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The Current Role of Endoscopic Stenting in Upper Gastrointestinal Surgery

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1. Introduction

Stenting is well established in the non-operative management of many sites, including, vascular system, biliary tree and tracheobronchial tree. Within the upper gastrointestinal tract, stenting is most frequently employed in oesophagus, but currently the role of stenting in stomach and duodenal has widely gained acceptance.

The first stent widely used in the esophagus was constructed from silicon rubber tube (Silastic, Dow Corning, Midland, MI). In 1959, Celestine described the use of plastic endoprosthesis introduced through laparotomy via an open gastrostomy to palliate the esophageal stricture but it was associated with high complication as high as 45%.[1] In 1970s, Atkinson introduced an endoscopically placed plastic endoprosthesis[2], which became popular over the years as it is associated with fewer complications despite smaller internal diameter. (Figure 1)

However, the invention of the self-expanding metal stent (SEMS) (Figure 2) marked the new era of modern esophageal stenting as it is associated with higher success rate, fewer complications and ease of insertion. The first description of the endoscopic placement of an expanding metallic spiral stent was made by Frimberger in 1983.[3] There are currently at least eight different types of metallic stent on the market, covered and uncovered, some of which have anti-reflux valves.

The use of endoscopic stent has an increasing role in upper gastrointestinal tract diseases as it offers immediate relief of obstruction and immediate coverage for anastomotic leak in a minimally invasive approach. Recently various self-expanding metal or plastic stents have been developed for palliation of malignant obstruction of the gastrointestinal tracts. The major impact of these newer stents relates to the ease of insertion due to

smaller delivery system with fewer complications and self –expandable property. However, the physician’s perception of ease of placement has major influence in choosing the type of stent to be used.[4]

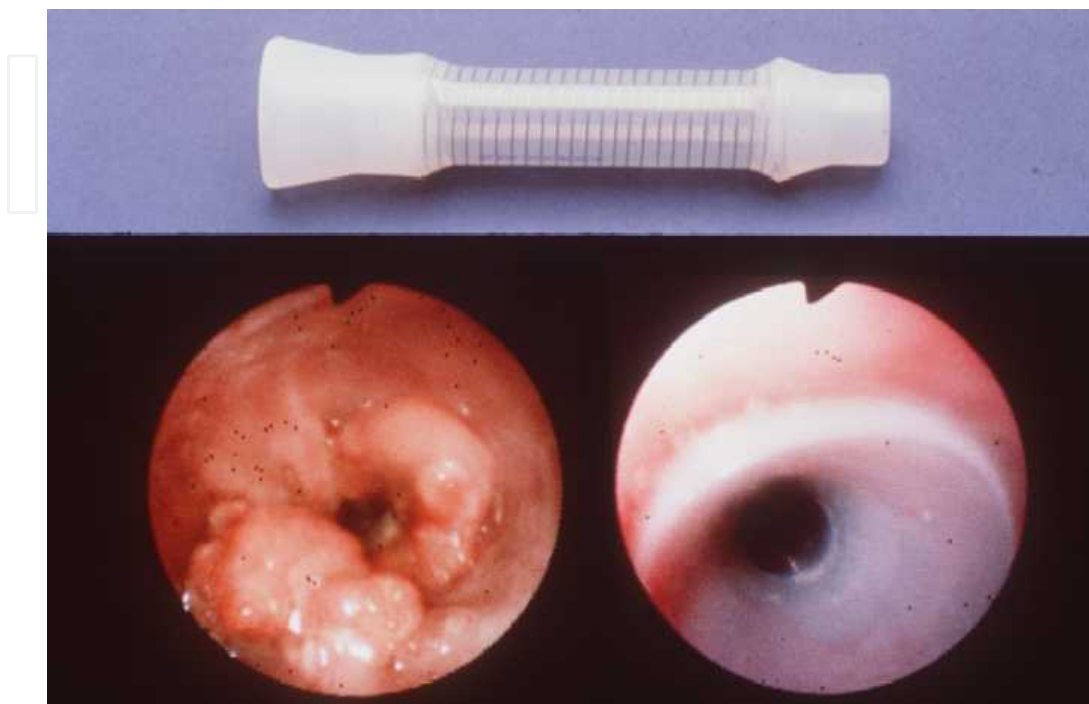


Figure 1. A Plastic stent which is successfully place endoscopically through the esophageal cancer

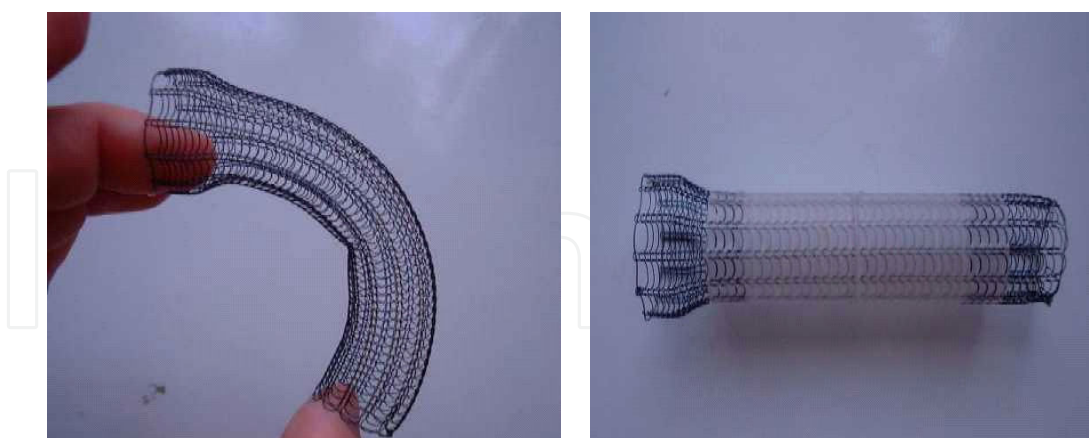


Figure 2. A retrievable self-expanding metallic stent

This review mainly focuses on the current status of self-expanding stent placement in esophageal and gastric disease, as well as considering the suitable candidate, side-effect, potential complications in relation to our experience of endoscopic stenting in various upper gastrointestinal tract disease, particularly in the management of post-operative complication.

2. Current availability stents and theirs indication

The stents are broadly classified into metallic and plastic stent. Metallic stents are made from nitinol (nickel-titanium alloy) or stainless steel and all are self-expanding metallic stents (SEMS). Although the metal used in this stent are made to be inert, resistant to erosion and non-allergenic but when the stent coils embedded into the mucosa, they still could trigger mild inflammatory reaction with fibrosis formation that reduce the risk of migration but it makes its removal difficult. The nitinol stent has thermal shape memory feature that enables it to expand at body temperature and adapts to the shape of a particular lesion. The initial type of metallic stent was uncovered but because of issues of tumour in-growth through the stent and tissue reaction, thus the current available stent is fully or partially covered. Current design of covered stent incorporates features such as partly uncovered portion, proximal flaring, placing the covering material on inside, to reduce the migration rate. The materials used for covered stent are silicone or plastic. However, the risk of stent migration is higher in the covered stent especially in high risk area such as distal esophagus. The covered stent is useful in benign lesion as it is easier to remove once the stricture expands. Stents are available in a wide variety of lengths and diameters. The most commonly available used stents are usually the 10-12cm long, 18- 21 mm diameter, covered SEMS. Besides, the availability of proximal release stent allows the stenting of very high esophageal lesion much easier with precise positioning under endoscopic guidance without flouroscopy[5] (Figure 3)

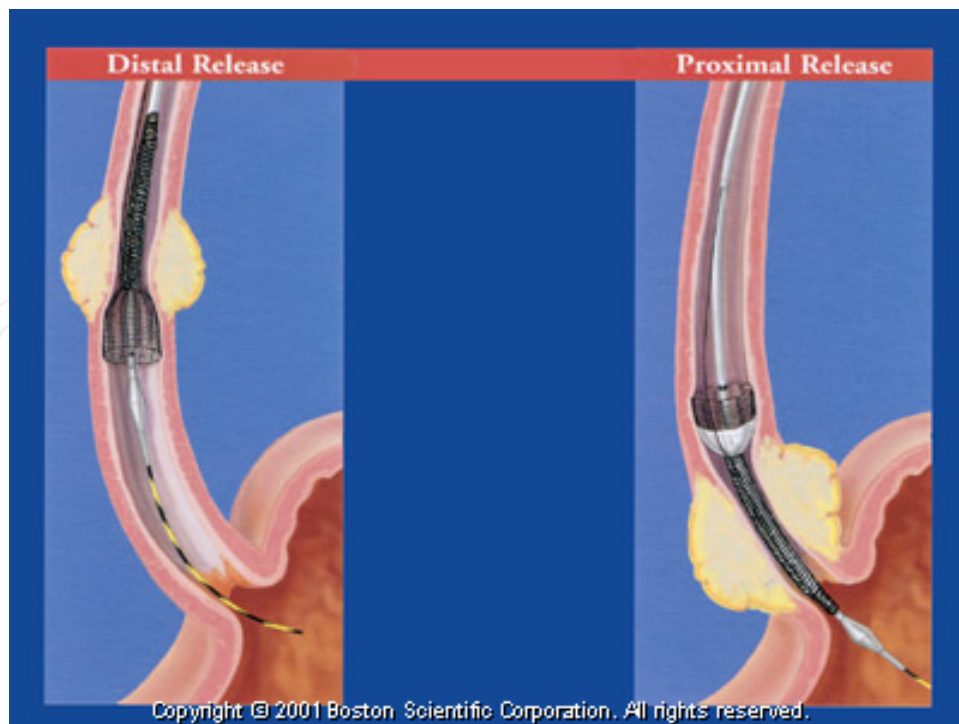


Figure 3. Two types of stent release mechanism

The self-expanding plastic stent (SEPS) is the latest development of stent design and it is indicated for esophageal stenosis such as refractory benign strictures and malignant esophageal stricture. Polyflex esophageal stent (Boston Scientific, USA) is the only stent on the market which is indicated for benign esophageal stricture and can be placed temporary up to 9 months according to manufacture guideline. However, the utility of this device is constrained by the requirement of a relatively large (12-14 mm) rigid introducer, manual assembly and the necessity of fluoroscopic guidance using a wire for appropriate positioning.

The important type of stents that are available on the market are given in Table 1

Name	Manufacturer	Material	Diameter (mm)	Length (mm)	Delivery system size (mm)	Special features
Polyflex	Boston Scientific, USA	Polyester, silicone covered	16-21	90-150	12.0-14.0	Need manual assembly prior to stent placement. Indicated for benign esophageal stricture
Niti-S	Taewoong Medical, Korea	Nitinol wire, silicone covered	16-20	60-150	5.8-6.5	Fully covered. Proximal/ distal release available. Retrievable if misplaced. Proximal lasso. Antireflux variant available
Ultraflex™	Boston Scientific, USA	Nitinol wire, polyurethane covered	18-23	100-150	6	Partially covered at mid-portion. Ideal for upper 1/3 esophagus. Little expansile force. Not intended to be repositioned or removed once deployed. Large proximal flares
Z-stent®	Wilson-Cook Medical, USA	Stainless steel, polyurethane covered	18	80-140	10	Non-shortening partially covered stent. Preloaded on a Z-speed introduction system
Bonastent™	Standard Sci-Tech, Korea	Nitinol wire, silicone covered	18	60-150	5	Fully covered. Repositionable if misplaced less than 50% of its length. Small delivery diameter (5 mm) Proximal and distal lasso, Antireflux variant available
Choo stent™	M.I.Tech, Korea	Nitinol wire, silicone covered	18	60-170	6	Retrievable if misplaced. Proximal and distal lasso. Antireflux variant available
Alimaxx-ES™	Merit Medical system, USA	Nitinol wire, polyurethane covered	12-14	70-120	7.4	Fully covered. Antimigration struts. Proximal suture knot for removal

Table 1. Commercially available covered esophageal stents

3. Indications and contraindications for stent placement

3.1. Indications

The aim for stenting is the palliation of malignant dysphagia in esophageal or gastric cancer in patients whom are not candidate for surgical resection due to extensive local or metastatic disease or poor functional status. Trecheo-esophageal fistula due to locally advanced cancer which leads to recurrent aspiration pneumonia is a good indication as studies has shown the used of covered stent may increase survival as compared to other therapies.[6]

The used of covered stent in benign esophageal lesions such as leak or perforation especially in high risk patients too precarious for major operation, has gain increasing acceptance in upper GI surgery.[7] In this selected group of patient, the choice of stent is utmost important as the stent must be left long enough for the leak to heal but without complication of difficult removal later on. The new designed fully covered stent such as SEMS (Nitinol coved stent) and SEPS (Polyflex) are particular suitable in this situation. Most stents are left for 2 to 3 months for the perforation to heal.

The use of stent in benign esophageal stricture has also gain popularity in recent years.[8] Those refractory esophageal strictures with failure of serial dilatation probably are the best candidate in this indication.[9] Placement of fully covered retrievable stent after dilation as non-permanent dilator and remove it after 1 to 2 months after the fibrosis has stabilised.

There are no real contraindications for stenting due to improvement of the stent design. Traditionally, it is not advisable to stent in high esophageal lesion due to risk of aspiration, pain or risk of tracheal compression. However, with the availability of new design and proximal release stent which allow accurate endoscopic placement make the treatment of this lesion a possibility.[10] In patient with advanced esophageal cancer with very short of expectancy (< 4 weeks) should probably not considered a candidate for stenting.

3.2. Complications of stent placement

Informed consent should be obtained prior to stent placement especially the information regarding the expected benefit, risk and possible short and long term complications should be properly conveyed to patients

The use of stenting has been shown to improve quality of life indices.[11, 12] The improvement of dysphagia has been the objective of the esophageal stenting. The dysphagia score is used to assess the degree of dysphagia. (Table 2)[13] Most published series showed the overall immediate technical success rate in 100%, with improvement of dysphagia score approaching 90%.[12] The ability of oral intake to allow gastronomic pleasure is also another benefit, which not only improve the quality of life but possibly the nutrition status of the patient.

Minor procedure complications which lead to morbidity were seen up to 40% in various series.[14, 15] Intra-procedure complications such as aspiration, sedation risk, malposition of the stent, bleeding and perforation could occur. Early complications may include chest pain,

bleeding or tracheal compression. Late complications such as stent migration, tumour overgrowth or ingrowth[16-18], delayed perforation, food bolus impaction, fistula formation may occur. However, fistula and perforation due to stent insertion are uncommon. Early chest pain occur in most patient, but prolonged pain only occur in fewer than 13% of patients.[18] Pain is most severe with high stricture and when large diameter of stent is used. [19] The migration rate for those uncovered stent is less than 3% in esophagus, but increases to 6% if placed across the cardia.[13, 17] The migration rate of covered stent is generally up to 30%, especially when positioned across cardia.[17, 18, 20] The migrated stent should be retrieved endoscopically as it may cause small bowel obstruction or perforation.[21]

Dysphagia score	Degree of dysphagia
0	No dysphagia
1	Able to swallow some solid food only
2	Able to swallow semi-solid only
3	Able to swallow liquids only
4	Complete dysphagia

Table 2. The dysphagia score

4. Technique of insertion

Before placement of the stent, a barium swallow should be obtained to delineate the site and length of the esophageal stricture. The stent could be deployed under endoscopic visualization, fluoroscopic guidance with the aid of guide wire and sometime require pre-dilatation of the lesion. It is especially helpful to have a nurse who experienced in complex endoscopic procedure to facilitate the success of stent deployment. Esophageal dilation is usually done before stent insertion but it is not a pre-requisite for successful stent deployment. The precise requirement of dilatation generally depends on the type of stent to be used, dilatation to no more than 12mm is recommended, which will facilitate introduction of the delivery system and allow rapid expansion of the stent. However, most people advocate do not pre-dilate the stricture as the stricture itself with hold the stent to reduce the risk of migration.

During procedure, the patient lies in left lateral position, Xylocaine spray is applied to the pharynx, the patient is sedated with an intravenous agent such as midazolam and analgesia is provided such as fentanyl. If the endoscope is managed to transverse the lesion, the proximal and distal border of the lesion are marked using radio-opaque markers, endoclips or contrast such as lipoidal agent. The stent is introduced over the guide wire until the marking on the stent are placed within 2cm of more margins proximal and distal to the lesion. Final adjustment is made under fluoroscopic guidance to ensure that the stent adequately covers the Lesion’s marking. By slowly retracting the outer

sheath of the delivery system while maintaining the position of the inner shaft, the stent is deployed under fluoroscopic guidance. It is important that the inner shaft of the delivery system is held stationary against the body while deployment and not allowed to move, as any movement may cause malposition of the stent. Endoscopic visualization of the stent placement also could be performed, especially with the aid of transnasal endoscopy which allows direct visual control of the esophageal stent placement without fluoroscopy.[22] After full deployment of stent and the expansion of the stent is verified fluoroscopically, the olive tip and the delivery system should be removed with care to prevent the dislodgment of the stent. For those stent that is placed too distally, a strong forcep could be used to hold the proximal lasso and the traction of it allow the stent narrows and be positioned more proximally. (Figure 4) Immediately after the procedure, non-ionic contrast medium is introduced through the catheter to look for any procedural related complications, especially esophageal perforation and to ascertain the stent patency. Endoscopy also can be done to ascertain the position of the stent but the endoscope should not be passed through the stent to prevent dislodgment of the stent. Chest x-ray should be carried out later to verify the position of the stent to look for sign of perforation.

Patient should stay overnight for post-procedure monitoring. Some patients might complain of chest discomfort or chest pain which could be relieved with simple analgesia. Occasionally the pain is so severe which needs stent removal.

Patient with stent must modify their diet to prevent food impaction that lead to stent occlusion. Diet should be introduced as tolerated. Patient with stent placed without anti-reflux valve should be started on a high dose proton pump inhibitor indefinitely to prevent gastroesophageal reflux. Stent occlusion due to food impaction could be dislodged endoscopically but those occlusion arises due to tumour overgrowth necessitate co-axial stenting on previous stent or laser ablation.

Technical points to consider

- Covered stent should be used for tumour with high risk of fistula formation and to prevent in-growth of tumour through the metal mesh.
- Stents with antireflux valve should be considered if position across the gastroesophageal junction due to disabling gastroesophageal reflux.[20, 23]
- The proximal margin of the stent could be held to mucosal tissue using endoclips to prevent stent migration.[24][25](Figure 5)
- The partially migrated stent could be fixed with another covered stent, placed coaxially overlapping the upper portion of the migrated stent.
- Those SEMS that is difficult to be removed due to tissue in-growth through the uncovered portion, a covered SEPS could be inserted overlapping the SEMS to press the tissue out of the stent mesh and causing pressure necrosis. Both of the stent could be removed few days later.[26, 27]

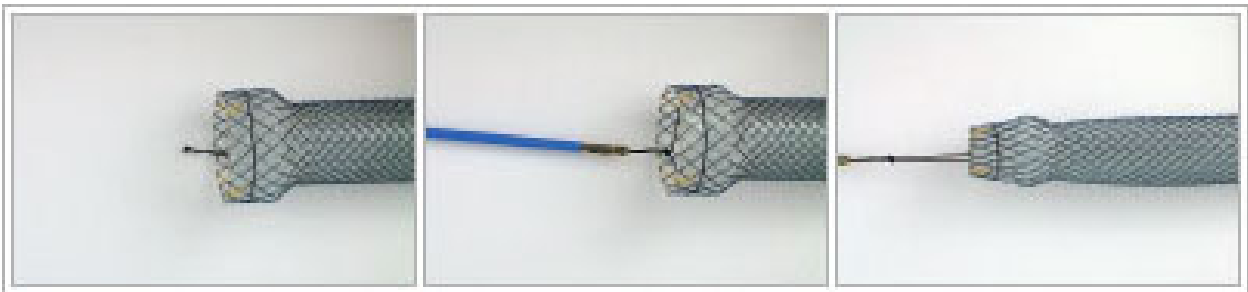


Figure 4. The proximal lasso could be retracted with strong grasper resulting narrowing of the stent body for easier removal.

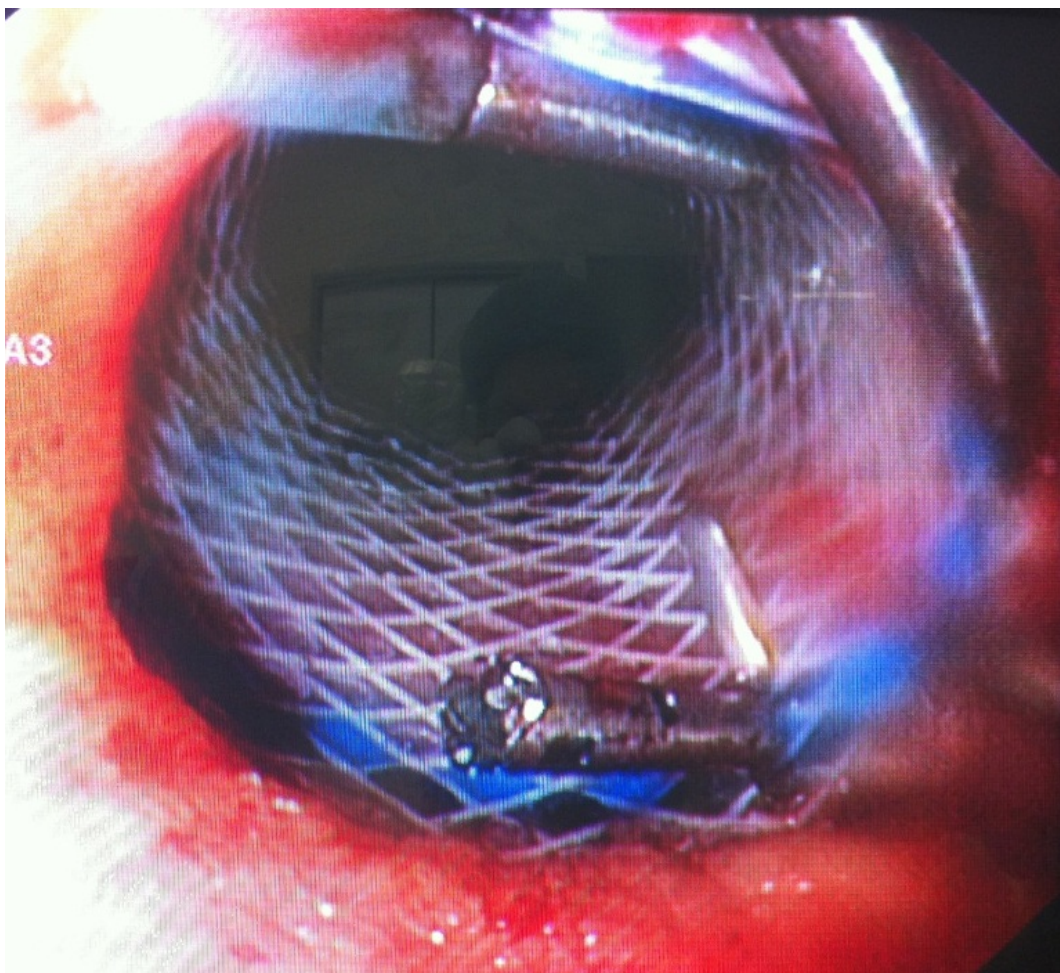


Figure 5. Use of endoclips to hold the proximal margin of stent to prevent stent migration.

5. Specific use of stent in upper gastrointestinal disease

The role of stenting in upper GI disease can be broadly divided into:

Esophagus:

1. Stents used in esophageal malignancy
2. Stents used in benign esophageal lesion such as stricture or perforation
3. Stents used in post-operative complication

Stomach:

1. Stents used in gastric outlet obstruction
2. Stents used in bariatric surgery

6. Esophageal stenting in malignancy

Most patients with upper GI cancer especially esophageal cancers presented late with locally advanced or metastatic disease, which preclude them from surgical resection.[28] Patients may have no symptoms until the diameter of the esophageal lumen has been reduced by 50% resulting in late presentation and poor prognosis.[29] However, the problem of dysphagia, vomiting and malnutrition will severely impair the quality of life of these patients. A variety of endoscopic treatment modalities such as thermal ablation, brachytherapy, photodynamic therapy, chemical injection, argon beam therapy and endoluminal stenting have been utilized with these objectives in mind, with options determined by the location and size of the tumour, as well as the patient's expected prognosis.[29] The use self-expanding stent in this kind of patients as a form of palliation,[30] instead of surgical bypass, is particularly helpful in relieving the obstruction while allow them to eat, manage their oropharyngeal secretions, reduce aspiration risk, and improve the nutrition status.

The esophageal stenting in malignancy can broadly divided into two situation:

1. Palliation in advanced cancer
2. Temporary stenting for patient undergoing neoadjuvant therapy

Palliation in advanced cancer

SEMS placement is a safe and effective technique with good symptom palliation in advanced esophageal cancer.[17] Case series showed that the dysphagia score improved faster, 85% within 2 week as compare to radiotherapy which the onset of palliation was slower, with only 50% of patients palliated at 2 weeks.[31] Successful stent placements are achieved in up to 98% cases.[32] In palliation of malignant esophagorespiratory fistula or perforation, covered metallic stent have a clinical success rate of 95-100%.[33, 34] (Figure 6) Sometime, fistulas close to the upper esophageal sphincter may be closed with placement of parallel covered metallic stents in the esophagus and trachea.[35] The quality of life also reported to improve after palliative esophageal stenting. [12] Another major problem of esophageal stenting in advanced cancer is the tumour overgrowth which leads to recurrent dysphagia

in patient who is survives long enough.[16, 36] This can be easily intervened with co-axial stent as overlapping stent. [36](Figure 7)

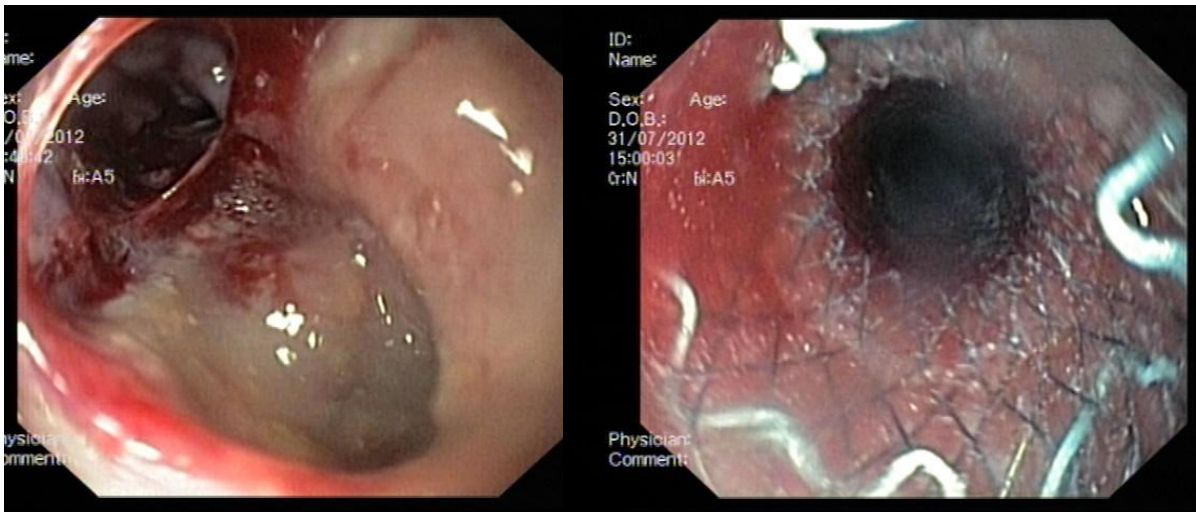


Figure 6. A locally advanced esophageal cancer with tracheoesophageal fistula presented with recurrent aspiration pneumonia and treated successfully with a covered esophageal stent for symptomatic relief.

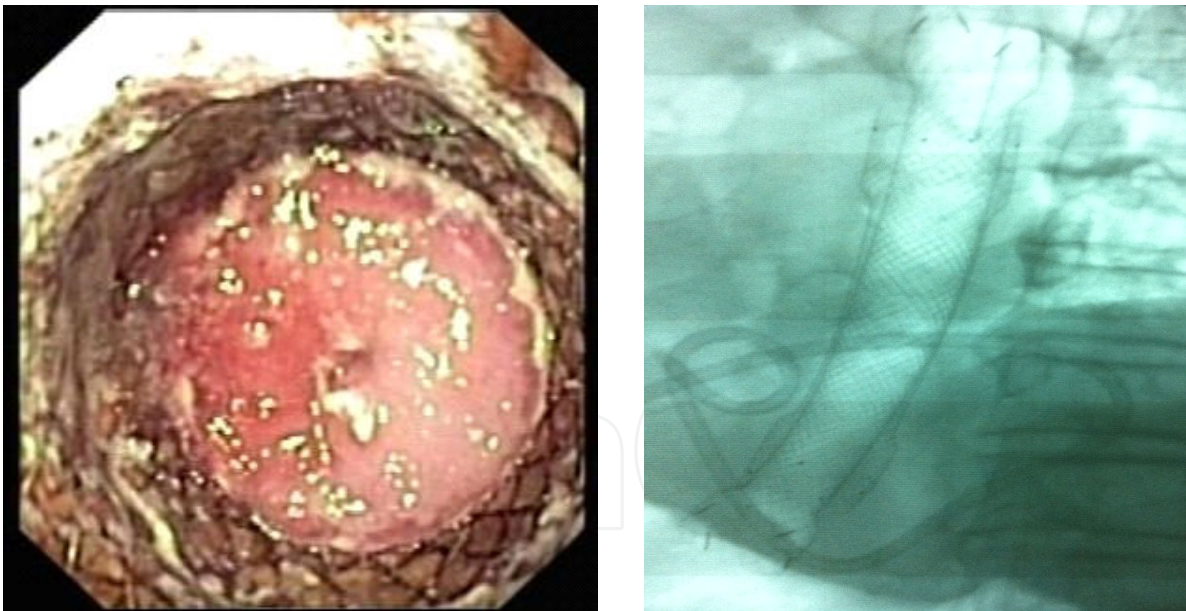


Figure 7. Tumour over growth at the distal end of the covered stent which was treated with another co-axial covered stent across the previous old stent to relieve the obstruction.

Temporary stenting before neoadjuvant therapy

Due to malignancy induced cachexia and dysphagia, nutrition compromise is extremely common for those patients undergoing neoadjuvant chemotherapy or radiotherapy, which result in poorer outcome after surgery. The insertion of stent in this setting has been report-

ed to have higher stent related complication such as migration or perforation and also difficulty of surgery later on. However, with the advent of fully covered SEMS with much reduced complication rate has led to renew interest in this indication.

The use of stenting in neoadjuvant setting results in improvement of dysphagia score and nutrition has been reported in several studies.[37-39] Although it is safe with effective palliation of symptom with minimal complication, the migration does occur up to 48% especially in esophageal stenting across the gastroesophageal stenting.[40] However, the migration of stent is usually indicating a positive response to neoadjuvant therapy and the stent could easily be retrieved prior to surgery.[38] The fully covered SEMS do not appear to compromise surgical resection. [40]There is no increased risk of peri-operative complication due to stent in all these series.

7. Benign esophageal strictures

Benign esophageal stricture in the esophagus can be due to a variety of causes such as reflux esophagitis, corrosive ingestion, post-radiation exposure, etc. The initial treatment of choice is serial dilatations. However, up to 30-40% of these strictures will recur and require repeated dilatation or even surgery.[41, 42] It is particularly important to differentiate between esophageal strictures that are simple (focal, straight strictures with a diameter that allows endoscope to passage) and those that are more complex (long, >2 cm, tortuous strictures with a narrow diameter).[9] These complex strictures are considered refractory when they cannot be dilated to an adequate diameter. The concept of using esophageal stent as a non-permanent dilator provides an alternative treatment of esophageal stricture instead of surgery.[43] The use of non-removable metal stents in benign esophageal stricture has been complicated by hyperplastic tissue reaction, tissue ingrowth, stricture formation and erosion into the surrounding organ. Therefore, removable fully covered self-expanding metal stent is recommended although the problem of tissue reaction or stent migrations also occur with these devices.[44]. The suggested stent of choice to be used in benign esophageal stricture is Polyflex stent (Boston Scientific, USA) as it causes less tissue reaction. This is the only SEPS available in the market and is approved for refractory benign stricture and treatment of trachea-esophageal fistula. This is self-expanding plastic stent made of polyester mesh that is fully covered with a silicone membrane with proximal flare to prevent migration. A systemic review showed the Polyflex is moderate effective, achieving dilatation free remission in 52% cases and achieves lower success rate when dealing with upper esophageal stricture.[8] This could due to more complex anatomy in upper esophagus which prevents effective remodelling of the stricture by SEPS. A recent meta-analysis showed that the efficacy of self-expanding covered stent placement in benign refractory strictures is only 46.2 % and associated with migration rate of 26.4 %.[45] Our early experience with this stent has been quite positive for the management of recurrent and refractory benign stricture. (Figure 8 and 9)

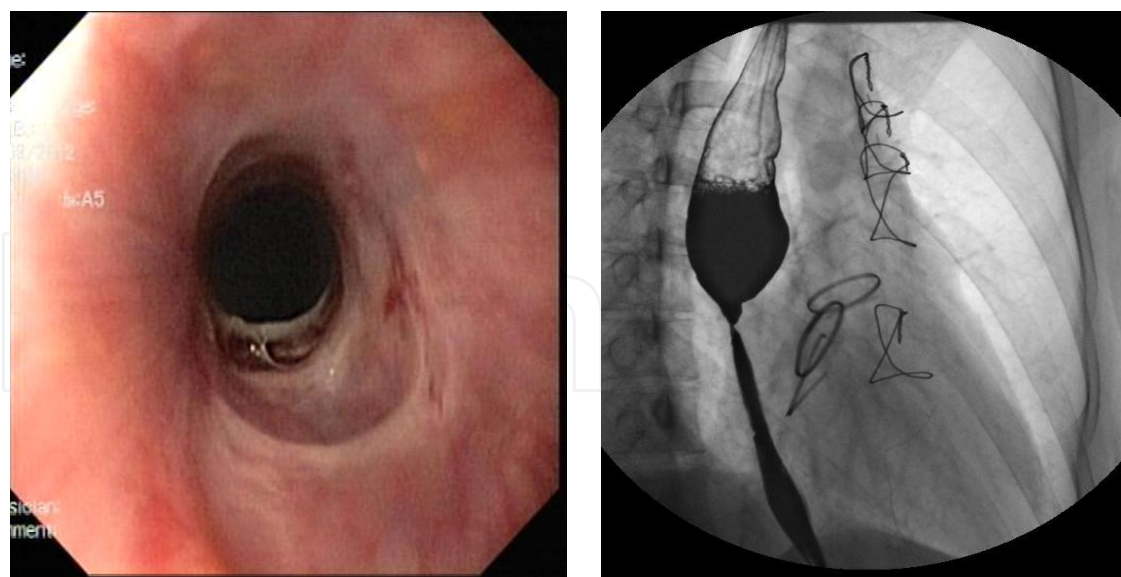


Figure 8. A 35 years old lady developed a short segment benign esophageal stricture at mid esophagus after cardiac surgery for closure of VSD and heart valve replacement. Multiple oesophageal dilatation had failed to relieve the obstruction. A polyflex stent was inserted temporary as non-permanent dilator with good symptomatic relief.



Figure 9. A high pharyngoesophageal stricture after laryngopharyngectomy treated with a proximal release fully covered Nitinol stent (TaewoongNiti-S, Korea) under endoscopic control.

8. Post-operative complication

Anastomotic leak in upper GI surgery is a serious complication especially when the leak is within the thoracic cavity with septic consequences. The sites of leak most commonly encountered are gastroesophageal or gastrojejunostomy or esophagojejunostomy anastomosis. Early intervention from the subtle clinical clues is the key to successful management. Traditionally, the management has most often consisted of re-operation for repair and drainage, prolonged hospitalisation and sometime necessitate resection or diversion which requires subsequent restorative surgery.

The use of endoluminal stenting for esophageal leak instead of surgical intervention has been reported with good outcome.[46, 47] In a large series, up to 77.6% of patients with post-operative leak responded to stenting with a median duration of SEMS treatment of 83 days and the stent should be removed after 6 weeks.[48] Polyflex of SEPS type has also been used with good success rate.[49]

The role of endoluminal stenting in Peri-operative setting could be considered in situations such as:

1. Those patients with an anastomotic leak that are diagnosed late in the course and in whom operative closure is not feasible.
2. Those patients with an anastomotic leak with medical condition who are too precarious for surgical intervention.
3. Those patients with chronic fistula due to anastomotic failure.

However, It has been shown that those anastomotic leak located in cervical esophagus, gastroesophageal junction, esophageal injury longer than 6 cm or an anastomotic leak associated with a more distal conduit leak tend to be not treated effectively with stenting. Therefore, traditional operative repair suggested to be used as initial therapy.[50]

In our practice, the authors found that the fully covered retrievable stent and with large diameter up to 21-23mm should be used for effective sealing of the defect. There is a problem of peri-stent leak especially from the jejunal limb in some cases. However, it is usually a contained leak which could be drained percutaneously under image guidance. (Figure 10) Sometime, another stent has to be inserted across the previous stent for effective sealing. The SEPS is preferred to be used as it causes less tissue reaction and ease to be removed later. The inserted stent should be removed within 2 months and sometime we left it permanently in patient with advanced cancer. Similarly, post-operative anastomotic stricture could also be managed effectively with stent. Leakage at the anastomosis and stapler anastomosis were found to be the risk factors for the development of strictures.[51, 52] Improvement in quality of life and relief of dysphagia could be achieved when dilatation of the stricture fails. In conclusion, endoluminal stenting is a minimally invasive therapy of anastomotic complication which is a safe and effective. It results in rapid leak occlusion and avoids morbidity of re-operative repair.

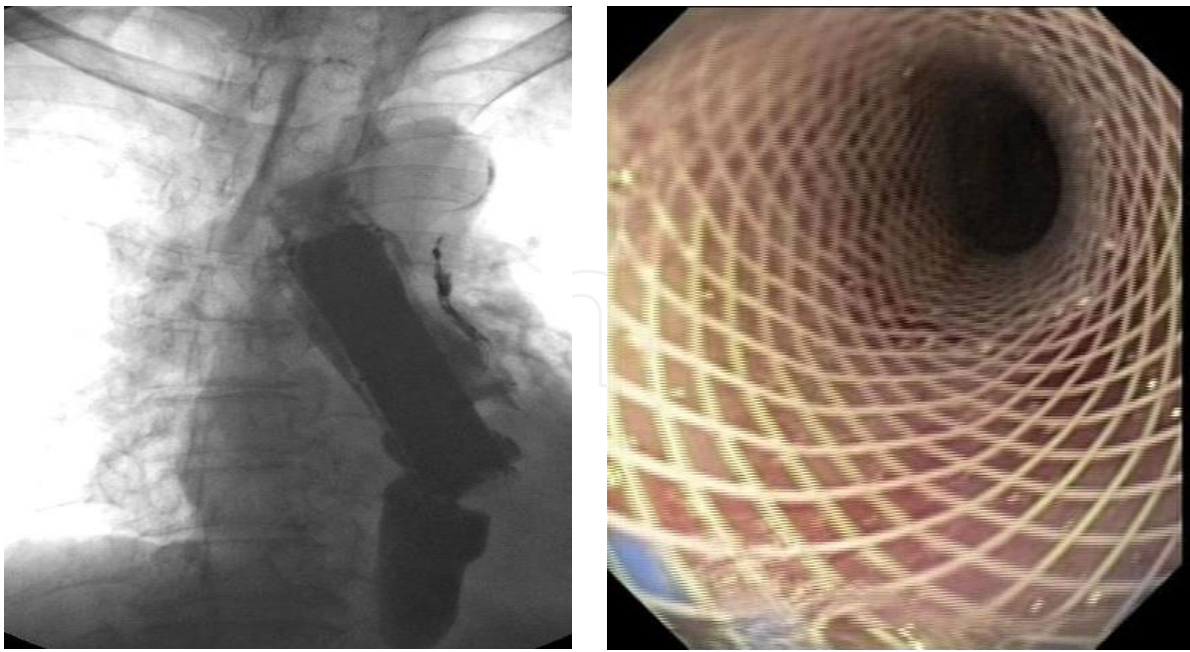


Figure 10. Post esophagectomy anastomotic leak. Two leak points at the anastomotic site located at both lateral corner of the staple line. A fully covered Polyflex stent, measured 21 mm diameter and 90 mm length inserted. The leak was successfully contained and a percutaneously drain was inserted into the chest cavity for external drainage.

9. Esophageal perforation

Esophageal perforation is most commonly iatrogenic induced but occasionally it occurs spontaneously such as in Boerhaave's syndrome. It carries a dismal prognosis due to mediastinitis and severe sepsis. Esophageal stenting has been shown to be effective in managing the leak as a less morbid intervention if compared with surgery.[48, 53] Several case series showed an effective healing leak rate up to 90%.[48, 54] The key to success outcome is prompt recognition of leak with rapid esophageal stenting immediately after the perforation and adequate debridement and lavage of the thoracic cavity. (Figure 11)

10. Stents used in gastric outlet obstruction

The usual causes of gastric outlet obstruction are due to tumour in gastric antrum, duodenal stricture, or obstruction secondary to direct invasion or extrinsic compression from pancreatic carcinoma. The aim in palliation in patients with malignant gastric outlet obstruction is to reestablish oral intake by restoring gastrointestinal continuity. Gastric outlet obstruction was traditionally treated with surgical gastroenterostomy and stenting is usually reserved for patients who are not fit for surgery.

Prolong nasojejunal tube feeding or percutaneous jejunostomy to provide nutrition is not an ideal palliation treatment in those patients not fit for surgical bypass as the tube will cause

significant discomfort in these terminal ill patients. Therefore, internal stenting of the lesion will offer the best method of palliation for these patients, apart from relieve of obstruction but also able them to resume oral intake. (Figure 12) Stents can be successfully deployed in the majority of patients.[55] Stent placement appears to lead to a shorter time to symptomatic improvement, shorter time to resumption of an oral diet, and shorter hospital stays as compared with surgical options.[56] However, surgical bypass results in better long-term outcomes as compared to internal stenting. A recent randomised controlled trial showed that despite slow initial symptom improvement, gastrojejunostomy is associated with better long-term results and is therefore the treatment of choice in patients with a life expectancy of 2 months or longer.[57] Currently, the metallic uncovered stents are commonly used to prevent the risk of migration.

Another interesting use of stent in locally advanced gastric cancer such as linitis plastica type which may cause gastroesophageal and gastric outlet obstruction. The placement of an extra long, covered stent traversing the cardioesophageal junction up to duodenum will provide symptomatic relief (Figure 13). The stent not only provides some degree of peroral intake but is able to relieve of the gastric outlet obstruction probably due to peri-stent flow.

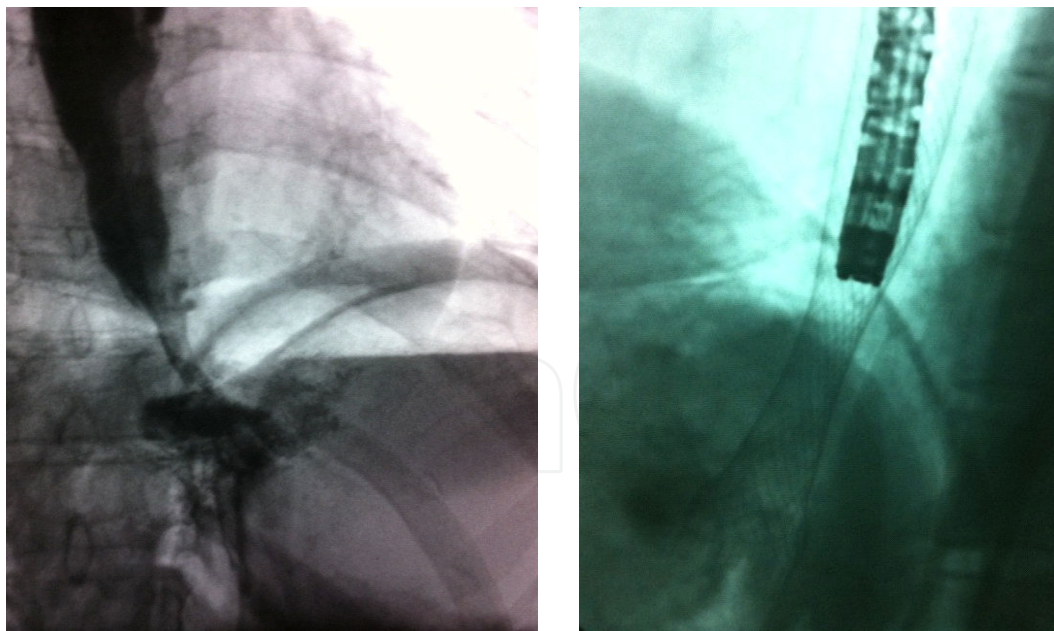


Figure 11. Lower esophageal perforation occurred after endoscopic dilatation and the defect was immediately stented under fluoroscopic control.

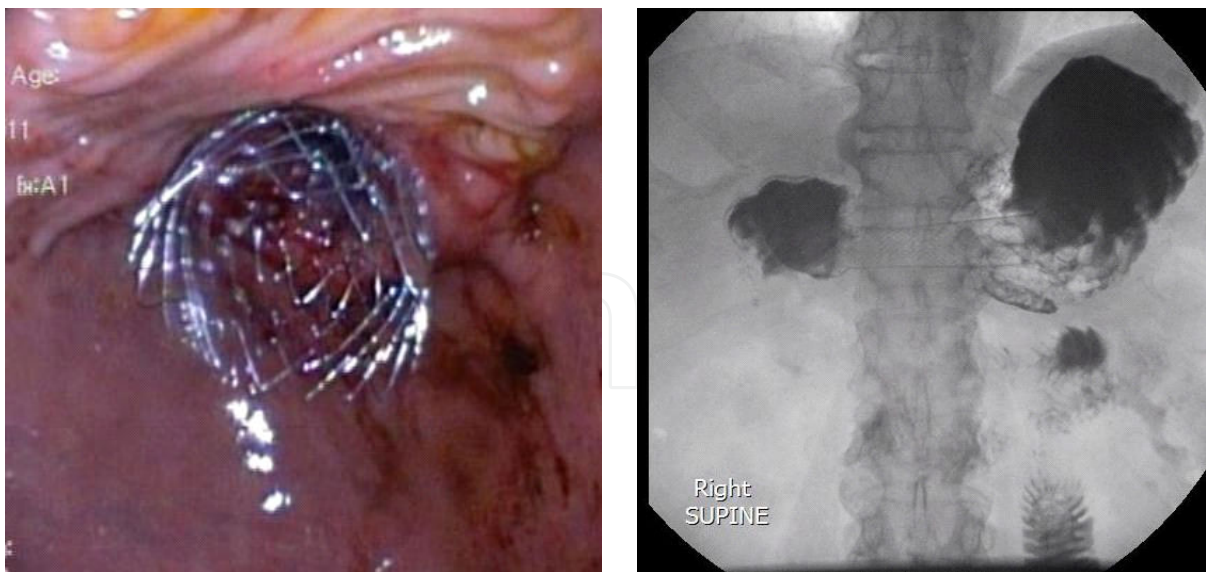


Figure 12. Barium meal showed good of barium trough the through the pyloric obstruction after internal stenting.



Figure 13. An extra long 23cm, fully covered Nitinol stent (Taewoong Niti-S, Korea) deployed crossing the gastroesophageal junction and pylorus in a 'linitis plastic type' gastric cancer to bypass the obstruction.

11. Bariatric surgery

Bariatric surgery has become an effective solution to treat morbid obesity. Laparoscopic adjustable gastric banding and laparoscopic Roux-en-Y gastric bypass carry a mortality rate of 0.1% and 0.5%, respectively. [58] Therefore, surgery on this high risk group of patients can be dangerous especially leak occur and carry a high risk of mortality if not detected and treated expediently. The leak usually arises from stapler line failures due to surgical technique, ischaemia and patient comorbid conditions. In sleeve gastrectomy, the leak site is usually found in the upper sleeve near the gastroesophageal junction.[59] Recently, the placement of long endoluminal stent have been demonstrated to be safe and effective to exclude the leak site, allowing oral intake and speeding healing.[59, 60]

The recent development of bariatric surgery is the placement of the EndoBarrier duodenal jejunal bypass liner which appears to be a promising, safe and effective method for facilitating weight loss.[61] The EndoBarrier is a plastic flexible tube which is endoscopically placed in the duodenal bulb, directly behind the pylorus. It extends from the duodenum to the proximal jejunum. Recent studies have demonstrated significant weight reduction in comparison to control-diet patients.[62] However, the lack of long term result and small samples size studies call for a need for longer randomised controlled trial before its widespread use.[63]

12. Which stent to use

All the stent are equally effective in achieving symptomatic palliation in malignant dysphagia. The type of stent chosen is usually based on subjective physician's preference. However, the stents vary in features such as the ease of insertion, removability, migration and occlusion rates. Covered and uncovered stents have different functional characteristics and stent type must be selected on an individual basis. A recent meta-analysis suggests that SEMS are superior to SEPS in terms of stent insertion-related mortality, morbidity, and quality of palliation.[4] The uncovered variety is disadvantaged by high rate of tumour in-growth.[4] The currently available SEPS, Polyflex is cumbersome to use due to its larger introduced system and higher rate of migration. However, the SEPS is equally effective in relieving dysphagia and useful in case of tissue ingrowth/overgrowth after SEMS placement.[64]

13. Conclusion

Stenting in upper gastrointestinal disease is now fully established in the management advanced cancer and complication due to surgery such as stricture or anastomotic leak. It offers a minimally invasive approach to address obstructive symptom and improve quality of life of patients. In difficult cases, a multi-disciplinary team approach involving sur-

geon, gastroenterologist and radiologist is the corner stone of successful endoscopic palliative therapy.

Continuous innovation of new stent will lead to higher technical and clinical success rates of endoscopic stenting, while reducing complication rates. Therefore, stenting will become much simpler and more convenient to use for physician but also more comfortable for the patients. Future development in stenting includes biodegradable stents for benign disease to reduce stent related complication [65] and radioactive [66] or drug-eluting [67] stents for malignant disease which will decrease tumour growth and sustain the stent patency.

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