it is simple, safe, fast, non-traumatic, and not stressful. It can be easily applied in any setting and no special equipment is required. No special neck movement or body position is needed in this method (Hung & Lee, 2008). Furthermore, Kwon et al (2015) stated that the traditional method was found to be with higher mucosal bleeding in comparison with the other GT insertion techniques (Kwon & Cho, 2015).

The present study revealed that the tip burning method group had the shortest duration of GT insertion, which ranged from 2 to 4 minutes. Then the Water filled method comes next. While the traditional group had a longer insertion time. Tip burning method and water-filled method save the nurse’s time and effort during GT insertion, which decreases patient’s anxiety, trauma occurrence, and pain.

This result is congruent with Mandal et al., (2018) who found that the duration of insertion in the traditional method was longer than the two other methods used in the GT insertion. Kim et al., (2018) found that GT insertion time was shorter

and successful from the first-attempt and the total insertion rate improved when using their novel method (GlideScope with modified Magill forceps) compared with the traditional method (Kim et al., 2018; Mandal et al., 2018). Moreover, Siddhartha, (2017) found that there was a high failure rate and long insertion time in the traditional method when compared to two other methods (reverse Sellick's maneuver and neck pressure with lateral flexion method)(Siddhartha et al., 2017).

The present study revealed that GT insertion by the traditional method the nurses use more than one tube for insertion, which makes the traditional method with high cost in comparison with the tip burning method and the water-filled method.

Factors that may affect the gastric tube insertion and its insertion success among the three groups:

The current study findings revealed that the traditional method has a high failure rate in comparison with the two other methods (water filled method and tip burning method). Several studies used the same traditional method and reported high failure in comparison to other GT insertion methods. Kvakli, et al (2017) used video laryngoscope and endotracheal tube assistance during GT insertion and compared them with the traditional techniques. They reported that the highest failure rate was in the traditional method. Kirtania et al, (2012) used esophageal guidewire-assisted insertion with manual forward laryngeal displacement technique. They reported the highest failure rate in the traditional method (Kavakli et al., 2017; Kirtania et al., 2012). Mandal et al, (2018) used reverse Sellick's method and frozen GT method and compared with the traditional method. They reported that the success rate of the traditional method was the lowest in comparison to the other techniques (Mandal et al., 2018).

The traditional method has a high failure rate due to several factors. These factors included devices related factors, as presence or absence of the advanced airway, endotracheal tube /tracheostomy size, tube cuff pressure, site and size of the GT. Moreover, patient-related factors, as the anatomical factors, piriform sinuses (two pouches in the right and left parts of the throat), and arytenoid cartilages of the trachea to the entrance of esophagus are the most common places wherein GT is usually lodged and make it difficult to direct it into the esophagus.

The present study illustrated that there was no significant relationship between the presence or absence of the advanced airway and GT insertion success. This result is contradictory with Desai et al, (2016) who reported that GT insertion before endotracheal intubation requires fewer attempts efforts and takes less time than GT insertion after endotracheal intubation (Desai & Torgal, 2016).

The current study also indicated that the ETT/TT size affects GT insertion success. Insertion of GT was successful in patients who had small size advanced airway. Insertion of GT tends to fail in patients who had large size advanced airway. This suggests that an increase in the tube size of the advanced airway (ETT / TT) leads to failure of GT insertion. Moreover, the distortion caused by the endotracheal tube and the loss of airway tone can be possible cause for difficulty in GT insertion. This study in line with Bear D et al, (2015) and Krensky, (2011) who documented that the rate of displacement is high in the ICU patients and related this to several factors one of these factors is the size of the tracheal tube.

The present study revealed that there is no relationship between the GT site or size and the GT success. On the same line Halloran (2011) et al, reported no significant differences were found in relation to the occurrence of complications and the site of the GT insertion whether it was nasogastric or oro-gastric. Moreover, Gohel and Kirby, (2016) indicated that there is no difference between GT insertion site nasal or oral, they attributed that the GT are usually inserted when a short-term need for enteral access. They also stated that the nasal approach may be better tolerated than oral tube placement in patients who are not mechanically ventilated and not sedated. In intubated patients, theories suggest that the gag reflex is suppressed and both the nasal and oral approaches should be equally well tolerated (Gohel & Kirby, 2016).

The current study results is contradictory with Dorothy et al, (2011), who documented that intubated patients are not protected from the pulmonary GT misplacement, which is associated with small size GT. In addition, the small diameter of GT can cross through the tracheal lumen alongside the flexible endotracheal tube (ET) balloon, leading to an intrapleural placement (Sparks et al., 2011). The small size of GT can be comfortable to the patient, but they kink easily which leads to a high failure rate in insertion and pulmonary intubation (Krenitsky, 2011).

The present study revealed that the gag reflex and the level of consciousness have a significant effect on GT insertion success. Conscious patient cooperates by swallowing on instruction while inserting GT. As the unconscious patients cannot follow the swallowing instructions, GT insertion in the unconscious patient may be difficult, often have first attempted failure rates. This suggests that a decrease in patients' consciousness may associate with a decrease in gag reflex, which leads to failure in GT insertion and causing complications that are more serious especially pulmonary misplacement.

Findings of the present study is in line with Ghatak et al, (2013) who reported that insertion of a GT in an unconscious patient may be difficult as they cannot follow the swallowing instructions, and therefore it has a high first-attempt failure rate (Ghatak et al., 2013). Additionally, Sriramka and Kumar, (2017) studied accidental insertion of GT in the airway in intubated unconscious patients. They reported that first attempt failure rates are usually combined with GT insertion in unconscious patients. Apart from failed attempts may be associated with complications (Sriramka & Pattnaik, 2017).

Moreover, Caramia, (2018) reported that patients with altered mental status or decreased cough or gag reflex are more prone to the bronchial placement of GT. The presence of an endotracheal tube or tracheotomy does not protect the tracheobronchial tree from accidental placement.

The current study finding is contrast with Fan et al, (2016) who reported that the non-swallow procedure of nasogastric tube intubation relieves discomfort and ensures the safety of patients. Patients subjected to nasogastric intubation are more likely to benefit from the non-swallow procedure when NG tube insertion is performed (Fan et al., 2016).

The play a crucial role in GT insertion; if a temporary tube is used; maintenance of the tube, administration of the feeding, prevention and detection of complications associated with this form of therapy, and participation in the assessment of the critically ill patient's response to the tube feeding. However, in more advanced critical care units, the critical care nurses calculate patient's needs of calories, body's requirements, analyze daily calories delivery, and advocate for early enteral feeding.

The basic knowledge and nursing activities regarding GT insertion can differ from health care institution to another and even within the same institution. Therefore, special studies should be carried out to explore nurses' knowledge and identify their practices regarding GT insertion to determine the gaps, defects and work necessary to overcome the defects by constructing and applying a well-designed instructional program based on the identified needs and observations. To enrich the critical care nurses' knowledge and improve their practices regarding the GT insertion among critically ill patient's organizations should developed regular workshops, in service education and continuing evaluation. Nurses' education will have a great effect, will be reflected in a high number of patients, and certainly will be more beneficial than patient-centered education. The improvement of nurses' knowledge and practices regarding GT insertion will directly or indirectly lead to reduce the complications and side effects related to GT insertion in the critical care unit.

5. CONCLUSION

The aim of the current study was to compare between two novels versus traditional methods of gastric tube(GT) insertion among critically ill patients. **Based on the current study findings, it can be concluded that:**

- The success rate of GT insertion can be increased by using tip burning method and water filled method rather than traditional method.
- There are different factors that affect success GT insertion based on current study result. These factors include devices related as (presence or absent of advanced airway, ETT/TT size) and patient related factors as (the gag reflex and level of consciousness). Two novel methods find some solution to overcome these factors as increase GT rigidity in water filled method and overcome anatomical factors which solved by curve induced in tip burning method.
- Gastric tube insertion procedure is a stressful event to the patient which affect in physiological parameters of patient especially (respiratory rate, spo_2 and mean arterial blood pressure and heart rate)
- Tip burning method and water filled method save nurse time and effort during GT insertion which decrease trauma occurrence and pain.
- Tip burning method is the most cost-effective method but only if tube burned correctly followed by water filled method.

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