



Jejunostomy: Techniques, Indications, and Complications

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Abstract. Jejunostomy is a surgical procedure by which a tube is situated in the lumen of the proximal jejunum, primarily to administer nutrition. There are many techniques used for jejunostomy: longitudinal Witzel, transverse Witzel, open gastrojejunostomy, needle catheter technique, percutaneous endoscopy, and laparoscopy. The principal indication for a jejunostomy is as an additional procedure during major surgery of the upper digestive tract, where irrespective of the pathology or surgical procedures of the esophagus, stomach, duodenum, pancreas, liver, and biliary tracts, nutrition can be infused at the level of the jejunum. It is also used in laparotomy patients in whom a complicated postoperative recovery is expected, those with a prolonged fasting period, those in a hypercatabolic state, or those who will subsequently need chemotherapy or radiotherapy. As a sole procedure it is advised for neurologic and congenital illnesses, in geriatric patients who pose difficult care demands, and for patients with tumors of the head and neck. The complications seen with jejunostomy can be mechanical, infectious, gastrointestinal, or metabolic. The rate of technical complications of the Witzel longitudinal technique is 2.1%, for the transverse Witzel up to 6.6%, for the Roux-en-Y 21%, for open gastrojejunostomy from 2%, and for the needle catheter technique from 1.5% with 0.14% mortality. The percutaneous endoscopic procedures have as much as a 12% complication rate; no figures exist for laparoscopy. The complications are moderate and severe: tube dislocation, obstruction or migration of the tube, cutaneous or intraabdominal abscesses, enterocutaneous fistulas, pneumatosis, occlusion, and intestinal ischemia. The infectious complications are aspiration pneumonia and contamination of the diet. The gastrointestinal complications are diarrhea 2.3% to 6.8%, abdominal distension, colic, constipation, nausea, and vomiting. The metabolic complications are hyperglycemia 29%, hypokalemia 50%, water and electrolyte imbalance, hypophosphatemia, and hypomagnesemia. These complications are secondary to inadequate selection of nutrition relative to the characteristics of the patient, to inadequate management of the mixture, and to deficient clinical care. The ideal jejunostomy technique depends on the material resources but more importantly on the experience of the surgeon. The benefits of jejunostomy justify the risks.

Jejunostomy is a surgical procedure by which a tube is situated in the lumen of the proximal jejunum, primarily to administer nutrients or sometimes medications and on rare occasions to aspirate intestinal contents. The first to accomplish a jejunostomy for nutritional purposes was Bush in 1858 in a patient with

nonoperable gastric cancer [1]. In 1878 Surmay de Havre exposed the jejunum and by means of an enterostomy introduced a tube for the purpose of feeding [2]. In 1891 Witzel described the most well known technique for jejunostomy, and it has undergone diverse modification, such as those adopted by Coffey and Albert. A definitive jejunostomy is that done by the Roux-en-Y technique [3]. In 1973 Delany et al. reported a needle catheter technique with a thin tube that before entering the intestinal lumen passed through a tunnel formed in the seromuscular space of the intestinal wall [4]. Another form of jejunostomy is that which places the tube in the lumen of the jejunum by means of a classic laparotomy gastrostomy. Gauderer et al. in 1980 and Ponsky and Gauderer in 1981 described a percutaneous endoscopic gastrostomy that gave rise to the endoscopic gastrojejunostomy [5, 6]. By 1990 minimal invasive surgery had appeared, and diverse options for jejunostomy by laparoscopy were described [7–11].

Justification

Throughout the centuries it has been accepted that a good level of nutritional is related to satisfactory health, and in recent years this concept has been corroborated. Studies by numerous investigators stand out; among them studies by Moore and Rhoads are important as are those of Dudrick during the latter half of the 1960s, who demonstrated that it is possible to nourish the patient completely and for prolonged periods by endovenous means. His finding has benefited many patients [12]. Our enthusiasm caused us momentarily to forget enteral nutrition, which is today returning to its rightful place: *To provide nutritional support the enteral route should be selected as the first option, even though we may be dealing with an intestine that is partially limited in function and length.* Many factors support this premise, among which the principal ones are as follows.

1. The modern surgeon better understands the metabolic and inflammatory response to trauma suffered by the surgical patient [13].
2. To date, it has not been demonstrated that fasting is compatible with health and, on the contrary, aggravates illness. Various authors have mentioned the repercussions of under-

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nourishment in the postoperative patient, including serious complications and prolonged hospital stay [14].

3. It has been demonstrated that among the patients who enter the hospital 15% to 65% present with alterations in the parameters of nutritional evaluation, and that once hospitalized for an obligated or indicated fast 50% to 100% become undernourished, aggravating their nutritional state, the fast, the infection, and the repeated surgical trauma [15].
4. It has been demonstrated that after major surgery or multi-systemic trauma, the small intestine maintains its peristaltic and absorptive capacity, which is not the case for the stomach and colon [16].
5. If the oral route is contraindicated but the patient requires enteral nutrition, jejunostomy is a good method for avoiding aspiration. Placing the feeding tube more distal to the ligament of Treitz minimizes the risk of gastroesophageal reflux and bronchial aspiration compared to a gastric tube [17].
6. Independent of the illness from which the patient suffers, the intestine should be used at the earliest moment, as the aphorism that an unused organ atrophies is a reality in this case. The intestine has multiple functions: digestion and absorption of nutrients, production of enzymes and hormones, and peristaltic movements. Great importance is also given to immunologic function. All of these functions decrease in the undernourished patient or in one whose intestinal lumen is not stimulated by nutrients. The patient then develops alterations in digestion and absorption, intestinal ileum, abdominal distension, intestinal atrophy, and bacterial translocation [18, 19].
7. Enteral nutrition, depending on the patient, can be administered in complete form, complementary form, or solely as a stimulus for intestinal trophism.
8. It has been demonstrated that enteral administration of nutrients improves the parameters of the nutritional evaluation (anthropometric, biochemical, immunologic, and functional) and decreases the morbidity-mortality of the critically ill patient with multiple trauma and immune depression [20].
9. Having access to industrialized food with known formulas and varied, stable, and sterile liquids, easily absorbed, allows us to select the appropriate nutritional product for the metabolic characteristics of the patient and to infuse them via thin tubes in the desired quantity and concentration.
10. There has been a notable technologic development in the equipment needed to administer enteral nutrition, among which are tubes, bags, and infusion pumps. All serve to make the procedure easier and to reduce complications.
11. From the surgeon's point of view, advances in the jejunostomy technique cause it to be less traumatic, more functional and efficacious, and able to nourish the patient during the immediate postoperative period and for prolonged lengths of time [21–23].
12. In addition, enteral nutrition offers advantages over parenteral nutrition [24].
 - a. It is the natural and physiologic route for nutrition.
 - b. The enteral diet can be only one product; for more specialized cases, there are enriched products.
 - c. These patients do not require a central venous catheter, avoiding pleuropulmonary accidents and catheter sepsis.
 - d. The enteral formulas favor early withdrawal of parenteral nutrition and can be administered for prolonged periods.

- e. The care that enteral nutrition requires is less, and the complications are normally easier to control.
- f. The patient adapts quickly to the enteral nutrition both in the hospital and at home.
- g. The cost of the enteral nutrition is less than that of parenteral nutrition.

Surgical Techniques

Jejunostomy can be performed by a number of techniques [2, 3, 6, 11, 25–27].

1. Laparotomy
 - a. Longitudinal and transverse Witzel
 - b. Roux-en-Y
 - c. Needle catheter technique
 - d. Jejunostomy by open gastrostomy
2. Percutaneous endoscopy
 - a. Gastrojejunostomy
 - b. Direct jejunostomy
3. Laparoscopy

Indications

Jejunostomy is considered for enteral nutrition in cases where the oral route is impossible or insufficient for use, if all possibilities for a nasoenteral tube have been exhausted, when the length of time will be more than 6 weeks, and perioperatively for upper digestive tract surgery where we expect recovery to involve a prolonged fast and complications.

The primary indication for a jejunostomy for enteral nutrition is as an additional surgical procedure in patients undergoing major surgery of the upper digestive tract (esophagus, stomach, duodenum, liver, biliary ducts, gallbladder, pancreas) where irrespective of the pathology or after the surgical procedure (e.g., gastric ascension, gastrectomy, biliodigestive derivation, pancreatectomy) a jejunostomy is effected through which the nutrients can be infused beginning during the postoperative period. Above all, it is indicated when the postoperative period is expected to be difficult, with a prolonged fast, gastric atony, dysfunction of the anastomosis, postoperative pancreatitis, or probable complications such as residual sepsis, enterocutaneous fistulas, or dehiscence of the anastomosis, which retards and impedes the provision of proper nutrition. Other candidates for jejunostomy are those who are hypermetabolic or hypercatabolic, such as patients with malignant neoplasias, those who are septic or polytraumatized, those with cancer who require chemotherapy or radiotherapy during the postoperative period, moderately to severely malnourished patients, the intraabdominal organ transplant patient, and the immune depressed patient. For all of the previously mentioned cases, there is sufficient literature to support the benefits obtained by adequate enteral nutrition early during the postoperative period.

Myers et al. presented a sample that is interesting for analyzing the indications. They performed 2022 subserous jejunostomies, of which 1813 (89.7%) were done as an additional technique during major elective abdominal surgery, 117 (5.8%) as an additional technique but in reintervention surgery for abdominal complications, and 92 (4.5%) as a sole surgical technique. Of the 1813 from the first group, 867 (48%) were secondary to major surgery of the upper digestive tract, 391 (22%) were done in preexisting under-

nourished patients, 325 (18%) in cases of multisystemic trauma, and 240 (13%) for other diverse indications [28].

A second group of patients are those in whom jejunostomy is performed as a sole surgical or endoscopic procedure and who must be fed for a prolonged time: (1) Patients with neurologic problems, a deficit in the state of consciousness, or problems with deglutition, mastication, or gastric motility. (2) Patients with problems emptying the stomach and who maintain a high gastric residual volume (> 200 ml), as is the case with diabetic gastropathy. Fontana and Barnett observed ketoacidosis and frequent hospitalizations for inadequate ingestion of nutrients; jejunostomy was indicated when these patients were refractory to medical treatment. They studied 25 patients with an average age of 31 years who suffered from neuropathy, retinopathy, and nephropathy. They provided nutrition by jejunostomy for an average of 20 months, whereupon the nausea and vomiting was alleviated in 39%. They had a lower frequency of hospitalization in 52%. Altogether 56% had an improvement in their nutritional state, and in 83% the overall status improved [29].

Another indication for jejunostomy is in pediatric patients with congenital problems of the esophagus and stomach, severe neurologic damage, cystic fibrosis, or multiple trauma. DiLorenzo et al. advised its use in children with chronic pseudoobstruction of the intestines in whom manometry was done and complex migratory motor demonstrated [30].

Jejunostomy is also of use in all undernourished patients in whom it is difficult to establish an adequate oral route and who have as a common denominator problems passing the nutrients (cancer of the head and neck, geriatric patients with difficult care needs) and overall problems of gastroesophageal reflux with aspiration that leads to repeated bouts of pneumonia. Myers et al. reported that 2022 needle catheter jejunostomies were done as a primary procedure and 1813 (86.9%) as a procedure added to major surgery: 47% were operations on the upper digestive tract, 21% in patients previously undernourished, and 18% in patients with multisystemic trauma. In another 117 cases (5.9% of the total cases) jejunostomy was performed as an additional procedure during reintervention surgery; the remainder 92 (4.5%) were the sole surgical procedure.

In this second group, the jejunostomies can be done by open surgery, endoscopy, or laparoscopy. The technique of choice, if there are trained personnel and adequate equipment, is percutaneous endoscopy, as it avoids the need for laparotomy. Bell, of the University of Toronto, performed 507 percutaneous endoscopic gastrojejunostomies (PEGJ), with a 95.1% success rate; it was not feasible in 2.1%, and the tube could not be advanced from the stomach to the jejunum in 2.8%. Stuart et al.'s patients had an average age of 64.5 years, and the indications were neurologic problems, 255 (45%); malignant disease of the head and neck, 176 (31%); disease of the gastrointestinal tract, 73 (13%); pulmonary disease, 20 (4%); psychiatric disease, 11 (2.3%); and decompression of the digestive tract, 14 (2.4%) [31]. Indirect percutaneous endoscopic jejunostomy (IPEJ) in patients with previous gastrojejunostomy is indicated when complications exist after major surgery of the upper digestive tract, such as late-appearing biliary fistulas, pancreatic or gastric changes in conduct that impede good oral ingestion, gastrointestinal obstruction proximal to the jejunostomy, or gastric stasis [26]. Direct percutaneous endoscopic jejunostomy (DPEJ) is indicated in patients operated for malignant problems of the upper digestive tract and who present with

aspiration or problems due to an upper obstruction. Shike et al. in 150 patients, all with cancer and an average age of 63 years, mentioned the following indications: upper digestive tract cancer 70%, leukemia 7%, gynecologic tumors 6%, and other types of cancer 17%. They were successful in 86%, with a higher success rate in patients who had had a previous gastric derivation. The procedure failed in 14% of the cases [32].

It is important to mention that when an endoscopic procedure is undertaken all of the patients should be evaluated with hepatic ultrasonography and fluoroscopy to demonstrate that there are no impediments to the technique, such as superposition of the liver or colon on the stomach, elevated gastric position, ascites, or esophageal or gastric stenosis. If the percutaneous procedures are contraindicated or were ineffectual, an open jejunostomy or laparoscopy should be performed. Laparoscopic procedures are preferred. They are less aggressive, less painful, and shorten the recuperation period. They are carried out in patients in whom all possibility for nasoenteral tubes have been exhausted. In these patients the percutaneous procedure is contraindicated and gastrostomy is not advised because of severe gastroesophageal reflux with aspiration and pneumonia, with or without problems of gastric emptying, when the stomach has been operated, and when it is necessary to keep the stomach intact for an upcoming surgical technique (stomach ascension or an inverted gastric tube).

We use the following steps for selection (Fig. 1):

1. We prefer enteral nutrition as an obligatory option and supplement it when necessary with parenteral nutrition.
2. If the enteral nutrition is to be given for less than 6 weeks, we prefer a nasoenteral tube.
3. If the enteral nutrition is to be given for more than 6 weeks, we proceed to the percutaneous endoscopic procedure. If this is unsuccessful, we progress to laparoscopy or, as a last option, open surgery.
4. If the decision is made during the abdominal surgery, we prefer to use the needle catheter technique as a complementary surgical procedure.

Selecting the best surgical procedure basically depends on the length of time enteral nutrition will be needed, an evaluation of the serious risks of aspiration, the general condition of the patient, if there is sufficient equipment and material, and above all the surgeon's experience [33].

Contraindications

The only absolute contraindication for a jejunostomy is intestinal obstruction. Other relative contraindications have been mentioned, such as significant edema of the intestinal wall, postradiation enteritis, and chronic inflammatory disease of the intestine (e.g., Crohn's disease) due to the possibility of enterocutaneous fistula formation. Coagulopathies are also a contraindication because of the possibility of bleeding and hematoma of the intestinal wall. Others are ascites and serious immunodeficiency problems, with the risk of intraabdominal infection or necrotizing fasciitis. For some authors severe pancreatitis is a contraindication, but our experience has demonstrated the opposite [34].

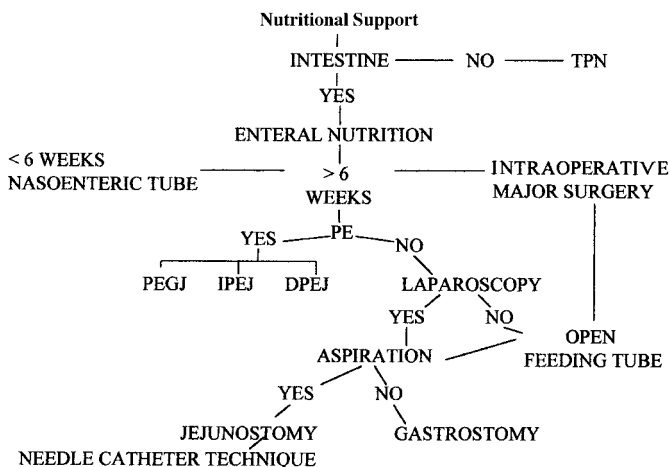


Fig. 1. Suggested flowchart to use when choosing the jejunostomy technique. TPN: total parenteral nutrition; PE: percutaneous endoscopy; PEGJ: percutaneous endoscopic gastrojejunostomy; IPEJ: indirect percutaneous endoscopic jejunostomy; DPEJ: direct percutaneous endoscopic jejunostomy.

Complications

The principal secondary complications of a jejunostomy performed for enteral nutrition can be classified as mechanical (Table 1), infectious, gastrointestinal, and metabolic.

Mechanical Complications

In 1932 Barber, using the Witzel technique, reported obstruction as the principal complication. Adams et al. mentioned mortality rates of 40% to 53%, and the operation was abandoned for many years [37]. Gerndt and Orringer performed the Witzel procedure in 523 patients undergoing surgery on a benign or malignant esophagus. They observed major complications in only 2.1% (intestinal occlusion, intraperitoneal leakage, local and intraabdominal abscesses), with no fatal complications. Therefore they advised using the Witzel technique as a routine procedure during surgery of the esophagus [1].

Using the transverse Witzel jejunostomy technique in 30 cases, Schwaizberg and Sable did not report obstruction or withdrawal of the tube. In one case there was intestinal reflux secondary to generalized intestinal ischemia; in another there was bleeding of the mucosa due to erosion by the tube. Both cases required surgery. These authors noted that the tube was removed with ease and without complications or fistulas. They were able to use it for 1 to 6 months, and only one tube had to be changed by means of a guidewire [35].

The Roux-en-Y jejunostomy has been used in a few cases. Brintnall reported that in 15% the stoma prolapsed, and there was leakage of biliary and pancreatic liquid in 6%.

Jejunostomy by means of open gastrostomy evidently produces the customary complications of a gastrostomy, which in the hands of experts appear at a rate of 2%. They are mainly problems secondary to anesthesia, infection of the wound, dehiscence of the stomach with leakage of gastric contents, peritonitis, gastric fistula, bleeding of the digestive tract, regurgitation of the jejunal tube to the stomach (increasing the risk of aspiration), and withdrawal or obstruction of the tube.

Table 1. Complications of jejunostomy.

Jejunostomy type	Cases (no.)	Complications (%)
Longitudinal Witzel [1]	523	2.1
Transverse Witzel [35]	30	6.6
Roux-en-Y [36]	34	21.0
Needle catheter [28]	2022	1.5
DPEJ [32]	150	12.0

DPEJ: direct percutaneous endoscopic jejunostomy.

Myers et al. analyzed needle catheter tube complications in 2022 cases done within a period of 16 years (1978–1994). There were 34 complications (1.5%) in 29 patient and a mortality rate of 0.14%. The most frequent complications were withdrawal and obstruction of the catheter in 15 cases (0.74%), subcutaneous abscesses 4 (0.19%), enterocutaneous fistulas 3 (0.14%), intestinal pneumatosis 3 (0.14%), abdominal wall infection 3 (0.14%), intestinal occlusion and volvulus 3 (0.14%), and intestinal ischemia 3 (0.14%) [28]. In 122 patients who had undergone needle catheter technique, Eddy et al. found 22 complications during the short term and 19 in the long term. In two patients he had to reoperate to remove the adhesions. They suggested another type of jejunostomy procedure, namely, a transoperative nasojejunal tube [38]. Schunn and Daly reported a rare complication, intestinal necrosis, that they found in 0.2%; it has a multifactorial origin with high mortality. In these cases, enteral nutrition should be interrupted immediately, parenteral nutrition given, and particular attention paid when there is abdominal pain, distension, increased output from nasogastric suction, or signs from the ileum [39].

Another complication of needle catheter technique is pneumatosis (presence of gas in the intestinal wall occasionally associated with gas in the portal vein). The first to report it secondary to the jejunostomy tube was Strain. The frequency has been reported at about 1%, and it may occur early (day 3) or late (day 14) and with a mortality of 36%. If gas exists in the portal vein, the mortality increases to 75%. Treatment is to suspend the nutrition by jejunostomy, perform nasogastric suction, give wide-spectrum antibiotics, closely monitor the patient, and in the event it is aggravated undertake surgical intervention. The jejunostomy tube can remain in place, and enteral nutrition can be reinitiated when the patient is in better condition [40].

Another complication of needle catheter technique is a subcutaneous abscess extending the length of the tube on the intestinal wall, which can be treated by removing the tube and administering antibiotics. The tube can also be withdrawn accidentally, resulting in loss of the route for nutrition; or it can become clogged owing to the type of nutrition infused and the lack of care given to a tube that is left kinked or not irrigated in the proper manner. Collier et al., for example, provided nutrition that contains fiber and recommended irrigating the tube daily and that ground medications not be passed by this route [41]. Although rare, the tube also can migrate to the abdominal cavity and infuse nutrients into the peritoneal space. To avoid this complication, the technique must include affixing the jejunum to the parietal peritoneum at the site of the puncture and then introducing the tube. The presence of intestinal leakage through the puncture site is highly unlikely because of the subserous tunnel. If there is a clinical suspicion of this, however, it should be confirmed radiologically and if positive the patient taken to surgery [42].

The few complications that occur with this simple technique most often have simple solutions, so we consider needle catheter jejunostomy to be a safe technique, especially because, as Myers et al. mentioned, the complications mostly occur with surgeons who have little experience; thus the problems encountered can be attributed to the learning curve. Thus in large patient groups of 150 or more the complication rate should not be more than 3% [28].

For the endoscopic procedure, Shike et al. reported 150 patients who underwent DPEJ. There was a 10% minor complication rate (infection of the wound) and a 2% major complication rate (bleeding of the stomach, perforation of the colon, and abscesses in the intestinal wall) [32]. Bergstrom et al. reported the morbidity-mortality incidence for endoscopic and open surgical procedures to be the same, which means that selection of the jejunostomy technique should be based on the experience of the person placing the tube [43].

When we perform a laparoscopic jejunostomy the complications are often inherent to the secondary problems brought on by increased intraabdominal pressure and the anesthetics. Those secondary to placement of the tube are intestinal obstruction, fistula, and sepsis [44].

Infectious Complications

Two infectious complications are important: pneumonia by aspiration and contamination of the diet. Inadequate placement of the jejunostomy permits migration to the stomach, leading to aspiration. This problem is reported in 10% to 54% of patients, with a mortality rate (due to pneumonia) up to 30%. As a consequence, we keep close watch that the tube is infusing the nutriment at the jejunum and not at the gastric level [45]. Another possibility is that the patient may have a hiatal hernia and gastroesophageal reflux, delayed gastric emptying (frequent in the neurologic patient), or upper residual volume of the stomach (frequent in sepsis, peritonitis, abdominal hematoma, pancreatitis). Patients who are confined to the bed; who are postoperative; who have cranial or severe multiple trauma, myocardial infarction, hepatic coma, hypercalcemia, myxedema, or malnutrition; who are using anticholinergic drugs or opiate analgesics; or who have a cough and are aided by mechanical ventilators are also at risk. Treatment is to suspend the enteral nutrition, remove the nasoenteral tube, apply nasogastric or tracheal suction (or both), and perform bronchoscopy. The positive pressures could be beneficial, and antibiotics are given that cover, inclusively, anaerobic germs [46]. Strong mentioned that there is no difference between the pre- or postpyloric tubes as a cause of aspiration, but other authors disagree; furthermore, we consider the fear of aspiration insufficient reason to avoid enteral nutrition [46]. Some authors recommend adding a dye to the nutrition or measuring the glucose in the pulmonary secretion to verify the existence of regurgitation. We can prevent aspiration if we know the previous pathology of the patient or if we understand the physiopathology currently present. As such, it is understood that the postpyloric tube decreases this problem.

Enteral diets are a rich culture medium; *Enterobacter*, *Escherichia coli*, *Klebsiella*, *Proteus*, *Salmonella enteritidis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, and beta-hemolytic streptococci have been cultured from them, with reports of septicemia. Even though the industrialized diets are

sterile, when it is necessary to dilute, mix, or add to them, the possibility of contamination is high. There may also be problems with transport, storage, and refrigeration of the diets. Contamination of the diet containers by intestinal bacteria has been reported. Because of reflux it is useful to use infusion pumps to pass the nutriments and to use the closed infusion system, which should be changed every 24 hours [47].

Gastrointestinal Complications

The most frequent gastrointestinal complications are abdominal distension, colic, diarrhea, constipation, and even nausea and vomiting. Abdominal distension and colic are secondary to alterations in intestinal motility, intestinal obstruction, fecal impaction, and fermentation of the diet. Constipation can be secondary to dehydration and lack of dietary fiber. The diarrhea has among its multiple causes the following: lactase deficiency, malabsorption of fats, hypoalbuminemia, medication (H₂-blockers, antacids, chemotherapy, laxatives, antibiotics), high osmolarity, and bacterial contamination of the formula or the infusion tubes [48]. These problems can be managed if one knows the intestinal characteristics of the patient and the quality of the diet we are administering.

Metabolic Complications

Metabolic complications are usually secondary to a poor indication for enteral nutrition, inadequate selection of the nutriments, deficient surgical technique when placing the tube, poor infusion technique, or inadequate clinical or biochemical attention to the alterations that occur. The complications most frequently mentioned are hypokalemia (50%), hyperglycemia (29%), water-electrolyte and acid-base imbalance, hypoglycemia, hypercalcemia, hypo- or hypernatremia, hypophosphatemia, and hypomagnesemia. Hill et al. placed in doubt the fact that the osmolarity of the diet is the principal cause of diarrhea; they demonstrated that drugs with high osmolarity are administered simultaneously with the nutriments, producing a hyperosmolar solution. They also noted that abuse of antibiotics (for prolonged periods) can cause diarrhea [49]. Benya et al. mentioned that the diarrhea is multifactorial, reporting frequencies of 2.3% to 68.0%. They emphasized the need to use more objective criteria to evaluate diarrhea in patients with enteral nutrition [50]. Hyperglycemia is observed when diets high in carbohydrates are used. In critically ill patients who have insulin resistance the hypokalemia is due to the significant demand to achieve anabolism.

Conclusions

1. Nutritional support should be part of all medical-surgical therapy.
2. The enteral nutrition route is always preferred over the parenteral route when the intestine can be used.
3. Selection of the infusion route for enteral nutrition depends on the experience of the surgeon and the resources available.
4. The complications of jejunostomy are within an acceptable range.
5. The benefits obtained for the patient using enteral nutrition via jejunostomy wholly justify the risks and the cost.

Résumé

Introduction. La jéjunostomie d'alimentation est une technique chirurgicale par laquelle un tube est placé dans la lumière du jéjunum proximal pour assurer la nutrition du patient. Techniques. Il existe de nombreuses techniques de jéjunostomie: la technique de Witzel longitudinale ou transverse, la gastrojéjunostomie par voie ouverte, la jéjunostomie à l'aiguille transmurale, les techniques réalisées par endoscopie ou par laparoscopie. Indications. L'indication principale de la jéjunostomie est l'alimentation complémentaire chez l'opéré du tube digestif supérieur, indépendamment de la pathologie ou du procédé chirurgical. Les patients opérés sur l'œsophage, l'estomac, le duodénum, le pancréas, le foie et les voies biliaires peuvent recevoir une alimentation au niveau du jéjunum. De même, sont candidats les patients ayant eu une laparotomie et pour lesquels on peut penser que l'évolution postopératoire sera compliquée, ou que la période postopératoire de jeune sera prolongée, les patients ayant un état hypercatabolique ou enfin ceux qui vont éventuellement avoir besoin d'une chimiothérapie et/ou une radiothérapie. La jéjunostomie peut également être indiquée, comme procédé isolé, chez le patient neurologique ou ayant une maladie congénitale, le patient gériatrique qui pose le problème délicat de sa prise en charge ainsi que pour les patients ayant une tumeur cervico-crânienne. Complications. Les complications observées après jéjunostomie peuvent être mécaniques, infectieuses, gastro-intestinales ou métaboliques. Le taux de complications techniques de la jéjunostomie longitudinale est de 2,1%, pour la jéjunostomie transversale, de 6,6%, de l'anse en Y, de 21%, pour la gastro-jéjunostomie ouverte, de 2%, de la jéjunostomie transmurale, de 1,5%, avec une mortalité de 0,14%. Les procédés endoscopiques percutanés ont un taux de complications de 12%, mais, il n'existe encore aucun chiffre pour la laparoscopie. Les complications peuvent être modérées ou sévères: délogement du tube, obstruction ou migration du tube, abcès cutané ou intra-abdominal, fistule entérocutanée, pneumatose, obstruction et ischémie intestinale. Les complications infectieuses sont la pneumopathie par aspiration et la contamination des aliments. On relève également des complications gastro-intestinales telles la diarrhée, 2,3 à 6,8%, la distension abdominale, les coliques, la constipation, les nausées et les vomissements. Les complications métaboliques sont l'hyperglycémie, 29%, l'hypokaliémie, 50%, les déséquilibres hydro-électrolytiques, l'hypophosphorémie et l'hypomagnésémie. Ces complications sont secondaires à une sélection inadaptée de la nutrition par rapport aux caractéristiques du patient, à un défaut de préparation des nutriments, ou aux soins insuffisants. Conclusions. La technique de jéjunostomie idéale dépend des ressources matérielles mais aussi de l'expérience du chirurgien. Les bénéfices de la jéjunostomie importent sur les risques.

Resumen

Introducción. La yeyunostomía es el procedimiento quirúrgico mediante el cual se introduce un tubo en la luz del yeyuno proximal con el propósito fundamental de suministrar nutrición. Diversas técnicas de yeyunostomía están en boga: Witzel longitudinal, Witzel transversa, gastroyeyunostomía abierta, catéter-aguja, percutánea endoscópica y laparoscópica. Indicaciones. La indicación principal de la yeyunostomía es su realización como procedimiento adicional en el curso de una operación mayor

sobre el tracto gastrointestinal superior a fin de administrar nutrición a nivel del yeyuno, cualquiera sea la patología o la operación que se haya practicado sobre el esófago, el estómago, el duodeno, el páncreas o el hígado y tracto biliar. Igualmente, está indicada en el paciente laparotomizado en quien se espera una evolución postoperatoria complicada, con un prolongado periodo de ayuno, estados hipercatabólicos o quien luego requerirá quimioterapia o radioterapia. Como procedimiento aislado, es aconsejable en ciertas enfermedades neurológicas y congénitas, en pacientes geriátricos de difícil manejo y en casos de tumores de cabeza y cuello. Complicaciones. Pueden ser mecánicas, infecciosas, gastrointestinales y metabólicas. Las tasas de complicaciones técnicas de la yeyunostomía longitudinal de Witzel es de 2,1%; hasta de 6,6% para la transversa de Witzel; de 21 para la yeyunostomía de Roux-en-Y; de 2% para la gastroyeyunostomía abierta, y de 1,5% para la catéter-aguja, con 0,14% de mortalidad. El procedimiento percutáneo endoscópico reporta una tasa hasta de 12%; todavía no se dispone de cifras pertinentes a la yeyunostomía laparoscópica. Las complicaciones pueden ser moderadas y severas: dislocación, obstrucción o migración del tubo, abscesos cutáneos o intraabdominales, fistulas enterocutáneas, neumatos, oclusión e isquemia intestinal. Las complicaciones infecciosas comprenden neumonía por aspiración y contaminación de la dieta. Las complicaciones gastrointestinales son: diarrea 2,3% a 6,8%, distensión abdominal, cólico, estreñimiento, náusea y vómito. Las complicaciones metabólicas son: hiperglicemia, 29%, hipokalemia, 50%, desequilibrio electrolítico, hipofostatemia e hipomagnesemia. Estas complicaciones son secundarias a selección inadecuada del régimen nutricional en relación con las características del paciente, a manejo inadecuado a las mezclas y a atención clínica deficiente. Conclusiones. La técnica ideal de yeyunostomía depende de los recursos materiales disponibles, pero, más importante, de la experiencia del cirujano. Los beneficios de la yeyunostomía justifican los riesgos.

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