Timely Topics in Nutrition

One-step placement of a percutaneous nonendoscopic low-profile gastrostomy port in cats

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Placement of a **percutaneous endoscopic gastrostomy (PEG)** tube in animals is a common method for surgical placement of gastrostomy tubes.[1-6] Methods of percutaneous nonendoscopic placement also have been described, allowing practitioners without endoscopic equipment the ability to place gastrostomy tubes quickly and easily.[7,8] Replacement of gastrostomy tubes with skin-level **low-profile gastrostomy ports (LPGP)** is an attractive alternative for long-term nutritional management or medication administration. The LPGP were first used in humans to improve cosmetic appearance, increase patient comfort, and reduce risk of premature tube dislodgement in children and elderly patients.[9] Similar benefits would be expected for animals, including decreased need for chronic occlusive bandaging, increased patient comfort and mobility, and improved cosmetic appearance.

Placement of LPGP is most commonly achieved as a 2-step procedure in humans[9-11] and dogs,[12] although a 1-step procedure has been reported in humans.[13,14] Physicians experienced in placement of LPGP recommend waiting a minimum of 3 months after placement of a PEG tube before replacing the gastrostomy tube with a LPGP. This allows maturation of the gastrocutaneous fistula to maximally prevent fatal disruption of the fistulous tract during LPGP placement.[9,10] This was the approach used by Bright et al[12] for placing a commercially available low-profile gastrostomy tube[a] in 2 dogs that required long-term nutritional support via PEG tubes. Although these dogs did not require anesthesia, our clinical experience with cats suggests that a conscious cat would not tolerate retrograde placement of a LPGP. In addition, endoscopy may be needed to aid positioning and verify proper port placement. It also can be difficult to fit cats with properly sized low-profile gastrostomy tubes, because they are only available in a few nonadjustable sizes. It would be beneficial for cats to have custom-fit LPGP from the day of initial placement of a feeding tube.

The purpose of our report is to describe nonendoscopic placement and management of a custom-fit 1-step percutaneous LPGP in cats. Potential advantages of this technique over the previously reported use of a commercially available low-profile gastrostomy tube[a] in dogs are that it involves only 1 anesthetic episode for the procedure, uses a custom-fit LPGP for each animal, reduces risk of complications during conversion of a PEG tube to a LPGP, decreases necessity for bandaging, and is a simple technique that requires minimal surgical experience.

Procedure

Animals—Thirteen (7 males, 6 females) healthy 8-month-old domestic shorthair cats purchased from a barrier-maintained purpose-bred colony[b] were used in the study. Male cats weighed (mean ± SD) 3.5 ± 0.3 kg (7.7 ± 0.7 lb), and female cats weighed 2.6 ± 0.1 kg (5.7 ± 0.2 lb). Each cat was housed separately during the study. All protocols involving the cats were approved by the University of Georgia Animal Care and Use Committee.

Equipment—Two commercially available kits were used for LPGP placement. Gastrostomy tubes were placed, using a reusable nonendoscopic gastrostomy placement kit.[c] Another commercially available kit[d] was used to create custom-fit LPGP; that kit included 20-F soft-silicone gastrostomy tubes previously marked at 1-cm intervals and equipped with an attached tapered end for endoscopic percutaneous placement. This attached tapered end was removed, because placement was done nonendoscopically. Materials for conversion of gastrostomy tubes to LPGP included a pair of atraumatic tube-holding forceps, an antireflux valve, a clip to secure the valve into the gastrostomy tube, and a protective silicone cap to cover the valve and clip.

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Surgical placement—All cats were anesthetized, using xylazine hydrochloride[e] (1 mg/kg [0.45 mg/lb] of body weight) and ketamine hydrochloride[f] (12 to 15 mg/kg [5.45 to 6.82 mg/lb]) administered IM. A single 100-mg dose of cefazolin (25 to 40 mg/kg [11.36 to 18.18 mg/lb]) was given IV 10 to 15 minutes before the procedure. All cats were intubated, positioned in right lateral recumbency, clipped, and aseptically prepared for surgery on the left abdominal wall.

Percutaneous nonendoscopic placement of gastrostomy tubes was accomplished as described elsewhere,[7] except that a threaded wire was pushed through a placement needle into the metal introduction rod. Once the wire exited the oral end of the metal introduction rod, the placement needle and introduction rod were removed. An internally threaded tapered-metal catheter adapter attached to the gastrostomy tube and anchored with 3-0 nylon suture was screwed onto the threaded wire (**Fig 1**). The gastrostomy tube was pulled through the abdominal wall as previously described.[7] Contrast radiography of the abdomen, accomplished by use of 3 ml of iothalamate sodium[g] followed by 3 ml of sterile saline (0.9% NaCl) solution, was flushed through the gastrostomy tube to verify correct placement of the tube in the stomach.

The gastrostomy tube then was converted to a LPGP, using the conversion kit. Gentle outward traction was applied to the gastrostomy tube. The plastic atraumatic tube clamp was applied to the gastrostomy tube at the point where it exited the body wall, and the gastrostomy tube then was cut 1.25 cm distal to the clamp (**Fig 2**). The antireflux valve was pushed to the base of its hub into the cut end of the gastrostomy tube (**Fig 3**), and the clip was snapped over the tube and valve stem (**Fig 4**). The protective silicone cover was placed over the wings of the clip, and its cap was closed over the antireflux valve (**Fig 5**). Tubes were not sutured to the skin, and flanges or bandages were not applied. Butorphanol tartrate[h] (0.2 mg/kg [0.091 mg/lb], IM) was administered after surgery.

Care and management of LPGP—Cats were examined twice daily for signs of discomfort, illness, or trauma to the LPGP. The LPGP were palpated and rotated to prevent formation of scabs between the stoma and port and to decrease skin irritation.

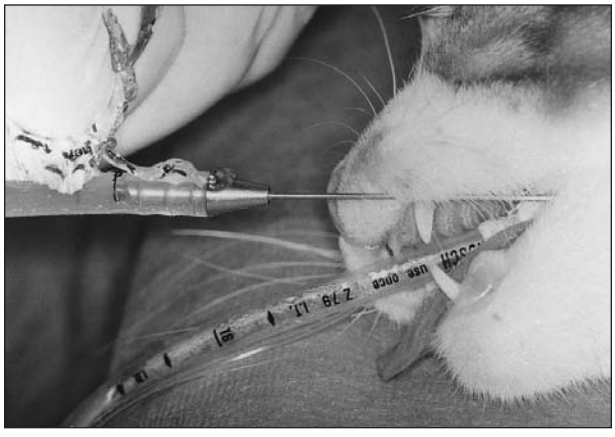

Figure 1—Standard nonendoscopic percutaneous placement of 20-F gastrostomy tubes in cats. Placement was accomplished by use of a commercially available placement device. After passing a threaded wire through the placement needle and metal introducer, the needle and introducer were removed. An internally threaded tapered catheter adapter was screwed onto the threaded wire end, and the gastrostomy tube was attached and anchored with 3-0 nylon suture.

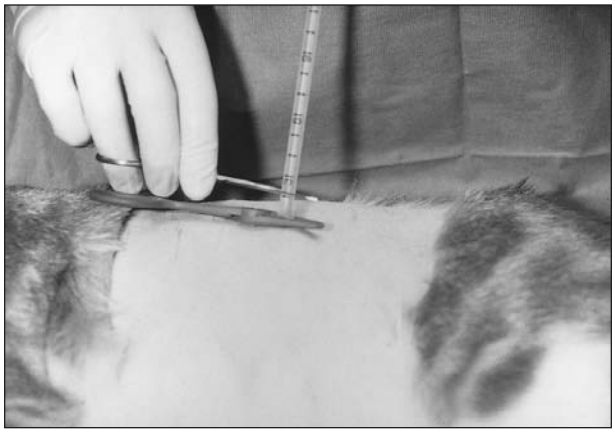

Figure 2—Conversion of the gastrostomy tube to a low-profile gastrostomy port (LPGP), using a commercially available conversion kit. Gentle outward traction was applied to the gastrostomy tube. The plastic atraumatic tube clamp was applied at the point at which the tube exited the body wall, and the tube was cut about 1.25 cm distal to the clamp.

Figure 3—Placement of the antireflux valve, which was pushed to the base of its hub into the cut end of the gastrostomy tube.

Figure 4—Positioning of the valve clip, which was snapped snugly over the tube and valve stem.

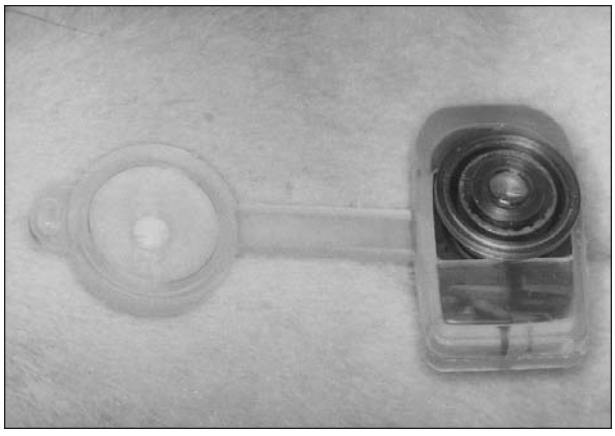

Figure 5—Placement of the protective silicone cover over the wings of the clip. The round cap of the silicone cover subsequently was flipped on top of, and loosely fastened to, the antireflux valve.

Bandages were applied to cats that licked or chewed at the gastrostomy ports. Using the provided feeding-decompression tube, water was flushed through the ports once weekly to monitor patency, to evaluate possible leakage, and to assess ease of use. Twelve of the cats that were in a concurrent pharmacokinetic study received medication through the LPGP once during the study period.

Dislodgements of LPGP were treated by surgically replacing the LPGP. A paracostal incision was made immediately caudal to the LPGP stoma. External tube displacement required placement of pursestring sutures around the gastric opening, because that opening had to be enlarged slightly to accommodate forceful insertion of the bulb of the gastrostomy tube into the stomach. Suture gastropexy was performed on 3 sides of each tube. The antireflux valve and clip were replaced in the end of the gastrostomy tube. Bandages were applied immediately after surgery and were changed once weekly for the remainder of the study.

Twelve of the 13 cats were euthanatized and necropsied 49 to 63 days after LPGP placement, in accordance with the protocol for the pharmacokinetic study. Gastrocutaneous fistulas were examined during necropsy. The LPGP of the thirteenth cat was removed 54 days after initial placement. That cat was anesthetized, using IM administration of xylazine and ketamine, and external traction was placed on the tube. The cat was monitored for 1 month after LPGP removal.

Results

Time required for placement of gastrostomy tubes was 5 to 7 minutes. Conversion to a LPGP required 3 to 4 minutes; thus, total time required for placement of LPGP was 8 to 11 minutes. All tubes were placed and converted to LPGP on the first attempt without procedural difficulties.

Five of 13 cats did not require protective bandaging for the duration of the study (mean ± SD, 59 ± 3.6 days; median, 61 days). In these 5 cats, complications included removal of the protective cap (n = 5), mild peristomal granulation tissue (2), peristomal skin necrosis under the wings of the plastic valve clip (2), transient postoperative peristomal dermatitis (1), and mild transient leakage from the antireflux valve (1). Treatment of these minor complications was limited to local cleansing of the wound or cleansing and topical application of an antibiotic-steroid cream once daily until the condition had resolved.

Peristomal granulation tissue developed in 2 male cats 4 weeks after LPGP placement and persisted throughout the study period. Mild peristomal skin necrosis under the corners of the plastic valve clip was noticed in the same 2 male cats 7.5 weeks after LPGP placement.

Peristomal dermatitis, suspected to be the result of peristomal leakage, completely resolved within 7 days after LPGP placement in 1 cat. That cat did not have additional complications for the remainder of the study.

The 3 wings of the antireflux valve of another cat did not appear to seal correctly at the time of placement, but only clear fluid (several drops) was detected leaking from the valve during the week after placement. Hair in the peristomal area did not appear wet, and the cat did not have signs of skin irritation. After the first week, further leakage was not evident, nor was leakage noticed during subsequent weekly flushing of the LPGP.

Eight cats required protective bandaging to prevent mutilation of the LPGP. Complications seen before preventive bandages were applied included removal of the protective cap (n = 8), internal dislodgement of the LPGP (2), external dislodgement of the LPGP (2), damage to the external portion of the tube (1), and mild leakage from the antireflux valve (1). Three cats were preventively bandaged and did not require surgical correction of damage to the LPGP during the course of the study (mean, 56 ± 4.7 days; median, 57 days). The remaining 5 cats required surgical management of internal (3) or external (2) displacement of the LPGP prior to (4) or after (1) application of the protective bandages.

Dislodgment in those 5 cats was detected after initial placement (mean, 18 ± 12.7 days; median, 11 days). External dislodgement resulted when 2 cats applied external traction that removed the entire LPGP as an undamaged single unit, including the gastrostomy tube, antireflux valve, and valve clip (0.5 and 39 days after placement, respectively). One cat that had an internal dislodgement had chewed on the tube and damaged it 8 days after initial placement; however, there was only minor damage to the tube at that time, and we were able to shorten the tube and replace the undamaged valve and valve clip. Internal dislodgement resulted in that cat 3 days later when it chewed through the silicone gastrostomy tube at the base of the antireflux valve stem (11 days after placement). Internal dislodgement in the second cat resulted when it opened the valve clip and extruded the valve from the end of the tube (11 days after placement). During surgery to repair dislodgements, 2 cats (dislodgements 11 and 39 days after placement) had gastrocutaneous fistulas that required disruption so the tube stem could be fed through the gastric opening and the tract in the abdominal wall. The stomachs of the other 2 cats (dis-

lodgements 0.5 and 11 days after placement) were not adhered to the body wall.

The fifth cat that had a dislodgement managed to mutilate the bandage and damage the silicone gastrostomy tube 29 days after placement, resulting in internal dislodgement of the tube and subsequent vomiting. The antireflux valve and valve clip remained in the bandage. During surgical repair, the stomach was not adhered to the body wall, but omentum was adhered to the gastric opening. Fibrous tissue at the gastric opening was resected, the gastrostomy tube was removed, and the 2-cm gastrotomy incision was closed, using a 2-layer technique.

Mild leakage from the antireflux valve was detected 3.5 weeks after placement in another cat. That cat began licking at the port and peristomal area, so a bandage was applied. Leakage was transient and minimal.

Management problems in cats after bandaging included mild-to-moderate peristomal discharge (n = 7), bandage slippage or mutilation (7), pressure necrosis of peristomal skin under the wings of the valve clip (5), tube mutilation (1), and internal dislodgement of the LPGP (1). Bandages that were protective against mutilation also were occlusive to the stoma. Subsequently, the peristomal skin remained slightly moist, and mild-to-moderate exudate accumulated between bandage changes. Exudate was removed easily with warm water.

Five cats developed substantial amounts of pressure necrosis of the peristomal skin at the point where the bandage compressed the plastic wings of the valve clip against the skin. One cat required suturing of a 2-cm diameter skin defect that resulted from pressure necrosis. Healing of peristomal skin necrosis was evident in all cats within 1 week after placing a pad of gauze between the wings of the clip and the skin. One cat created a hole in the LPGP tube 51 days after placement that necessitated repair; the tube was made 0.3 cm shorter, and the valve and valve clip were replaced in the undamaged tube end.

Necropsy revealed 2 interesting findings for the LPGP and associated fistulas. First, the spleen was located cranial to the LPGP, and the LPGP penetrated the omentum between the spleen and left lobe of the pancreas in 5 of the 12 cats necropsied. Second, 4 gastrocutaneous fistulas appeared complete but thin. Two of these fistulas were disrupted when the LPGP were removed by external traction.

Figure 6—View of an LPGP in a healthy 9.5-month-old female cat 6 weeks after initial placement. Notice the complete hair regrowth up to the base of the LPGP and that peristomal discharge, drainage, or cellulitis is not evident.

In the thirteenth cat, the LPGP was easily removed by external traction during general anesthesia. The cat had leakage of gastric fluids through the stoma site for 36 hours after tube removal.

Cosmetic results in cats without bandages were excellent (**Fig 6**). In these cats, there was complete hair regrowth up to the base of the tube and minimal peristomal discharge.

Discussion

Our experience with the 1-step nonendoscopic percutaneous placement of LPGP in cats was positive, particularly in those cats that weighed < 3.0 kg (6.6 lb). Placement of the LPGP was accomplished quickly and easily. This procedure also could be done endoscopically. The LPGP were placed by a faculty member (MAMS; 1), clinical intern (KSS; 6), and senior veterinary student (CWS; 6), documenting that advanced surgical training was not necessary for success.

All cats appeared comfortable and had typical movement and agility after placement of the LPGP and recovery from anesthesia. All cats played normally in their cages and were able to jump onto and off from a 30.5-cm (12-inch)-high hammock without signs of discomfort.

Cost of the procedure was limited to the 1-time purchase of a percutaneous nonendoscopic placement device ($200), combination gastrostomy and low-profile conversion kit ($150), and expenses for anesthetic drugs. The gastrostomy tube can be immediately modified into a LPGP, similar to the procedure reported here, or the conversion kit can be used to modify the gastrostomy tube at a later time. For those cats that tolerate the LPGP without bandaging, the overall cost to clients is likely to be less than that for conventional gastrostomy tubes. The lack of a second anesthetic episode, long-term bandaging, and treatment for bandage-induced complications should result in cost savings and be more convenient for owners. A more traditional nonendoscopic gastrostomy tube for short-term feeding would require the placement device ($200), gastrostomy tube ($25), and expenses for anesthetic drugs, for an initial benefit of $125 from the cost for placement of an LPGP. It is unlikely that the LPGP would be cost-effective in cats needing short-term feeding (≤ 2 weeks). However, cats requiring long-term medication (ie, renal transplant recipients, treatment for persistent viral diseases such as that caused by feline immunodeficiency virus, chemotherapy patients, administration of fluids in cats with chronic renal failure) or nutritional supplementation (ie, oral or esophageal disorders) would be logical candidates for placement of an LPGP.

Bandage maintenance with traditional gastrostomy tubes is a common source of problems for pet owners.[15] Subsequently, 1 of the objectives in the study reported here was to eliminate the need for bandages after surgery. However, although the LPGP initially was tol-

erated well by most of the cats, some cats did require placement of a protective bandage to prevent destruction or dislodgement of the tube. Five cats began to chew or lick the LPGP. At the initial detection of chewing or licking of the LPGP, bandages were placed on the cats. We aggressively protected the LPGP, because it was imperative for the tubes to be in place for the concurrent pharmacokinetic study. Similar to the situation reported in humans,[16] our experience was that LPGP maintained without occlusive bandages or ointments had the best cosmetic and peristomal appearance. Occlusive dressings accumulated moisture and encouraged mild peristomal discharge and hyperemia of the peristomal skin. Bandages also made it cumbersome to use the LPGP. In some cats, a lighter, less-occlusive t-shirt-type bandage may be more ideal for the local wound and for client convenience when using the LPGP.

The most commonly observed complication in our study was removal of the protective silicone caps that fit over the antireflux valve and clip (Fig 5). This cover is not necessary for proper function of the port and apparently was easily removed by the cats. It appeared that these covers may provide an initial source of irritation (or interest) for the cats, because they increased the size of the device and offered a convenient handle on which to pull and chew. After replacing the covers several times on each cat, we subsequently removed all silicone covers within a few days after LPGP placement. We do not believe that the protective caps are necessary or helpful and do not intend to use them in patients in the future.

The most serious complications seen were premature dislodgement (internal and external) of the tubes. Reported rates for dislodgement of gastrostomy tubes in animals range from 5.5 to 33.3%.[1,2,6-8] Rate of LPGP dislodgement in our study was slightly more frequent (5 of 13; 38%), but the study reported here provided an observation period that was 4 to 6 weeks longer than those reported previously.[1,2,7,8] Two tubes were displaced 29 and 39 days after initial placement of LPGP. Rate of LPGP dislodgement during the initial 2 weeks after placement was 3 of 13 (23%), comparable to the value for that time period in other reports. Dislodgement in either direction can result in peritonitis when it happens prior to adequate maturation of the gastrocutaneous fistula. Dislodgements were detected and treated rapidly in this study, such that none of the cats developed septic peritonitis. In addition, internal dislodgement results in a gastric foreign body, because the retention bulb of the gastrostomy tube is too large to pass through the intestinal tract of cats. In that situation, removal of the gastrostomy bulb is indicated, whether by endoscopy or surgery. The importance of owners monitoring their cats after LPGP placement cannot be overstated, particularly during the early days when the gastrocutaneous fistula is forming.

Regardless of the method of LPGP dislodgement, the valves or valve clips did not receive catastrophic mechanical damage in this study. All tubes, valves, and valve clips were functional for replacement. The original 1.25-cm portion of tube left outside the abdominal wall was sufficient to enable us to shorten the damaged tubes by approximately 0.3 cm; thus, damaged external portions of the tubes could be trimmed and reused. Thus, all materials should be carefully examined after dislodgement for possible reuse in the same cat.

Wound complications associated with the LPGP and their management were similar to those reported for gastrostomy tubes, including bandage maintenance, mild formation of peristomal granulation tissue, and mild amounts of peristomal dermatitis.[7,15,17] A problem unique to the LPGP was pressure necrosis of the peristomal skin attributable to the wings of the antireflux valve clip. When bandages were used, this issue was resolved by placing gauze padding between the skin and wings of the clips. Two 10 × 10-cm (4 × 4-inch) gauze squares were stacked and folded in half. A slit was cut in the middle through which the LPGP valve clip could be passed, which anchored the gauze around the base of the tube to prevent slippage. Free edges of the gauze were folded under the wings of the clips to double the amount of padding and were taped to each other to prevent unfolding. Mild peristomal skin irritation and pressure necrosis resolved within 5 to 7 days after the wings of the clips were padded.

Mutilation of bandages and LPGP was common during this study. It was unclear whether the cats chewed on the bandages and ports because of boredom, irritation, or both. All cats in this study were young energetic cats. Our assessment was that many of them had destructive behavior because of boredom. In cats that dislodged their LPGP, we did not detect signs of peristomal cellulitis, discharge, or infection to support tube irritation as an inciting cause. In fact, 1 cat continued to aggressively chew at a protective bandage placed after the internally dislodged LPGP was removed during gastrotomy. Although we believe the behavior of most client-owned cats in a stimulating home environment may not result in damage of the LPGP, mutilation will be a problem with some cats.

The LPGP used in the study reported here were not used for enteral provision of nutrients. However, tubes were flushed once weekly with tap water to ensure patency and to assess ease of use of the decompression-feeding adapter tubes. Adapter tubes were easy to clip onto the LPGP, and an audible click indicated proper attachment of the tube to the LPGP. The antireflux valve adequately prevented reflux of stomach contents when disconnecting the feeding tube. Disconnecting the feeding tube required slightly more manual dexterity than attaching the tube. This may be difficult for clients with substantial joint pain or dysfunction of the hands and fingers. Analysis of our study supports the use of these LPGP for long-term administration of medication or fluids. However, because feeding was not done, complications common to gastrostomy tubes, such as tube obstruction, should be anticipated when LPGP are used for enteral provision of nutrients.

When placing LPGP, we attempted to position them 2 to 2.5 cm caudal to the costal arch. It is possible that our efforts to prevent tube interference with the ribs caused excessive stretching of the stomach so that the placement device pushed beyond the greater curvature of the stomach, resulting in tube passage

through the caudodorsal wall of the stomach (visceral surface) rather than the cranioventral wall (parietal surface) in the larger cats. Although the placement of LPGP through the omentum between the spleen and left lobe of the pancreas did not cause obvious problems for any of the cats, our preference would have been for the tubes to be placed cranial to the spleen and to exit the cranioventral wall of the stomach. It is possible that increased tension on the stomach and LPGP caused chronic stomal irritation that incited some of the peristomal granulation tissue we saw in the larger (> 3 kg) cats. This also could have contributed to peristomal skin necrosis in 2 of the larger male cats that did not receive bandages. Alternatively, chronic motion associated with the LPGP also could have incited peristomal skin complications. We recommend placing tubes just caudal to the costal arch with the stomach under minimal tension.

During necropsy 2 months after tube placement, gastrocutaneous fistulas in the cats reported here did not appear to be as thick and strong as expected. This parallels the findings of a study in dogs with minimally stabilized PEG tubes that were loosely pulled against the abdominal wall.[18] Delayed maturation of gastrocutaneous fistulas was seen 7 and 14 days after tube placement. The weakest part of the fistula was immediately adjacent to the abdominal wall, which probably corresponded to the concentrated point of tube motion. In the cats of our study, some fistulas were still sufficiently weak 2 months after LPGP placement such that external traction to remove the tubes could have had dire consequences for those cats. Reasonable alternatives to consider for cats may be to allow at least 3 months for fistula formation before removal of a LPGP, placing a stabilized gastrostomy tube for 1 to 2 months before converting the gastrostomy tube to a LPGP, and removing the LPGP bulb endoscopically rather than by use of external traction.

We found 1-step placement of LPGP in cats to be a quick, easy procedure to perform; however, clinicians must be diligent in the management and care of these devices. Major postoperative complications can occur. As stated by Gauderer,[16] even endoscopically performed percutaneous gastrostomies should not be considered simple procedures. Appropriate patient selection, knowledge of and constant surveillance for signs of problems, and good technique for initial placement are necessary for success.

[a]The Bard Button replacement gastrostomy device, CR Bard Inc, Billerica, Mass.
[b]Harlan, Indianapolis, Ind.
[c]Gastrostomy tube introduction set: nonendoscopic placement technique for animals < 10 kg (No. V-GTIS-1000), Cook Veterinary Products, Bloomington, Ind.
[d]Gauderer Genie PEG System Ponsky "Pull" Placement Technique (No. 000392), CR Bard Inc, Billerica, Mass.
[e]Rompun, Bayer Corporation, Shawnee Mission, Kan.
[f]Ketaset, Fort Dodge Animal Health, Fort Dodge, Iowa.
[g]ConRay 400, Mallinckrodt Inc, St Louis, Mo.
[h]Torbugesic, Fort Dodge Animal Health, Fort Dodge, Iowa.

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