Clinical Feasibility and Safety of Endoscopic Self-Expandable Metal Stent Placement for Upper Gastrointestinal Pathologies

Bünyamin Gürbulak1, Esin Kabul Gürbulak2, Hasan Bektaş1, İsmail Ethem Akgün2, Hızır Yakup Akyildiz1, Özgür Segmen1, Fevzi Celayir2, Muharrem Battal2, Kenan Büyükasık1

1Department of General Surgery, Istanbul Training and Research Hospital, Istanbul, Turkey
2Department of General Surgery, Şişli Etfal Training and Research Hospital, Istanbul, Turkey

We aimed to review our experiences to evaluate the practicality, safety, and effectiveness of endoscopic stent placement for the palliation of malignant obstructions of the upper gastrointestinal system (GIS) and the treatment of postoperative complications such as failure of anastomoses and fistulae. Endoscopic stent placement is increasingly used in the upper GIS for the management of both high grade malignancies causing obstruction and benign pathologies such as anastomosis failures, gastrointestinal fistulae, and strictures. Hospital records, clinical data, and endoscopy reports of 61 patients who had undergone endoscopic stenting between the years 2012 and 2015 were analyzed retrospectively. For all patients, self-expandable metal covered stents were used. Data involving technical and clinical success rates, complication, morbidity, and mortality rates of the endoscopic stenting procedure was collected and simple statistical analyses were made. Endoscopic stenting was successful in 60 of 61 patients (98.3%). Overall technical success rate was found to be 98.3%; clinical success rate, 86.6%; complication rate, 4.9%. No stent related mortality was observed in our series. Endoscopic stents can be effectively and safely used in the treatment of various lesions of the upper GIS.

Key words: Endoscopic stent – Gastrointestinal malignancy – Anastomotic leakage
Endoscopic stent placement is increasingly used in the upper gastrointestinal system (GIS) for the management of both high-grade malignancies causing obstruction and benign pathologies such as Anastomosis failures, gastrointestinal fistulae, and strictures.

Upper GIS obstruction as a late complication of advanced esophagus, stomach, or duodenum malignancies is a problematic situation that might result in malnutrition and thus worsen the quality of life. For such patients with limited life expectancy, the purpose of surgery is only to provide passage through the GIS to allow feeding. However, procedures such as feeding gastrostomy / jejunostomy or palliative surgical interventions such as bypass surgery are reported to be associated with high rates of mortality and morbidity. Numerous studies recommend endoscopic stent placement as a viable alternative to surgery in such patients not suitable for definitive surgery. After any upper GIS surgery, detachment at the anastomosis or suture line, or fistulae are life-threatening complications with high rates of mortality and morbidity. Early diagnosis and appropriate treatment are crucial for prevention from fulminant mediastinitis or intraabdominal sepsis. Among classical approaches are primary repair, resection, and drainage combined with esophageal exclusion. Though surgical intervention in the first 24 hours is considered to improve survival, reported mortality rates are still high. Surgical mortality is comparable to conservative treatment, especially in the elderly and debilitated patients. Recently, closure of the segment containing the leaking anastomosis or the fistula tract with an endoscopic stent has been practiced as an effective treatment method.

In this article, we aimed to review our experiences and reported a wide variety of indications for endoscopic upper GIS stent placement, including malignant obstructions of the upper GIS, benign esophageal strictures due to peptic ulcer disease, leaks after sleeve gastrectomies, and anastomotic strictures.

Materials and Method

Hospital records, clinical data, and endoscopy reports of 61 patients who have received endoscopic stents in the General Surgery Clinic, Endoscopy Units of Sisli Etfal Training and Research Hospital and Istanbul Training and Research Hospital, Istanbul between the years 2012 and 2015 were retrospectively analyzed. Demographic data, indications for stent placement, anatomic localization of the current pathology, technical and clinical success of the procedure, complications, follow-up duration, morbidity, and mortality rates were recorded. In this study, pathologies related to tumor were referred to as malignant lesions, whereas benign lesions expressed as pathologies related to postoperative anastomotic line or peptic/inflammatory strictures.

For all patients, self-expandable metal covered stents were used (Hanarostent Duodenum/Pylorus Lasso – NCN, MI Tech Co, Seoul, South Korea). While those used for patients with benign strictures were fully covered, others were partially covered. For patients with malignancy or strictures, the procedure was performed under fluoroscopy to ascertain the length of the stent and to determine the size of the stent to be used. All patients were given oral nutrition 24 hours after stent placement.

Postprocedural pain in patients with esophageal stents was controlled by nonsteroidal anti-inflammatory drugs. The follow-up and treatment of patients stented for detachment of anastomosis and fistulae continued in the hospital setting until the fistulae were closed and the clinical signs were normal. Patients stented for stricture of anastomosis, fistulae, and benign strictures had the stent moved 3 to 4 weeks after the initial procedure to ensure easier removal of the stent.

Technical success stands for the endoscopic stenting procedure to be performed without any complications; clinical success for clinical symptoms to disappear and not recur after stenting with no need for repeat procedures; complication for pathologic events associated with the stent; and mortality for death associated with the stent.

Data involving technical and clinical success rates, complication, morbidity; and mortality rates of the endoscopic stenting procedure was collected and simple statistical analyses were made.

Results

The mean age of the patients was 60.4 (23–97) years. Of the 61 patients, 29 had a tumor at the esophagus, 11 at the esophagogastric junction and 6 had pyloric obstruction due to a tumor at the distal stomach. For 2 patients, stents were placed because of a tracheoesophageal fistula due to an esophageal tumor and pleura-esophageal fistula formation secondary to lung cancer. Table 1 lists the pathologies of the patients undergoing endoscopic stent placement.
Endoscopic stenting was successful in 60 of 61 patients (98.3%). In 1 patient with obstruction due to a tumor at the gastric outlet the procedure was not successful as the guide wire could not be passed beyond the stricture. Surgical gastrojejunostomy was performed for this patient.

Of the 60 patients successfully stented, 4 had complications related to the stent (4.9%).

One patient with sleeve gastrectomy performed for obesity and postoperative fistula from the anastomosis had nausea and vomiting 3 days after the procedure. In the endoscopic examination performed on the fourth day, the stent was seen as migrated proximally. The stent was removed and a new stent was placed. No early or late complications were observed after the second procedure.

Another patient with cardia tumor stent migrated 3 days after. The stent was removed and a new stent has been placed.

Another patient with total gastrectomy performed for gastric tumor developed a fistula on postoperative day 5. In the endoscopic examination, the anastomosis line was observed as 50% detached from the anterior. The site of leakage was closed by placing a full covered stent. With the fistula controlled, the patient was discharged with cure 1 week after the stenting procedure. Twenty days after stenting, the patient presented with hematemesis and was allowed to the inpatient clinic. In the upper GIS endoscopy, the stent was in place and there was recent coagulum in the lumen, but no source of hemorrhage was observed. The stent could not be removed due to risk of hemorrhage. During follow-up, the patient became hemodynamically unstable because of sudden onset massive hematochezia and hematemesis. The emergency coeliac angiography revealed a pseudoaneurysm in the splenic artery in contact with the lower end of the stent and active bleeding from this site (Fig. 1). The hemorrhage was controlled by coil-embolization from the origin of the splenic artery (Fig. 2). On the 12th day after embolization the patient was discharged with cure. Twenty-eight days after embolization, removal of the stent was attempted but failed. Despite completion of adjuvant chemotherapy, the patient died on the postoperative 8th month due to progression of disease. The cause of mortality was not associated with the stent.

---

**Table 1 Pathologies of patients undergoing endoscopic stent placement**

| Pathological characteristics                  | n = 60 (%) |
|-----------------------------------------------|------------|
| Malignant pathologies                         |            |
| Esophageal cancer                             | 29 (48.3)  |
| Esophago-gastric junction cancer               | 11 (18.3)  |
| Gastroduodenal cancer                         | 5 (8.3)    |
| Benign pathologies                            |            |
| Anastomotic leakage/fistulae                  | 7 (11.6)   |
| Anastomotic stricture                         | 3 (5)      |
| Esophageal peptic/inflammatory stricture      | 5 (8.3)    |

---

**Fig. 1** Celiac angiography shows a pseudoaneurysm in the splenic artery in contact with the lower end of the stent.

**Fig. 2** Coil-embolization of total splenic artery from the origin to the splenic hilus.
Treatment of patients stented for detachment at the anastomosis and fistulae continued in the hospital until clinical recovery. Mean duration of hospital stay in this group was 10 (4–36) days. In 2 patients who had a stent placed for malignancy related esophageal obstruction, the stent lumen was found to be occluded due to tumor growth 29 and 62 days after stenting. The passage was provided by placing another stent through the existing stent.

Five patients with strictures due to inflammation and benign ulcers in the esophagus were treated with an average of 4 (2–6) sessions of balloon dilatation and 3 patients with strictures at the hypopharyngeal anastomosis after esophagectomy with an average of 3.6 (3–4) sessions of rigid dilatation using Savary–Gilliard dilators (No. 7, 9, 11, 12.8: in order). For these 5 cases where the dilatation procedure failed, stenosis was overcome by placing fully covered self-expandable metallic stents. One patient had stent migration 28 days after the procedure. The stent was removed and dilatation procedure was restarted for this patient. Other patients’ stents were removed with no complications after an average of 5 (4–6) weeks. Two of these cases had recurrent stricture after 4 (3–5) weeks average. Consequently dilatation with Savary–Gilliard dilators was performed once again. Three cases with anastomosis strictures whose stenosis resolved and dysphagia regressed are still being followed.

Of the 60 patients stented, 49 were stented for obstruction and fistulae related to tumors. Seven of these patients have left clinical follow-up. Among those under surveillance, a total of 17 patients (7 with esophageal tumors, 7 with esophagogastric junction tumors, 1 with tumor related tracheoesophageal fistula, and 2 with tumors at the distal stomach causing pyloric obstruction) have died during follow-up because of disease progression. Neoadjuvant therapy was planned for the 3 patients with pyloric obstruction due to tumor at the distal stomach and 12 patients with tumor related obstruction at the esophagus. Endoscopic stents were applied to these patients to allow feeding during neoadjuvant therapy.

In this group, mean survival after stent placement was 51 (12–165) days. No stent obstruction or any other complications were observed throughout the survival of other patients with malignancies.

All 5 patients stented for fistulae at the suture line after bariatric surgery had their stents removed after an average of 7 (6–8) weeks. All patients stented for fistulae had their stents removed with no complications after the 6th week. No complications or mortality occurred for any of the patients. Approaches to clinical failure and complications, as well as the outcomes, are summarized in Table 2.

According to this data, overall technical success rate was found to be 98.3%; clinical success rate, 86.6%; complication rate, 4.9 %. For malignancies only, technical success rate was 97.8%; clinical success rate, 95.5%; and complication rate, 2.3%. No stent related mortality was observed in our series. For benign lesions, technical success rate was 100%; clinical success rate, 60%, and complication rate, 13.3% (Table 3).

Discussion

Despite the advances in surgical techniques, palliation might be the only option in high grade malignancies of the GIS. The main goals of palliation are controlling symptoms, eliminating dysphagia, allowing oral nutrition intake, and preventing aspiration. Also, gastrointestinal surgery might have serious complications even when performed for

| Complications and clinical failures | Managements | Outcomes | N = 60 (%) |
|------------------------------------|-------------|----------|------------|
| Migration                          | Stent removal: |
|                                    | Restenting  |
|                                    | Dilations of stricture  |
| Stent obstruction                  | Stent in stent placement |
| Hemorrhage                         | Angiographic embolization |
| Stricture recurrence               | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |

| Complications | Managements | Outcomes | N = 60 (%) |
|---------------|-------------|----------|------------|
| Migration     | Stent removal: |
|               | Restenting  |
|               | Dilations of stricture  |
| Stent obstruction | Stent in stent placement |
| Hemorrhage     | Angiographic embolization |
| Stricture recurrence | Dilations of stricture |
benign reasons. This last situation results in long hospitalization, need for reoperation, increase in mortality rates, and increased costs. Therapeutic endoscopy might play an important role in such problems of the upper GIS. Self-expandable metallic stent procedures have been widely accepted as an effective treatment option. On the other hand, complications such as bleeding, perforation, stent obstruction due to tumor growth, or migration related to endoscopic stenting for malignant obstructions of the upper GIS can be observed. However, no statistically significant difference has been shown between the rates of the aforementioned complications and those of standard palliative surgical interventions. Besides, delayed oral nutrition after surgery and longer hospitalization can be considered as disadvantages of surgery. In this study, the majority of the cases involving placed endoscopic stents were patients with malignant obstruction. Malignant obstruction of the upper GIS is a common complication of high grade tumors. More than 50% of esophageal tumors are inoperable at the time of diagnosis. For these patients, palliative chemotherapy has not been proven superior to supportive treatment in terms of survival. The classical procedure for palliative treatment of inoperable upper GIS tumors is surgically opening feeding gastrostomies / jejunalostomies or bypass procedures. In recent years, noninvasive procedures have been increasingly preferred. These procedures, each of which has different rates of success and risks of complication, are thermal ablation, photodynamic therapy, radiotherapy, chemotherapy, chemical injection, electrocoagulation, and stenting procedures. Endoscopic stent placement procedure is increasingly preferred over other methods because it resolves the obstruction faster and for a longer duration than other methods, has lower morbidity rates, shorter hospital stay, and lower costs. For obstructive esophageal tumors, technical success rate of stenting as reported is 85%–100%; clinical success rate, 80%–90%; complication rate, 30%. Another complication of esophageal tumors is tracheoesophageal fistulae caused by the infiltration of cancer to the respiratory tract. Many case series report successful closure of the fistulae by endoscopic stenting. These series report technical success rates of 70%–100% and complication rates of 10%–30%.

Technical success rates of the endoscopic stent placement procedure for palliation of malignancies causing obstruction at the gastric outlet is not different from that of esophageal stent placement. However, clinical success rates of the stenting procedures for gastric outlet obstruction are reported to be lower. The reasons for this finding can be listed as incomplete opening of the stent, acute angulation of the stent and insufficient stent length for long segment lesions, among others.

In our series, the majority of the patients stented for malignancy related symptoms had esophagus or esophagogastric junction tumors, and to a lesser extent, distal stomach malignancies causing pyloric obstruction. Our results for cases with upper GIS malignancies are consistent with previous studies; technical success rate being 97.8% and clinical success rate being 95.5%.

Rate of recurrence of symptoms and stent obstruction requiring repeat intervention due to tumor growth is 13%–18%. Stent obstruction is directly related to the length of survival. In our series, only 2 patients with esophageal tumor stented for malignant obstruction had stent obstruction due to tumor growth. Compared to the literature, a complication rate of 2.3% is extremely low. The time it has taken from the placement of the stent to its obstruction (29 and 68 days), however, is longer than the average survival (51 days). As one of the complications following upper GIS surgery for both malignant and benign pathologies, failure of anastomoses causing leakage and fistulae has significant morbidity and mortality (50% and 10%, respectively). The management options of this complication are surgical interventions and conservative treatment consisting of restricting oral intake, antibiotic treatment, and drainage procedures. Because of the high mortality of surgical interventions, such cases of anastomosis failure are currently treated by closing with self-expandable metallic stents. Endoscopic stent placement procedure for anastomosis failure is suitable for detachments smaller than 50%–70% of the circular perimeter of the anastomosis. In the existence of longer anastomosis detachments, peritonitis or mediastinitis, or persistent severe sepsis, surgical treatment is recommended. On the other hand, Donnie et al have reported a case of complete anastomosis failure treated by endoscopic stenting. Still, evidence from randomized controlled trials in a well-defined population is needed. Even though there are no randomized controlled trials about endoscopic stenting for fistulae and leakages, the rate of success is reported to be 80%–85% in systematic reviews.

Possible complications after the treatment of fistulae and leakages by stenting are stent migration, perforation, and hemorrhage. In a meta-analysis by
Van Beckel et al stent migration rate is reported as 9%–26%. Rate of migration is reported to be especially higher in fully covered stents than partially covered stents.29

Hemorrhage, one of the major complications, is rare (<5%).30 Although the mechanisms of hemorrhage after stenting are not defined in the literature in detail, case reports usually report such incidents weeks after the stenting procedure. One possible mechanism is sharp edges of the metal stent causing ulcer formation and hemorrhage by eroding the mucosa. Most of such cases of hemorrhage are controlled with conservative treatment.31 On the other hand, a case of massive hemorrhage after stenting resulting in death has been reported by Due et al.32 In our series, 1 case that was applied a self-expandable metallic stent because of 50% detachment at the esophagojejunostomy and had massive gastrointestinal hemorrhage 20 days after the procedure was revealed by angiography to be resulting from the lower end of the metal stent causing erosion at the splenic artery. The hemorrhage was controlled by angiographic splenic artery coil embolization. Twenty-eight days after angiography removal of the stent was attempted, but failed. Despite adjuvant chemotherapy, carcinomatosis peritonei developed and the patient died due to disease progression on 8th month postoperatively. Even though this patient had cancer, the stented lesion is a benign leakage developing postoperatively. Thus, mortality of this case was not related to the stent but rather considered to be the result of malignancy. The incidence of stricture at the anastomosis line following upper gastrointestinal surgery is between 5% and 46% and varies greatly.33,34 Postoperative anastomosis failure, fistulae, or ischemic injury are complications contributing to the development of strictures at the anastomosis line.35 Recently, stent placement procedure is increasingly used for anastomosis strictures. Even though fully covered self-expandable metallic stents are approved by the FDA only for use in malignancies, they are ideal for use in benign esophageal strictures. The purpose here is to resolve the stricture by applying extended radial force on the stenosis.36,37 Most of the data on the use of self-expandable metallic stents for esophageal strictures is derived from case series or case reports.38–40 According to the management algorithm from the review by Manta et al for anastomosis strictures; first, 4 to 6 sessions of dilatation; if the stricture does not resolve, 1 to 2 times radial incision with or without dilatation; if still not successful, surgery; or for patients not suitable for surgery, stent dilatations is recommend-
ed.10 Self-expandable metallic stent procedures for benign esophageal strictures might cause serious complications such as migration, bleeding, fistulae, perforation, and recurrence of stricture.41,42 Five cases in our series were applied self-expandable metallic stents for esophageal strictures persisting even after repeated dilatations.

Although our technical success rate regarding stent placement for benign esophageal strictures appears to be 100%, compared to patients with malignant obstructions, our clinical success rate in this group is lower (95.5% versus 60%) and stent related complication rate higher (2.3% versus 13.3%). Many studies have concluded that long term success in metallic stenting is related to the etiology and short length of the stricture. Clinical success rate in radiotherapy induced strictures is higher than that in benign peptic strictures or anastomotic strictures.43,44 It has also been reported that using small sized stents might decrease new stricture formation.39 Thus, Jee et al do not recommend routine use of self-expandable metallic stents for benign esophageal strictures. Until long term data is available from controlled clinical trials, self-expandable metallic stents are only recommended for selected patients.23 Stenting procedure for benign strictures has disappointing results; rate of the stricture resolving and symptoms disappearing in the long term is reported as 6%–30% and rate of migration, the most common complication, 22%–64%.45 In our series, for patients with benign strictures, despite a clinical success rate (60%) that was higher than that reported in the literature and a similar complication rate (13.3%), complications during follow-up after stenting was one of the factors causing a low total success rate.

Our study has weak points such as being retrospective, nonrandomized, and not making a comparison with other stent types as only covered metal stents were used. However, it contributes to data supporting endoscopic stenting as an effective and safe strategy in upper gastrointestinal system lesions.

Conclusions

Endoscopic stents can be effectively and safely used in the treatment of various lesions of the upper GIS. In addition to its palliative use in high grade malignant upper GIS obstructions, endoscopic stent placement is a valuable treatment modality to allow feeding during treatment for patients with malignant obstruction with a neoadjuvant therapy plan. Clinical results are similar to palliative surgical
procedures such as feeding gastrostomy / jejunostomy or bypass surgery while avoiding the morbidity and mortality of surgery.

Because of disappointing clinical results, the routine use of self-expandable metallic stents in benign esophageal lesions such as anastomotic failure, fistulae, and strictures is limited. It is recommended for selected patients.

Acknowledgments

Gürbulak B, Kabul Gürbulak E, Bektaş H, Segmen Ö, and Battal M contributed equally to this work; Gürbulak B, Kabul Gürbulak E, Bektaş H, Akgün IE, Segmen Ö, Celayir F, Battal M, Büyükaşık K designed the research; Gürbulak B, Kabul Gürbulak E, Bektaş H, and Akgün IE performed the research; Gürbulak B, Kabul Gürbulak E, Bektaş H, and Büyükaşık K contributed new reagents/analytic tools; Gürbulak B, Kabul Gürbulak E, Segmen Ö, and Celayir F analyzed the data; Gürbulak B, Kabul Gürbulak E, Bektaş H, Battal M and Segmen Ö wrote the paper. This study has not been published elsewhere nor has it ever been presented in any national or international symposia. Prior to the design of this study, a well-written informed consent from the patient was received. All authors have declared no potential conflict of interest relevant to this article.

References

1. Sabharwal T, Irani FG, Adam A. Cardiovascular and Interventional Radiological Society of Europe. Quality assurance guidelines for placement of gastroduodenal stents. Cardiovasc Intervent Radiol 2007;30(1):1–5
2. Mehta S, Hindmarsh A, Cheong E, Cockburn J, Saada J, Tighe R et al. Prospective randomized trial of laparoscopic gastrojejunostomy versus duodenal stenting for malignant gastric outflow obstruction. Surg Endosc 2006;20(2):239–242
3. Yim HB, Jacobson BC, Saltzman JR, Johannes RS, Bounds BC, Lee JH et al. Clinical outcome of the use of enteral stents for palliation of patients with malignant upper GI obstruction. Gastrointest Endosc 2001;53(3):329–332
4. Maetani I, Tada T, Ukita T, Inoue H, Sakai Y, Nagao J. Comparison of duodenal stent placement with surgical gastrojejunostomy for palliation in patients with duodenal obstructions caused by pancreaticobiliary malignancies. Endoscopy 2004;36(1):73–78
5. Maetani I, Akatsuka S, Ikeda M, Tada T, Ukita T, Nakamura Y et al. Self-expandable metallic stent placement for palliation in gastric outlet obstructions caused by gastric cancer: a comparison with surgical gastrojejunostomy. J Gastroenterol 2005;40(10):932–937
6. Raju GS, Thompson C, Zwischenberger JB. Emerging endoscopic options in the management of esophageal leaks (videos). Gastrointest Endosc 2005;62(2):278–286
7. Brinster CJ, Singhal S, Lee L, Marshall MB, Kaiser LR, Kucharzczuk JC. Evolving options in the management of esophageal perforation. Ann Thorac Surg 2004;77(4):1475–1483
8. Tilanus HW, Bossuyt P, Schattenkerk ME, Obertop H. Treatment of oesophageal perforation: a multivariate analysis. Br J Surg 1991;78(5):582–585
9. Turkyilmaz A, Eroglu A, Aydin Y, Tekinbas C, Muharrem Erol M, Karaoglanoglu N. The management of esophagogastric anastomotic leak after esophagectomy for esophageal carcinoma. Dis Esophagus 2009;22(2):119–126
10. Manta R, Magno L, Conigliaro R, Caruso A, Bertani H, Manno M et al. Endoscopic repair of post-surgical gastrointestinal complications. Dig Liver Dis 2013;45(11):879–885
11. Sabharwal T, Hamady MS, Chui S, Atkinson S, Mason R, Adam A. A randomised prospective comparison of the Flamingo Wallstent and Ultraflex stent for palliation of dysphagia associated with lower third oesophageal carcinoma. Gut 2003;52(7):922–926
12. Vakil N, Morris AI, Marcon N, Segalin A, Peracchia A, Bethge N et al. A prospective, randomized, controlled trial of covered expandable metal stents in the palliation of malignant esophageal obstruction at the gastroesophageal junction. Am J Gastroenterol 2001;96(6):1791–1796
13. Johnsson E, Thune A, Liedman B. Palliation of malignant gastroduodenal obstruction with open surgical bypass or endoscopic stenting: clinical outcome and health economic evaluation. World J Surg 2004;28(8):812–817
14. Larraga JOA, Villegas JCA, Cossio SS, Guerrero AH, Levy GML, Barojas PF. Self-expanding metal stents versus antrectomy for the palliative treatment of obstructive adenocarcinoma of the gastric antrum. Rev Esp Enferm Dig 2012;104(4):185–189
15. Homs MY, van der Gaast A, Siersema PD, Steyerberg EW, Kuipers EJ. Chemotherapy for metastatic carcinoma of the esophagus and gastroesophageal junction. Cochrane Database Syst Rev 2010;12(5):CD004063
16. Jeurnink SM, Steyerberg EW, van Hooft JE, van Eijck CH, Schwartz MP, Vleggaar FP et al. Surgical gastrojejunostomy or endoscopic stent placement for the palliation of malignant gastric outlet obstruction (SUSTENT study): a multicenter randomized trial. Gastrointest Endosc 2010;71(3):490–499
17. Frenken M. Best palliation in esophageal cancer: surgery, stenting, radiation, or what? Dis Esophagus 2001;14(2):120–123
18. Homs MY, Kuipers EJ, Siersma PD. Palliative therapy. J Surg Oncol 2005;92(3):246–256
19. 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(6):543–550
20. Bethge N, Sommer A, Vakil N. Treatment of esophageal fistulas with a new polyurethane-covered, self-expanding mesh stent: a prospective study. Am J Gastroenterol 1995;90(12):2143–2146
21. Kozarek RA, Ratzl S, Brugge WR, Schapiro RH, Waxman I, Boyce HW et al. Prospective multicenter trial of esophageal Z-stent placement for malignant dysphagia and tracheoesophageal fistula. Gastroint Endosc 1996;44(5):562–567
22. Rajman I, Siddique I, Ajani J, Lynch P. Palliation of malignant dysphagia and fistulae with coated expandable metal stents: experience with 101 patients. Gastroint Endosc 1998;48(2):172–179
23. Jee SR, Cho JY, Kim KH, Kim SG, Cho JH; Stent Study Group of the Korean Society of Gastrointestinal Endoscopy. Evidence-based recommendations on upper gastrointestinal tract stent-based treatment: a report from the stent study group of the korean society of gastrointestinal endoscopy. Clin Endosc 2013;46(4):342–354
24. Jeurnink SM, Van Eijck CH, Steyerberg EW, Kuipers EJ, Kumar N, Thompson CC. Endoscopic management of benign esophageal strictures: a prospective two-center study. Am J Gastroenterol 2008;103(12):2988–2994
25. Kumar N, Thompson CC. Endoscopic management of complications after gastrointestinal weight loss surgery. Clin Gastroenterol Hepatol 2013;11(4):343–353
26. Chopra SS, Mrak K, Hünerrbein M. The effect of endoscopic treatment on healing of anastomotic leaks after anterior resection of rectal cancer. Surgery 2009;145(2):182–188
27. Kozarek RA, Ratzl S, Brugge WR, Schapiro RH, Waxman I, Boyce HW et al. Prospective multicenter trial of esophageal Z-stent placement for malignant dysphagia and tracheoesophageal fistula. Gastroint Endosc 1996;44(5):562–567
28. Schubert D, Scheidbach H, Kuhn R, Wex C, Weiss G, Eder F. Endoscopic treatment of thoracic esophageal anastomotic leaks by using silicone-covered, self-expanding polyester stents. Gastroint Endosc 2005;61(7):891–896
29. Doniec JM, Schniewind K, Kalife V, Kremer B, Grimm H. Therapy of anastomotic leaks by means of covered self-expanding metallic stents after esophagectomy. Endoscopy 2003;35(8):652–658
30. Swinnen J, Eisendath P, Rigaux J, Kaheqese L, Lemmers A, Le Moine O et al. Self-expandable metal stents for the treatment of benign upper GI leaks and perforations. Gastroint Endosc 2011;73(5):890–899
31. Wai CT, Khor C, Lim SE, Ho KY. Post-metallic stent placement bleeding caused by stent-induced ulcers. World J Gastroenterol 2005;11(36):5739–5741
32. Dua KS, Vleggaar FP, Santharam R, Siersema PD. Removable self-expanding plastic esophageal stent as a continuous, non-permanent dilator in treating refractory benign esophageal strictures: a prospective two-center study. Am J Gastroenterol 2006;101(12):2988–2994
33. Pieper JP, de Graaf PW, Poon H, van der Tweel I, Obertop H. Incidence and management of benign anastomotic stricture after cervical esophagogastrectomy. Br J Surg 1993;80(4):471–474
34. Said A, Brust DJ, Gaumann EA, Rechtemeter M. Predictors of early recurrence of being esophageal strictures. Am J Gastroenterol 2003;98(6):1252–1256
35. Honkoop P, Siersema PD, Tilanus HW, Stassen LP, Hop WC, van Blankenstein M. Benign anastomotic strictures after transmural esophagogastrectomy and cervical esophagostomy: risk factors and management. J Thorac Cardiovasc Surg 1996;111(6):1141–1148
36. Rejchart A, Kopacova M, Brozik J, Bures J. Biodegradable stents for the treatment of benign stenoses of the small and large intestines. Endoscopy 2011;43(10):911–917
37. Wilson JL, Louie BE, Fariar AS, Vallières E, Aye RW. Fully covered self-expanding metal stents are effective for benign esophagogastric disruptions and strictures. J Gastrointest Surg 2013;17(12):2045–2050
38. Ackroyd R, Watson DI, Devitt PG, Jamieson GG. Expandable metallic stents should not be used in the treatment of benign esophageal strictures. J Gastroenterol Hepatol 2001;16:484–487
39. Conio M, Blanchi S, Filiberti R, Repici A, Barbieri M, Bilardi C et al. A modified self-expanding Niti-S stent for the management of benign hypopharyngeal strictures. Gastroint Endosc 2007;65(4):714–720
40. Cheng YS, Li MH, Chen WX, Chen NW, Zhuang QX, Shang KZ. Temporary partially-covered metal stent insertion in benign esophageal stricture. World J Gastroenterol 2003;9(10):2359–2361
41. Repici A, Hassan C, Sharma P, Conio M, Siersema P. Systematic review: the role of self-expanding plastic stents for benign esophageal strictures. Aliment Pharmacol Ther 2010;31(12):1268–1275
42. Sandha GS, Marcon NE. Expandable metal stents for benign esophageal obstruction. Gastroint Endosc Clin N Am 1999;9(3):437–446
43. Fiorini A, Fleischer D, Valero J, Israeli E, Wengrower D, Goldin E. Self-expandable metal coil stents in the treatment of benign esophageal strictures refractory to conventional therapy: a case series. Gastroint Endosc 2000;52(2):259–262
44. Song HY, Jung HY, Park SI, Kim SB, Lee DH, Kang SG et al. Covered retrievable expandable nitinol stents in patients with benign esophageal strictures: initial experience. Radiology 2000;217(2):551–557
45. Holm AN, de la Mora Levy JG, Gostout CJ, Topazian MD, Baron TH. Self-expanding plastic stents in treatment of benign esophageal conditions. Gastroint Endosc 2008;67(1):20–25