

## Percutaneous endoscopic gastrostomy – Too often? Too late? Who are the right patients for gastrostomy?

Christoph G Dietrich, Konrad Schoppmeyer

**ORCID number:** Christoph G Dietrich (0000-0001-6927-7970); Konrad Schoppmeyer (0000-0002-0522-9811).

**Author contributions:** Dietrich CG developed the concept of this review, and both authors wrote the manuscript.

**Conflict-of-interest statement:** The authors declare that they have no conflict of interest.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Manuscript source:** Invited manuscript

**Received:** January 4, 2020

**Peer-review started:** January 4, 2020

**First decision:** March 21, 2020

**Revised:** April 30, 2020

**Accepted:** May 15, 2020

**Article in press:** May 15, 2020

**Published online:** May 28, 2020

**P-Reviewer:** Hu B

**S-Editor:** Ma YJ

**L-Editor:** A

**E-Editor:** Zhang YL

**Christoph G Dietrich**, Medical Clinic, Bethlehem-Gesundheitszentrum Stolberg/Rhld., Stolberg D-52222, Germany

**Konrad Schoppmeyer**, Medical Clinic II, Euregio-Klinik Nordhorn, Nordhorn D-48529, Germany

**Corresponding author:** Christoph G Dietrich, MD, PhD, Chief Doctor, Med. Klinik, Bethlehem-Gesundheitszentrum Stolberg/Rhld., Steinfeldstr. 5, Stolberg D-52222, Germany. [dietrich@bethlehem.de](mailto:dietrich@bethlehem.de)

### Abstract

Percutaneous endoscopic gastrostomy is an established method to provide nutrition to patients with restricted oral uptake of fluids and calories. Here, we review the methods, indications and complications of this procedure. While gastrostomy can be safely and easily performed during gastroscopy, the right patients and timing for this intervention are not always chosen. Especially in patients with dementia, the indication for and timing of gastrostomies are often improper. In this patient group, clear data for enteral nutrition are lacking; however, some evidence suggests that patients with advanced dementia do not benefit, whereas patients with mild to moderate dementia might benefit from early enteral nutrition. Additionally, other patient groups with temporary or permanent restriction of oral uptake might be a useful target population for early enteral nutrition to maintain mobilization and muscle strength. We plead for a coordinated study program for these patient groups to identify suitable patients and the best timing for tube implantation.

**Key words:** Gastrostomy; Nutrition; Dementia; Percutaneous endoscopic gastrostomy; Oncologic diseases; Endoscopy; Neurodegenerative disorders

©The Author(s) 2020. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** Gastrostomy is an established method for enteral nutrition of patients, but according to our experience and clinical studies, the wrong patients are often supplied with tube feeding. In addition to patients with clear indications, patients with advanced dementia receive gastrostomies for long-term-feeding. More data are needed for indication and timing of tube implantation, not only in demented patients.

**Citation:** Dietrich CG, Schoppmeyer K. Percutaneous endoscopic gastrostomy – Too often?



Too late? Who are the right patients for gastrostomy? *World J Gastroenterol* 2020; 26(20): 2464-2471

URL: <https://www.wjgnet.com/1007-9327/full/v26/i20/2464.htm>

DOI: <https://dx.doi.org/10.3748/wjg.v26.i20.2464>

## INTRODUCTION

The method of percutaneous endoscopic gastrostomy (PEG) as a tool for enteral nutrition was first described in 1980 by Gauderer *et al*<sup>[1]</sup>. Since then, PEG has evolved as the method of choice in patients with apparent or imminent long-term restriction of oral nutrition. Gastrostomy is easy to install percutaneously using translucency during gastroscopy. The tube needs some care, which is largely standardized and, if necessary, can be easily removed by simple gastroscopy.

When a technique comes of age, it is time to review its current practice as well as the indications for and complications of this intervention. Is enteral nutrition indeed superior to parenteral nutrition? Are patients who receive a gastrostomy appropriately chosen for this intervention? Do we need more data to assess the usefulness of PEG in certain situations?

## ENTERAL VS PARENTERAL NUTRITION

There is ample evidence from experimental and clinical studies that enteral nutrition (orally or *via* a tube) confers many positive effects in comparison to parenteral nutrition. These effects include preservation of the intestinal mucosal barrier, reduction of intestinal and other infections and improvement of the overall prognosis of patients with long-term artificial nutrition<sup>[2-7]</sup>. Additionally, parenteral nutrition requires administration of lipid formulations *via* a port system, which promotes port infections and septic complications. In a meta-analysis comprising almost 4000 patients who had undergone surgery for gastrointestinal (GI) tumors, parenteral nutrition was associated with a significantly higher rate of infectious and noninfectious complications<sup>[8]</sup>. In a very recent Japanese study, enteral nutrition *via* PEG was associated with a significantly longer survival (median survival of 317 *vs* 195 d) compared to parenteral nutrition in older patients with dysphagia<sup>[9]</sup>. Therefore, as far as it is technically and functionally feasible, enteral nutrition is preferable to parenteral nutrition. This is also emphasized by the ESPEN guideline for ethical aspects of artificial nutrition, which recommends enteral over parenteral nutrition in order "to support intestinal functions to the greatest possible extent"<sup>[10]</sup>.

## COMPLICATIONS AND TYPE OF ACCESS AND TUBE

Several large case series have investigated complication rates in PEG patients. Severe complications during or immediately after gastrostomy are rare (1.8%) and include bleeding, perforation and peritonitis<sup>[11]</sup>. Late complications occur in approximately 5% of patients and are mostly associated with nursing failures, leading to tube leakage or blockage, mucosal overgrowth of the retaining plate in the stomach ("buried bumper") or aspiration. Mild local infections at the tube insertion site have been reported in approximately 11% of cases<sup>[11,12]</sup> and require only local treatment. More recent studies have reported severe complications (acute and during feeding) in 3.8%-10% of PEG patients<sup>[13,14]</sup>. Patients with dementia did not have significantly more complications than those without dementia in one large study<sup>[15]</sup>, but this remains controversial.

To ensure maximal effect of enteral nutrition *via* tube feeding, before gastrostomy, basic considerations are necessary for each individual case to check suitability of the patient and the clinical situation for this intervention (see [Table 1](#)). These considerations should also encompass alternative interventions such as metal stents or surgical procedures.

The pull method is the standard procedure for gastrostomy and tube implantation. Since 2000, a push-/introducer-PEG method has also been possible; this method is extremely attractive for patients with pharyngeal or esophageal tumor stenosis precluding gastroscopic access to the stomach<sup>[16]</sup>. However, in our clinical experience as well as according to existing data, whenever possible, the pull-PEG method should

**Table 1 Basic considerations for percutaneous endoscopic gastrostomy implantation and typical access types**

<b>Basic considerations for PEG implantation</b>	
Is oral nutrition - for whatever reason - so inadequate that intervention is justified?	
Is enteral nutrition likely to be necessary for at least 3 wk?	
Is the intestine distal to the access path functional?	
Are risk factors for complications absent?	
Is the anatomy suitable for PEG?	
Is compliance sufficient for PEG handling (feeding in (half) upright position, infection prophylaxis, mobilization of the PEG tube, <i>etc.</i> )?	
<b>Typical access types</b>	
Pull-PEG (Ponsky-Gauderer)	After diaphanoscopy, primary puncture with a trocar followed by pulling the tube with a thread through the esophagus
Push-/Introducer-PEG (Russell)	With diaphanoscopy, primary gastropexy followed by direct introduction of a balloon-fixed tube

PEG: Percutaneous endoscopic gastrostomy.

be preferred due to lower complication rates and better handling<sup>[17,18]</sup>.

## ACCEPTED INDICATIONS FOR GASTROSTOMY

Percutaneous endoscopic gastrostomy has been established as a treatment option for transient or permanent dysphagia due to neurologic disorders, *e.g.*, stroke<sup>[19,20]</sup>. In the same way, patients with oncological diseases of the mouth and throat as well as the esophagus can benefit from a temporary PEG tube during multimodal therapy, especially during radiotherapy. Ensuring adequate nutrition allows the therapy to be carried out in a timely manner and at full dose by preventing weight loss and, thus, ultimately improves patient prognosis<sup>[21]</sup> (Table 2).

## DEMENTIA – THE MOST DOUBTFUL INDICATION FOR GASTROSTOMY

Patients with degenerative cerebral diseases, above all dementia, have increasingly received gastrostomies and represented in some studies and regions the largest group of tube fed patients<sup>[22-24]</sup>. Given the lack of evidence for a benefit in this patient group, this issue generates debates already for decades. In a time with an increasing economic health burden, a necessity to improve the efficiency of health care in an aging society and health care workers often pressed for time, this development is understandable but must be viewed with great skepticism.

Frequently, the indication of gastrostomy is the result of an acute deterioration in the health state and/or expression of a state of emergency in caring for these patients. Occasionally, cultural or religious reasons also play a role when relatives do not approve limiting therapy, although the quality of life is already dramatically reduced, and the prognosis is limited. Sometimes, gastrostomy is advocated because people caring for the patient, including their physicians, are unable to cope with difficult nursing and medical situations.

Comfort feeding<sup>[25]</sup> is propagated as an alternative to artificial nutrition, but this approach requires more human resources, is very cost-intensive and probably cannot be executed in high numbers in today's care structures. From a practical point of view, it is understandable that gastrostomy is performed to keep processes and personnel structures within affordable limits in a nursing home, but this approach often does not meet the needs of the patient. Eventually, gastrostomy, as well as long-term tube feeding, carry similar risks as other interventional measures<sup>[26,27]</sup>; additionally, it may detain patients from the pleasures of tasting and of social contacts. Furthermore, advanced dementia patients tend to manipulate access points and tubes and thereby are prone to injure themselves. A risk-benefit analysis is therefore particularly important in any patient group and should be provided to the patient and/or his relatives.

The wish of supporting the nutrition of demented patients using tube feeding leads to a high rate of gastrostomies in patients with already advanced disease. Often these patients already suffer from progressive malnutrition and immobility. In many studies with demented patients, the complication rate of gastrostomy is unacceptably

**Table 2 Accepted and data-supported indications for percutaneous endoscopic gastrostomy (for references see text)**

Main disease groups	Diagnosis/reason for dysphagia
Cancer	Head and neck cancer Pharyngeal cancer Esophageal carcinoma Cancer with functional bowel obstruction (percutaneous endoscopic gastrostomy used as a decompression measure)
Neurodegenerative disorders	Stroke Amyotrophic lateral sclerosis Multiple sclerosis Severe brain damage from various reasons (trauma, persistent vegetative state, psychomotor retardation, <i>etc.</i> )

high<sup>[28,29]</sup>. We and others think that this is more related to patient factors than an innate risk of the intervention<sup>[30]</sup>. This view is supported by data from studies showing that control patients (with no PEG) had a very similar or even worse mortality<sup>[29,31]</sup>, and patients with only mild dementia had a significant higher benefit than those with advanced dementia<sup>[28]</sup>.

We call this the PEG paradox – choosing the patients too late for the intervention leads to missing benefit and greater harm including higher morbidity and mortality.

A Cochrane systematic review conducted in 2009 did not find a single randomized controlled trial that investigated the benefits of tube feeding in patients with dementia<sup>[32]</sup>. Consequently, recent guidelines do not encourage gastrostomy in patients with advanced dementia<sup>[33]</sup>, although clear and high-quality data in this clinical field are lacking. Table 3 shows the recent studies that examined the effects of tube feeding in patients with dementia<sup>[34-39]</sup>. Reviews and meta-analyses<sup>[40-42]</sup> mostly identified two severe problems of PEG studies in dementia patients. First, no randomized, prospective, properly controlled studies have been conducted. Most available studies have retrospective designs and suffer from a huge selection bias, and control groups are poor or unmatched. Second, in most studies, patients with dementia are not properly staged and are treated as a homogenous patient group. This prevents the identification of subgroups (*e.g.*, patients with only mild to moderate dementia) that might benefit from enteral nutrition *via* tube feeding. Other problems include poor exclusion and inclusion criteria, inappropriate outcome measures and small sample sizes<sup>[42]</sup>.

## NON-NEUROLOGICAL PATIENT GROUPS WITH POSSIBLE BENEFIT

In our opinion and clinical experience, there are other patient groups in clinical medicine that could benefit significantly from early gastrostomy. Even though it is hardly supported by study data, patients with chronic pancreatitis and pronounced (postprandial) pain syndrome often benefit from tube feeding that prevents weight loss, maintains mobility and physical activity, and thus, improves their quality of life. In our clinical experience, pulmonary cachexia in chronic obstructive pulmonary disease (COPD) patients can also be either avoided or alleviated by early PEG application. Although COPD has been identified as a risk factor for early mortality in patients with a PEG tube for other indications<sup>[43]</sup>, there is not a single study investigating the effect of early enteral nutrition in patients with COPD who manifest cachexia or are at risk for malnutrition. In many cancers, even cancer outside the GI tract such as lung, prostate and hematological tumors, malnutrition is frequent<sup>[44]</sup> (Table 4). Early and consistent enteral nutrition can enable timely and dose-appropriate chemotherapy and thus improve prognosis, since weight loss is one of the main risk factors for premature death in many cancers<sup>[45-47]</sup>. At least for the quality of life endpoint, this has already been shown in several studies<sup>[48]</sup>, but proof for hard endpoints such as overall survival is currently lacking.

It is also conceivable that patients with other severe diseases (such as ulcerative reflux disease or severe eosinophilic esophagitis) may also benefit from gastrostomy,

**Table 3 Studies of enteral nutrition with dementia patients in recent years**

Ref.	Design	Number of patients with dementia	Main results	Study problems/Appraisal
Higaki <i>et al</i> <sup>[15]</sup> , 2008	Retrospective cohort study	311 (143 with and 168 w/o dementia)	No significant differences in survival	No controls w/o PEG
Suzuki <i>et al</i> <sup>[28]</sup> , 2012	Observational study	1353	Significantly more benefit in patients with early dementia	Endpoint "Level of independent living of demented elderly" not validated, no controls
Ticinesi <i>et al</i> <sup>[34]</sup> , 2016	Observational study	184 (54 with PEG, 130 w/o PEG)	Survival with PEG significantly worse	Selection bias, no basic data for PEG-group <i>vs</i> non-PEG-group, patients with advanced dementia had better results compared to those with early dementia
Nunes <i>et al</i> <sup>[35]</sup> , 2016	Retrospective observational study	46 (only CDR 2 and 3)	Low albumin, transferrin and cholesterol as predictors for poor survival	No controls
Cúrdia <i>et al</i> <sup>[36]</sup> , 2017	Prospective cohort study, uncontrolled	26 (out of 60 in the whole cohort)	Significant decrease in hospitalization and visits to ER, > 50% healing of pressure ulcers	Only internal controls, no dementia grading
Ayman <i>et al</i> <sup>[37]</sup> , 2017	Retrospective cohort	165, control group with PEG for other reasons	Significantly shorter survival in dementia patients	No dementia control group, no dementia rating
Gingold-Belfer <i>et al</i> <sup>[38]</sup> , 2017	Retrospective Cohort, uncontrolled	189	Albumin level associated with longer survival (at baseline as well as during observation)	No control group, no dementia rating
Van Bruchem-Visser <i>et al</i> <sup>[39]</sup> , 2019	Retrospective cohort	42 (out of 303 in the whole cohort), no controls w/o PEG	Survival with PEG significantly shorter in patients with dementia	Selection bias, no dementia rating, PEG-indication partly unclear

w/o: Without; ER: Emergency room; PEG: Percutaneous endoscopic gastrostomy.

even if they are young. However, supporting data are lacking. Therefore, physicians are often reluctant to consider gastrostomy in these otherwise healthy and, often, young patients. At present, such decisions must remain extremely individualized. To what extent an intermittent PEG system in this patient population can contribute to the maintenance of a certain body weight and, thus, help to avoid physical weakness should be the subject of future studies. Nevertheless, data regarding the prognosis of such patients with or without enteral nutrition are quite important and economically and individually relevant; for example, for employment biographies.

## TIMING OF GASTROSTOMY

In the neurological field, gastrostomy also represents an important therapeutic option for patients with amyotrophic lateral sclerosis (ALS), depending on the overall situation and the preference of these patients<sup>[49]</sup>, who are conscious until their death. Weight loss in these patients is present very often, even without dysphagia<sup>[49]</sup>. Recent data also indicate that the time of tube insertion should be advanced compared to the current approach<sup>[50]</sup>. Patients with ALS had a significant better survival if enteral nutrition was initiated before the presence of weight loss<sup>[49]</sup>. To date, this aspect of the "timing" of gastrostomy has been disregarded. Earlier continuous enteral nutrition has the potential to improve prognosis significantly and should be considered in future studies. "Early" in this respect would mean gastrostomy before the underlying disease (regardless whether neurological or non-neurological) has caused significant malnutrition and weight loss accompanied by catabolism or restricted mobility. Here, the GLIM criteria can play an important role (with the underlying disease as etiologic criterion and a clear cut anticipatory definition of the phenotypic criterion)<sup>[51]</sup>. Timing of the intervention by such criteria would improve the patient selection and reduce the complication rate. With early gastrostomy, the prevalence of low albumin, higher age and higher comorbidity (all risk factors for worse outcome<sup>[29]</sup>) would be lower in patients selected for this intervention.

This may close the circle of argumentation in the case of patients with dementia; much more than before, gastroenterologists must also learn to assess patients with

**Table 4 Additional patient groups with a lack of data but potential benefit if the timing of gastrostomy is correct**

Chronic pancreatitis
COPD with manifest or imminent undernutrition/cachexia
Severe eosinophilic esophagitis
Severe ulcerative reflux disease
Cancer with undernutrition syndrome
(Mild to) moderate dementia

COPD: Chronic obstructive pulmonary disease.

chronic degenerative cerebral diseases. These diseases will increase substantially during the next decades. In patients with very advanced stages of dementia with complete immobility, lack of speech production and contractures, a gastrostomy is probably more harm- than useful. However, patients with early or moderate dementia, for whom we have not thought about enteral feeding so far, could possibly benefit from tube feeding.

Early tube feeding could prevent the progressive immobility of dementia patients and, thus, preserve their quality of life for longer. Data regarding these patients are extremely scarce (see discussion above), but a few subgroup analyses as well as some studies with better defined patient groups support this view<sup>[28,36,52]</sup>. In a large Japanese study, the selection of patients with early or moderate dementia increased the proportion of patients with a benefit as measured by the level of independent living four times as compared to patients with advanced dementia<sup>[28]</sup>.

However, in studies regarding nutritional support for dementia patients, no general benefits were obtained in cognitive tests<sup>[33]</sup>. Therefore, while dementia cannot be stopped, mobility and quality of life may be maintained longer. To date, due to this poor data situation, tube feeding and parenteral nutrition have only been recommended “to overcome a crisis situation” and “for a limited time” in the guidelines for this group of patients overall, and not at all or only as “very rare exception” for patients in late stages<sup>[33]</sup>.

## CONCLUSION

In our opinion, we must therefore pay attention to the following: Patients with dementia in very advanced stages should no longer be treated with artificial nutrition of any kind. We must explain this to the relatives and referring doctors. We must draw their attention to the data that suggest more and more severe complications in these patients than in less seriously ill patients as well as to the missing benefit for these patients. On the other hand, we may have to think about tube feeding at an earlier stage for patients at nutritional risk due to temporary or chronic restrictions of oral feeding. These patients should be made more consistently aware of the possibility of a gastrostomy before weight loss or even catabolism has occurred. This can affect younger, otherwise completely healthy patients as well as dementia patients in an earlier, still mobile stage.

In summary, while there may not necessarily be a current under- or over-utilization of PEG, there is a need to improve patient selection. To achieve this goal, we need more prospective randomized controlled studies to better define the indications for PEG in the patient groups and conditions outlined above.

## REFERENCES

- 1 **Gauderer MW**, Ponsky JL, Izant RJ. Gastrostomy without laparotomy: a percutaneous endoscopic technique. *J Pediatr Surg* 1980; **15**: 872-875 [PMID: 6780678 DOI: 10.1016/s0022-3468(80)80296-x]
- 2 **Ralls MW**, Demehri FR, Feng Y, Woods Ignatoski KM, Teitelbaum DH. Enteral nutrient deprivation in patients leads to a loss of intestinal epithelial barrier function. *Surgery* 2015; **157**: 732-742 [PMID: 25704423 DOI: 10.1016/j.surg.2014.12.004]
- 3 **Feng Y**, Ralls MW, Xiao W, Miyasaka E, Herman RS, Teitelbaum DH. Loss of enteral nutrition in a mouse model results in intestinal epithelial barrier dysfunction. *Ann N Y Acad Sci* 2012; **1258**: 71-77 [PMID: 22731718 DOI: 10.1111/j.1749-6632.2012.06572.x]
- 4 **Sun X**, Spencer AU, Yang H, Haxhija EQ, Teitelbaum DH. Impact of caloric intake on parenteral nutrition-associated intestinal morphology and mucosal barrier function. *JPEN J Parenter Enteral Nutr* 2006; **30**: 474-479 [PMID: 17047170 DOI: 10.1177/0148607106030006474]

- 5 **Lehocky P**, Sarr MG. Early enteral feeding in severe acute pancreatitis: can it prevent secondary pancreatic (super) infection? *Dig Surg* 2000; **17**: 571-577 [PMID: 11155001 DOI: 10.1159/000051964]
- 6 **Chen Z**, Wang S, Yu B, Li A. A comparison study between early enteral nutrition and parenteral nutrition in severe burn patients. *Burns* 2007; **33**: 708-712 [PMID: 17467914 DOI: 10.1016/j.burns.2006.10.380]
- 7 **Bengmark S**. Nutrition of the critically ill - emphasis on liver and pancreas. *Hepatobiliary Surg Nutr* 2012; **1**: 25-52 [PMID: 24570901 DOI: 10.3978/j.issn.2304-3881.2012.10.14]
- 8 **Yan X**, Zhou FX, Lan T, Xu H, Yang XX, Xie CH, Dai J, Fu ZM, Gao Y, Chen LL. Optimal postoperative nutrition support for patients with gastrointestinal malignancy: A systematic review and meta-analysis. *Clin Nutr* 2017; **36**: 710-721 [PMID: 27452745 DOI: 10.1016/j.clnu.2016.06.011]
- 9 **Masaki S**, Kawamoto T. Comparison of long-term outcomes between enteral nutrition via gastrostomy and total parenteral nutrition in older persons with dysphagia: A propensity-matched cohort study. *PLoS One* 2019; **14**: e0217120 [PMID: 31577813 DOI: 10.1371/journal.pone.0217120]
- 10 **Druml C**, Ballmer PE, Druml W, Oehmichen F, Shenkin A, Singer P, Soeters P, Weimann A, Bischoff SC. ESPEN guideline on ethical aspects of artificial nutrition and hydration. *Clin Nutr* 2016; **35**: 545-556 [PMID: 26923519 DOI: 10.1016/j.clnu.2016.02.006]
- 11 **Richter-Schrag HJ**, Richter S, Ruthmann O, Olschewski M, Hopt UT, Fischer A. Risk factors and complications following percutaneous endoscopic gastrostomy: a case series of 1041 patients. *Can J Gastroenterol* 2011; **25**: 201-206 [PMID: 21523261 DOI: 10.1155/2011/609601]
- 12 **Löser C**, Wolters S, Fölsch UR. Enteral long-term nutrition via percutaneous endoscopic gastrostomy (PEG) in 210 patients: a four-year prospective study. *Dig Dis Sci* 1998; **43**: 2549-2557 [PMID: 9824149 DOI: 10.1023/a:1026615106348]
- 13 **Schneider AS**, Schettler A, Markowski A, Luettig B, Kaufmann B, Klamt S, Lenzen H, Momma M, Seipt C, Lankisch T, Negm AA; \*Conference presentation: 36th ESPEN Congress in Leipzig, Germany on August 31st – September 3rd, 2013. Complication and mortality rate after percutaneous endoscopic gastrostomy are low and indication-dependent. *Scand J Gastroenterol* 2014; **49**: 891-898 [PMID: 24896841 DOI: 10.3109/00365521.2014.916343]
- 14 **Jafari A**, Weismüller TJ, Tonguc T, Kalf JC, Manekeller S. [Complications after Percutaneous Endoscopic Gastrostomy Tube Placement - A Retrospective Analysis]. *Zentralbl Chir* 2016; **141**: 442-445 [PMID: 26258619 DOI: 10.1055/s-0035-1557765]
- 15 **Higaki F**, Yokota O, Ohishi M. Factors predictive of survival after percutaneous endoscopic gastrostomy in the elderly: is dementia really a risk factor? *Am J Gastroenterol* 2008; **103**: 1011-6; quiz 1017 [PMID: 18177448 DOI: 10.1111/j.1572-0241.2007.01719.x]
- 16 **Dormann AJ**, Glosemeyer R, Leistner U, Deppe H, Roggel R, Wigglinghaus B, Huchzermeyer H. Modified percutaneous endoscopic gastrostomy (PEG) with gastropexy--early experience with a new introducer technique. *Z Gastroenterol* 2000; **38**: 933-938 [PMID: 11194881 DOI: 10.1055/s-2000-10025]
- 17 **Pih GY**, Na HK, Ahn JY, Jung KW, Kim DH, Lee JH, Choi KD, Song HJ, Lee GH, Jung HY. Risk factors for complications and mortality of percutaneous endoscopic gastrostomy insertion. *BMC Gastroenterol* 2018; **18**: 101 [PMID: 29954339 DOI: 10.1186/s12876-018-0825-8]
- 18 **Van Dyck E**, Macken EJ, Roth B, Pelckmans PA, Moreels TG. Safety of pull-type and introducer percutaneous endoscopic gastrostomy tubes in oncology patients: a retrospective analysis. *BMC Gastroenterol* 2011; **11**: 23 [PMID: 21410958 DOI: 10.1186/1471-230X-11-23]
- 19 **Moran C**, O'Mahony S. When is feeding via a percutaneous endoscopic gastrostomy indicated? *Curr Opin Gastroenterol* 2015; **31**: 137-142 [PMID: 25590659 DOI: 10.1097/MOG.0000000000000152]
- 20 **Geeganage C**, Beavan J, Ellender S, Bath PM. Interventions for dysphagia and nutritional support in acute and subacute stroke. *Cochrane Database Syst Rev* 2012; **10**: CD000323 [PMID: 23076886 DOI: 10.1002/14651858.CD000323.pub2]
- 21 **Gavazzi C**, Colatruglio S, Valoriani F, Mazzaferro V, Sabbatini A, Biffi R, Mariani L, Miceli R. Impact of home enteral nutrition in malnourished patients with upper gastrointestinal cancer: A multicentre randomised clinical trial. *Eur J Cancer* 2016; **64**: 107-112 [PMID: 27391922 DOI: 10.1016/j.ejca.2016.05.032]
- 22 **Grant MD**. Gastrostomies in older patients: the 1990 National Hospital Discharge Survey. *J Am Board Fam Pract* 1998; **11**: 187-192 [PMID: 9625509 DOI: 10.3122/15572625-11-3-187]
- 23 **Grant MD**, Rudberg MA, Brody JA. Gastrostomy placement and mortality among hospitalized Medicare beneficiaries. *JAMA* 1998; **279**: 1973-1976 [PMID: 9643861 DOI: 10.1001/jama.279.24.1973]
- 24 **Mitchell SL**, Mor V, Gozalo PL, Servadio JL, Teno JM. Tube Feeding in US Nursing Home Residents With Advanced Dementia, 2000-2014. *JAMA* 2016; **316**: 769-770 [PMID: 27533163 DOI: 10.1001/jama.2016.9374]
- 25 **Palecek EJ**, Teno JM, Casarett DJ, Hanson LC, Rhodes RL, Mitchell SL. Comfort feeding only: a proposal to bring clarity to decision-making regarding difficulty with eating for persons with advanced dementia. *J Am Geriatr Soc* 2010; **58**: 580-584 [PMID: 20398123 DOI: 10.1111/j.1532-5415.2010.02740.x]
- 26 **Haller A**. [Enteral tube feeding]. *Ther Umsch* 2014; **71**: 155-161 [PMID: 24568855 DOI: 10.1024/0040-5930/a000497]
- 27 **Stayner JL**, Bhatnagar A, McGinn AN, Fang JC. Feeding tube placement: errors and complications. *Nutr Clin Pract* 2012; **27**: 738-748 [PMID: 23064019 DOI: 10.1177/0884533612462239]
- 28 **Suzuki Y**, Urashima M, Izumi M, Ito Y, Uchida N, Okada S, Ono H, Orimo S, Kohri T, Shigoka H, Shintani S, Tanaka Y, Yoshida A, Ijima M, Ito T, Endo T, Okano H, Maruyama M, Iwase T, Kikuchi T, Kudo M, Takahashi M, Goshi S, Mikami T, Yamashita S, Akiyama K, Ogawa T, Ogawa T, Ono S, Onozawa S, Kobayashi J, Matsumoto M, Matsumoto T, Jomoto K, Mizuhara A, Nishiguchi Y, Nishiwaki S, Aoki M, Ishizuka I, Kura T, Murakami M, Murakami A, Ohta T, Onishi K, Nakahori M, Tsuji T, Tahara K, Tanaka I, Kitagawa K, Shimazaki M, Fujiki T, Kusakabe T, Iiri T, Kitahara S, Horiuchi A, Suenaga H, Washizawa N, Suzuki M. The Effects of Percutaneous Endoscopic Gastrostomy on Quality of Life in Patients With Dementia. *Gastroenterology Res* 2012; **5**: 10-20 [PMID: 27785173 DOI: 10.4021/gr392w]
- 29 **Kurien M**, Leeds JS, Delegge MH, Robson HE, Grant J, Lee FK, McAlindon ME, Sanders DS. Mortality among patients who receive or defer gastrostomies. *Clin Gastroenterol Hepatol* 2013; **11**: 1445-1450 [PMID: 23639596 DOI: 10.1016/j.cgh.2013.04.025]
- 30 **Wilcox CM**, McClave SA. To PEG or not to PEG. *Clin Gastroenterol Hepatol* 2013; **11**: 1451-1452 [PMID: 23891917 DOI: 10.1016/j.cgh.2013.07.009]
- 31 **Arora G**, Rockey D, Gupta S. High In-hospital mortality after percutaneous endoscopic gastrostomy: results of a nationwide population-based study. *Clin Gastroenterol Hepatol* 2013; **11**: 1437-1444.e3

- [PMID: 23602822 DOI: 10.1016/j.cgh.2013.04.011]
- 32 **Sampson EL**, Candy B, Jones L. Enteral tube feeding for older people with advanced dementia. *Cochrane Database Syst Rev* 2009; CD007209 [PMID: 19370678 DOI: 10.1002/14651858.CD007209.pub2]
- 33 **Volkert D**, Chourdakis M, Faxen-Irving G, Frühwald T, Landi F, Suominen MH, Vandewoude M, Wirth R, Schneider SM. ESPEN guidelines on nutrition in dementia. *Clin Nutr* 2015; **34**: 1052-1073 [PMID: 26522922 DOI: 10.1016/j.clnu.2015.09.004]
- 34 **Ticinesi A**, Nouvenne A, Lauretani F, Prati B, Cerundolo N, Maggio M, Meschi T. Survival in older adults with dementia and eating problems: To PEG or not to PEG? *Clin Nutr* 2016; **35**: 1512-1516 [PMID: 27091773 DOI: 10.1016/j.clnu.2016.04.001]
- 35 **Nunes G**, Santos CA, Santos C, Fonseca J. Percutaneous endoscopic gastrostomy for nutritional support in dementia patients. *Aging Clin Exp Res* 2016; **28**: 983-989 [PMID: 26582081 DOI: 10.1007/s40520-015-0485-2]
- 36 **Cúrdia GT**, Marinho C, Magalhães J, Barbosa M, Monteiro S, Dias de Castro F, Boal Carvalho P, Rosa B, Figueiredo L, Cotter J. Percutaneous endoscopic gastrostomy: confirming the clinical benefits far beyond anthropometry. *Eur J Gastroenterol Hepatol* 2017; **29**: 1097-1101 [PMID: 28746159 DOI: 10.1097/MEG.0000000000000923]
- 37 **Ayman AR**, Khoury T, Cohen J, Chen S, Yaari S, Daher S, Benson AA, Mizrahi M. PEG Insertion in Patients With Dementia Does Not Improve Nutritional Status and Has Worse Outcomes as Compared With PEG Insertion for Other Indications. *J Clin Gastroenterol* 2017; **51**: 417-420 [PMID: 27505401 DOI: 10.1097/MCG.0000000000000624]
- 38 **Gingold-Belfer R**, Weiss A, Geller A, Sapoznikov B, Beloosesky Y, Morag-Koren N, Niv Y, Boltin D, Issa N, Schmilovitz-Weiss H. Increasing Serum Albumin Level Shortly After Gastrostomy Tube Insertion Predicts Longer Survival in Elderly Patients With Dementia. *J Clin Gastroenterol* 2017; **51**: 339-344 [PMID: 27479141 DOI: 10.1097/MCG.0000000000000616]
- 39 **van Bruchem-Visser RL**, Mattace-Raso FUS, de Beaufort ID, Kuipers EJ. Percutaneous endoscopic gastrostomy in older patients with and without dementia: Survival and ethical considerations. *J Gastroenterol Hepatol* 2019; **34**: 736-741 [PMID: 30551264 DOI: 10.1111/jgh.14573]
- 40 **Goldberg LS**, Altman KW. The role of gastrostomy tube placement in advanced dementia with dysphagia: a critical review. *Clin Interv Aging* 2014; **9**: 1733-1739 [PMID: 25342891 DOI: 10.2147/CIA.S53153]
- 41 **Brooke J**, Ojo O. Enteral nutrition in dementia: a systematic review. *Nutrients* 2015; **7**: 2456-2468 [PMID: 25854831 DOI: 10.3390/nu7042456]
- 42 **Lynch MC**. Is tube feeding futile in advanced dementia? *Linacre Q* 2016; **83**: 283-307 [PMID: 27833208 DOI: 10.1080/00243639.2016.1211879]
- 43 **Lang A**, Bardan E, Chowers Y, Sakhnini E, Fidler HH, Bar-Meir S, Avidan B. Risk factors for mortality in patients undergoing percutaneous endoscopic gastrostomy. *Endoscopy* 2004; **36**: 522-526 [PMID: 15202049 DOI: 10.1055/s-2004-814400]
- 44 **Gyan E**, Raynard B, Durand JP, Lacau Saint Guily J, Gouy S, Movschin ML, Khemissa F, Flori N, Oziel-Taieb S, Bannier Braticovic C, Zeanandin G, Hebert C, Savinelli F, Goldwasser F, Hébuterne X; NutriCancer2012 Investigator Group. Malnutrition in Patients With Cancer: Comparison of Perceptions by Patients, Relatives, and Physicians-Results of the NutriCancer2012 Study. *JPEN J Parenter Enteral Nutr* 2018; **42**: 255-260 [PMID: 29505137 DOI: 10.1177/0148607116688881]
- 45 **Dewys WD**, Begg C, Lavin PT, Band PR, Bennett JM, Bertino JR, Cohen MH, Douglass HO, Engstrom PF, Ezdinli EZ, Horton J, Johnson GJ, Moertel CG, Oken MM, Perlia C, Rosenbaum C, Silverstein MN, Skeel RT, Sponzo RW, Tormey DC. Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. *Am J Med* 1980; **69**: 491-497 [PMID: 7424938 DOI: 10.1016/s0149-2918(05)80001-3]
- 46 **Arends J**, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, Fearon K, Hütterer E, Isenring E, Kaasa S, Krznaric Z, Laird B, Larsson M, Laviano A, Mühlebach S, Muscaritoli M, Oldervoll L, Ravasco P, Solheim T, Strasser F, de van der Schueren M, Preiser JC. ESPEN guidelines on nutrition in cancer patients. *Clin Nutr* 2017; **36**: 11-48 [PMID: 27637832 DOI: 10.1016/j.clnu.2016.07.015]
- 47 **Arends J**, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NEP, Erickson N, Laviano A, Lisanti MP, Lobo DN, McMillan DC, Muscaritoli M, Ockenga J, Pirllich M, Strasser F, de van der Schueren M, Van Gossum A, Vaupel P, Weimann A. ESPEN expert group recommendations for action against cancer-related malnutrition. *Clin Nutr* 2017; **36**: 1187-1196 [PMID: 28689670 DOI: 10.1016/j.clnu.2017.06.017]
- 48 **Baldwin C**, Spiro A, Ahern R, Emery PW. Oral nutritional interventions in malnourished patients with cancer: a systematic review and meta-analysis. *J Natl Cancer Inst* 2012; **104**: 371-385 [PMID: 22345712 DOI: 10.1093/jnci/djr556]
- 49 **Körner S**, Hendricks M, Kollewe K, Zapf A, Dengler R, Silani V, Petri S. Weight loss, dysphagia and supplement intake in patients with amyotrophic lateral sclerosis (ALS): impact on quality of life and therapeutic options. *BMC Neurol* 2013; **13**: 84 [PMID: 23848967 DOI: 10.1186/1471-2377-13-84]
- 50 **Dorst J**, Dupuis L, Petri S, Kollewe K, Abdulla S, Wolf J, Weber M, Czell D, Burkhardt C, Hanisch F, Vielhaber S, Meyer T, Frisch G, Kettemann D, Grehl T, Schrank B, Ludolph AC. Percutaneous endoscopic gastrostomy in amyotrophic lateral sclerosis: a prospective observational study. *J Neurol* 2015; **262**: 849-858 [PMID: 25618254 DOI: 10.1007/s00415-015-7646-2]
- 51 **Cederholm T**, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, Baptista G, Barazzoni R, Blaauw R, Coats A, Crivelli A, Evans DC, Gramlich L, Fuchs-Tarlovsky V, Keller H, Llido L, Malone A, Mogensen KM, Morley JE, Muscaritoli M, Nyulasi I, Pirllich M, Pisprasert V, de van der Schueren MAE, Siltharm S, Singer P, Tappenden K, Velasco N, Waitzberg D, Yamwong P, Yu J, Van Gossum A, Compher C; GLIM Core Leadership Committee; GLIM Working Group. GLIM criteria for the diagnosis of malnutrition - A consensus report from the global clinical nutrition community. *Clin Nutr* 2019; **38**: 1-9 [PMID: 30181091 DOI: 10.1016/j.clnu.2018.08.002]
- 52 **Fischbach W**, Dorlöchter C, Sahraizadeh H, Dietrich CG, Al-Taie OH. Life With PEG. Is There a Need for Reassessment? Results From a Large Prospective Study. Part II: Acceptance and Satisfaction Estimated by Patients, Family Members, Nursing Team, and Doctors. *Gastroenterology* 2014; **146**: S554-S555 [DOI: 10.1016/S0016-5085(14)62006-0]



Published by Baishideng Publishing Group Inc  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
Telephone: +1-925-3991568  
E-mail: [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
Help Desk: <http://www.f6publishing.com/helpdesk>  
<http://www.wjgnet.com>

