Gastrointestinal Intervention

journal homepage: www.gi-intervention.org

Review Article

Through the keyhole: Radiological management of malignant gastric outflow obstruction beyond the pylorus

Robert Charles Stockwell,^{1,*} Ji Hoon Shin²

ABSTRACT

This review article presents the radiological options for management of malignant gastric outflow obstruction distal to the pylorus. We place these options in context with surgical and endoscopic alternatives and recommend their use, particularly in those institutions where endoscopic alternatives may not be readily available.

Copyright © 2016, Society of Gastrointestinal Intervention. All rights reserved.

Keywords: Duodenal obstruction; Self expandable metal stents; Technology, radiologic

Introduction

Malignant gastric outflow obstruction (MGOO) is an unpleasant and potentially life-shortening condition. MGOO can result from primary tumours of the stomach and duodenum. It can occur as a local effect of pancreatic, bile duct and hepatic tumours. It can also be caused by secondary deposits from other tumours or lymphoma.^{1,2}

Currently the management of MGOO is largely based on the endoscopic placement of a self-expanding metal stent (SEMS) or surgical gastroenterostomy.³ The purpose of this treatise is to discuss the role and technique of radiological stent management of MGOO arising beyond the pylorus.¹

Digression

Before embarking upon this, and with the kind beneficence of the editor, some clinical aspects of MGOO require highlighting.

Gastric outflow obstruction due to malignancy is an unpleasant outcome of a number of malignancies affecting the upper abdomen.^{1,2} The patient typically presents with large volume and/or projectile vomit every two to three days and an apparent ability to eat and drink normally in the intervening periods.^{1,2} At presentation, they may not be known to have a malignant condition. It is the very episodic nature of the vomiting that is both the hall mark

of MGOO and also a cause of failure to consider it as a diagnosis. This can result in patients with MGOO not having the condition managed within a satisfactory period of time.¹ This can lead to the patient being more debilitated than need be when management is undertaken. All patients, therefore, who have symptoms of MGOO, should have this condition considered and investigated early rather than seizing on the “normal” intervening periods.

Having considered, as outlined above, the diagnosis of MGOO, how may it be investigated? A simple plain film (Fig. 1) may show a distended stomach. Upper gastrointestinal fluoroscopy in many cases will outline the obstruction (Fig. 2) as will gastroscopy although retained food within the stomach can limit views. Computed tomographic or magnetic resonance imaging of the abdomen can also confirm and delineate the diagnosis (Fig. 3).

There are many avenues to confirm the diagnosis, some simple, some more complex. The diagnosis must, however, be considered in the first place.

Evangelism is over and now on with the discussion.

Management of MGOO

The diagnosis of MGOO having been considered and confirmed, how may it be managed?

If not already under the care of a Multidisciplinary Upper Gastrointestinal Team, the patient should be urgently referred to

¹Department of Radiology, Lancashire Teaching Hospitals NHS Foundation Trust, Preston, UK

²Department of Radiology and Research Institute of Radiology, University of Ulsan College of Medicine, Asan Medical Center, Seoul, Korea

Received September 25, 2015; Revised October 27, 2015; Accepted October 30, 2015

* Corresponding author. Department of Radiology, Chorley and South Ribble District General Hospital, Preston Road, Chorley, Lancashire PR7 1PP, UK.

E-mail address: Robert.stockwell@lthtr.nhs.uk (R.C. Stockwell).

Fig. 1. Distended stomach on plain film. Gas-fluid level (white arrows). Outline of greater curvature of stomach (black arrows).

Fig. 3. Computed tomographic coronal image shows distended stomach (black arrow).

Fig. 2. (A) Distended stomach on barium study. Gas-fluid level (white arrows). “Falling barium” characteristic of malignant gastric outflow obstruction (black arrows). (B) Barium outlining stricture in 2nd/3rd part of duodenum. Stricture (black arrows).

such a team. The means of managing MGGO fall into three broad categories—surgical, endoscopic, and radiological. None of these has pre-eminence over the others. There should be no “turf war” between speciality groups. The patient should be managed by a team.^{4,5} If the patient’s disease and clinical status permits they should be treated with radical intent—usually surgical resection following neo-adjuvant chemotherapy. If the patient is clearly at a late palliative stage then considerably less aggressive measures should be undertaken—best supportive care. The majority of patients, however, lie between these two extremes of the spectrum and other means must be found to relieve their MGGO.

Surgical Management

Surgical management is based on bypass of the stricture most commonly a gastroenterostomy or a duodenoenterostomy depending on the level of obstruction.³ Whilst in many patients these procedures can be carried out utilising minimally invasive or laparoscopic surgery, all require the patient to be fit enough to

undergo a general anaesthetic. There is also a variable but often lengthy period of postoperative recovery required.

Endoscopic Management

Endoscopic management is centred on the placement of a SEMS across the stricture.⁶ This procedure generally requires the patient to be fit enough for conscious sedation. A suitable endoscopic skill set is also required. More distal levels of obstruction (e.g., 4th part of duodenum, proximal jejunum) may prove difficult to access with standard endoscopy equipment.⁷

Of these options the placement of a SEMS is currently the most frequently undertaken.⁶ SEMS insertion is most likely to be carried out endoscopically with fluoroscopic assistance.

Radiological Management

Radiological management of MGGO is also based on the placement of a SEMS across the obstructing stricture.

Radiological insertion of SEMS in the gastrointestinal tract using catheter-guide wire techniques has been undertaken for over twenty years, initially in the oesophagus to relieve obstruction from oesophageal cancer. As experience with management of such oesophageal strictures has grown, together with developments in stent technology, progress has been made further down the upper gastrointestinal tract. Initially this has been to stent obstructing stenoses within the stomach.⁹ This is essentially a natural progression of the oesophageal stent insertion technique, albeit using different SEMS designs.

In order to place a SEMS in the duodenum using catheter-guide wire techniques, there are two potential access routes, per-oral or percutaneous (transgastric). Each of these will be considered in turn commencing with the per-oral approach.

Per-oral Approach

Use of the mouth to access the upper gastrointestinal tract is a long established technique.⁹ In order to insert a SEMS to the duodenum using catheter-guide wire techniques, a number of issues must be considered. The standard length of radiological catheters is 100 cm and the duodenum is a comparatively long way from the incisors. The access is anything but a straight line, involving at least three right angle bends before reaching the target area. As noted earlier, the stomach is often distended with fluid and food debris which causes difficulty with catheter-guide wire manipulation. Finally the stricture to be dealt with is physically beyond all of these considerations.

In order to maximise success with the per-oral approach, preparation of the patient is important. This preparation is primarily based around getting the stomach empty prior to the procedure. Whilst one of the defining features of MGGO is large volume vomiting, this is not the safest method of emptying the stomach. A more appropriate means is placement of a nasogastric tube (NGT) of sufficient calibre to permit temporary drainage of the stomach.¹⁰ Such a drainage tube should be placed 24 to 48 hours prior to the planned stent insertion. During this period the patient may have oral fluids to assist in breakdown of the solid material present in the obstructed stomach. Such drainage offers a number of advantages. The risk of aspiration by the patient dur-

ing the procedure is reduced. The volume of the stomach is also reduced as is the amount of any remaining food debris. Both of these make catheter-guide wire manipulation within the stomach less difficult.

The means of stent placement using this approach are in essence an extension of the standard insertion technique for an oesophageal stent.

The patient is monitored, supplementary oxygen is administered via nasal cannulae and intravenous access is obtained. The patient is placed in a left lateral decubitus position. Topical anaesthesia (Xylocaine spray; AstraZeneca UK Ltd., Cambridge, UK) is applied to the oropharynx and hypopharynx. Intravenous conscious sedation can be administered if so desired.

A steerable catheter (5 Fr Biliary Manipulation Catheter 40 cm; William Cook Europe, Bjaeverskov, Denmark) together with flexible guide wire (Bentson Cerebral Wire Guide 145 cm; William Cook Europe) are placed in the oropharynx and manipulated under fluoroscopic guidance to the oesophagus. Intra oesophageal position is confirmed with injection of water-soluble contrast media (Omnipaque 300; GE Healthcare AS, Oslo, Norway). Catheter exchange is undertaken (5 Fr H1 100 cm; Cordis Corp., Cashel, Ireland) and the catheter-guide wire combination manipulated into the stomach. The patient is then turned into a supine position (Fig. 4A). The catheter-guide wire combination is then manipulated to the duodenum, taking due care to prevent looping of the catheter within the stomach. A guiding sheath may be helpful to prevent looping of the guidewire.¹¹ Once the level of obstruction is reached, catheter and guide wire are manipulated across the stricture (Fig. 4B). A hydrophilic wire (Terumo Europe NV, Leuven, Belgium) may be used to facilitate this passage. Once the stricture has been traversed, the catheter-guide wire combination should be placed as far distal to the stricture as possible. The wire should then be exchanged for a long (300 cm) stiff wire (Amplatz Extra Stiff Wire Guide; William Cook Europe). Following placement of the stiff wire the stent may be inserted (Fig. 4C, 4D). A SEMS manufactured with Nitinol and of a woven or knitted construction is preferred (EGIS stent; S&G Biotech Inc., Seongnam, Korea). Our most commonly used stent size is 22 × 100 mm. This diameter provides sufficient lumen for passage of gastric contents and length covers most anticipated stricture lengths. Despite all

Fig. 4. (A) Per-oral technique. H1 "headhunter" catheter (white arrow) in the stomach with contrast outlining duodenal stricture (white asterisks). Nasogastric tube tip (NGT) in stomach (black arrow). (B) H1 "headhunter" catheter (white arrow) across stricture (white asterisks). NGT tip in stomach (black arrow). (C) EGIS double bare Nitinol stent (22 × 100 mm, S&G Biotech Inc.; black arrows) post deployment across stricture (white asterisks). (D) EGIS double bare Nitinol stent (black arrows) fully expanded 24 hours post deployment.

attempts, however, to ascertain the length of the stricture prior to the procedure, the true length of the stricture may only be revealed following initial stent deployment. Consequently two stents may be required, placed coaxially with overlap of approximately 50%.¹

Radiological placement per-orally is successful in 83% to 94% compared with endoscopic placement success of 92% to 100%.^{1,12–14}

Advantages of catheter-guide wire per-oral placement with respect to endoscopic placement are:

- The use of smaller diameter equipment which is generally better tolerated by the patient than an endoscope.
- The ability to place a catheter on the far side of the stricture allows more precise placement of stents, particularly in very tight strictures which are not negotiable by a scope.
- The technique is essentially an extension of catheter-guide wire oesophageal stent placement, a widely available procedure in radiology departments.⁸

Disadvantages of per-oral catheter-guide wire placement are:

- The distended nature of the stomach despite drainage can lead to difficulties with catheter looping and subsequent difficulty in catheter manipulation.
- Similar issues can also arise when passing the stent system over the stiff wire. Endoscopic placement by the very nature of the scope is a more supportive means of delivering both the initial wire and the stent.
- The limits placed on the per-oral approach by the length (100 cm) of standard catheters means this approach is practically limited to the junction of D2 and D3. This is, however, dependent on the degree of residual gastric distension.

Percutaneous or Transgastric Approach

This approach offers advantages over both endoscopic placement and per-oral catheter-guide wire placement.

The percutaneous approach to stent placement starts, as with the per-oral approach, with pre-procedure drainage of the stomach by large bore NGT. In addition to reducing the chance of patient aspiration during the procedure, this drainage also reduces the likelihood of peritoneal spillage during access to the stomach. The NGT also provides a means of insufflating the stomach prior to percutaneous access.

The patient is monitored. Supplementary oxygen is given by mask or nasal cannulae. Intravenous hyoscine butylbromide is administered to paralyse the stomach. The stomach is insufflated by means of the NGT. With fluoroscopic assistance in both posteroanterior (Fig. 5A) and lateral planes (Fig. 5B) a suitable site for skin puncture over the distended stomach is located and marked. Ideally this site should be in the distal body of the stomach or antrum to permit a short and straight route to the pylorus.¹ If so desired, intravenous conscious sedation can be administered. The procedure can, however, be readily performed without such sedation. Following skin cleansing and instillation of local anaesthetic (10 mL 2% plain lidocaine) from skin to anterior gastric wall, two or three gastropexy sutures are placed around the mark with the assistance of lateral fluoroscopy. Definitive puncture (Fig. 5C) is made and the needle angled towards the pylorus. A guide wire (Bentson Cerebral Wire Guide; William Cook Europe) is placed and over this a 6 Fr vascular sheath is positioned, again directed to the pylorus. A Biliary Manipulation Catheter (6 Fr 65

Fig. 5. (A) Percutaneous technique. Stomach distended with air (white asterisks) following insufflation via nasogastric tube (NGT; black arrow). Puncture site selection in posteroanterior plane (white arrow). (B) Stomach distended with air (white asterisks) following insufflation via NGT (black arrow). Puncture site confirmation in lateral plane (white arrow). (C) Two gastropexy sutures (white asterisks) *in situ*. Definitive puncture (black arrow) between sutures. (D) The 6 Fr vascular sheath (white arrows) placed between gastropexy sutures (white asterisks) and angled towards pylorus. Biliary Manipulation Catheter (William Cook Europe; black arrow) in duodenum. Stricture (black asterisks) delineated by contrast. (E) Biliary Manipulation Catheter (black arrow) manipulated across double duodenal stricture (black asterisks). (F) Amplatz Extra Stiff wire (William Cook Europe; white asterisks) deployed into the jejunum. The 6 Fr vascular sheath exchanged for 11 Fr vascular sheath (black arrows). Two EGIS double bare Nitinol stents (22 × 100 mm, S&G Biotech Inc.; white arrows) deployed across double duodenal stricture. (G) Following removal of the Amplatz Extra Stiff wire the insufflated air is aspirated via the 11 Fr vascular sheath (white asterisks) and the NGT (black asterisks) prior to gastropexy suture release.

cm length; William Cook Europe) is then used to manipulate the wire to the duodenum (Fig. 5D) and across the stricture (Fig. 5E). A hydrophilic wire (Terumo Europe NV) may be of assistance in traversing the stricture. For more distal strictures in the distal 3rd and 4th parts of the duodenum and the proximal jejunum, it may be necessary to exchange for a longer catheter such as an H1 (Cordis Corp.). Once the stricture has been traversed an Amplatz Extra Stiff wire (William Cook Europe) is deployed. The 6 Fr vascular sheath is exchanged for an 11 Fr vascular sheath to enable insertion of the 10 Fr stent delivery system. Over the wire a suitable Nitinol woven or knitted stent is deployed (Fig. 5F). A shorter deployment system than that used for the per-oral approach should be utilised and a number are available (EGIS double bare pyloric stent, S&G Biotech Inc.; NITI-S pyloric stent, Taewoong Medical, Goyang, Korea). Typical stent size again would be 22 × 100 mm. In general uncovered stents should be used to diminish the chance of occlusion of the ampulla of Vater. Once the stent has been deployed, the insufflated gastric air should be aspirated via both the NGT and the indwelling vascular sheath (Fig. 5G). Deflation of the stomach can be monitored fluoroscopically. When the stomach has been decompressed the vascular sheath can be removed and the gastropexy sutures released. It is not necessary to leave a drainage gastrostomy providing stent deployment has been successful. The patient may commence free fluids immediately if no sedation has been utilised (or once the effects of sedation have passed). Providing these are tolerated, the NGT can be removed after 6 hours.

Success with percutaneous placement is 90% on a par with endoscopic placement of 92% to 100%.^{1,12}

Not all patients are suitable for a percutaneous approach. An absolute contraindication is evidence of proximal tumour infiltration in the anterior gastric wall. Such infiltration disrupts the normal anatomy of the gastric wall musculature which in normal circumstances acts as a self-sealing structure. Attempting to place any device across an infiltrated wall risks splitting the tumour, causing bleeding, perforation and peritonitis. Relative contraindications include large volume ascites, abnormal clotting and the presence of extensive varices across the anterior gastric wall.

Advantages of the percutaneous approach over per-oral catheter-guide wire or endoscopic stent insertion are:

- The procedure may be carried out purely under local anaesthesia of the anterior abdominal and gastric wall. Sedation is not required, although it can be utilised if desired.
- The shorter, more direct approach to the pylorus and subsequently the site of the stricture negates the issue of catheter-guide wire looping in a distended stomach.
- The position of the access site also allows a shorter approach to more distal lesions in the third and fourth parts of the duodenum and the proximal jejunum. These regions are frequently difficult to reach via the per-oral route using either catheter or endoscope.
- Should it prove impossible to traverse the stricture and place a stent, the percutaneous access allows a drainage gastrostomy to be placed and the drainage NGT to be removed.
- The technique is readily carried out by any radiologist familiar with radiological insertion of a gastrostomy (RIG).
- Some, perhaps many, patients prefer not to be endoscoped.

Disadvantages of the percutaneous approach include:

- The necessity to puncture the stomach. This potentially can cause bleeding, leakage of gastric contents or air during the

procedure resulting in peritonitis.

- Damage to other structures during the gastric puncture.

Conclusion

The entity of MGOO is an unpleasant and potentially life-shortening process occurring in patients whose life expectancy is already short. It should be considered early as a diagnosis and treated expeditiously. The procedure of percutaneous or trans-gastric insertion of a SEMS is another means of achieving this. It has a number of advantages over the more frequently carried out endoscopic placement and is a technique that should fall within the skill mix of any radiologist familiar with intervention in the upper gastro-intestinal tract.

In particular the technique of percutaneous or trans-gastric SEMS insertion should be considered in those departments which lack endoscopic expertise in duodenal stent placement.

It should also be considered in those patients who decline endoscopy.

Conflicts of Interest

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

References

1. Miller BH, Griffiths EA, Pursnani KG, Ward JB, Stockwell RC. An assessment of radiologically inserted transoral and transgastric gastroduodenal stents to treat malignant gastric outlet obstruction. *Cardiovasc Intervent Radiol*. 2013;36:1591-601.
2. Jin EH, Kim SG, Seo JY, Im JP, Kim JS, Jung HC. Clinical outcomes of re-stenting in patients with stent malfunction in malignant gastric outlet obstruction. *Surg Endosc*. 2015. doi: 10.1007/s00464-015-4338-z. [Epub ahead of print]
3. Roy A, Kim M, Christein J, Varadarajulu S. Stenting versus gastrojejunostomy for management of malignant gastric outlet obstruction: comparison of clinical outcomes and costs. *Surg Endosc*. 2012;26:3114-9.
4. van Hagen P, Spaander MC, van der Gaast A, van Rij CM, Tilanus HW, van Lanschot JJ, et al. Impact of a multidisciplinary tumour board meeting for upper-GI malignancies on clinical decision making: a prospective cohort study. *Int J Clin Oncol*. 2013;18:214-9.
5. Kersten C, Cvanarova M, Mjåland S, Mjåland O. Does in-house availability of multidisciplinary teams increase survival in upper gastrointestinal-cancer? *World J Gastrointest Oncol*. 2013;5:60-7.
6. Larssen L, Hauge T, Medhus AW. Stent treatment of malignant gastric outlet obstruction: the effect on rate of gastric emptying, symptoms, and survival. *Surg Endosc*. 2012;26:2955-60.
7. Markogiannakis H, Theodorou D, Toutouzias KG, Gloustianou G, Katsaragakis S, Bramis I. Adenocarcinoma of the third and fourth portion of the duodenum: a case report and review of the literature. *Cases J*. 2008;1:98.
8. Katsanos K, Sabharwal T, Adam A. Stenting of the upper gastrointestinal tract: current status. *Cardiovasc Intervent Radiol*. 2010;33:690-705.
9. Lau WY, Leow CK, Li AK. History of endoscopic and laparoscopic surgery. *World J Surg*. 1997;21:444-53.
10. Ripamonti CI, Easson AM, Gerdes H. Management of malignant bowel obstruction. *Eur J Cancer*. 2008;44:1105-15.
11. Park JH, Song HY, Kim MS, Chung R, Kim JH, Na HK, et al. Usefulness of a guiding sheath for fluoroscopic stent placement in patients with malignant gastroduodenal obstruction. *Acta Radiol*. 2013;54:267-71.
12. Gaidos JK, Draganov PV. Treatment of malignant gastric outlet obstruction with endoscopically placed self-expandable metal stents. *World J Gastroenterol*. 2009;15:4365-71.
13. Kim JH, Song HY, Shin JH, Hu HT, Lee SK, Jung HY, et al. Metallic stent placement in the palliative treatment of malignant gastric outlet obstructions: primary gastric carcinoma versus pancreatic carcinoma. *AJR Am J Roentgenol*. 2009;193:241-7.
14. Kim JH, Song HY, Shin JH, Choi E, Kim TW, Jung HY, et al. Metallic stent placement in the palliative treatment of malignant gastroduodenal obstructions: prospective evaluation of results and factors influencing outcome in 213 patients. *Gastrointest Endosc*. 2007;66:256-64.