Palliative Venting Gastrostomy in Patients with Malignant Bowel Obstruction and Ascites

Colette Shaw, MD¹, Roland L. Bassett, MS², Patricia S. Fox, MS², Kathleen M. Schmeler, MD³, Michael J. Overman, MD⁴, Michael J. Wallace, MD¹, Sanjay Gupta, MD¹, and Alda Tam, MD¹

¹Section of Interventional Radiology, Department of Diagnostic Radiology, The University of Texas MD Anderson Cancer Center, Houston, TX; ²Department of Biostatistics, The University of Texas MD Anderson Cancer Center, Houston, TX; ³Department of Gynecologic Oncology and Reproductive Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX; ⁴Department of Gastrointestinal Medical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX

ABSTRACT

Background. Fluoroscopic-guided placement of a percutaneous decompression gastrostomy tube (PDGT) is used to palliate patients with malignant bowel obstruction (MBO). We report our clinical experience in cases of MBO and ascites that were known to be technically difficult and at increased risk for complications after PDGT placement.

Methods. Between October 2005 and April 2010, a total of 89 consecutive oncology patients with MBO and ascites underwent at least one attempt at PDGT placement. We retrospectively reviewed the electronic medical record to collect demographic details, procedure information, and morbidity and mortality data. Kaplan–Meier curves were used to calculate median survival after PDGT.

Results. Ninety-three new gastrostomy encounters occurred in 89 patients. The primary and secondary technical success rates were 72 % (67 of 93) and 77.4 % (72 of 93), respectively. Inadequate gastric distention was the reason for failure in 84.6 % (22 of 26) of the cases in which the initial PDGT attempt was unsuccessful. For ascites management, 13 patients underwent paracentesis and 78 patients underwent placement of an intraperitoneal catheter. The overall complication rate in successful placements

was 13.9 %, with a major complication rate of 9.7 %. After PDGT, the median overall survival rate was 28.5 days (95 % confidence interval 20–42).

Conclusions. PDGT is feasible in the majority of patients with MBO and ascites, although there is an inherent risk of major complications. An intraperitoneal catheter can be used to manage ascites to facilitate PDGT.

Malignant bowel obstruction (MBO) is a common manifestation in terminal cancer patients, occurring in up to 42 % of patients with advanced ovarian cancer and up to 24 % of patients with advanced colorectal carcinoma.^{1–6} Given that the surgical management of MBO has been associated with 30-day mortality rates of up to 40 %, venting gastrostomy, placed either endoscopically (PEG) or fluoroscopically, has been advocated for the palliation of these patients.^{2,4,7–10} A venting gastrostomy obviates the need for nasogastric suction, and, together with intravenous hydration and pharmacologic support, it allows for terminally ill patients to be cared for at home or in hospice.¹¹

Although the etiology of bowel obstruction in patients with advanced cancer is multifactorial (malignant vs. benign, mechanical vs. functional), MBO, brought on by mechanical compression of bowel loops or impairment of bowel peristalsis, is a frequent manifestation of patients with extensive peritoneal carcinomatosis.^{12–17} The presence of peritoneal disease, and often coexisting ascites, can make fluoroscopic-guided percutaneous decompression gastrostomy tube (PDGT) placement technically challenging, and are considered by some to be a contraindication to endoscopic or PDGT placement.^{18–22} Peritoneal tumor implants can limit access to and prevent adequate distention of the

Presented in part at the 94th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 28–December 3, 2009, Chicago, IL (oral presentation, abstract 8013734).

© Society of Surgical Oncology 2012

First Received: 25 February 2012;
Published Online: 11 September 2012

A. Tam, MD
e-mail: alda.tam@mdanderson.org

stomach.²³ Peritoneal carcinomatosis is also the most common cause of malignant ascites, which by itself is also an independent factor that can complicate the management of MBO.^{24–26} Ascites is considered a relative contraindication to percutaneous gastrostomy for the following reasons: the fluid can make puncturing the anterior wall of the stomach more difficult; the development of ascites between the stomach and the abdominal wall can increase the intraperitoneal catheter length and may predispose to tube dislodgment; and finally, ascites may prevent maturation of a tube track, thus facilitating pericatheter leakage of ascites and/or gastric contents, which may result in skin breakdown and/or peritonitis.^{19,21,22,27}

The potential pitfalls associated with PDGT placement in the presence of peritoneal carcinomatosis and ascites render the palliation of terminal cancer patients with MBO and ascites challenging. A meta-analysis of the gastrostomy literature by Wollman et al. did not consider this subset of patients separately when reporting complications and outcomes.²⁸ As a result, the risks and outcomes of PDGT in this high-risk patient population are poorly understood. The aim of this study was to assess the feasibility and safety of PDGT placement in terminal cancer patients with MBO and concomitant ascites.

MATERIALS AND METHODS

This study was approved by the institutional review board, and a waiver of informed consent was obtained for this retrospective, Health Insurance Portability and Accountability Act-compliant review. The electronic medical records of all patients with MBO and concomitant ascites ($n = 89$) who were referred to interventional radiology for PDGT from October 2005 to April 2010 were reviewed.

All patients had advanced malignancy (Table 1), intestinal obstruction, and coexisting ascites (20 male and 69 female patients; age range, 22–83 years; median age of 57 years). In three patients, PDGT placement was required on more than one distinct occasion, separated by more than 6 months from initial PDGT removal to reinsertion. For the purposes of this study, all PDGT attempts that occurred more than 6 months apart were considered new encounters, and thus 93 new PDGT encounters were used to calculate primary technical success. Repeat catheter insertion attempts within 7 days of each new encounter were used to determine secondary technical success.

All patient records and imaging studies were reviewed. Data elements collected included demographic information, procedure technique, fluid management method, complications, and overall survival. Preprocedural diagnostic cross-sectional imaging and relevant endoscopy reports were reviewed by an interventional radiologist

TABLE 1 Tumor histology of 89 patients in the study group

Tumor histology	<i>n</i>
Gastrointestinal malignancy ($n = 40$)	
Gastric	11
Colorectal	12
Pancreas	9
Other ^a	8
Gynecologic malignancy ($n = 43$)	
Ovarian	33
Other ^b	10
Genitourinary malignancy ($n = 3$)	
Prostate	1
Renal	1
Bladder	1
Other primary malignancy ($n = 3$)	
Lymphoma	1
Sarcoma	1
NSCLC	1

NSCLC non-small cell lung cancer

^a Includes appendiceal carcinoma, small bowel carcinoma, or carcinoma of unknown primary origin

^b Includes fallopian tube, vulvar, uterine, cervical, or peritoneal carcinoma

(A.T.) to document the presence of gastric wall involvement and the presence of peritoneal carcinomatosis, and to subjectively classify the volume of ascites.

All procedures were performed, under monitored moderate sedation or sedation provided by the anesthesiology service, by an interventional radiologist after written informed consent was obtained. Patients underwent a minimum of overnight nasogastric tube (NGT) decompression of the stomach before the procedure. Ascites was managed by paracentesis or placement of a 10F nontunneled intraperitoneal (i.p.) drain (Mac-Loc catheter; Cook Medical, Bloomington, IN), performed in the days before or at the time of PDGT placement. After adequate drainage of the ascites, as assessed by ultrasound, a PDGT was placed via fluoroscopic guidance and Seldinger technique.²⁹ Typically, a 14F catheter with a self-locking retention loop (Mac-Loc catheter; Cook Medical) was placed for gastric decompression. The PDGT was connected to gravity drainage, and after 24 h, the NGT was removed and diet advanced. Caregivers were educated on how to care for the PDGT and i.p. catheter. Up to 1 L of fluid was to be drained from the i.p. catheter daily, and the tube capped in the interim. If symptom relief was inadequate, the caregiver was advised to contact the interventional radiology service to discuss the concerns, and the volume drained could be adjusted if appropriate. No routine additional follow-up was performed to evaluate for the presence of residual ascites. The PDGT was to be

connected to gravity drainage. Patients who were able to eat were advised to cap the tube during and for 1 h after meals. Dressings were to be changed daily.

For each patient, the end of follow-up was defined as the date of death or date of last contact. The Kaplan–Meier method was used to estimate the distribution of the times to discharge and death after PDGT insertion, and distributions were compared by the log-rank test. One patient had three separate successful tube placements on separate dates; this patient was considered three times for the analysis of time to discharge, but only once in survival analyses. Complications were classified by outcome according to the Society of Interventional Radiology guidelines and the National Cancer Institute Common Terminology Criteria for Adverse Events, version 4.0.^{30,31} The impact of technical factors on the development of a complication was evaluated by Fisher's exact tests and Student *t*-tests. All statistical analyses were performed by SAS 9.2 for Windows (SAS, Cary, NC), and a *p* value of < 0.05 was considered statistically significant.

RESULTS

The primary and secondary technical success rates for PDGT placement were 72 % (67 of 93) and 77.4 % (72 of 93), respectively. Table 2 summarizes the imaging findings and procedural details for the patient group. The median interval between drainage of ascites and attempted PDGT placement in successful placements was 1 day (range 0–79 days) with 29 patients receiving their paracentesis or i.p. catheter immediately preceding the PDGT placement attempt.

The failure rate of PDGT placement on new encounters was 28 % (26 of 93), of which 39 % (10 of 26) and 23 % (6 of 26) occurred in patients with ovarian and gastric primary disease, respectively. Secondary attempts were performed within 7 days of the initial PDGT encounter in 27 % (7 of 26) and was ultimately successfully in 5 out of 7 patients. Inadequate gastric distention was the primary reason for failure to place a PDGT in 84.6 % (22 of 26). Supportive measures such as the use of anesthesia for deep sedation, the use of C-arm cone beam computed tomography to delineate a percutaneous access route, and the use of a long micropuncture needle were used to overcome this technical challenge during five of the seven secondary attempts at PDGT placement (71.4 %). A large volume of residual ascites prevented placement of a PDGT in only one patient despite the presence of an i.p. catheter. For the 26 patients whose initial attempt at PDGT placement failed, the final management of MBO was as follows: successful placement of a PDGT either via a percutaneous or endoscopic route (*n* = 8), placement of a decompression duodenostomy (*n* = 1), placement of a tube for bowel

TABLE 2 Summary of imaging findings and procedural details in the patient group

Characteristic	Number of patients (%)
Peritoneal carcinomatosis	85/93 (91.4 %)
Tumor infiltration of the gastric wall	10/93 (10.8 %)
Volume of ascites	
Small	10/93 (10.8 %)
Moderate	51/93 (54.8 %)
Large	32/93 (34.4 %)
Use of T-fastener ^a	33/72 (45.8 %)
Use of CBCT during initial placement ^b	10/93 (10.8 %)
Use of CBCT during second attempt	2/7 (28.6 %)
Method of fluid management	
Paracentesis	13/93 (13.9 %)
Intraperitoneal catheter placement	78/93 (83.9 %)
No intervention	2/93 (2.2 %)
PDGT size	
12F	3/72 (4.2 %)
14F	69/72 (95.8 %)

CBCT C-arm cone beam computed tomography, PDGT percutaneous decompression gastrostomy tube

^a A T-fastener is a tool used for gastropexy where the stomach is fixed to the anterior abdominal wall

^b CBCT is an advanced 3-D imaging tool available in the interventional radiology suite. It allows for the acquisition and reconstruction of multiplanar, computed tomography-like images during fluoroscopic-guided interventions

decompression through an existing enterocutaneous fistula (*n* = 1), NGT drainage (*n* = 8), nothing (*n* = 3), and disposition not available (*n* = 5).

Follow-up was available for the 70 patients who underwent successful placement of a PDGT. The overall complication rate was 13.9 % (10 of 72), with a 9.7 % (*n* = 7) major (more than grade 3) and a 4.2 % (*n* = 3) minor (grade 1 or 2) complication rate (Table 3). The overall pericatheter leakage rate was 6.9 % (5 of 72), with pericatheter leakage of gastric contents and ascites occurring in 50 % of patients with complications. Four patients, all with peri-PDGT leakage, developed peritonitis with isolation of an organism. Ninety-six percent (75 of 78) of patients who underwent i.p. catheter placement for ascites management did not develop peritonitis. There were no cases of peritonitis in the 13 patients who underwent paracentesis or the two patients in whom no intervention was required.

Three of the patients with major complications had clinic notes in the medical record documenting improper care or usage of the i.p. catheter or PDGT, such as prolonged clamping of one or both tubes, infrequent drainage of ascitic fluid, or failure to change the dressings around the catheters. There was no evidence of an association

TABLE 3 Complications after placement of PDGT in 10 patients^a

Patient no.	Primary malignancy	Complication	Time to patient discharge after PDGT	Time to complication	Classification	Outcome
1	NSCLC ^b	Death	<24 h	<24 h	Major; grade 5	Death attributed to disease progression; no autopsy
2	Pancreas ^c	Peri-PDGT leakage and abdominal wall infection	POD 61	POD 7	Major; grade 3	Admitted for i.v. antibiotics; PDGT upsized to 16F POD 35
3	Pancreas ^b	Peritonitis, sepsis	POD 2	POD 10	Major; grade 4	Admitted for i.v. antibiotics, ascites grew <i>Enterococcus faecalis</i> ; discharged to home hospice POD 22
4	Fallopian tube ^{b,c}	Peri-PDGT leakage, peritonitis	POD 1	POD 12	Major; grade 4	2nd i.p. catheter placed POD 15 to manage persistent ascites; ascites grew <i>E. faecalis</i> ; admitted for i.v. antibiotics; transferred to inpatient hospice POD 20
5	Rectum ^c	Peri-PDGT leakage, peritonitis	POD 6	POD 17	Major; grade 3	Additional paracentesis performed for persistent ascites POD 17; ascites grew yeast; PDGT pulled out POD 34, new PDGT placed POD 35
6	Uterus	Peri-PDGT leakage, peritonitis, skin breakdown	POD 42	POD 23	Major; grade 3	Additional paracentesis performed POD 41; ascites grew <i>Klebsiella pneumoniae</i> ; PDGT upsized to 16F POD 56
7	Ovary	Enterocutaneous fistula	POD 2	POD 90	Major; grade 3	Small bowel traversed during original PDGT placement
8	Ovary	Site infection	POD 10	POD 7	Minor; grade 1	Treated with oral antibiotics
9	Colon ^b	Abdominal pain	POD 13	POD 14	Minor; grade 2	Admitted to hospital for pain management
10	Colon	Peri-i.p. catheter leakage	POD 8	POD 30	Minor; grade 1	I.p. catheter blocked, exchanged for new catheter POD 30

PDGT percutaneous decompression gastrostomy tube, NSCLC non-small cell lung cancer, POD postoperative day, i.v. intravenous, i.p. intraperitoneal

^a All patients underwent successful placement of PDGT on the first attempt

^b Patients who died within 30 days of PDGT placement. In patients 3 and 4, it is possible that the placement of the PDGT hastened the patient's death as a result of the complications that developed

^c Clinical notes document misuse of either the i.p. catheter or PDGT

between the development of a complication and age ($P = 0.22$), gender ($P = 0.68$), type of malignancy ($P = 0.76$), the use of a T-fastener for gastropexy ($P = 0.50$), the use of an i.p. catheter ($P = 0.67$), or time interval between ascites drainage and PDGT placement ($P = 0.98$), although it should be noted that the number of complications was small.

Patients were discharged at a median of 2 days (range 0–60 days, 95 % confidence interval 2–3) after PDGT placement. The log-rank test showed a trend toward statistical significance ($P = 0.053$) when comparing the time to discharge after placements with complications ($n = 10$, median 7 days) and placements without complications ($n = 62$, median 2 days) (Fig. 1). Most complications (70 %) manifested after discharge. The longest time to a complication occurred 90 days after PDGT placement in a patient who developed an enterocutaneous fistula. The tube

had traversed the small bowel, and the patient became symptomatic only after the PDGT was removed. Fifty-one patients were discharged home, 26 of whom received home hospice services. Of the remaining patients, 16 were discharged to an inpatient hospice facility and two to long-term acute care facilities, and three died in the hospital at 1, 14, and 44 days after PDGT placement. Mortality data were available for 95.7 % (67 of 70) of patients who underwent successful PDGT placement. The median overall survival time was 28.5 days (range <24 h to 620 days, 95 % confidence interval 20–42) (Fig. 1).

DISCUSSION

MBO is often a preterminal event in patients with advanced malignancy. The average survival rate for patients treated medically after the onset of MBO has been

FIG. 1 a Kaplan–Meier survival curve demonstrating the probability of survival after PDGT placement ($n = 70$). The median overall survival time after PDGT insertion was 28.5 days. **b** Kaplan–Meier curve for time to discharge after PDGT insertion stratified by complication status in days ($n = 72$), $P = 0.053$

reported to be between 13.4 days and 3.7 months.³² The symptoms of MBO make the condition debilitating, and palliation, while clinically challenging, is clearly necessary for these patients at the end of life. The palliative care literature has demonstrated PEG or PDGT placement resolves nausea and vomiting symptoms in 84–100 % of patients; permits diet advancement; and, in some patients, facilitates the continuation of palliative chemotherapy.^{33–38} Although PDGT has largely replaced surgery and is a better alternative to long-term NGT placement for the relief of obstructive symptoms in patients with MBO and ascites, there is a gap in knowledge as to the true risk for this procedure in this high-risk patient population. This study demonstrated that PDGT placement was feasible in 77 % of patients. Furthermore, we noted that i.p. catheter drainage was successful in alleviating ascites and facilitating PDGT placement without increasing the risk of infection.

Table 4 reviews and summarizes the literature on PEG or PDGT placement in patients with MBO. Most studies are retrospective in nature, with small patient numbers and no consistent reporting of a method for ascites management. The reported failure rates range 0–11 %, as compared to our rate of 23 %. Most of the studies in the literature review were published over 10 years ago, and the higher rate of failure in this study may be related to changes that have occurred in the patient population over time. Given the advances in oncologic therapy, the patients we are seeing now have been through more surgical and medical treatments, which may make their disease more advanced at presentation for PDGT placement. We are also deliberately selecting patients with ascites, a known factor complicating technical success, which contributes to selection bias. Lastly, our experience may simply reflect a greater willingness to make an initial attempt at PDGT

placement despite preprocedure imaging findings suggestive of technical failure.

Patients with ovarian or gastric carcinoma were the most technically challenging for PDGT placement, accounting for 62 % of initial placement attempt failures in this study. This may be the result of undiagnosed tumor infiltration of the stomach, which is frequently underestimated on standard imaging and a hindrance to gastric distention, which was the major reason listed for technical failure. Repeat attempts at PDGT placement with additional supportive measures, such as the use of anesthesia services and advanced imaging technology (i.e., C-arm cone beam computed tomography), may be required to adequately drain these patients if an initial attempt at placement fails.

The second major finding of this study is that i.p. catheters can be used to manage ascites in patients with MBO in preparation for and after placement of PDGT. Our use of i.p. catheters, as opposed to repeat paracenteses for the management of fluid reaccumulation, has not been associated with an increased risk of infection, as previously hypothesized.¹⁹ Ninety-six percent of our patients who were treated with i.p. catheter placement had no evidence of peritonitis during follow-up. Considering the short median survival of these patients, a single i.p. catheter allows for periodic and continued drainage of the ascitic fluid and eliminates the burden of having to return to the hospital for repeat sonography and/or paracentesis at the end of life.²³ Although ascites does not preclude placement of PDGT, its presence or reaccumulation is a risk for morbidity.^{18,19,22} Peri-PDGT leakage of ascitic fluid or gastric contents is not uncommon and has been reported to range 10–27 % (Table 4). In our series, ascites was a contributing factor in five of seven major complications. This underscores the importance of optimizing the drainage of the ascitic fluid and the need for proper education on

TABLE 4 Review of the literature describing technical success of decompression gastrostomy

Study	Type (n) of tubes placed	Technical success rate	Ascites and management	Reason for failure	Catheter size (F)	Survival	Major complication rate	Minor complication rate
O'Keeffe et al., 1989 ²²	PFG (33), PDGT (67)	100 %	Ascites in 25, management NR	NA	10–14 (PFG), 24–28 (PDGT)	30-d mortality 15 %; median survival 42 d	None	27 % including 6/25 (24 %) with ascites had pericatheter leakage
Lee et al., 1991 ⁴⁰	PDGT (12)	11/12 (92 %)	Ascites in 12, pre-PDGT paracentesis in 75 %	Stomach encased by tumor	12–24	NR	None	36.4 % (27.3 % pericatheter leakage)
Herman et al., 1992 ³⁸	Endoscopic (46)	41/46 (89 %)	Ascites in 22, management NR	Failure of transillumination or visualization	28	30-d mortality 29 %	2.4 % procedure-related death	17.1 % (4.9 % pericatheter leakage)
Marks et al., 1993 ⁴¹	Endoscopic (28)	26/28 (93 %)	Ascites in “almost all,” management NR	Failure of transillumination	20	Two in-hospital deaths; 1–8-mo survival for remaining patients	None	None
Zera et al., 1993 ²⁷	Endoscopic (18)	100 %	Ascites in 5, management NR	NA	NR	NR	2 of 5 patients with ascites developed peritonitis resulting in death	22 % of tubes failed to provide relief from MBO
Van Ooijen et al., 1993 ¹⁰	Group 1: (3) surgical, no ascites/palpable mass Group 2: (12) surgical, ascites/palpable mass Group 3: (25) endoscopic	NR	Ascites in 23, management NR	NR	22	Group 1: 154 d median survival/time to recurrent obstruction Group 2: 36 d median survival/time to recurrent obstruction Group 3: 33 d median survival/time to recurrent obstruction	5 %	10 %
Cunningham et al., 1995 ³³	PDGT (20)	20/20 (100 %)	Ascites in 8; 3 had prior paracentesis > 48 h before PDGT	NA	14	NR	None	35 % (10 % pericatheter leakage)

TABLE 4 continued

Study	Type (n) of tubes placed	Technical success rate	Ascites and management	Reason for failure	Catheter size (F)	Survival	Major complication rate	Minor complication rate
Campagnutta et al., 1996 ³⁶	Endoscopic (34)	32/34 (94.1 %)	NR	Tense ascites; inability to localize appropriate puncture site	15–20	NR	None	6.2 %
Ryan et al., 1998 ²³	PDGT (6), PDGJT (39)	44/45 (98 %)	Ascites in 45, all received preprocedure paracentesis; postprocedural serial sonography and paracentesis as needed	Undrainable loculated ascites	14–16	30-d procedure-related mortality 2.2 %	6.7 %	8.9 %
Brooksbank et al., 2002 ³⁵	Endoscopic (48), surgical (4), PDGT (1)	51/53 (96 %)	No. of patients with ascites NR; ascites drained before procedure when present	Esophageal obstruction; inadequate gastric distention	16–20	Median survival 17 d	None	21.6 % (11.8 % pericatheter leakage)
Pothuri et al., 2005 ³⁴	Endoscopic (92), PDGT (2)	94/94 (100 %)	Ascites in 59, preprocedure paracentesis in 37 %	NA	12–28	Median survival 8 wk	None	19.1 % (8.5 % pericatheter leakage)
Current study, 2012	PDGT (93)	72/93 (77 %)	Ascites in 93; preprocedure paracentesis (13) or i.p. catheter placement (78)	Inability to distend stomach; subcostal location of stomach; residual ascites; inability to sedate	12–14	Median survival 0.94 mo	9.7 %; 5.6 % (4/72) pericatheter leakage	4.2 %; 1.4 % (1/72) pericatheter leakage

PFG percutaneous feeding gastrostomy, *PDGT* percutaneous decompression gastrostomy tube, *NR* not recorded, *NA* not applicable, *MBO* malignant bowel obstruction, *PDGJT* percutaneous decompression gastrojejunostomy tube, *i.v.* intravenous, *i.p.* intraperitoneal

* Included feeding gastrostomy tube cases; complications related to the PDGT groups were not separately reported in these papers

FIG. 2 Algorithm for treatment of patients with MBO and ascites. *MBO* malignant bowel obstruction, *GYN* gynecology, *OR* operating room, *PDGT* percutaneous decompression gastrostomy tube, *PEG* percutaneous endoscopic gastrostomy, *NGT* nasogastric tube, *IP* intraperitoneal

catheter maintenance. The ability of the patient or family to manage and maintain the PDGT and i.p. catheter appropriately is critical to mitigating periprocedural morbidity.

The limitations of this study include bias inherent in a retrospective review. There was a lack of standardization among the operators with respect to PDGT placement technique, thus impeding the interpretation of how these variables potentially affect patient outcomes. Furthermore, it was difficult to assess these patients for symptom resolution, as this was not consistently documented in the medical record and many patients were discharged to hospice without subsequent follow-up. The number of complications ($n = 10$) was too few to use regression models to predict complication status. Despite these limitations, the study represents a detailed look at the potential for complications after PDGT in this high-risk group of patients.

Our major complication rate of 9.7 % is greater than that reported by Bell et al. (1.3 %) and Wollman et al. (5.9 %).^{28,29} PDGT remains the best option for long-term palliation of symptoms related to MBO, and for most patients, it is a safe and effective procedure; however, it is essential that the increase in risk for major complications be acknowledged and discussed with the patient during the consent process. A multidisciplinary approach to the management of a patient with MBO both facilitates and optimizes the medical, surgical, and minimally invasive treatment options for symptom palliation and preservation of quality of life.^{38,39} As a result of this study, we have adopted an algorithmic and staged approach (Fig. 2),

similar to that of Laval et al., to the evaluation of a patient who may require a PDGT.³⁷ The first step for patients who have MBO and ascites that have not responded to medical management and who are not eligible for surgical management is to undergo i.p. catheter placement. If the i.p. catheter fails to relieve symptoms, patients undergo a trial of NGT decompression. Because symptom relief from NGT decompression is predictive of clinical success from PDGT, only patients whose symptoms are alleviated by NGT decompression are accepted for PDGT placement.³⁵

In conclusion, patients with MBO and ascites represent a unique subgroup of patients requiring gastrostomy placement. These patients have disease characteristics that make them technically challenging cases and that also inherently increase their risk for major complications.

REFERENCES

- Solomon HJ, Atkinson KH, Coppleson JV, et al. Bowel complications in the management of ovarian cancer. *Aust N Z J Obstet Gynaecol.* 1983;23:65–8.
- Tunca JC, Buchler DA, Mack EA, et al. The management of ovarian-cancer-caused bowel obstruction. *Gynecol Oncol.* 1981;12:186–92.
- Baines M, Oliver DJ, Carter RL. Medical management of intestinal obstruction in patients with advanced malignant disease. A clinical and pathological study. *Lancet.* 1985;2:990–3.
- Lund B, Hansen M, Lundvall F, et al. Intestinal obstruction in patients with advanced carcinoma of the ovaries treated with combination chemotherapy. *Surg Gynecol Obstet.* 1989;169:213–8.
- Phillips RK, Hittinger R, Fry JS, Fielding LP. Malignant large bowel obstruction. *Br J Surg.* 1985;72:296–302.

6. Krebs HB, Goplerud DR. Mechanical intestinal obstruction in patients with gynecologic disease: a review of 368 patients. *Am J Obstet Gynecol*. 1987;157:577–83.
7. Rubin SC, Hoskins WJ, Benjamin I, Lewis JL Jr. Palliative surgery for intestinal obstruction in advanced ovarian cancer. *Gynecol Oncol*. 1989;34:16–9.
8. Krebs HB, Goplerud DR. Surgical management of bowel obstruction in advanced ovarian carcinoma. *Obstet Gynecol*. 1983;61:327–30.
9. Gemlo B, Rayner AA, Lewis B, et al. Home support of patients with end-stage malignant bowel obstruction using hydration and venting gastrostomy. *Am J Surg*. 1986;152:100–4.
10. van Ooijen B, van der Burg ME, Planting AS, et al. Surgical treatment or gastric drainage only for intestinal obstruction in patients with carcinoma of the ovary or peritoneal carcinomatosis of other origin. *Surg Gynecol Obstet*. 1993;176:469–74.
11. Abuksis G, Mor M, Segal N, et al. Percutaneous endoscopic gastrostomy: high mortality rates in hospitalized patients. *Am J Gastroenterol*. 2000;95:128–32.
12. Ripamonti C. Management of bowel obstruction in advanced cancer. *Curr Opin Oncol*. 1994;6:351–7.
13. Addison NV. Pseudo-obstruction of the large bowel. *J R Soc Med*. 1983;76:252–5.
14. Lautenbach E, Lichtenstein GR. Retroperitoneal leiomyosarcoma and gastroparesis: a new association and review of tumor-associated intestinal pseudo-obstruction. *Am J Gastroenterol*. 1995;90:1338–41.
15. Liang BC, Albers JW, Sima AA, Nostrant TT. Paraneoplastic pseudo-obstruction, mononeuropathy multiplex, and sensory neuronopathy. *Muscle Nerve*. 1994;17:91–6.
16. Spears H, Petrelli NJ, Herrera L, Mittelman A. Treatment of bowel obstruction after operation for colorectal carcinoma. *Am J Surg*. 1988;155:383–6.
17. Mangili G, Aletti G, Frigerio L, et al. Palliative care for intestinal obstruction in recurrent ovarian cancer: a multivariate analysis. *Int J Gynecol Cancer*. 2005;15:830–5.
18. Wills JS, Oglesby JT. Percutaneous gastrostomy. *Radiology*. 1983;149:449–53.
19. Ho CS, Gray RR, Goldfinger M, et al. Percutaneous gastrostomy for enteral feeding. *Radiology*. 1985;156:349–51.
20. Nicholson FB, Korman MG, Richardson MA. Percutaneous endoscopic gastrostomy: a review of indications, complications and outcome. *J Gastroenterol Hepatol*. 2000;15:21–5.
21. McFarland EG, Lee MJ, Boland GW, Mueller PR. Gastropexy breakdown and peritonitis after percutaneous gastrojejunostomy in a patient with ascites. *AJR Am J Roentgenol*. 1995;164:189–93.
22. O'Keeffe F, Carrasco CH, Charnsangavej C, et al. Percutaneous drainage and feeding gastrostomies in 100 patients. *Radiology*. 1989;172:341–3.
23. Ryan JM, Hahn PF, Mueller PR. Performing radiologic gastrostomy or gastrojejunostomy in patients with malignant ascites. *AJR Am J Roentgenol*. 1998;171:1003–6.
24. Garrison RN, Kaelin LD, Galloway RH, Heuser LS. Malignant ascites. Clinical and experimental observations. *Ann Surg*. 1986;203:644–51.
25. Malden LT, Tattersall MH. Malignant effusions. *Q J Med*. 1986;58:221–39.
26. Cardozo P. A critical evaluation of 3000 cytologic analyses of pleural fluid, ascitic fluid, and pericardial fluid. *Acta Cytol*. 1966;10:455.
27. Zera RT, Nava HR, Fischer JJ. Percutaneous endoscopic gastrostomy (PEG) in cancer patients. *Surg Endosc*. 1993;7:304–7.
28. Wollman B, D'Agostino HB, Walus-Wigle JR, et al. Radiologic, endoscopic, and surgical gastrostomy: an institutional evaluation and meta-analysis of the literature. *Radiology*. 1995;197:699–704.
29. Bell SD, Carmody EA, Yeung EY, et al. Percutaneous gastrostomy and gastrojejunostomy: additional experience in 519 procedures. *Radiology*. 1995;194:817–20.
30. Wallace MJ, Chin KW, Fletcher TB, et al. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. *J Vasc Interv Radiol*. 2010;21:431–5.
31. U.S. Department of Health and Human Services NIOH, National Cancer Institute. Common Terminology Criteria for Adverse Events (CTCAE). <http://evs.nci.nih.gov/ftp1/CTCAE>. Version 4.03 (June 2010).
32. Mercadante S, Casuccio A, Mangione S. Medical treatment for inoperable malignant bowel obstruction: a qualitative systematic review. *J Pain Symptom Manage*. 2007;33:217–23.
33. Cunningham MJ, Bromberg C, Kredentser DC, et al. Percutaneous gastrostomy for decompression in patients with advanced gynecologic malignancies. *Gynecol Oncol*. 1995;59:273–6.
34. Pothuri B, Montemarano M, Gerardi M, et al. Percutaneous endoscopic gastrostomy tube placement in patients with malignant bowel obstruction due to ovarian carcinoma. *Gynecol Oncol*. 2005;96:330–4.
35. Brooksbank MA, Game PA, Ashby MA. Palliative venting gastrostomy in malignant intestinal obstruction. *Palliat Med*. 2002;16:520–6.
36. Campagnutta E, Cannizzaro R, Gallo A, et al. Palliative treatment of upper intestinal obstruction by gynecological malignancy: the usefulness of percutaneous endoscopic gastrostomy. *Gynecol Oncol*. 1996;62:103–5.
37. Laval G, Arvieux C, Stefani L, et al. Protocol for the treatment of malignant inoperable bowel obstruction: a prospective study of 80 cases at Grenoble University Hospital Center. *J Pain Symptom Manage*. 2006;31:502–12.
38. Herman LL, Hoskins WJ, Shike M. Percutaneous endoscopic gastrostomy for decompression of the stomach and small bowel. *Gastrointest Endosc*. 1992;38:314–8.
39. Ripamonti C, Twycross R, Baines M, et al. Clinical-practice recommendations for the management of bowel obstruction in patients with end-stage cancer. *Support Care Cancer*. 2001;9:223–33.
40. Lee MJ, Saini S, Brink JA, et al. Malignant small bowel obstruction and ascites: not a contraindication to percutaneous gastrostomy. *Clin Radiol*. 1991;44:332–4.
41. Marks WH, Perkal MF, Schwartz PE. Percutaneous endoscopic gastrostomy for gastric decompression in metastatic gynecologic malignancies. *Surg Gynecol Obstet*. 1993;177:573–6.