

Complications Developing in Intensive Care Patients Receiving Enteral Feeding and Nursing Interventions

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ABSTRACT

Objective: The objectives of this study were to investigate the complications seen in intensive care patients being fed enterally, and possible nursing interventions aimed at preventing such complications.

Materials and Methods: The study was designed as a descriptive study model. The study sample included 52 patients who were fed enterally during treatment. A three-part data collection form was used for the collection of study data. The first section was aimed at garnering patient information, the second section gathered data on the enteral feeding method and any complications that developed, and the third section detailed the nursing interventions applied in the unit.

Results: Of the total, 88.4% of the patients underwent post-pyloric feeding. No increase was seen in the monitored gastric residual volume, and no vomiting, aspiration or tube blockage was noted. The interventions made by the nurses included the monitoring of gastric residual volume, vital indicators, amount of liquid intake and discharge, dehydration indicators and electrolyte values, as well as the replacement of feeding bags once every 24 hours, monitoring of blood glucose levels and regulation of the bed-head at 30–45 degrees for all patients.

Conclusion: It was found in the study that nurses routinely applied such interventions as the monitoring of gastric residual volume, regulation of the bed head at 30–45 degrees, or to monitor any complications that may occur. In contrast, it was found that the nurses did not apply such actual nonpharmacological interventions as abdominal massage and exercise.

Keywords: Complication, enteral feeding, intensive care unit, nursing

INTRODUCTION

In cases where oral feeding is not possible, enteral feeding is preferred in patients treated in intensive care units (1). Current manuals recommend that enteral feeding should be initiated within 24-48 hours of unsatisfactory oral food intake in patients referred to the intensive care unit (2). There are many complications associated with enteral feeding that can lead to an interruption of feeding (3), including gastrointestinal disorders, such as diarrhoea, nausea and vomiting, mechanical problems of aspiration or tube blockage, problems associated with fluid-electrolyte balance and metabolic complications such as hyperglycaemia (4,5) The main gastrointestinal complications, known collectively as intolerances, are abdominal distension, vomiting, diarrhoea and an increase in gastric residual volume (GRV), all of which can lead to an interruption in enteral feeding (3,6). Intolerances in this sense tend to emerge three

days after the start of enteral feeding, leading to nutritional deficiencies (6). A study involving patients being fed enterally found that intolerance developed in 33% of the total, and at significantly higher rates in patients treated in the intensive care unit (7). In a study investigating digestive system dysfunctions, risk factors and complications in intensive care patients fed by way of enteral nutrition showed that diarrhoea and vomiting developed in 26% and 19% of the patients, respectively (8). In a similar study, Pancorbo-Hidalgo and colleagues (9) reported that besides diarrhoea (32.8%) and vomiting (20.4%), there were other complications connected to enteral feeding, such as dislocation of tubes (48.5%) and aspiration issues (3.1%). Another study examining drug-food interactions in intensive care patients receiving enteral feeding noted the development of hyperkalaemia (12%), hyponatremia (8%) and hyperglycaemia (32%) in the study sample (10).

There have been several studies investigating the complications that develop in connection to enteral feeding in intensive care patients (3, 6, 8, 9) although there have been only limited studies focusing specifically on nursing interventions aimed at preventing and managing such complications (11,12). This study examines complications in intensive care patients undergoing enteral feeding, and provides insight into the nursing interventions that are applied to prevent such complications. The study further identifies the strengths and weaknesses in nursing interventions, providing data for inclusion in current manuals and contributing to randomised controlled studies.

MATERIAL and METHODS

Design

The study was designed as a descriptive study model and conducted between April 2016 and April 2017

Participants

This study was conducted in the adult medical intensive care unit of a university hospital in Turkey and involved 52 patients being fed enterally.

Data Collection

The data was collected using a questionnaire developed by the researchers that had been created based on the findings of previous studies (3, 7, 13, 14, 15) and comprising three sections. The first section garnered data about the patients, such as age, gender, diseases and date of hospitalization; the second section documented the enteral feeding methods and the complications that were likely to develop; and the third section detailed the nursing interventions applied in the unit. The forms were filled in by the researchers who visited the patients between the hours of 08:00 and 16:00, during which patient records were examined and the abdominal circumference of patients was measured. As gastrointestinal symptoms arising from enteral feeding can emerge within a few hours, or in some cases, 72 hours after the onset of feeding, the patients included in the study were monitored for at least three days, and at most, seven days.

Ethical Considerations

Ethical approval was obtained from the Ethical Committee for Clinical Studies of a university and prior to starting the study, written approval was obtained from the Office of the Head Physician of the hospital and also from the participating patients and their relatives.

Data Analysis

Statistical analyses were performed using IBM SPSS (Statistical Package for Social Sciences) statistical program version 21.0. Continuous variables were stated as mean \pm standard deviation (SD), and categorical variables as number (n) and percentage (%). Chi-square, Fisher's Exact Chi-square and Friedman Variance Analyses were made of the associative groups. The significance level of the statistical comparison tests was $p < 0.05$.

RESULTS

The mean age of the patients, of whom 59.6% were male, was 68.08 ± 13.3 , and 44.4% were hospitalized for a disorder arising from the respiratory tract. Table 1 below shows that while 57.8% of the patients had a Glasgow coma score (GKS) of between 8 and 12 (precoma), 25% had a Ramsey sedation scale value of 4 (distinct response to a light touch of the glabella or loud audio stimulus). The findings concerning the feeding of the patients indicate that 88.4% were fed through postpyloric feeding, with an average feeding speed of 46.76 ± 7.24 ml/h and an average daily calorie amount of 1086.61 ± 426.65 . Only 38.5% of the patients monitored during the administration of the study continued to receive enteral feeding for seven days (Table 1).

The complications that developed in the patients were categorized into those arising from the gastrointestinal system, those from metabolic complications and those from mechanic complications. Among the complications resulting from the gastrointestinal system, the patients most frequently experienced diarrhoea (44.2%) and abdominal distension (28.8%). Vomiting, on the other hand, was the complication that was least frequently experienced among these patients (1.9%), and no aspiration was reported. The abdominal circumference of the patients was measured throughout the monitoring period, and was found to increase in parallel to the duration of the feeding time in days ($\chi^2=22.108$, $p=0.001$). Metabolic complications included hypoalbuminemia

Table 1. Clinical Information about Patients

Information	n	%
Mean age (Mean \pm SD; min-max)		68.08 \pm 13.3 Min:30, Max:99
Diagnosis leading to hospitalisation*		
Disorders of the respiratory system	28	44.4
Cardiovascular disorders	18	30.1
GIS disorders	6	9.6
Glasgow Coma Score		
13-15 (Conscious)	11	21.1
8-12 (Precoma)	30	57.8
8 and below (Coma)	11	21.1
Ramsey Sedation Scale Score		
1 (Anxious and agitated or uneasy of both)	5	9.6
2 (Cooperative, oriented and calm)	3	5.8
3 (Just obeys orders)	12	23.1
4 (Distinct response to a light touch on the glabella or loud audio stimulus)	13	25.0
5 (Slight response to light touch on the glabella or loud audio stimulus)	9	17.3
6 (No response to a light touch on the glabella or a loud audio stimulus)	10	19.2
Mean Feeding Speed per Hour (Mean \pm SD; min-max)		46.76 \pm 7.24 Min:34.29 ml/h, Max:70.0 ml/h
Mean Daily Calorie Amount (Mean \pm SD; min-max)		1086.61 \pm 426.65 kcal/day Min:86 kcal/day Max:1780 kcal/day
Placement of the feeding tube		
Prepyloric	6	11.6
Postpyloric	46	88.4

* The most common three diagnosis leading to hospitalization

Table 2. Complications Developed in Patients

Complications	n	%
Complications arising from gastrointestinal system		
Diarrhoea	23	44.2
Abdominal distension	15	28.8
Constipation	9	17.3
Gastric residual volume increase	7	13.4
Vomiting	1	1.9
Metabolic complications		
Hyponatremia	16	30.8
Hypernatremia	12	23.1
Hypokalemia	22	42.3
Hyperkalemia	4	7.7
Hypoalbuminemia	50	96.2
Hyperglycaemia	24	46.2
Hypoglycaemia	5	9.6
Mechanical complications		
Dislocation of the tube	4	7.7

(96.2%), hypokalemia (42.3%) and hyponatremia (30.8%). Hyperglycaemia was diagnosed in 46.2% of the patients being fed enterally, and the most frequent mechanical complication was the dislocation of the tube (7.7%) (Table 2).

The study identified a significant relationship between the age and Ramsey scores of the patients, and complications related to the gastro-intestinal system (GIS) ($p < 0.05$), indicating that patients over the age of 65 years and with a Ramsey score of over 3 are at greater risk of GIS complication development. No significant relationship as noted between gender, body mass index (BMI) and Glasgow Coma Scale (GCS) values, and GIS, metabolic and mechanical complications. Although no significant difference was identified between the location of the feeding tube and the probability of development of complications (Table 3).

The interventions made by the nurses included the monitoring of gastric residual volume, vital indicators, amount of fluid intake and discharge, dehydration indicators and electrolyte values, as well as the replacement of feeding bags once every 24 hours, monitoring of

Table 4. Nursing Care Interventions undertaken in patients against Gastrointestinal, Metabolic and Mechanical Complications

Interventions	n	%
Interventions against complications resulting from gastrointestinal system		
Monitoring the gastric residual volume	52	100
Monitoring the fluid taken in and discharged	52	100
Regulating the head of bed level at 30-45 degrees	52	100
Monitoring of defecation	52	100
Pharmacological approaches (Antiemetic application application of enema/laxatives etc.)	10	19.2
Taking stool sample	9	17.3
Reducing the feeding speed	5	9.6
Changing the nutritional substance	4	7.9
Interventions in connection with metabolic complications		
Monitoring the electrolyte values	52	100
Monitoring the dehydration indicators	52	100
Monitoring the vital indicators	52	100
Monitoring the blood sugar	40	77
Electrolyte replacement	40	77
Increasing the feeding speed	27	52
Regulating the insulin dosage		
Interventions against mechanical complications		
Replacement of feeding bags once every 24 hours	52	100
Washing the tube with water	52	100
Interrupting the feeding	33	63.5
Replacing the tube	3	5.8.

the blood glucose levels and regulation of the head of bed at 30–45 degrees for all patients. Other interventions included electrolyte replacement and increased feeding speed (77%), interruption of feeding (63.5%) and regulation of insulin dosages (52%) (Table 4).

DISCUSSION

Numerous interventions are undertaken to prevent enteral feeding-related complications that fall under the responsibility of intensive care nurses. The results of the present study indicate that it is gastrointestinal and metabolic complications that generally occur in association with enteral feeding.

Table 3. Development of Complications by Patients' Informations (n=52)

Information	GIS Complication			Metabolic Complication			Mechanical Complication		
	Developed	Not Developed	P	Developed	Not Developed	P	Developed	Not Developed	P
Gender									
Women	16 (30.7%)	5 (9.6%)	P=0.70	20 (38.5%)	1 (1.9%)	P=0.40	2(3.8%)	19 (36.5%)	P=1.00
Men	25 (48.1)	6 (11.6%)		31(59.6%)	0(0%)		2(3.8%)	29(55.9%)	
Age									
Below 65	18 (34.6%)	1 (1.9%)	P=0.040	19 (36.5%)	0(0%)	P=1.00	0(0%)	19 (36.5%)	P=2.84
65 and over	23 (44.2)	10 (19.3%)		32(61.5%)	1(1.9%)		4(7.7%)	29(55.9%)	
Ramsey Score									
3 and below	8 (15.4%)	12 (23.1%)	P=0.038	19 (36.5%)	1(1.9%)	P=1.00	1(1.9%)	19 (36.5%)	P=1.80
3 and over	23 (44.2%)	9 (17.3%)		32(61.5%)	0(0%)		3(5.8%)	29(55.9%)	
GCS Score									
GCS>8	31 (59.7%)	10 (19.2%)	P=0.50	40 (76.9%)	1(1.9%)	P=0.40	2(3.8%)	39 (75%)	P=1.00
GCS≤8	10 (19.2%)	1 (1.9%)		11(21.2%)	0(0%)		2(3.8%)	9(17.4%)	

GIS: Gastrointestinal System

GCS: Glasgow Coma Scale

In the present study, the most frequent gastrointestinal complications seen in the patients were diarrhoea (44.2%) and abdominal distension (28.8%). Diarrhoea is the most prevalent complication that occur in association with enteral feeding (4). Prieto and colleagues (16) reports that its incidence rate varies between 5 and 64%. Diarrhoea seen in patients fed through enteral nutrition do possibly develop in interrelation with different variables such as current diseases, current medication content of the nutritional solutions, hydration level, patients' condition in respect of mobilisation, in-bed exercises or passive exercises, nutrition, intestinal peristalsis and age.

In our study during the monitoring period, abdominal distension occurred in 28.8% of the patients. The distension of the abdomen increased in parallel to the length of the feeding period ($\chi^2=22.108$, $p=0.001$). Another study performed with patients receiving enteral feeding in an intensive care unit found that 14.4% of the patients had the complication of distended abdomen (17). Abdominal distension can develop depending on various reasons such as the density and temperature of the feeding solution delivered, its fat content and the drugs used by the patient. It is, however, of essential importance to deliver the nutrition in an appropriate speed to prevent distension (14). Another problem seen in 30-51% of the patients fed through enteral way is gastric residual volume (GRV). In our study, 13.4% of the patients had a higher GRV. A study investigating the effects of abdominal massage on patients fed enterally at intervals demonstrated that while 8% of the patients to whom abdominal massage was applied had high GRV, the same rate was found to be 34% in patients not treated with abdominal massage (3). The patients in the present study had a lower GRV than those in previous studies, which can be attributed to the interventional procedures adopted in the intensive care unit in the present study where enteral feeding is started at a lower speed in the initial phase and accelerated in accordance with the GRV values recorded over time, with feeding interrupted as necessary.

The laboratory results of metabolic complication tests revealed that almost all of the patients had an electrolyte imbalance and hypoalbuminemia. Hypercatabolism developing in intensive care patients may lead to changes in their laboratory values (18). The reason for the electrolyte and albumin imbalances observed in the present study can, therefore, not be entirely attributed to enteral feeding. In addition, more than half of the patients (66.2%) had hyperglycaemia, and to bring hyperglycaemia under control, it is important to monitor patients' calorie intake, to re-structure their insulin doses, to monitor blood glucose levels and to deliver the appropriate nutritional solutions (19). In the present study, the blood sugar level of all patients was monitored, and insulin treatment was administered when necessary under the direction of the responsible physician. Previous studies have shown that the mechanical complications that occur in 2-10% of patients during enteral feeding include pulmonary aspiration, dislocation or obstruction of the feeding tube or placement in the tracheae, and perforation or intestinal obstruction (14). In the present study, tube dislocation occurred in 7.7% of the patients, which can be attributed to factors such as the patient's state of consciousness, and the fixing and maintenance of the tube, mirroring the findings of previous researches.

The study identified a significant difference between patients over 65 years of age and those with a sedation scale score of over 3, and the probable development of a GIS complication ($p<0.05$). In contrast, Metin and Özdemir (14) demonstrated that no significant difference existed between the age of patients and the probable development of complications resulting from enteral feeding. Pinilla and colleagues (20) showed, that the demographic features of patients had no effect on incidences of complications arising from enteral feeding. Old age brings some changes to the gastrointestinal system, such as a decline in gastric acid secretion, a slowing of intestinal movements and a slower food passage through the intestines (21). The results of the present study suggest in this respect that the patients over the age of 65 years suffered more GIT, metabolic and mechanical complications. At the same time, a Ramsey score of over 3 suggests that patients show a weaker response to stimuli and are not fully conscious, which is a condition that may increase the risk of the development of a GIT complication, particularly aspiration.

The knowledge of enteral feeding practices among nurses, and the prevention of complications through appropriate nursing interventions undertaken on the basis of current evidence are aimed at lowering hospitalization times and improving the quality of life of the patient (22). Designing a bedside protocol, which is a practice undertaken in recent years by nurses to support the enteral feeding process, is also recommended. Through the application of such protocols, feeding can be initiated relatively faster, leading, consequently, to a higher calorie intake, lower infection rates, shorter hospitalization times and lower mortality rates. Such protocols come with another positive effect, in that they motivate nurses to take an active role in the care of patients being fed enterally (23). In the present study, the nurses made the following interventions in all the patients: monitoring of GRV, monitoring fluid intake and discharge, replacement of feeding bags once every 24 hours, interruptions to feeding, reductions in feeding speeds, monitoring defecation frequency and form, monitoring blood glucose and electrolyte balance, and ensuring the level of the head of bed is always set at 30–45 degrees. Koçhan and Akın (22) found that nurses had a medium level of knowledge about enteral feeding practices, and that they needed to be supported during the assessment of GRV. A higher GRV delays gastric discharge and increases the risk of intolerance, regurgitation and aspiration, and this led a previous research to recommend that nurses monitor abdominal distension, evaluate gastrointestinal function by listening to bowel sounds and control GRV levels so as to reduce the risk and intensity of aspiration (24). However, in publications on enteral feeding appeared in recent years, and several studies have reported that monitoring GRV cannot be used to identify enteral feeding intolerance, and to show that no relationship exists between GRV and gastric discharge. Nowadays, GRV monitoring is being suggested as an inappropriate means of determining GIT intolerance (23). Another result of the present study was that none of the patients received abdominal massages and no in-bed exercises were conducted. There have been many studies reporting the use of abdominal massage to improve digestive functions (25, 26, 27). Abdominal massage reduces vomiting and distension, and improves defecation patterns (26). A study undertaken by Momenfar and colleagues (28) involving intensive care patients and investigating the effect

of abdominal massage on GRV concluded that GRV levels were reduced. In a study carried out by Uysal (3) involving patients being fed at intervals enterally also found that abdominal massage reduced GRV, vomiting and abdominal distension. Early exercise/mobilization plays an important role in intensive care units due to the positive effect on general health. In recent years there have been several studies investigating the effects of early-stage exercise/mobilization in intensive care patients (29, 30). In a study of intensive care patients with reduced intestinal motility who had undergone cardiovascular surgery, it was shown that passive exercises applied to the lower extremities and body increased the volume of bowel sounds (31). The nurses participating in the present study still routinely monitor GRV, but do not undertake such interventions as abdominal massage or passive exercises to regulate GIS functions suggest that the intensive care unit involved in the study do not yet sufficiently draw upon current practices.

A study performed by Al-Hawaly and colleagues (32) demonstrated that while the majority of nurses (71.1%) had sufficient knowledge of feeding management, 62.2% were unqualified with respect to the practices of feeding management. In a study where they examined the files of patients fed through a tube, Mula and colleagues (33) found that many nursing interventions regarding feeding through a tube were not recorded; the interventions recorded were feeding regime (55.1%), monitoring the bowel sounds (19.2%), monitoring the fluid balance (52.6%) and

monitoring the complications (15.4%). The nurses involved in our study undertook, contrary to these results, many routine interventions intended to early diagnose and prevent complications. The interventions that were not undertaken were, on the other hand, those that the nurses could carry out independently, such as evaluations of distension, monitoring of bowel sounds, abdominal massage and in-bed exercises. We believe that the results based primarily on the records of practical work provide no information of the level of knowledge of the nurses.

CONCLUSION

The study concluded that gastrointestinal and metabolic complications are highly prevalent in patients being fed enterally. To prevent these complications and to monitor them when they develop, nurses generally carried out interventions in accordance with the literature, but did not apply such actual nonpharmacological interventions as abdominal massage and exercise. Enteral feeding is an important therapeutic approach aimed at improving the outcome of patients in the intensive care unit, and nurses play a key role in achieving the feeding objectives set for the patients. The findings of the present study may contribute to the design of protocols and manuals and the planning of in-service training for nurses, supporting them in the prevention of complications in patients fed enterally and in the management of complication in the event of emergence.

AUTHOR CONTRIBUTIONS:

Concept: BBK, KK, ESÖ, SK; **Design:** BBK, KK, ESÖ, SK; **Supervision:** BBK, KK, ESÖ; **Resources:** BBK, KK, ESÖ, SK, MT, GA; **Materials:** BBK, KK, ESÖ, SK, MT, GA; **Data Collection and/or Processing:** BBK, KK, ESÖ; **Analysis and/or Interpretation:** KK; **Literature Search:** BBK, KK, ESÖ; **Writing Manuscript:** BBK, KK, ESÖ, SK, GA; **Critical Review:** SK, MT, GA.

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