Effect of Implementing Nursing Guidelines for Tube Feeding on the Occurrence of Aspiration among Critically Ill Patients

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Abstract: Pulmonary aspiration is a serious complication among enterally tube fed and mechanically ventilated patients. It results in increased patient mortality, length of hospital stay, and healthcare costs. This article describes an evidence-based practice approach to the creation of an enteral feeding guideline and an aspiration risk reduction algorithm. Thus, a safe and effective enteral feeding practices can be implemented for the critically ill patients. The aim of this study is to evaluate the effect of implementing nursing guidelines for tube feeding on the occurrence of aspiration among critically ill patients. A quasi experimental research design was utilized and the study was conducted on 60 adult patients. Sixty patients were assigned to two groups (study and control) each group consisted of 30 patients. The study group involved patients on tube feeding following enteral feeding guidelines while the control group involved patients on tube feeding following the conventional feeding method. The study was conducted in the Intensive Care Unit at Emergency Hospital of Mansoura University. The results of the present study indicated that occurrence of aspiration was found in 23.3% of the control group compared to 3.3% of the study group. Consistent relationship was found between occurrence of aspiration and its risk factors such as supine position, advanced age, decrease level of consciousness, low endotracheal cuff pressure, high gastric residual volumes, and poor oral care. The findings indicated that tube feeding guidelines can minimize the occurrence of aspiration in critically ill patients.

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Key word: tube feeding, pulmonary aspiration, risk factors, evidence based guidelines, critical care, and strategies to minimize aspiration.

1. Introduction

Enteral feeding (EF) techniques have developed over recent years with advanced technology to be more safe, efficient and comfortable means of providing nutritional support. Enteral feeding is a key component in the management of critically ill patients to tolerate feeding into the gastrointestinal tract. The reported benefits of enteral nutrition over parenteral nutrition include preservation of intestinal mucosa, optimal nutrient utilization, safer administration, and reduced cost [1, 2].

Enteral feeding is a relatively safe procedure with limited complications that can usually be avoided or managed. These complications can be classified as primarily gastrointestinal, mechanical, metabolic, and infectious categories. The most serious of these complications is pulmonary aspiration, which can be fatal. Critically ill patients are vulnerable to aspiration because of decreased level of consciousness, altered gastrointestinal motility, slower gastric emptying, and presence of artificial airways [3, 4].

Pulmonary aspiration can be defined as inhalation of oropharyngeal or gastric contents into the larynx and lower respiratory tract. Patients can aspirate oral secretions or refluxed stomach contents containing tube-fed formula[5]. Although aspiration of formula into the lungs is a less-often reported complication of enteral nutrition, it represents a significant hazard, because it may cause pneumonia or death. Conflicting reports exist about the frequency with which pulmonary aspiration occurs; it ranges from <1% to 40%. This wide range may be due to the lack of a set definition and clinically practical method of measuring aspiration[6].

Many patients aspirate without overt symptoms; detection is key to both prevention and treatment. It is vital for the nurses to determine if the patients are aspirating oral secretions or tube feedings[7]. Traditionally, this goal was accomplished by adding methylene blue dye to tube feedings and noting the color of expectorated or suctioned respiratory secretions. Recovery of blue-tinged tracheal secretions was considered as evidence of aspiration[8]. Appropriate enteral feeding is one of the most effective VAP preventative strategies that are widely applied by the critical care nurses. So, it is important to ensure that critical care nurses are involved in

developing and updating feeding guidelines based on the best of evidence [9,10].

The development and implementation of the Clinical Practice Guidelines (CPG) is the best way to improve the quality of care delivered to enterally fed patients and to guarantee the application of evidence based practice (EBP) [11]. It is also anticipated that the implemented guidelines will improve nursing practices regarding enterally fed patients, decrease complications associated with tube feeding and facilitate the utilization of collaborative approach for providing patient care. Therefore, this study was conducted to develop and implement nursing guidelines for patients undergoing tube feeding to minimize aspiration [12].

Aim of the study:

The aim of this study was to evaluate the effect of implementing nursing guidelines for tube feeding on the occurrence of aspiration among critically ill patients.

Research hypothesis:

Enterally fed patients using evidence based guidelines will reduce the occurrence of aspiration than those who are on the conventional feeding method.

2. Material and Methods

Materials:-

Research Design:

A quasi experimental research was utilized in this study.

Setting:

The study was conducted at the Surgical and Medical Intensive Care Unit in the Emergency Hospital at Mansoura University.

Subjects:

A convenient sample of sixty adult unconscious patients of both sex admitted to the previously mentioned setting was studied. The sixty patients were randomly classified into two main groups, group (A) the control group and group (B) the study group, each group consists of 30 patients. The control group received the conventional tube feeding. While, the study group received the tube feeding following the developed guidelines.

All patients in the study sample met the following criteria:

- Ages 18 years or more.
- All patients on enteral feeding through nasogastric tube.
- All patients were intubated.

Tools:

Data were collected using three tools in order to achieve the aim of the study.

Tool one: Pulmonary Aspiration Preventive Measures Checklist.

This tool was developed by the researcher after reviewing the related literature (6,12, 35,37,38) it includes patient assessment, checking for nasogastric tube placement, bowel sounds, gastric residual volume, endotracheal tube cuff pressure measurement, oral care and oropharyngeal suction and its frequency.

Tool two: Patient Assessment Sheet.

This tool was developed by the researcher after reviewing the related literature[6,12,29,30,35,37,39]. It includes the following parts:

Part I:-

This part includes demographic data, health relevant data, enteral nutrition data, position during and after feeding, airway parameters, gastrointestinal data.

Part II:-

This part includes manifestations of aspiration such as (tachycardia, fever, cough, tachypnea, cyanosis, crackles, rhonchi, wheezing, and frothy sputum), vital signs, tracheal suction schedule for detection of methylene blue dye aspiration at intervals of 2 hours, 4 hours, 6 hours after application of dye.

Tool three: Appraisal of Guidelines for Researcher and Evaluation "AGREE instrument"

It was adopted from AGREE collaboration and used to evaluate the developed guidelines by the nursing and medical specialist. The AGREE instrument consists of 23 key items organized in six domains. Each domain is intended to capture a separate dimension of guideline quality; each item is rated on a four point scale from "Strongly Agree" to "Strongly Disagree" with two mid points 3 "Agree" and 2 "Disagree".

Method:

An official approval for conducting the study was obtained from the responsible administrative personnel at Mansoura University Emergency Hospital. The tools were developed by the researcher after reviewing the related literature. The tools were submitted to a jury of 7 members who are experts in the critical care nursing field for its content validity. The validity for the various items varied between 80% &100%. A pilot study was carried out on 10 patients who met the predetermined

selection criteria to assess the clarity and feasibility of the tools, the necessary modifications were done. The methylene blue dye was prepared in Emergency Hospital laboratory. A 100 mg of methylene blue powder was added to 100 ml of distilled water to prepare 0.1% of methylene blue solution. The study was conducted over 1 year period extending from Febrarury 2010 to March 2011 in four phases: "Observational phase, Developing guidelines phase, Implementation phase and Evaluation phase".

Phase One "Observation phase" during this phase, the researcher observed the actual nursing practices for prevention of aspiration and conventional interventions for enterally fed patients for the control group. After observation of nursing practice the researcher observed patients for occurrence of aspiration in the control group through recording manifestations of aspiration and tracheal suction schedule for detection of methylene blue dye aspiration. The researcher added 2- 4 drops of 0.1% methylene blue food coloring dye to 250 ml of tube feeding formulas to achieve a visible blue color, the tracheal secretions were suctioned at intervals of 2 hours, 4 hours, and 6 hours after instillation of the dye. The tracheal secretions were collected in a transparent suction trap (after evacuation and cleansing it) and examined for blue discoloration; the patients were monitored for any manifestation of aspiration 2 hours, 4 hours, and 6 hours after instillation of the dye. Additionally, vital signs (temperature, pulse, respiration, blood pressure) were measured and recorded at 2 hours, 4 hours, 6 hours after instillation of the dye.

Phase Two "Developing Guideline phase" Tube feeding guidelines were developed by the researcher based on review of the related literature [12, 30,38,44]. This phase was accomplished through the following steps: determination of the need and scope of guidelines, establishment of a multidisciplinary guidelines development group, identification of guidelines purpose and target audience, identification of health outcomes, development of clinical questions, systematic searches and literature review, formulation of guidelines draft, finally revision and evaluation of guidelines using AGREE instrument **(tool III)**.

Phase three "Guideline Implementation Phase" the developed guidelines were implemented for the study group. The following steps were followed during its implementation:

- **Pre feeding step:** written physician order was obtained from responsible physician for amount and frequency of enteral feeding. Enteral feeding was administered by the bolus method using a Tommy syringe, the total amount of feeding was divided into 16 feedings per day from 9 am to 12 pm, with resting period of 8 hours from 12 pm to 8 am. The tube placement was confirmed before starting each feed, ETT cuff pressure was maintained at 30 cmH_2O by the cuff inflator device, also gastric residual volume was checked before each feeding for all patients in the study group.
- **Implementation step:** During this step physiological and psychological preparation of patients in the study group were done by the researcher, patients were positioned with head of bed (HOB) elevated to 30-45°, the researcher observed patients for occurrence of aspiration in the study group through recording manifestations of aspiration and tracheal suction schedule for detection of dye aspiration as in the control group.
- **Post feeding step:** All patients were maintained at HOB elevated 30-45° for 30 -60 minutes after feeding, patients were monitored for signs and symptoms of aspiration (tachycardia, fever, cough, tachypnea, cyanosis, crackles, rhonchi, wheezing, and frothy sputum) to detect aspiration.

Phase four: "Evaluation Phase" Comparison between the control and study group findings in relation to occurrence of pulmonary aspiration in order to test the effectiveness of implementing tube feeding guidelines.

3. Results:

This part presents study findings regarding the effect of implementing nursing guidelines for tube feeding on the occurrence of aspiration among critically ill patients. initially, the conventional method of enteral feeding and prevention of aspiration for the control group are described then the effect of implementing guidelines for prevention of pulmonary aspiration for study group are presented. The presentation also includes findings concerning manifestations of aspiration and factors affecting its occurrence. A comparison between the study group and control group findings regarding occurrence of pulmonary aspiration and other complications associated with tube feeding are demonstrated.

Table (1): Demonstrates the specific nursing practices for prevention of aspiration for enterally fed patients in the control group. It was found that the majority of nurses did not ***check NGT position*** before feeding. It was also observed that only 15.6% checked tube placement using air insufflation through the nasogastric tube, while 13.3% aspirated the gastric content, and none of critical care nurses measured nor recorded the length of tube. It can be

noted from the same table that none of critical care nurses have checked gastric residual volume before nasogastric tube feeding. On the other hand, the entire nurse flushed NGT with water after feeding.

Regarding ***ETT cuff pressure***, the results of the present study reveal that none of critical care nurses have checked endotracheal tube cuff pressure before nasogastric tube feeding. Concerning ***patient position***, it was observed that 86.7% of nurses kept HOB 30- 45 degree during feeding. However, only 28.9% of the nurses kept patients head in a neutral position (i.e. straight cervical).

As regards oral ***hygiene***, it was found that 73.3% of nurses performed mouth care once per day. In relation to ***oropharyngeal suction***, it was noted that 77.7% of nurses performed oropharyngeal suction when needed. Concerning turning of patient position, it was noted that 97.8% of nurses changed patient position and performed other nursing procedures at any time regardless of nasogastric tube feeding.

Table (1I): demonstrates the results of reviewers evaluation of tube feeding guidelines using ***AGREE*** instrument. Structure and content of the AGREE Instrument organized in six domains including: Scope and purpose, Stakeholder involvement, Rigour of development, Clarity and presentation, Applicability, and Educational independence. Regarding ***Scope and purpose***, ***Stakeholder Involvement***, ***Rigour of Development***, Clarity ***and Presentation***, ***Applicability and Editorial Independence***, the overall scores for this domain were 93%, 85.4%, 80.5%, 88.5%, 80.2% and 85.3% respectively. The overall scores indicate that the criteria for scope and purpose, stakeholder involvement, rigour of development, clarity and presentation, guidelines applicability and editorial independence were met.

The total grade of the developed tube feeding guidelines was 85.4%. All reviewers strongly recommend its application in clinical practice.

Table (III): presents patients demographic and health relevant data of both the control and study group. Sixty patients were included in the study. The ***age*** of the study sample ranged from (18 to 60) year, the mean age was 50.13 ± 16.90 and 50.70 ± 17.71 year for the control and study group respectively. In relation to ***sex***, the majority of patients in both groups were males. It represents 60% for the control and 73.3% for the study group.

As regards to current diagnosis, 36.7% and 46.7% of patients suffered from neurological disorders in the control group and study group respectively., On the other hand only 3.3% of patients in the study group had a respiratory disorder While none in the control group suffered from a respiratory disorder. Concerning past medical history, (46.7%) of patients in the control group suffered from hypertension likewise (33.3%) of patients from the study group.

In relation to ***GCS score***, the study findings reveals that the Mean±SD of Glasgow Coma Score was 6.43 ± 2.94 for the control is the difference to 7.40 ± 2.74 for the study group. The difference between the two groups (control & study) in relation to past medical history were not statistically significant P=(0.11) .

Table (IV): illustrates the incidence of pulmonary aspiration and other complications associated with enteral feeding for control and study group. It was observed that ***aspiration*** occurred after 2 hours of instillation of the methylene blue dye, aspiration was detected in 23.3% in the control group compared to 3.3% of the study group. The difference between the two groups (control & study) in relation to occurrence of aspiration is statistically significant (P=0.050). ***Tube displacement*** was identified in 23.3% of patients in the control group compared to 6.7% of patients in the study group but the difference between the two groups was not statistically significant P=(0.145). It was noted that 30% of patients in the control group had ***tube clogging*** compared to 13.3% of the study group. The differences between the two groups were not statistically significant.

Regarding to ***high residuals*** as one complication of enteral feeding, four patients (13.3%) in the study group suffered from high residuals compared to 63.3% of patients in the control group. Statistically the difference between the two groups is highly significant P=(0.00). It was observed that 46.7% of patients in the control group had ***vomiting*** during NGT feeding compared to 23.3% of the study group. The difference between the two groups is not statistically significant (P=0.103).

It can be noted from the same table that 60% of patients in the control group suffered from diarrhea compared to 26.7% of the study group. The difference between the two groups is statistically significant (P=0.018).

Table (V): reflects the relationship between aspiration and factors affecting its occurrence (age, GCS, posture, oral care, oropharyngeal suction, cuff pressure and gastric residual volume). It was found that 37.5% of the patients who experienced aspiration were between 45- 60 years old , It was also noted that half (50%) of the patients who experienced aspiration had a GCS (3-5). Concerning body position during and after feeding, it was observed that 37.5% of patients experienced aspiration when positioned flat. The difference was

statistically significant (P=0.01) (incidence of aspiration increased with supine position).

Concerning ***oral care*** as a factor affecting the occurrence of aspiration, it was found that 62.5% of aspirated patients did not receive any oral care compared to 55.8% of patients who did not experience aspiration inspite of being given oral care on a regular base namely twice daily. The difference between occurrence of aspiration and technique of oral care was statistically significant (P=0.002) . The occurrence of aspiration was inversely related to the oral care technique.

Oropharyngeal suctioning according to patients needs being considered as an important factor to minimize pulmonary aspiration among critically ill patients, it was found there was not a significant relation between oropharyngeal suctioning according to patients needs and occurrence of aspiration (P=0.16).

The current study findings also reveal that there is a significant relation between ETT cuff pressure and occurrence of aspiration (P=0.006) (incidence of aspiration increased with low cuff pressure). On the other hand, it was noted that the highest incidence (75%) of aspiration reported among patients who had high **gastric residual volume** (> 200 ML) followed by (25%) among patients who had normal gastric residual volume (≤150 ML).

Table (VI): shows the relation between occurrence of aspiration and appearance of its manifestations. The present study reveals that fever, cyanosis, cough and chest crepitation were found to be the most common reported manifestations of aspiration among the whole sample. It can be noted that there is a significant relation between the occurrence of aspiration and the appearance of its manifestation.

Table (I). Routine Nursing Practices for prevention of aspiration in enterally fed patients of the control group (N= 45)

Nursing practices	Done		Not done	
	No	%	No	%
Pre feeding phase				
• Assess tube placement				
▪ Auscultation of air insufflated through the tube	7.0	15.6	38.0	84.4
▪ Aspirate gastric content	6.0	13.3	39.0	86.7
• Check gastric residual volume	0.0	0.0	45.0	100.0
• Ensure appropriate ETT cuff pressure	0.0	0.0	45.0	100.0
• Perform mouth care	33.0	73.3	12.0	26.6
• Perform oropharyngeal suctioning	35	77.7	10	22.2
Implementation phase				
• Position patient in semi fowler during feeding	39.0	86.7	6.0	13.3
Post feeding phase				
• Maintain patient in semi Fowler position for 30-60 min after feeding	39.0	86.7	6.0	13.3
• Avoid nursing procedures such as suction, exercise, repositioning immediately after feeding	1.0	2.2	44.0	97.8

Table (II): Results of Reviewers Evaluation of Tube Feeding Guidelines Using AGREE instrument.

AGREE Domains	*Face validity (%)*
1. Scope and Purpose	**93%**
2. Stakeholder Involvement	**85.4%**
3. Rigour of Development	**80.5%**
4. Clarity and Presentation	**88.5%**
5. Applicability	**80.2%**
6. Editorial Independence	**85.3%**
Validity Index of Guidelines	**85.4%**
Overall Assessment	**95.8%**

Table (III): Demographic and Health Relevant Data of the Control and Study Groups

Characteristics	Groups				Test (p)
	Control n=30		Study n=30		
	No	(%)	No	(%)	

Age	18- <30	5	16.7	3	10.0	
30-<45		5	16.7	10	33.3	$X^2 = 2.41$
45-< 60		8	26.7	7	23.3	(0.49)
60+		12	40.0	10	33.3	
Age average Mean ± SD		50.13 ± 16.90		50.70 ± 17.71		T = 0.12 (0.90)
Gender:	Male					
Female		18	60.0	22	73.3	$X^2 = 1.200$
		12	40.0	8	26.7	(0.41)
Present Diagnosis:						
Respiratory disorder		0	0.0	1	3.3	
Neurological disorder		11	36.7	14	46.7	
Cardiovascular disorder		3	10.0	2	6.7	$X^2 = 5.22$
Renal disorder		0	0.0	2	6.6	(0.38)
Head or chest trauma		9	30.0	8	26.6	
others		7	23.3	3	10.0	
Past medical history:						
Cardiac disorder		6	20.0	5	16.7	
Respiratory disorder		0	0.0	1	3.3	
Neurological disorder		3	10.0	1	3.3	8.82 $X^2 =$
Renal disorder		0	0.0	1	3.3	0.11)(
Diabetes Mellitus		7	23.3	6	20.0	
Hypertension		14	46.7	10	33.3	
No past history		0	0.0	6	20.0	
GCS category:						
3-5		14	46.7	8	26.7	$X^2 = 3.43$
6-8		9	30.0	9	30.0	(0.17)
More than 8		7	23.3	13	43.3	
GCS average Mean ± SD		6.43 ± 2.94		7.40 ± 2.74		T = 1.31 (0.19)
Sedative drug use:						
No		2	80.0	25	83.3	$X^2 = .111$
Yes		6	20.0	5	16.7	(1.00)
Artificial airway:						
Endotracheal tube		27	3 90.0	27	90.0	$X^2 = 000$
Tracheostomy tube			10.0	3	10.0	(1.00)

Significant at P≤ 0.05

Table (IV): Incidence of Pulmonary Aspiration and Other Complications Associated with Enteral Feeding for Control and Study groups.

Groups	Control n=30		n=30 Study		Test
	No	%	No	%	
Pulmonary aspiration					
▪ Yes	7	23.3	1	3.3	$X^2 = 5.192$
▪ No	23	76.7	29	96.7	P = (0.050)*
Tube displacement					
▪ Yes	7	23.3	2	6.7	$X^2 = 3.268$
▪ No	23	76.7	28	93.3	P = (0.145)
Tube clogging					
▪ Yes	9	30.0	4	13.3	$X^2 = 2.455$
▪ No	21	70.0	26	86.7	P = (0.209)
High residuals					
▪ Yes	19	63.3	4	13.3	$X^2 = 15.864$
▪ No	11	36.7	26	86.7	P = (0.000)**
Vomiting					
▪ Yes	14	46.7	7	23.3	$X^2 = 3.590$
▪ No	16	53.3	23	76.7	P = (0.103)
Diarrhea					
▪ Yes	18	60.0	8	26.7	$X^2 = 6.787$
▪ No	12	40.0	22	73.3	P = (0.018)*

Significant at p ≤ 0.05

Table (V): Relation between Aspiration and Factors Affecting its Occurrence among the whole sample N = (60).

Parameters	Aspiration				Test
	Occur n=(8)		Not occur n=(52)		
	No	%	No	%	
Age					
▪ 18- 29	2	25.0	6	11.5	X^2= 1.695
▪ 30-44	1	12.5	14	26.9	P = (0.638)
▪ 45-59	3	37.5	16	30.8	
▪ ≥ 60	2	25.0	16	30.8	
GCS					
▪ 3-5	4	50.0	18	34.6	X^2= 1.823
▪ 6-8	3	37.5	15	28.8	0.402)(P =
▪ More than 8	1	12.5	19	36.5	
Position during feeding					
▪ Semi fowler	5	62.5	50	96.2	X^2= 10.280
▪ Flat	3	37.5	2	3.8	P = (0.014)*
Position after feeding within one hour					
▪ Semi fowler	5	62.5	50	96.2	X^2= 10.280
▪ Flat	3	37.5	2	3.8	P = (0.014)*
Oral care					
▪ No	5	62.5	6	11.5	X^2= 12.547
▪ Once	2	25.0	17	32.7	P = (0.002)**
▪ Twice	1	12.5	29	55.8	
Cuff pressure					
▪ (30 cmH_2O)	1	12.5	30	57.7	X^2= 10.323
▪ (< 30 cmH_2O)	7	87.5	1	12.5	P =(0.006)**
▪ (> 30 cmH_2O)	0	0.0	7	13.5	
Gastric residual volume					
▪ (≤150 ML)	2	25.0	38	73.1	X^2= 7.212
▪ (> 200 ML)	6	75.0	14	26.9	P = (0.013)

Table (VI): Correlation between occurrence of aspiration and appearance of its manifestations among the whole sample N = (60).

Manifestations	Aspiration				Test
	Not occur n=(52)		Occur n=(8)		
	No	%	No	%	
Fever					X^2=4.97
▪ Yes	31	59.6	8	100.0	P = (0.025)*
▪ No	21	40.4	0	0.0	
Cyanosis					X^2=27.692
▪ Yes	7	13.5	8	100.0	P = (0.000)**
▪ No	45	86.5	0	0.0	
Chest Crepitation					X^2=6.737
▪ Yes	20	38.5	7	87.5	P = (0.009)**
▪ No	32	61.5	1	12.5	
Wheezes					X^2=4.366
▪ Yes	9	17.3	4	50.0	P = (0.037)*
▪ No	43	82.7	4	50.0	
Cough					X^2=27.692
▪ Yes	7	13.5	8	100.0	P = (0.000)**
▪ No	45	86.5	0	0.0	
Frothy sputum					
▪ Yes	48	92.3	6	75.0	X^2=2.308
▪ No	4	7.7	2	25.0	P = (0.129)

4. Discussion

Enteral feeding (EF) is one of the most frequently used nursing practices for critically ill patients to maintain or improve the nutritional status. Enteral feeding is more physiological, less costly and easier to administer than parenteral feeding. It also maintains a normal intestinal mucosa reduces the hazard of bacteria and toxins crossing the GIT wall.

Moreover, EF was associated with improved clinical outcomes which include a significant reduction in morbidity and ICU length of stay [13]. As with most therapies, EF has associated risks. The most serious potential complication is tracheobronchial aspiration of gastric contents [47]. Aspiration of gastric contents has been recognized as an important factor of morbidity and mortality in critically ill patients. Thus, it is reasonable to assume that strategies to prevent aspiration also may reduce aspiration related pneumonia [14,38].

The current study revealed unsatisfactory nursing practices regarding prevention of aspiration and enteral feeding management in the intended ICUs. This may be due to shortage of nursing staff to provide high quality nursing care for critically ill patients. The ratio of critical care nursing staff to patients in the intended ICUs was 1: 2 throughout the three shifts. The nursing practice was based primarily on individual past experience and tradition, with senior nurses teaching procedures to the junior nurses. Evidence-based nursing practice was not the standard for care. Therefore, the unsatisfactory practices predispose the patient to numerous complications. Systematic review provided clear evidence of an association between the numbers of registered nurses and patient outcomes in acute care settings [15]. Several studies concluded that each additional registered nurse per patient per day was associated with a 4% decrease in the number of deaths [16, 17,36].

The status of feeding tube placement is obviously a safety concern for aspiration. The results of the present study demonstrated that the majority of nursing staff did not check NGT position before feeding by any method in the intended ICUs. The importance of checking tube placement in prevention of aspiration highlighted by **Persenius *et al.*,** [18] **and Metheny,** [38]**,** who reported that clinicians should be encouraged to monitor the position of feeding tubes more closely during feedings and must ensure that the tube remains in the desired gastrointestinal site (either the stomach or the small bowel) during feedings. Also, the Center for Disease Control and Prevention recommends routine verification of appropriate feeding tube placement to prevent aspiration [48]. The confirmation of nasal feeding tubes placement by air insufflation with auscultation over the epigastric area is not the best practice in ICUs and found no evidence to support alternate methods of confirming feeding tube placement other than abdominal X-ray [38].

The current study also revealed that the majority of nursing staff did not measure ***ETT cuff pressure*** by an objective means; this may be due to unavailability of cuff inflator device in the intended ICUs. These results are in agreement with **Vyas *et al.*,** [19], **Othman,** [29]**.** They documented that cuff pressure was not measured regularly in the majority of intensive care unit, they suggested that cuff pressure in the critical care settings should be measured regularly and with any change in patient position or ventilation.

Measurement of ***Gastric residual volume*** (***GRV***) is one technique used to prevent aspiration, it should be measured at a 4 hour interval and the feeding policy must be reviewed if the volume exceeds 200 mL to determine which patients are at greatest risk for aspiration [19]. During the present study it was noted that the majority of nursing staff did not check GRV. This may be attributed to lack of awareness of the importance of this procedure, lack of time because the critical care nurses may be responsible for many nursing procedures for more than one patient at the same time, and lack of guidelines or feeding protocols in the intended ICUs. This result is consistent with those results of **Mentec and his associates,** [20] who showed that the majority of ICU nurses never checked GRV before every enteral feeding. In another study done by **Bankhead *et al.*,** [46]**,** reported that the practice of measuring GRV is poorly defined, and who attributed that the standardization of how to measure GRVs, when to measure them and definition of a high GRV remains controversial and confusing to clinicians.

Concerning ***patient's position*** as a factor for reduction of the possibility of pulmonary aspiration during enteral feeding, the current study demonstrated that the majority of critical nurses maintained HOB elevation of at least 30-45° during enteral feeding which highlights that all nurses' take into account patient's position in the intended ICU. This may be attributed to the hospital policy and ICU authority orders by the head of the department of the ICU that all critically ill patients must be taken care in high Fowler's position. However, during the current study the nursing staff disregarded the timing of turning the patients and changed position irrespective of the time of nasogastric feeding. The results of the present study are in accordance with the results reported by **Dillon *et al.* (2002)** [22] and **Othman (2004)** [29] who found that nurses are accurate in estimating backrest elevation. Recently it was recommended by **Kenny and Goodman,**[40] in the evidence based practice protocols for enteral tube feeding that head of patients' beds should be maintained at 30- 45°at all times during feeding and for 30 to 60 minutes after feeding.

In response to performance gaps and high variance in procedures related to management of enteral tube feedings indicated lack of standardization and use of evidence for performance

of efficient and effective patient procedures. The researcher planned to optimize enteral nutrition in acutely ill patients to minimize aspiration by using an evidence-based, standardized approach of enteral feeding.

Numerous studies documented that use of enteral feeding guidelines and protocols have been advocated as effective and efficient methods for providing nutritional support ,decrease the risk of aspiration and its attendant morbidity and mortality in critically ill mechanically ventilated patients [12,33,34,38,41,42,44,46]. Furthermore, standardization of patient management through the use of guidelines is increasingly being adopted as a means to improve quality of care and enhanced patient outcomes

The current guidelines were developed by multidisciplinary group involved member from different disciplines, critical care nursing, critical care medicine, academic and intensive care clinicians, to provide adequate care for critically ill patients. The reviewers evaluation of the present guidelines was based on the application of ***AGREE*** instrument [23] which provides an assessment of the predicted validity and reliability of the guidelines. The results of reviewers' evaluation of the developed guidelines demonstrated that 85.4% of tube feeding guidelines criteria were met and they are strongly agreeing its application in clinical area.

In the present study, most patients characteristics in both groups (age, sex, GCS, present diagnosis, past medical history, type of artificial airway, sedative drug use) were almost equally distributed and no significant differences were found between them. In regard to **sex**, the findings of the present study showed that more than half of the sample was males in both groups this is in line with **Metheny *et al.,*** [21] study which revealed that the number of male patients is than higher than female patients because the study site is in the emergency and trauma center.

Concerning ***factors affecting occurrence of aspiration***, the result of the current study revealed that a significant relation between the ***level of consciousness*** and occurrence of aspiration. The occurrence of aspiration increased with decreased level of consciousness. It is not surprising that a low level of consciousness increases the risk for aspiration, because low levels of consciousness interfere with patients' ability to protect the airway from regurgitated gastric contents.

In relation to ETT ***cuff pressure*** as a factor affecting occurrence of aspiration, it is noted from the current study findings that the occurrence of pulmonary aspiration increased with low ETT cuff pressure. Thus, maintaining ETT cuff pressure is an important factor in the prevention of tracheal leakage around ETT cuff and subsequently minimizes tracheal aspiration of gastric contents and oropharyngeal secretions. Moreover, the occurrence of aspiration was higher in the control group than in the study group. This is because the low cuff pressure was observed among patients in the control group it reached to in some patients to (<10 cmH_2O). The findings of the present study are in accordance with the results reported by **Othman,**[29] who reported that incidence of aspiration decreased by increasing ETT cuff pressure and low cuff pressure exposes patients to the risk of aspiration suggesting that controlling intra-cuff pressure could minimize occurrence of aspiration.

In relation to ***subglottic suction*** as a factor affecting occurrence of aspiration it was found during the current study that there was a significant relation between oropharyngeal suctioning and occurrence of aspiration. This result is in agreement with the results of **Othman,** [30] who highlighted the importance of continuous subglottic secretions suctioning in reducing occurrence of aspiration in critically ill patients in ICUs[30].

Concerning ***gastric residual volume***, high GRVs have an independent effect on risk for aspiration when entwined with other known risk factors. The results of the current study indicated that high GRVs have been identified as a factor related to occurrence of aspiration in enterally fed critically ill patients. One clinical study found that GRV ≥ 200 -250 mL was a more realistic volume to increase aspiration risk and for cessation of feedings in patients fed into the stomach [21]. Considerable controversy and variations in practices exit with regard to what volume represents a clinically relevant risk for aspiration[31]. Furthermore, research of the association between occurrence of aspiration and GRV has 2 problems: (a) use of unreliable methods to detect aspiration and (b) inaccurate measurement of GRVs. On the other hand, **Bankhead *et al.,*** [46] **and Metheny *et al.,*** [21] found that no direct relationship between aspiration and GRVs that is, patients aspirated even when high GRVs were absent.

In relation to ***complications associated with enteral feeding***, the findings of the current study demonstrated that the frequency of aspiration differed between the control and study group. It can be noted that the incidence of aspiration is lower in the study group than in the control group due to absence of standardized criteria for caring of critically ill tube fed patients for prevention of aspiration in the control group. Several studies have shown the benefits of simple nursing measures to decrease aspiration risks and improve patient outcomes[27,29,32,35]. In the current study, pulmonary

aspiration was detected by methylene blue dye that is based on the assumption that addition of blue food coloring or dye to the feeding formula helps the bedside clinician visualize aspiration events, which appeared during suctioning of the endotracheal tube. Several studies documented that the incidence of aspiration ranges from <1% to 40%. This wide range can be explained by many factors as the difference in clinical method used to detect aspiration and patients group studied [29,33].

As regard to ***manifestations of aspiration,*** , the results of the current study revealed that fever, cyanosis, and chest crepitation were the most common followed by wheezes and cough that were manifested within 6 hours of instillation of dye in the majority of patients. Similar results were reported by **Rawlinson & Minchom,** [27], **Othman,** [29] who attributed that tachycardia, tachypnea and cyanosis detected in 80% of the aspirated patients. During the present study, it was observed that the majority of the study sample had fever from the beginning of the study and increased after aspiration. Fever may be due to aspiration itself or may be due to other infectious factors and may also be related to medical diagnosis of neurological disorder and head trauma which affect body temperature regulator center in the brain[27,29].

Although it is improbable that a tube can become displaced into the respiratory tract after being correctly positioned as a complication of enteral feeding which increases risk of aspiration. The findings of the present study revealed that ***feeding tube displacement*** happened among intubated patients in the control higher than study group when replacing endotracheal tube and after pulling of the tube by agitated patients**.** Also ***feeding tube displacement*** occurred during changing patients position or due to loss of the securing device. In a study by **Kesek *et al.,*** [48] twenty-eight of 73 patients had displaced nasogastric tubes. A tube may be pulled out by a confused patient, or it may be accidentally displaced during the delivery of care or during movement in bed.

Another common complications associated with enteral feeding showed in the current study was ***vomiting***. Patients in the control group suffered from vomiting more than patients in the study group. This may be attributed to the rapid rate of infusion, effect of medication, and patients position after feeding also delayed gastric emptying, diabetes, neurological dysfunction, or improper tube placement. This justification is consistent with **EL-Baz,**[1] who reported that the increased rate and pressure during gastric feeding causes nausea, distension and vomiting. Additionally, the latter findings recommended that the prevention of these problems includes assessing the medication list for drugs that contribute to these symptoms then eliminating or changing them, whenever possible. Checking and documenting residual volumes are essential reducing the rate of feeding and administer a prokinetic agents can alleviate the intolerance.

Diarrhea is a common GIT complication in critically ill patients receiving EF. The occurrence and frequency of diarrhea among patients in the control group was higher than of the study group. This results was in agreement with **EL-Baz,** [1] who reported that diarrhea had occurred in more than half of the studied sample which may be due to contamination of feeding formula during the process of preparation, packaging, or transfer, in addition to receiving antibiotics parenterally. Common nursing intervention to decrease the occurrence of diarrhea; is to take all precautions such as evaluating the feeding formula, infusion rate, also assess the tube position, document volume, frequency, consistency, and daily intake and output. Strict clean technique must be followed in handling, delivering and storage formula. Finally, in the light of this finding it would be preferred to use antidiarrheal agents after ruling out intestinal infections as after consulting the treating physician.

This study is relevant to evidence based practice in critical care settings. Also, use of tube feeding guidelines increases nutritional intake in critically ill patients and contribute to positive outcomes for patients. The developed tube feeding guidelines and aspiration risk reduction algorithm achieved its goal of improvement in key areas of interest, decrease rate of occurrence of aspiration and other complications associated with tube feeding.

Conclusion

According to the results of the present study, it can be concluded that the majority of critical care nurses in the intended ICU did not apply the most recommended nursing practices to minimize aspiration among critically ill patients. On the contrary, the implementation of tube feeding guidelines developed in the present study was safe and promoted patients outcomes. The study findings revealed that implementations of the enteral feeding guidelines and aspiration risk reduction algorithm achieved its goal of improvement and decrease in incidence of aspiration and other complications compared to patients who received the conventional unit care.

Recommendations

Based on the results of the present study the following recommendations are suggested:-

1. The critical care mangers should establish unit policy to incorporate tube feeding guidelines in clinical practice as a routine of unit care.
2. Establishing team in clinical area to be responsible for the implementation of tube feeding guidelines.
3. Tube feeding algorithm should be employed in clinical practices as a routine of ICU.
4. Maintain head of bed elevated 30 – 45° to reduce risk of pulmonary aspiration during EF and for 30 -60 minutes after feeding.
5. Gastric residual volumes should be checked regularly before each feeding.
6. Oral hygiene should be applied at least every 12 hours and subglottic secretions should be suctioned every 3 hrs according to patients needs.
7. Feeding tube placement should be reassessed periodically by checking the mark to make sure the tube hasn't shifted.

Further Research:

- More researches are needed to determine the best delivery methods and feeding sites for specific types of tube-fed patients to prevent, or at least minimize aspiration.
- Studies are needed to evaluate nursing performance and the degree of compliance with the proposed tube feeding guidelines.
- Prospective studies to evaluate the effect of different GRV threshold values on protection against aspiration and on clinical outcomes are needed.
- Additional research is needed to determine the best methods used to detect pulmonary aspiration and compare clinical outcomes.

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