Carol Rees Parrish, RD, MS, Series Editor

To PEG or Not To PEG

William M. Plonk, Jr.

Percutaneous endoscopic gastrostomy (PEG) tubes have become increasingly popular for providing artificial enteral nutrition. Recent studies, however, have raised doubts about their long-term benefit and concerns about their overuse. In only four conditions has patient benefit from PEG tube insertion been demonstrated, and even in these its advantage over nasogastric tube use or medical therapy is unclear. Physicians poorly inform patients and families regarding PEG tube benefits, burdens, and alternatives, and often perform non-beneficial PEG tube placements to avoid difficult discussions with patients, families, or colleagues. Multiple barriers exist to limiting PEG tube overuse, but interventions involving evidence-based placement guidelines and palliative care consultations have shown some success.

INTRODUCTION

Recent interest in the Terri Shiavo case has brought the issue of percutaneous endoscopic gastrostomy (PEG) tubes into active public discussion. What was missing from that debate, however, was a clear discussion of the evidence behind their use. A critical review of the clinical literature reveals that PEG tubes have a limited role in only a few conditions, that even in these conditions their advantage over nasogastric (NG) tubes or medical therapy is questionable, and that they are widely overused in current practice.

Those who argue a PEG tube is not a medical intervention have likely never seen one placed. Creating a hole into the stomach through the anterior abdominal wall is surgery, regardless of who does the procedure. As such, it should be performed only if its benefits clearly outweigh its risks and burdens. PEG placement cannot be justified, therefore, without convincing objective clinical evidence of patient benefit. Ultimately, only two patient outcomes matter: making life longer (improving mortality) or better (improving quality of life). The burden of proof of benefit lies not

(continued on page 19)

William M. Plonk Jr., M.D., Assistant Professor of Geriatrics, Department of Internal Medicine, University of Virginia Health System, Charlottesville, VA.

(continued from page 16)

Table 1
Burdens and Complications Associated with PEG Tube Feeding

Wound dehiscence	Local bleeding	Stoma stenosis
Skin excoriation	Hematoma	Bumper erosion
Tube migration	Tube malfunction	Placement failure
Pain at tube site	Aspiration	Gastric perforation
Gastric prolapse	Gastrocolic fistula	Pneumoperitoneum
Prolonged ileus	Eviseration	Pneumatosis intestinalis
Intussusception	Peritonitis	Cellulitis
Necrotizing fasciitis	Abdominal abscess	Subphrenic abscess
Diarrhea	Bowel obstruction	GI bleeding
Nausea	Vomiting	Gastroesophageal reflux
Fluid overload	Death	Restraint use
Metabolic disturbance	Pneumonia	Esophageal perforation
Loss of gustatory pleasure	Loss of dignity	Loss of social interaction

only with the provider requesting the tube but also with the physician placing it, especially when the latter has a financial incentive to do so. Ethical physicians should decline to order or place PEG tubes for conditions not shown to benefit from them.

Gauderer introduced PEG tube placement in 1980 as a safe and effective alternative to open surgical gastrostomy (1). It was considered safe because it had less than a 2% intra-operative complication rate and effective because it allowed tube feeding in almost all cases. It was also cost-efficient for multiple providers, including physicians, hospitals, nursing homes, and home health agencies, and was presumed to be beneficial since poor nutrition was a known risk factor for worse outcomes. Unfortunately, little attention was paid initially to patient outcomes after the immediate post-operative period.

PEG tubes quickly became the procedure of choice for providing enteral nutrition in the United States. In Medicare patients, its use doubled from about 61,000 annually in 1988 to about 123,000 annually in 1995 (2). By 1999, 34% of severely cognitively impaired residents of U.S. nursing homes had PEG tubes (3). As their popularity grew, PEG tube use began to show some disturbing trends. One hospital saw its 30-day mortality after PEG tube placement rise from 8% to 22% in ten years and its use for non-evidence-based indications rise from 16% to 31% (4). Other studies showed particularly high six-month mortality rates associated with cancer, dementia, and neurodegenerative disease, as well as marked racial disparities, with blacks receiving tubes at nearly twice the rate of whites (6,42).

Such data led many to question the possible overuse and misuse of this procedure. While safe and effective in the short term, it began to be recognized as an invasive artificial means of life support with multiple serious long-term complications (Table 1). Furthermore, bioethical and legal opinions (such as those surrounding the Nancy Cruzan case) began to question the medical imperative to provide nutritional support in cases where no benefit could be demonstrated.

THE CLINICAL EVIDENCE

The evidence base regarding PEG tubes has grown substantially over the past ten years. Researchers have shown increasing interest in studying long-term outcomes after PEG tube placement, not just those in the peri-operative period. Retrospective studies have been followed by prospective ones and small randomized trials. Finally, large randomized controlled trials comparing PEG tube placements to less invasive alternatives (FOOD, PEGASUS) are beginning to produce quality evidence to help guide clinical practice (26).

RISK FACTORS, BURDENS, AND COMPLICATIONS

Identified poor prognostic indicators for PEG placement are listed in Table 2 (5,6). What is striking about

Table 2
Poor Prognostic Indicators for PEG Placement

Age > 75	Charlson score >3
Male gender	Low BMI
Diabetes mellitus	Albumin <3 g/dL
COPD	Hospitalized
Advanced cancer	Bedridden
Previous aspiration	Pressure sores
NPO ×7 days	Confusion
UTI	Cardiac disease

this list is that it includes several widely accepted indications for PEG tube placement. If the condition for which a procedure is being performed is itself a risk factor for poor outcome, the benefit of that procedure becomes suspect. PEG tube placement has been associated with multiple burdens and complications, some of which are listed in Table 1 (7). Conversely, it has been associated with benefit in only a handful of conditions, as discussed below.

DEMENTIA

In a seminal 1999 *JAMA* review article, Finucane and colleagues found no evidence that tube feeding in patients with advanced dementia prolongs survival, prevents aspiration pneumonia, reduces the risk of pressure sores or infections, improves function, or provides comfort (8). Subsequent studies have documented a poor prognosis for hospitalized patients with advanced dementia (50% mortality at 6 months) that tube feeding failed to improve (9). In fact, one prospective trial in demented veterans showed an increase in mortality with PEG tube placement, although the difference was not statistically significant (10). Other studies have associated PEG tubes in dementia with significant increases in complication rates, restraint use, and emergency department visits (11,12). A 2000 New England Journal of Medicine editorial concluded that feeding tubes "are generally ineffective in prolonging life, preventing aspiration, and even providing adequate nourishment in patients with advanced dementia"(13). Appropriately, there has been a decline in PEG tube use with dementia in Veterans Administration hospitals since 1996, though racial disparities persist (14).

CANCER

In 1994, Klein and Koretz reviewed the published prospective randomized controlled trials of nutrition support in cancer and concluded that the evidence "failed to demonstrate the clinical efficacy of providing nutrition support to most patients with cancer" (15). One exception was head and neck cancer, where PEG placement has been shown to improve quality of life but not mortality (16). When compared with NG tube use, however, PEG placement resulted in more persistent dysphagia, perhaps because there was less incentive to participate aggressively in therapy (17). A recent Swedish study showed fatal or severe complications of PEG placement in head and neck cancer patients occurred in 26% of cases over two years and warned "for a very sick patient, a theoretically easy procedure could turn into a potentially dangerous operation"(18).

NEUROMUSCULAR DEGENERATIVE DISEASE

In amyotrophic lateral sclerosis, PEG use has been shown to improve quality of life scores and weight but not mortality (19). A recent Scottish study, however, showed a median survival from insertion of less than five months and a 30-day mortality of 25%, outcomes similar to those in advanced dementia (20). A 2004 Cochrane Review found no adequately controlled trials of PEG tube use in muscular dystrophy or other chronic muscle diseases (21).

STROKE

Two randomized controlled trials published in BMJ in 1992 and 1996 showed that compared to NG tube use, PEG tube placement after stroke decreased mortality, treatment failures, and malnutrition (22,23). Unfortunately, these trials were short (six weeks), small (49 patients total), and poorly randomized (NG patients were both older and sicker) (24). Cochrane reviewers note that "too few studies have been performed, and these have involved too few patients"(25). The recently published multicenter FOOD trial found no benefit to early versus delayed PEG feeding and an increased risk of death or poor neurologic outcome with PEG compared to NG use ($p = 0.05$) (26). Other studies have found high 30-day mortality and complication

rates associated with PEG tube use after stroke (27,28). New techniques for securing NG tubes to prevent treatment failure have been developed (29).

ASPIRATION PNEUMONIA

Aspiration pneumonia is the most common cause of death after PEG placement (30). Data consistently show that feeding tubes (both NG and PEG) actually increase the risk of aspiration pneumonia, perhaps by increasing gastroesophageal reflux or oropharyngeal colonization (31,32). Neurogenic dysphagia patients fed with NG, PEG, jejunostomy, or post-pyloric tubes all have similar rates of aspiration pneumonia (33,34). Interestingly, aspiration seen on modified barium swallow has not been associated with an increased risk of pneumonia or mortality in the majority of studies, raising the question of whether aspiration should be treated at all (35).

GASTRIC DECOMPRESSION

Gastric decompression with PEG placement effectively resolved most cases of persistent nausea and vomiting in bowel obstruction due to gynecologic malignancy and allowed most patients to be discharged from the hospital with hospice support (36). Octreotide, a somatostatin analogue that decreases gastrointestinal secretions, was effective in cases unresponsive to PEG placement and has been promoted as a useful alternative to NG or PEG decompression, but no trials comparing medical to surgical treatment have been performed (37).

TIMING OF PEG TUBE PLACEMENT

In 2000, Abuksis noted that inpatients who underwent PEG placement had significantly higher 30-day mortality than outpatients (38). He subsequently showed that stroke patients who received PEG placement 30 days after hospital discharge had significantly lower 30-day mortality than those who received PEG placement during their hospitalization, even accounting for those who died while waiting for PEG placement (39).

ETHICAL ISSUES

Our culture attaches great emotional symbolism to providing nutrition to loved ones. Many physicians feel they cannot refuse PEG tube placement if it is requested by the patient or family. Most ethics and legal scholars, however, argue physicians have no obligation to provide nonbeneficial treatments, and at least one bioethicist has noted that without an expectation of benefit, artificial feeding can be considered a form of torture (40). Informed consent for PEG placement is routinely poor. One large community teaching hospital documented adequate discussion of procedure-specific benefits, burdens, and alternatives in only 0.6% of PEG placements (41). Extensive anecdotal evidence suggests families unsure about PEG placement commonly feel pressured into consenting and often later regret their decisions (42,43).

The ethical burden of providing only beneficial care lies with both the physician ordering a feeding tube and the physician placing it. Most physicians would refuse a family request to repair a ventral hernia in an elderly demented patient, but many are willing to place a PEG tube in the same individual, even though both procedures are safe, effective, and non-beneficial. The use of PEG tubes in persistent vegetative states clearly can improve mortality, but the benefit of that outcome is ethically questionable in a permanently unconscious patient.

WITHHOLDING AND WITHDRAWING ARTIFICIAL NUTRITION

The overwhelming majority of patients who stop eating do not experience hunger or hunger only initially (44). Terminal anorexia and dehydration may actually benefit dying patients by inducing ketosis, uremia, and endorphin release. Terminal anorexia and cachexia appear to be due largely to inflammatory cytokines unimproved by nutrition; even prolonged tube feeding with adequate formula failed to improve nutritional parameters in chronically ill nursing home residents (45).

Though stopping tube feeding is widely considered ethically and legally indistinguishable from never starting it, discontinuation is much more difficult emotionally (46). Artificial nutrition is typically the last life-sustaining measure withdrawn, and 25% of demented nursing home residents die while still receiving tube feedings (47). Providers should reconsider starting a treatment that may be unusually difficult to discontinue.

(continued on page 25)

(continued from page 21)

Table 3
Practice Guidelines for PEG Tube Placement

Reference	*Do not offer*	*Offer but advise against*	*Offer and recommend*	*Discuss PEG vs. no PEG*	*Discuss PEG vs. NG*
AGA 1995	Anorexia-cachexia syndrome	Feeding need <30 days	Feeding need >30 days	Complicated dysphagia (dementia, stroke)	
Rabeneck 1997		Permanent vegetative state	Uncomplicated dysphagia with no other quality of life deficits		
Angus/Burakoff 2003	Prognosis <2 months, Cancer cachexia, Advanced progressive unresponsive cancer	Persistent vegetative state End-stage dementia without acute neurologic deficit	Bowel obstruction with prognosis >2 months and unable to place stent Cancer treatment expected >4 weeks with moderate-severe malnutrition and intact GI tract Dysphagia with persistent obtundation, brain stem stroke, bilateral stroke, or gross aspiration	Complicated dysphagia End-stage COPD Advanced dementia	Dysphagia without gross aspiration
Niv/Abuksis 2002	Aspiration Cancer with short life expectancy Dementia PVS Anorexia-cachexia syndromes		Head and neck cancer Acute stroke with persistent dysphagia 30 days after hospital discharge Neuromuscular dystrophy syndromes Gastric decompression		

AGA guideline: Enteral nutrition. *Gastroenterology* 1995;108:1280; Rabeneck L, McCullough LB, Wray NP: Ethically justified, clinically comprehensive guidelines for percutaneous endoscopic gastrostomy tube placement. *Lancet* 1997;349:496-8; Angus F, Burakoff R: The percutaneous endoscopic gastrostomy tube: medical and ethical issues in placement. *Am J Gastro* 2003;98:272-7; Niv Y, Abuksis G: Indications for percutaneous endoscopic gastrostomy insertion: ethical aspects. *Dig Dis* 2002;20:253-6.

PRACTICE GUIDELINES

Several practice guidelines for PEG tube placement have been published and are summarized in Table 3. The most evidence-based and clinically useful is that of Niv and Abuksis, which recommends the consideration of PEG placement in only four conditions: head and neck cancer, acute stroke with dysphagia, neuromuscular dystrophy syndromes, and gastric decompression. They further recommend not using NG feeding until 30 days following hospital discharge to decrease 30-day mortality.

BARRIERS TO APPROPRIATE USE

Numerous barriers to the appropriate use of PEG tubes exist. Many physicians, including many gastroenterologists, are unfamiliar with the evidence-based indications for PEG tubes and continue to recommend them for aspiration, advanced dementia, and late-stage cancer (48). Published practice guidelines are conflicting and often unsupported by the literature. Physicians in training often are taught not to question PEG placement decisions and to insert them even for inappropriate indications. The financial incentives of multiple providers (physicians, hospitals, nursing facilities) encourage the overuse of this procedure and often conflict with the patient's best interest. For example, feeding severely demented nursing home residents via PEG cost nursing facilities significantly less per day than feeding them by hand (49). PEG placements often are a major source of provider income, although recent data suggests that inpatient insertions are more poorly reimbursed (50). Families are often reluctant to withhold or withdraw artificial nutrition from loved ones, and physicians often find it easier to recommend a nonbeneficial procedure than to confront difficult end-of-life issues. Ethics and palliative care consultations are seldom used in these cases and often only after the PEG tube has failed to provide clinical improvement (51). PEG tube placement often is "required" for nursing home admis-

sion, despite the obvious clinical, ethical, and legal problems associated with mandating invasive non-beneficial surgery for facility enrollment (42).

INTERVENTIONS TO REDUCE INAPPROPRIATE USE

Two published interventions have been shown to reduce inappropriate PEG tube placement. Sanders and colleagues were able to reduce PEG placements by 39% through the use of explicit hospital-specific guidelines (52). Monteleoni and Clark reduced placements in patients with dementia by 80% with staff education and mandatory palliative care consultations (53). Multidisciplinary "PEG teams," while popular, have not been shown to decrease inappropriate use, though they rarely include geriatric or palliative care input.

RECOMMENDATIONS FOR PRACTICE

Based on current literature, PEG tube placement should be considered only in early head and neck cancer, amyotrophic lateral sclerosis, malignant bowel obstruction with intractable vomiting, and acute stroke with dysphagia persisting one month after hospital discharge. Physicians who order or place PEG tubes should do so only for these evidence-based indications and should avoid using the procedure to evade difficult discussions regarding prognosis or goals of care. Physicians are not obligated to provide non-beneficial care requested by patients, families, or colleagues. To reduce PEG tube overuse, institutions should include evidence-based placement guidelines or palliative care consultants in the decision-making process.

CONCLUSION

Introduced 25 years ago, PEG tubes illustrate dramatically how significant technical medical advances can become harmful with overuse. In only four conditions has patient benefit from PEG tube insertion been demonstrated, and even in these its overall advantage over NG use or medical therapy is unclear. Withholding or withdrawing artificial nutrition is difficult emotionally despite the lack of evidence that tube feeding is beneficial in dying patients. Physicians poorly inform patients and families regarding PEG tube benefits, burdens, and alternatives and often perform non-beneficial PEG tube placements to avoid difficult discussions with patients, families, or colleagues. Ethical physicians should decline to order or place PEG tubes for conditions not shown to benefit from them. Multiple barriers exist to limiting PEG tube overuse, but some targeted quality improvement interventions have shown success.

As more outcomes research on PEG tubes is published, their evidence-based indications may change. Physicians should remember, however, that medical care remains about the patient, not the procedure. Twenty years after originating the technique, Gauderer observed:

Because of its simplicity and low complication rate, this minimally invasive procedure also lends itself to overutilization. Therefore, as percutaneous endoscopic gastrostomy enters its third decade, much of our effort in the future needs to be directed toward the ethical aspects associated with long-term enteral feeding. In addition to developing new procedures and devices, or to perfecting existing ones, we as physicians must continuously strive to demonstrate that our interventions truly benefit the patient (54). ■

References

1. Gauderer MW, Ponsky JL, Izant RJ Jr. Gastrostomy without laparotomy: a percutaneous endoscopic technique. *J Pediatr Surg,* 1980;15:872-875.
2. National Hospital Discharge Surveys, 1989 and 1995.
3. Mitchell SL, et al. Clinical and organizational factors associated with feeding tube use among nursing home residents with advanced cognitive impairment. *JAMA,* 2003; 290:73.
4. Janes SE, Price CS, Khan S. Percutaneous endoscopic gastrostomy: mortality trends and risk factors. *J Postgrad Med,* 2005;51:23-29.
5. Mitchell SL, Tetroe JM. Survival after percutaneous endoscopic gastrostomy tube placement in older persons. *J Gerontol A Biol Sci Med Sci,* 2000;55:M735-M739.
6. Grant MD, Rudberg MA, Brody JA. Gastrostomy placement and mortality among hospitalized Medicare beneficiaries. *JAMA,* 1998;279:1973-1976.
7. Lang A, Bardan E, Chowers Y, et al. Risk factors for mortality in patients undergoing percutaneous endoscopic gastrostomy. *Endoscopy,* 2004;36:522-526.
8. Finucane T, Christmas C, Travis K. Tube feeding in patients with advanced dementia: a review of the evidence. *JAMA,* 1999;282:1365-1370.
9. Meier DE, et al. High short-term mortality in hospitalized patients with advanced dementia: lack of benefit of tube feeding. *Ann Int Med,* 2001;161:2385-2386.

(continued on page 31)

(continued from page 26)

10. Murphy LM, Lipman TO. Percutaneous endoscopic gastrostomy does not prolong survival in patients with dementia. *Arch Int Med,* 2003; 163:1351-1353.
11. Li I. Feeding tubes in patients with severe dementia. *Am Fam Physician,* 2002; 65:1605-1610.
12. Odom SR, et al. Emergency department visits by demented patients with malfunctioning feeding tubes. *Surg Endo,* 2003;17:651-653.
13. Gillick MR. Rethinking the role of tube feeding in patients with advanced dementia. *NEJM,* 2000;342: 206-210.
14. Braun UK, Rabeneck L, McCullough LB, et al. Decreasing use of percutaneous endoscopic gastrostomy tube feeding for veterans with dementia—racial differences remain. *J Am Geriatr Soc,* 2005;53:242-248.
15. Klein S, Koretz RL. Nutrition support in patients with cancer: what do the data really show? *Nutr Clin Pract,* 1994;9:87-89.
16. Sartori S, et al. Cost analysis of long term feeding by percutaneous endoscopic gastrostomy in cancer patients in an Italian health district. *Support Care Cancer,* 1996; 4: 21-26.
17. Mekhail TM, et al. Enteral nutrition during the treatment of head and neck carcinoma. *Cancer,* 2001;91:1785-1790.
18. Ehrsson YT, Langius-Eklof A, Bark T, Laurell G. Percutaneous endoscopic gastrostomy (PEG)—a long-term follow-up study in head and neck cancer patients. *Clin Otolaryngol,* 2004;29:740-746.
19. Mitsumoto H, et al. Percutaneous endoscopic gastrostomy (PEG) in patients with ALS and bulbar dysfunction. *Amyotroph Lateral Scler Other Motor Neuron Disord,* 2003; 4: 177-185.
20. Forbes RB, et al. Frequency, timing, and outcome of gastrostomy tubes for amyotrophic lateral sclerosis/motor neurone disease. *J Neurol,* 2004;251:813-817.
21. Hill M, et al. Treatment for dysphagia in chronic muscle disease. *Cochrane Database Syst Reviews,* 2005.
22. Norton B, Homer-Ward M, Donnelly MT, et al. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after acute dysphagic stroke. *BMJ,* 1996;312:13-16.
23. Park RH, Allison MC, Lang J, et al. Randomised comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding in patients with persisting neurological dysphagia. *BMJ,* 1992;304:1406-1409.
24. Duncan HD, Walters E, Silk DB. Percutaneous endoscopic gastrostomy feeding after acute dysphagic stroke. Mortality associated with nasogastric tube feeding was high. *BMJ,* 1996;312:973.
25. Bath PM, Bath FJ, Smithard DG. Interventions for dysphagia in acute stroke. *Cochrane Database Syst Rev,* 2005.
26. Dennis MS, Lewis SC, Warlow C, et al. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. *Lancet,* 2005;365:764-772.
27. Hu I, Hauge T. Percutaneous endoscopic gastrostomy (PEG) for enteral nutrition in patients with stroke. *Scand J Gastroenterol,* 2003;9:962-966.
28. Wijdicks EF, McMahon MM. Percutaneous endoscopic gastrostomy after acute stroke: complications and outcome. *Cerebrovasc Dis,* 1999;9:109-111.
29. Anderson MR, et al. The nasal loop provides an alternative to percutaneous endoscopic gastrostomy in high-risk dysphagic stroke patients. *Clin Nutr,* 2004;23:501-506.
30. James A, Kapur K, Hawthorne AB. Long-term outcome of percutaneous endoscopic gastrostomy feeding in patients with dysphagic stroke. *Age Aging,* 1999;27:671-676.
31. Finucane TE, Bynum JPW. Use of tube feeding to prevent aspiration pneumonia. *Lancet,* 1996;348:1421-1424.
32. Langmore SE, et al. Predictors of aspiration pneumonia: how important is dysphagia? *Dysphagia,* 1998;13:69-81.
33. Marik PE, Zaloga GP. Gastric vs. post-pyloric feeding: a systematic review. *Crit Care,* 2003;7:R64-R51.
34. Strong RM, et al. Equal aspiration rates from postpyloric and intragastric-placed small-bore nasogastric tubes: a randomized prospective study. *J Parenter Enteral Nutr,* 1992; 16:59-63.
35. Ramsey DJ, Smithard DG, Kalra L. Early assessments of dysphagia and aspiration risk in acute stroke. *Stroke,* 2003;34:1252-1257.
36. Campagnutta E, et al. Palliative treatment of upper intestinal obstruction by gynecologic malignancy: the usefulness of percutaneous endoscopic gastrostomy. *Gynecol Oncol,* 1996; 62:103-105.
37. Ripamonti C, Panzeri C, Groff L, Galeazzi G, Boffi R. The role of somatostatin and octreotide in bowel obstruction: pre-clinical and clinical results. *Tumori,* 2001;87:1-9.
38. Abuksis G, Mor M, Segal N, et al. Percutaneous endoscopic gastrostomy: high mortality rates in hospitalized patients. *Am J Gastro,* 2000;95:128-132.
39. Abuksis G, Mor M, Plaut S, Fraser G, Niv Y. Outcome of percutaneous endoscopic gastrostomy (PEG): comparison of two policies in a 4 year period. *Clin Nut,* 2004;23: 341-346.
40. Yarborough M. Why physicians must not give food and water to every patient. *J Fam Pract,* 1989;29:683-684.
41. Brett AS, Rosenberg JC. The adequacy of informed consent for placement of gastrostomy tubes. *Arch Intern Med,* 2001;161:745-748.
42. Verhoef MJ, Van Rosendaal GM. Patient outcomes related to percutaneous endoscopic gastrostomy placement. *J Clin Gastroenterol,* 2001;32:49-53.
43. Van Rosendaal GM, Verhoef MJ, Kinsella TD. How are decisions made about the use of percutaneous endoscopic gastrostomy for long-term nutritional support? *Am J Gastroenterol,* 1999;94:3225-3228.
44. McCann RM, et al. Comfort care for terminally ill patients: the appropriate use of nutrition and hydration. *JAMA,* 1994;272: 1263-1266.
45. Henderson CT, et al. Prolonged tube feeding in long-term care: nutritional status and clinical outcomes. *J Am Coll Nutrition,* 1992;11:309-325.
46. Fins JJ, et al. End of life decision-making in the hospital: current practice and future prospects. *J Pain Symptom Manage,* 1999;17:6-15.
47. Mitchell SL, Kiely DK, Hamel DB. Dying with advanced dementia in the nursing home. *Arch Int Med,* 2004;164:321-326.
48. Shega JW, et al. Barriers to limiting the practice of feeding tube placement in advanced dementia. *J Palliat Med,* 2003;6:885-893.
49. Mitchell SL, Buchanan JL, Littlehale S, Hamel MB. Tube-feeding versus hand-feeding nursing home residents with advanced dementia: a cost comparison. *J Am Med Dir Assoc,* 2004;5:S22-S29.
50. Plonk WM. Lack of financial benefit of inpatient percutaneous endoscopic gastrostomy placements. *Am J Gastroenterol* (in press)
51. Morgenstern L, Laquer M, Treyzon L. Ethical challenges of percutaneous endoscopic gastrostomy. Surg Endoscopy, 2004 Epub of Poster #216 at SAGES meeting 3/14/03.
52. Sanders DS, et al. Percutaneous endoscopic gastrostomy: a prospective audit of the impact of guidelines in two district general hospitals in the United Kingdom. *Am J Gastroenterol,* 2002;97:2239-2245.
53. Monteleoni C, Clark E. Using rapid-cycle quality improvement methodology to reduce feeding tubes in patients with advanced dementia: before and after study. *BMJ,* 2004;329: 491-494.
54. Gauderer M. Twenty years of percutaneous endoscopic gastrostomy: origin and evolution of a concept and its expanded applications. *Gastrointest Endosc,* 1999;50:879-883.