Diagn Interv Radiol 2012; 18:360–364

ABDOMINAL IMAGING

ORIGINAL ARTICLE

Placement of duodenal stents across the duodenal papilla may predispose to acute pancreatitis: a retrospective analysis

Liu Shi-Yi, Mao Ai-Wu, Jia Yi-Ping, Wang Zhen-Lei, Jiang Hao-Sheng, Li Yong-Dong, Yin Xiang

PURPOSE

To evaluate retrospectively the incidence, predictive factors, and management of acute pancreatitis which develops following placement of duodenal stents in patients with malignant gastroduodenal obstruction.

MATERIALS AND METHODS

Among 242 patients with symptomatic malignant gastroduodenal obstruction successfully treated with duodenal stent placement, acute pancreatitis occurred in 10 patients (4.1%) at 1–7 days after stent placement. Univariate and multivariate analyses were performed to evaluate factors predictive of acute pancreatitis. Management of acute pancreatitis was also evaluated.

RESULTS

Ten patients with acute pancreatitis presented with abdominal pain and distention with vomiting at 1–7 days after stent placement, and seven patients developed acute jaundice. Pancreatitis resolved in four patients with a regime of fasting and intravenous nutrition. The remaining six cases were managed with percutaneous transhepatic cholangiography and drain (PTCD) placement. Univariate analysis showed that acute pancreatitis was associated with stent location in the descending duodenum ($P = 0.001$) and with stents bridging the duodenal papilla ($P < 0.001$). Multivariate analysis demonstrated that the presence of a stent bridging the duodenal papilla (odds ratio, 18.48; 95% confidence interval, 2.298–148.48; $P = 0.006$) was an independent predictor of acute pancreatitis.

CONCLUSION

Acute pancreatitis is an uncommon early complication of duodenal stent placement in patients with malignant gastroduodenal obstruction. In this group of patients, acute pancreatitis was associated with stent location in the descending duodenum and occurred in patients with stents bridging the duodenal papilla; the latter may be the most important predictor of acute pancreatitis. Jaundice can be managed conservatively or with PTCD.

Key words: • *pancreatitis* • *duodenum* • *stents* • *duodenal obstruction*

From the Department of Interventional Radiology (M.A.W. ✉ *maoaw@sohu.com.cn*), Shanghai St. Luke's Hospital, Shanghai, China.

Received 4 September 2011; revision requested 29 September 2011; revision received 18 October 2011; accepted 24 October 2011.

Published online 8 March 2012
DOI 10.4261/1305-3825.DIR.5045-11.1

Placement of self-expanding metal stents is a safe and effective palliative treatment method for symptomatic patients with gastric outlet and duodenal obstruction (1–13). It has a higher clinical success rate and is associated with a shorter hospital stay and less morbidity and mortality than palliative surgery (6, 14). However, complications such as acute pancreatitis, perforation, peritonitis, bleeding, stent migration, tumor ingrowth, food impaction, obstructive jaundice, and stent collapse may occur following stent placement (1–6, 9–13, 15–17). Of these complications, acute pancreatitis, although rarely reported, is one of the most important due to its association with a high mortality rate (18).

Theoretically, acute pancreatitis can occur following duodenal stent placement due to increased pressure in the pancreatic duct resulting from compression or irritation of the duodenal papilla by the stent. To the best of our knowledge, due to lack of specific symptoms and signs, acute pancreatitis after duodenal stenting is often misdiagnosed because the abdominal pain and vomiting are associated with the underlying disorder. Awareness of acute pancreatitis which develops following gastric and duodenal stent placement leads to earlier diagnosis and treatment and is therefore crucial for the reduction of associated morbidity and mortality.

The purpose of this study was to evaluate acute pancreatitis following duodenal stent placement in patients with malignant gastroduodenal obstruction and to determine the incidence of and predictive factors for acute pancreatitis. However, because of the small size of the study population, definitive conclusions cannot be drawn about the true incidence and factors predictive of the condition.

Materials and methods

Our Institutional Review Board approved this retrospective study, and informed consent was obtained from each patient. Between March 1993 and December 2010, bare-metal stent placement for gastric outlet or duodenum obstruction was successfully performed at a single institution in 242 patients with primary and secondary malignant cancer. The characteristics of the study patients are summarized in Table 1. Due to the presence of advanced or metastatic disease, none of the 242 patients was considered suitable for surgery. The preoperative diagnosis of gastric outlet or duodenum obstruction was based on the patients' clinical presentation, multislice computed tomography (CT), contrast medium gastroenterograms, and gastroscopy. The final pathological diagnosis was made by histological examination of endoscopic biopsy, percutaneous needle aspiration biopsy, or forceps biopsy during percutaneous transhepatic or endonasal biliary drainage before the procedure. Among the 242 patients successfully treated with stent placement, acute pancreatitis occurred in 10 (4.1%) between 1 and 7 days after stent placement. Seven

Table 1. Baseline characteristics of the study population (n=242)

Characteristics	Value
Age (years, mean±SD [range])	63.48±10.81 (37–84)
Female/male (n)	83/159
Site of obstruction (n [%])	
Non-descending duodenum	148 (61.2%)
Descending duodenum	94 (38.8%)
Length of obstruction (cm, mean±SD [range])	6.26±2.00 (2.7–12.4)
Type of malignancy (n)	
Gastric cancer	127
Duodenal cancer	54
Gallbladder cancer	29
Metastasis	32

SD, standard deviation.

of these patients were male, and three were female (mean age, 64.50±10.93 years; age range, 45–81 years). No acute pancreatitis event was identified in any of the 10 patients by medical history or CT examination prior to stent placement.

Stent placement and follow-up

The duodenal stent (Micro-Tech, Nanjing, China) was woven from a single thread of 0.16-mm-diameter highly elastic nitinol wire. The stent was in a tubular configuration with a drum structure at the proximal and distal ends, as shown in Fig. 1. The body of the device was 18–22 mm in diameter when fully expanded and 60–160 mm in length. The drum structure at the proximal and distal ends of the device was 5 mm wider than the body and 10 mm in length. For implantation under fluoroscopic or endoscopic guidance, the stent was delivered in a compressed form inside an introducer sheath with a diameter of 16 F. All procedures were performed by an interventional radiologist and an endoscopist under fluoroscopic guidance. Details of the stent placement technique are described elsewhere (4, 6, 19, 20) (Fig. 2a and 2b).

All patients underwent plain abdominal radiography, clinical examination, contrast medium radiographic study, and/or endoscopy between 1 and 7 days after stent placement to confirm the position and patency of the stent and to evaluate possible complications. For patients with abdominal pain, vomiting, or jaundice post-stent placement, laboratory examinations, including blood count, electrolytes, clotting time, liver and renal function, and blood, urine, and pancreatic amylase were performed. A contrast-medium study and endoscopy were performed at one month after stent placement to detect the presence of delayed complications, such as stent migration and obstruction. Further follow-up contrast-medium studies and endoscopy were performed only for those patients with recurrent symptoms.

Variables

The variables analyzed were age at the time of operation, sex, type of malignancy (gastric, duodenal, and gallbladder cancer and metastasis), length of obstruction, location of obstruction (descending duodenum [Fig. 2a] or non-descending duodenum), degree of obstruction (moderate or severe), number of stents, radiotherapy (administered or not before stent placement), chemotherapy (administered or not before stent placement), and stent bridging the duodenal papilla (yes or no; Fig. 2b). We excluded pancreatic cancer from this study because pancreatic cancer itself can cause acute pancreatitis, and it can therefore be difficult to distinguish acute pancreatitis resulting from pancreatic cancer from that secondary to the presence of a duodenal stent.

Definition and analysis of data

Acute pancreatitis was defined as acute abdominal pain, vomiting with hemodiastase, and/or increase in urinary amylase and pancreatic enlargement between 1 and 7 days after stent placement. Data are presented as the mean±standard deviation (SD). Univariate analysis was performed to compare variables between the groups with and without acute pancreatitis. The Mann-Whitney U test was used to compare continuous variables, and Fisher's exact test was used for categorical variables.

A multivariate logistic regression model with forward stepwise selection was planned for finding independent predictive factors associated with acute pancreatitis. Only variables with $P < 0.2$ on univariate analysis (Mann-Whitney U test or Fisher's exact test) were entered into the multivariate logistic regression model. Statistical analyses were performed with a commercially available software (Statistical Package for Social Sciences, version

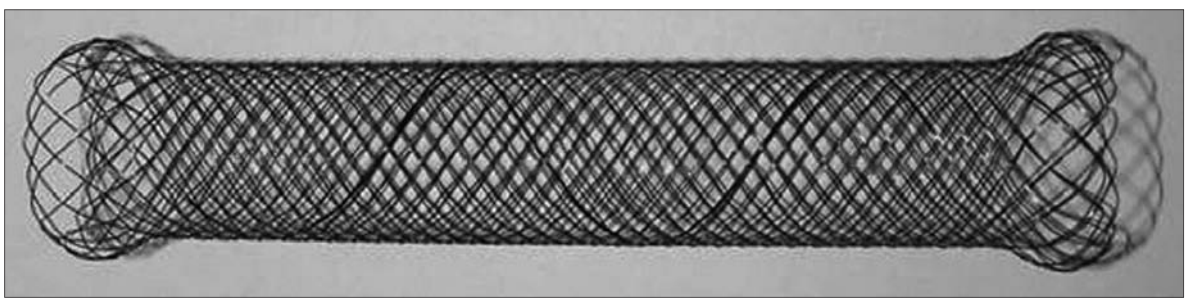

Figure 1. Photograph of the duodenal stent.

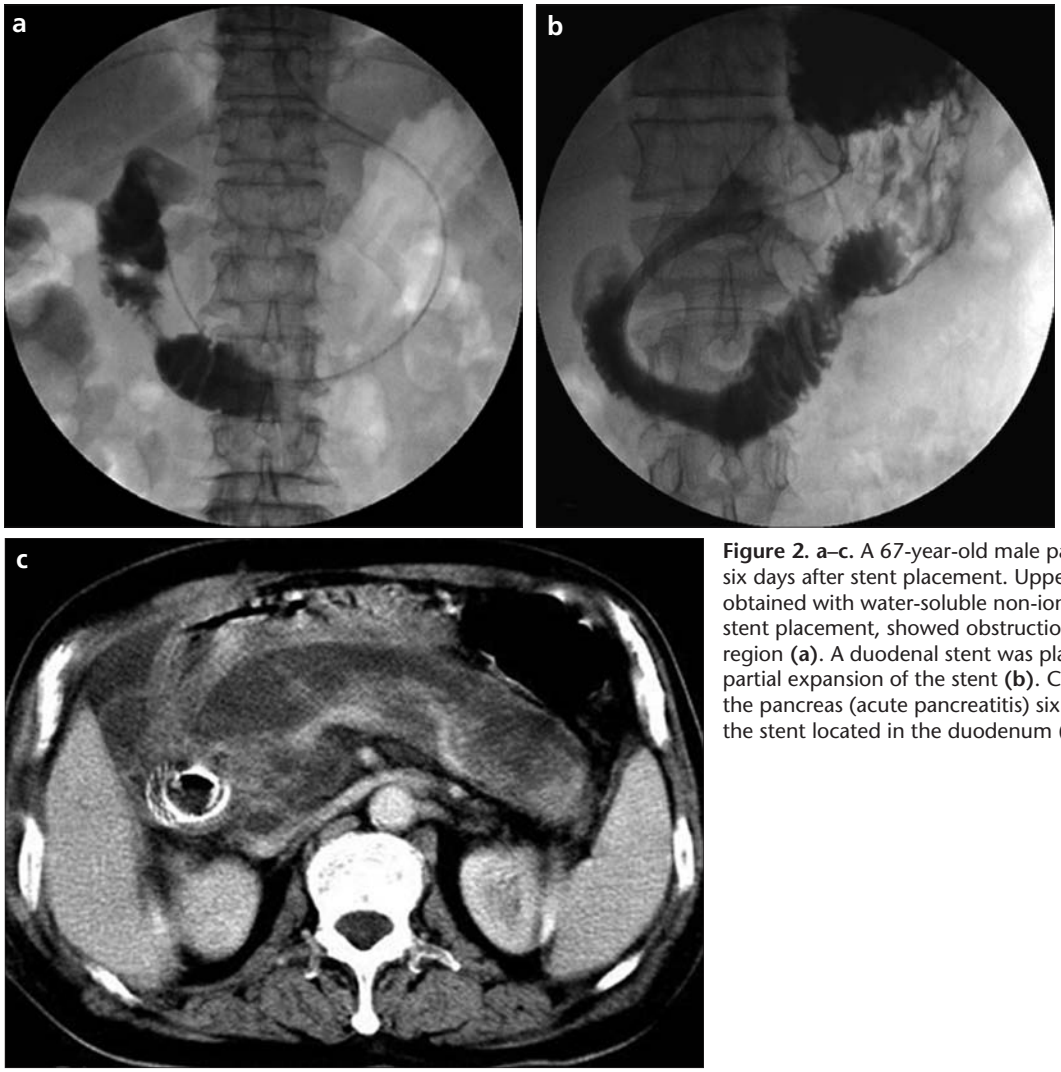

Figure 2. a–c. A 67-year-old male patient with acute pancreatitis at six days after stent placement. Upper gastrointestinal radiography, obtained with water-soluble non-ionic contrast medium before stent placement, showed obstruction at the level of the duodenal region **(a)**. A duodenal stent was placed at the stricture area with partial expansion of the stent **(b)**. CT demonstrated enlargement of the pancreas (acute pancreatitis) six days after the procedure, with the stent located in the duodenum **(c)**.

13.0, SPSS Inc., Chicago, Illinois, USA). A P value ≤ 0.05 was considered statistically significant.

Results

Characteristics and management of acute pancreatitis

All patients with acute pancreatitis initially presented with abdominal pain and distention with vomiting after stent placement. Seven patients developed acute jaundice one week after the procedure due to misdiagnosis of the presenting abdominal pain. Additionally, CT imaging demonstrated pancreatic enlargement or edema in all patients (Fig. 2c).

Acute pancreatitis was observed between one and three days after the procedure in three cases, and this resolved with fasting, intravenous nutrition, and appropriate antibiotics for seven days. The remaining seven cases of acute pancreatitis were not diagnosed until the occurrence of acute jaundice. Six patients were managed with percutaneous transhepatic cholangiography and drain (PTCD) placement, and one patient was treated conservatively. There was no mortality in the study.

Predictive factors of acute pancreatitis

Ten variables were compared between the two groups (acute pancreatitis and no acute pancreatitis) in univariate analysis. The results are presented in Table 2. Univariate analysis revealed that acute pancreatitis was associated with stent location in the descending duodenum (P = 0.001) and with a stent bridging the duodenal papilla (P < 0.001) (Table 2). Other variables showed no significant difference between the two groups with acute pancreatitis.

Two variables with P < 0.2 at univariate analysis were entered into the multiple logistic regression model: location of obstruction and stent bridging the duodenal papilla. Multivariate analysis confirmed that a stent bridging the duodenal papilla (odds ratio [OR], 18.48; 95% confidence interval [CI], 2.298–148.48; P = 0.006) was an independent predictor of acute pancreatitis (Table 3).

Discussion

The results demonstrate that acute pancreatitis is very rare following stent placement, which occurred with a frequency of 4.1% (10/242) and tended to occur early. In our multiple logistic regression analysis, a stent bridging the duodenal papilla (OR, 18.48; P = 0.006) was a significant predictor of the development of acute pancreatitis. On the other hand, age, sex, type of malignancy, length, location, and degree of obstruction, number of stents, radiation, and chemotherapy all showed no association.

Table 2. Univariate analysis of risk factors of acute pancreatitis

Characteristics	Acute pancreatitis not present	Acute pancreatitis present	*P*
Age (years, mean±SD)	63.44±10.83	64.50±10.93	0.719
Female/male (n)	80/152	3/7	0.770
Location of obstruction (n [%])			
Non-descending duodenum	147 (63.4)	1 (10)	0.001
Descending duodenum	85 (32.6)	9 (90)	
Type of malignancy (n [%])			
Gastric cancer	122 (52.6)	5 (50)	0.732
Duodenal cancer	52 (22.4)	2 (20)	
Gallbladder cancer	28 (12.1)	1 (10)	
Metastasis	30 (12.9)	2 (20)	
Length of obstruction (mean±SD)	6.26±2.03	6.22±1.56	0.771
Degree of obstruction (n [%])			
Moderate	176 (75.9)	6 (60)	0.256
Severe	56 (24.1)	4 (40)	
Number of stents (mean±SD)	1.06±0.24	1.10±0.32	0.611
Prior chemotherapy (n [%])			
No	78 (33.6)	3 (30)	0.813
Yes	154 (66.4)	7 (70)	
Prior radiotherapy (n [%])			
No	197 (84.9)	7 (70)	0.205
Yes	35 (15.1)	3 (30)	
Stent bridging the duodenal papilla (n [%])			
No	156 (67.2)	1 (10)	< 0.001
Yes	76 (32.8)	9 (90)	

SD, standard deviation.

Table 3. Results of multivariate logistic regression analysis for evaluation of factors predictive of acute pancreatitis

Variable	n (%)	Odds ratio	95% CI	*P*
Stent bridging the duodenal papilla				
No	157 (64.9)	1.000	2.298–148.48	0.006
Yes	85 (35.1)	18.48		

CI, confidence interval.

Two main factors were associated with the occurrence of acute pancreatitis after duodenal stent placement. One was related to closure of the orifice of the duodenal papilla, which may have directly caused an increase in pressure in the pancreatic duct. The duodenal papilla was compressed or irritated by the stent, which led to acute edema or shrinkage of the orifice of the duodenal papilla and subsequently to an increase in pressure in the duct. Another reason was that the blood supply to the pancreas decreased as a result of compression of the peripheral vessels when the stent was placed in the descending duodenum, leading to acute pancreatitis. Additionally, covered duodenal stents may be another important risk factor for acute pancreatitis because they can occlude the orifice of the duodenal papilla, which may directly cause a pressure increase in the pancreatic duct (2). In this study, bare duodenal stents were used in all patients, and thus this factor was excluded.

Although acute pancreatitis is not an unexpected complication of this procedure (2, 6, 18, 21), to the best of our knowledge, there have been no previous reports of acute pancreatitis, which develops following placement of stents in the descending duodenum. There are several explanations for this lack of reports. First, it is easy to misdiagnose abdominal pain and vomiting due to the lack of specific symptoms, which generally leads to conservative treatment. When abdominal pain and vomiting occur, it is often ascribed to reobstruction or pain resulting from stent compression rather than to acute pancreatitis. Second, when the covered stent is applied to the duodenal area, PTCD is usually performed before stent placement, thus preventing the occurrence of acute pancreatitis (4, 22).

This study had a number of limitations. First, it was a retrospective analysis. Second, the sample size of the study population with acute pancreatitis may have been too small to detect real differences between the two groups (type II error). Furthermore, we excluded pancreatic cancer from this study to rule out the possibility that acute pancreatitis might have resulted from the cancer itself. As a result, our results may not be generally applicable.

As a conclusion, acute pancreatitis was an uncommon early complication of duodenal stent placement in patients with malignant gastroduodenal obstruction. Acute pancreatitis was associated with stent location in the descending duodenum and occurred in patients with a stent bridging the duodenal papilla, with the latter identified as an independent predictor of acute pancreatitis. Acute pancreatitis can be managed conservatively or by PTCD when acute jaundice develops. For patients who present with severe

or worsening abdominal pain and fever or vomiting following stent placement for gastric outlet or duodenal stenosis, acute pancreatitis should be considered.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. 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.
2. Seo EH, Jung MK, Park MJ, et al. Covered expandable nitinol stents for malignant gastroduodenal obstructions. J Gastroenterol Hepatol 2008; 23:1056–1062.
3. Traversa G, Zippi M, Colaiacomo MC, Gualdi GF, Occhigrossi G. Use of expandable metal stents for gastroduodenal outlet obstruction. Clin Ter 2007; 158:249–251.
4. Jung GS, Song HY, Kang SG, et al. Malignant gastroduodenal obstructions: treatment by means of a covered expandable metallic stent-initial experience. Radiology 2000; 216:758–763.
5. Park KB, Do YS, Kang WK, et al. Malignant obstruction of gastric outlet and duodenum: palliation with flexible covered metallic stents. Radiology 2001; 219:679–683.
6. Lopera JE, Brazzini A, Gonzales A, Castaneda-Zuniga WR. Gastroduodenal stent placement: current status. Radiographics 2004; 24:1561–1573.
7. Chopita N, Landoni N, Ross A, Villaverde A. Malignant gastroenteric obstruction: therapeutic options. Gastrointest Endosc Clin N Am 2007; 17:533–544.
8. Graber I, Dumas R, Filoche B, et al. The efficacy and safety of duodenal stenting: a prospective multicenter study. Endoscopy 2007; 39:784–787.
9. Kaw M, Singh S, Gagneja H, Azad P. Role of self-expandable metal stents in the palliation of malignant duodenal obstruction. Surg Endosc 2003; 17:646–650.
10. de Baere T, Harry G, Ducreux M, et al. Self-expanding metallic stents as palliative treatment of malignant gastroduodenal stenosis. Am J Roentgenol 1997; 169:1079–1083.
11. Binkert CA, Jost R, Steiner A, Zollikofer CL. Benign and malignant stenoses of the stomach and duodenum: treatment with self-expanding metallic endoprostheses. Radiology 1996; 199:335–338.
12. Bessoud B, de Baere T, Denys A, et al. Malignant gastroduodenal obstruction: palliation with self-expanding metallic stents. J Vasc Interv Radiol 2005; 16:247–253.
13. Truong S, Bohndorf V, Geller H, Schumpèlick V, Günther RW. Self-expanding metal stents for palliation of malignant gastric outlet obstruction. Endoscopy 1992; 24:433–435.
14. Del Piano M, Ballarè M, Montino F, et al. Endoscopy or surgery for malignant GI outlet obstruction? Gastrointest Endosc 2005; 61:421–426.
15. Kim JH, Song HY, Shin JH, et al. Stent collapse as a delayed complication of placement of a covered gastroduodenal stent. Am J Roentgenol 2007; 188:1495–1499.
16. Thumbe VK, Houghton AD, Smith MS. Duodenal perforation by a wallstent. Endoscopy 2000; 2:495–497
17. Kim JH, Song HY, Shin JH, et al. Metallic stent placement in the palliative treatment of malignant gastroduodenal obstructions: prospective evaluation of results and factors influencing outcome in 213 patients. Gastrointest Endosc 2007; 66:256–264.
18. Greer SE, Burchard KW. Acute pancreatitis and critical illness: a pancreatic tale of hypoperfusion and inflammation. Chest 2009; 136:1413–1419.
19. Telford JJ, Carr-Locke DL, Baron TH, et al. Palliation of patients with malignant gastric outlet obstruction with the enteral Wallstent: outcomes from a multicenter study. Gastrointest Endosc 2004; 60:916–920.
20. Laasch HU, Martin DF, Maetani I. Enteral stents in the gastric outlet and duodenum. Endoscopy 2005; 37:74–81.
21. Huang Q, Dai DK, Qian XJ, Zhai RY. Treatment of gastric outlet and duodenal obstructions with uncovered expandable metal stents. World J Gastroenterol 2007; 13:5376–5379.
22. Iwamuro M, Kawamoto H, Harada R, et al. Combined duodenal stent placement and endoscopic ultrasonography-guided biliary drainage for malignant duodenal obstruction with biliary stricture. Dig Endosc 2010; 22:236–240.