CLINICAL SCIENCE OF NUTRITION

Review

Clin Sci Nutr 2020; 2(1): 1-14 • DOI: 10.5152/ClinSciNutr.2020.984

Nursing Practices in Enteral Nutrition

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Cite this article as: Akçay K, Suluhan D, Kesik G, Uzunoğlu K, Kartal E, Şahna A. Nursing Practices in Enteral Nutrition. Clin Sci Nutr 2020; 2(1): 1-14.

ABSTRACT

Enteral nutrition is the preferred route of nutrition when patients have a functioning gastrointestinal tract but are unable to meet their requirements orally. In terms of patient safety and quality of life, it is important that enteral nutrition must be administered by the nutrition team consisting of experienced interdisciplinary health professionals. Members of the nutrition team should have up-to-date knowledge and skills to monitor and evaluate the patients during the enteral feeding process and prevent the development of complications. The nurse, as a member of the team, has important responsibilities, such as correct and safe enteral nutrition practices, care of the enteral nutrition route, and follow-up of patients in accordance with the guidelines.

Keywords: Care, enteral nutrition, nursing

Introduction

Nutrition is an action that needs to be done consciously to get the nutrients needed by the body in sufficient quantity and at the appropriate time in order to maintain the body functions, protect and improve health, and improve the quality of life (1). Malnutrition develops in cases where nutritional therapy cannot be performed or is not sufficiently carried out. Nutritional therapy is needed for the prevention or treatment of malnutrition. Enteral nutrition (EN) is often preferred as the closest method to oral nutrition. EN has many advantages: it is cheap and safe and maintains the structure and functions of the intestine (2).

EN treatment is preferred in patients whose gastrointestinal system (GIS) functions are normal or close to normal and who cannot meet some or all of their daily nutritional requirements (1). EN is used in cases of impaired oral intake for longer than 5–7 days or the prediction of its deterioration, development of malnutrition, unconsciousness, difficulty swallowing, partial intestinal failure, pancreatitis, cancer, mental disorders, cachexia accompanying coma and chronic diseases, metabolic diseases, congenital heart diseases, digestive system anomalies, when necessary after all types of surgery, and eating disorders (3, 4).

Access routes for enteral nutrition therapy

Nurses must have up-to-date knowledge and skills about EN access routes and nutrition methods for proper and safe administration of EN. The first method to be selected in the patient's diet is oral way. However, in cases where oral feeding is insufficient due to difficulties in swallowing and vomiting, or in cases such as coma where feeding is not possible, EN treatment with nasal/oral tube or gastrostomy tube (GT) is preferred while GIS function is normal (1).

In the selection of the access route for EN treatment, the characteristics of the disease, gastric and intestinal motility and functional status, GI changes due to previous surgery, and the estimated duration of nutritional therapy to be applied are taken into consideration. The most important of these factors is the duration of EN treatment. If nutritional therapy will take less than 4–6 weeks, EN therapy is recommended through nasogastric (NGT)/nasoenteric tube (NET). If the duration is longer than 4–6 weeks, EN

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Submitted: 02.04.2020 **Accepted:** 17.06.2020 **Available Online Date:** 16.07.2020

therapy is recommended through enterostomy (gastrostomy or jejunostomy) (2, 4, 5).

Tube feeding is specifically EN provided into the gastrointestinal tract through a tube, catheter, or stoma that delivers nutrients distal to the oral cavity. The tube is inserted through the nose (nasogastric or nasojejunal) or from a stoma (gastrostomy, percutaneous endoscopic gastrostomy with jejunal extension [PEG-J], or percutaneous endoscopic jejunostomy [PEJ]) that opens to the stomach or jejunum endoscopically, surgically or radiologically (1, 4).

Enteral nutrition therapy with nasal tube: NGT and NET are the most common access routes used in the treatment of EN. The most important advantage is that it can be placed easily at the bedside. The direct delivery of foods to the stomach makes it possible to use hypertonic foods and to deliver them at higher speeds and in bolus style (4, 6, 7). NGTs are used in adult patients. NGTs used for gastric access are preferred for less than 4–6 weeks (Table 1). The lengths of the tubes range from 90 to 120 cm; their diameter varies between 6 and 22 French; and they have one/three lumen tube types made of more rigid polyvinyl, more flexible silicone, or less traumatic polyurethane material (7, 8).

Evaluation of whether NGT or NET is in place before every use is an important nursing intervention in terms of safe application and patient safety. Radiological evaluation (x-ray), the measurement of the distance between the proximal end of the tube and the nose, and pH control are the methods used to evaluate the placement of the tube. Radiological evaluation is recommended as the gold standard in the assessment of tube placement in the guidelines of the American Society for Parenteral and Enteral Nutrition (ASPEN) (2009) and the Dietitians Association of Australia (2018) (7, 9). The American Association of Intensive Care Nurses suggests that the tube location should be marked with the indelible pen at the edge of the nose, and this mark should be checked every four hours and before each feeding/drug application (10). If the outer length of the tube is stable and the pH of gastric aspirate is less than 5, NGT is placed in the stomach (8). In the treatment of nutrition with the nasojejunal tube, double lumen gastrojejunal tubes may be preferred in patients who require gastric decompression with small bowel nutrition. These tubes are placed by experienced physicians under the guidance of endoscopy or fluoroscopy (6, 7).

Nutrition therapy with gastrostomy tube: Nutrition with the GT is a fairly common and safe procedure. For long-term EN treatment (more than 4–6 weeks), if delayed gastric emptying and obstruction are not present, nutritional therapy with GT is preferred (2, 4). EN treatment with GT is considered superior to other methods for the following reasons: gastric acid having a bactericidal effect, normal functions of pancreatic enzymes, stomach being more appropriate for bolus nutrition, better tolerance of hyperosmolar nutrients, reduced frequency of lung infections, and its ease of application and comfort level (4). In cases where gastrostomy is contraindicated, jejunostomy is the preferred access route for EN therapy in patients with a risk of aspiration pneumonia (8).

Oral nutritional supplements

Oral nutritional therapy is essentially the delivery of oral nutritional supplements and defined as "foods with special medical purpose" (1). Oral nutritional supplements are the solutions to meet macro- and micronutrient needs. They are ready-made liquids, creams, or powdered supplements that can be added to drinks or food. Liquid oral nutritional supplements that are ready for drinking or made from powders are sometimes referred to as sip feeds (6).

Table 1. Features of tubes according to their types (9)

Features	Polyvinyl chloride (PVC) tubes	Polyurethane (PE) and silicone tubes
Measurement (French)	6–12 Fr	14–22 Fr
Purpose of usage	Gastric drainage, gastric aspiration, and gastric decompression	Enteral nutrition
Structure	Hard Soluble in stomach contents	Soft
Patient comfort	Comfortless	Comfortable
Approximate time of use	10 days	4–6 weeks
Wire guide	None	Yes/none
Type	Levin tube Ryles tube Salem tube	Many types

Enteral Nutrition Application Methods

EN products are given to the digestive system that becomes functional by using one of the continuous or intermittent nutrition methods.

Continuous nutrition: The nutritional solution is given to the patient continuously by using a pump without interruption (16–24 hours). With this method, the EN product is given at a constant speed with the help of a feeding pump throughout the day or at a desired time continuously (4).

It has advantages such as reducing the risk of aspiration resulting from reflux or high gastric residual volume (GRV), providing controlled delivery into the intestine, and help in controlling blood glucose level (4, 8, 11, 12).

Intermittent nutrition: When nutrition is carried out at the decided time in intermittent or cyclic nutrition method (one hour or more), the nutrition is stopped for four to eight hours during the rest of the day, and the gastrointestinal system is rested. In intermittent feeding, EN treatment is carried out using the hanging feeding bag or a feeding injector with the effect of gravity. Intermittent feeding can be applied three to five times a day by bolus or cyclically. While bolus nutrition can be applied with NGT or GT, its application with the jejunal tube is contraindicated.

In bolus feeding method, the plunger of the syringe is removed during EN treatment. The injector body is attached to the distal end of the tube to be used as a funnel through which the enteral product is provided with the effect of gravity. It has many advantages such as providing fast treatment, not requiring an infusion pump, and allowing the stomach to rest between feeding periods (12, 13). Although there is no significant difference between continuous and intermittent nutrition, continuous nutrition is the preferred choice because of the reduction of GI complications and ease of applying EN treatment (8, 14, 15).

Nursing practices in Enteral nutrition

It is important to perform nursing practices in patients receiving EN in line with the recommendations of the guidelines that provide up-to-date and high-level information in order to ensure patient safety and increase the quality of life. The nurses' responsibilities in the safe delivery of EN therapy include effective interdisciplinary communication, EN implementation, maintenance of delivery routes, and patient monitoring and recording (16-21).

Application of enteral nutrition therapy: Enteral products are given to the patient with NGT in short-term nutritional support and via enterostomy (gastrostomy, jejunostomy) in long-term nutritional therapy (2, 4, 5). In our country, on 19 April 2011, the Ministry of Health published the "Regulation on the Amendment of the Nursing Regulation." According to this regulation, it is the responsibility of the nurse to place and remove the NGT with the decision of the physician (22). Nursing practices in EN are included in Tables 2, 3, and 4 within the scope of this responsibility.

One of the issues to be considered in the implementation of EN therapy is the correct understanding of the preapplication treatment protocol. In the ASPEN (2017) guideline, it is recommended to check the patient's information, the enteral feeding route (NET, NGT, GT, PEG-J), the EN method (intermittent/continuous/bolus feeding), and the feeding speed before giving EN to the patient (8).

Maintenance of access routes: Maintenance of access routes includes dressing of the enteral tube and maintaining the patency of the path. The dressing of the enteral tube varies according to the type of tube the patient has. In NGT maintenance, the tapes used for tube fixing should be changed daily. Before replacing the fixed tape with a new one, the distal length of the tube should be checked to determine if the tube is in place. To prevent trauma that may occur in the nasal mucosa, the tape should be fixed to another side of the nostril at each time (18). The nasal mucosa should be observed daily for any irritation (18, 19). In case of irritation in the nasal mucosa, the tube should be removed and inserted through the other nostril and hypoallergic and disposable products that ensure secure fixation should be preferred (18). The maintenance of the peristomal area (GT, PEG-J) is performed using the aseptic technique to reduce the risk of local infection, according to local wound management policy. Although the use of dressings is not recommended, the European Society of Clinical Nutrition and Metabolism (ESPEN) recommends a sterile GT dressing the next morning and the first 7 days following the placement of the PEG tube (10). In the first 48 hours after the insertion of the GT, the peristomal area should be evaluated for bleeding (a small amount of bleeding may occur) and hematoma.

The peristomal area should be evaluated at 4-hour intervals in the first 24 hours following the insertion of gastrostomy with the monitoring of vital signs and then should be followed the clinical procedure. In the evaluation of peristomal area, symptoms such as redness, increased temperature, increased pain, excessive discharge, or odor may show local infection (peristomal infection). The presence of leakage (contents of the stomach) from the edge of the tube may indicate that the location of the tube has changed.

Table 2. Nursing interventions and reasons in the application of enteral nutrition therapy with nasogastric tube (8, 17-22)

Interventions	Reasons
The individual's condition and medical records are evaluated: Nasal patency, swallowing reflex, and bowel movements	If bowel sounds are not heard, peristaltic movements may not have returned. The risk of aspiration and abdominal distention increases.
Order is checked.	The correct application is realized.
Materials to be used are prepared.	• Enteral formula (at room temperature) • Emesis basin • Towel or paper towel • Container for dirty objects • Disposable gloves • 50-mm feeding injector/feeding bag • Water at room temperature
All materials are brought to the individual, in an area that you can easily reach.	The process is made easier and saves time.
The process and its purpose are explained to the individual in detail and his/her approval is obtained.	This application relieves the anxiety of the individual. It ensures compliance and participation.
Hands are washed and gloves are worn.	You prevent the spread of microorganisms in your hands.
Unless there is a medical indication, the patient's head is raised at least 30–45 degrees in lying position.	It decreases the risk of aspiration.
Towels or paper towels are laid on the chest of the individual.	The contamination of the individual's clothes is prevented.
The tip of the nasogastric tube is clamped, and the connections of the tube are removed.	Leakage of stomach contents or entry of air into the stomach is prevented.
After placing the injector at the end of the tube, the clamp on the tube is opened and, if necessary, the contents of the stomach are drawn into the injector by withdrawing the plunger of the injector.	It gives information about whether previously given enteral formula is tolerated by the digestive system.
If the enteral formula is to be given with a feeding bag: The enteral formula in the box/bottle at room temperature is shaken and filled into the feeding bag, and the bag is hung on the serum rack. The formula poured into the bag is passed through the set, and the set air is removed. Before enteral nutrition therapy, the recommended amount of water at room temperature is given to the patient. If the enteral formula is to be given with a feeding injector: The recommended amount of water at room temperature before feeding is given to the patient through the tube with an injector. The plunger of the feeding injector is removed, and the injector body is placed at the distal end of the probe to be used as a funnel. The tube is clamped with the help of hand during the addition of the formula to the injector. The enteral formula in the box/bottle at room temperature is filled into the injector by shaking. The nutritional injector is kept 30–35 cm above the level of the stomach so that it can reach there with the effect of gravity. The flow rate is adjusted by the height of the injector.	The entry of air into the stomach is prevented.

Table 2. Nursing interventions and reasons in the application of enteral nutrition therapy with nasogastric tube (8, 17-22) (Continued)

Interventions	Reasons
After the enteral nutrition treatment is finished, the recommended amount of water at room temperature is given through the tube.	The formula left in the tube is allowed to go from the tube to the stomach, and the tube is prevented from clogging.
When enteral nutrition therapy is finished, the cap at the distal end of the tube is closed.	The formula may leak out.
Oral care is given if necessary.	The individual is provided with care to feel comfortable.
Tools and equipment are properly removed from the environment.	The spread of microorganisms will be prevented.
If contraindicated, for 30–60 minutes after enteral nutrition treatment, the head of the individual is left at 30–45 degrees.	It is necessary for the prevention of aspiration.
Gloves are removed and hands are washed.	The spread of microorganisms will be prevented.
The application, the individual's response, and participation are recorded.	It provides data for the individual's subsequent procedures and provides legal basis for the nurse.

Maintaining the opening of the access route and tube maintenance: Despite the differences in the amount of water used and the time of delivery of water in maintaining the opening of the access route in clinical practice, in the ASPEN guide (2017), it is recommended that feeding tube should be washed with minimum 30-mL water every four hours during continuous nutrition and before and after feeding in intermittent nutrition (8).

The tube should be regularly washed with water before and after drug administration during intermittent or continuous feeding in order to prevent the complication of tube obstruction (23). In cases where EN treatment with GT is not allowed, the dysfunctional GT should be changed in line with the institutional policies and manufacturer's recommendations. In the ASPEN (2017) guideline, recommendations regarding the replacement of tubes are given below (8):

1. Development of institutional protocols including manufacturer's instructions for changing enterotomy tubes.
   a. Routine removal and replacement of a well-preserved PEG may not be necessary.
   b. It is recommended to change it according to the manufacturer's instructions.
2. If any of the following is identified in the patient, the tube replacement may be considered earlier than the time specified in the manufacturer's manual.
   a. Nonfunctional tube.
   b. Balloon rupture in tubes, internal fixator of which is balloon.
   c. Presence of peristomal infection that persists despite appropriate antimicrobial therapy (local infection).
   d. Skin maceration.
   e. Ulcer formation that does not heal despite good wound care practice.
   f. Colocutaneous or gastrocolic fistulas.
3. It is recommended that percutaneous tube should be changed after stoma maturation (30–90 days after the initial placement of the tube) or according to institutional protocols.
4. Routine replacement of the percutaneous tube after stoma maturation (30 days after the initial placement of the tube) or in accordance with institutional protocols may be considered.

Ensuring tube safety: Because bulky dressings between external fixators and the skin can increase tube tension, they can lead to displacement of the GT or injury. It is also necessary to make sure that the external fixator is not too tight or too loose to prevent embedded buffer syndrome and complications such as hypergranulation. In the literature, it is recommended to check the distance between the tube's external fixator and the skin while the patient is in a sitting position, and the ideal distance should be 2–5 mm (10, 13, 20, 21).

Tube rotation: In seamless tubes, unless contraindicated, standard GT (with or without balloons) should be rotated 360 degrees per day. Rotating the tube reduces physical pressure on the gastric mucosa. It is recommended to start rotating the GT 24 hours after the first insertion and to do it daily (10, 13).

Table 3. Nursing interventions and reasons in the application of enteral nutrition with gastrostomy/ jejunostomy tube (8, 17-21, 30)	
Interventions	**Reasons**
The individual's condition and medical records are evaluated: Ostomy region, gastrostomy/jejunostomy tube and bowel movements.	It gives information about the patient's peristomal area and gastrointestinal system.
Order is checked.	The correct application is deployed.
Materials to be used are prepared.	• Connection set (only required for button gastrostomy tube) • Enteral formula • Emesis basin • Towel or paper towel • Container for dirty objects • Disposable gloves • 20–50 mm feeding injector • Water at room temperature
All materials are brought to the individual, in an area that you can easily reach.	The process is made easier and saves time.
The process and its purpose are explained to the individual in detail and his/her approval is obtained.	This application relieves the anxiety of the individual. It ensures compliance and participation.
Hands are washed and gloves are worn.	You prevent the spread of microorganisms with your hands.
Unless contraindicated, the patient's head is raised at least 30–45 degrees in lying position.	It decreases the risk of aspiration.
After placing the injector at the end of the gastrostomy tube, the clamp on the tube is opened, and, if necessary, the contents of the stomach are drawn into the injector by withdrawing the plunger of the injector.	It gives information about the tolerance of the enteral formula previously given by the digestive system.
The recommended amount of water is given from the gastrostomy tube before enteral nutrition therapy.	The opening of the tube is provided.
If the enteral formula is to be given with a feeding bag: After shaking the feeding formula at room temperature, it is poured into the feeding bag, and the bag is hung on the serum rack. Air in the feeding set is discharged with enteral formula.	The nutrition formula at room temperature prevents abdominal distension and cramp. Shaking the formula ensures that the product is poured homogeneously into the bag.
The tip of the feeding set, with the air removed within it, is placed in the PEG or gastrostomy tube. If the patient has a buttoned gastrostomy tube, the feeding set added to the tip of the feeding bag is carefully placed in the buttoned gastrostomy tube.	The feeding set provides a connection between the feeding bag and buttoned gastrostomy tube.
Maximum amount of total product to be given with 6–8 hours should be added to the feeding bag. The speed of the enteral formula, to be sent hourly, is adjusted in the feeding machine. Nutritional product is given to the patient.	Enteral products opened at room temperature should be consumed within a maximum of 6–8 hours. (The maximum time for keeping the formulas at room temperature may differ from each other. Therefore, the instructions for use of the preferred formula should be carefully examined.)
If the enteral formula is to be given with an injector:	
Remove the plunger from the syringe and place the tip of the syringe into tube connector at end of the PEG or gastrostomy tube	

Table 3. Nursing interventions and reasons in the application of enteral nutrition with gastrostomy/ jejunostomy tube (8, 17-21, 30) (Continued)	
Interventions	**Reasons**
If the patient has a button gastrostomy feeding tube (low profile gastrostomy feeding tubes), a water-filled extension set is carefully placed in a buttoned gastrostomy tube. The plunger of the feeding injector is then removed, and the injector body is placed at the distal end of the feeding set to be used as a funnel.	The feeding set acts as a connection between the feeding bag and buttoned gastrostomy.
When enteral nutrition therapy is completed, the recommended amount of water is given through the gastrostomy tube.	Blockage of the feeding probe is prevented.
When the procedure is completed, the cap at the distal end of the probe is closed.	Food can leak out.
If it is not contraindicated, it is ensured that the head of the bed remains elevated at 30–45 degrees at least for 30–60 minutes after enteral nutrition therapy.	The development of aspiration is prevented.
Oral care is given if necessary.	The individual is provided oral care to feel comfortable.
Tools and equipment are properly removed from the environment.	
Gloves are removed and hands are washed.	The spread of microorganisms will be prevented.
Information about application of enteral nutrition, formula type, and amount are recorded.	It provides data for the individual's subsequent procedures and provides legal basis for the nurse.

Tube position: The centimeter mark of the tube at the peristomal skin level (except for low-profile GT) should be recorded and observed before each use (24). A deviation from the first recorded measurement may indicate the movement of the GT. Thus, to prevent any complication, the nurse should inform the physician about the change in the position of the tube before using it.

Access route-related complications and nursing interventions in enteral nutrition

Once EN therapy is initiated, minor and major complications can sometimes occur. Minor complications of EN with GT include pulmonary aspiration, peritonitis, gastrocolic fistula, bleeding, necrotizing fasciitis, and embedded buffer syndrome. Major complications include occlusion of the tube caused by the dysfunctional tube, the fracture or rupture of the tube, the displacement of the tube, dislocation of the tube, and leakage around the tube. In the EN guideline of ASPEN (2017), it is emphasized that nursing care and discharge training are important in preventing minor complications related to GT and enterostomy (8). Nurses should provide training to caregivers or patients about the causes of complications and the prevention methods, to apply appropriate nursing interventions in the treatment of complications, to evaluate and monitor the patient for safe EN treatment. The reasons and solutions for common complications are given in Table 5. Although there are no research results that provide very strong evidence for the prevention and treatment of some complications, recommendations for some complications in the table are feasible interventions in line with clinical procedures.

Complications related to enteral nutrition and nursing interventions

Diarrhea, nausea or vomiting, regurgitation or aspiration, and refeeding syndrome are common complications of EN therapy. Knowing and preventing the causes and proper treatment of these complications are the responsibilities of the nurses of the nutrition team. Table 6 contains the causes of common EN-related complications and applications for their prevention and treatment.

One of the common complications associated with EN is aspiration (Table 6). Oropharyngeal secretions and/or reflux of stomach contents into the esophagus may be associated with aspiration. Intensive care patients and patients with swallowing disorders may have problems with respiratory tract (8). The American Association of Critical-Care Nurses (AACN) recommends to place the head of the bed at 30–45 degrees or higher for 30–60 minutes during or after the completion of EN, if not contraindicated to reduce the risk of aspiration (25).

Table 4. Nursing interventions and reasons in drug applications from enteral feeding tube (8, 14, 15, 17)	
Interventions	**Reasons**
Medicine cards written according to the physician's order are checked.	It prevents wrong applications, and it is determined whether the drug order is changed. Thus, errors that may occur are prevented.
Information about the effect and side effect of the drug to be applied is obtained.	This information helps to evaluate the therapeutic effects of drugs.
Materials to be used are prepared.	• Drug card • Drug to be used • Drug glass • Drug tray • Injector/scale (liquid drugs) • Drug divider (solid drugs) • Water/fruit juice
Hands are washed.	It prevents the spread of microorganisms.
The name of the drug, its dosage, the form and time of administration, and the patient's name and surname are checked again from the drug card.	It prevents the administration of missing drug, missing dose, or overdose of drug.
When necessary, clinical pharmacist is consulted for the suitability of dosage forms, prevention of interactions, and administration of medication from the feeding tube.	It ensures safe drug administration.
The drug is properly prepared.	
Preparation of liquid dosage forms:	
The preparation is shaken properly before use.	It provides accurate dosing.
Medicines in liquid form are diluted according to the pharmacist's recommendation.	It prevents clogging of the tube.
Medicines in liquid form should not be added directly to the enteral nutrition formula.	It prevents interaction of drug with enteral formula.
Preparation of solid dosage forms:	
The tablets are simply compacted and ground, and the powder obtained is mixed with sterile water.	
If necessary, tablets are crushed to a fine powder in the mortar. 5 mL of water is added, and crushing is continued with a pestle. 5 or 10 mL of water is added again with continuous crushing and mixing, thus creating a good suspension. The suspension is drawn into the syringe of appropriate type and size and applied through the tube.	
In order to avoid any medication in the mortar, 10–20 mL of water is added to the mortar, and it is drawn with the syringe and then applied from the tube. If necessary, this process is repeated until there is no medicine left in the mortar.*	
Effervescent tablets are diluted with 1/2–1/3 glass of water.	
Hard gelatin capsules containing powdered medicines are opened according to the pharmacist's recommendation and diluted with 10–15 mL of water to form a slurry.	
Capsules containing granules should not be crushed after opening.	
In the application of the prolonged-release capsule containing enteric-coated pancreatic enzymes from the feeding tube according to the pharmacist's recommendation, the content is mixed with apple juice.	

Table 4. Nursing interventions and reasons in drug applications from enteral feeding tube (8, 14, 15, 17) (Continued)	
Interventions	**Reasons**
Hard gelatin capsules are opened according to the pharmacist's recommendation, and the powder is mixed with sterile water.	
Soft gelatin capsules are applied to the feeding tube after being pierced with a needle and the liquid contents are drawn with the injector.	
According to the pharmacist's recommendation, the capsule can be put into warm water, and the whole mixture can be applied from the tube.	
Drugs are applied separately.	
Drug should not be added directly to the enteral nutrition formula.	
Before applying the drug, feeding is stopped and, if not contraindicated, the tube is washed with at least 15 mL of sterile water.	Drug interaction is prevented with enteral formula.
Oral injectors with the instruction "only for oral use" are used for drug administration from the feeding tube.	Drug interaction is prevented with enteral formula.
To avoid altering the bioavailability of the drug, enteral nutrition therapy may be delayed for 30 minutes or more, if appropriate.	Drug interaction is prevented with enteral formula.
After applying all medicines, if not contraindicated, the tube is washed once more with 30 mL of water.	Drug interaction is prevented with enteral formula.
Information on drug administration, form, amount of drug, application time, and the person performing the application are recorded.	It provides data for the individual's subsequent procedures and provides legal basis for the nurse.
*This method should be used carefully for patients with fluid restriction.	

• Unless contraindicated, the head of the bed is 30–45 degrees.
• Reduce sedative drug use as much as possible.
• Evaluation of the location of the feeding tube at four-hour intervals.
• Observing the external length of the tube.
• Evaluation of GI intolerance (nausea, abdominal distension, and pain) at four-hour intervals.
• Avoid bolus feeding if there is a high aspiration risk.
• Evaluation of swallowing before starting oral feeding for patients extubated after prolonged intubation.
• Keeping the endotracheal tube cuff pressure at an appropriate level.
• Removal of secretions on the cuff before reducing the endotracheal tube cuff pressure.

Current data on gastric residue volume measurement: One of the factors indicating the nutritional tolerance of the patient receiving EN therapy is GRV. How to measure GRV, when to measure, and what a high GRV actually implies are the major controversies for the clinicians. Many variables, including the type of feeding tube and the patient position, can affect GRV measurements. The control of GRVs in patients with GT in the intensive care setting varies according to local hospital policy. There is no evidence in the literature to suggest the control of GRVs in patients with GT out of the setting of the intensive care. While some studies suggest GRV control (26-28), some do not recommend it (29). The acceptable range for GRV can vary significantly. The acceptable range for GRV has not been established in studies conducted to date. However, the British Association for Parenteral and Enteral Nutrition (BAPEN) (2003) recommends that the stomach should be aspirated every four hours in patients with suspected gastrointestinal motility, and a nutritional policy should be revised if the gastric aspirates exceed 200 mL (Table 7) (30).

Patient monitoring: Monitoring of the patient with EN by an experienced nutrition support team contributes to the prevention of complications (31). Objectives of patient monitoring are to reach the target body weight and clinical laboratory findings in the normal range and to improve the quality of life (8, 31). ASPEN (2017) and BAPEN (2003) suggest performing the following applications in the follow-up of the patient with EN (8, 30).

- Monitoring and evaluating the patient with EN treatment to determine physical examination findings, laboratory values, anthropometric data, and all changes in parameters (8).
- Evaluation of the nutritional risk during the treatment of the patient with EN (8):
  a. Determining the frequency of reevaluation considering the clinical course of the patient.
  b. Establishing protocols related to patient assessment on a daily and/or weekly basis, monitoring nutritional status, and giving more attention to data on reevaluation.

Table 5. Complications related to gastrostomy (8, 10, 13, 19-21, 30-32)	
Complication **Tube-related complication**	**Suggestions**
Tube blockage Reason • Unproper usage of the tube (use of drugs with high viscosity, small tube lumen, use of gravity method instead of feeding machine for EN)	• Preference of liquid forms of medicines, if possible • Washing the tube before and after each feeding/drug application • Washing the feeding tubes with 30 mL of water every 4 hours during continuous feeding or before and after intermittent feeding in an adult patient (Evidence A) • Washing the feeding tube with 30 mL of water after GRV measurements in an adult patient (Evidence B) • Washing of feeding tubes in newborns and pediatric patients with the minimum volume required to clean the tube (Evidence C) • It is recommended to use sterile water before and after drug administration in adult and newborn/pediatric patients (Evidence C) • Following protocols of proper washing of the tubes before and after drug administration (Evidence B) • Using sterile water for washing of the tubes in patients with weakened immunity or critical illness due to lack of evidence suggesting the use of tap water (Evidence C)
Tube displacement Reason • Accidental removal of the tube • In gastrostomies with an internal fixator balloon, the bursting of the balloon or decreasing the amount of balloon fluid used to inflate the balloon • Tube moves toward the intestine	• Fixing the external extension to the skin with tape • Preference of tubes with external fixator • Recording of tube type and external length • Avoiding using tubes that are not intended for long-term enteral feeding, such as urine or gastrointestinal drainage tubes without external fixator • Checking the tube balloon • Avoiding the use of the tube until it is confirmed to be in the right place
Embedded buffer syndrome Reason • The tube is not rotated • External fixative is too loose or too tight	• The tube is pushed about 2–3 cm every day and carefully retracted until the inner buffer resistance is felt • Rotation of the tube to 180–360 degrees around its axis (rotation of jejunal or gastrojejunal tubes is not recommended) • The distance between the external fixator and the skin is 2–5 mm
Stoma-related complication	
Leak around the tube Reason • Cases in which the pressure in the abdomen increases (constipation, cough, ventilated patient, vomiting, etc.) • Bursting of balloon in balloon gastrostomy tubes/reduced amount of balloon fluid used to inflate the balloon • The size of the tube (French) not suitable for the stoma entry point • Tube displacement • Nutrition intolerance	• Replacing the tube • Balloon volume control in balloon tubes • Inflation of the balloon • To verify that the tube is not displaced, it is necessary to check the numerical mark on the tube in the stoma outlet area every 4 hours or before using the tube. • Confirmation of tube placement in adults by radiography if the tube is suspected to be displaced • Using barrier products • Dressing and closing with gauze/or wound care materials

Table 5. Complications related to gastrostomy (8, 10, 13, 19-21, 30-32) (Continued)	
Complication **Tube-related complication**	**Suggestions**
Local irritation Reason • The contact of gastric content to the skin • Harsh cleansing of peristomal skin • Use of antibacterial or other topical drugs	• Using barrier products to protect and heal the skin • Use of absorbable dressing material
Local infection Reason • Poor hygiene • MRSA	• Cleaning 2–3 times a day with sterile water or physiological serum • Avoid excessive moistening of the peristomal area • Taking culture • Use of ordered antibiotics • Use of silver dressing
Hypergranulation tissue • Reason • Excessive mobility of the tube in the stoma • Excessive moisture • Use of tube with inadequate size	• Ensuring and maintaining the tube's stability • Fixing the external extension of the tube to the skin with tape • To prevent excess moisture that may collect in the peristomal region, not covering the stoma with dressing materials (gauze, wound care products), and leaving the peristomal area open. • Using appropriate-sized (French) tube for the stoma • Short-term use of ordered corticosteroid creams (triamcinolone acetonide 5%) (3 times a day, 5–7 days) • Silver nitrate usage: up to 5 days or once a day until hypergranulation tissue shrinks. • Using barrier powder or foam dressing to control moisture
EN: enteral nutrition; GRV: gastric residual volume; MRSA: methicillin-resistant *Staphylococcus aureus*	

- Daily monitoring of fluid balance (30).
- Evaluation of body weight or body mass index twice a week or more frequently if there is concern of hydration (30).
- If the patient is receiving EN treatment in the acute unit, daily evaluation of vital signs such as body temperature, pulse, and breathing to detect signs of infection and dehydration (30).
- Daily evaluation of the intestine to determine EN tolerance (30).
- In order to detect hypo-/hyperglycemia, daily evaluation of capillary blood glucose at the beginning until stability is achieved, and once in every four hours daily if the patient has diabetes (30).
- Daily oral care (30).
- Daily evaluation of the physical structure, position, and peristomal area of the tube (30).
- Checking the GT rotation daily, and checking the balloon volume in ballooned GTs weekly (30).
- Evaluation of sodium, urea, and creatinine levels daily until stability is achieved in line with clinical procedures. In case of refeeding syndrome, evaluating them daily, three times a week until stabilized, then as clinically indicated (30).
- Assessment of C-reactive protein twice a week until stability is achieved, assessment of the acute phase response, and interpretation of protein and micronutrient results.
- Weekly evaluation of albumin until stabilized, since low albumin reflects disease rather than protein status (30).
- Assessment of complete blood count twice a week until stabilized to check on infection and anemia (30).
- Evaluation of zinc, copper, selenium, folate, and vitamin B12 if there are clinical indications (30).
- Evaluation of vitamin D in patients with six-month long-term EN or generally in patients receiving EN treatment at home (30).
- Reevaluation of the patient who has received long-term ET nutrition in the hospital at least once a month (8).
- Reassessment of a patient having received ET nutrition at home for a long-term at least once in every three months (8).
- Recording the care and treatment of patient with EN ensures effective communication with the nutrition support team and health care professionals between clinical units or shifts (16).

Table 6. Complications seen during enteral nutrition (13)	
Complication	**Prevention/treatment**
Diarrhea Reason • High infusion rate • Bolus feeding intolerance • Nutrition with high osmolarity • Microbial contamination of enteral product	• Switching to hydrolyzed formula or modular feeding • Decreasing the feeding rate and increasing it as tolerated • Delivering frequent, smaller amounts of food or switching to continuous feeding • Use of sterile, commercially manufactured products if possible • Preparation of nutritional product in clean environment
Nausea or vomiting Reason • Drugs (antibiotic, laxative, etc.) • High infusion rate • Delivery of drug during feeding • Psychological factors	• Checking the drugs • Decreasing infusion rate • Giving prokinetics • Gaining regular intestinal habit by using sufficient liquid, fibrous foods, and/or laxatives • Interruption of continuous feeding during drug administration, not performing nutrition and drug administration at the same time • Review of nutritional behavior; considering referral to a psychologist
Regurgitation or aspiration Reason • Gastroesophageal reflux • Clogged tube • High infusion rate • Intolerance of bolus feeding	• Correct position, enteral product thickener, drugs, continuous nutrition, jejunal tube, fundoplication • Checking the tube regularly • Decreasing infusion rate • More frequent feeding with less amount or continuous infusion

Refeeding syndrome
Reason
	• Identification of patients at risk of refeeding syndrome before starting EN
	• Risk factors include:
	  • Malnutrition for more than 2 weeks
	  • Poorly controlled diabetes
	  • Before and during cancer treatment
	  • Anorexia nervosa
	  • Short bowel syndrome
	  • Inflammatory bowel disease
	  • Being an elderly patient living alone
	  • Low birth weight and preterm birth
	  • Chronic infections
	• Monitoring of fluid balance, daily body weight and electrolyte status (potassium, magnesium, and phosphorus), and other metabolic parameters (glucose) depending on the clinical condition of the patient
	• Evaluation of metabolic and nutritional parameters before starting enteral nutrition therapy
	• Starting 25% of target requirements on the first day of enteral nutrition therapy
	• Delivery of complementary thiamine (intravenously or orally) when enteral nutrition is started
	• When starting enteral nutrition, monitoring parameters such as serum potassium, phosphorus, magnesium, and glucose

EN: enteral nutrition	

Conclusion

One of the responsibilities of the nutrition support team is to have the knowledge and skills to monitor and evaluate the patient during the EN treatment and to prevent the development of complications. The nurse, who is a member of the team, has important responsibilities in safe EN implementation and patient monitoring. Nurses' performance of nutritional practices in accordance with current literature and the contribution of evidence-based research results to practice are important in preventing complications associated with

Table 7. Current recommendations regarding measurement of gastric residual volume (30)

Suggestions for application
• Evaluate all patients fed with tube in terms of risk of aspiration (Evidence A)*. • Make sure that the feeding tube is in the correct position before you start feeding (Evidence A)*. • Always keep the head of the bed 30–45 degrees high during enteral feeding (Evidence A)*. • For patients with gastric feeding, check GRVs every 4 hours for the first 48 hours. After the EN target rate is reached, patients who are not in the intensive care can be monitored for GRVs in every 6–8 hours (Evidence C)*. • In intensive care patients, measurement can be done every 4 hours (Evidence B)*. • In adult patients, a promotility agent should be considered if GRV is 250 mL or more after the second measurement (Evidence A)*. • If GRV is more than 500 mL, EN treatment should be stopped using an algorithm for physical evaluation, gastrointestinal evaluation, evaluation of glycemic control, minimizing sedation, and patient's nutritional tolerance (Evidence B)*. • In sick children who constantly receive EN, GRVs can be checked every 4 hours, and EN is stopped if GRV is higher than or equal to the hourly rate. If the child receives EN by bolus method, GRV can be checked before the next feeding, and EN is stopped if GRV is more than half of the previous feeding volume (Evidence C)*.

EN: enteral nutrition; GRV: gastric residual volume. *Evidence definitions in ASPEN 2017 guideline (8): Evidence A = There is good research-based evidence to support the guideline (prospective, randomized studies). Evidence B = There is appropriate research-based evidence to support the guideline (well-designed studies without randomization). Evidence C = Based on guideline, expert opinion, and editorial consensus

EN, reducing the length of hospital stay, and increasing the quality of life.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – D.S., K.A.; Design – D.S., K.A.; Supervision – A.Ş., E.K., K.U.; Resources – D.S., K.A., E.K.; Analiz ve/veya Yorum / Analysis and/or Interpretation – D.S., K.A., K.U., G.K., A.Ş., E.K.; Literature Search – D.S., G.K.; Writing Manuscript – D.S., K.A.; Critical Review – D.S., K.A., K.U., G.K., A.Ş., E.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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