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EDITORIAL

Post-pyloric feeding

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Abstract

Postpyloric feeding is an important and promising alternative to parenteral nutrition. The indications for this kind of feeding are increasing and include a variety of clinical conditions, such as gastroparesis, acute pancreatitis, gastric outlet stenosis, hyperemesis (including gravida), recurrent aspiration, tracheoesophageal fistula and stenosis in gastroenterostomy. This review discusses the differences between pre- and postpyloric feeding, indications and contraindications, advantages and disadvantages, and provides an overview of the techniques of placement of various postpyloric devices.

Key words: Postpyloric feeding; Nasojejunal feeding; Nasojejunal tube; Jejunostomy; Nasoenteric tube; Percutaneous endoscopic gastrostomy-jejunostomy tube; Percutaneous endoscopic jejunostomy

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INTRODUCTION

According to both European and American guidelines for enteral and parenteral nutrition, enteral feeding is the preferred method of nutritional support in patients who have a functioning gastrointestinal (GI) tract but cannot maintain an adequate oral intake[1,2]. Enteral nutrition prevents GI mucosal atrophy, keeps intestinal integrity and prevents bacterial translocation from the GI lumen to the rest of the body, by maintaining normal permeability of the GI mucosal barrier[3-6]. In addition, it is less expensive and has significantly fewer complications than parenteral nutrition[1,2].

The enteral route traditionally delivered nutrition directly into the stomach *via* a nasogastric tube or gastrostomy (prepyloric feeding). The concept of postpyloric feeding has been developed over the past few decades and has become a part of the routine practice of nutritional teams in many countries. A wide variety of postpyloric nutrition devices are currently available, including different types of nasoduodenal and nasojejunal tubes and jejunostomies.

What are the differences between pre- and postpyloric feeding approaches? Why is the location of the tip of a nutritional device before or after the pylorus so important? The current review will discuss the major differences between these two methods of enteral nutrition in order to provide essential information for every nutritionist and gastroenterologist in making the right choice for every specific case. This review will provide a comprehensive overview of accepted indications and contraindications of postpyloric feeding, based on existing studies and guidelines. In addition, various devices for postpyloric feeding, as well as different techniques for their insertion, their advantages and disadvantages will be discussed.

PHYSIOLOGICAL DIFFERENCES BETWEEN PRE- AND POSTPYLORIC FEEDING

There are several physiological differences between pre- and postpyloric feeding. The first major difference is a mechanical one. Postpyloric delivery of food significantly reduces the likelihood of aspiration/vomiting caused by gastroesophageal reflux, especially in the case of intrajejunal and not intraduodenal feeding. The second major difference is the neurohormonal effect of food that is supplied directly to the small intestine or the duodenum, compared to intragastric supply. It has different effects on pancreatico-biliary secretions and on small bowel and gallbladder motility. Ledeboer *et al*[7] have demonstrated that intraduodenal feeding causes a stronger GI response than intragastric feeding. It stimulates gallbladder

Table 1 Differences between gastric and jejunal feeding

	Nasogastric tube	Nasojejunal tube
Indications	Anorexia, dysphagia, odynophagia	Gastroparesis, gastric outlet obstruction, recurrent aspirations, severe pancreatitis, hyperemesis gravida, proximal enteric fistula, postoperative anastomotic gastroenteric stenosis
Insertion technique	Easy access, no need for endoscopic or radiological study or medication	Needs endoscope or prokinetic agents
Costs	Much cheaper because: 1. low cost of the tube; 2. may be inserted by a nurse	More expensive because: 1. costly equipment; 2. requires insertion by physician
Physiology	More physiological, keep normal motility and hormonal profile	Less controlled motility and hormonal control. Less pancreatic stimulation if inserted after the Trietz ligament
Feeding mode	Bolus or continuous. Pump is not mandatory	Continuous only. Pump is mandatory in most cases
Risk of aspiration	High in patients with GER and swallowing impairments	Less frequent but not absolutely prevented
Clogging rate	Rare thanks to larger diameter of tube	Frequent

contractions, accelerates small bowel transit time, and increases cholecystokinin and pancreatic polypeptide release[7]. Intrajejunal feeding has a completely different effect[8,9]. The classic work in a canine model by Ragins *et al*[10] has demonstrated that jejunal feeding does not stimulate pancreatic secretion, as is seen in intragastric or intraduodenal delivery of food, which increases the volume and changes the content of pancreatic secretions. These results have been supported by animal and human studies on models of acute pancreatitis[11-14].

Unfortunately, almost all these studies have focused on the influence of intrajejunal feeding on the pancreas and failed to address the intriguing issue of its impact on small bowel function. Data on the changes in the levels of relevant hormones and changes in the motor pattern of the small and large intestine are scarce.

Table 1 demonstrates differences between gastric and jejunal feeding.

ACCESS ROUTES FOR POSTPYLORIC FEEDING

The access routes for postpyloric feeding include nasoduodenal and nasojejunal tubes and jejunostomy. Nasoenteric tubes may be placed manually or with endoscopic, radiological or surgical guidance. Nasoenteric tubes are a good choice for short-term feeding but have many drawbacks for long-term management. They tend to recoil into the stomach, become clogged, cause nasal pressure sores, and can be pushed out of place accidentally. As such, jejunostomy is the preferred option for long-term postpyloric feeding. Feeding by jejunostomy generally requires surgical placement, although endoscopic or fluoroscopic placement for jejunostomy has been successful in some medical centers with adequate experience[15,16]. In cases for which a surgical jejunostomy is considered, the benefits and tolerability of surgical jejunostomy and postpyloric feeding can be assessed by temporarily placing a nasojejunal tube or by inserting a jejunal extension of a percutaneous endoscopic gastrostomy-jejunostomy (PEG-J).

There are several kinds of nasoenteric tubes made from various materials (e.g. polyurethane and polyvinylchloride), that have different diameters (8-12 French), with and without guide wires, and with and without weight at their tips. Unweighted tubes of smaller diameter (8 French) are used for endoscopic insertion to ensure a proper passage through a working channel of the endoscope. The length of a nasoenteric tube ranges from 140 cm to 220 cm.

Nasoduodenal tubes and duodenostomies have been in common use in the past, but cumulative experience has shown that the duodenal route is very problematic because of the tendency of a nasoduodenal tube to recoil back into the stomach, as well as the strong stimulatory effect of intraduodenal feeding on pancreatic secretions[7]. In addition, a feeding formula tends to flow to the stomach because of duodenogastric reflux[17-19]. Thus, intraduodenal feeding is contraindicated in the setting of recurrent aspiration and severe pancreatitis, which are the most common indications for postpyloric feeding. As a result, intraduodenal feeding is no longer routinely used in most medical centers and will not be discussed further.

INDICATIONS FOR POSTPYLORIC FEEDING

There are several clinical situations in which postpyloric feeding is preferable to the intragastric route. One of most common indications is gastroparesis that is not responsive to prokinetics[20,21]. This situation is most frequently encountered in the early postoperative setting or in critical care patients. Theoretically, postpyloric feeding would appear to be an attractive option in critically ill patients because of the frequently present problems of gastroparesis and aspirations[22-25]. It is, however, associated with significant cost and risks of nasojejunal tube insertion. It has been accepted widely in the past that every critically ill patient should be fed postpylorically, and this approach has been investigated in many studies and meta-analyses[26-29]. One of the most interesting of these was by Montejo *et al*[30], who conducted a multicenter, prospective, randomized, single-blind study on 110 patients with similar characteristics who were randomized to be fed pre- or postpylorically. The authors concluded that the nutritional results were similar in both groups, and therefore, the routine use of a nasojejunal tube in critically ill patients is not justified. It may, however, have a role in selected patients with high gastric residuals on nasogastric feeding, or

with various conditions of the GI tract, such as severe pancreatitis. Boulton-Jones *et al*[31] have investigated postpyloric feeding in selected groups of 138 critically ill patients who suffered from burn injury, severe pancreatitis, sepsis, postoperative gastroparesis, and vomiting induced by bone marrow transplantation and chemotherapy. The results of that study demonstrated good nutritional results in all the patients. On the basis of these and additional studies that have been published since then, the current European and American guidelines for enteral and parenteral nutrition[1,2] support nasojejunal feeding only in selected groups of critically ill patients with one of indications mentioned in this section (i.e. gastroparesis, recurrent aspirations, severe hyperemesis, and severe acute pancreatitis).

Another common indication for postpyloric feeding is recurrent aspiration caused by severe gastroesophageal reflux disease (GERD) in bedridden patients[22,23]. One of the classic studies on this subject was by Montecalvo *et al*[22]. Thirty-eight patients were randomly assigned to feeding by nasogastric or nasojejunal tube. There were no documented aspirations in the postpyloric feeding group compared to two aspirations in the nasojejunal tube group. It is important to define whether episodes of aspiration are truly caused by GERD or are the result of disorders in swallowing.

Nasojejunal tube insertion has become routine practice in many hospitals in cases of severe pancreatitis. This kind of feeding enables the provision of enteral nutrition with less stimulation of pancreatic secretions and less exacerbation of inflammation in the pancreas. There are four phases of pancreatic secretions: (1) basal - very little pancreatic secretion during fasting; (2) cephalic - mildly increased secretion when the individual looks at food; (3) gastric - increased pancreatic secretion initiated by gastric distention with food and mediated by gastrin and acid; and (4) duodenal - extensive stimulation of pancreatic secretions initiated by the entry of chyme and acid into the duodenum, and mediated by secretin and cholecystokinin. The classic work of Ragins *et al*[10] in a canine model has demonstrated that intragastric or intraduodenal delivery of food increases the volume and changes the content of pancreatic secretions. In contrast, jejunal feeding does not stimulate pancreatic secretions[11,32]. Since it is very important to provide pancreatic rest during acute pancreatitis, the idea of intrajejunal feeding has become very attractive and it has been investigated in animal models of acute pancreatitis[33] and in several prospective randomized controlled human studies that have compared nasojejunal feeding with total parenteral nutrition (TPN)[12,13,34]. The consensus is that nasojejunal feeding has a good and even better clinical outcome and time of recovery from severe pancreatitis than those with TPN[32]. Moreover, TPN is more expensive and associated with more complications than intrajejunal feeding, giving further advantage to the latter. There have been only a few studies on the formula of choice for nasojejunal feeding in severe pancreatitis[35-37]. Most of these studies support polymeric formulas, but some show advantages for elemental or semi-elemental formulas. Polymeric formulas are preferred in most centers because of their lower cost.

A rare but important indication is a proximal enteric fistula. For example, if a fistula is located in the esophagus/stomach/duodenum (usually tracheo-esophageal fistula), a nasojejunal tube will supply food more distally and make it possible to provide food enterally as an alternative to parenteral nutrition.

A relatively newly defined indication is hyperemesis gravida. Parenteral nutrition had previously been indicated in some cases of severe hyperemesis gravida with significant weight loss. Two small studies have described the possibility of nasoenteric tube feeding in these women[38,39]. A pioneer study by Vaisman *et al*[40] has examined the feasibility and efficacy of nasojejunal feeding in 11 pregnant women with severe hyperemesis gravida that persisted despite in-hospital anti-emetic treatment. The nasojejunal feeding approach proved to be effective, reducing vomiting within the first 48 h, with complete resolution after 5 d in most of the women. More prospective studies are needed to validate this promising method.

Postpyloric feeding is the only route for enteral feeding in pyloric or duodenal outlet stenosis. This condition is common in malnourished oncological patients with gastric or pancreatic cancers who are waiting for definitive or palliative surgery, and who are required to improve their nutritional status prior to undergoing surgery.

Another common situation is the postoperative setting after Bilroth Ⅱ or Whipple procedures. Postoperative transient edema in a gastroenteric anastomosis might create a significant problem in gastric emptying. Temporary insertion of a nasojejunal tube below the anastomosis will provide an enteral feeding route for these patients until the edema resolves[41]. In some cases of difficult GI anastomosis, the preventive intraoperative insertion of a nasojejunal tube is recommended to enable early postoperative enteral feeding.

CONTRAINDICATIONS FOR POSTPYLORIC FEEDING

The major contraindication for postpyloric feeding is an obstruction in different parts of the GI tract (esophagus, gastric outlet or intestine). An endoscopic nasojejunal tube or an endoscopic jejunostomy are contraindicated in some clinical scenarios because of the inability of inserting the gastroscope postpylorically, but surgical jejunostomy may still be indicated, as in the case of complete obstruction of the esophagus/stomach/duodenum. Endoscopic nasojejunal tube insertion may nevertheless be an option in some cases of partial obstruction of the upper GI tract because it is possible to push the tip of the tube far beyond the location of the endoscope, and the procedure might even be done blindly beyond a visible stricture. The feasibility of inserting an endoscopic nasojejunal tube depends on the degree of stenosis. Even a pinpoint passage that is sufficient for passage of a guide wire permits the insertion of a nasojejunal tube. Of course, surgical jejunostomy does not require any passage of an endoscope through the GI tract, which provides more

possibilities for applying this kind of technique.

The most important absolute contraindication for all kinds of postpyloric feeding is bowel obstruction or perforation/leakage. Therefore, exact information about the GI tract's mechanical problems, previous GI tract surgery, imaging of the GI tract and verification of GI tract patency must be obtained before postpyloric feeding can be considered.

Contraindications for jejunostomy, but not for a nasojejunal tube, are significant ascites, coagulopathy, peritoneal dialysis, and peritoneal metastasis. For endoscopic insertion of jejunostomy, there are additional contraindications, such as morbid obesity and the inability to transilluminate through the abdominal wall or to see a digital imprint.

TECHNIQUES OF INSERTION

Nasoenteric tube placement

Nasoenteric tubes may be placed by using manual (blind) techniques or with the aid of fluoroscopy or endoscopy[42]. Nasojejunal tubes for surgical patients may be placed during laparotomy. There are several manual techniques for nasojejunal tube placement. Usually, a nasoenteric tube (8-9 French) is inserted with a guide wire and a weighted tip is inserted into the stomach using the usual technique for nasogastric tube insertion. The patient is then asked to change his/her position to right lateral decubitus and the tube is pushed through the pylorus. The guide wire should be removed at the end of the procedure[43]. Several techniques have been developed to facilitate the passage of the tube through the pylorus, among them air insufflation of the stomach[44,45], pH-sensor feeding tube guidance[46,47], and prokinetic agents, such as intravenous erythromycin (250-500 mg)[48-51] or 10 mg metoclopramide[52-54]. For example, a very interesting randomized, double-blind, placebo-controlled study has been published by Griffith *et al*[51]. Thirty-six critical ill patients were randomized to receive a single bolus of intravenous erythromycin (500 mg) or saline before placement of 10-French feeding tubes, using a standardized active bedside protocol. The conclusion of the study was very impressive, with a 93% success rate in the erythromycin group *versus* 55% in the placebo group. In contrast, a study by Gharpure *et al*[50], with a similar design, on a group of critically ill children demonstrated no clinical advantage with intravenous erythromycin (10 mg/kg) *versus* saline in facilitation of transpyloric passage of nasojejunal tubes.

There is no consensus on the best technique of manual insertion of a nasojejunal tube because of the great variety of success rates (30%-95%) reported in many studies carried out in different centers[44,46,48,52]. The advantage of weighted over unweighted tubes is uncertain[55], although it is a widely accepted belief.

The nasojejunal feeding tube is commonly placed endoscopically, which allows placement under direct vision[56-59]. Its major disadvantage is the requirement of a complete gastroscopy, which increases the cost and duration of the procedure, the risks related to intravenous sedation, and the number of possible complications associated with gastroscopy, such as perforation and dental injury. The high success rate of this procedure (93%-98%), however, makes it very attractive[56-59]. The technique is simple: after a gastroscope is placed deeply in the duodenum, a flexible unweighted 8-French nasojejunal tube with a guide wire is advanced through a working channel of the endoscope and pushed deep into the jejunum, beyond the tip of the endoscope during simultaneous withdrawal of the endoscope. When the procedure has been completed, the guide wire is removed and a feeding tube is passed from the mouth to the nose by means of a plastic device. Some centers also use a drag technique in which a suture is tied to the end of a feeding tube, which is then passed into the stomach *via* the nasopharynx. This suture is dragged with the endoscope snare or forceps from the stomach to the duodenum. Once the tube is in position, the suture is released and the endoscope is withdrawn. This procedure is less successful because the feeding tube frequently moves back into the stomach when the endoscope is removed.

A new technique of nasoenteric tube insertion has become very popular. It involves a transnasal thin endoscope that is inserted transnasally into the stomach and then into the duodenum[60-62]. A thin guide wire is inserted though a working channel while the endoscope is removed, after which a feeding tube is placed over the guide wire, which is then removed.

Fluoroscopic techniques of nasoenteric tube placement require skilled radiological support and exposure to radiation. In addition, they necessitate changes in the patient's position that may not be feasible for the critically ill. The success rate of radiological placement varies from 40% to 94%, depending on the local expertise of the staff in different medical centers[57,63-65].

Whatever the technique that is used for nasojejunal tube placement, proper position of the nasoenteric feeding tubes must be verified radiographically before the feeding is initiated[66]. Clinicians should not rely on the accepted ways of checking nasogastric tube position, because it is impossible to adequately hear the entrance of air injected through the tube into the jejunum, and to distinguish its erroneous placement in the stomach/esophagus/lungs. In addition, air insufflation of the jejunum is unsafe.

Jejunostomy placement

Most jejunostomies are placed at least 20 cm beyond the ligament of Treitz (a point of transition of the duodenum to the jejunum) because of the increased rate of complications of duodenostomy compared with jejunostomy. A jejunostomy may be inserted with endoscopic assistance (percutaneous endoscopic jejunostomy; PEJ) or surgically (surgical jejunostomy). A PEJ may be inserted indirectly *via* a previously placed gastrostomy (PEG-J)[16,67,68] or directly[15,69-71].

For the placement of a PEG-J, a feeding tube long enough to pass beyond the pylorus is inserted through an existing PEG tube. The tip of the feeding tube is then grasped with the biopsy forceps of the endoscope and the tube is pushed as far as possible into the duodenum. Extra tubing length is left within the stomach to allow peristalsis to pull the tip of the feeding tube past the

ligament of Treitz. Although this procedure is simple, its major disadvantage is the tendency of the feeding tube to return back into the stomach during the withdrawal of the gastroscope. In addition, the feeding tube tends to dislodge from the outer gastrostomy.

An enteroscope or colonoscope should be placed into the proximal jejunum for direct PEJ placement[15,69-71]. One of the most common techniques[70] includes the insertion of a 19-gauge needle into the jejunal lumen at the site of the transillumination or a finger indentation marking the jejunal loop that is closest to the abdominal wall. The needle should be snared tightly, fixing the small bowel against the abdominal wall. The plastic sheath with stylet should then be inserted adjacent to the 19-gauge needle and snared by a wire loop that has been removed from the needle. An insertion wire should then be passed through the plastic sheath and grasped with a snare. The rest of the procedure is similar to the PEG's pull technique: the gastroscope together with a wire is pulled out through the duodenum, stomach, esophagus and mouth. The insertion wire is then secured to the loop at the end of the feeding tube with an internal jejunal bolster and the assembly is pulled through the mouth all the way to the duodenum. The tube is pulled through an incision in the abdominal wall, sufficiently tight to compress the jejunal wall against the anterior abdominal wall. Intrajejunal tube placement is then verified by a second gastroscopy. Finally, a skin disk is secured to the outside portion of the feeding tube to ensure the creation of a tract between the skin and jejunal lumen. It is important to avoid excess tension when approximating the jejunum to the abdominal wall, so as to prevent pressure sores of the skin or jejunal mucosa.

For patients in whom endoscopy is contraindicated, jejunal feeding tubes can be placed with radiological guidance[72]. Access is obtained at a previous gastrostomy site[73] or by direct jejunal punctures[74]. With this method, the stomach and the jejunum are insufflated with air *via* a nasogastric or nasojejunal tube, and the location of internal organs is identified by means of ultrasound or fluoroscopy to ensure that no organs lie between the jejunum and the abdominal wall. A needle is inserted through the abdominal wall into the jejunal lumen and a guide wire is inserted through the needle. The needle is removed, the tract is dilated, and a feeding tube is placed over the guide wire and secured.

Surgical placement of a jejunostomy can be performed by a needle catheter or by Witzel techniques. A needle catheter jejunostomy is placed during laparotomy for surgical patients who need short-term enteral support[75,76]. A purse-string suture is placed in the bowel wall, through which a large-bore needle is tunneled subserosally for several centimeters before entering the bowel lumen. A 5-, 7-, or 9-French feeding catheter with a flexible stylet is inserted through this needle and advanced distally into the bowel. The needle is removed and the purse string is tied. Next, a 3-5 cm Witzel tunnel is created in the abdominal wall proximal to the catheter insertion. A second large-bore needle is inserted through the abdominal wall and the feeding catheter and stylet are passed through the needle to the skin. The needle and stylet are then removed and the intestine is fastened to the anterior abdominal wall to prevent leakage.

The Witzel jejunostomy is another open-surgery method. A tube is placed through an incision in the anterior abdominal wall and a tunneled incision is made in the jejunal wall. The adherence of jejunum to the abdominal wall is ensured by sutures[77].

Some centers perform laparoscopic jejunostomy. Duh *et al*[78] have used this technique in 36 patients who could not undergo gastrostomy, with a good rate of success.

COMPLICATIONS AND DISADVANTAGES OF POSTPYLORIC FEEDING

There are various complications of postpyloric feeding. Some of them are specific to a specific device (nasojejunal tube *versus* jejunostomy) and others are universal for all kinds of postpyloric feeding techniques. Tables 2 and 3 specify common and uncommon complications of nasojejunal and jejunostomy feedings. The common complications of nasojejunal tubes are as follows: failure of nasojejunal tube placement (the rate depends on the technique of insertion), displacement of the tube, clogging of the tube, mild transient epistaxis, nasal mucosal irritation, feeding-related diarrhea, abdominal cramping, and hyperglycemia[79]. The common complications of jejunostomy include pain and infection at the jejunostomy site, displacement of the jejunostomy, clogging, feeding-related diarrhea, abdominal cramping, hyperglycemia, transient pneumoperitoneum immediately after the insertion (in most cases, without any clinical significance), and leakage around the jejunostomy site[80,81]. It is essential to take into account any existing risks of intravenous sedation and gastroscopy as well as the risks of anesthesia and surgery. There is a possibility that the patient will experience abdominal cramping, hyperperistalsis and diarrhea whatever device is used for this kind of feeding. The considerable costs of postpyloric devices compared to prepyloric ones need to be taken into account as well[82].

Although the list of possible complications is a long one, most of them might be successfully avoided by using proper techniques of placement and management of the post-pyloric devices. For example, a misplacement of a nasojejunal tube and subsequent aspiration may be detected and avoided by radiological verification of the tube's location before feeding is started[66]. The displacement of a nasojejunal tube may be prevented by proper fixation. Nasoenteric tubes tend to be blocked because they are usually longer and of finer bore. They are especially susceptible to being obstructed by crushed medications, viscous feeds and inadequate flushing. Therefore, these tubes should be flushed every 4-6 h, always before and after usage, and dense feeds and medications should be avoided. In the event of clogging, a tube can usually be unblocked by flushing it with hot water, coca-cola or pancreatic enzymes. The sudden influx of a hyperosmotic formula is likely to lead to abdominal cramping, hyperperistalsis and diarrhea since the jejunum relies on controlled delivery of isotonic substrates. An intrajejunal feeding is less physiological compared with an intragastric one. The ability of the

Table 2 Potential complications of nasojejunal tube feeding

Common (> 10%)
Failure of placement[1]
Displacement
Clogging of the tube
Mild transient epistaxis
Irritation of nasal, pharyngeal or esophageal areas
Feeding-related diarrhea
Abdominal cramping
Metabolic complication, such as hyperglycemia
Uncommon (< 10%)
Otitis media
Nasal mucosal pressure sores
Esophageal ulcers
Risks of intravenous sedation and gastroscopy
Sinusitis
Misplacement (pulmonary or intracranial intubation)
Dumping-like symptoms

[1]Depends on the technique of insertion.

stomach to distend and contain a large amount of food all at once is a great advantage compared to the limited distension capability of the jejunum. Some patients who are fed postpylorically may develop symptoms similar to dumping syndrome, i.e. faintness, palpitations, sweating, tachycardia, rebound hypoglycemia, and diarrhea. Therefore, intrajejunal feeding should always be carried out continuously by pump and not by boluses[42]. The recommended actions for cases of diarrhea are to exclude other possible causes, to decrease the rate of feeding, and to consider a change in formula to a less osmotic one and one that contains fibers.

FORMULAS FOR POSTPYLORIC FEEDING

The mode of administration, the appropriate formula and the rate of administration are important features for successful postpyloric feeding. The preferable kind of formula has yet to be determined, and there are few studies that have addressed this issue[35,36,83,84]. Some of them advocate elemental and semi-elemental feeds and others support polymeric solutions. Lacking sufficient data, each medical center develops its own protocol.

Postpyloric feeds for children have traditionally been elemental or hydrolyzed and less viscous because of the narrow lumen of the tubes needed to pass the pylorus, although polymeric feeds have also been tolerated[85]. For adults, polymeric formulas are usually chosen except for patients with malabsorptive disorders or lymph duct problems.

As mentioned earlier, the sudden influx of a hyperosmotic feed is likely to lead to abdominal cramping, hyperperistalsis, diarrhea and symptoms similar to dumping syndrome, since the jejunum relies on a controlled delivery of isotonic substrates. It is worth repeating that postpyloric feeds should be administered continuously by pump. The initial rate of administration should be slow and increased gradually. Parenteral support is sometimes used as caloric intake is gradually increased until the target caloric intake has been reached.

Table 3 Potential complications of jejunostomy feeding

Common (> 10%)
Pain at the jejunostomy site
Skin infection of the jejunostomy site
Feeding-related diarrhea
Abdominal cramping
Clogging of tube
Transient pneumoperitoneum immediately after the insertion (but it has no clinical significance in most cases)
Metabolic complication, such as hyperglycemia
Displacement of jejunostomy
Leakage around the jejunostomy
Uncommon (< 10%)
Failure of placement
Misplacement
Gastric hemmorhage
Perforation of internal organs during the placement and peritonitis
Colocutaneous fistula
Persistent jejunocutaneous fistula after the removal of jejunostomy
Risks of intravenous sedation and gastroscopy or risks of anesthesia and surgery
Hemorrhage at jejunostomy site
Pressure sore due to skin disk of jejunostomy
Dumping-like symptoms

CONCLUSION

The postpyloric route is a promising method of enteral feeding. In some cases, it is the only feasible way of maintaining enteral input and avoiding parenteral nutrition. Knowledge on the indications, contraindications, advantages and disadvantages and experience with the placement and replacement of different kinds of postpyloric devices should be an essential part of training of gastroenterologists and nutritionists. Further research on the physiological differences between intragastric and intra-jejunal food supply, including hormonal and enzymatic changes, is warranted.

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