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Expandable Metal Stents : Practical Informations for GI Endoscopists

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EXTRACT

This review will briefly provide information regarding all expandable stents available in the market. Indications, contraindications and practical tips for deployment on each type for many GI location of the stents are described in practical way.

Key words : metallic stent, endoscopy, technique

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INTRODUCTION

Currently therapeutic endoscopy has become a major advancement for treatment of many gastrointestinal disorders. For patient with gastrointestinal obstruction by any cause, stenting is accepted as a comparable treatment to bypass surgery. In the early era of stent therapy, plastic stent was a pioneer on treatment for patient with biliary tract obstruction. One of the limitations in the past when plastic stent was used to bypass biliary stricture is early clogging of the stent. The main reason for a very limited patency time of the plastic stent is diameter size of the stent that can not be larger than the accessory channel of the endoscope. The largest stent that can be placed trough the largest channel (4.2 mm.) is 12 F. Over the last decade, expandable metal stent has become available worldwide. The size of the biliary stent now can be 1 centimeter in diameter. By rough calculation the area of bile flow in the expandable stent can be 6 times bigger than the plastic stent. Therefore, it is a standard stent to be chosen now for patient who require longterm patency of the stent.

Initially, this stent was mainly used within the GI tract for palliation of malignant biliary obstruction, but it is now used for palliation of malignant dysphagia, gastric outlet obstruction, and colonic obstruction.

Currently, there are many types of expandable stents available, the differences are usually the material that made the stent. Stainless steel has a higher radial force than Nikle-Titanium (nitinol) one. But nitinol stent has a better flexibility that the stainless steel stent. Therefore, in the angulated area of the stricture, the endoscopist may prefer nitinol stent than the other. When dealing with a very tight stricture area, stainless steel stent give the highest force to expand against the luminal wall. With the new covered stent that recently available in the market, its use has expanded into the idea of sealing fistula between GI system and other organs such as tracheoesophageal fistula. On special circumstance, distal esophageal tumor requires a covered stent that contain an antireflux valve to prevent

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severe esophagitis that come after the lower esophageal sphincter has been widely opened by the stent.

This review will briefly provide informations regarding all expandable stents that available in the market, indications, contraindications and practical tips for deployment on each type for many GI location of the stents.

Basic Informations on Expandable Stents

Currently, there are two techniques for deployment of the stent. The first one is through the scope technique (TTS). With this technique the endoscopist can control the step of deployment under the endocopic image. The delivery system for this stent has to be fit or smaller compared to the size of the accessory channel. The other technique of deployment is to performed outside the scope (non-TTS). With this technique, the endoscopist has to do it in the same way as interventional radiologists by deploying the stent under fluoroscopy. The delivery system for these stents can be as large as 1 cm.

Usually, all esophageal stents and some of colonic stents have to be deployed by non-TTS technique.

Generally, any location in GI tract that can be reached by the scope is stentable but with sharp angulation or tortousity of the anatomy, stent palcement may fail. Esophagus, pylorus, upper small bowel, colon and bile duct are among the commonest sites for stenting. Rarery, stent is placed for pancreatic duct stricture but its use has been published and pancreatic stenting is a new area that need further evaluation[1].

Stenting strictures close to anal canal and upper esophageal sphincter may cause annoying problems. Tenesmus has been reported form rectal stent and oropharyngeal dysphagia is a possible complication that develop after a very high esophageal stent placement.

There are three main indications for GI stenting. The most common one is bypassing luminal GI strictures. Second common indication that recentely well accepted is placing covered stent to seal fistula in a special area such as tracheoesophageal fistula and vesicorectal or colonic rents. The third indication is to improve patient quality of life by changing two stages into only one stage surgery in patient with colonic obstruction who usually require a colostomy first. With colonic stenting, patients can be prepared and also improving their nutrition prior to a definitive one-stage surgery for resection of the tumor followed by reanastomosis.

Many expandable stents has a significant degree of shortening after deployment, therefore positioning of the stent precisely and accurate estimation of the stricture length prior to deployment are very important. Stainless steel stent has the highest degree of shortening. Its radial force against luminal wall is also very strong. Placing this stent may cause perforation in the area of very thin wall[2,3] .

Complications related to stenting

Usually, early complications are related to endoscopic procedure and sedation. Aspiration is one of the most common complications since majority of these patients may have a lot of food residual due to impairment of food passage. Stent malposition is a nightmare event for inexperienced endoscopists. Repositioning is usually difficult and required stent to be reloaded, many experts recommend placing a second stent instead.

Bleeding can occur immediately or later depend upon the etiology. The most common cause is tumor or granulation tissue oozing nearby the stent.

Uncovered stents bare a condition called “tumor ingrowth”. The tumor tissue can grow through the mesh and cause luminal obstruction. Tumor ablaion by laser or chemical agents or placing a second stent is usually required. Deploying covered stents may overcome this problem but many endoscopistes still face “tumor overgrowth” which is a condition that happen in patient who live long enough. The treatment of this complication is possible only by placing a second stent above or below the area of tumor overgrowth.

Food impaction is usually happened in upper GI tract stents. This condition may mimic tumor ingrowth by radiography. Endoscopy is not only able to distinquish these two conditions but also provide therapeutic modality. By scope manipulation or forcep poking the food is usually dislodge easily.

Pain is also common after stent placing. It usually lasts during the expanding period of the stent. Some patient may develop pain more and more after the stent has embedded into the esophageal mucosa. This may be secondary to poor stretching and peristaltic pain of the fixed esophagus by the stent.

Esophageal Stents

There are many types of esophageal stents available in the market (Table1). The differences are material of the stents, covering membrane, and antireflux

valve. A study by Siersema demonstrated an equal degree of palliation for dysphagia by Z stent, ultraflex and flamingo wall stent but Z stent was associated with more complications than others[4].

Patients with a stricture in the mid esophagus can use any esophageal stent but the stricture caused by extrinsic mass, a stent with high radial force is prefered. The major benefit of covered stent is to seal a fistula but there are many reports regarding early stent migration due to poor tissue embedment[5]. With double layers stent or a bare-end stent this problem may be solved. Patients with cardial lesion also develop distal migration of the stent easily. They have a higher possibility of reflux esophagitis due to wide open lower esophagus, therefore it is recommended to place antireflux stents in these patients. The valve to prevent reflux can be a wind sock system or tricuspid one, it usually made from polyuretrane membrane and last long enough until patients die. Extreme proximal tumor is usually refered as a relative contraindication due to a possibility of oropharyngeal dysphagia that may develop after stent placement. This is usually caused by stent ablating upper esophageal sphincter tone.

All esophageal stent have to place outside the scope with or without fluoroscopic guidance. A diagnostic scope is preferred since it can traverse the stricture easier than a larger scope. If the scope can not pass the stricture placing a guidewire will overcome this problem. Dilation of the stricture to place the stent is usually not recommended unless the delivery system can not pass the stricture. Dilation if required will not exceed 36 F since the largest delivery system diameter is 1 centimeter (Z stents and Korean stents). A very proximal or distal stricture will require a marker. The marker can be placed externally by opaque material or internally by hemoclip or lipiodol injection. At least a proximal site has to be marked under fluoroscopy while a scope is just above the tumor. Ultraflex stents are available for both proximal and distal release system. Proximal release type can be helpful while placing a stent for proximal obstruction since the endoscopist can push the stent downward while releasing if the position of the stent is not proper. Vice versa, a distal release system can be pulled while placing stent in the distal esophagus.

Enteral Stents

There are many sites in the upper GI tract that can cause obstruction. Pylorus is usually obstructed

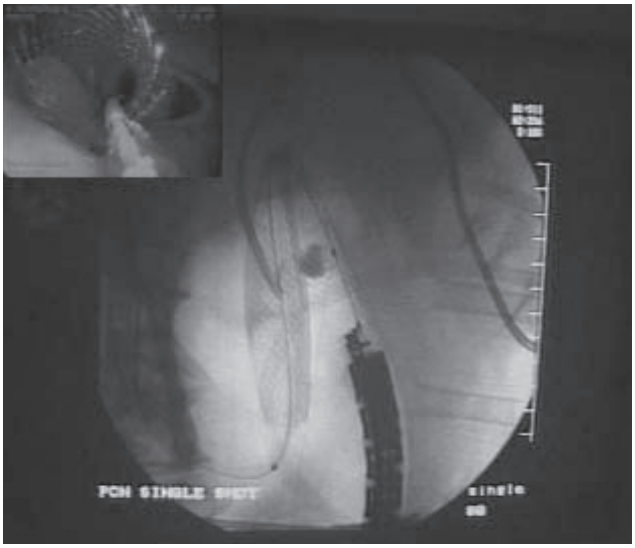

Figure 1 Pyloric stent in patient with malignant pyloric obstruction

by gastric cancer (Figure 1). Second part of the duodenum is mainly involved by carcinoma of the pancreatic head. On the other hand, cancer of pancreatic body usually obtructiong third and fourth part of duodenum. Other parts of small bowel can be obstructed by metastatic cancers or lymphoma. Enteral wallstent is the only stent available nowsaday that can be placed for small bowel strictures. With adaptation ultraflex for esophageal stricture can be placed for pyloric stricture but this has to be done outside the scope. Technique for small bowel stent placement has to begin with enteroscopy and guidewire exchange. Later, a 240 cm. delivery system can be passed through the scope for stent deployment. Prior to stent placement barium study of the small bowel is recommended to check for anatomy, site and length of the obstruction. If there are multiple sites for obstructions the farthest site has to be reachable by the scope otherwise there is no use for only proximal site stenting. Limitations for enteral stent placement are varies, some of the most common causes are severe looping of the stomach, stricture beyond the reach of the scope, inability to pass the guide wire, post surgical anatomical change. Stricture that too far but almost reachable by the scope may get a short cut by placing a stent trough the mature gastrostomy tract. Sometimes, external compression may help the scope to advance further down.

The absolute contraindications for enteral stenting are free perforation and tension pneumoperitoneum. At this moment benign stricture is not advisible for

stenting. Documented peritoneal carcinomatosis may not get full benefit from this procedure. Bile duct stenting may require prior to stenting second part of the duodenum since it is difficult to access the papilla again after this. Some centers recommended biliary stenting later via percutaneous approach.

Overall technical success for this procedure is reaching 95%. Eighty per cent of patients who had a stent were able to take food by mouth with significant improvement in dietary score[6,7]. Moreover in patient with concomittant biliary obstruction, it was successfully managed in 92%[6,7].

It has been proved that enteral stenting provide a similar median survival (90 days) to surgical bypass. Interestingly, stenting has a lower hospital charge and also a shorter hospital stay than surgery. Wong *et al.* reported that 30 days mortality rate in patients who underwent surgical bypass was significantly higher than enteral stenting (18 vs 0%)[8].

Colonic Stents

The main puposes for colonic stenting in general are preoperative decompression for patient with acute colonic obstruction from left sided cancer and palliative treatment for advanced cancer. Occasionally, stenting will be selected for resectable tumor in patient with poor comorbid illness who can not tolerate laparotomy. Patient with colonic fistula connected to bladder or vagina will have benefit from covered colonic stent. Unfortunately, the enteral stent that can be placed in the right sided of colon is available only for non-covered version, therefore sealing ascending colonic fistula may be impossible at this moment.

To date, there are many colonic stents available, majority of them have to be placed outside the scope since the delivery system are usuallay larger than 5 mm. The enteral wall stent is the only stent that can be placed through the scope. Moreover, it is the system that can be placed for right sided colonic lesion.

Prior to stent placement, the barium or water soluble enema is a requisite prior to stenting to assess the colonic anatomy, length and degree of obstruction. More importantly a synchronous colonic cancer that may cause proximal obstruction has to be excluded prior to stenting. It is possible to place tandem stents for a long stricture or a second stent across the proximal site of colonic obstruction but this will be very costly and technical demanding.

Usually, colonic preparation is unneccessary especially left sided lesion. Moreover, patient presented with abdominal distension, bowel preparation is contraindicated due to a possibility of complete colonic obstruction. Usually, fluoroscopy is required in patient with colonic obstruction but endoscopy may not be needed if the colon is not tortous. Broad spectrum antibiotics is recommended for a very dilated colon due to a possibility of bacteremia from microperforation during stenting. Patient can be placed laterally or supine. If the stent is placing through the scope, prone position may be helpful to prevent over distension of the obstructed colon while air is insufflating from the scope. If the scope is not able to pass beyond the stricture, injecting the water soluble contrast through ERCP catheter above into the proximal colon after guidewire placement is preferred. This is to prevent iatrogenic guide perforation and misplacement of the stent.

The result of colonic stent for preoperative bowel decompression is promising. Martinez-Santoz *et al.* reported that more than half of the patient from the stent group were able to avoid colostomy and went for one stage surgery. They also demonstrated a shorter hospital stay, ICU stay in this group[9].

The most worrisome complication from colonic stenting is perforation. It is advisable to avoid this by not performing post stenting colonic balloon dilation due to a higer rate of perforation[10-12]. Distal migration can occure if the stent is too small or the esophageal stent is used with the enlarged flange upside down. With a new ultaflex precision system, the stent has the upper part larger. The advantage of this stent to prevent distal migration is awaiting from many ongoing studies. Bleeding as a complication is low (0-5%) reported by Khot *et al.*[12] If the lesion is to close (within 2 cm) to the anal canal, post stenting tenemus may develop. About 15% of patients reported recurrent colonic obstruction from stool impaction, therefore low residue diet is advised[12]. Tumor ingrowth is another delayed complication that can be fixed by placing a second stent through the first one but differentiating this from stool impaction by endoscopy is necessary prior to restenting.

Biliary Stents

Despite many metallic stents available worldwide, biliary stent is taking part as the main market share. In addition, techniques that required for all kinds of stenting are adapted form biliary skill. Endoscopist has to be acquainted to biliary devices since some of

them may be needed for non-biliary stenting.

Biliary stenting can be categorized into two location; hilar and non-hilar. The stents that available are made from either stainless steel or nitinol. The stainless steel stent has a significant degree of shortening, whereas nitinol one usually has a stable length after deployment. Nitinol is a material that hardly seen by roentgenogram. Since placing biliary stent always requires fluoroscopy, therefore extra markers are placed on the nitinol stent for more clarified location during stent placement.

The benefit of metallic stent is a longer patency. Usually patency of plastic stent for distal CBD stricture is usually less that 6 month. The larger diameter usually has a longer duration. In contrast, patency of stent in hilar lesion is much shorter due to a longer stent that needed to bypass the higher lesion from the ampulla. Results form our recent publication has shown a shorter patency of plastic stent in advanced hilar stricture compared to distal CBD stricture (41 vs 87.2 days)[13].

The mean duration of biliary metallic stent patency is around 250 days[14]. The main cause of obstruction is tumor ingrowth through the mesh. Recently, with a new development by adding polyuretrane membrane on the mesh the new stent will be able to prevent this problem and has a longer patency.[15-17] Results from a larger comparison studies are required. It has been noted that the covered stent is not applicable to hilar lesion due to the possibility of intrahepatic ducts being occluded by the membrane.

Technique for placing biliary stent for distal CBD lesion (Figure 2) is not different from other locations . In addition to guide-wire exchange, stricture dilation may be required. Dilation can be success by using either Soehendra or balloon biliary dilator. The size of dilation does not need to exceed 10 F since the largest delivery system is 9 F.

There are many debates on whether how many stents are needed for hilar obstruction.

Gostamagna *et al.* suggested a better outcome of patients with hilar obstruction who underwent multiple stents placement compared to unilateral stent placement[18]. Unfortunately, double stenting may be failed in a very tight stricture. This intern may lead to a higher rate of post ERCP cholangitis[19]. De Palma *et al.* reported an excellent result on unilateral hilar plastic stenting. They reported a success rate of 97% for stent insertion with a low rate of early cholangitis (5%) in 61 patients. About 86% of them were able to clear their jaundice[20].

The most very important pitfall for double hilar stenting with metallic stents (Figure 3) is placement of guide-wire bilaterally before placing the stent. After accessing the tight stricture by a hydrophilic guidewire, exchange the wire to a more stiffer one is usually recommended. This has to follow by stricture dilation by the technique mentioned above. It is advisable to place a stent into the left system or the most difficult site first. The second stent has to follow the first one as soon as possible since the expanding first stent will preclude passing the second stent along.

Another technique for placing double hilar stent is placing the second stent through the first one. With

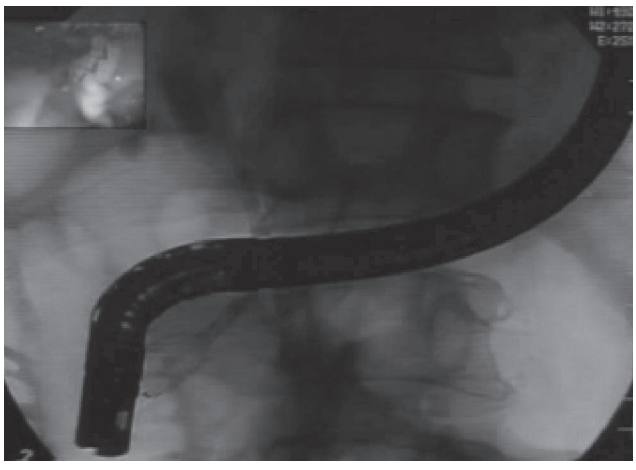

Figure 2 Metallic stent for distal CBD stricture

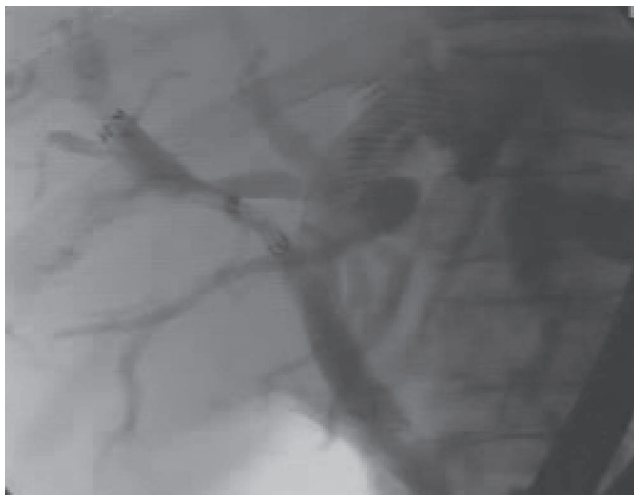

Figure 3 Double metallic stents in patient with hilar cholangiocarcinoma

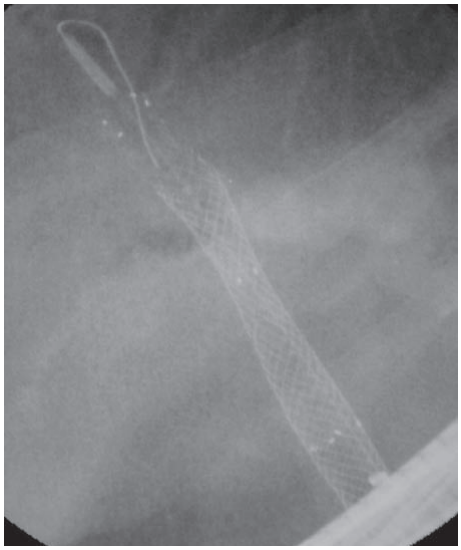

Figure 4 Second metallic stent in patient with tumor ingrowth

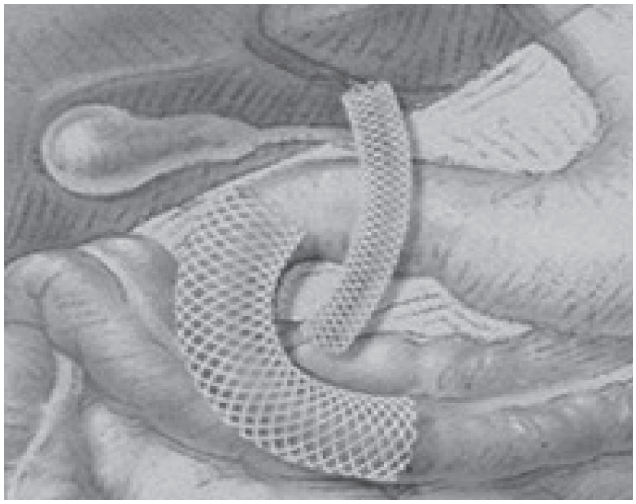

Figure 5 Double metallic (enteral and biliary stent) in carcinoma of at head of the pancreas causing biliary and duodenal obstruction

this technique, the first stent has to be a wide mesh stent such as a diamond stent otherwise balloon dilation through the mesh is required. Thereafter, the second stent can be placed through the wide-open mesh.

One of the major culprits of double hilar stenting is inability to access the stent afterward. Due to the length of the stent available in the market is shorter that the length required for hilar tumor (8 cm. the most), therefore it is almost impossible to selectively re-enter the two stents that run parallel to each other and have both lower ends inside the bile duct.

Early complications from bilary stenting apart from post ERCP cholangitis are related to endoscopic procedure and sedation. Late complications are mainly by tumor ingrowth or outgrowth. This can be treated by restenting with either plastic or metallic stent (Figure 4). In addition, distal migration and bleeding may develop later after stenting. Distal migration is rarely happen but it develops more often with a covered stent. Bleeding post stenting is not only caused by post sphincterotomy but also occur in case of distal end of the stent causing duodenal ulcer.

Patient with pancreatic head tumor causing distal CBD obstruction has a higher chance of developing duodenal obstruction. The recommended treatment for this condition is placing a duodenal stent (Figure 5).

CONCLUSION

In summary, metallic stent is a new non-operative treatment for patient who required surgical bypass in the past. Main indications are luminal obstruction, fistula, and preoperative decompression in colonic cancer. Biliary stenting is the most common procedure performed nowadays for metallic stenting. It is advisable that endoscopist has to be familiar with ERCP and guide-wire exchange prior to performing these procedures. The results of stenting are usually similar or better than surgery. Complications are usually related to endocopy technique and sedation. Tumor ingrowth is the most common delayed complication overall. This can be retreated by restenting. Careful patient selection is recommended since the cost is still relative high, otherwise the result can not be called as “excellent”.

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