

## Comparative retrospective study on the use of plastic prostheses and self-expanding metal stents in the palliative treatment of malignant strictures of the esophagus and cardia

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**SUMMARY.** Palliative treatment of malignant strictures of the esophagus and cardia is usually carried out by the endoscopic placement of a prosthesis. The aim of this retrospective study was to evaluate short- and long-term outcomes of the use of expandable stents, compared with conventional plastic prostheses. One hundred and thirteen endoscopic intubations were carried out in 120 patients affected by malignant stenosis of the esophagus and cardia using plastic prosthesis and self-expanding metal stents. Dysphagia was scored according to Atkinson and Ferguson's classification and the preoperative median score (3.6) was comparable in both groups. The technical success rate was 94.4% with plastic prosthesis and 93.7% with self-expanding metal stent while the functional success rate was, respectively, 85.2% and 88.8%. Three deaths occurred with plastic prostheses (4.4%), while no deaths were observed with metal stents. A comparative analysis of the results of this study suggests that the endoscopic placement of self-expanding metal stents is effective and safe and has to be preferred to the conventional plastic prosthesis for easier implantation and lower morbidity.

**KEY WORDS:** Esophageal and cardia malignant strictures, palliative treatment, plastic prosthesis, self-expanding metal stent.

### INTRODUCTION

Despite recent therapeutic advances, carcinoma of the esophagus and cardia is still a high-grade malignant neoplasm and its treatment often produces poor results since most patients locally present with a widespread or metastatic disease at the time of diagnosis.<sup>1</sup> The advanced stage of the tumor precludes radical surgery and therefore treatment demands palliation that quickly and permanently relieves dysphagia, which hardly compromises the quality of patients' remaining life. The ideal method of palliative treatment consists of a single, technically simple, safe and well tolerated procedure that does not require general anaesthesia and that leads to permanent relief of dysphagia. The procedure must be performed in a single and brief hospital-stay because of the short life-expectancy of patients, and it must be characterized by low morbidity and mortality rates. At the present surgical endoscopy is

the treatment of choice and laser therapy and stenting are the main available procedures. Intubation plays an important role because it allows a durable dilation of the neoplastic stricture in the majority of patients. The technique is widely used and continuously developing through the improvement in quality of both operative instruments and stents. Furthermore, a new advance has recently been made by the introduction of expandable metal stents in the clinical practice; they can be inserted without significant tumor dilation because the stent is compressed and it self-expands after placement through the stricture. The aim of this retrospective study was to evaluate the current role of endoscopic intubation in the palliation of esophageal and cardia malignant strictures, compare to the efficacy of traditional plastic prostheses and self-expanding metal stents in our experience.

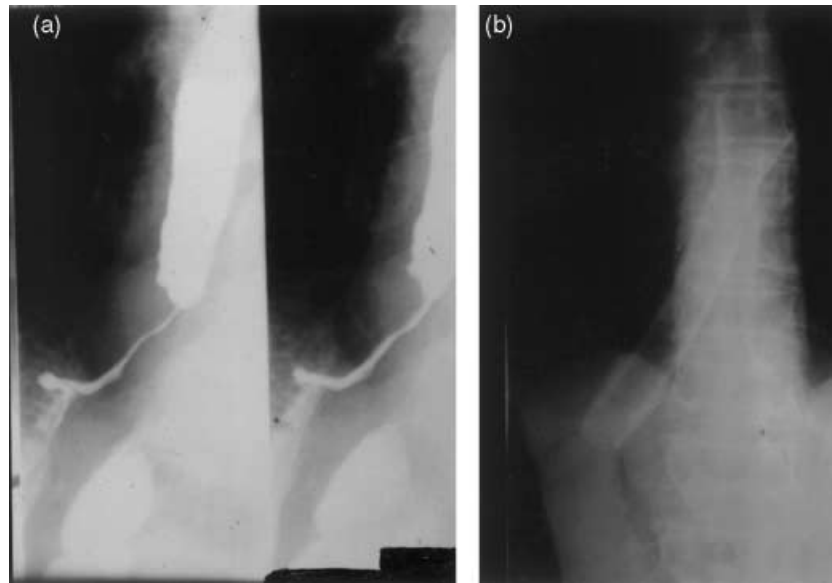
### PATIENTS AND METHODS

Between 1973 and the present, 183 patients affected by malignant strictures of the esophagus and cardia

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**Table 1** Inoperable malignant strictures of the esophagus and cardia: features of patients

	Plastic prosthesis ( <i>n</i> = 72)	Metallic stents ( <i>n</i> = 48)
Sex (M/F)	52/20	34/14
Mean age (years)	69.3	72.5
Primary esophageal carcinoma	66	37
Lung carcinoma	2	10
Recurrence after surgery	4	1
Median dysphagia score before treatment	3.67	3.6

**Fig. 1** (a) Adenocarcinoma of the cardia; (b) managed by the placement of an Atkinson prosthesis

were referred to our Unit. One hundred and twenty patients with inoperable malignancies for tumor extension and/or poor general health underwent palliative endoscopic intubation.

From July 1980 to April 1993 plastic prostheses were inserted in 72 patients. Fifty-two were male and 20 female, with a mean age of 69.3 years (range 41–92; Table 1). In two cases (2.7%) the stenosis was due to a bronchial carcinoma infiltrating the esophagus and in 70 cases the carcinoma was primitive. In 44 patients (61.1%) cancer was located in the distal esophagus or in the cardia, in 18 (25%) cancer was in the thoracic esophagus and in three (4.1%) it was in the cervical tract. In four patients (5.5%) an anastomotic recurrence was found after the resection of a cardia adenocarcinoma, while one patient (1.3%) presented with cardia and midthoracic locations. Adenocarcinoma was the most frequent histologic type (68.5%) and other tumors were squamous cell carcinoma.

In 27 patients tumor resection was not possible because of local extension of the neoplasm, in 21 because of metastatic disease and in 24 because of poor general health.

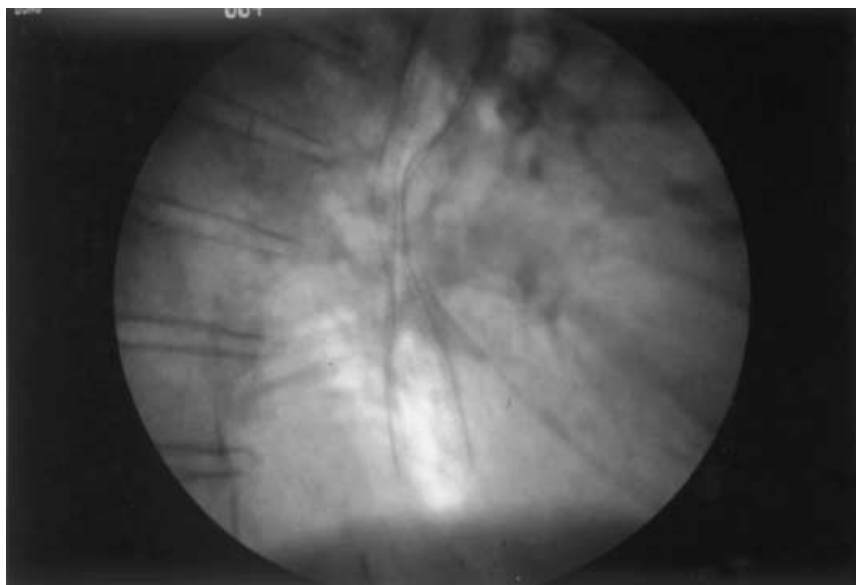
Dysphagia was classified according to Atkinson and Ferguson's score: grade 0, normal ability to swallow; grade 1, ability to swallow some solids; grade 2, ability to swallow semisolids; grade 3, ability to swallow liquids only; grade 4, absolute dysphagia. In 48 patients dysphagia was of grade 4, in 24 of grade 3, with a mean score of 3.67. We employed the Celestin pulsion tube (Medoc) in 18 patients, the Atkinson's prosthesis (Keymed) in 23 (Fig. 1) and the Wilson-Cook tube (Wilson-Cook) in 27.

From May 1993 onwards we carried out intubation with self-expanding metal stents in 48 patients (Table 1). Thirty-four were male and 14 female, with a mean age of 72.5 (range 52–88). In 10 cases the esophageal stricture was due to a bronchial cancer, in 17 to a squamous carcinoma and in 21 to an adenocarcinoma. Twenty-four tumors were located in the cardia or distal esophagus, 20 in the mid-thoracic esophagus, four in the cervical tract and one patient had an anastomotic recurrence after esophago-gastric upper resection (Table 1). Esophago-bronchial fistulas were present in four cases.

In 19 patients tumor resection was not feasible because of local extension of the neoplasm, in 13

**Table 2** Plastic prosthesis versus self-expanding metal stent in the palliative treatment of malignant strictures of the esophagus and cardia: early results

	Plastic prosthesis ( <i>n</i> = 72)	Metallic stent ( <i>n</i> = 48)
Technical success	68 (94.4%)	45 (93.7%)
Functional success	58 (85.3%)	40 (88.8%)
Median dysphagia score after treatment	0.9	0.8
Acute complications	4 (5.9%)	0
Pharyngeal perforation	1	0
Hemorrhage	2	0
Proximal stent migration	1	0
Median hospital stay (days)	5	2
Perioperative mortality	3 (4.4%)	0

**Fig. 2** Ultraflex stent placed through a squamous cell carcinoma of the midthoracic esophagus

because of metastatic disease and in 16 because of poor general health. Laser therapy had failed in one patient and local alcoholic injection in another one.

Twenty-nine patients had dysphagia of grade 4, 19 of grade 3, with a preoperative mean score of 3.6 (Table 1). We used the Ultraflex stent in all patients (Microvasive, Boston Scientific Corp.) (Fig. 2), the covered type in 30 of them and the uncovered one in 15.

Both groups of patients were treated under oropharyngeal local anaesthesia and light intravenous sedation, according to Tietjen procedure.<sup>2</sup> After marking the oral and distal ends of the stenosis, a guide wire is passed through the endoscope over the stricture; the endoscope is withdrawn and a dilation with Savary-Gilliard dilators over the guide wire is performed; the stent is positioned and deployed under fluoroscopic control.

Following intubation, patients were allowed fluids only for 24 hours and subsequently encouraged to take a soft diet, progressing on to more solid food as tolerated. After discharge, patients were reviewed at 1 and 3 months interval thereafter until death.

## RESULTS

The two stented groups were compared under the following criteria:<sup>3</sup>

- technical success, as rate of good outcome intubations;
- functional success, as improvement of dysphagia grade;
- incidence of acute complications;
- length of hospital stay and procedure-related mortality rate;
- incidence of late complications and survival.

The rate of technical success for plastic prostheses was 94.4% (68/72) and for self-expanding metal stents 93.7% (45/48); the plastic stent was not placed in four patients and the expandable stent in three patients because it proved impossible to pass the guide wire through the stenosis (Table 2).

After intubation with traditional plastic prostheses the mean score of dysphagia dropped to 0.9; dysphagia improved to grade 0–1 in 57 patients, to

**Table 3** Plastic prosthesis versus self-expanding metal stent in the palliative treatment of malignant strictures of the esophagus and cardia: long-term results

	Plastic prosthesis ( <i>n</i> = 68)	Metallic stent ( <i>n</i> = 45)
Food obstruction	7	1
Stent migration	3	3
Tumor overgrowth	4	0
Tumor ingrowth	0	3
Bleeding	0	2
Median survival time (days)	183	151

grade 2 in one patient, while in 10 patients no improvement was achieved (functional success rate, 85.3%). After intubation with self-expanding metal stent the mean score of dysphagia was 0.8 because in 38 patients dysphagia improved to grade 0–1, in two to grade 2, while in five cases no dysphagia improvement was achieved (functional success, 88.8%; Table 2).

No cases of acute complications occurred with expandable stents, while in the traditional plastic prostheses group we observed one pharyngeal perforation, two severe hemorrhages and one proximal stent migration during its detachment (4/68 = 5.9%; Table 2).

In the plastic prosthesis group the mean hospital stay was 5 days (range 3–14) and the perioperative mortality rate was 4.4% (3/68 cases): one patient died from severe hemorrhage (it was an error of indication because the patient was coagulopathic) and another two patients affected by bronchial carcinoma died, respectively, from acute cardiocirculatory failure and myocardial infarction (Table 2). The rate of late morbidity was 20.6% (14/68): food obstruction (seven cases) was the most frequent complication and in all cases it was possible to fragment the food endoscopically, pulling the pieces down into the stomach. Gastric dislocation of the stent occurred in three cases and a second stent was endoscopically re-implanted in one patient and through a gastrotomy in another two. Tumor overgrowth occurred in four patients and the restoration of the lumen patency was achieved by photocoagulation. Mean survival time after stenting was of 183 days (range 58–486); one patient died of stroke, another one of myocardial infarction and all the others of metastatic disease (Table 3).

In the group of patients managed by Ultraflex stent the mean hospital stay was 2 days (range 1–3). No deaths related to the procedure occurred (Table 2) and the morbidity rate was 20% (9/45). Three out of 15 patients intubated by a noncovered Ultraflex stent developed tumor ingrowth after a median period of 5 weeks following the procedure: one patient was managed by the placement of a nutritional probe, another one by laser therapy and

the last one by the insertion of a new stent. In one patient the obstruction was related to food impaction 12 days after stenting and we easily managed the complication by endoscopy in outpatient regime. The stent distantly migrated in three patients and a new tube was inserted. Two patients suffered moderate hemorrhages because of the traumatizing action of the stent on crumbly neoplastic vegetation, but only one needed blood transfusion 20 days after intubation. The mean survival time was 151 days (range 40–545) and the deaths were all related to metastatic disease (Table 3).

## DISCUSSION

In most patients affected by malignant strictures of the esophagus and cardia, surgical resection cannot be performed because of the advanced stage of the tumor and/or poor general health; in these patients the only treatment possible is to relieve dysphagia and to improve the patients' quality life.<sup>1,4, 5</sup>

The ideal method of palliative treatment is by a single, simple, safe and well tolerated procedure, that allows a rapid and permanent restoration of the ability to swallow.<sup>6</sup> Therapeutic options are traditional surgery, radiotherapy or surgical endoscopy.

Palliation of dysphagia by surgical resection has significant morbidity and mortality rates and it is not practical in the majority of patients, while alimentary fistula is the last resort after all other conservative methods have failed because it is a psychologically disabling, symptomatically and nutritionally ineffective procedure.<sup>7,8</sup>

Endocavitary and/or external radiotherapy achieves short-term success in about 40% of patients, but it is time-consuming and burdened by several complications such as esophago-bronchial fistula and postirradiation stenosis. In some patients dysphagia becomes worse because of local side-effects of radiation that force a stop to the treatment.<sup>9</sup>

Surgical endoscopy is today the most widespread palliative treatment and the choice is between stenting or laser therapy; both methods are successful in dysphagia regression, but laser treatment is restricted by the need for repeated sessions, while stent intubation has the potential for long-lasting functional results.<sup>2,9–12</sup>

Indications for intubation and laser therapy essentially depend on tumor morphology: a stent has to be preferred in infiltrating tumors; and a laser has to be chosen in crumbly, easily bleeding and noncircumferential neoplasms because the stent needs a good anchorage.<sup>2,13–17</sup> Moreover, laser therapy has to be employed in tumor overgrowth of the stent and in angulated cardia strictures because the stent is horizontally positioned and the

functional results are poor.<sup>18</sup> Only intubation can be performed in esophageal stenosis due to a bronchial carcinoma and in esophago-respiratory fistulas. For all these reasons careful selection of patients is necessary, excluding those in whom the procedure has few chances of proper results and high morbidity rate.<sup>9-12,19-26</sup>

In our experience endoscopic intubation has become the palliative treatment of choice. Improvements to quality of life, restoration of feeding ability, shorter hospital stays and non-repeated treatments are better than in the other procedures; moreover, stent implantation has the advantage of being a single procedure in most cases and, in our opinion, this aspect is very valuable for patients with a short life expectancy.

Endoscopic intubation is an old method, because first experiences of the procedure date back to the nineteenth century (Symmonds, in 1887). Before the introduction of the flexible fibre-optic endoscope, the stent was placed by a laparotomic pull-through or by a rigid endoscope push-through, but both methods had moderate rates of morbidity and mortality. In 1977 Atkinson designed a method of prosthesis placement after positioning a guide wire through the stenosis under fibroendoscopic and fluoroscopic control. In recent years instrument quality has further improved and several stents are now available, with new designs continuing to emerge.

Our experience has also evolved in several steps, starting from the use of Eder-Puestow metallic dilators and Nottingham introducer, and later of Savary-Guillard introducer. At the same time we firstly employed the Celestin pulsion tube in 18 patients, the wholly radiopaque Atkinson prosthesis in 23 and the Wilson-Cook tube in 27. These stents are made of latex or siliconed rubber reinforced by a nylon or metallic core to prevent wall collapse, and they are partially or entirely radiopaque to make them easily detectable by fluoroscopic control.

Since May 1993 we have employed self-expanding metal stents, which can be inserted in a compressed form and gradually self-expand after placement through the stenosis. Their main advantage is the need of only a minor dilation and that means fewer incidents of acute complications, shorter hospital stays and a final reduction of global outlay, in spite of the lower cost of plastic prosthesis. A further advantage of metallic stent is the wider luminal diameter when it is fully expanded, that means better improvement of symptoms and long-lasting patency. Moreover the expandable metal stent has a better flexibility and springiness, making it fit to be employed in cervical locations and in esophago-respiratory fistulas.<sup>22,23,27-34</sup>

We employed the Ultraflex stent, made of nitinol, a nickel-titanium alloy that gives the stent a high degree of flexibility; in the covered model the

stent is externally lined with a thin wall of polyurethane that prevents tumor ingrowth.<sup>35,36</sup> We always performed intubation under light intravenous sedation and oropharyngeal local anaesthesia. The introducer set consists of an internal catheter that is assembled with the compressed stent, encased in a gelatine cover; the stent is rounded by a protective Teflon sheath, which prevents unsuitable contact of the stent with esophageal fluids. The introducer has a conical tip that easily gets through the stenosis and an internal lumen that enables the passage of thin guide wires. Upon exposure to body temperature and esophageal fluids, the gelatine dissolves and allows the stent to expand to its full diameter.

The retrospective comparative analysis of the results in our two stented groups (plastic prosthesis vs self-expanding metal stent) shows a similar rate of technical success in both series (94.4% vs 93.7%). The main limitation to endoscopic intubation is total esophageal obstruction that does not allow the introduction of the guide wire through the stricture and its dilation; it occurred in four patients with plastic prosthesis and in three with self-expanding stent.

The functional success rate, as dysphagia regression, is similar in both groups of patients (85.3% vs 88.8%), while the acute complications (5.9% vs 0) and mortality rate (4.4% vs 0) are both lower with self-expanding stents. We had one pharyngeal perforation, two severe hemorrhages and one stent distal migration during the detachment procedure when we employed plastic prosthesis, while no acute complication occurred with expandable stents. Procedure-related deaths only occurred in the plastic prosthesis group: one patient died from severe bleeding and two died, respectively, from acute cardiocirculatory failure and myocardial infarction (Table 2).

Mean hospital-stay was longer with the plastic stents (5 days vs 2) because of the higher incidence of acute complications that delay the patient's discharge. For this reason the metallic stent, although more expensive, is globally cheaper.<sup>28</sup>

The rate of late complications is similar in both groups of patients (20.8% vs 20%). Food obstruction (seven vs one) and distal migration (three vs three) were the most common complications in both series but tumor overgrowth (4 cases) was only observed in the conventional plastic group, while tumor ingrowth (three cases) and bleeding (two cases) occurred only with the metallic stent (Table 3). Hemorrhage is more frequent with a self-expanding stent because of the higher dilating strength on the esophageal wall with possible tissue necrosis.<sup>10,11</sup>

Perforation is the most serious complication; it occurred with Celestin pulsion tube in a patient

with cervicoarthrosis, so it was difficult to pass the Nottingham introducer through the cervical esophagus. The patient complained of pharyngeal pain and subcutaneous emphysema in the neck; we immediately started parenteral nutrition and antibiotic therapy and the patient recovered under conservative treatment with healing of the perforation in 8 days.

Food obstruction occurred in seven patients intubated with a plastic prosthesis and in one patient treated with a metallic stent; when this complication arises a wash of gas drinks can be attempted, but for most patients it can only be managed by endoscopic deobstruction procedures, which we always performed in day hospital.

Tumor ingrowth and overgrowth usually arise after a mean period of 7 weeks.<sup>6,37</sup> These complications occurred in four patients with plastic prostheses and in three with self-expanding stents and we treated the patients with photocoagulation in five cases, by the placement of a nutritional probe in one and by the insertion of a new stent in another one.

Stent distal migration is usually due to an error of indication (stent diameter smaller than stenosis or poor anchorage in cardia neoplasm); other reasons for dislocation can be an excessive dilation of a crumbly tumor or postintubation radiotherapy. Gastric dislodgement occurred in three patients of the conventional group and in three of the self-expanding series; the Ultraflex stent was always left in the stomach because it did not obstruct the pylorus, one plastic prosthesis was spontaneously evacuated from the bowels while the other two stents were removed through a gastrotomy; a second stent was reinserted in all the patients; by endoscopic procedure in four cases, and through a gastrotomy in two.<sup>38,39</sup>

## CONCLUSIONS

Endoscopic intubation is the main option in the palliative treatment of malignant stenosis of the esophagus and cardia. The procedure has to be preferred to other palliative methods because it improves life quality, allows restoration of oral feeding, needs only a short hospital stay and avoids repeat treatment sessions.

The first aim of the procedure is not to increase survival, but rather to improve the quality of remaining life and agreement is unanimous: dysphagia is relieved and alimentary transit restored allowing adequate oral feeding.

The results of our retrospective analysis suggest that the:

- technical success rates for the two stented groups are comparable (94.4% vs 93.7%)

- functional success rates are similar (88.8% vs 85.3%)
- rate of acute complications is 5.9% with plastic prostheses, while no acute complication occurred with self-expanding stents
- rate of late complications (20.6% vs 20%) and mean survival time (151 vs 183 days) are comparable in both groups
- procedure-related mortality rate was 4.4% with a plastic stent, while no death occurred with the Ultraflex stent.

The comparative analysis of our results confirms that the self-expanding stents are the most efficacious; implantation is easy and safe, feasible in most patients and carries a low rate of critical complications and mortality. Continued developments are necessary to further reduce long-term complications and to improve effectiveness.

## References

- 1 Earlam R J, Cunha-Melo J R. Oesophageal squamous cell carcinoma. A critical review of surgery. *Br J Surg* 1980; 67: 381–7.
- 2 Tietjen T G, Pasricha P J, Kalloo A N. Management of malignant esophageal stricture with esophageal dilation and esophageal stents. *Gastrointest Endosc Clin N Am* 1994; 4: 851–61.
- 3 De Palma G D, Di Matteo E, Romano G, Fimmano A, Rondinone G, Catanzano C. Plastic prosthesis versus expandable metal stents for palliation of inoperable esophageal thoracic carcinoma. A controlled prospective study. *Gastrointest Endosc* 1996; 43: 478–82.
- 4 Lambert R. Esophageal cancer. Which stent, who places it, and where? *Endoscopy* 1995; 27: 509–11.
- 5 Lambert R. Treatment of esophagogastric tumors. *Endoscopy* 2000; 32: 322–30.
- 6 Grund K E, Storek D, Becker H D. Highly flexible self expandable meshed metal stent for palliation of malignant esophagogastric obstruction. *Endoscopy* 1995; 27: 486–94.
- 7 Cantero R, Torres A J, Hernando F, *et al.* Palliative treatment of esophageal cancer. Self-expanding metal stents versus Postlethwait technique. *Hepatogastroenterology* 1999; 46: 971–6.
- 8 Hourneaux G, de Moura E, Sakai P, Ceconello I, Ishioka S. Palliative treatment of advanced esophageal cancer. Comparative study: auto-expandable metal stent and isoperistaltic esophagogastric bypass. *Acta Gastroenterol Latinoam* 2001; 31: 13–22.
- 9 Tytgat G N J. Endoscopic therapy of esophageal cancer. Possibilities and limitations. *Endoscopy* 1990; 22: 263–7.
- 10 Ell C, Hochberger J, May A, Fleig W E, Hahn E G. Coated and uncoated self-expanding metal stents for malignant stenosis in the upper GI tract. Preliminary clinical experiences with Wallstents. *Am J Gastroenterol* 1994; 89: 1496–500.
- 11 Ell C, May A, Hahn E G. Gianturco-Z stents in the palliative treatment of malignant esophageal obstruction and esophagotracheal fistulas. *Endoscopy* 1995; 27: 495–500.
- 12 Tytgat G N J, Huibregtse K. Endoscopic palliative therapy of gastrointestinal and biliary tumors with prosthesis. *Clin Gastroenterol* 1986; 15: 249–71.
- 13 Anderson D, Wright P D. Laser recanalization versus endoscopic intubation in the palliation of malignant dysphagia. *Br J Surg* 1990; 77: 1151–3.
- 14 Fleischer D E, Bull-Henry K. A new coated self-expanding metal stent for malignant esophageal stricture. *Gastrointest Endosc* 1992; 38: 86–8.
- 15 Fleischer D. Endoscopic laser therapy for esophageal cancer. Present status with emphasis on past and future. *Lasers Surg Med* 1989; 9: 6–16.

- 16 Fugger R, Niederle B, Jantash H. Endoscopic tube implantation of malignant esophageal stenosis. *Endoscopy* 1990; 22: 101–4.
- 17 Lindbergh C G, Cwikiel W, Ivancev K. Laser therapy and insertion of wall-stent for palliative treatment of esophageal carcinoma. *Acta Radiol* 1991; 32: 345–8.
- 18 Spinelli P, Cerrai F G, Ciuffi M, Ignomirelli O, Meroni E, Pizzetti P. Endoscopic stent placement for cancer of the lower esophagus and gastric cardia. *Gastrointest Endosc* 1994; 40: 455–7.
- 19 Colt H G, Meric B, Dumon J F. Double stents for carcinoma of the esophagus invading the tracheo-bronchial tree. *Gastrointest Endosc* 1992; 38: 485–9.
- 20 Do Y S, Song H Y, Lee B H, *et al.* Esophagorespiratory fistula associated with esophageal cancer. Treatment with a Gianturco stent tube. *Radiology* 1993; 187: 673–7.
- 21 Wu W C, Katon R M, Saxon R R. Silicone-covered self-expanding metallic stents for the palliation of malignant obstruction and esophagorespiratory fistulas. Experience in 32 patients and a review of the literature. *Gastrointest Endosc* 1994; 40: 22–33.
- 22 Siersema P D, Schrauwen S L, van Blankenstein M, *et al.* Self-expanding metal stents for complicated and recurrent esophago-gastric cancer. *Gastrointest Endosc* 2001; 54: 579–86.
- 23 Siersema P D, Hop W C, van Blankenstein M, *et al.* A comparison of 3 types of covered metal stents for the palliation of patients with dysphagia caused by esophagogastric carcinoma. A prospective, randomized study. *Gastrointest Endosc* 2001; 54: 145–53.
- 24 Conio M, Caroli-Bosc F, Demarquay J F, *et al.* Self-expanding metal stents in the palliation of neoplasms of the cervical esophagus. *Hepatogastroenterology* 1999; 46: 272–7.
- 25 Bartelsman J F, Bruno M J, Jensema A J, Haringsma J, Reeders J W, Tytgat G N. Palliation of patients with esophago-gastric neoplasms by insertion of a covered expandable modified Gianturco-Z endoprosthesis. Experiences in 153 patients. *Gastrointest Endosc* 2000; 51: 134–8.
- 26 Vakil N, Morris A I, Marcon N, *et al.* A prospective, randomized, controlled trial of covered expandable metal stents in the palliation of malignant esophageal obstruction at the gastroesophageal junction. *Am J Gastroenterol* 2001; 96: 1791–6.
- 27 Davies N, Thomas H G, Eyre-Brook I A. Palliation of dysphagia from inoperable oesophageal carcinoma using Atkinson tubes or self-expanding metal stents. *Ann R Coll Surg Engl* 1998; 80: 394–7.
- 28 Shimi S M. Self-expanding metallic stents in the management of advanced esophageal cancer. A review. *Semin Laparosc Surg* 2000; 7: 9–21.
- 29 Knyrim K, Wagner H J, Bethge N, Keymling M, Vakil N. A controlled trial of an expandable metal stent for palliation of esophageal obstruction due to inoperable cancer. *N Engl J Med* 1993; 329: 1302–7.
- 30 Lightdale C J. Self-expanding metal stents for esophageal and gastric cancer. A new opening. *Gastrointest Endosc* 1992; 38: 86–8.
- 31 Rajman I, Walden D, Kortan P. Expandable esophageal stents. Initial experience with a new nitinol stent. *Gastrointest Endosc* 1994; 40: 614–21.
- 32 Hoepffner N, Foerster E C, Kautz G, Domschke W. Polyurethane-covered mesh stent for malignant esophageal stenosis with fistulas. *Gastrointest Endosc* 1994; 40: 651.
- 33 Kozarek R A, Ball T J, Patterson D J. Metallic self-expanding stent application in the upper gastrointestinal tract. Caveats and concerns. *Gastrointest Endosc* 1992; 38: 1–6.
- 34 Song H Y, Do Y S, Han Y M. Covered expandable esophageal metallic stent tubes. Experiences in 119 patients. *Radiology* 1994; 193: 689–95.
- 35 Birch J F, White S A, Berry D P, Veitch P S. A cost-benefit comparison of self-expanding metal stents and Atkinson tubes for the palliation of obstructing esophageal tumors. *Dis Esophagus* 1998; 11: 172–6.
- 36 Mokhashi M S, Hawes R H. The ultraflex stents for malignant esophageal obstruction. *Gastrointest Endosc Clin N Am* 1999; 9: 413–22.
- 37 McManus K, Khan I, McGuigan J. Self-expanding oesophageal stents. Strategies for re-intervention. *Endoscopy* 2001; 33: 601–4.
- 38 De Palma G D, Iovino P, Catanzano C. Distally migrated esophageal self-expanding metal stents. Wait and see or remove. *Gastrointest Endosc* 2001; 53: 96–8.
- 39 Von Schonfeld J. Endoscopic retrieval of a broken and migrated esophageal metal stent. *Z Gastroenterol* 2000; 38: 795–8.