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Self-Expandable Metallic Stent Placement in Malignant Gastric Outlet Obstruction

A Comparison Between 2 Brands of Stents

Bing-Wei Ye, MD, Kuei-Chuan Lee, MD, PhD, Yun-Cheng Hsieh, MD, Chung-Pin Li, MD, PhD, Yee Chao, MD, PhD, Ming-Chih Hou, MD, and Han-Chieh Lin, MD

Abstract: Malignant gastric outlet obstruction is a late complication of intraabdominal malignancy. Self-expandable metallic stent placement has been a safe palliative treatment to relieve obstructive symptoms. We aimed to assess the efficacy and safety of metallic stents in our patients and analyzed the clinical outcome of different brands.

Seventy-one patients with inoperable gastric outlet obstruction receiving WallFlex enteral stents (WallFlex group) or Bonastents (Bonastent group) since April 2010 were analyzed retrospectively.

The overall technical and clinical success rates of stent placement were 100% and 93%, respectively. The baseline characteristics and clinical outcomes including procedure-related complications, restenosis, and reintervention rates were comparable between the 2 groups. However, the Bonastent group had a higher rate of stent fracture than the WallFlex group (13.3% vs 0%, $P = 0.03$). The mean duration of overall stent patency was 132.7 days. The mean duration of survival was 181.9 days. Resumption of regular diet or low residual diet at day 7 after stent insertion predicted stent patency (hazard ratio [HR]: 0.28, $P = 0.01$). Cancer with gastric origin (HR: 0.25, $P = 0.045$) and poststent chemotherapy (HR: 0.38, $P = 0.006$) predicted lower mortality; however, peritoneal carcinomatosis (HR: 3.09, $P = 0.04$) correlated with higher mortality.

Metallic stent placement is a safe and effective method for relieving gastric outlet obstruction. Except higher rate of stent fracture in the Bonastent group, there is no significant difference in clinical outcomes between the Bonastent group and the WallFlex group.

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Abbreviations: CT = chemotherapy, ECOG = Eastern Cooperative Oncology Group, GJ = gastrojejunostomy, GOOSS = gastric outlet obstruction scoring system, HR = hazard ratio, MGOO = malignant gastric outlet obstruction, RT = radiotherapy, SD = standard deviation, SEMS = self-expandable metallic stent, UGI = upper gastrointestinal.

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From the Division of Gastroenterology (B-WY, K-CL, Y-CH, C-PL, YC, M-CH, H-CL), Department of Medicine; Cancer Center (YC); Endoscopic Diagnosis and Therapeutic Center (M-CH), Taipei Veterans General Hospital; and Department of Medicine (B-WY, K-CL, Y-CH, C-PL, YC, M-CH, H-CL), National Yang-Ming University School of Medicine, Taipei, Taiwan.
Correspondence: Kuei-Chuan Lee, Division of Gastroenterology, Department of Medicine, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan (e-mail: kclee2@vghtpe.gov.tw).
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INTRODUCTION

Malignant gastric outlet obstruction (MGOO) is a late complication of intraabdominal malignancy, especially in pancreatic cancer and gastric cancer. It is common and has been reported up to 20% in pancreatic cancer patients and 35% in distal gastric cancer patients.[1–4] It can cause significant morbidity including intractable nausea, vomiting, poor oral intake, and severe weight loss. These symptoms lead to dehydration, malnutrition, cachexia, and poor quality of life. These patients are also put at the risk of aspiration pneumonia. Of these patients, the prognosis is poor with median survival about only 3 to 4 months.[5]

Two treatment modalities to relieve obstructive symptoms that are commonly used are surgical gastrojejunostomy (GJ) and self-expandable metallic stent (SEMS) placement. The technical and clinical outcomes between GJ and SEMS seem to be comparable.[6] The GJ is associated with significant mortality and morbidity rate, prolonged hospital stay, delayed symptoms relief, and increased cost.[6–8] Although GJ has better survival outcome in patients with Eastern Cooperative Oncology Group (ECOG) 0–1[9]; however, most patients who suffer from MGOO are already at preterminal stages with only limited life expectancies and are unsuitable for surgery. Thus, SEMS placement seems to be a good option in this patient population.

SEMS insertion is an effective and safe alternative palliative procedure for MGOO. Roy et al[6] reported that the stent placement had lower median length of stay in hospital and costs in comparison with GJ. Jeurnink et al[8] found earlier food intake in stent group than GJ group. Espinel et al[7] found that the enteral stent had lower 30 days mortality than GJ with 16.6% than 29.4%. The trend of low complication rate was also found with 4% versus 17.6%.

There are also several commercially available enteral SEMS with a variety of stent lengths and designs to be chosen from, such as enteral Wallstent, enteral WallFlex, Hanarostent, Niti-S pyloric/duodenal stent, Comvi Niti-S pyloric/duodenal stent, and Bonastent. In our hospital, SEMS placement for MGOO in inoperable patients was performed since April 2010. Two brands of uncovered metallic stent (WallFlex stent and Bonastent) are available in our hospital. The safety and effectiveness of WallFlex stents for MGOO were already known in the previous study,[10] but the related data in clinical use of Bonastent still lacks. In addition, no head-to-head study comparing the 2 brands is reported so far. Thus, we aimed to assess the efficacy and safety of metallic stent placement and compared the clinical outcome of both brands of stents in our patients.

METHODS

Patients

Seventy-one consecutive patients with inoperable intraabdominal malignancy causing MGOO and treated with metallic stent insertion were recruited retrospectively from April 2010 to April 2014. All cases were followed up to death or until February 2015 and received metallic stent placement at Taipei Veterans General Hospital, Taipei, Taiwan. They had symptoms of obstruction such as nausea, vomiting, abdominal fullness, and poor appetite. MGOO was confirmed by upper gastrointestinal (UGI) endoscopy and computed tomography scans. This retrospective study was approved by the Institutional Review Board of Taipei Veterans General Hospital and was in accordance with the ethical standards of Declaration of Helsinki. The informed consent was waived because of retrospective study design.

Stent Placement

Several days before stent placement, a computed tomography scan and UGI endoscopy were performed to evaluate the site, severity, and the length of stricture. All patients received nasogastric tube drainage and received nil per os to minimize the risk of aspiration and ensure adequate gastric emptying.

The tip of the UGI endoscope with wide caliber working channels (GIF-2T240 or GIF-2TQ260M; Olympus, Tokyo, Japan) was inserted in the area before the obstructive site. Then, a guide wire (Hydra Jagwire; Boston Scientific Corporation, Marlborough, MA) through the working channel of the endoscope was passed through the stricture under fluoroscopic guidance. The length and location of the stricture were measured by injecting watersoluble radiographic contrast. The length of the stent was determined by adding 4 to 6 cm to the stricture length. Using fluoroscopy for guidance, the uncovered metallic stents either WallFlex single-use duodenal stents (Boston Scientific Corporation) or Bonastents pyloric/duodenal (Standard SciTech Inc, Seoul, South Korea) were implanted. Both the ends of the stents were 2 to 3 cm beyond the stricture ends. Before the procedure, we had provided the details of the 2 brands of stents including the price, manufacturing companies, and countries of origin to each patient. Because the metallic stents were not covered by our National Health Insurance, the selection in brands of the self-paid metallic stents was determined by the patients themselves.

Evaluation of the Degrees of Gastric Outlet Obstruction

Gastric outlet obstruction scoring system (GOOSS) was used to measure the degrees of outlet obstruction. On the basis of oral intake, a GOOSS value was assigned as a 4-point scale: 0 for no oral intake, 1 for liquid diet only, 2 for soft diet, and 3 for low residual diet or regular diet.[11]

Definition of Clinical, Technical Success and Procedure-Related Complications

The clinical success was defined as resolution of obstructive symptoms with improved oral intake at day 7 after the stent implantation. The technical success was defined as the adequate deployment of the stent with proper position across stricture. Procedure-related complications were separated into minor and major complications. The minor complications were referred to as no life-threatening complications including abdominal pain, nausea, and vomiting. The major complications mean life-threatening complications, such as aspiration pneumonia, sepsis, bleeding, and perforation.[12]

Data Collection

The data from patients' medical records including radiology reports, procedure reports, daily notes, and phone interview were obtained. The data we collected included the baseline characteristics, GOOSS values, complications, procedure time, duration of stent patency, and survival.

Statistics Analysis

All the continuous variables are presented as mean ± standard deviation (SD) or number (percentage) (n, %). The GOOSS value changes were compared by Wilcoxon signed rank test. The baseline characteristics between 2 stents were compared by Student t test or χ^2/Fisher exact test depending on whether the variables were continuous or categorical. The subgroup analysis of duration of stent patency and survival among different cancer origins were analyzed by 1-way analysis of variance. The univariate analysis was performed by Kaplan–Meier analysis compared with the log-rank test. Variables with P values <0.1 in univariate analysis were selected for multivariate analysis. The multivariate analysis was performed by Cox regression model. Significance is assumed only at a P value <0.05. All the statistic analysis was performed by Statistical Product and Service Solutions version 21.0 (SPSS Inc., Chicago, IL).

RESULTS

Patients' Demographic Characteristics

The demographic characteristics of recruited patients are summarized in Supplemental Digital Content 1, table, http://links.lww.com/MD/A338, which demonstrates the demographic characteristics in all the patients. Median follow-up time was 139 days (75%: 237 days, 25%: 71 days). Most patients (71.8%) had the primary cancer of gastric origin. The patients manifested with advanced stages and up to 87.3% of them were in stage IV. Thirty-four patients (47.9%) had obstruction at pylorus, 20 (28.2%) at antrum, and 17 (23.9%) at duodenum.

Technical and Clinical Success

The placement of duodenal stents was successfully deployed in all the patients. The mean procedure time was 26.8 ± 8.9 minutes (see table, Supplemental Digital Content 2, http://links.lww.com/MD/A338, which demonstrates the clinical outcomes of stent placement).

Overall, the clinical success was achieved in 66 patients (93%), which improved in GOOSS value at least 1 point at day 7. Only 1 patient had worse dietary status at day 30. The mean preprocedure basal GOOSS value was 0.4 ± 0.5 (mean ± SD). The GOOSS value significantly increased on the next day (1.2 ± 0.5, $P < 0.001$ vs day 0), and gradually increased to 2.3 ± 0.8 ($P < 0.001$ vs day 0) at day 7 and maintained at day 30 (2.4 ± 0.8, $P < 0.001$ vs day 0) (Figure 1). The percentages of patients attaining GOOSS 2 to 3 at day 1, day 7, and day 30 after stent insertion were 12/71 (16.9%), 57/71 (80.3%), and 56/66 (84.8%), respectively.

Comparison of Baseline Characteristics and Clinical Outcomes Between Patient Groups Receiving WallFlex Stents or Bonastents

No significant difference in the baseline characteristics of 2 groups was noted (Table 1). Forty-one patients received WallFlex stents (WallFlex group) whereas 30 patients received Bonastents (Bonastent group). There is also no significant

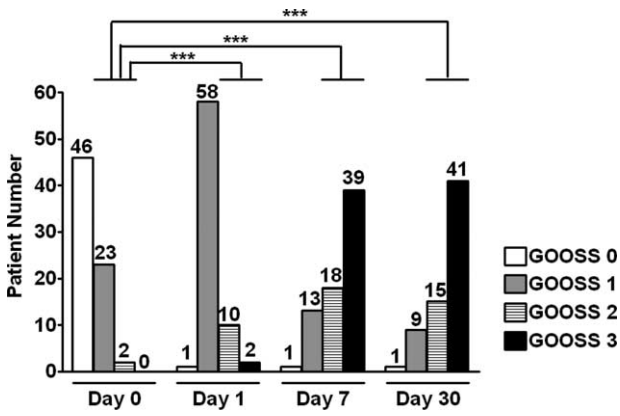

FIGURE 1. Distribution of GOOSS values before and after placement of metallic stents for gastric outlet obstruction. $^{***}P < 0.001$ versus the day 0 group. GOOSS = gastric outlet obstruction scoring system.

difference in the rates of procedure-related complications, restenosis, and reintervention between the 2 groups except stent fracture. The rate of stent fracture in the Bonastent group was significantly higher than that in the WallFlex group (13.3% vs 0%, $P = 0.03$) (Table 2).

Overall Complications and Clinical Outcomes

Seven (9.9%) patients suffered from abdominal pain after stent placement, and they recovered several days later. Seven (9.9%) patients had symptoms of nausea and 9 (12.7%) patients had vomiting (see table, Supplemental Digital Content 2, http://links.lww.com/MD/A338, which demonstrates the clinical outcomes of stent placement). These symptoms were controlled medically within 1 week.

None of the patients suffered from biliary obstruction or pancreatitis in this cohort. Two patients (2.8%) developed aspiration pneumonia after stent insertion. One of the 2 patients recovered after adequate antibiotic treatment and was discharged 1 week later. However, the other patient developed respiratory failure and died 3 days later because of no further resuscitation requested by the patient. One patient (1.4%) became septic after stent placement and recovered after antibiotic treatment. One (1.4%) patient receiving chemotherapy (CT) after stent insertion had stent migration at day 38. The endoscope finding showed that stent was dislodged at the third portion of duodenum and the stent was retrieved without adverse events. However, stent fracture developed in 4 patients during the follow-up period. Two of 4 patients were found because of the development of GOO symptoms that were relieved by another stent insertion. The fractured parts were found to be dislodged at fundus and were retrieved out without adverse events before another stent insertion. However, the others were found incidentally without obstructive symptoms at routine follow-ups of computed tomography scans for evaluation of the CT responses. The fractured stent from one of them disappeared while performing UGI scope for retrieval and passed out with stool spontaneously. Another fractured stent was still in position and fixed by ingrowth of tumor. The time from insertion to stent fracture was 90, 146, 151, and 153 days, respectively. Three of 4 had received poststent placement CT and only 1 of them showed disease progression.

TABLE 1. Baseline Demographic Characteristics of Patients With Different Brands of Stents

Variable	WallFlex (n = 41)	Bonastent (n = 30)	*P* Value
Age, y	70.3 (16.5)	71.6 (13.9)	0.72
Sex (M/F)	27/14	18/12	0.61
BMI	20.9 (3.8)	19.9 (2.8)	0.22
Albumin, g/dL	3.0 (0.5)	3.1 (0.7)	0.72
ECOG	1.8 (1.3)	1.8 (0.7)	0.82
GOOSS	0.4 (0.5)	0.4 (0.6)	0.80
Tumor origin			0.97
Stomach	29 (70.7%)	22 (73.3%)	
Pancreas	6 (14.6%)	4 (13.3%)	
Bile duct	6 (14.6%)	4 (13.3%)	
Tumor staging III/IV	4/37	5/25	0.48
Peritoneal carcinomatosis	19 (46.3%)	14 (46.7%)	0.98
Length of stenosis, cm	4.2 (1.8)	4.1 (2.0)	0.83

Data were expressed as mean (SD) or number (%). BMI = body mass index, ECOG = Eastern Cooperative Oncology Group, GOOSS = gastric outlet obstruction scoring system value, SD = standard deviation.

TABLE 2. Clinical Outcomes of Poststent Placement With Different Brands of Stents

Variable	WallFlex (n = 41)	Bonastent (n = 30)	*P* Value
Patency time, d	132.6 (106.4)	132.8 (90.9)	>0.99
Survival time, d	181.7 (197.1)	182.1 (165.9)	>0.99
Procedure time, min	26.8 (9.0)	26.8 (8.8)	0.99
BMI-1[#]	20.1 (3.9)	20.1 (2.8)	0.97
Albumin-1[#]	2.9 (0.6)	2.7 (0.7)	0.30
ECOG-1[#]	2.3 (1.5)	2.4 (1.0)	0.78
Time to oral intake, d	1.0 (0.5)	1.2 (0.9)	0.26
GOOSS-D7	2.3 (0.8)	2.4 (0.9)	0.59
GOOSS-D30[#]	2.4 (0.8)	2.6 (0.7)	0.23
Procedure-related complications			
Major complications			0.32
Aspiration pneumonia	2 (4.9%)	0 (0%)	
Sepsis	1 (2.4%)	0 (0%)	
Minor complications			0.95
Abdominal pain	4 (9.8%)	3 (10%)	
Nausea	4 (9.8%)	3 (10%)	
Vomiting	6 (14.6%)	3 (10%)	
Stent dysfunction	14 (34.1%)	8 (26.7%)	0.61
Restenosis	13 (31.7%)	4 (13.3%)	0.10
Fracture	0 (0%)	4 (13.3%)	0.03[*]
Migration	1 (2.4%)	0 (0%)	>0.99
Reintervention	10 (24.4%)	4 (13.3%)	0.37

Data were expressed as mean (SD) or number (%). -1 = 1 month later, BMI = body mass index, ECOG = Eastern Cooperative Oncology Group, GOOSS-D7/D30 = gastric outlet obstruction scoring system values at day 7/day 30, SD = standard deviation.

[*] $P < 0.05$.

[#] These parameters were collected from 66 patients (WallFlex/Bonastent: 37/29) because of early death (within 30 d after stent insertion) in some patients (WallFlex/Bonastent: 4/1).

Twenty patients had recurrence of symptoms of GOO. One of these patients suffered from stent migration after CT as mentioned earlier and received radiotherapy (RT) only after the old stent was removed. Two of them suffered from stent fracture and received another stent insertion smoothly. The other 17 patients developed stent restenosis. Six of the 17 patients (35.3%) with stent restenosis received supportive care only because of terminal stage and the requests of no further invasive intervention. Eight of the 17 patients (47.1%) with stent restenosis received stent-in-stent insertion (see figure, Supplemental Digital Content 3, http://links.lww.com/MD/A338, which illustrates the outcomes of patients with MGOO treated with metallic stent placement).

Factors Predicting Restenosis

The mean duration of the stent patency was 132.7 days (ranged from 13 to 570 days). Figure 2A shows the time to restenosis after stent placement. In univariate and multivariate analyses, only GOOSS 3 point at day 7 was significantly associated with stent patency (Table 3 and Figure 2B).

Factors Predicting Survival

In total, 69 patients died during the follow-up period. Five patients passed away within 30 days after stent insertion (WallFlex/Bonastent: 4/1, $P = 0.39$). One patient death in WallFlex group was because of procedure-related aspiration pneumonia. Four patients deceased because of natural terminal course (WallFlex/Bonastent: 3/1). In the univariate analysis, several factors including female sex, advanced ECOG state, nongastric cancer origin, obstruction level in duodenum, previous RT, no poststent CT, peritoneal carcinomatosis, the presence of ascites, and GOOSS <3 point at day 7 were poor prognostic factors. However, in the multivariate analysis, only tumor origin, poststent CT, and peritoneal carcinomatosis significantly affected the mortality (Table 4 and Figure 3).

Moreover, in subgroup analysis, the longest survival and patency time was in the gastric cancer group, 218.0 ± 202.6 and 150.1 ± 107.6 days, respectively. The difference of survival and patency time among the 3 groups were significant ($P = 0.02$ and $P = 0.03$, respectively) (see table, Supplemental Digital Content 4, http://links.lww.com/MD/A338, which demonstrates the subgroup analysis of survival and patency time).

DISCUSSION

This study demonstrates that metallic stent insertion had a high technical and clinical success with acceptable complication rates in MGOO. This suggests that SEMS placement is a safe and effective palliative method for patients with MGOO. Interestingly, this study first showed that except higher rate of stent fracture in Bonastent group, there was no difference in other clinical outcomes between the Bonastent and WallFlex groups. In addition, we further showed that GOOSS point <3 at day 7 can predict early restenosis. Regarding survival, gastric cancer origin, and poststent CT predicted lower mortality; however, peritoneal carcinomatosis predicted higher mortality.

In this study, the technical and clinical success rates of stent placement were high. In addition, the duration of stent patency, survival, and major complication rates were comparable with the previous studies.[10,13,14] The improvement of GOOSS levels was rapid and maintained until death in most patients, which is in agreement with the previous studies.[11,15]

Notably, 4 patients developed stent fracture, which is a rare complication of stent placement. A case report and a study ever reported this as a late stent complication.[16,17] In this study, all of stent fractures occurred in the Bonastent group. However, the rates of overall stent dysfunction, restenosis, reintervention, and clinical success were still comparable between the 2 groups. The mechanisms underlying stent fracture are uncertain. Patel and Levey[18] and Maetani et al[19] suggested some possible causes of stent fractures including tumor ingrowth/outgrowth, mucosa hyperplasia, and food impaction. In addition, the possible mechanisms underlying the fracture were postulated as repeated shearing force, constant and prolonged compression, and mechanic and electric damage to stents while clearing the blocked tumor tissue in stents.[20–24] However, there was no any mechanic or electrocoagulation management performed on our patients. The possible causes might be contributed by the composition of stent itself, the width of wire, and the method of wire weaving. However, these might involve the commercial secrets and we could not know about these detail information.

It has been shown that carcinomatosis,[25] the presence of ascites,[15,25] and the obstruction level of duodenum[13] are the prognostic factors for stent patency. In this study, the above risk factors did not correlate with stent patency in univariate analysis. Interestingly, the GOOSS 3 point at day 7 was found

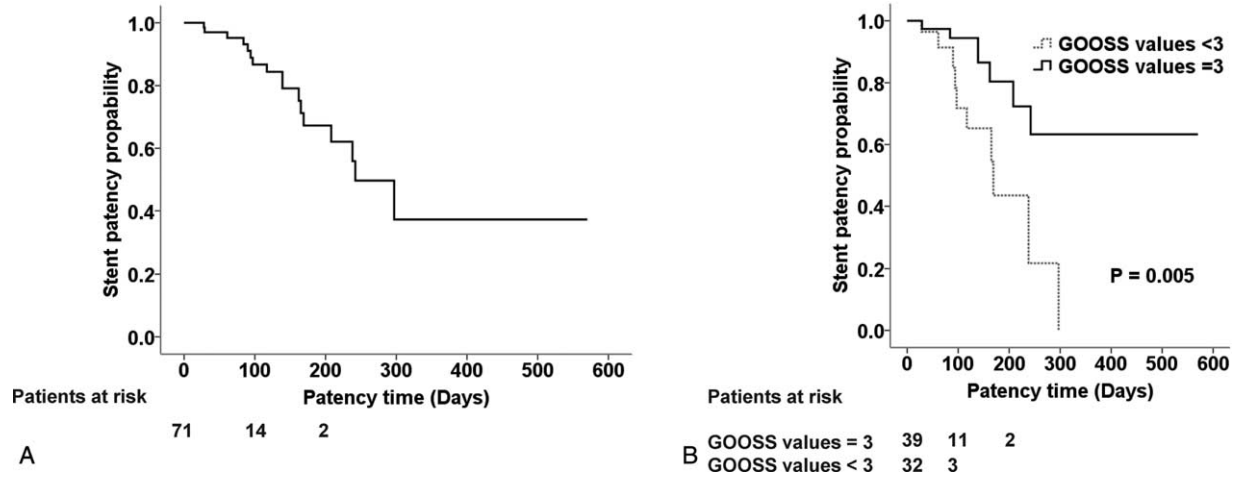

FIGURE 2. Time to stent restenosis in (A) overall patients after stent placement or (B) patients with GOOSS values at day 7 after stent insertion who attained 3 points or <3 points. GOOSS: gastric outlet obstruction scoring system.

TABLE 3. Univariate and Multivariate Analyses of Stent Patency

	Univariate Analysis			Multivariate Analysis		
Variable	**Number**	**Restenosis Number (%)**	***P* Value**	**HR**	**95% CI**	***P* Value**
Age (<70/≥70 y)	34/37	6/11 (17.6/29.7)	0.24			
Sex (M/F)	45/26	10/7 (22.2/26.9)	0.08	0.41	0.14–1.19	0.10
ECOG (≥2/<2)	43/28	10/7 (23.3/25.0)	0.95			
Tumor origin (gastric/nongastric cancer)	51/20	16/1 (31.4/5.0)	0.31			
Staging (IV/III)	62/9	16/1 (25.8/11.1)	0.10			
Location of obstruction (stomach/duodenum)	54/17	16/1 (29.6/5.9)	0.39			
Length of stenosis (<4.5/≥4.5 cm)	44/27	10/7 (22.7/25.9)	0.37			
Length of stent (≤9/>9 cm)	41/30	13/4 (31.7/13.3)	0.22			
Previous RT (yes/no)	9/62	2/15 (22.2/24.2)	0.40			
Post-RT (yes/no)	14/57	4/13 (28.6/22.8)	0.55			
Previous CT (yes/no)	35/36	9/8 (25.7/22.2)	0.21			
Post-CT (yes/no)	34/37	9/8 (26.5/21.6)	0.59			
Peritoneal carcinomatosis (yes/no)	33/38	8/9 (24.2/23.7)	0.15			
Ascites (yes/no)	24/47	6/11 (25.0/24.4)	0.23			
GOOSS-D7 = 3 (yes/no)	39/32	7/10 (17.9/31.2)	0.005**	0.28	0.10–0.74	0.01*
Stent brand (WallFlex/Bonastent)	41/30	13/4 (31.7/13.3)	0.14			

CI = confidence interval, CT = chemotherapy, GOOSS-D7 = gastric outlet obstruction scoring system value at day 7, HR = hazard ratio, RT = radiotherapy.
* $P < 0.05$.
** $P < 0.01$.

as an independent and novel predictor of stent patency. In the study by Piesman et al,[11] it was demonstrated that 56% of the patients receiving stent insertion attained GOOSS 2 to 3 at 7 days after stent insertion, whereas in our study, 80.3% of the patients receiving stent insertion attained GOOSS 2 to 3 at 7 days after stent insertion. Although, the study by Piesman et al[11] did not investigate the correlation between GOOSS values and stent patency, they found that 48% of the patients attaining GOOSS 2 to 3 at 7 days after stent insertion remained on solid food until death or last follow-up in a 24-week follow-up period.

TABLE 4. Univariate and Multivariate Analyses of Survival

	Univariate Analysis			Multivariate Analysis		
Variable	**Number**	**Death (%)**	***P* Value**	**HR**	**95% CI**	***P* Value**
Age (<70/≥70 y)	34/37	94.1/100	0.53			
Sex (M/F)	45/26	95.6/100	0.06	0.66	0.38–1.13	0.13
ECOG (≥2/<2)	43/28	97.7/96.4	0.04*	1.39	0.68–2.84	0.37
Tumor origin (gastric/nongastric cancer)	51/20	96.1/100	<0.001***	0.25	0.06–0.97	0.045*
Staging (IV/III)	62/9	98.4/88.9	0.09	1.09	0.46–2.55	0.85
Location of obstruction (stomach/duodenum)	54/17	96.3/100	<0.001***	0.65	0.16–2.54	0.53
Length of stenosis (<4.5/≥4.5 cm)	44/27	97.7/96.3	0.51			
Length of stent (≤9/>9 cm)	41/30	100/93.3	0.35			
Previous RT (yes/no)	9/62	100/96.8	0.02*	1.94	0.81–4.66	0.14
Post-RT (yes/no)	14/57	100/96.5	0.80			
Previous CT (yes/no)	35/36	100/94.4	0.20			
Post-CT (yes/no)	34/37	94.1/100	<0.001***	0.38	0.19–0.76	0.006**
Peritoneal carcinomatosis (yes/no)	33/38	100/94.7	0.004**	3.09	1.04–9.19	0.04*
Ascites (yes/no)	24/47	100/95.7	0.009**	0.89	0.34–2.31	0.80
GOOSS-D7 = 3 (yes/no)	39/32	94.9/100	0.001**	0.87	0.45–1.68	0.67
Stent brand (WallFlex/Bonastent)	41/30	100/93.3	0.77			

CI = confidence interval, CT = chemotherapy, ECOG = Eastern Cooperative Oncology Group, GOOSS-D7 = gastric outlet obstruction scoring system value at day 7, HR = hazard ratio, RT = radiotherapy.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

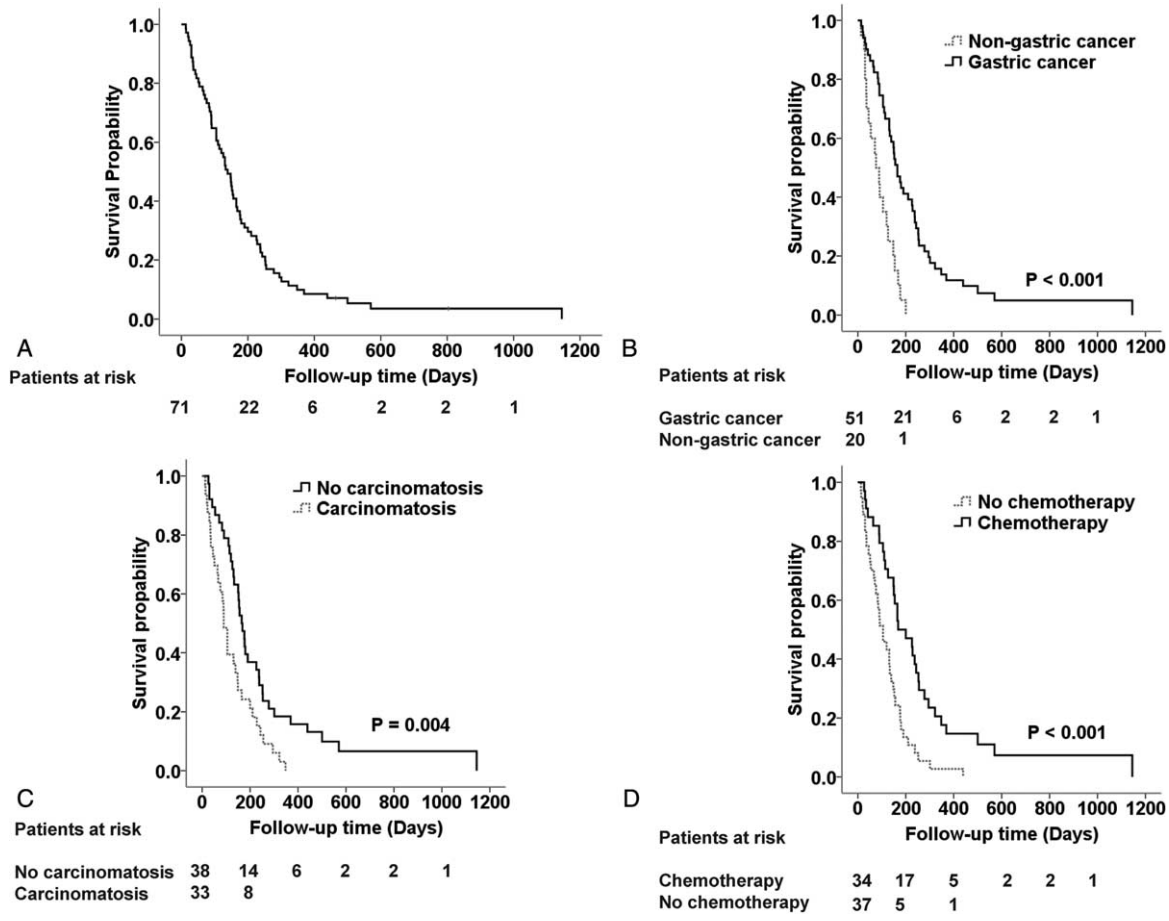

FIGURE 3. Survival curves in (A) overall patients, (B) patient with gastric or nongastric cancer origin, (C) patients with or without peritoneal carcinomatosis, or (D) patients with or without poststent chemotherapy after stent placement.

Therefore, the observation of GOOSS at day 7 could predict stent patency, which is useful in clinical practice.

In this study, nongastric cancer origin, no poststent CT, and peritoneal carcinomatosis were associated with shorter survival. Kim et al[26] compared the clinical outcome of MGOO caused by gastric cancer and pancreatic cancer and found that the survival was longer in gastric cancer than in pancreatic cancer. Similarly, Jemal et al[27] reported that the survival of pancreatic cancer was shorter than those of gastric cancer and duodneal cancer. Furthermore, the fact that CT might prolong survival in patients with advanced gastric and pancreatic cancer has been demonstrated.[28–30] Even cholangioacarcinoma, a relative poor respondor to CT, still benefited from CT with prolonged survival.[31] Peritoneal carcinomatosis, however, was considered as poor prognostic sign in gastrointestinal cancer even than distant metastasis.[32] Patients with peritoneal carcinomatosis from gastric origin had median survival of 1 to 3 months.[33] CT could improve survival of metastatic gastric cancer up to 7 to 10 months,[34] but none of the same improvement was reported in patients with peritoneal carcinomastasis from gastric cancer.[35]

In this study, patients with gastric cancer had significantly longer duration of survival and stent patency followed by pancreatic cancer and cholangiocarcinoma. Kim et al[26] reported that the median survival period in the patients with gastric cancer and MGOO was significantly longer than that in the patients with pancreatic cancer and MGOO. However, the cumulative stent patency did not differ between the 2 groups. We thought the difference in the duration of stent patency might result from the relative shorter survival in pancreatic cancer and cholangiocarcinoma in our study. First, the relatively high proportion of advanced stages in pancreatic cancer and cholangiocarcinoma (all stage IV) than in gastric cancer was noted. Second, previous studies showed that the mean survival time of gastric cancer was longer than that of pancreatic cancer and cholangiocarcinoma.[27,29] Thus, shorter stent patency time in pancreatic and cholangiocarcinoma groups might partly be attributed to death which was considered as censor of stent patency in this study.

In conclusion, metallic stent placement is a safe and effective method for relieving patients with symptoms of GOO. GOOSS 3 point at day 7 is a novel predictor of stent patency. Although the rate of stent fracture in the Bonastent group is significantly higher than the WallFlex group, the procedure-related complications, restenosis, and reintervention rates were still comparable in the 2 stent groups. Our study was retrospective in nature and had relatively small patient numbers. Whether stent fracture has a significant clinical impact and whether types of brand indeed matter deserve further prospective studies to elucidate.

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REFERENCES

1. Lopera JE, Brazzini A, Gonzales A, et al. Gastroduodenal stent placement: current status. *Radiographics.* 2004;24:1561–1573.
2. Samad A, Shoukat KTI. Gastric outlet obstruction: change in etiology. *Pak J Surg.* 2007;23:29.
3. Adler DG, Baron TH. Endoscopic palliation of malignant gastric outlet obstruction using self-expanding metal stents: experience in 36 patients. *Am J Gastroenterol.* 2002;97:72–78.
4. van Heek NT, van Geenen RC, Busch OR, et al. Palliative treatment in ''peri''-pancreatic carcinoma: stenting or surgical therapy? *Acta Gastroenterol Belgica.* 2002;65:171–175.
5. Ly J, O'Grady G, Mittal A, et al. A systematic review of methods to palliate malignant gastric outlet obstruction. *Surg Endosc.* 2010;24:290–297.
6. Roy A, Kim M, Christein J, et al. Stenting versus gastrojejunostomy for management of malignant gastric outlet obstruction: comparison of clinical outcomes and costs. *Surg Endosc.* 2012;26:3114–3119.
7. Espinel J, Sanz O, Vivas S, et al. Malignant gastrointestinal obstruction: endoscopic stenting versus surgical palliation. *Surg Endosc.* 2006;20:1083–1087.
8. Jeurnink SM, Steyerberg EW, Hof G, et al. Gastrojejunostomy versus stent placement in patients with malignant gastric outlet obstruction: a comparison in 95 patients. *J Surg Oncol.* 2007;96:389–396.
9. No JH, Kim SW, Lim CH, et al. Long-term outcome of palliative therapy for gastric outlet obstruction caused by unresectable gastric cancer in patients with good performance status: endoscopic stenting versus surgery. *Gastrointest Endosc.* 2013;78:55–62.
10. van Hooft JE, Uitdehaag MJ, Bruno MJ, et al. Efficacy and safety of the new WallFlex enteral stent in palliative treatment of malignant gastric outlet obstruction (DUOFLEX study): a prospective multicenter study. *Gastrointest Endosc.* 2009;69:1059–1066.
11. Piesman M, Kozarek RA, Brandabur JJ, et al. Improved oral intake after palliative duodenal stenting for malignant obstruction: a prospective multicenter clinical trial. *Am J Gastroenterol.* 2009;104:2404–2411.
12. Kim JH, Song H-Y, Shin JH. Malignant gastric outlet obstructions: treatment with self-expandable metallic stents. *Gut Liver.* 2010;4 (suppl 1):S32.
13. Canena JM, Lagos AC, Marques IN, et al. Oral intake throughout the patients' lives after palliative metallic stent placement for malignant gastroduodenal obstruction: a retrospective multicentre study. *Eur J Gastroenterol Hepatol.* 2012;24:747–755.
14. Sasaki T, Isayama H, Maetani I, et al. Japanese multicenter estimation of WallFlex duodenal stent for unresectable malignant gastric outlet obstruction. *Dig Endosc.* 2013;25:1–6.
15. Sasaki T, Isayama H, Nakai Y, et al. Predictive factors of solid food intake in patients with malignant gastric outlet obstruction receiving self-expandable metallic stents for palliation. *Dig Endosc.* 2012;24:226–230.
16. Javaid MR, Yusuf AM. An instant rare complication a fractured metallic pyloric stent. *BMJ Case Rep.* 2013;2013:bcr2012007695.
17. Kim CG, Park SR, Choi IJ, et al. Effect of chemotherapy on the outcome of self-expandable metallic stents in gastric cancer patients with malignant outlet obstruction. *Endoscopy.* 2012;44:807–812.
18. Patel S, Levey PRJ. Endoscopic stenting: an overview of potential complications. *Pract Gastroenterol.* 2003;27:44–54.
19. Maetani I, Ukita T, Tada T, et al. Metallic stents for gastric outlet obstruction: reintervention rate is lower with uncovered versus covered stents, despite similar outcomes. *Gastrointest Endosc.* 2009;69:806–812.
20. Rousseau H, Dahan M, Lauque D, et al. Self-expandable prostheses in the tracheobronchial tree. *Radiology.* 1993;188:199–203.
21. Lee KW, Im JG, Han JK, et al. Tuberculous stenosis of the left main bronchus: results of treatment with balloons and metallic stents. *J Vasc Intervent Radiol.* 1999;10:352–358.
22. Ell C, Fleig WE, Hochberger J. Broken biliary metal stent after repeated electrocoagulation for tumor ingrowth. *Gastrointest Endosc.* 1992;38:197–199.
23. Yoshida H, Tajiri T, Mamada Y, et al. Fracture of a biliary expandable metallic stent. *Gastrointest Endosc.* 2004;60:655–658.
24. Fernandez-Bussy S, Akindipe O, Kulkarni V, et al. Clinical experience with a new removable tracheobronchial stent in the management of airway complications after lung transplantation. *J Heart Lung Transplant.* 2009;28:683–688.
25. Jeon HH, Park CH, Park JC, et al. Carcinomatosis matters: clinical outcomes and prognostic factors for clinical success of stent placement in malignant gastric outlet obstruction. *Surg Endosc.* 2014;28:988–995.
26. Kim JH, Song HY, Shin JH, et al. Metallic stent placement in the palliative treatment of malignant gastric outlet obstructions: primary gastric carcinoma versus pancreatic carcinoma. *AJR Am J Roentgenol.* 2009;193:241–247.
27. Jemal A, Murray T, Ward E, et al. Cancer statistics, 2005. *CA Cancer J Clin.* 2005;55:10–30.
28. Wagner AD, Unverzagt S, Grothe W, et al. Chemotherapy for advanced gastric cancer. *Cochrane Database Syst Rev.* ((3)):2010:CD004064.
29. Wagner AD, Grothe W, Haerting J, et al. Chemotherapy in advanced gastric cancer: a systematic review and meta-analysis based on aggregate data. *J Clin Oncol.* 2006;24:2903–2909.
30. Ryan DP, Hong TS, Bardeesy N. Pancreatic adenocarcinoma. *N Engl J Med.* 2014;371:1039–1049.
31. Valle J, Wasan H, Palmer DH, et al. Cisplatin plus gemcitabine versus gemcitabine for biliary tract cancer. *N Engl J Med.* 2010;362:1273–1281.
32. Coccolini F. Peritoneal carcinomatosis. *World J Gastroenterol.* 2013;19:6979–6994.
33. Okines A, Verheij M, Allum W, et al. Gastric cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol.* 2010;21 (suppl 5):v50–v54.
34. Pyrhonen S, Kuitunen T, Nyandoto P, et al. Randomised comparison of fluorouracil, epidoxorubicin and methotrexate (FEMTX) plus supportive care with supportive care alone in patients with non-resectable gastric cancer. *Br J Cancer.* 1995;71:587–591.
35. Hanazaki K, Mochizuki Y, Machida T, et al. Post-operative chemotherapy in non-curative gastrectomy for advanced gastric cancer. *Hepatogastroenterology.* 1999;46:1238–1243.