

Self-Expanding Metal Stents for Malignant Esophagogastric Obstruction: Experience with a New Design Covered Nitinol Stent

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Abstract

Background and aims. Dysphagia is the most common disabling symptom in patients with inoperable esophagogastric carcinoma. Self-expanding metal stents are highly effective in the palliation of these patients. **Methods.** In 35 patients with inoperable carcinoma of the esophagus or the stomach, with recurrent tumor or complications after transhiatal esophagectomy or gastrectomy or with esophageal stenosis caused by pulmonary cancer, a self-expanding nitinol stent was placed to reduce dysphagia. Dysphagia and WHO performance status were assessed, before and after stent placement. **Results.** In 35 patients, 39 stents were placed without technical problems. Dysphagia improved significantly. The WHO performance status remained stable. Mean survival of all patients was 11 weeks. Major complications occurred in 3 patients. One patient died of massive tumor bleeding. Minor complications such as stent migration or retrosternal pain occurred in 5 patients. In 2 patients the migrated stent could successfully be placed in the correct position after giving ice-cooled water through the endoscope. Four patients had esophagorespiratory fistulas which were all initially successfully occluded. **Conclusion.** This nitinol stent is highly effective for improving dysphagia in patients with malignant esophagogastric obstruction. We observed no procedure-related complications. Bleeding was the principal major complication. The early intake of cold beverages resulted in stent migration. Recurrent dysphagia due to overgrowth by tumor or nonmalignant tissue remains a problem. Technical improvements are desirable to reduce the overgrowth by nonmalignant tissue.

Key words

Esophagogastric carcinoma – palliative therapy – self-expanding metal stents

Introduction

Most patients suffering from carcinoma of the esophagus or gastric cardia have inoperable stage at presentation (1). Dysphagia is the most common disabling symptom in the majority of these patients. The best palliative treatment is unclear. Thermal tumor ablation is reported to improve dysphagia (2). Alternatively, self-expanding metal stents are highly effective in the palliation of patients with dysphagia which, in turn, may improve nutritional status and the overall quality of life (3). Both uncovered (3, 4) and membrane-covered (5) metal stents have been shown to be associated with fewer complications than prosthetic tubes. Therefore, insertion of self-expanding metal stents has become the treatment of choice for patients with unresectable carcinoma of the esophagus or the gastric cardia. Currently, several types of metal stents are available. We report our experience with a self-expanding thermal-shaped memory metal stent made of nitinol in a consecutive series of patients with malignant strictures of the esophagus or the stomach. This stent was first described in 1997 in an uncoated form (6). In Germany, it has been commercially available in a covered version since 2001.

Patients and methods

Patients

From January 2002 to August 2004, a self-expanding metal stent was placed in 35 patients with inoperable carcinoma of the esophagus or the stomach, with recurrent tumor or complications after transhiatal esophagectomy or gastrectomy or with esophageal stenosis caused by pulmonary cancer. Complications were defined as anastomotic insufficiency or stenosis after tumor resection. All patients gave written consent before insertion of the metal stent. Dysphagia was patient-assessed on a

scale of 0 to 4: 0, normal food intake with no sensation of food hold-up; 1, difficulty with swallowing some solids; 2, able to swallow only soft food; 3, able to swallow liquids only; 4, complete inability to swallow. The general health of the patients was assessed using the WHO performance status: 0, fully active; 1, restricted in physically strenuous activity but ambulatory and able to carry out light work; 2, ambulatory and capable of self-care but unable to carry out any work activities; 3, capable of limited self-care; 4, completely disabled, unable to carry out any self-care; 5, dead.

Twenty-two patients had radiation (2), chemotherapy (11) or a combination of both, radiation and chemotherapy (9), prior to placement of a metal stent.

Methods

The stent (Flextent, Medwork, Neuss, Germany) used is made of nitinol which possesses a memory effect (Fig. 1). At body temperature it develops maximum radial force. Two types are available, a partial or a completely polyurethane covered type. Therefore, it prevents the in-growth of tumour tissue. The 15-mm-long ends of the partial covered stent are tulip-shaped without covering.

The delivery system consists of an 8 mm diameter outer tube and an inner pusher tube with a preloaded stent. The stent is available in numerous sizes in length and 20 mm or 24 mm in diameter.

Under endoscopic visualization, the proximal and distal margins of the tumor were identified. A stent at least 2 to 4 cm longer than the tumor stenosis was chosen to allow for a 1 to 2 cm extension beyond the proximal as well as the distal tumor margins. After endoscopic assessment, a 0.035-inch stiff guide wire was placed through the tumor stenosis into the stomach. When it was impossible to pass an endoscope the tumor stenosis was dilated to 10 mm. The margins of the tumor were marked under fluoroscopic guidance with small metal devices which were located on the patient's skin. Then the endoscope was removed and the delivery system was introduced over the guidewire. The stent was deployed under fluoroscopic control (Fig. 2). Endoscopic examination was performed immediately following stent insertion (Fig. 3) and a radiographic contrast

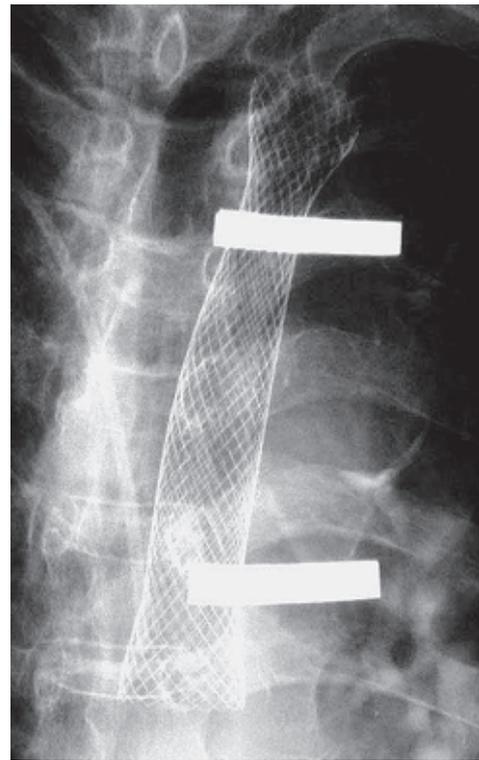


Fig. 2 Radiograph after successful implantation. The metal devices mark the proximal and the distal tumor margin.

examination with water-soluble contrast media was carried out within 1 day after stent placement. All endoscopic procedures were performed under mild sedation with midazolam (3-5 mg) and analgesia with meperidine (50 mg) intravenously. If stent migration was observed or the stent could be retrieved, it was flushed with ice-cooled water via the accessory channel of the endoscope. In this way, the stent was shortened. Then, it could be grasped with rat-toothed forceps and repositioned or taken out.

Statistics

Results are means \pm standard deviation (SD). Values before and after stent placement were compared using the Wilcoxon test.



Fig. 1 The nitinol stent (Flextent™) partially covered with polyurethane at body temperature.

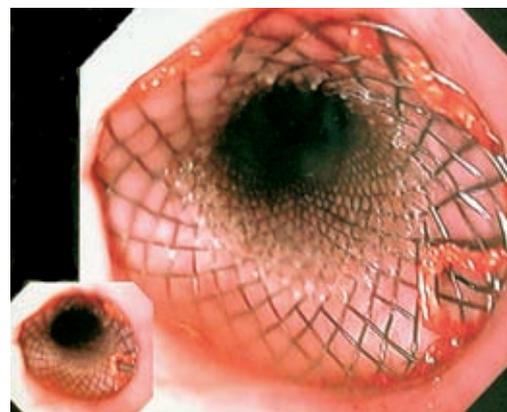


Fig. 3 Endoscopic view into the proximal tulip of the nitinol stent after implantation.

Results

A total of 39 stents were placed in 35 patients. The clinical characteristics are listed in Table I.

Table I Clinical characteristics of the 35 patients

Mean age (range) (yr)	66 (30-82)
Gender (M/F)	28/7
Localization of tumor (n=35)	
Upper esophagus	7
Middle esophagus	6
Lower esophagus	9
Cardia	7
Stomach	2
Anastomosis stenosis after tumor resection	1
Tumor histology (n=35)	
Squamous cell carcinoma of the esophagus	13
Adenocarcinoma of the esophagus	3
Cardia carcinoma	6
Gastric carcinoma	6
Lung carcinoma	6
Other	1
Fistula	4
Concomitant therapy prior to stent placement (n=22)	
Radiation	2
Chemotherapy	11
Radiation + chemotherapy	9
Size of stent inserted (mm) (n=39)	
80	7
100	13
120	10
140	9

No technical problems or complications occurred during placement of the prosthesis. Reasons for multiple stent placement included the following: distal migration after insertion (n=2) and tumor overgrowth at the upper tulip of the stent (n=2). The majority of the patients obtained a 100 mm or a 120 stent with a diameter of 20 mm (Table I). Most stents (n=16) were placed in the distal part of the esophagus and into the gastric cardia. Dysphagia improved significantly from a mean of 3.2 ± 0.12 to 0.9 ± 0.15 ($p < 0.001$). The WHO performance status remained stable in all patients (Table II).

Mean survival of all patients was 11 weeks with a range from 1 to 90 weeks.

Table II Outcome in 35 patients

	Before stent placement	After stent placement
Dysphagia grade		
0	-	14
1	1	13
2	3	6
3	12	2
4	19	-
Mean (S.D.)	3.2 (± 0.72)	0.9 (± 0.15)*
WHO performance status		
0	6	4
1	19	18
2	10	12
3	-	1
Mean (S.D.)	1.11 (± 0.11)	1.29 (± 0.12)

* $p < 0.001$

Major complications occurred in 3 patients (9%), who developed upper gastrointestinal bleeding (Table III). One patient died of massive tumor bleeding 7 weeks after stent placement. Minor complications like stent migration during the first week after stent placement (n=4; 11%) or retrosternal pain (n=1; 3%) occurred in 5 patients (14%). In 2 patients the migrated stents were successfully placed in the correct position after giving ice-cooled water through the endoscope. Four patients had esophagorespiratory fistulas. Initially, all fistulas were successfully occluded. In one patient, with an esophagorespiratory fistula, stent migration led to a recurrence of the fistula. It was occluded by the insertion of an additional stent.

Table III Complications and cause of death in 35 patients

Minor complications (n=5)	
retrosternal pain	1
stent migration	4
Major complications (n=3)	
upper gastrointestinal bleeding	3
Cause of death (n=24)	
Procedure related	0
Stent related	1
Tumor progression	23

In one patient with gastric cancer, the indication for stent placement was leakage of the anastomosis after gastrectomy. Initially, a covered stent was placed without any problems. Eight weeks later, when the stent removal was planned, the patient complained of a progression of dysphagia. Endoscopically, the proximal tulip of the metal stent showed an overgrowth by granulation tissue (Fig.4). Complex endoscopic preparation using a needle knife and an insulated tip knife allowed us to remove the stent after four endoscopic sessions.

Two patients with a squamous cell carcinoma near the upper esophageal sphincter developed tumor overgrowth at the proximal tulip of the stent with impairment of dysphagia. In these cases a second completely covered stent (including the tulips) was inserted into the primarily placed



Fig.4 Overgrowth of granulation tissue at the proximal end of the stent.

stent. Afterwards, dysphagia and swallowing were improved.

Discussion

Dysphagia is the most common cause of impaired quality of life in malignant esophageal obstruction (7). Therefore, the aims of palliation in these patients were to overcome dysphagia and optimize the quality of life by using interventions that have minimal complications. Endoscopic placement of self-expanding metal stents is an acceptable treatment for patients with unresectable malignant esophageal obstruction. In most cases rapid relief of dysphagia and adequate oral intake of nutrients can be achieved (2). Insertion of self-expanding metal stents can be combined with other palliative treatment strategies. However, treatment with palliative chemotherapy, radiation or combined radio-chemotherapy has significant side effects. In a well-designed study it was demonstrated that combined radio-chemotherapy alleviated dysphagia in only 58%. Life-threatening complications occurred in 20% of patients, whereas serious complications were seen in 44% (8).

Siersema et al (5) reported major complications in 23% and minor complications in 33% after stent placement in a total number of 57 patients with esophagogastric carcinoma. They differentiated between procedure-related and stent-related complications. Of the patients who had stent-related complications, 60% had undergone prior radiation, chemotherapy, or both. It is still unclear whether prior radiation and/or chemotherapy increases the risk of complications after stent placement. Formerly, Siersema et al postulated that the association between stent-related complications and prior treatment is an established finding (5, 9). In a recent study the same group did not find an increase of life-threatening complications or differences in survival after stent placement in patients with concomitant radiation and/or chemotherapy (10). Retrosternal pain occurred more frequently in patients who had previously undergone radiation and/or chemotherapy. In our study, bleeding, severe pain and stent migration occurred in 8 patients (22.9%). We found no significant correlation between stent placement and prior treatment of the tumor.

Stent migration alone, a stent-related complication, occurred in 4 patients who had drunk cold beverages in the early phase after stent placement. No stent migrated into the stomach. Two migrated stents could be replaced easily after flushing with ice cooled water through the endoscope.

The addition of a covering membrane might make stent migration more likely. Fan et al (6), using an uncoated type of the stent implanted in our study, have described two predetermined physical forms of the stent, depending on its temperature. In its low temperature phase, as in ice water, the material becomes very pliable and facilitates migration. Therefore, cold beverages should be avoided, at least during

the first month after stent placement. However, it is an advantage of the low temperature phase that an incorrect positioned stent can be replaced after giving ice cooled water through the stent. It is very important to be extremely careful because reposition or removal of metal stents is usually difficult especially when not using coated stents.

The second form of the stent achieved in the body temperature phase is defined by continuous expansion to its maximum diameter, dilating the stricture. The advantage of this form is the expansile force and a large diameter which is established after transforming to its tube shape.

The procedure of stent placement was well tolerated by all patients. The application of the delivery system is simple and allows a safe and correct placement. A disadvantage of the delivery system is the stiffness which makes passage through the pharynx difficult in a few cases.

Proximal tumor overgrowth is a common problem in esophageal stenting and can be treated in most cases with laser debridement or argon plasma coagulation. Overgrowth of granulation tissue might represent a problem especially in cases where the stent should be removed after temporary placement. Probably, the greater diameter of the tulip or the form of the tulip leads to a localized inflammation of the mucosa with consecutive development of granulation tissue. Additionally, the type of metal used for the stent might have a causative role. This nonmalignant tissue is predominantly found at the proximal end of the stent. The histologic findings associated with overgrowth by nonmalignant tissue include granulation tissue, reactive hyperplasia, and fibrosis (11). It is uncertain whether this tissue might be the cause of recurrent dysphagia. Mayoral et al (11) found this to be the cause in 32% of their patients. However, Siersema et al observed granulation tissue in a number of patients without relevant recurrent dysphagia (12). In our study, the development of overgrowth by nonmalignant tissue did not cause a relevant stent obstruction but instead impairment of dysphagia. Tumor overgrowth with recurrent dysphagia was observed in two cases and could be treated by the placement of a second, completely covered, metal stent.

In conclusion, this self-expanding nitinol stent is highly effective for the improvement of dysphagia in patients with malignant strictures of the esophagus or the stomach. It has a strong expansile force. The application is simple and safe. In our study, procedure-related complications did not occur. Bleeding was the main major complication and was the cause of death in one patient. The memory effect of nitinol represents an advantage in cases where removal or repositioning of the stent is made. However, early intake of cold beverages might result in stent migration. Therefore, cold beverages should be avoided in the first period after stent placement. Recurrent dysphagia due to overgrowth by tumor or nonmalignant tissue remains a problem. Possibly, impregnation of stents with cytotoxic agents might reduce the tumor overgrowth. Additionally, technical improvements, especially of the tulip, are desirable to reduce the overgrowth by nonmalignant tissue.

Conflicts of interest

There is no commercial association (e.g., equity ownership of interest, consultancy, patent and licensing agreement, or institutional and corporate associations) that might be a conflict of interest in relation to the submitted manuscript.

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