Gastrointestinal Intervention

journal homepage: www.gi-intervention.org

Review Article

Management of gastroduodenal stent-related complications

Stephen Y. Oh, Richard A. Kozarek*

ABSTRACT

Endoscopic placement of a gastroduodenal self-expandable metallic stent (SEMS) is a safe and minimally invasive intervention for patients with malignant gastric outlet obstruction (GOO). One major shortcoming of SEMS, however, is a frequent need for re-interventions due to stent-related complications, such as occlusion and migration. With continuing advances in oncologic therapy and improved survival in patients with malignancy, these complications may be encountered more frequently. Mild complications include abdominal discomfort, low grade fever, and occasional vomiting without obstruction. Major complications occurring within the first week include bleeding, perforation, stent migration, severe pain, fever, and jaundice. Significant late complications include fistula formation, stent obstruction, late perforation or bleeding, biliary obstruction, and stent migration. Correctly identifying and managing SEMS-related complications in a timely manner is essential in maintaining effective palliation in patients with malignant GOO. In this review article, we discuss the management of complications arising from the placement of gastroduodenal SEMS in patients with malignant GOO.

Copyright © 2015, Society of Gastrointestinal Intervention. All rights reserved.

Keywords: Biliary obstruction; Complications; Gastric outlet obstruction; Gastroduodenal self-expandable metallic stent

Introduction

Endoscopic placement of a gastroduodenal self-expandable metallic stent (SEMS) is a safe and minimally invasive intervention for patients with malignant gastric outlet obstruction (GOO).¹ Several prospective studies have demonstrated the efficacy and safety of gastroduodenal SEMS in the palliation of malignant GOO with technical success rates of 89% to 100% and clinical success rates ranging from 72% to 88%.^{2–8} Because patients with malignant GOO are generally older and have short anticipated life expectancy, an endoscopic stent placement may be preferable to a surgical gastrojejunostomy as it leads to faster resumption of food intake and shorter hospitalization compared with an open surgical intervention.^{9,10} One major shortcoming of SEMS, however, is a frequent need for re-interventions due to stent-related complications, such as occlusion and migration. With continuing advances in oncologic therapy and improved survival in patients with malignancy, these complications may be encountered more frequently.

Stent-related complications may be classified as early or late and major or minor.¹¹ Early major complications occurring within the first week include stent migration, perforation, bleeding, se-

vere pain and biliary obstruction. Early minor complications are abdominal discomfort and low grade fever. Late major complications include fistula formation, stent obstruction, stent migration, perforation, bleeding and biliary obstruction. Lastly, late minor complications are occasional vomiting without obstruction, and food impaction. A systematic review of 606 patients with malignant GOO treated with stent placement reported an overall complication rate of 27%, with stent occlusion and migration accounting for the vast majority.¹² Correctly identifying and managing SEMS-related complications in a timely manner is essential in maintaining effective palliation in patients with malignant GOO.

In this review article, we discuss the management of complications arising from the placement of gastroduodenal SEMS in patients with malignant GOO.

Stent Occlusion

Tumor ingrowth refers to growth of the tumor through the interstices of a stent, and overgrowth refers to growth beyond the length a previously placed stent (Fig. 1). Stent occlusion due to tumor ingrowth or overgrowth occurs in 9% to 26% of patients with malignancy undergoing SEMS placement for GOO

Digestive Disease Institute, Virginia Mason Medical Center, Seattle, WA, USA

Received June 23, 2015; Revised August 7, 2015; Accepted August 18, 2015

* Corresponding author. Digestive Disease Institute, Virginia Mason Medical Center, 1100 Ninth Avenue, Seattle, WA 98101, USA.

E-mail address: Richard.Kozarek@virginiamason.org (R.A. Kozarek).

pISSN 2213-1795 eISSN 2213-1809 <http://dx.doi.org/10.18528/gii150008>

© This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

(Table 1).^{2–8,12} A recent large retrospective series showed that the time to stent occlusion was shorter in patients with pancreatic cancer compared with those with other types of malignancies (1.6 vs 4.3 months, $P = 0.06$).¹³ Although not statistically significant, the difference could be due to the aggressive tumor biology associated with pancreatic cancer.

In patients with stent occlusion, a stent-in-stent placement of a secondary gastroduodenal SEMS can be performed to re-establish stent patency. Four retrospective studies (3 Korean and 1 Japanese) have evaluated the outcome of a secondary SEMS place-

ment predominantly in patients with gastric cancer (Table 2).^{14–17} These studies reported excellent technical and clinical success rates with a median patency of a secondary stent ranging from 3 to 6.3 months and stent occlusion rate of 10% to 34%. One of the studies found that complications occurred more frequently when the distal end of an additional stent was placed distal to a primary stent,¹⁶ which may be due to an impaired flexibility and conformity to the curved anatomy of the duodenum at the overlapping portion of stents.^{17,18} Although serious complications were uncommon, one study reported an alarmingly high perforation rate of

Fig. 1. (A) Tumor ingrowth (arrows) causing stent occlusion. (B) A stent-in-stent secondary self-expandable metallic stent placement.

Table 1 Complication Rates of Gastroduodenal SEMS in Prospective Trials

Study	No. of patients	Type of SEMS	Occlusion	Migration	Bleeding	Perforation	Biliary obstruction	Pain	Other
Tringali et al ² (2014)	108	Evolution	17 (16)	2 (2)	5 (6)	2 (2)	Exact number NR*	2 (2)	17 (16)*
van den Berg et al ³ (2013)	46	Evolution	12 (26)	2 (4)	NR	1 (2)	1 (2)	1 (2)	1 (2) [†]
Costamagna et al ⁴ (2012)	202	WallFlex	25 (12)	3 (1.5)	6 (3)	1 (0.5)	NR	6 (3)	1 (0.5) [†]
Kim et al ⁵ (2011)	50	Comvi	9 (18)	5 (10)	Nil	Nil	Nil	NR	NR
van Hooft et al ⁶ (2011)	52	Niti-S	11 (21)	2 (4)	NR	Nil	1 (2)	4 (8)	NR
van Hooft et al ⁷ (2009)	51	WallFlex	6 (12)	1 (2)	2 (4)	Nil	3 (6)	2 (4)	NR
Piesman et al ⁸ (2009)	43	WallFlex	4 (9)	NR	1 (2)	2 (5)	1 (2)	1 (2)	6 (14) [§]

Values are presented as number only or number (%).

Complications related to the stent and/or procedure in the setting of malignant gastric outlet obstruction.

Manufacturers' information: Evolution (Cook Endoscopy, Winston-Salem, NC, USA); WallFlex (Boston Scientific, Natick, MA, USA); Comvi (Taewoong Medical, Gimpo, Korea); Niti-S (Taewoong Medical).

SEMS, self-expandable metallic stent; NR, not reported.

*Nausea, vomiting, pancreatitis, cholangitis, jaundice, biliary obstruction, chemotherapy-related gastritis, ileus, infected biloma, infected tumor mass causing portal vein thrombosis and liver abscess.

[†]1 pancreatitis.

[‡]1 vomiting.

[§]5 nausea or vomiting, 1 sepsis.

Table 2 Retrospective Series of Patients Treated with a Secondary Stent-in-Stent SEMS Placement for Malignant GOO

Study	No. of patients	Type of cancer (%)	Type of secondary SEMS used (%)	Technical success (%)	Clinical success (%)	Re-occlusion of secondary SEMS (%)	Secondary SEMS patency (mo)
Sasaki et al ¹⁴ (2015)	29	Pancreatic (55), gastric (24)	WallFlex (61)	100	86	10	3
Kim et al ¹⁵ (2014)	48	Gastric only	Niti-S (72)	98	90	21	6.3
Kang et al ¹⁶ (2013)	68	Gastric (71), PB (26)	Nitinol Stent (100)	97	85	10	NR
Park et al ¹⁷ (2012)	64	Gastric (91), PB (9)	Niti-S (55)	100	88	34	5.4

Manufacturers' information: WallFlex (Boston Scientific, Natick, MA, USA); Niti-S (Taewoong Medical, Gimpo, Korea); Nitinol Stent (S&G Biotech, Seongnam, Korea). SEMS, self-expandable metallic stent; GOO, gastric outlet obstruction; PB, pancreatobiliary; NR, not reported.

14%, which was attributed to the strong axial force of a SEMS.¹⁴ In addition, one of the technical challenges associated with a secondary SEMS placement is the difficulty inserting a guidewire through the lumen of a primary stent under fluoroscopic guidance.¹⁶ If successfully performed, however, a stent-in-stent secondary SEMS placement can provide adequate symptomatic relief in patients with stent occlusion. More simple techniques to manage stent occlusion include the endoscopic or fluoroscopically

Fig. 2. Balloon dilation of a partially occluded stent.

guided removal of food impaction using foreign body removal devices¹⁹ and balloon dilation of an occluded or angulated stent (Fig. 2).

Alternatively, gastrojejunal bypass surgery can be performed to accomplish the anastomosis between the stomach and jejunum. Recently, endoscopic ultrasound (EUS)-guided gastrojejunostomy has been proposed as a minimally invasive means of establishing an anastomosis in patients who are not ideal candidates for surgery. In this technique, a gastrojejunal fistula is created by obtaining an access to the jejunum via an EUS-guided needle, placing a guidewire through the needle and dilating the tract over the wire using a dilator catheter, balloon and/or electrical cautery needle. Subsequently, a lumen-apposing stent is placed across the fistula (Fig. 3). This technique has recently been described in 2 case reports.^{20,21}

Nevertheless, it should be noted that these patients who were fortunate enough to outlive primary stents have extremely short life expectancy, and serious complications including perforation can occur with these interventions. The benefits and risks of a secondary intervention should therefore be weighed carefully for each individual patient.

Stent Migration

Stent migration occurs in 2% to 10% of patients who undergo gastroduodenal SEMS placement for malignant GOO (Table 1, Fig. 4).^{2-8,12} There have been attempts to improve the design of SEMS and develop devices to prevent stent migration. Although an uncovered SEMS is prone to an occlusion due to tumor or tissue ingrowth through the mesh-like framework, the mesh allows tissue embedding to minimize the risk of migration, and the access

Fig. 3. A 66-year-old female with metastatic cholangiocarcinoma and gastric outlet obstruction undergoing endoscopic ultrasound (EUS)-guided gastrojejunostomy. (A) Tumor ingrowth into two previously placed duodenal stents. (B) EUS visualization of a 20 mm balloon inflated in the proximal jejunum (large arrow) followed by a 19-gauge needle puncture (small arrow). (C, D) Balloon dilation (arrow) of the gastrojejunal fistula over a 0.035 inch guidewire. Endoscopic (E) and fluoroscopic (F) demonstration of contrast flow across 10 × 15 mm lumen-apposing stent (arrow) into the jejunum (images courtesy of Shayan Irani, MD, Virginia Mason Medical Center).

Fig. 4. (A, B) Migration of a gastroduodenal self-expandable metallic stent to the distal small bowel (arrows).

to the papilla when a biliary drainage is indicated. Several studies have shown that stent migration occurs less frequently with uncovered compared with covered SEMS^{22–24} and one study has demonstrated that an uncovered SEMS was associated with lower re-intervention rates for stent-related complications compared with a covered SEMS (although the rate of migration was similar between the two groups).²⁵ Therefore, an uncovered SEMS is generally considered a better choice for GOO than a covered SEMS. Recently, a new partially covered “big cup” SEMS has been developed in the hope of reducing both stent migration and tissue ingrowth but a trial was terminated prematurely due to three proximal stent migrations in the first six patients necessitating endoscopic removal and placement of another SEMS.²⁶ Lastly, the use of an endoscopic clip to fix the proximal end of a SEMS to the upper gastrointestinal mucosa to prevent migration has been reported in small series^{27–29} but has not been validated in large prospective trials.

Migration of a gastroduodenal SEMS can be managed in several ways—observation until spontaneous passage of a stent in the stool, endoscopic or surgical removal of a stent, and a secondary SEMS placement. However, as the downward migration of gastroduodenal SEMS carries the risk of intestinal obstruction and perforation, the watch and wait strategy should be discussed with a surgical team for potential emergency laparotomy. In a series reporting the outcomes of migrated SEMS, 2 out of 6 patients with migrated gastroduodenal SEMS required a surgical removal, whereas only 1 out of 64 migrated esophageal SEMS required surgery.³⁰

Yoon et al³¹ described three different techniques (standard, proximal mesh and eversion) for stent removal using a retrieval device consisting of a hookwire, a dilator, a sheath and a guidewire. In the standard technique, the hookwire is manipulated to grasp the drawstring at the proximal end of the stent to collapse the proximal stent into the sheath. The sheath, hookwire, and stent are then removed all together. If the hookwire fails to grasp the drawstring, the proximal third of the stent is grasped and removed in its expanded state. The eversion technique is where the distal part of the stent is grasped and the stent invaginated into itself during removal. The study reported the successful removal of 4 out of 6 gastroduodenal SEMSs (4 malignant and 2 benign strictures). However, the removal of a gastroduodenal stent can be more technically challenging compared with an esophageal stent. In the two patients with unsuccessful stent removal, stents had migrated into the gastric fundus where the proximal end of

the stent faced an unfavorable direction and a guidewire insertion was not possible despite air inflation and change in the position of the patients.

Lastly, the placement of a secondary stent could be considered, either overlapping a migrated stent or following its removal. A potential issue with this approach is the risk of the migration of a secondary stent. A recent small series have demonstrated that the long-term patency of a secondary stent was achieved in the majority of patients with a covered primary stent (86%, 6/7) but the migration of a secondary stent was observed in half of the patients with an uncovered primary stent (50%, 2/4).¹⁵

In summary, the evidence for endoscopic management of migrated gastroduodenal SEMS is predominantly based on small series and further prospective studies are needed to validate the effectiveness of these techniques. The management plan should be discussed with a surgical team if there is a potential risk of small bowel perforation or obstruction secondary to the downward migration of a stent.

Biliary Obstruction

One unique complication of gastroduodenal SEMS is the precipitation of cholangitis or biliary obstruction caused by compression of the papilla (Fig. 5).^{12,32,33} Prospective studies have shown that biliary obstruction occurs in 2% to 6% of patients following a gastroduodenal SEMS placement for malignant GOO (Table 1). Concomitant biliary obstruction with malignant GOO is also very common, and occurs in 59% of patients with pancreatic cancer.³⁴ Because the papilla cannot typically be accessed after the placement of a gastroduodenal SEMS, a biliary SEMS should be placed before a gastroduodenal stent when biliary obstruction is present or impending.³⁵ When a biliary drainage is indicated after a gastroduodenal stent has been placed, biliary stenting through the mesh of the duodenal SEMS, percutaneous transhepatic biliary drainage or EUS-guided approach are all potential solutions.

Perforation

As with SEMS in other areas of the gastrointestinal tract, perforation is the most serious complication of a gastroduodenal SEMS placement, occurring in 0.5% to 5% of patients (Table 1).^{2–8,12} Several strategies to minimize the risk of perforation have been suggested, including the use of lower axial-force SEMS, partially covered SEMS to prevent tumor ingrowth or overgrowth, and sys-

Fig. 5. (A, B) Placement of a biliary stent in a patient with gastroduodenal self-expandable metallic stent *in situ*.

Fig. 6. (A) Tumor ingrowth into a previously placed gastroduodenal self-expandable metallic stent without apparent perforation on endoscopic imaging. (B) Leakage of the contrast into the peritoneal cavity on fluoroscopic imaging outlining the distal duodenum and proximal jejunum (arrows). (C) Placement of a covered secondary stent overlapping the distal end of the primary stent, with a good flow of contrast to the distal small bowel.

temic chemotherapy to prevent local tumor progression.^{36,37} Stent strut perforation of the bowel wall is an extremely rare complication with few reported cases.^{38–40} Perforation is usually managed with surgical repair, or endoscopic placement of a covered stent (Fig. 6).

Bleeding

Bleeding occurs in up to 6% of patients with a gastroduodenal GOO.^{2–8,12} The majority of cases are mild and can be managed effectively with simple endoscopic interventions such as cautery and clip placement. Catastrophic, fatal bleeding is rare but has been described in a case report.⁴¹ Potential therapeutic options for severe bleeding include radiotherapy for a diffuse oozing and vascular embolization for a documented arterial bleed.

Severe Pain

Pain occurs in 2% to 8% of patients with a gastroduodenal SEMS^{2–8,12} and can be treated with oral analgesia. Stent removal is rarely required as the pain is usually transient. In patients with pancreatic cancer, pain is often due to the underlying disease

itself and can persist and celiac plexus intervention has been shown to provide effective pain relief.^{42–46}

Fistula Formation

Fistula formation due to a gastroduodenal SEMS is rare. In a series of 46 patients with malignant GOO treated with a gastroduodenal SEMS, one patient developed an aortoenteric fistula from stent erosion in the setting of a previous pancreaticoduodenectomy. The patient was treated with an endovascular aortic stent followed by definitive repair.⁴⁶

Summary and Conclusion

Gastroduodenal SEMS in the setting of malignant GOO are frequently complicated by stent occlusion and migration which can be effectively managed either endoscopically or surgically.

Biliary obstruction also occurs commonly and may require percutaneous or endoscopic (usually endoscopic retrograde cholangiopancreatography [ERCP], or EUS if ERCP is unsuccessful) decompression. Less frequent complications include perforation, bleeding, pain and fistula formation. The evidence for interven-

tions such as a secondary stent placement and stent removal are predominantly based on small series and further prospective studies are necessary to demonstrate the efficacy of these techniques. In addition, given the very limited life expectancy of these patients with an advanced malignancy, the benefits and risks of a secondary intervention should be weighed carefully for each individual patient.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

Fig. 3E and 3F images are courtesy of Shayan Irani, MD, Virginia Mason Medical Center.

References

- Gaidos JK, Draganov PV. Treatment of malignant gastric outlet obstruction with endoscopically placed self-expandable metal stents. *World J Gastroenterol*. 2009;15:4365–71.
- Tringali A, Didden P, Repici A, Spaander M, Bourke MJ, Williams SJ, et al. Endoscopic treatment of malignant gastric and duodenal strictures: a prospective, multicenter study. *Gastrointest Endosc*. 2014;79:66–75.
- van den Berg MW, Haijink S, Fockens P, Vleggaar FP, Dijkgraaf MG, Siersema PD, et al. First data on the Evolution duodenal stent for palliation of malignant gastric outlet obstruction (DUOLUTION study): a prospective multicenter study. *Endoscopy*. 2013;45:174–81.
- Costamagna G, Tringali A, Spicak J, Mutignani M, Shaw J, Roy A, et al. Treatment of malignant gastroduodenal obstruction with a nitinol self-expanding metal stent: an international prospective multicentre registry. *Dig Liver Dis*. 2012;44:37–43.
- Kim YW, Choi CW, Kang DH, Kim HW, Chung CU, Kim DU, et al. A double-layered (comvi) self-expandable metal stent for malignant gastroduodenal obstruction: a prospective multicenter study. *Dig Dis Sci*. 2011;56:2030–6.
- van Hooft JE, van Montfort ML, Jeumink SM, Bruno MJ, Dijkgraaf MG, Siersema PD, et al. Safety and efficacy of a new non-foreshortening nitinol stent in malignant gastric outlet obstruction (DUONITI study): a prospective, multicenter study. *Endoscopy*. 2011;43:671–5.
- van Hooft JE, Uitdehaag MJ, Bruno MJ, Timmer R, Siersema PD, Dijkgraaf MG, 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;69:1059–66.
- Piesman M, Kozarek RA, Brandabur JJ, Pleskow DK, Chuttani R, Eysselein VE, et al. Improved oral intake after palliative duodenal stenting for malignant obstruction: a prospective multicenter clinical trial. *Am J Gastroenterol*. 2009;104:2404–11.
- Ly J, O'Grady G, Mittal A, Plank L, Windsor JA. A systematic review of methods to palliate malignant gastric outlet obstruction. *Surg Endosc*. 2010;24:290–7.
- Jeumink SM, Steyerberg EW, van Hooft JE, van Eijck CH, Schwartz MP, Vleggaar FP, et al; Dutch SUSTENT Study Group. Surgical gastrojejunostomy or endoscopic stent placement for the palliation of malignant gastric outlet obstruction (SUSTENT study): a multicenter randomized trial. *Gastrointest Endosc*. 2010;71:490–9.
- Kochar R, Shah N. Enteral stents: from esophagus to colon. *Gastrointest Endosc*. 2013;78:913–8.
- Dormann A, Meisner S, Verin N, Wenk Lang A. Self-expanding metal stents for gastroduodenal malignancies: systematic review of their clinical effectiveness. *Endoscopy*. 2004;36:543–50.
- Oh SY, Edwards A, Mandelson M, Ross A, Irani S, Larsen M, et al. Survival and clinical outcome after endoscopic duodenal stent placement for malignant gastric outlet obstruction: comparison of pancreatic cancer and nonpancreatic cancer. *Gastrointest Endosc*. 2015;82:460–8.e2.
- Sasaki T, Isayama H, Nakai Y, Takahara N, Hamada T, Mizuno S, et al. Clinical outcomes of secondary gastroduodenal self-expandable metallic stent placement by stent-in-stent technique for malignant gastric outlet obstruction. *Dig Endosc*. 2015;27:37–43.
- Kim CG, Choi IJ, Lee JY, Cho SJ, Kim SJ, Kim MJ, et al. Outcomes of second self-expandable metallic stent insertion for malignant gastric outlet obstruction. *Surg Endosc*. 2014;28:281–8.
- Kang MK, Song HY, Kim JW, Kim JH, Park JH, Na HK, et al. Additional gastroduodenal stent placement: retrospective evaluation of 68 consecutive patients with malignant gastroduodenal obstruction. *Acta Radiol*. 2013;54:944–8.
- Park JC, Park JJ, Cheoi K, Chung H, Lee H, Shin SK, et al. Clinical outcomes of secondary stent-in-stent self-expanding metal stent placement for primary stent malfunction in malignant gastric outlet obstruction. *Dig Liver Dis*. 2012;44:999–1005.
- Ebrahimi N, Claus B, Lee CY, Biondi A, Benndorf G. Stent conformity in curved vascular models with simulated aneurysm necks using flat-panel CT: an in vitro study. *AJNR Am J Neuroradiol*. 2007;28:823–9.
- Song M, Song HY, Kim JH, Park JH, Jung HY, Kim JH, et al. Food impaction after expandable metal stent placement: experience in 1,360 patients with esophageal and upper gastrointestinal tract obstruction. *J Vasc Interv Radiol*. 2011;22:1293–9.
- Tyberg A, Kumta N, Karia K, Zerbo S, Sharaiha RZ, Kahaleh M. EUS-guided gastrojejunostomy after failed enteral stenting. *Gastrointest Endosc*. 2015;81:1011–2.
- Ikeuchi N, Itoi T, Tsuchiya T, Nagakawa Y, Tsuchida A. One-step EUS-guided gastrojejunostomy with use of lumen-apposing metal stent for afferent loop syndrome treatment. *Gastrointest Endosc*. 2015;82:166.
- Kim JW, Jeong JB, Lee KL, Kim BG, Ahn DW, Lee JK, et al. Comparison between uncovered and covered self-expandable metal stent placement in malignant duodenal obstruction. *World J Gastroenterol*. 2015;21:1580–7.
- Kim CG, Choi IJ, Lee JY, Cho SJ, Park SR, Lee JH, et al. Covered versus uncovered self-expandable metallic stents for palliation of malignant pyloric obstruction in gastric cancer patients: a randomized, prospective study. *Gastrointest Endosc*. 2010;72:25–32.
- Lee KM, Choi SJ, Shin SJ, Hwang JC, Lim SG, Jung JY, et al. Palliative treatment of malignant gastroduodenal obstruction with metallic stent: prospective comparison of covered and uncovered stents. *Scand J Gastroenterol*. 2009;44:846–52.
- Maetani I, Ukita T, Tada T, Shigoka H, Omuta S, Endo T. Metallic stents for gastric outlet obstruction: reintervention rate is lower with uncovered versus covered stents, despite similar outcomes. *Gastrointest Endosc*. 2009;69:806–12.
- van den Berg MW, Walter D, Vleggaar FP, Siersema PD, Fockens P, van Hooft JE. High proximal migration rate of a partially covered “big cup” duodenal stent in patients with malignant gastric outlet obstruction. *Endoscopy*. 2014;46:158–61.
- Vanbiervliet G, Filippi J, Karimjee BS, Venissac N, Iannelli A, Rahili A, et al. The role of clips in preventing migration of fully covered metallic esophageal stents: a pilot comparative study. *Surg Endosc*. 2012;26:53–9.
- Kim ID, Kang DH, Choi CW, Kim HW, Jung WJ, Lee DH, et al. Prevention of covered enteral stent migration in patients with malignant gastric outlet obstruction: a pilot study of anchoring with endoscopic clips. *Scand J Gastroenterol*. 2010;45:100–5.
- Park SY, Park CH, Cho SB, Lee JS, Joo SY, Park HC, et al. The usefulness of clip application in preventing migration of self-expandable metal stent in patients with malignant gastrointestinal obstruction. *Korean J Gastroenterol*. 2007;49:4–9.
- Ko HK, Song HY, Shin JH, Lee GH, Jung HY, Park SI. Fate of migrated esophageal and gastroduodenal stents: experience in 70 patients. *J Vasc Interv Radiol*. 2007;18:725–32.
- Yoon CJ, Shin JH, Song HY, Lim JO, Yoon HK, Sung KB. Removal of retrievable esophageal and gastrointestinal stents: experience in 113 patients. *AJR Am J Roentgenol*. 2004;183:1437–44.
- Adler DG, Baron TH. Endoscopic palliation of malignant gastric outlet obstruction using self-expanding metal stents: experience in 36 patients. *Am J Gastroenterol*. 2002;97:72–8.
- Baron TH. Expandable metal stents for the treatment of cancerous obstruction of the gastrointestinal tract. *N Engl J Med*. 2001;344:1681–7.
- Varadarajulu S, Banerjee S, Barth B, Desilets D, Kaul V, Kethu SA, et al; ASGE Technology Committee. Enteral stents. *Gastrointest Endosc*. 2011;74:455–64.
- Park CI, Kim JH, Lee YC, Jahng J, Youn YH, Park H, et al. What is the ideal stent as initial intervention for malignant gastric outlet obstruction? *Dig Liver Dis*. 2013;45:33–7.
- Kim CG, Park SR, Choi IJ, Lee JY, Cho SJ, Park YI, et al. Effect of chemotherapy on the outcome of self-expandable metallic stents in gastric cancer patients with malignant outlet obstruction. *Endoscopy*. 2012;44:807–12.
- Pua U. Strut perforation of the duodenum by a WallFlex duodenal stent: detection using multi-detector CT. *Gastrointest Endosc*. 2010;71:220–1.
- Bessoud B, de Baere A, Kuoch V, Ducreux M, Precetti S, et al. Malignant gastroduodenal obstruction: palliation with self-expanding metallic stents. *J Vasc Interv Radiol*. 2005;16:247–53.
- Thumbe VK, Houghton AD, Smith MS. Duodenal perforation by a Wallstent. *Endoscopy*. 2000;32:495–7.
- Matsumoto K, Hayashi A, Yashima K, Harada K, Takeda Y, Onoyama T, et al. Late complications of self-expandable metallic stent placement for malignant gastric outlet obstruction. *Intern Med*. 2014;53:2773–5.
- Yan BM, Myers RP. Neurolytic celiac plexus block for pain control in unresectable pancreatic cancer. *Am J Gastroenterol*. 2007;102:430–8.
- Puli SR, Reddy JB, Bechtold ML, Antillon MR, Brugge WR. EUS-guided celiac plexus neurolysis for pain due to chronic pancreatitis or pancreatic cancer pain: a meta-analysis and systematic review. *Dig Dis Sci*. 2009;54:2330–7.
- Kaufman M, Singh G, Das S, Concha-Parra R, Erber J, Micames C, et al. Efficacy of endoscopic ultrasound-guided celiac plexus block and celiac plexus neurolysis for managing abdominal pain associated with chronic pancreatitis and pancreatic cancer. *J Clin Gastroenterol*. 2010;44:127–34.
- Arcidiacono PG, Calori G, Carrara S, McNicol ED, Testoni PA. Celiac plexus block for pancreatic cancer pain in adults. *Cochrane Database Syst Rev*. 2011;(3):CD007519.
- Wyse JM, Carone M, Paquin SC, Usatii M, Sahai AV. Randomized, double-blind, controlled trial of early endoscopic ultrasound-guided celiac plexus neurolysis to prevent pain progression in patients with newly diagnosed, painful, inoperable pancreatic cancer. *J Clin Oncol*. 2011;29:3541–6.
- Phillips MS, Gosain S, Bonatti H, Friel CM, Ellen K, Northup PG, et al. Enteral stents for malignancy: a report of 46 consecutive cases over 10 years, with critical review of complications. *J Gastrointest Surg*. 2008;12:2045–50.