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BRIEF ARTICLE

Covered nitinol stents for the treatment of esophageal strictures and leaks

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Abstract

AIM: To compare 2 different types of covered esophageal nitinol stents (Ultraflex and Choostent) in terms of efficacy, complications, and long-term outcome.

METHODS: A retrospective review of a consecutive series of 65 patients who underwent endoscopic placement of an Ultraflex stent (n = 33) or a Choostent (n = 32) from June 2001 to October 2009 was conducted.

RESULTS: Stent placement was successful in all patients without hospital mortality. No significant differences in patient discomfort and complications were observed between the Ultraflex stent and Choostent groups. The median follow-up time was 6 mo (interquartile range 3-16 mo). Endoscopic reintervention was required in 9 patients (14%) because of stent migration or food obstruction. No significant difference in the rate of reintervention between the 2 groups was observed (P = 0.8). The mean dysphagia score 1 mo after stent placement was 1.9 ± 0.3 for the Ultraflex stent and 2.1 ± 0.4 for the Choostent (P = 0.6). At 1-mo follow-up endoscopy, the cover membrane of the stent appeared to be damaged more frequently in the Choostent group (P = 0.34). Removal of the Choostent was possible up to 8 wk without difficulty.

CONCLUSION: Ultraflex and Choostent proved to be equally reliable for palliation of dysphagia and leaks. Removal of the Choostent was easy and safe under mild sedation.

Key words: Dysphagia; Esophageal neoplasms; Endoscopy; Palliative care; Surgical anastomosis; Stricture; Neoadjuvant therapy; Self-expanding metal stents

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INTRODUCTION

Less than 50% of patients with esophageal carcinoma are suitable for surgery at the time of diagnosis. Most of these patients present with locally advanced or metastatic disease and/or significant comorbidities. In such circumstances, the only therapeutic option is palliative care to treat dysphagia and prevent respiratory complications secondary to aspiration.

Over the past 20 years, the use of covered self-expanding metal stents (SEMS) has proven effective in

patients with unresectable esophageal carcinoma and in those with a tracheo-esophageal fistula[1-3]. In addition, covered SEMS have been successfully used in the management of patients with anastomotic leaks or fistulas[4,5]. Despite the large number of different covered metal stents available on the market, the superiority of one type over another has not yet been proven[6,7]. The aim of this study was to review our experience with 2 types of covered nitinol stents in the management of patients with esophageal strictures and anastomotic complications.

MATERIALS AND METHODS

From July 2001 to October 2009, 422 patients with esophageal stricture due to cancer were seen at our institution. A total of 263 (62.3%) patients had surgical resection with or without neoadjuvant chemotherapy or chemoradiotherapy. We retrospectively reviewed the charts of 65 consecutive patients who underwent endoscopic placement of a covered nitinol stent. Two types of stents were used: Ultraflex (Boston Scientific, MA, USA), and, more recently, Choostent (M.I. Tech, Seoul, Korea). Ultraflex stents had a diameter of 18 or 23 mm and a length of 10 or 12 cm; Choostent stents had a diameter of 18 mm and lengths of 8, 11, 12 or 14 cm.

The indications for placement of the stent are shown in Table 1. The grade of dysphagia at presentation was defined using a 0 to 4 grading system as shown in Table 2. Demographic and clinical data are presented in Table 3.

Assessment of the extent of disease included a videoesophagram, upper endoscopy with biopsy, chest and abdominal computed tomography scan. In a subset of patients, total body positron emission tomography was performed to rule out the presence of distant metastases. If the tumor was in close proximity with the carina, a fiber-optic bronchoscopy was performed to evaluate the presence of infiltration and/or compression that could affect ventilation after placement of the stent. In some patients, Savary esophageal dilators were used to simulate the presence of the stent during the bronchoscopic examination. Written consent for the treatment was obtained from all patients.

Prior to the procedure, an antibiotic (ceftazidime 1 g iv) was administered to the patient. Endoscopic stent placement was performed with fluoroscopic guidance in the operating room, with the patient in left lateral decubitus. In 95% of the cases, conscious sedation with midazolam was used; in 3 patients propofol was required to achieve an adequate level of sedation. If the diameter of the lumen was too small to allow placement of the stent, dilatation up to 9 mm in diameter was performed with Savary bougies.

In patients with tumors of the thoracic esophagus, the proximal and distal margins of the lesion were marked with water-soluble ink injected into the submucosa. In patients with tumors located at the gastroesophageal junction, only the proximal margin was marked. In a few cases the proximal and distal limits of the tumor were marked using metallic endoclips[8]. Complete opening of the stent was expected within 48-72 h after implantation. In most patients, no attempt was made to pass the stent with the endoscope after its deployment in order to prevent migration.

Table 1 Indication for use of the stent in 65 patients

	n (%)
Esophageal carcinoma	51 (78.5)
Adenocarcinoma	31
Squamous-cell carcinoma	20
Complications of esophagogastric anastomosis	8 (12.3)
Fistula	3
Stricture	3
Tumor recurrence	2
Extrinsic compression	4 (6.1)
Lung cancer	2
Pleural mesothelioma	1
Mediastinal lymphoma	1
Post-radiotherapy stricture	2 (3.1)

Table 2 Classification of dysphagia

Grade	Definition
0	Normal swallowing
1	Able to swallow some solid food
2	Able to swallow semi-liquid food
3	Able to swallow liquids only
4	Absolute dysphagia

After the procedure, a non-steroidal antiinflammatory (ketorolac) and proton pump inhibitors (e.g. pantoprazole) were administered intravenously. Chest X-ray and a gastrografin swallow study were performed the day after stent placement. Patients were then allowed to eat a semi-liquid diet until discharge.

RESULTS

Stent placement was technically successful in all patients. Nine patients (13.8%) presenting with severe stricture required preliminary dilation before deployment of the Ultraflex (n = 5) or the Choostent (n = 4). The procedure took a mean of 16 min (range, 12-35 min) with the Ultraflex, and 17 min (range, 13-27 min) with the Choostent (P = 0.8). There were no deaths related to the procedure. Periprocedural complications occurred in 4 patients (6.1%): 2 had fever probably related to aspiration pneumonia, 1 had an episode of atrial fibrillation managed with amiodarone iv, and 1 had acute urinary retention requiring catheterization. The 2 types of stent showed equal palliative efficacy against dysphagia. Most patients were discharged within 48 h. The results of the treatment are summarized in Table 4.

Early and late post-procedural complications are shown in Table 5. Severe chest pain immediately after stent insertion was present in 3 patients who had an Ultraflex implanted. The pain disappeared within 36 h of iv infusion of morphine. Overall, 9 patients (14%) needed a second endoscopic intervention. In 1 patient of the

Table 3 Demographic and clinical data of the patient population

	Total	Ultraflex	Choostent	*P*-value
Patients	65	33	32	-
Male/female	43/22	23/10	20/12	0.5
Mean age (range)	67.5 (34-86)	66.8 (34-83)	68.3 (42-86)	0.6
Grade of dysphagia (mean ± SD)	3.4 ± 0.4	3.4 ± 0.3	3.5 ± 0.4	0.9
Diagnosis				
Adenocarcinoma	31	16	15	0.9
Squamous cell carcinoma	20	11	9	0.8
Extrinsic compression	4	2	2	0.9
Anastomotic fistula	3	2	1	0.6
Anastomotic stricture	3	1	2	0.5
Anastomotic recurrence	2	1	1	0.9
Post-radiotherapy stricture	2	0	2	0.1
Site of lesion				
Cervical	3	2	1	0.6
Upper thoracic	9	6	3	0.3
Middle thoracic	21	11	10	0.9
Lower thoracic	32	14	18	0.4
Tumor stage (n = 51)				
Ⅲ	19	12	7	0.6
ⅣA	17	8	9	0.7
ⅣB	15	7	8	0.5

Table 4 In-hospital characteristics and long-term outcome after stent placement

	Ultraflex (n = 33)	Choostent (n = 32)	*P*-value
Duration of the procedure (min)	16 (12-35)	17 (13-27)	0.8
Median hospital stay (d)	2 (2-7)	2 (2-4)	0.7
Hospital mortality (%)	0	0	1.0
Hospital morbidity (%)	6.1 (2/33)	6.2 (2/32)	0.8
Pain score (scale 0-10)	6.3	4.8	0.2
Residual dysphagia (grade)	1.9 ± 0.3	2.1 ± 0.4	0.6
Mean survival (mo)	6.5 (1-19)	6 (3-26)	0.7

Table 5 Early and late complications after stent placement

	n (%)	Ultraflex (n = 33)	Choostent (n = 32)	*P*-value
Abrasion of soft palate	1 (1.5)	1	0	0.3
Odynophagia	1 (1.5)	0	1	0.3
Malposition	1 (1.5)	0	1	0.3
Late distal migration	3 (4.6)	2	1	0.6
Persistent chest pain	3 (4.6)	2	1	0.6
Persistent hiccups	3 (4.6)	1	2	0.6
Gastroesophageal reflux	14 (22)	7	7	0.9
Food obstruction	5 (7.6)	2	3	0.6

Choostent group, the radiographic control showed malpositioning of the stent (too distal release) thus requiring the insertion of a second device overlapping the first one. No stent migration was observed within 72 h after starting oral intake. Interestingly, symptomatic gastroesophageal reflux occurred in 14 (43.7%) of the 32 patients with a stent placed in the lower esophagus.

Upper gastrointestinal endoscopy was performed 1 mo after the procedure in 21 patients with the Ultraflex and in 19 patients with the Choostent. None of these individuals were complaining of dysphagia. The cover membrane of the Choostent appeared to be damaged more frequently compared to the Ultraflex (26% *vs* 14%, $P = 0.34$).

Satisfactory palliation of dysphagia was achieved also in patients with stricture of the esophagogastric anastomosis, and post-radiotherapy stricture. In the majority of these individuals the Choostent was easily removed 3 to 4 wk after the insertion under mild intravenous sedation. One of the 2 patients with an Ultraflex stent required general anesthesia for removal because of a marked tissue reaction and embedding of the proximal edge of the stent.

The worst clinical outcome was recorded in patients suffering from extrinsic malignant compression. One of these patients with dysphagia caused by a bronchial carcinoma died because of massive bleeding 21 d after stent placement. The other 3 patients did not achieve complete palliation of dysphagia and died within 2 mo because of progression of the underlying disease.

The stenting procedure was effective in 2 of the 3 patients with fistula of the esophagogastric anastomosis. The stent was successfully removed in all patients after a mean of 4 wk. Radiological evaluation showed persistent leakage in 1 patient who required insertion of another stent.

Twenty-six of the 65 patients (40%) received chemotherapy or chemoradiotherapy after stent implantation. In 7 patients, a Choostent was uneventfully removed under mild sedation within 8 wk from the beginning of chemotherapy and oral intake was well tolerated. Three of these patients showed significant down-staging of the disease that eventually allowed esophagectomy to be performed without complications.

The incidence of mechanical complications requiring further endoscopic intervention after stent implantation was similar in patients treated or not with chemotherapy or chemoradiotherapy. In treated patients (n = 26) there was an 11.5% incidence of stent dislocation, whereas in

patients who did not receive additive treatment (n = 31) there was a 12.9% incidence of food obstruction.

DISCUSSION

Self-expanding metal stents came onto the market at the beginning of the 1990s and gradually replaced the old Celestin tube. The endoscopic placement of SEMS has proven to be technically easier, requiring minimal dilatation, and resulting in less morbidity and better palliation of dysphagia. In addition, SEMS provide a better quality of life[9], particularly for patients with a Karnofsky index greater then 50[10]. The efficacy of these stents, the ease of insertion, and the large spectrum of diameters and lengths available has resulted in their widespread use also in patients with anastomotic leaks[11].

The standardization of the endoscopic technique and the precise placement mechanism have reduced, but not eliminated, the rate of intraoperative complications. Late complications range from 26% to 52%, especially in patients with adenocarcinoma, and complications requiring additional intervention are frequent[12]. The choice of the correct stent diameter in each patient may represent an important factor for the success of the procedure. The use of an Ultraflex stent with a large diameter significantly reduced the chances of recurrent dysphagia, formation of granulation tissue, and the risk of food obstruction compared to other SEMS[13]. Despite the reported high incidence of covered stent migration at the gastroesophageal junction[14], we believe this is still the best available palliative option in these patients. However, the overall incidence of symptomatic gastroesophageal reflux was 22% in our series, and was almost double (43.7%) among the 32 patients with a stent placed in the lower esophagus. Theoretically, the use of stents provided with an antireflux valve can prevent gastroesophageal reflux, thereby avoiding the risk of aspiration pneumonia[15].

To date, no significant differences in outcomes or complication rates have been reported with the available covered SEMS. The present study shows that there are no statistically significant differences between the Ultraflex and the Choostent, although insertion of the Choostent in the oro-pharynx was less traumatic and post-procedural pain was reduced in the Choostent group. In general, we found it more convenient to use the Ultraflex in patients with strictures of the proximal esophagus because of the ease of stent application under visual control (proximal release). In contrast, the distal release mechanism of the Choostent still allows the operator to modify the site of delivery before the stent has reached 50% of the maximum diameter. Interestingly, a greater frequency of degeneration of the covering film was observed at the 1-mo follow-up endoscopy in the Choostent group compared to the Ultraflex group.

Another finding of this study is that temporary stent placement has indeed a role in patients undergoing neo-adjuvant therapy and in those with anastomotic complications or post-radiotherapy strictures. In such circumstances, the complete cover membrane of the Choostent may cause less granulation tissue and allows easier removability a few weeks later. The benefit of temporary stent insertion has been suggested as a "bridge" to surgery in patients undergoing neo-adjuvant therapy[16]. This minimally invasive and reversible treatment can represent an alternative to trans-nasal feeding tube placement, endoscopic percutaneous gastrostomy, or jejunostomy. Stent placement is usually better accepted by patients, but no conclusive scientific evidence exists on this issue[16,17]. In our series, the use of a Choostent device allowed optimal nutrition and tolerance of neo-adjuvant therapy until tumor downstaging was documented. The stent was easily removed under mild sedation within 2 mo in 7 patients, 3 of whom underwent surgical resection without complications.

In conclusion, covered nitinol stents are safe and effective devices for palliation of dysphagia in patients with esophageal strictures. The Ultraflex and the Choostent proved to be equally reliable in the achievement of this goal. Close patient monitoring is required to avoid late complications. When temporary stent insertion is required, as in patients undergoing neo-adjuvant therapy and in those with anastomotic complications or post-radiotherapy strictures, the Choostent is preferable because of its easy and safe removal.

COMMENTS

Background

Less than 50% of patients with esophageal carcinoma are suitable for surgery at the time of diagnosis. In such circumstances, the self-expanding metal stents (SEMS) represent an excellent palliative option. Covered SEMS have also been used in the management of patients with anastomotic complications, malignant extrinsic compression of the esophagus, and post-radiotherapy stricture.

Research frontiers

Despite the large number of covered metal stents available on the market, the superiority of one type over another has not been proven yet in the management of esophageal strictures and leaks.

Innovations and breakthroughs

This study compared two different types of nitinol stents that were proven to be equally reliable for palliation of dysphagia and leaks. Both stents also proved to be easily removable up to 2 mo after insertion.

Applications

Temporary stent placement has a role in patients undergoing neo-adjuvant therapy and in those with anastomotic complications or post-radiotherapy strictures. This minimally invasive and reversible treatment can represent an alternative to trans-nasal feeding tube placement, endoscopic percutaneous gastrostomy, or jejunostomy in selected patients.

Peer review

This is an interesting and worthwhile report on the use of expandable covered metal stents for the treatment of esophageal problems.

REFERENCES

1 **Baron TH**. Expandable metal stents for the treatment of cancerous obstruction of the gastrointestinal tract. *N Engl J Med* 2001; **344**: 1681-1687

2 **Segalin A**, Bonavina L, Carazzone A, Ceriani C, Peracchia A. Improving results of esophageal stenting: a study on 160 consecutive unselected patients. *Endoscopy* 1997; **29**: 701-709

3 **Conio M**, Repici A, Battaglia G, De Pretis G, Ghezzo L, Bittinger M, Messmann H, Demarquay JF, Blanchi S, Togni M, Conigliaro R, Filiberti R. A randomized prospective comparison of self-expandable plastic stents and partially covered

self-expandable metal stents in the palliation of malignant esophageal dysphagia. *Am J Gastroenterol* 2007; **102**: 2667-2677
4 **Raijman I**, Siddique I, Ajani J, Lynch P. Palliation of malignant dysphagia and fistulae with coated expandable metal stents: experience with 101 patients. *Gastrointest Endosc* 1998; **48**: 172-179
5 **Bona D**, Sarli D, Saino G, Quarenghi M, Bonavina L. Successful conservative management of benign gastro-bronchial fistula after intrathoracic esophagogastrostomy. *Ann Thorac Surg* 2007; **84**: 1036-1038
6 **Riccioni ME**, Shah SK, Tringali A, Ciletti S, Mutignani M, Perri V, Zuccalà G, Coppola R, Costamagna G. Endoscopic palliation of unresectable malignant oesophageal strictures with self-expanding metal stents: comparing Ultraflex and Esophacoil stents. *Dig Liver Dis* 2002; **34**: 356-363
7 **Nathwani RA**, Kowalski T. Endoscopic stenting of esophageal cancer: the clinical impact. *Curr Opin Gastroenterol* 2007; **23**: 535-538
8 **Segalin A**, Bonavina L, Bona D, Chella B. Endoscopic clipping: a helpful tool for positioning self-expanding esophageal stents. *Endoscopy* 1995; **27**: 348
9 **Madhusudhan C**, Saluja SS, Pal S, Ahuja V, Saran P, Dash NR, Sahni P, Chattopadhyay TK. Palliative stenting for relief of dysphagia in patients with inoperable esophageal cancer: impact on quality of life. *Dis Esophagus* 2009; **22**: 331-336
10 **Yajima K**, Kanda T, Nakagawa S, Kaneko K, Kosugi S, Ohashi M, Hatakeyama K. Self-expandable metallic stents for palliation of malignant esophageal obstruction: special reference to quality of life and survival of patients. *Dis Esophagus* 2004; **17**: 71-75
11 **Roy-Choudhury SH**, Nicholson AA, Wedgwood KR, Mannion RA, Sedman PC, Royston CM, Breen DJ. Symptomatic malignant gastroesophageal anastomotic leak: management with covered metallic esophageal stents. *AJR Am J Roentgenol* 2001; **176**: 161-165
12 **Ross WA**, Alkassab F, Lynch PM, Ayers GD, Ajani J, Lee JH, Bismar M. Evolving role of self-expanding metal stents in the treatment of malignant dysphagia and fistulas. *Gastrointest Endosc* 2007; **65**: 70-76
13 **Verschuur EM**, Steyerberg EW, Kuipers EJ, Siersema PD. Effect of stent size on complications and recurrent dysphagia in patients with esophageal or gastric cardia cancer. *Gastrointest Endosc* 2007; **65**: 592-601
14 **Christie NA**, Buenaventura PO, Fernando HC, Nguyen NT, Weigel TL, Ferson PF, Luketich JD. Results of expandable metal stents for malignant esophageal obstruction in 100 patients: short-term and long-term follow-up. *Ann Thorac Surg* 2001; **71**: 1797-1801; discussion 1801-1802
15 **Elphick DA**, Smith BA, Bagshaw J, Riley SA. Self-expanding metal stents in the palliation of malignant dysphagia: outcome analysis in 100 consecutive patients. *Dis Esophagus* 2005; **18**: 93-95
16 **Vleggaar FP**. Stent placement in esophageal cancer as a bridge to surgery. *Gastrointest Endosc* 2009; **70**: 620-622
17 **Lopes TL**, Eloubeidi MA. A pilot study of fully covered self-expandable metal stents prior to neoadjuvant therapy for locally advanced esophageal cancer. *Dis Esophagus* 2009; Epub ahead of print

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