Approach to Oral and Enteral Nutrition (PN) in Adults

Module 8.3

Techniques of Enteral Nutrition

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Learning Objectives

- To know about the different types of tubes and access routes;
- To know when to use which type of tube and access route;
- To understand the indications for the various feeding techniques (oral nutritional supplements, continuous versus bolus versus intermittent tube feeding, minimal enteral nutrition, early enteral feeding);
- To know when and how to use starting regimens;
- To know how to react in case of high gastric reflux.

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Key Messages

- If oral nutrition cannot be maintained artificial enteral nutrition may be indicated using a feeding tube;
- The material and construction of a feeding tube should result in a maximum of safety, comfort and functionality;
- Bacterial contamination of the enteral feeding system has to be avoided;
- Correct placement of the feeding tube in the stomach or upper jejunum has to be controlled to avoid dislocation and aspiration;
- Placement of a feeding tube into the upper jejunum is a special challenge in daily practice;
- Enteral feeding via tube can be delivered as a bolus or continuously, depending on the clinical situation;
• After the start of feeding gastric reflux has been controlled and a treatment algorithm for high gastric reflux should be given;
• The indications for propulsive drugs have to be defined.

1. Introduction

In patients who cannot achieve an adequate oral nutritional intake the indication for specialized nutritional support should be considered. Once the indication for specialized nutritional support is given, decisions about the route (enteral or parenteral) should be made. There is general consensus, that gastrointestinal delivery of nutrients (enteral nutrition, EN) should be preferred whenever possible. In several randomized studies EN, compared to total parenteral nutrition (TPN), is associated with a reduced morbidity, especially reduced infectious complications. For the delivery of EN different routes and methods are available. The general rule is to obtain a maximum of safety and treatment quality for the patient. To reach these goals the process of enteral feeding has to be determined. In addition, diverse technical solutions for EN have been developed like special tubes, feeding pumps, and food container. Therefore, process management as well a high level of structural quality are necessary to provide an optimized nutritional service.

2. Legal Regulation

Enteral delivery systems are medical devices. Directives in the countries regulate the legal requirements for medical devices. There are also recommendations from a EU commission directive.

3. Safety and Quality Standards

3.1 Feeding Tubes and Delivery Systems

Enteral feeding tubes are in contact to skin or mucosal surface; therefore they should be anti-allergic and free of potentially toxic material, which could be absorbed. Material used are polyvinyl, silicone, and polyurethane. Polyvinyl tubes are more rigid, therefore the more flexible and less traumatic silicone or polyurethane tubes are preferred. Tubes should be non-leaching, pliable, and non-stiffing. The connecting systems of enteral and parenteral systems should be different to prevent mistakes, especially, the accidentally parenteral infusion of enteral solutions. Feeding tubes must be strong enough to handle the increased pressure, when a feeding pump is used.

3.2 Hygienic Aspects of Enteral Feeding Systems

Figure 1 Nasogastral feeding tubes with different diameters
Although normal food is not sterile, enteral feeding solutions should be sterile and contamination has to be avoided. Commercial enteral feeding solutions are sterile. Open or closed feeding systems are available. Contamination of feeds can be minimised by minimal, meticulous handling and the use of closed rather than open systems. With increasing length of use, feeding tubes are frequently colonized with bacteria. Although retrograde contamination of the set can be observed, minimising manipulation of the enteral nutrition bags at the bedside is critical for bacterial safety.

**Figure 2 Routes of enteral access for enteral nutrition**

4. Contraindications for Enteral Access

In the following situations EN is contraindicated:
- failure of intestinal function, complete intestinal obstruction;
- high-output intestinal fistula;
- a relative contraindication may be increased likelihood of opportunistic infection (e.g. maxillo-facial surgery);
- ethical considerations (e.g. terminal care).

5. Routes of Enteral Access

Several methods for enteral access for nutritional support are available: nasogastric/nasoenteral tube (NGT/NET), percutaneous endoscopic gastrostomy (PEG), radiological or sonographical guided gastrostomy (PSG), surgical gastrostomy (Witzel fistula), jejunal extended PEG (PEG-J), direct percutaneous endoscopic gastrostomy (PEJ), surgical jejunostomy (direct or fine needle catheter jejunostomy) (Fig. 2). In daily practise nasogastric/nasoenteral tubes, PEG, PEJ, and fine needle catheter jejunostomy are most commonly used. The choice of the feeding route depends on the underlying pathology, anticipated duration, and preference of the patients. Nasogastric feeding is the least expensive and easiest way to gain enteral feeding access and is the preferred route for short time feeding. PEG is usually indicated when the patient is anticipated to need tube feeding for longer than 4 weeks For additional description of feeding tubes and EN related complications see also the following module 8.4 Monitoring and complications of EN
5.1 Nasogastric/Nasoenteric Tube

Nasogastric tube placement is usually a bedside procedure (Fig. 3).

Figure 3 Potential routes for EN

In difficult cases it can be performed with endoscopic or fluoroscopic assistance. Blind insertion has the potential of malposition with tracheal, pulmonary, or pleural positions in 0.5% to 15%, depending on the clinical state of the patient. Especially, patients with absence of cough reflexes (e.g. neurological impairment, coma, old age) have a higher risk of tracheal malposition of the tube. Therefore, the correct tube position must be verified either by aspiration of stomach or bowel content or radiologically.

Figure 4 Placement of a nasogastric/ nasoenteric feeding tube

A special challenge is the postpyloric or jejunal positioning of the feeding tube. Spontaneous transpyloric migration occurs only in 5% - 15% of patients. A protocol consisting of a 10 F tube, a right lateral positioning, gastric insufflation, tube tip angulation, and clockwise torque during insertion results in 70% to 93% in small bowel intubation after 23 to 40 minutes. The use of promotility drugs like metoclopramide or erythromycin may facilitate transpyloric passage of the tube. However, the success rate of this procedure strongly depends on the level of experience of the practitioner.

Transpyloric tube positioning can be effectively done with fluoroscopic or endoscopic assistance. There are further bedside methods described, such as continuous stomach electrocardiogram, electromyogram feedback, or external magnetic guidance, but these methods are rarely available.
Figure 5 Two lumen feeding tube after application of contrast medium. The distal lumen is placed in the small bowel and the proximal lumen drains the stomach.

Using a long guidewire under fluoroscopic assistance a success rate of postpyloric placement has been described in up to 86%, jejunal position can be achieved in approximately 50%. In this method the patient is exposed to radiation for ~20 minutes, and the radiation burden has to be considered.

Endoscopic placement of a postpyloric/jejunal feeding tubes can be done either by the guide-wire or pull-along method. With the pull-along method the tube and the endoscope are placed in the stomach. The tip of the feeding tube is grabbed with a long foreign body forceps and then moved with the endoscope to postpyloric or jejunal position. Then with a pull-push manoeuvre the forceps with the tube stays in the small bowel while the endoscope is replaced. At last the forceps is opened and can carefully retracted. With the guide-wire method a long guide wire is placed through the biopsy channel of an endoscope directly in the small bowel. The endoscope is then withdrawn and a flexible feeding tube is passed over the guide wire. An elegant and atraumatic approach is to perform the guide-wire method with an ultrafine thin transnasal endoscope (5.8 mm). After introducing the feeding tube over the guide, a second endoscopy will be performed in the opposite nostril to confirm NET placement and eliminating need for abdominal radiography. Advantage of endoscopic placement is the additional information on condition of the gastrointestinal mucosa, disadvantage is the increased utilisation of medical and personal resources. Radiological or endoscopical placement are at last equal, therefore, the decision for endoscopic or fluoroscopic assistance should be driven by local experience and facilities.

To obtain jejunal access and gastric drainage feeding tubes with two or three lumen have been developed. While the small distal feeding tube (9 F) is positioned in the duodenum or jejunum, a second larger lumen of the same tube is positioned in the stomach for drainage. The disadvantage of these tubes are their stiffness, therefore, these catheters are predominantly used in intensive care with sedated patients.

5.2 Percutaneous Endoscopic Gastrostomy (PEG)

Basic precondition for a PEG placement is that the endoscopic esophago-gastral passage is possible.

Relative and absolute contraindications for PEG are:
- Relative contraindications;
- Massive ascites;
- Severe portal hypertension;
- Severe hepatomegaly;
- Absolute contraindications;
- Failure of endoscopy due to pharyngeal or oesophageal obstruction;
- Severe coagulopathy;
- Failure for diaphanoscopy.
Three techniques for PEG placement are established: the “pull” method, the “push” method, and the “introducer” method. The most used method is the pull method introduced 1980 by Gauderer et al. (Fig. 4).

After diaphanoscopy by the endoscope to facilitate the direct contact of the stomach to the abdominal wall, the abdominal wall and the anterior stomach wall are punctured by a Seldinger needle. Then a thread is introduced and is grasped by a biopsy forcep and the endoscope with the thread is withdrawn of the patient’s mouth. The feeding tube is attached to the thread and pulled through the patient’s abdominal wall and secured in the stomach by a retaining plate and to the skin by a disk. With the “push” variant a feeding tube is placed over a Seldinger wire. This procedure can also be performed under sonographical or radiological guidance. When a direct puncture of the stomach succeeds, a placement of a feeding tube by the Seldinger technique allows the facilitation of a feeding tube in patients with an obstructed esophago-gastral passage (e.g. tumor obstruction). The “introducer” method use a ballon catheter which is placed transabdominally into the stomach after punction and dilatation according to the Seldinger technique. This technique has an increased risk of misplacing due to deflection of the stomach wall. A new safer “introducer” method has become available, which uses the combination of a double gastropexy with a peel away sheath introducer to place an intragastric ballon catheter, which is externally secured to the skin with a plate. This method may be suitable for patients, where the standard “pull” technique cannot be used because of increased risk during the internal bumper passage through the esophagus.
In the classical pull PEG several studies reported a rate of 13% - 40% minor complications, 0.4% - 4% major complications, and 0% - 1% procedure related mortality.

Complications of PEG are:
- Bleeding 0.6% - 1.2%;
- Tube site infection 3% - 30%;
- Intraperitoneal leakage;
- Perforation of small/large bowel;
- Metastatic head and neck cancer to the PEG exit site (< 1%);
- „Burried bumper“ migration of the internal bumper into the gastric abdominal wall.

There is good evidence, that a peri-interventional antibiotica prophylaxis reduce the risk of wound infections in risk patients (e.g. impaired immune function, ongoing chemotherapy, leukopenia, diabetes, malnutrition). A single administration of a broad spectrum antibiotic 30 min before PEG insertion has been shown to reduce the incidence of peristomal wound infection from 29% to 7%.

To prevent the “burried bumper syndrome” (migration of the internal bumper into the stomach wall) excessive traction applied to the PEG tube should be avoid. In addition, is advisable to mobilize the PEG from outside at least every second day.

**Figure 8 Buried bumper syndrome. Migration of the internal bumper of a PEG into the stomach wall**

Feeding via PEG can be started as early as 6 hours after placement after an uncomplicated PEG procedure.

### 5.3 Skin Level Gastrostomy (Button)

**Figure 9 Button with the external connecting system**
To reduce the stigma of a PEG and to improve the patients’ quality of live, skin level devices for EN were developed, especially for pediatric patients. There are three types of so called “buttons” available with two different retaining elements (balloon and retention dome). The external connecting system can be easily removed and only a small skin level head of the button remains. The indications are the predominantly the patients wish and peristomal problems. To place a button a stoma channel must be established, therefore, the first step is to place a PEG, which than can be changed after 4 weeks to a button system. Initial button placement should be done under endoscopic control, to avoid misplacement and to remove the initially placed PEG. A defect button can be usually replaced without endoscopic advice.

5.4 Percutaneous Endoscopic Jejunostomy (PEG-J or D-PEJ)

Long term jejunal access for EN can be achieved with a duodenal or jejunal extension of an already established PEG (PEG-J) or by direct percutaneous endoscopic jejunalostomy (D-PEJ).

Potential indications for PEG-J or D-PEJ are:
- PEG-J  D-PEJ;
- Vomiting    gastric resection;
- Aspiration    PEG not possible;
- Reflux    recurrent dislocalisation of PEG-J;
- Gastroparesis;
- Gastric outlet stenoses.

Contraindications are the same as in PEG placement (see above).
In case of a PEG-J a 9 F jejunal feeding tube is passed through the previously placed 15 F PEG into the stomach (Fig. 10).

![Image of PEG tube with internal jejunal extension](image)

Figure 10 PEG tube with internal jejunal extension

Then this tube is placed radiologically via a guide wire or endoscopically by the pull along method and moved behind the ligament of Treitz. This is essential to reduce the retrograde migration rate. However, the retrograde tube migration is frequently leading to tube dysfunction caused by kinking and obstruction of the feeding tube. This problem may be overcome by endoscopically placed clips to secure the tip of the jejunal tube and prevent migration. But risk of obstruction due to the small bore 9F lumen still remains. Alternatively the D-PEJ can be performed. According to the “pull” PEG technique an enteroscope or colonoscope is introduced into the small bowel. If diaphanoscopy is present a first puncture through the abdominal and jejunal wall into the jejunal lumen with a 21-gauge anesthesia needle is done. Grasping the tip of the needle with a biopsy forceps helps to stabilize the segment of the jejunum. Using the anesthesia needle as a guide the larger trocar
for the introduction of the thread and placement of the 15 F feeding tube by the pull technique can be placed. In retrospective series technical success has been reported in 72% to 88% of patients. The potential complications are similar to the complications with the PEG procedure.

5.5 Surgical Access
Open surgical access for EN is usually performed by the Witzel technique at the stomach or jejunum. Laparoscopic techniques of direct or percutaneous gastrostomy and jejunostomy have been developed. In general these procedures should be considered in patients in whom endoscopic procedures are not possible.

The fine needle catheter jejunostomy (FNCJ) is a frequently used alternative, especially, when jejunal access is achieved during (upper) abdominal surgery (e.g. gastrectomy). A large-bore needle is tunneled subserosally before entering the jejunal lumen, then a feeding catheter is inserted before the needle is removed. The feeding catheter is fixed with a purse-string tied. Then the catheter is exteriorized through the abdominal wall by a second large-bore needle. At least the jejunal loop with the 9 F feeding catheter is fixed to the abdominal wall.

![Figure 11 Introducing a feeding tube via fine needle catheter jejunostomy](image)

The complications of a FNCJ comprise:
- Tube obstruction due to the small lumen (only 9 F);
- Wound infection;
- Peritoneal leakage;
- Very rarely volvulus;
- Necrosis of small bowel.

6. Management

6.1 Bolus versus Continuous Feeding
There are principal two methods to deliver the enteral feeding solution through the tube: continuous or intermittent (bolus). In critically ill patients the continuous administration via a feeding pump is well established. In awake and mobilised patients the majority of patients can be fed via a gravitation based feeding system. Either a continuous or bolus application of feeding solutions is possible. The decision for either method should take into account the patients individual tolerance and personal wishes. The advantage of a bolus based feeding protocol is that the time for the feeding procedure is reduced and the patients can organise his daily activities more individually. If the patient develop diarrhea or vomiting with bolus application, the patient should switch to continuous feeding, starting with a low feeding rate.

6.2 Approach to a Feeding Protocol
Especially critical care setting, intolerance to EN, defined by high gastric residual (> 250 ml), is a frequent problem. This may result in an increased risk for gastro-esophageal reflux, aspiration associated pneumonia, and inadequate delivery of EN. One basic procedure to avoid reflux and aspiration is positioning of the head in an elevated position of 30 degrees. This has been shown to significantly reduce the incidence of aspiration pneumonia. After initiating EN with a rate of 40-50 ml/h gastric residuals should be checked after 6-8 hours.
The use of promotility drugs are a further attempt to overcome high gastric residuals. Currently two promotility drugs are used in clinical practice. The most widely used one is metoclopramide (10mg every 6 hours), which increase gastric emptying by acting as an inhibitor to the inhibitory effects of dopamine in the gut. The other one is erythromycin, which promotes the motility of the proximal gastrointestinal tract by activating motilin receptors. The usual dose of erythromycin is 200 mg every 8 hours, but there is experimental evidence, that a dose of 70 mg has comparably adequate promotility effects. A one-time dose of erythromycin may facilitate postpyloric feeding tube insertion. The use of motility agents is associated with increased gastric emptying, decreased gastric residual volumes, and improved tolerance to EN. Another attempt to face high gastric residuals and gastroesophageal reflux is duodenal or jejunal feeding via an appropriately positioned feeding tube. Although small bowel feeding may be associated with a reduced rate of pneumonia and an increased rate of appropriate nutrient delivery, nasogastric feeding is preferred for almost all patients. Small bowel feeding is not currently recommended for all patients because the benefits do not appear to outweigh the logistic and cost considerations. Metoclopramide is the preferred prokinetic agent. Nevertheless, when despite using promotility drugs gastrointestinal intolerance develops in a nasogastrically fed patient, a small bowel feeding tube should be inserted at the earliest opportunity.

A feeding protocol (Fig. 6) has the potential to optimize the process quality in EN. The successful implementation of such a protocol requires active dissemination strategies, which includes: (i) use of opinion leaders, (ii) education on different levels, (iii) audit and feedback, (iv) involving of all professional guilds.

Summary
When enteral nutrition is indicated and can not adequately achieved orally enteral access can be assed by nasogastric, nasojejunal or percutaneous routes. Which route should be choosen and how to perform artificial enteral nutrition depends on the clinical circumstances. The general rule is to obtain a maximum of safety and treatment quality for the patient. Nasogastric feeding is the least expensive and easiest way to gain enteral feeding access and is the preferred route for short time feeding. Percutaneous approaches like PEG or PEJ are usually indicated when the patient is anticipated to need tube feeding for longer than 4 weeks. All health care provider involved in enteral nutritional support should be aware of the potential complications and side effects of enteral nutrition under different clinical conditions. The implementation of standard operation protocols for enteral nutritional support improves the quality of enteral nutrition.

References