Review Article

Malignant gastroduodenal obstruction: An endoscopic approach

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A B S T R A C T

Malignant gastric outlet obstruction describes a constellation of symptoms that can result as a common endpoint from a variety of primary tumours, particularly those of the upper gastrointestinal tract and pancreas. Affected patients face a dismal, undignified and rapid decline in health secondary to malnutrition, dehydration and constant nausea with associated vomiting. Palliative treatment has traditionally involved a gastrojejunostomy—a major undertaking given the functional status of these patients. More recent advances in the endoscopic placement of metal stents to relieve obstruction have clear benefits over the surgical method. We look at the factors involved in patient selection, the techniques and considerations involved in stent deployment and the potential complications associated with this method.

Keywords: Duodenal neoplasm; Endoscopy; Gastric outlet obstruction; Stents

Introduction

The aetiology of gastric outlet obstruction (GOO) includes both benign and malignant pathologies with the latter cause being far more common.1 In malignant GOO the commonest causes are gastric and pancreatic tumours, in these patients approximately 10% to 20% experience symptoms attributable to GOO, usually towards an advanced stage of the disease process.2,3 Other causes include periampullary tumours, gallbladder and bile duct tumours, lymphoma and metastatic disease involving the stomach, duodenum or proximal small bowel.4,5 Active treatment of GOO in an otherwise palliative patient is still indicated as the combination of vomiting, malnutrition and dehydration rapidly leads to clinical deterioration and worsening of quality of life.2

Imaging in Gastric Outlet Obstruction

The initial management of patients with GOO differs for those with and for those without an established diagnosis. In the case of no formative diagnosis the initial line of investigation in patients with symptoms of GOO, anorexia and weight loss is likely to be upper gastrointestinal endoscopy. This investigation will establish the site of obstruction and allow for histological sampling to be undertaken at the same time. Trying to cross the lesion to determine the length of obstruction is seldom undertaken or in fact possible and can have the potential for perforation if attempted. Whilst histological analysis is awaited the patient will usually go on to have cross-sectional imaging of the thorax, abdomen and pelvis with computed tomography (CT). This imaging will give invaluable information on the likely cause of the GOO and also provide useful knowledge of the extent of any extra-luminal disease that may have a bearing on expected survival, the presence and extent of liver metastases is an example.

For patients with an established diagnosis presenting with symptoms of GOO the need for an endoscopy investigation is rarely, if ever, justified. Technical factors relating to food within the stomach and the risk of aspiration with conscious sedation in the ambulatory position means that endoscopy is not a rational choice of investigation. Assessment for these individuals begins with an up to date CT of the thorax, abdomen and pelvis. With modern thin-slice scanners and multi-planar reformats the reporting radiologist can glean key information on the site of obstruction, its length and the extent of any extra-luminal disease burden all in a single modality non-invasive investigation. The presence of further obstruction ‘down-stream’ within the bowel can also be accurately assessed.

Whilst CT imaging provides most if not all of the information needed in the assessment of GOO some clinicians and radiologists

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alike prefer a dynamic fluoroscopic study to guide management. Whilst it is true that dynamic investigations can potentially give better visualisation of the degree of functional obstruction caused by a stricture most radiologists would opt for cross-sectional imaging in the first instance. If fluoroscopy is required then water soluble contrast media has to be used. Barium must be avoided as this has an adverse effect on subsequent attempted interventions, particularly those employing endoscopes as barium can clog the equipment.

### Planning Management

Once up-to-date imaging and histological confirmation of the diagnosis has been established, discussion in a Multi-Disciplinary Team (MDT) setting is recommended to determine a management plan.

The combination of imaging, histology and performance status of the patient will allow for an informed opinion with regards to the expected survival of the patient to be made by the MDT clinicians.

Several options are available at this point and each needs to be considered with an individual patient centred approach. Treatment options can include doing nothing when the disease process is advanced particularly when there are multiple points of bowel obstruction. CT is useful in these circumstances. In these patients there is no benefit in merely relieving a single proximal point of obstruction. Decompressing the stomach either by wide bore nasogastric tubing or a venting gastrostomy may provide symptomatic relief particularly if the stomach contents are mainly fluid consistency. Both of these strategies are useful only as potential short term measures for symptom control.

The two recognised medium term palliative procedures for malignant GOO are a surgical gastrojejunostomy (GJJ) procedure or the endoscopic placement of a self-expanding metal stent (SEMS). Data from the largest multicenter randomized controlled trial (RCT) comparing the two treatment options is hamstrung by wide bore nasogastric tubing or a venting gastrostomy may provide symptomatic relief particularly if the stomach contents are mainly fluid consistency. Both of these strategies are useful. The surgical gastrojejunostomy or endoscopic stent placement for the palliation of malignant gastric outlet obstruction (SUSTENT study) involved randomization of only 39 patients to either treatment group.\(^7\)

The key findings from the study are as follows; the more invasive GJJ procedure group showed slower symptom improvement based on the Gastric Outlet Obstruction Scoring System (GOOSS) but achieved better long term results with respect to reintervention rates. These patients showed an improvement of \(\geq 2\) on their GOOSS score at a median of \(8\) days compared to \(5\) days with the SEMS group \((P < 0.01)\). This finding supports earlier studies which describe faster symptom relief and improvement of GOOSS in stented patients.\(^{10,11}\) However, the longer term symptom relief with the GJJ group was better showing that more patients lived longer with a GOOSS score of \(2\) or more than after stent placement \((72\) vs \(50\) days, respectively, \(P = 0.05)\).

Reintervention rates primarily for return of symptoms were higher for the stent group when compared to GJJ \((8\) patients vs \(1\) patient, \(P = 0.02\)). No differences in median survival or quality of life were observed. Finally, the initial cost of both procedures marginally favoured the stent group. A key factor in this study was the reduced length of hospital stay for stented patients, a finding previously described.

The conclusion drawn from the SUSTENT study is that in those patients with a predicted survival of over \(2\) months a GJJ procedure is the treatment of choice provided they are deemed fit and accept the more invasive procedure. Conversely an endoscopically placed SEMS is preferred in those with an expected survival of less than \(2\) months or are deemed unfit for surgery. The key limitation of the study is the small sample size and therefore reduced statistical power of the findings—nevertheless it is at present the largest RCT available.

### Procedure

#### Sedation and monitoring

Endoscopic duodenal stenting is ideally performed under conscious sedation. This may be supervised by an anaesthetist or more recently either a Physician’s Assistant in Anaesthetics or nurse sedation specialist. These services may not be widely available and sedation may be the responsibility of the operator. In 2003, The Royal College of Radiologists published guidance on the use of sedative techniques within radiology departments describing pre-procedural assessment, patient monitoring, staffing levels, administration techniques and recovery requirements. A combination of an intravenous benzodiazepine (midazolam) and short acting opioid (fentanyl) is commonly used to achieve safe conscious sedation.\(^{2,13}\) Patients who are dehydrated are vulnerable to over sedation and cautious drug administration with meticulous monitoring is mandatory.

#### Scope selection

Either a forward viewing or side viewing therapeutic endoscope may be used for stent insertion. Forward viewing gastroscopes are suited for tackling strictures from the pylorus to the second part of duodenum whilst side viewing duodenoscopes work well for strictures beyond the second part of the duodenum.\(^{14}\) The elevator of the duodenumoscope provides additional control to drive stent delivery systems forward. The diameter of the working channel of the endoscope also needs to be considered prior to stenting, ideally at least \(3.8\) mm.

#### Placement technique

Although gastroduodenal stenting can be performed without endoscopy,\(^{15}\) using an endoscope in combination with fluoroscopy has a number of advantages including reduced radiation doses, faster procedure times and increased stability during stent placement.

Following endoscopic intubation and any additional lavage of stagnant gastric content, attempts are made to identify the point of obstruction. A number of endoscopic cannulas and guidewires may be used, such as those used in endoscopic retrograde cholangiopancreatography (ERCP; StarTip [Olympus, Tokyo, Japan] and Hydra Jagwire [Boston Scientific, Natick, MA, USA]). Most wires are currently at least \(400\) cm to accommodate both the scope and stent delivery system lengths. Guidewire and cannula manipulation through the stricture is performed under fluoroscopy and position confirmed with injection of iodinated contrast medium to delineate the stricture and bowel lumen beyond. Length can either be gauged by adjacent vertebral bodies or using measuring catheters. Once successfully through the stricture, it is worth ensuring that the guidewire is advanced a good length beyond to ensure a stable position to stent and to allow for inadvertent wire displacement during removal of the cannula.

The stent is prepared for delivery by flushing the guidewire and sheath channels with water. Adding oil to the water and also flushing the working channel of the endoscope can be beneficial.
for tortuous scope positions and covered stents, reducing friction between the stent, the sheath and working channel.

Position of the stent in relation to the stricture is confirmed fluoroscopically as well as endoscopically as the sheath delivery system has radiopaque and visible markers. To prevent forward movement of the stent on deployment, applying a degree of tension to the stent system will avoid stent misplacement.

**Outcomes**

Technical success defined by accurate stent placement across the stricture, is reported as 97% in Dormann’s systematic review of 606 patients. Clinical success defined as relief of symptoms and/or improvement of oral intake, in the same review was 89%. The GOOSS score was 0.4 and 2.4 before and after intervention. Failure tends to be either the inability to pass a guidewire through the stricture, unsuccessful deployment, or placement of a stent. There may be a lack of an easily identifiable lumen to cannulate such as with strictures beyond the corners of the duodenal loop. The stricture may be too tight, too distal or too many. Deep intubation with a long and tortuous position of the endoscope particularly with strictures from the third part of duodenum to the duodenojejunal flexure may cause sharp bends on the delivery device impeding deployment of the stent (Fig. 1).

Despite successful stent placement and adequate stent patency, a minority of patients do not improve. Stents restore continuity but not necessarily function of the gastrointestinal tract. Gastric emptying scintigraphy has been used to assess this disparity between technical and clinical success and one such study reported that despite stent patency 38.9% of patients had delayed gastric emptying 1 week following stent insertion. Lack of clinical improvement may be attributable to impaired gastric emptying and gut motility from either neural involvement by tumour or side effects from narcotic analgesia, previous chemotherapy, and unidentified sites of malignant obstruction or diffuse peritoneal carcinomatosis. There have been two recent studies with opposing views but patient selection for stenting should take into account the presence of carcinomatosis with ascites and poor performance status.

Stent patency is defined as the time period without need for re-intervention and ideally should exceed patient life expectancy. Current literature quotes median stent patency ranging from 190 to 385 days, with adequate resolution of symptoms until death in the majority. One study reported an estimated stent patency of 86.2% at 60 days and 63.4% at 180 days with only 10.2% still alive at the time. Another study reported 95.9% of patients were able to tolerate oral intake following stenting and that 78.4% required no further intervention until death. Stent patency can be influenced by additional treatments such as radiotherapy or chemotherapy which act to reduce tumour burden and prolong time to progression.

The overall median hospital admission after stent placement ranges from 2 to 15 days with a mean of 6.3 days. Median survival ranges from 49 to 182 days with a mean of 86 days.

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**Fig. 1.** Fluoroscopy image shows deployment of a stent across a duodenojejunal flexure stricture.

**Fig. 2.** Fluoroscopy image shows guidewire perforation with extraluminal contrast.

**Fig. 3.** Water soluble contrast study shows tumour overgrowth at the proximal stent end.
Complications

Procedural complications include those related to conscious sedation, iatrogenic perforation during endoscopy or guidewire manipulation (Fig. 2) and aspiration, particularly in patients who have not had effective prior nasogastric tube drainage.

Stent related complications tend to be due to either recurrent obstruction (Fig. 3) or migration, less frequently biliary obstruction, acute pancreatitis, stent fracture or collapse (Fig. 4, 5), bleeding and perforation.

Recurrent obstruction occurs in up to 26% of patients usually due to tumour ingrowth through the interstices of the stent and is associated more frequently with uncovered than covered stents. Overgrowth occurs beyond the ends of the stent.\(^{23}\)

Stent migration occurs in up to 10% of patients and is associated more with covered than uncovered stents.\(^{23}\) Distal is more common than proximal migration. If migration occurs proximally, the stent should be easily removed endoscopically. If it migrates distally the stent may pass innocently per rectum but if it does not and the patient becomes symptomatic, surgery is indicated.

Perforation following stent insertion is rare and usually delayed < 1%\(^{21}\). Stents with closed wire loops at their ends are preferred to stents with sharp protruding wire ends.\(^{24}\) This should be borne in mind as stents vary in their propensity to shorten and straighten. Ideally the proximal or distal ends of the stent should avoid angular junctions. Case reports have described migrated stents complicated by distal bowel perforation.\(^{25}\)

Stent collapse (Fig. 6, 7) has been described as a delayed complication with double layered covered stents.\(^{26}\) A 4.6% incidence of stent collapse occurred with the Hercules SP pyloric stent (S&G Biotech, Seongnam, Korea) which consists of an outer partially covered and inner uncovered stent designed to be placed coaxially. The outer stent incorporated a nylon mesh with uncovered ends. Stent collapse was thought likely to be due a combination of the resistance of the covering membrane to tumour ingrowth and low radial force of the inner stent.

Obstructive jaundice often precedes GOO with tumours in and around the head of pancreas. Historically duodenal obstruction from pancreatic cancer has been quoted in up to 25%, with modern chemotherapy and/or radiotherapy this figure may now be an underestimation.\(^{27}\) A variety of anatomical and clinical scenarios need to be considered when jaundice develops either concomi-

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**Fig. 4.** Computed tomography demonstrates stent fracture.

**Fig. 5.** Abdominal X-ray demonstrates stent fracture.

**Fig. 6.** Computed tomography demonstrates stent collapse.

**Fig. 7.** Abdominal X-ray demonstrates stent collapse.
tantly or after onset of GOO.

When both conditions occur simultaneously, biliary stenting is performed before the duodenum either endoscopically or percutaneously. The site of the duodenal stricture in relation to the papilla may be classified into 3 subtypes: type 1, above and sparing the papilla; type 2, level with and involving the papilla; and type 3, distal to the papilla without involvement.28 Type 2 strictures are not as straightforward as the other types for the endoscopist, requiring ingenuity and skill to access the biliary tree.29 For a radiologist who endoscopes, duodenal stenting can be performed immediately after percutaneous biliary stenting.

Biliary obstruction that occurs after duodenal stenting can be managed relatively easily. Uncovered duodenal stents when placed across the papilla may still allow either percutaneous or endoscopic biliary access between the interstices of the stent. Fenestration or argon plasma coagulation may be required for those patients with covered stents that overlie the papilla. Alternative options include endoscopic ultrasound guided biliary stenting.

The dilemma remains over whether to stent the biliary tree prophylactically in patients who are likely to develop jaundice but have a normal serum bilirubin prior to duodenal stenting across the papilla. Performing percutaneous or endoscopic biliary stenting is not without risk. There is also mixed opinion whether covered stents across the papilla cause biliary obstruction.30

Acute pancreatitis and its associated complications are rare following duodenal stenting. One study quoted a 4.1% incidence with use of uncovered stents bridging the ampulla.31 This is thought to be related to compression or irritation of the papillary orifice by the stent with subsequent oedema and increased pressure in the pancreatic duct. The incidence of pancreatitis following ERCP is reported to be 3.5%.32 Perhaps rectal non-steroidal anti-inflammatory drugs prophylaxis as suggested by the European Society of Gastrointestinal Endoscopy (ESGE) guidelines for low risk ERCPs could be adopted for duodenal stenting across the papilla. Although not widely prescribed routinely, the same principle could also be applied to antibiotic prophylaxis and prevention of cholangitis if subsequent biliary obstruction occurs.33

Uncovered or Covered Duodenal Stents or Both?

Uncovered stents allow the surrounding tumour or mucosa to embed within the mesh framework after expansion. The advantage is stent anchorage preventing migration. The disadvantage though is a higher obstruction rate due to either tumour ingrowth or mucosal hyperplasia through the mesh. Stent dysfunction occurred in 30% of patients following placement of the Evolution stent (Cook Medical, Limerick, Ireland), an uncovered nitinol double flanged stent.34 The 20% was attributable to tissue ingrowth and obstruction, 4% migration, 4% stent compression, and 2% food impaction. The same group evaluated the uncovered D-weave Niti-S stent (Taewoong Medical, Seoul, Korea). Stent dysfunction occurred in 25% of patients, 21% due to obstruction, and 4% migration.35

Covered stents are more resistant to tissue ingrowth and obstruction but due to reduced anchorage are more prone to migration. One study found a significantly lower tissue ingrowth rate for covered stents but with a significantly higher migration rate, the negative features of the two types of stents compensated each other resulting in comparable overall stent patency times.36 Another study reported that covered stents were associated with a more frequent need for reintervention than uncovered stents, despite similar outcomes.37 In van Halsema et al’s systematic review38 of recently published prospective literature, stent dysfunction occurred in 19.6% out of 1,281 patients, 12.6% due to obstruction, and 4.3% stent migration. Obstruction was more common with uncovered stents as compared to partially covered (14.9% vs 5.1%, \(P < 0.001\)) and migration more frequent with partially covered stents (10.9% vs 2.2%, \(P < 0.001\)). The same study also suggested higher clinical success rates for partially covered stents (92.3% vs 83.6%, \(P < 0.001\)).39

Do outcomes of stenting vary according to the type of stent used and site of obstruction? One study reported that in the peri-pyloric region, the complication rate was lower for partially covered stents because both covered and uncovered had fewer complications than fully covered stents.40

Recently a study evaluated a new stent with an uncovered proximal “big cup” which fitted the pre-pyloric area as a modification to prevent distal migration with a fully covered duodenal portion to prevent ingrowth.40 Unfortunately, the study was terminated prematurely due to three instances of proximal stent migrations in six patients. Proximal stent migration is rare as compared to distal migration and the authors concluded that the “big cup” design was the most likely explanation for this complication.

The Niti-S Comvi stent (Taewoong Medical) is a triple layered stent designed to have the advantages of both uncovered and covered stents with low migration and ingrowth rates. Its structure consists of a Polytetrafluoroethylene membrane layer sandwiched between two uncovered stents. Its knitted cell weave design with optimal combination of radial and axial forces allows the stent to conform well to the loop of the duodenum. One study with this stent reported 100% technical and 88% clinical success rates with 10% migration and 8% stent obstruction due to tumour overgrowth with no instances of ingrowth.41 A prospective randomized trial showed that Niti-S Comvi were associated with less episodes of stent dysfunction more than 4 weeks after implantation when compared with uncovered Niti-S stents.42

The radial force of a SEMS is the expansion force that dilates and resists the compression exerted by a tumour. Axial force on the other hand is the recovery force when a stent is bent. High axial forces are associated with poor stent conformability and may trigger stent migration.43 The anatomical configuration of the duodenum and fixed points of ligament attachment present a challenge for stent design and properties. The perfect gastroduodenal stent should have a good radial force, low axial force, resist tumour ingrowth, feature an anti-migration property and should alleviate the symptoms of GOO without complication over a patient’s lifetime.

Conclusion

Malignant GOO is a dismal and undignified pre-terminal condition. Stenting is an established technique and perhaps has become the first line treatment. In these modern times, there are now more laparoscopic GJJ procedures performed for morbid obesity rather than for malignant GOO. The primary goal of a palliative procedure in malignant GOO is to improve quality of life, abolish symptoms of vomiting and restore the ability to eat and drink. Stenting is safe and effective, less invasive than surgery and provides fast relief of symptoms. If late complications from stents occur during the limited life expectancy of patients with advanced malignancy, placement of another stent remains an option.
Conflicts of Interest

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

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