Other uses of non-vascular stents

Tony Nicholson

New generation metallic stents are making an impact on coronary, peripheral vascular and biliary diseases. However, their use is not limited to these: other areas include the oesophagus and upper gastrointestinal tract, the small bowel, large bowel and dacryocystic duct.

As discussed in the first article of this pair (Nicholson, 1999), since their development, the range of stents available and the range of possible uses has increased. This article looks at some of the less common uses of non-vascular stents.

OESOPHAGEAL STENTS

The earliest symptom of oesophageal malignancy is dysphagia, and weight loss is almost always seen at presentation. In the late stage of the disease the patient is not able to swallow saliva and its aspiration will cause severe lung complications. If the patient is not treated, starvation is the commonest cause of death. Surgical treatment is the only cure for resectable tumours, providing a 5-year survival rate of 5–15% (Angorn and Haffejee, 1998). Survival rate for early oesophageal carcinoma with no lymph node involvement has been reported as 30% at 5 years (Caspers et al, 1988). Laser therapy and oesophageal dilatation have been used to palliate patients in these circumstances, but both require multiple treatments. In addition, perforation of the oesophagus is a common complication.

Percutaneous gastrostomy achieves good nutritional results but is associated with a poor quality of life. Previously plastic endoprostheses were inserted, often under general anaesthesia, but results were poor, with migration, obstruction caused by food impaction and perforation of the oesophagus being common. In addition, the mortality resulting from stent insertion was high.

Knyrim et al published a randomized study in 1993 which showed a highly significant difference in complications including mortality between plastic and metal stent insertion. There are now multiple studies in peer review journals describing the safety and efficacy of self-expanding covered metal endoprostheses and there are several randomized studies, all of which show improved morbidity and mortality from their use (Knyrim et al, 1993; Roseveare et al, 1998; Siersema et al, 1998). In all of these studies the initial high cost of the covered metal endoprosthesis is offset by the reduced complication rate and all demonstrate the cost-effectiveness of these stents. There are also studies demonstrating the superiority of stenting to laser treatment (Adam et al, 1997). There is now no justification for the use of plastic endoprostheses in the palliation of malignant oesophageal dysphagia.

Which stent?

At present there is no single oesophageal stent that is suitable for all oesophageal malignancies. Supracarinal oesophageal tumours require a stent that can be placed with pinpoint accuracy in order to avoid cricopharyngeus. Stenting across this muscle results in severe odynophagia. It is therefore probably wise to choose a stent which can be accurately placed and easily removed. Not all self-expanding stents are easy to remove. The covered Ultraflex stent (Boston Scientific, St Albans, Herts) is the stent of choice for these lesions.

Most of the stents currently available are suitable for mid-oesophageal lesions, although there is an unacceptably high rate of migration with stents that are covered externally and which do not have adequate fixation areas. Stent migration is a real problem at the gastro-oesophageal junction. Again, accurate placement is vital to ensure distal coverage of the obstructing lesion without leaving inadequate stent length in the oesophagus. Uncovered stents, such as the Oesophacoil (Kimal,

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Uxbridge, Middlesex), or stents which have fixation hooks, such as the Cook (Letchworth, Herts) stent, are probably best at this site.

Accurate placement

Fluoroscopy is far more important for the accurate placement of self-expanding metal stents than the direct vision provided by endoscopy. Indeed, endoscopy is not at all necessary for their insertion and adds considerably to the cost and length of the procedure. In addition, attempts to pass wires and catheters through the endoscope without the use of fluoroscopy leads to occasional perforation of the oesophagus.

Fluoroscopy following water soluble non-ionic contrast swallow provides a view of the length of stricture which can then be negotiated safely with catheter and wire. The correct use of fluoroscopy, however, is a skill acquired from experience and training. A question often asked by endoscopists is 'How can the proximal and distal ends of a tumour be seen by fluoroscopy?' The answer to this is that with experience it is possible to determine both the proximal and distal ends of tumour spread and the use of the longest stent appropriate with accurate placement is usually sufficient to cover the full length of tumour. In any case, the endoscopist can only see the distal extent of tumour by passing a scope through the tumour, a manoeuvre which increases the risk to the patient.

Other than migration, a common complication of oesophageal stenting is retrosternal discomfort and chest pain. This is presumably a result of the radial force exerted by the stent on the tumour and thence on the mediastinum. The severity of this discomfort can be reduced by insertion of an appropriately sized oesophageal stent. Small patients probably only require a 16 mm diameter stent and if a 25 mm stent is used they will get pain.

Figure 1. A postsurgical malignant stricture appears to have caused a complete and impassable occlusion in the distal oesophagus. Attempts to pass an endoscope had resulted in a perforation.

Covered oesophageal stents are also extremely useful in the treatment of iatrogenic oesophageal perforations, postsurgical oesophageal leaks unresponsive to conservative treatment and malignant broncho-oesophageal fistulae. *Figure 1* shows a distal oesophageal perforation as a result of repeated attempts to pass an endoscope through a postsurgical malignant stricture. This was negotiated fluoroscopically with a simple wire and catheter and insertion of a covered Cook Oesophageal stent

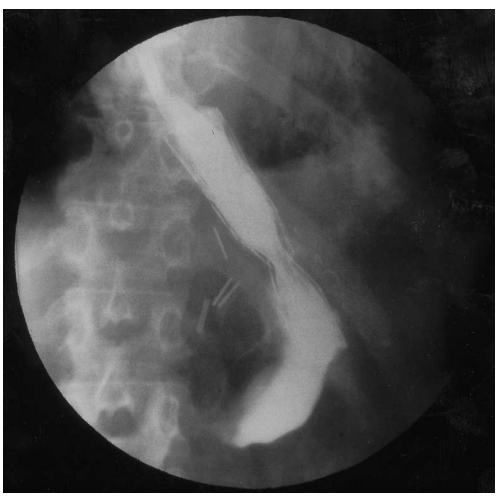

Figure 2. The lesion in Figure 1 *was easily crossed with a simple wire and catheter and a Cook's Oesophageal stent placed. Despite the fact that this could not be fully expanded because of the tightness of the stricture, the patient was able to eat and drink relatively normally following the procedure.*

Figure 3. A patient who had recently undergone oesophagectomy developed an early ischaemic anastomotic leak.

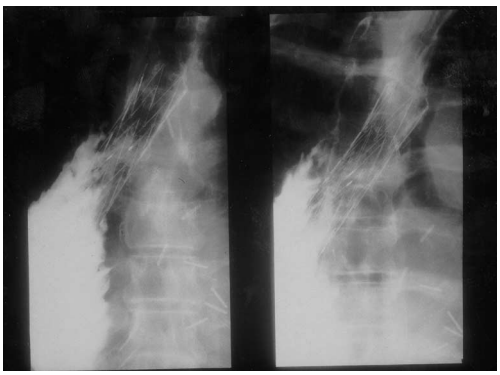

Figure 4. The leak shown in Figure 3 *was sealed with a fluoroscopically inserted Ultraflex stent.*

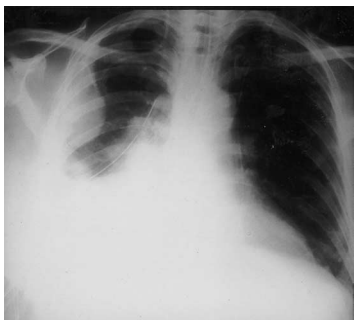

Figure 5. The pre-stent insertion chest X-ray of the patient in Figures 3 *and* 4 *demonstrating a large pleural effusion secondary to the anastomotic leak.*

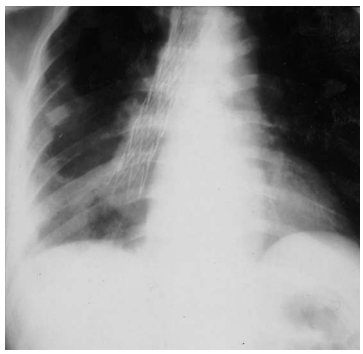

Figure 6. Post-stent insertion chest X-ray of the patient in Figures 3–5 *demonstrating resolution of the pleural effusion.*

(Figure 2) resulting in discharge from hospital 48 hours later and a further 6 months dysphagia and hospital-free life. *Figure 3* shows a severe postsurgical anastomotic leak, which again was instantly sealed by the fluoroscopic insertion of a Cook Oesophageal stent, and *Figures 4–6* show the pre- and post-procedural chest X-rays on this patient.

Figures 7 and *8* demonstrate a broncho-oesophageal fistula which proved to be extremely difficult to cross antegradely. The stomach was therefore punctured under local anaesthetic under ultrasound guidance and the lesion crossed retrogradely with a wire and catheter. Having brought the wire out through the mouth the lesion was then stented with a Telestep prosthesis (Schneider, Boston Scientific, St Albans, Herts) with no further problem until the patient died 6 weeks later.

The use of self-expanding metal endoprostheses for benign strictures is controversial. My own experience is of universal epithelial overgrowth and ingrowth *(Figures 9* and *10)*, resulting in the need for frequent laser therapy. Others have also found a significant rate of early stent occlusion (Tan et al, 1997) and these endoprostheses probably should not be used for benign lesions.

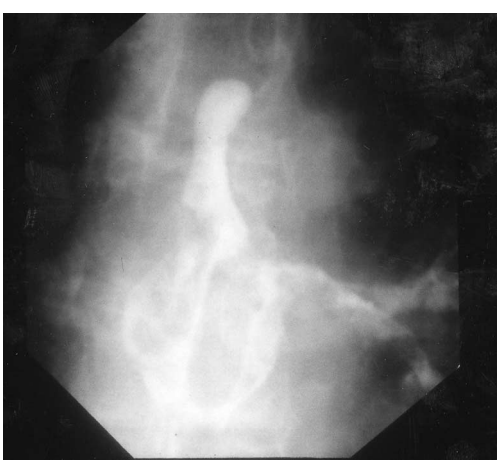

Figure 7. Water-soluble contrast swallow demonstrating a broncho-oesophageal fistula secondary to an inoperable oesophageal carcinoma.

TREATMENT OF OTHER UPPER GASTROINTESTINAL STRICTURES

The introduction of covered and uncovered stents which have radial strength, flexibility and improved super-elasticity allows their use in inoperable malignant strictures of the stomach, pylorus and upper small intestine (Yates et al, 1998).

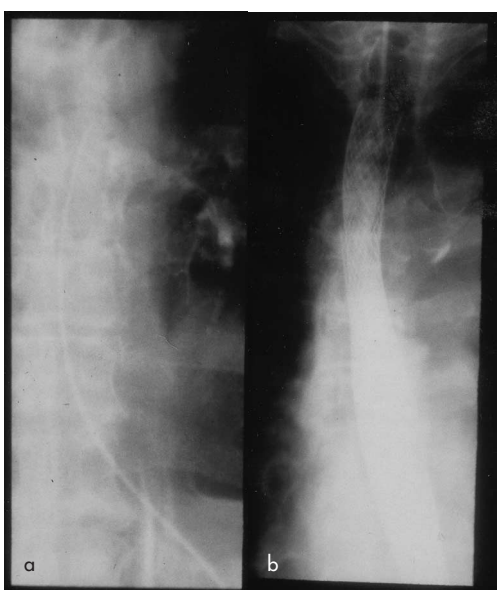

Figure 8. a. An attempt to cross the fistula shown in Figure 7 *from the mouth resulted in the wire and catheter continually entering a bronchus. The stomach was therefore punctured under ultrasound control and a retrograde attempt made to cross the lesion. b. Following the retrograde passage of a catheter across the broncho-oesophageal fistula, a wire was brought out through the mouth and a covered stent placed across the fistula, immediately sealing it.*

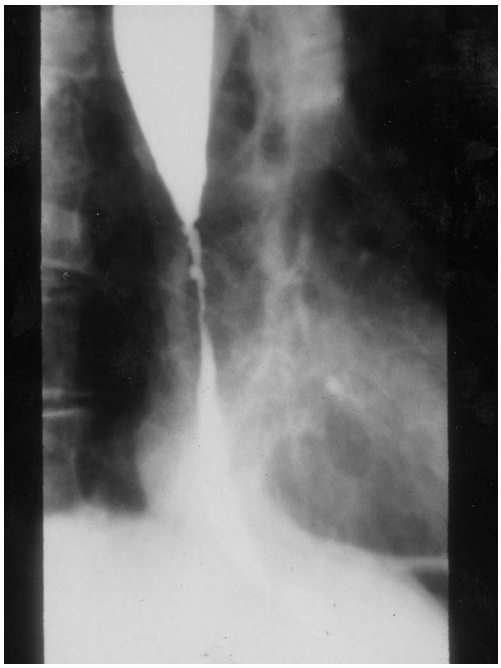

Figure 9. Water soluble contrast study demonstrating a long, smooth oesophageal stricture which had undergone multiple dilatations which were becoming more and more frequent.

METALLIC STENTS IN THE TREATMENT OF COLORECTAL OBSTRUCTION

In the USA approximately 140 000 new cases of colorectal carcinoma are diagnosed each year. Between 8 and 29% of these cases will present with complete or partial colonic obstruction, and 75% of the obstructing neoplasms are located in the left hemicolon. These patients are often in poor general condition because of the underlying disease, dehydration and electrolyte imbalance.

Surgical treatment for these patients usually includes resection of the affected segment and colorectal anastomosis. A primary end to end anastomosis is usually not advisable because of the increased risk of anastomotic leak and infection in patients who undergo surgery with an unprepared colon, but may also be affected by ischaemic changes. In many cases the patient will be treated with an emergency temporary colostomy followed by an interval abdominoperineal or anterior resection.

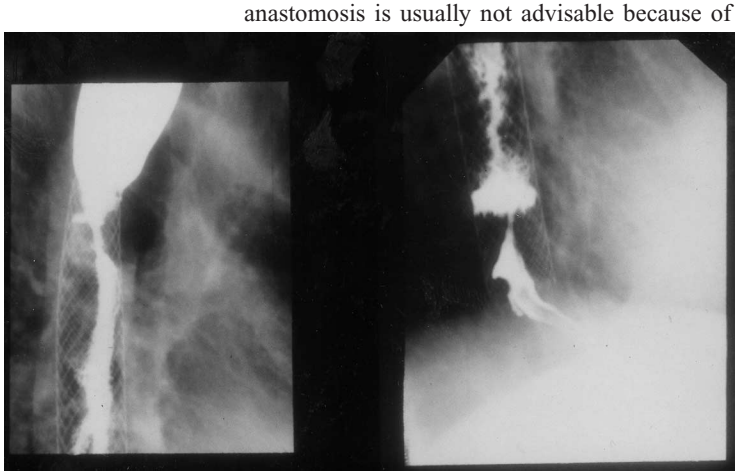

Figure 10. A stent was placed across the benign lesion shown in Figure 9. *Within 1 month there was marked overgrowth and ingrowth which histologically was benign.*

Increasingly, surgeons are using partial or subtotal colectomy and primary anastomosis with interoperative lavage of the colon but this is reserved for selected patients as it carries a significant morbidity. A mortality of 22% has been reported for patients undergoing emergency surgical treatment of acute obstruction by colonic neoplasm (Morel et al, 1989). This mortality decreases to between 0.9% and 6% for patients undergoing elective surgery (Morel et al, 1989). In addition, some elderly patients may have T3 and T4 tumours with lymph node and distal metastases. In these patients surgery is inappropriate, although it was previously necessary in the obstructed patient.

The development of covered metal endoprostheses on delivery systems long enough and trackable enough to reach obstructing lesions which have sufficient radial strength, flexibility and super-elasticity to cope with colonic movement and deformation allows temporary relief of obstruction before elective surgery or definitive palliation for the inoperable lesion.

At present there is no ideal stent which actually fulfills the above criteria but both the Enteral Wallstent (Schneider, Boston Scientific, St Albans, Herts) and the Memotherm stent (Bard, Crawley, West Sussex) are close. The Wallstent is not always long enough and suffers from excessive shortening, particularly when its distal end is placed in the cavernous obstructed end of the colon. The Memotherm stent is still difficult to place accurately and if the retrograde movement of the catheter is inhibited during deployment, the stent can move forward of its intended site.

Both these stents will be modified in the future and other stents with more ideal characteristics will doubtless appear. Their insertion should often be via a combined fluoroscopic/colonoscopic approach. Lesions in the non-tortuous sigmoid colon are relatively easy to access and cross (*Figures 11* and *12*), but more often than not the sigmoid is extremely tortuous and although lesions in the descending colon can be accessed and crossed, it often takes much time, effort and prolonged screening. It is much easier to assess the degree of difficulty and the lesion's position with a water-soluble contrast enema and then opt for fluoroscopy alone or the combined of fluo-

roscopy and colonoscopy to get to and cross the lesion. The actual placement and release of the stent should be performed fluoroscopically.

In most people's experience failure to cross the obstructing lesion and stent migration or misplacement have been the major complications of the procedure. Colorectal tumours may have areas of necrosis that can be perforated by the dilatation of the metal stent. This complication has to be detected early and treated as a surgical emergency. Colonic neoplasms that present with spontaneous perforation should not be considered for stenting. Bleeding caused by trauma of guidewires, catheters and metallic stent dilatation has also occurred.

STENTS IN THE MANAGEMENT OF NASOLACRIMAL OBSTRUCTION

Epiphora, caused by the obstruction of tear drainage through the lacrimal duct so that they fall over the lid margin on to the cheek, is a common ophthalmic problem comprising 3% of ophthalmological presentations (Linberg and McCormick, 1986). Most cases are the result of idiopathic inflammation and scarring of the duct. It is frequently accompanied by pain and discomfort in addition to the embarrassment of constant watery eyes.

Previously silicon intubation caused many complications such as recurrent dacryocystitis, granuloma formation and erosion of the duct. Dacryocystorhinostomy, in which the lacrimal sac is anastomosed edge to edge to the nasal mucosa, is the definitive treatment. Primary repairs result in an 89–95% success rate (Massaro et al, 1990). However, uncommonly complications of this procedure do occur, including complete or partial closure of the fistulous track, hypertrophic facial scar and regrowth of the mucus membrane over the nasolacrimal opening.

The use of self-expandable metal stents has been advocated as a means of overcoming these infrequent complications. However, the insertion of a stent is a minimally invasive outpatient procedure and this should be the main reason for the further development of this technique. The nasal mucosa is anaesthetized and an infra-trochlear nerve block over the medial canthal and lacrimal sac is accomplished with 1% lignocaine. The superior punctum is then dilated and an angled 0.018 inch guidewire is introduced and under fluoroscopic guidance advanced gently across the obstruction into the inferior meatus. The wire is then grasped in the inferior meatus and a 6F sheath advanced across the lesion. A 4 mm self-expanding stent is then passed into the sheath and with a pusher maintaining its position the sheath is withdrawn *(Figure 13a,b)*.

The use of metal stents has three major limitations. If a stent becomes blocked after insertion it cannot be removed without surgery. The pre-

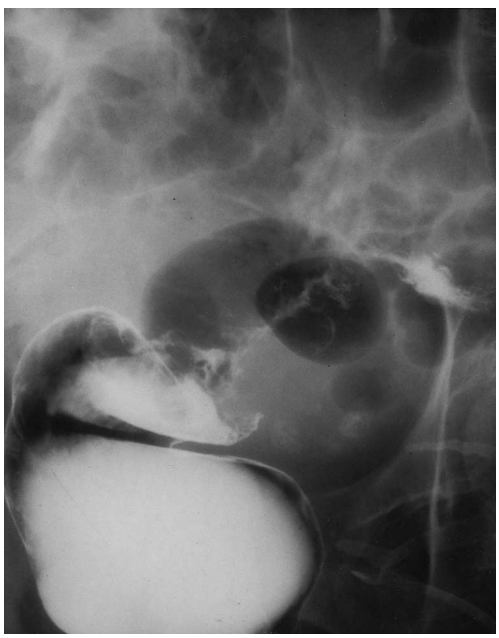

Figure 11. Water-soluble contrast enema demonstrating a recto-sigmoid malignant stricture causing acute large bowel obstruction.

Figure 12. An enteral Wallstent was placed across the stricture shown in* Figure 11.** ***This resulted in decompression of the colon. In this case the patient was elderly and had a T4 tumour. The stent was therefore left in situ as definitive palliation. The patient died from other causes 3 months later.

sent generation of self-expanding metal stents for the nasolacrimal duct lack super-elasticity and in addition, obstruction of the stent by granulation tissue is common. For these three reasons nylon stents have been developed and are showing good long-term results. However, because balloon dilatation is necessary before stent placement, the procedure can be expensive and time-consuming. In addition, because the nylon stent is stiff, discomfort has been reported. New polyurethane stents overcome these difficulties. The future of these stents is at present uncertain until more information about their long-term patency is obtained.

PROSTATIC STENTS

Transurethral resection of the prostate (TURP) is one of the most common surgical procedures performed in the UK. Waiting times for this operation are universally unacceptable and this has been the motivating factor in the search for more minimally invasive less expensive alternatives for the treatment of benign prostatic hyperplasia. In addition, there is moderate morbidity and a small but significant mortality associated with TURP.

Several distressing and significant side-effects are sometimes associated with TURP such as retrograde ejaculation, impotence, urinary incontinence and urethral stricture. The Wallstent (Boston Scientific, St Albans, Herts), Strecker stent (Boston Scientific, St Albans, Herts) and Cook Gianturco stent (Cook, Letchworth, Herts) are most frequently used and can be placed either cystoscopically or fluoroscopically. Patients are usually pretreated with antibiotics and the device is usually placed over a wire in conventional fashion. However, this is still a developing technology, offering a therapeutic alternative to indwelling catheters or TURP. Preliminary results are encouraging but longer follow-up is necessary.

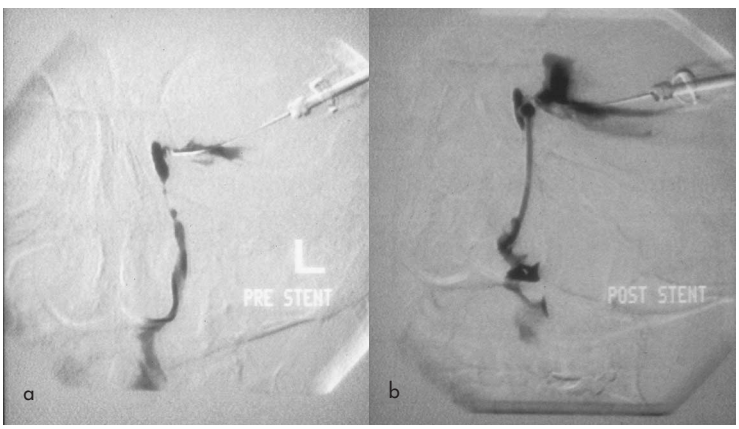

Figure 13. a. A dacryocystogram demonstrating an occluded left dacrocystic duct. b. A 3 mm self-expanding stent was placed across the occluded duct. There was good flow of contrast at the end of the procedure but this stent occluded at 1 month.

KEY POINTS

- Covered and uncovered stents have many uses.
- Fluoroscopy is essential if complications are to be avoided.
- Choose the appropriate stent for the lesion being treated.

CONCLUSIONS

The development of self-expanding and balloon mountable covered and uncovered metal endoprostheses has been one of the most significant medical advances of the last decade. Their future development as devices for maintaining patency and as devices for drug delivery will result in decreased morbidity, mortality and length of hospital stay and they will have a major impact on decreasing the cost of medical treatment. Although their initial cost is high their cost-effectiveness is increasingly being recognized. HM

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