

Nutritional Support of Cancer Patients without Oral Feeding: How to Select the Most Effective Technique?

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Keywords

Endoscopy · Nutrition · Cancer · Gastrointestinal obstruction

Abstract

Background: Digestive tumours are among the leading causes of morbidity and mortality. Many cancer patients cannot maintain oral feeding and develop malnutrition. The authors aim to: review the endoscopic, radiologic and surgical techniques for nutritional support in cancer patients; address the strategies for nutritional intervention according to the selected technique; and establish a decision-making algorithm to define the best approach in a specific tumour setting. **Summary:** This is a narrative non-systematic review based on an electronic search through the medical literature using PubMed and UpToDate. The impossibility of maintaining oral feeding is a major cause of malnutrition in head and neck (H&N) cancer, oesophageal tumours and malignant gastric outlet obstruction. Tube feeding, endoscopic stents and gastrojejunostomy are the three main nutritional options. Nasal tubes are indicated for short-term enteral feeding. Percutaneous endoscopic gastrostomy (PEG) is the gold standard when enteral nutrition is expected for more than

3–4 weeks, especially in H&N tumour and oesophageal cancer patients undergoing definite chemoradiotherapy. A gastrostomy push system may be considered to avoid cancer seeding. Radiologic and surgical gastrostomy are alternatives when an endoscopic approach is not feasible. Postpyloric nutrition is indicated for patients intolerant to gastric feeding and may be achieved through nasoenteric tubes, PEG with jejunal extension, percutaneous endoscopic jejunostomy and surgical jejunostomy. Oesophageal and enteric stents are palliative techniques that allow oral feeding and improve quality of life. Surgical or EUS-guided gastrojejunostomy is recommended when enteric stents fail or prolonged survival is expected. Nutritional intervention is dependent on the technique chosen. Institutional protocols and decision algorithms should be developed on a multidisciplinary basis to optimize nutritional care. **Conclusions:** Gastroenterologists play a central role in the nutritional support of cancer patients performing endoscopic techniques that maintain oral or enteral feeding. The selection of the most effective technique must consider the cancer type, the oncologic therapeutic program, nutritional aims and expected patient survival.

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Suporte nutricional no doente oncológico sem via oral: Como seleccionar a técnica mais adequada?

Palavras Chave

Endoscopia · Nutrição · Cancro · Obstrução gastrointestinal

Resumo

Introdução: O cancro digestivo encontra-se entre as principais causas de morbilidade e mortalidade globais. Uma fração significativa de doentes oncológicos não consegue manter a via oral no decurso da doença e desenvolve desnutrição. Os autores pretendem: rever as técnicas endoscópicas, radiológicas e cirúrgicas de suporte nutricional em doentes com cancro; abordar as estratégias de intervenção nutricional tendo em conta a técnica escolhida; estabelecer algoritmos de decisão para definir a melhor abordagem técnica no contexto de neoplasias específicas. **Sumário:** Revisão narrativa não sistemática, realizada através da pesquisa eletrónica na literatura médica com recurso à PubMed e UpToDate. A impossibilidade de manter a via oral é uma causa major de desnutrição em doentes com neoplasias cervicofaciais, cancro do esófago e tumores que condicionam obstrução do trato de saída gástrico. A alimentação por tubo (*tube feeding*), as próteses metálicas autoexpansíveis (PMAE) colocadas por via endoscópica e a gastrojejunostomia são as três principais abordagens para suporte nutricional. As sondas nasais estão indicadas para nutrição entérica de curta duração. A gastrostomia endoscópica percutânea (PEG) é a técnica *gold-standard* sempre que se antecipa a necessidade de nutrição entérica por um período superior a 3–4 semanas, em particular nos doentes com neoplasias cervicofaciais e tumores do esófago com indicação para quimiorradoterapia definitiva. A utilização de um sistema *push* com gastropexia pode ser equacionada para evitar o risco de metastização no estoma. A gastrostomia radiológica e cirúrgica são alternativas válidas quando a abordagem endoscópica não é possível. A nutrição pós-pilórica está recomendada nos doentes intolerantes à alimentação intragástrica, podendo ser realizada através de sondas nasoentéricas, PEG com extensão jejunal, jejunostomia endoscópica percutânea ou jejunostomia cirúrgica. As PMAE esofágicas e entéricas estão indicadas para palição, permitindo manter a via oral e melhorar a qualidade de vida. A gastrojejunostomia cirúrgica ou guiada por ecoendoscopia deve ser equacionada perante a falência técnica das próteses entéricas ou alternativamente quando uma

sobrevida prolongada é expectável. As estratégias de intervenção nutricional dependem da técnica selecionada. Protocolos institucionais e algoritmos de decisão devem ser desenvolvidos em contexto multidisciplinar para otimizar os cuidados nutricionais prestados ao doente oncológico. **Conclusões:** Os gastroenterologistas desempenham um papel central no suporte nutricional do doente oncológico com a realização de procedimentos endoscópicos que permitem manter a via oral e/ou entérica. A seleção da técnica mais adequada deve ter em conta a neoplasia subjacente, a estratégia terapêutica, os objetivos nutricionais e a sobrevida esperada.

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1 Introduction

Cancer is among the leading causes of morbidity and mortality worldwide [1]. Digestive oncology is a major area of gastroenterology practice, comprising a wide range of diseases responsible for a large number of admissions to gastroenterology wards and endoscopy units. The incidence of gastrointestinal (GI) tumours has been increasing during the last years, and nowadays it accounts for 10% of the overall mortality in Portugal [2, 3].

Most patients with digestive tumours have a high nutritional risk [4]. The European Society for Clinical Nutrition and Metabolism defines malnutrition as a state resulting from lack of uptake of nutrients that leads to an altered body composition with an impaired clinical outcome. The diagnostic criteria for malnutrition have recently been reviewed, requiring a BMI below 18.5 kg/m² or, alternatively, unintentional weight loss associated with either a reduced BMI or a low fat free mass index [5].

Weight loss is extremely common amongst cancer patients, and malnutrition occurs in 40–80% of cases, leading to poor outcome in terms of mortality, tolerance to chemotherapy, infection risk and worse surgical results [6–8]. Cancer-related malnutrition is caused by (1) inability to ingest food due to lumen obstruction that causes dysphagia and recurrent vomiting; (2) harmful effects of surgery and medical treatment that prevent an adequate nutritional intake due to swallowing dysfunction, severe mucositis, nausea and anorexia; and (3) metabolic modifications induced by the cancer-associated systemic inflammatory response [6–9]. Nutritional counselling and oral nutritional supplements (ONS) are the first-line approach in the nutritional support of cancer patients. En-

teral nutrition through tube feeding is recommended if inability to eat for more than 7 days is anticipated or the dietary intake is below 60% of the estimated requirements for more than 10 days [9–11].

Upper GI obstruction is a usual consequence of digestive cancer with a potential negative impact on patients' nutritional status and quality of life [4, 6]. Head and neck (H&N) cancer, particularly pharyngeal and laryngeal lesions, oesophagogastric tumours and all neoplasia causing gastric outlet obstruction (GOO), such as tumours of pancreatic, hepatobiliary and duodenal origin, are important causes of intolerance to oral intake [12–15]. In fact, gastroenterologists play a central role in the nutritional management of cancer patients through their endoscopic techniques that allow maintenance of oral and/or enteral feeding. Radiologic and surgical interventions are alternatives if an endoscopic approach is not feasible.

The present article aims to: (1) review the endoscopic, radiologic and surgical techniques used for nutritional support of cancer patients; (2) address the strategies for nutritional intervention according to the selected technique; and (3) establish a decision-making algorithm to define the best technique to be applied in a specific tumour setting.

2 Materials and Methods

A narrative non-systematic review was performed based on an electronic search through the medical literature using PubMed and UpToDate. The keywords “Cancer,” “Malnutrition,” “Gastrointestinal Obstruction,” “Head and Neck Cancer,” “Esophageal Cancer,” “Gastric Outlet Obstruction,” “Enteral Nutrition,” “PEG,” “Gastrostomy,” “Jejunostomy,” “Esophageal Stent,” “Enteric Stent” and “Gastrojejunostomy” were used. English-language articles were considered. No publication time restriction was defined; nevertheless, review articles and guidelines from gastroenterology, endoscopy, nutrition and cancer societies that have been published during the last 10 years were prioritized. Data regarding malnutrition in cancer patients and techniques for nutritional support were included. Decision-making algorithms are proposed by the authors at the end of this review.

3 Results and Discussion

3.1 Techniques of Nutritional Support for Cancer Patients without Oral Feeding

Dysphagia, odynophagia and GOO are common consequences of cancer [12–15]. Several techniques are available to deal with these conditions and optimize nutritional support mostly in two different situations: when pa-

tients are under cancer treatment with curative intent (chemotherapy, radiotherapy or awaiting surgical resection) or when they are referred for symptom palliation in cases of advanced disease and a poor performance status. The techniques may be grouped into three main types, namely tube feeding, endoscopic stents and gastrojejunostomy (GJ). Table 1 summarizes the main points of each technique.

3.1.1 Tube Feeding

Tube feeding is the cornerstone of enteral nutrition and plays an important role in patients with H&N and oesophageal cancers. It may be performed using nasal or transabdominal tubes placed using endoscopic or non-endoscopic methods [11, 16].

3.1.1.1 Nasal Tubes

Nasogastric tubes (NGT) and nasojejunal tubes (NJT) are flexible single- or double-lumen tubes that pass proximally from the nose into the stomach or small bowel, allowing gastric or postpyloric feeding. NGT are made of polyvinyl chloride, polyurethane or silicone and display several different sizes. The more flexible and less traumatic silicone or polyurethane tubes are therefore preferred. Although no specific recommendations regarding the material and size of NGT were provided given the absence of clinical studies, it should be noted that thinner tubes may be more comfortable for patients but thicker tubes allow easy insertion of home-made formulas and medications. NJT are more flexible, have smaller diameters and vary in length. Most NGT are placed safely using a blind technique. NJT and NGT placement in patients with partial obstructive lesions or large hiatal hernias often requires endoscopic or fluoroscopic guidance. Routine radiologic confirmation of the NJT position is advisable and may also be considered with NGT if insertion was not easy and some doubt about the intragastric position of the tip persists [17, 18].

Nasal tubes are generally recommended for a short period, particularly if tube feeding is not anticipated to exceed 3–4 weeks, given the associated discomfort and the potential risks of a more prolonged use [19]. However, they may be considered the first-line technique for patients with obstructive tumours proximal to the cardia in order to initiate nutritional support without delay. NJT may also be inserted to bypass lesions located distally to the stomach, in gastrectomized patients and in those who do not tolerate gastric feeding due to recurrent aspiration, severe gastro-oesophageal reflux, gastroparesis and GOO [20].

Table 1. Summary of the available techniques for nutritional support for cancer patients without oral feeding

Technique	Indications	Contraindications	Advantages	Disadvantages	Comments
Nasogastric tube (NGT)	Short-term enteral nutrition	Basilar skull fracture Facial fracture	Easy to insert and remove Safe technique with few risks	Mucosal injury Gastro-oesophageal reflux Pulmonary aspiration Nose ulceration Patient discomfort	Insertion blindly at the bedside in most patients Radiologic confirmation of the tube's position is recommended in selected cases
Nasojejunal tube (NJT)	Short-term enteral nutrition if: - Intolerance to gastric feeding - After gastrectomy	Basilar skull fracture Facial fracture	Safe technique with few risks Readily removable if needed	Mucosal injury Nose ulceration More invasive placement	Placement usually requires endoscopy Radiologic confirmation of the tube's position is recommended Tube dislodgment and malfunction is common
Percutaneous endoscopic gastrostomy (PEG)	Long-term enteral nutrition	Cervical fracture Sepsis Severe coagulopathy Haemodynamic instability Interposed organs Absence of diaphanouscopy Uncontrollable agitation	Overall safe technique Less discomfort compared to NGT Simple to use by the patients and their caregivers	Invasive technique Risks associated with sedation Tube removal only possible after 2-4 weeks - risk of peritonitis if removal occurs before 2 weeks Risk of tumour seeding	Consider the introducer technique to avoid cancer seeding Major complications: bleeding, aspiration pneumonia, internal organ injury, necrotizing fasciitis and buried bumper syndrome Minor complications: granuloma formation, local wound infection, peristomal leakage, tube dislodgement, gastric outlet obstruction and pneumoperitoneum
PEG with jejunal extension (PEG-J)	Long-term enteral nutrition if: - Intolerance to gastric feeding - Gastric outlet obstruction	Similar contraindications to PEG	Postpyloric feeding via percutaneous access Easier insertion compared to NJT	Invasive technique Risks associated with sedation Backward migration to the stomach	May be performed with PEG or as a later procedure Similar complications to PEG
Percutaneous endoscopic jejunostomy (PEJ)	Long-term enteral nutrition if: - Intolerance to gastric feeding - Gastric outlet obstruction - After gastrectomy	Similar contraindications to PEG	Postpyloric feeding via percutaneous access Tube dysfunction less common than with PEG-J	Risks associated with sedation High technical unsuccess rate High rate of procedural complications	Perform with the pull technique (risk of cancer seeding?) Small bowel occlusion, invagination and transfixation of multiple intestinal loops are possible complications, in addition to those associated with PEG
Radiologically inserted gastrostomy (RIG)	Long-term enteral nutrition as alternative to PEG	Severe coagulopathy Interposed organs Impossibility of distending the stomach	Only requires topic anaesthesia Avoidance of cancer seeding	Need to insert an NGT to distend the stomach in most cases Impossible to perform in case of obstructive tumours Low experience of some radiologic teams	Attractive alternative for patients with a high sedation risk
Surgical gastrostomy	Long-term enteral nutrition as alternative to PEG and/or RIG	Severe coagulopathy Haemodynamic instability High anaesthetic risk	May be performed at the same time as other surgical interventions May be performed on patients with organ interposition Laparoscopic approach	Surgical intervention Requires hospital admission	Nowadays rarely used
Surgical jejunostomy	Long-term enteral nutrition as alternative to PEG-J and/or PEJ	Severe coagulopathy Haemodynamic instability High anaesthetic risk	May be performed at the same time as other surgical interventions High technical success rate Few adverse events	Surgical intervention Requires hospital admission	Postoperative enteral feeding after major gastrointestinal surgery and when a complicated postoperative period is anticipated
Oesophageal stents	Palliation of dysphagia	Severe coagulopathy Haemodynamic instability	Maintenance of oral feeding	Need of a soft diet Complications: bleeding, perforation, migration and stent occlusion; trachea-oesophageal fistula formation; gastro-oesophageal reflux	Not recommended as a bridge to surgery or in patients undergoing radiotherapy In upper oesophageal tumours, endoscopic evaluation of the tracheobronchial tree is advisable due to the risk of compression after stent expansion
Enteric stents	Palliation of gastric outlet obstruction	Severe coagulopathy Haemodynamic instability	Maintenance of oral feeding	Need of a soft diet Complications: bleeding, perforation, migration, stent occlusion, and stent ingrowth and/or overgrowth	High intervention rate among patients with long survival
Gastrojejunostomy	Palliation of gastric outlet obstruction if: - Survival >6 months - Failed or impossible stenting	Severe coagulopathy Haemodynamic instability High anaesthetic risk	Maintenance of oral feeding Low reintervention rate due to tumour regrowth	Invasive technique Surgical risk	May be performed surgically (most common) or guided by EUS

3.1.1.2 Transabdominal Tubes

Transabdominal feeding tubes may be placed using an endoscopic, radiologic or surgical approach. Although endoscopic tube placement is usually considered the first option as it is simple, practical and readily available, alternative techniques may be necessary, especially if abdominal wall transillumination is not achieved (due to overweight, visceral interposition or the presence of large hiatal hernias) or access to the stomach/jejunum is prevented by complete pharyngo-oesophageal obstruction. The choice of the procedure will depend on local expertise, anatomic considerations and whether the patient is undergoing surgery for other reasons.

3.1.1.2.1 Endoscopic Tube Placement

3.1.1.2.1.1 Percutaneous Endoscopic Gastrostomy

Percutaneous endoscopic gastrostomy (PEG) is a safe and effective technique for long-term enteral nutrition. It is recommended if dysphagia is anticipated for more than 3–4 weeks [10, 18–21]. There are several commercially available PEG kits, mostly involving a pull-through technique. Tube calibres usually range from 12 to 24 Fr; however, a study comparing 12- and 20-Fr PEG tubes showed no difference regarding complications or long-term patency [22]. Other systems (Freka® Pexact and Cook® Medical) may also be used to perform a gastropexy, allowing percutaneous introduction of the gastrostomy tube under endoscopic guidance, which avoids passage of the PEG tube through the superior aerodigestive structures (introducer technique) [23].

Actually, patients with proximal GI cancers are at risk of seeding from the primary tumour site to the PEG tract by mechanical transfer. In 1989, Preyer and Thul [24] reported the first patient with PEG tract metastasis, and since then, new cases have been identified annually [24–27]. In a recent prospective controlled study involving 50 patients, positive cytology for malignant cells was described in 22.5% of the stomas immediately after PEG placement using the pull method, and after 3–6 months of follow-up, persistence of these cells was detected in 9%. Although no patient developed clinically manifest stoma metastasis, most had advanced disease at the time of PEG placement and died before the end of the study. There was a trend for short survival in the 9% group of patients with microscopic cancer seeding [28]. Although clinically evident metastasis seems to be uncommon, the median time for its appearance was described as 6–8 months and its incidence has been underdiagnosed due to the short patient follow-up after PEG that was reported in different series [29]. The

incidence rate has been estimated at 0.1–3% amongst patients with H&N cancer. Although some cases of favourable evolution have been reported, this adverse event is often associated with a poor oncologic outcome [24, 26, 29]. Thus, the use of a direct gastric puncture technique for percutaneous feeding tube placement in patients with proximal GI cancer has been recommended by several authors, especially in patients receiving radical therapy with curative intent [20, 25]. Comparative studies have shown similar complication rates, except for a more common occurrence of delayed tube disfunction and minor bleeding episodes with the introducer approach [30, 31].

H&N tumours usually compromise swallowing due to involvement of the mouth, pharynx and upper oesophageal sphincter. These patients often undergo high-dose chemoradiotherapy that also induces severe mucositis. Chemoradiotherapy is the base for oesophageal cancer treatment, as only a few candidates are suitable for direct surgery [32]. Thus, nutritional intake may become markedly reduced [33]. In patients undergoing chemoradiotherapy for H&N tumours, PEG is associated with low procedure-related morbidity and may provide better nutritional outcomes than nasogastric tube feeding [20]. However, the timing of PEG tube placement in this clinical setting has not been clearly established [33]. PEG feeding was traditionally started after swallowing impairment or a compromised nutritional status. In contrast, some authors have reported the beginning of enteral nutrition prior to treatment, showing that prophylactic PEG placement and early tube feeding were associated with limited weight loss, allowing effective and safe nutrition during chemoradiotherapy [34–36]. Current evidence does not show significant differences in survival rates with the use of prophylactic PEGs; nevertheless, the potentially high risk of sedation and procedure complications in patients who have undergone PEG with established malnutrition and a poor performance status should also be considered [37]. The evidence to support the ideal timing of PEG in patients undergoing H&N cancer treatment is weak and should be decided case by case considering the baseline nutritional status. Close nutritional and clinical monitoring is essential to identify patients who will benefit from an early PEG to avoid nutritional deterioration. This must be balanced with some evidence suggesting that gastrostomy leads to more prolonged tube dependency and long-term dysphagia [38–40].

Concerns that PEG may render the stomach unusable for the formation of a gastric tube at the time of oesopha-

gectomy in patients with oesophageal cancer have also been raised by some authors. Despite certain guidelines recommending against its routine use, recent studies have described no impact on postoperative outcomes. Local surgeon preferences and technical skills should be taken into account [20, 41].

3.1.1.2.1.2 PEG with Jejunal Extension and Percutaneous Endoscopic Jejunostomy

PEG with jejunal extension (PEG-J) and direct percutaneous endoscopic jejunostomy (PEJ) allow direct administration of feed into the small bowel. These procedures are recommended if tube feeding is indicated for more than 3–4 weeks, as an alternative to NJT [20]. Most experience was obtained with PEG-J, in which a jejunal tube is passed through the PEG tube at the time of PEG placement or as a separate procedure using a previously inserted PEG. The procedure is easier if PEG is performed on the gastric antrum, allowing a more direct route for the extension tube to cross the pylorus and reducing the risk of gastric looping, which may favour further displacement. Backward migration to the stomach is a common event, which may be reduced if the tip is initially placed beyond the ligament of Treitz [20]. In order to reduce repeated manipulation and the risk of gastric migration of the jejunal tube, the connection of a drainage PEG to the feeding PEG-J was proposed for GOO patients [42, 43].

PEJ is an alternative approach, involving the direct placement of the feeding tube into the jejunum. A paediatric colonoscope or an enteroscope is needed unless the patient had a prior gastrectomy. Standard PEG tube kits can be used for PEJ, but the selection of a small-sized internal bumper will minimize the risk of occluding the small bowel. The other principles of the technique and postprocedural care are the same as with PEG; however, significant failure of tube placement (15–20%) and more frequent complications were described [32].

Either PEG-J or PEJ should be offered as the primary procedure for patients who do not tolerate gastric feeding due to severe gastro-oesophageal reflux, delayed gastric emptying, regurgitation or recurrent aspiration. PEJ should be considered if recurrent failure of PEG-J develops. Tube dysfunction and the need for reintervention are significantly lower with PEJ, which should be preferred if long-term postpyloric feeding is indicated. Nevertheless, there are conflicting data regarding whether jejunal feeding truly reduces the rate of reflux and aspiration [20].

3.1.1.2.2 Non-Endoscopic Tube Placement

3.1.1.2.2.1 Radiologically Inserted Gastrostomy

Radiologically inserted gastrostomy (RIG) is performed using fluoroscopic guidance. The stomach is distended with air using an NGT, and the site for abdominal puncture is selected with fluoroscopy. A gastropexy is first accomplished. Air aspiration confirms the intragastric location and a guidewire is advanced. The gastrostomy tube is placed over the guidewire. At the end of the procedure, contrast is injected to confirm the correct tube position. Whether there is a difference in morbidity and mortality rates between endoscopic and radiologic gastrostomy tube placement is not clear. RIG may be considered for patients with H&N or oesophageal cancers in order to avoid tumour seeding to the gastrostomy tract if a PEG cannot be performed using the introducer technique. Since RIG just commonly requires abdominal topical anaesthesia with no need of sedation, it may also be a useful technique for patients with significant comorbidities and a high anaesthetic risk. Nevertheless, although no endoscopy is necessary, RIG usually requires the passage of an NGT, which may be impossible in some cancer patients. Furthermore, few radiology teams seem to have acquired extensive experience with this technique [44–48].

3.1.1.2.2.2 Surgical Gastrostomy

Surgical gastrostomy (SG) can be performed via a laparoscopic or an open approach. Laparoscopic gastrostomy is performed similarly to RIG, using T-fasteners to affix the stomach to the abdominal wall before the tube is placed. Open gastrostomy involves a gastric incision to place the tube. Studies comparing SG with PEG have shown no differences in morbidity and mortality rates; nevertheless, PEG is less expensive and is easier and faster to perform [49]. SG is commonly reserved for patients who will undergo another surgical procedure or in a setting in which PEG and RIG are contraindicated or not locally available [49, 50].

3.1.1.2.2.3 Surgical Jejunostomy

Fine needle catheter jejunostomy is a common alternative often achieved during upper digestive tract surgery such as oesophagectomy, gastrectomy and pancreatic interventions. It is mainly performed on patients for whom a complicated postoperative recovery is expected; those with a prolonged fasting period being at risk of malnutrition; or patients who will subsequently need chemotherapy or radiotherapy and have not previously had a percutaneous feeding tube placed. With this technique, a large-

bore needle is tunnelled through the subserosa before entering the jejunal lumen, and then a 8- to 9-Fr feeding catheter is inserted and further exteriorized through the abdominal wall. Surgical jejunostomy is an effective approach providing enteral access for early enteral nutrition and to deliver medications in the postoperative period. This technique is also useful to have a prolonged enteral access in patients who develop surgical complications [51, 52]. Radiologic jejunostomy was also addressed by some authors as a non-surgical alternative; however, the available data are still limited [53].

3.1.2 Endoscopic Stent Placement

Self-expandable metal stents (SEMS) are endoscopic devices commonly used for the non-surgical management of obstructive GI neoplasms, particularly oesophageal cancer, extra-oesophageal malignancies that compress or invade the oesophagus and tumours that cause GOO, namely gastric and pancreatic cancers. Since they allow maintenance of oral feeding, a positive impact on nutrition and quality of life may be expected.

3.1.2.1 Oesophageal Stents

In recent years, different designs of oesophageal stents have emerged to improve dysphagia in patients with malignant oesophageal tumours, tracheo-oesophageal fistulas or extrinsic compression. They comprise (1) uncovered SEMS; (2) fully covered SEMS, in which the entire length of the stent is covered; (3) partially covered SEMS, in which the proximal and distal ends of the stent are devoid of a covering; and (4) fully covered self-expandable plastic stents. Fully and partially covered SEMS are predominantly used for the treatment of malignant dysphagia, and self-expandable plastic stents do not appear to present advantages over SEMS in this clinical setting [54].

More than 95% of cancer patients undergoing oesophageal stent placement show improvement in dysphagia, and 75–100% of those who present with tracheo-oesophageal fistulas achieve successful fistula closure. However, subsequent tumour ingrowth or overgrowth is common and requires additional interventions for recurrent symptoms in up to 50% of cases [55, 56].

Oesophageal stenting for malignant obstruction is nowadays recommended as a palliation technique for patients with unresectable tumours or metastatic disease, or for individuals unfit for curative treatment due to a poor performance status. Current guidelines do not advise SEMS placement in dysphagic patients as a bridge to surgery or prior to chemoradiotherapy, since it is associated

with adverse events such as stent migration (35%) [54]. More importantly, a negative impact on oncologic outcomes was also documented, including lower rates of R0 resection, a lower median time to recurrence, and increased morbidity and mortality. Furthermore, in palliative patients who will undergo palliative radiotherapy, SEMS placement should be postponed until the end of this therapy. In these circumstances, if the patient has to start enteral nutritional support, tube feeding should be considered [55–60].

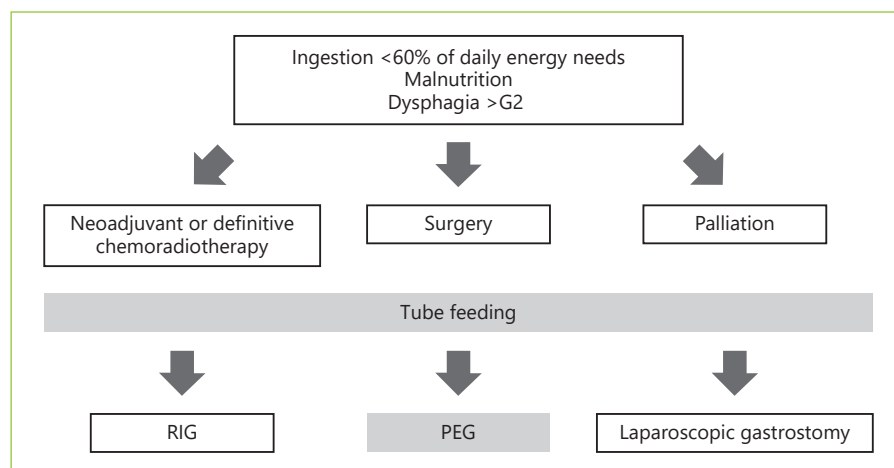
3.1.2.2 Enteric Stents

The main goal of enteral stenting for malignant gastroduodenal obstruction is to restore lumen patency in symptomatic patients with unresectable malignancy. Enteric stents may be covered or uncovered, with the latter being preferred due to the lower risk of migration; nevertheless, tumour ingrowth is a potential disadvantage. Stent placement is not recommended if GOO is asymptomatic and the patient is tolerating a normal diet, nor as a bridge to surgery. Ideally, individuals should have a short life expectancy from less than 2 to 6 months [61, 62]. The presence of other sites of small bowel obstruction should be investigated, since stenting of a proximal stricture is unlikely to be clinically effective [63]. However, contrary to what would be expected, some data suggest that enteral stent placement may actually work in patients with peritoneal carcinomatosis, as was described by Mendelsohn et al. [64] in a retrospective analysis of 215 patients, who found similar outcomes regarding clinical success, need for reintervention and major complications. Actually, the decision on whether to palliate GOO patients with peritoneal carcinomatosis using SEMS remains empirical and need to be taken case by case until further clinical studies are available.

In patients with coexistent biliary obstruction, a self-expandable metal biliary stent should be considered prior to – or in the same endoscopic period as – gastroduodenal stent placement, because it may be harder to achieve biliary cannulation once a duodenal stent has been deployed across the papilla [65, 66].

Enteric stents can be placed successfully in over 90% of patients, with clinical success rates above 80%. Although they are associated with less morbidity and lower procedure-related mortality rates and costs, when compared with surgical palliation, 15–40% of patients require reintervention for recurrent symptoms. Also, abnormal gastric motility caused by neural tumour involvement may prevent any significant improvement in some patients after GOO palliation [61, 67–70].

Fig. 1. Algorithm for nutritional support technique selection for patients with head and neck cancer. RIG, radiologically inserted gastrostomy; PEG, percutaneous endoscopic gastrostomy.



3.1.3 Gastrojejunostomy

3.1.3.1 Surgical Gastrojejunostomy

GJ is a surgical procedure in which an anastomosis is created between the stomach and a proximal loop of the jejunum. This technique is an alternative to gastric drainage if GOO occurs, allowing oral feeding, and it can be performed via a laparoscopic, minimally invasive approach. GJ is usually reserved for palliation in patients who have failed or are not candidates for gastroduodenal stents. When compared to stenting, palliative GJ is associated with lower reintervention rates and more long-term symptom relief without significant differences in mortality rates. It may be considered if patients' life expectancy is longer than 6 months [70, 71].

3.1.3.2 EUS-Guided Gastrojejunostomy

EUS-guided GJ is an innovative procedure that has been described as an alternative to surgical GJ. In this procedure, an endosonographic placement of a lumen-apposing metal stent is performed to create a gastrojejunal anastomosis, which bypasses the gastroduodenal obstruction [72, 73]. A recent international multicentre study that included 26 patients showed a technical and clinical success rate of 92 and 85%, respectively [73]. When compared to laparoscopic GJ, EUS-guided GJ seems to be associated with fewer adverse events and lower costs, as was described by a Spanish group in a comparative study [74]. Further studies comparing this approach with luminal stent placement are warranted.

3.2 Nutritional Intervention for Cancer Patients without Oral Feeding

Nutrition intervention is mandatory in cancer therapy. For these patients, the energy and protein require-

ments are estimated to be 25–30 kcal/kg/day and 1.2–1.5 g of protein/kg/day, respectively. If severe protein depletion occurs, higher doses up to 2.0 g/kg/day may be necessary to maintain or restore the lean body mass [4, 8, 73]. In malnourished patients or those at risk of refeeding syndrome, feeding should be performed gradually, starting with 25% of the estimated requirements and slowly increasing the rate over 4–7 days [75–78].

Prepyloric tube feeding enables large volumes and high osmotic loads. For patients with NGT, PEG, RIG, SG or GJ, standard and fibre-enriched formulas can be safely and effectively employed. High-energy and high-protein formulas may also be considered, depending on the patient's nutritional requirements, volume tolerance and GI symptoms. Infusion into the stomach allows either bolus or continuous feeding and higher feeding rates. If not tolerated, switching to continuous infusion can reduce discomfort and maximize nutritional support [79–82]. In postpyloric feeding, osmolality and volume may become relevant. For patients with NJT, PEG-J, PEJ or SJ, isotonic formulas with continuous feeding at a controlled rate are needed due to the lack of small bowel reservoir capacity. Jejunal feeding does not stimulate pancreatic secretions, although most studies support polymeric formulas. Whole protein feeds may be well tolerated and should be standard practice. If malabsorption occurs, a period of hydrolysed protein feed is recommended [78, 83, 84].

As an alternative to commercial enteral formulas, home-made blenderized tube feedings can be provided. Nevertheless, they are more likely to cause tube blockage, are often nutritionally unbalanced and present an increased risk of bacterial contamination. Also, they are not suitable for patients on postpyloric feeding [78, 85, 86].

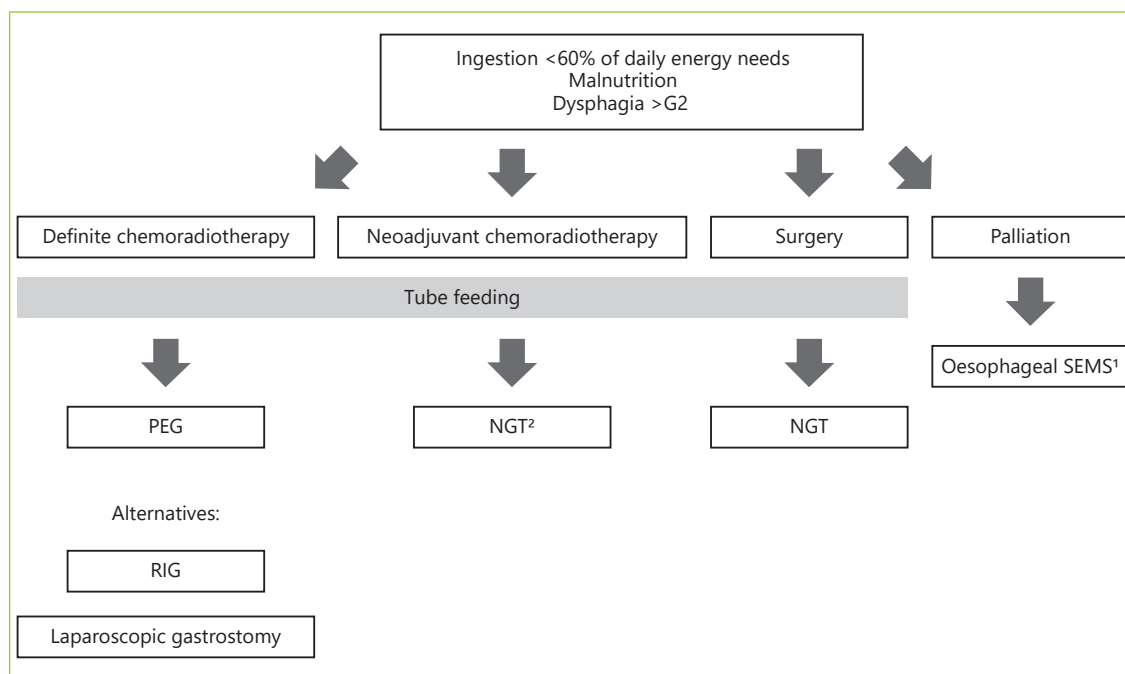


Fig. 2. Algorithm for nutritional support technique selection for patients with oesophageal cancer. SEMS, self-expandable metal stent; PEG, percutaneous endoscopic gastrostomy; NGT, nasogastric tube; RIG, radiologically inserted gastrostomy. ¹ SEMS are recommended only if dysphagia or a malignant fistula is present in palliative patients. ² PEG may be considered after discussion with the surgical team.

After oesophageal/enteric stenting, oral feeding should be initiated with fluids and gradually progress to a soft diet. To prevent blockage, food should be very well chewed and have a moist and soft swallowed consistence. Recommendations state several small daily meals with adequate fluid intake avoiding high-fibre, dry and stringy foods. If nutrient intake remains inadequate with normal food, ONS should be prescribed [87].

Clinical studies have reported positive results with immunonutrient supplementation in cancer patients; *n*-3 polyunsaturated fatty acids and arginine supplements proved to be beneficial, improving inflammatory markers and body weight, maintaining the lean body mass and reducing chemoradiotherapy-induced mucositis [4, 8, 81, 87–89]. Immunoenhancing enteral formulas containing arginine, nucleic acids and *n*-3 polyunsaturated fatty acids are also recommended for patients undergoing major cancer surgery [79, 90].

Early referral for dietary counselling should be considered at the time of diagnosis in order to adopt the best individualized nutritional intervention during the course of cancer treatment.

3.3 Algorithms for Decision-Making in Clinical Practice

3.3.1 Nutritional Support in H&N Cancer

H&N cancer patients should promptly start tube feeding if malnutrition is established or when grade 3–4 dysphagia develops. If oral ingestion targeting at least 60% of daily energy needs is not possible even through ONS, tube feeding is recommended. This may occur prior to or during cancer treatment. NGT should be used as a transient approach, but PEG is indicated for long-term enteral nutrition. Given its equivalent safety to that of the pull method, the gastropepy push system (introducer technique) may be considered for cancer patients treated with a curative intent; nevertheless, the evidence for its routine application to all patients is scarce, as cancer seeding seems to be infrequent and the overall risk low. RIG is an alternative if there is a high anaesthetic risk, and SG is reserved for patients who fail a less invasive approach (Fig. 1).

3.3.2 Nutritional Support in Oesophageal Cancer

Patients with oesophageal tumours undergoing definitive chemoradiotherapy should receive tube feeding through PEG. RIG or laparoscopic gastrostomy are alter-

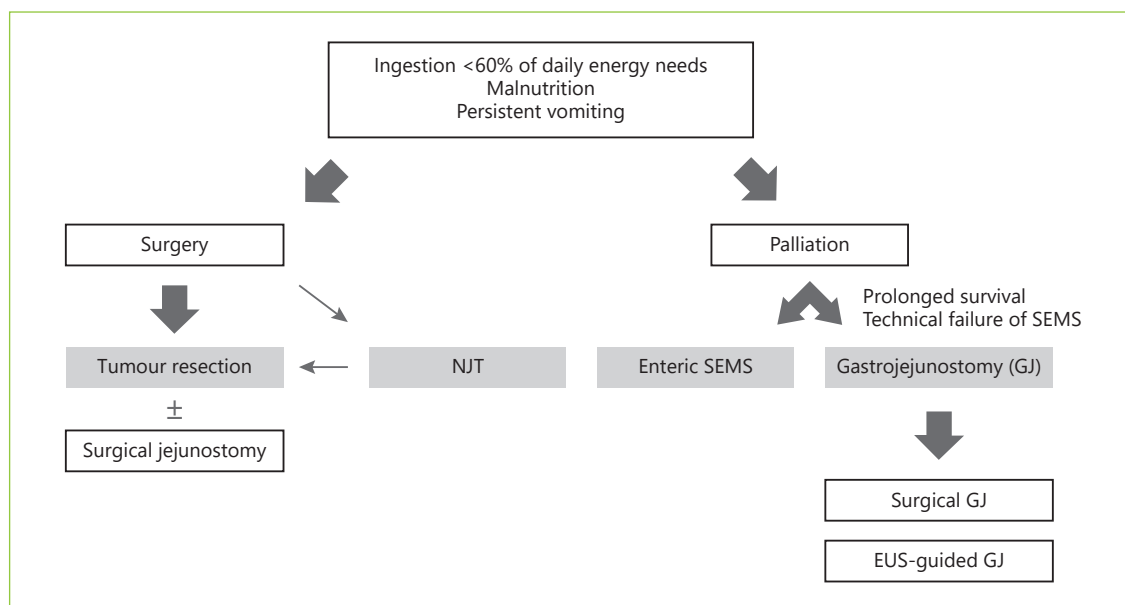


Fig. 3. Algorithm for nutritional support technique selection in patients with gastric outlet obstructive tumours. NJT, nasojunal tube; SEMS, self-expandable metal stent.

natives as in H&N cancer. For patients eligible for surgical resection who need preoperative tube feeding, NGT should be used, although the possibility of PEG may be considered after discussion with the surgical team. Oesophageal SEMS are indicated for palliation, but they should be postponed in patients undergoing palliative radiotherapy. They may be an effective choice to palliate dysphagia in obstructive tumours involving the proximal, middle and distal oesophagus (Fig. 2).

3.3.3 Nutritional Support in Gastric Outlet Obstructive Cancers

Surgical resection is the best option to manage patients with GOO undergoing curative therapy. NJT feeding may be a transient approach to optimize the nutritional status before surgery; nevertheless, neoadjuvant therapy is not indicated for patients with obstructive tumours. Surgical jejunostomy is an alternative method that may be performed at the time of surgery, allowing effective postoperative nutritional support. In palliative patients, enteric SEMS can effectively manage GOO, especially if the expected survival is below 6 months. If the life expectancy is longer or SEMS cannot be placed or fail, GJ is the best option. The choice between a surgical and an EUS-guided approach will depend on the available skills and expertise (Fig. 3).

4 Conclusions

Digestive tumours and H&N cancer are complex and heterogeneous disorders that usually impair oral feeding. Gastroenterologists play a central role in the nutritional support of these patients by performing endoscopic techniques that maintain oral and enteral nutrition. When selecting the most adequate technique one must consider the cancer type, the oncologic therapeutic program, the nutritional aims and the patient's expected survival. Nutritional recommendations in cancer require an interdisciplinary approach. Patients should be routinely evaluated and have an individualized nutritional plan aiming to prevent malnutrition and improve cancer-related outcomes.

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

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Author Contributions

G. Nunes performed the literature search, selected the bibliography and wrote the paper; A.T. Barata performed the literature search and selected the bibliography; J. Fonseca, P. Pimentel-Nunes and M. Dinis-Ribeiro conceived the structure of the paper and critically reviewed the text. All authors approved the final version of the paper.

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