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The role of stents in the management of colorectal complications: a systematic review.

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Abstract

Background

Complications in colorectal surgery include a wide range of clinical conditions, which increase mortality, morbidity, hospital stay and costs. In some cases, the placement of a self-expanding metal stent may represent a possible therapeutic strategy, avoiding further surgery.

Methods

In order to verify the feasibility and safety of the technique, we reviewed the medical literature, between January 1997 and 2015, selecting 32 studies. Inclusion criteria were based on Preferred Reporting Items for Systematic reviews and Meta-Analyses recommendations.

Results

The estimated rate of early success was 73.3% (95% CI 66.3–79.3), raising from 25 to 68% in the time frame 1997–2007. The rate of early complications was 31.4% (95% CI 25.3–38.3%), progressively decreasing from 75 to 43% up to 2009. The rate of surgery for acute complication was 9.3% (95% CI 6.0–14.2%), reduced on time course from 25 to 9%. The rate of closure of dehiscence was 74.5% (95% CI 62.8–83.5%), while the rate of long-lasting success was 57.3% (95% CI 50.3–64.0%).

Conclusions

Endoscopic stenting in the early postoperative management of anastomotic complications after colorectal surgery should be considered in patients with minimal risk for sepsis, as a safe and often effective alternative to surgery. However, in order to establish the safety and efficacy of this technique, prospective studies involving a larger cohort of patients are required.

Keywords

Self-expandable stents SEMS Anastomotic leakage Anastomotic fistula Anastomotic stenosis

Complications in colorectal surgery include a wide range of clinical conditions, which increase mortality, morbidity, hospital stay and costs. Anastomotic leak (AL) and fistula (AF) are serious complications that occur with an incidence ranged up to 39% [1] and are always associated with relative high rate of morbidity and mortality [2]. Anastomotic stricture (AS), defined as the inability to pass a 12-mm endoscope through the anastomosis, is usually a late complication and occurs in up to 30% of patients after colorectal surgery [3].

In some cases, the placement of a self-expanding metal stent (SEMS) may represent a possible therapeutic strategy, avoiding further surgery. Different types of SEMS include fully covered (FC), partially covered (PC), uncovered (UC) and biodegradable (BD) stents, depending on the presence and the extension of a silicon cover. Stent coverage prevents communication between the lumen and the extra-luminal space, and tissue ingrowth allows stent removal, but favors migration.

In the last years, endoscopic techniques, including repeated debridement, fibrin glue injection, stent insertion, and most recently application of endoluminal vacuum devices, have been increasingly used for the management of colorectal anastomotic leaks. Since the management of complications after colorectal surgery is a challenging task, the aim of this systematic review was to assess the effectiveness and safety of SEMS in different clinical situations.

Methods

The methods used for the analysis and selection of inclusion criteria were based on Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) recommendations.

A literature review was performed in July 2015 by two trained investigator (RB, GLS), who conducted a search of the following databases: PubMed, EMBASE, MEDLINE, Current Controlled Trials Register (http://www.controlled-trials.com) and the Cochrane Database of Controlled Trials. All studies published between January 1997 and May 2015, in which patients underwent endoscopic treatment of colorectal postsurgical fistula, leak or stricture, were reviewed. Non-human studies, review articles, position papers, editorials, commentaries and book chapters were excluded from the review. If there was any suspicion of cohort overlap between studies, only the most recent study was considered for inclusion. The strings ‘anastomotic dehiscence,’ ‘colorectal strictures,’ ‘colonic fistula after surgery,’ ‘stent,’ ‘endoprothesis’ and ‘prosthesis’ and the MeSH headings ‘endoprothesis,’ ‘colorectal anastomotic leak’ OR ‘dehiscence’ and ‘colorectal anastomotic strictures’ were used in combination with the Boolean operators AND or OR. Data extraction was performed independently by two reviewers using pre-defined forms. A third investigator (AA) arbitrated in the event of any lack of agreement.

The primary outcomes were the rates of a early success, defined as symptom resolution, clinical evidence (passage of stools, pain relief) and radiological evidence of colonic decompression within 48 h of stent insertion, without the need for re-intervention, early complications (occurring within 30 days after the procedure), defined as stent retrieval, perforation, bleeding, migration, pain, fecal incontinence, foreign body sensation, stent impaction and hyperplastic tissue overgrowth, surgery for acute complication, defined as the occurrence of immediate or early complications or symptom recurrence requiring a surgical procedure, closure of dehiscence and long-lasting success, defined as resolution of symptoms and endoscopic confirmation of complete healing at the latest follow-up. The secondary outcomes were the rates of migration, defined as the overall rate of migration of a stent persisting dehiscence, persisting stenosis, endoscopic dilatation, need for any surgery, fully covered stent, stent-related migration, defined as the rate of migration of a stent positioned for stricture with or without fistula or leak and stent-related long-lasting success, defined as the rate of success of a stent positioned for stricture with or without fistula or leak at the latest follow-up.

Attempts were made to contact authors if data presentation was incomplete or if it was necessary to resolve an apparent conflict or inconsistency in the article. However, additional data were only sought regarding the primary outcome.

Per-patient rate of early success was defined as the ratio between the absolute number of patients treated by stent positioning for surgical complications and the overall number of patients who had an immediate clinical benefit in the short term, as reported by the author. The same methodology was applied to all the secondary outcomes.

Statistical analyses

All primary outcomes were analyzed by the fixed-effects model, where the proportions of single studies were used to estimate an overall proportion. The fixed-effects model incorporates heterogeneity among studies, taking into account differences in sample size by which proportions were measured in each study; this within-study variation was accounted for by using the exact binomial distribution. Individual and pooled estimates of these proportions together with 95% confidence intervals (95% CI) were presented in the forest plots. As for secondary outcomes, they were analyzed by the fixed-effects model except for the 3 subgroup analyses (fully covered stent, stent-related migration and stent-related long-lasting success), which were estimated by the random-effects model, due to their notable heterogeneity.

Heterogeneity was assessed by the I^2 measure of inconsistency, statistically significant if $I^2 > 50\%$. Potential sources of heterogeneity were explored by two sensitivity analyses: checking the results either of cumulative (sequentially including studies by date of publication) or influence analyses (calculating pooled estimates by omitting one study at a time). Publication bias was assessed by generating a funnel plot and performing the rank correlation test of its asymmetry. All analyses were performed using R 3.2.3 package meta (R Foundation for Statistical Computing, Vienna, Austria) [4].

Results

Study selection

A flow diagram of this systematic review, with the number of papers retrieved, included and excluded, as well as the reasons for exclusion, is shown in Fig. 1. In summary, 518 studies were identified by the literature search. After removing non-pertinent papers, 32 published papers were included in the systematic review [5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37]. The reasons for exclusion are given in Fig. 1.

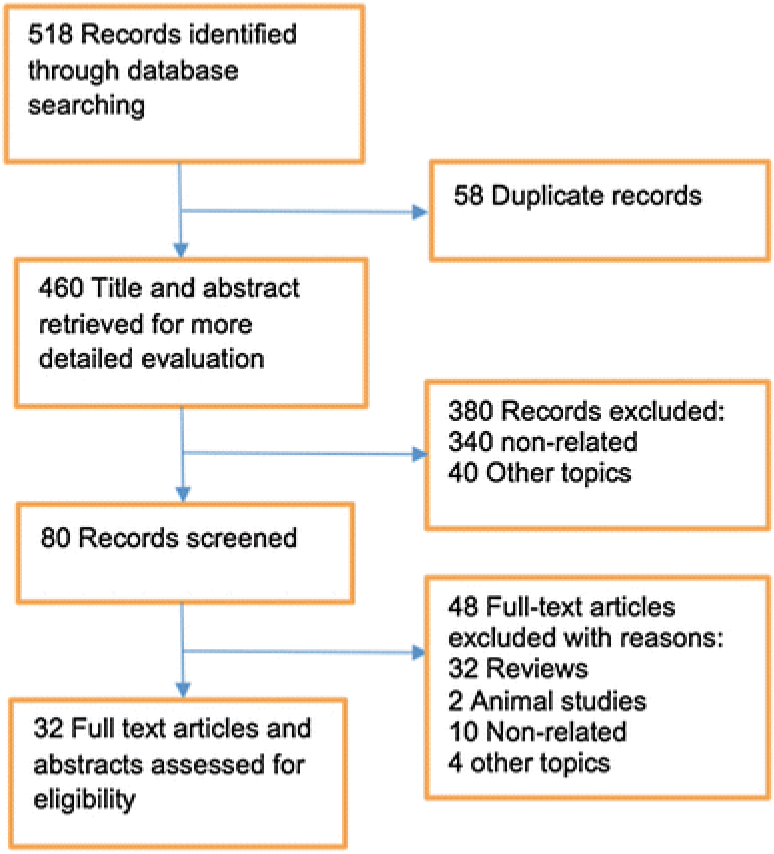

Fig. 1

Flow diagram of this systematic review

Characteristics of the included studies

Thirty-one of the included series were single-center studies and 1 multicenter study (Table 1). Six were prospective, while 19 retrospective series and 7 case report. The enrollment period ranged widely from 1997 to 2015.

Table 1

Characteristics of the included

References	Study design	*N*	Mean age	Gender (M/F)	Type of stent	Mean distance from anal verge (cm)	Reason for surgery	N. P.
Gürbulak et al. [5]	MC; CR	1	62	0/1	1 PC	17	CRC	N/A
Caruso et al. [6]	MC; R	16	76	10/6	16 FC	N/A	12 CRC/1 Div/1 IBD	19
Cooper et al. [7]	MC; R	8	55.8	5/3	8 FC	N/A	5 CRC/3 Div	9
Lamazza et al. [8]	MC; CS	6	53.5	0/6	5 FC/1 UC	6	CRC	3
Lamazza et al. [9]	MC; P	20	71	12/8	4 UC/16 FC	20	19 CRC/1 Gyn	20
Vanbiervliet et	MultiC;	40	67.2	22/18	40 FC	28	19 CRC/21	N/A

References	Study design	*N*	Mean age	Gender (M/F)	Type of stent	Mean distance from anal verge (cm)	Reason for surgery	N. P.
al. [10]	P						DIV	
Pérez Roldán et al. [11]	MC; R	5	66.5	5/0	3 BD/2 FC	5	CRC	11
Lamazza et al. [12]	MC; R	10	73.2	7/3	9 FC/1 UC	10	CRC	10
Repici et al. [13]	MC; R	11	64	7/4	11 BD	11	10 CRC/1 Div	12
Caruso et al. [14]	MC; R	10	72	N/A	10 FC	6	N/A	N/A
DiMaio et al. [15]	MC; R	5	69.2	1/4	4 FC/1 PC	4	1 CRC/4 Gyn	N/A
Pérez Roldán et al. [19]	MC; R	10	69.3	8/2	9 BD/1 FC	5	9 CRC/1 Gyn	16
Janík et al. [16]	MC; R	3	65	3/0	3 BD	3	3 CRC	N/A
Saida et al. [18]	MC; R	5	69	N/A	5 FC	2	5 CRC	6
Dai et al. [20]	MC; R	13	58	10/3	N/A	9	11 CRC/2 Div	23
Keränen et al. [21]	MC; R	10	64.2	N/A	9 FC/1 UC	N/A	4 CRC/2 Div/2 Gyn/2 IBD	17
Abbas [22]	MC; CR	2	62.5	1/1	N/A	1	1 CRC/1 Div	4
Amrani et al. [23]	MC; P	3	47.6	1/2	3 FC	2	1 CRC/2 Div	4
Chopra et al. [24]	MC; R	6	65	N/A	N/A	6	CRC	6
Rayhanabad and Abbas [25]	MC; R	6	65	N/A	N/A	6	CRC	6
Small et al. [26]	MC; P	3	66	2/1	3 FC	1	Div	4
Abbas and Falls [27]	MC; CR	2	68	0/2	2 FC	2	1 Gyn/1 Div	3
Forshaw et al. [28]	MC; R	5	71	5/0	5 FC	5	CRC	6
Stefanidis et al. [29]	MC; R	1	47	0/1	1 FC	1	N/A	1
Scileppi et al. [30]	MC; CR	1	58	1/0	N/A	1	CRC	1
Forshaw et al. [31]	MC; P	4	70	4/0	4 FC	2	CRC	4
Guan et al. [32]	MC; CR	1	48	1/0	1 FC	1	Trauma	2
Delaunay-Tardy et al. [33]	MC; R	3	71	2/1	3 FC	N/A	CRC	3
Paul et al. [34]	MC; P	8	62.7	4/4	6 FC/2 UC	2	6 CRC/2 Div	9
Odurny et al. [35]	MC; CS	3	72	2/1	3 FC	3	CRC	4
Repici et al. [36]	MC; CR	1	76	0/1	1 FC	1	CRC	1

References	Study design	*N*	Mean age	Gender (M/F)	Type of stent	Mean distance from anal verge (cm)	Reason for surgery	N. P.
Jeyarajah et al. [37]	MC; CR	1	57	0/1	1 PC	N/A	CRC	1

N patients treated for colorectal surgical complications; *N.P*. number of procedure

Study design: *MC* monocentric, *MultiC* multicenter, *CR* case report, *R* retrospective, *P* prospective, *CS* case series

Type of stent: *FC* fully covered, *PC* partially covered, *UC* uncovered, *BD* biodegradable

Reason for surgery: *CRC* colorectal cancer, *Div* diverticulitis, *Gyn* gynecological disease, *IBD* inflammatory bowel disease

A total of 223 patients were enrolled in the selected studies. The number of patients enrolled in each study ranged from 1 to 40, with a median of 7. The median of the mean ages across the included studies was 66 years (range 47–73 years). The median proportion of male patients was 61% (0–100%).

The clinical indication for SEMS positioning was AL in 2 studies, AF in 4 studies, AS in 15 studies and AS associated with AL or AF in 11 studies (Table 2). The most represented location was rectum and sigmoid colon, with a median of mean distance from anal verge of 15 cm, from 7.5 to 25 cm.
Table 2

Clinical indication for SEMS

References	*N*	Type of stent	Stent mean stay in place (day)	Indication for AF	Indication for AL	Indication for AS	Indication for AS + AL or *AS* ± *AF*	Follow-up (months)
Guburlak et al. [5]	1	1 PC	24	1				N/A
Caruso et al. [6]	16	16 FC	59			16		21
Cooper et al. [7]	8	8 FC	45		3	5		3.5
Lamazza et al. [8]	6	5 FC/1 UC	N/A	6				N/A
Lamazza et al. [9]	20	4 UC/16 FC	N/A			10	10	21
Vanbiervliet et al. [10]	40	40 FC	21			33	7	16
Pérez Roldán et al. [11]	5	3 BD/2 FC	93.8	3	2			16.1

References	*N*	Type of stent	Stent mean stay in place (day)	Indication for AF	Indication for AL	Indication for AS	Indication for AS + AL or *AS* ± *AF*	Follow-up (months)
Lamazza et al. [12]	10	9 FC/1 UC	N/A			10		18
Repici et al. [13]	11	11 BD	N/A			11		19.8
Caruso et al. [14]	10	10 FC	56			10		30
DiMaio et al. [15]	5	4 FC/1 PC	20		5			N/A
Pérez Roldán et al. [19]	10	9 BD/1 FC	N/A	3		6	1	13.3
Janík et al. [16]	3	3 BD	120			3		4
Saida et al. [18]	5	5 FC	N/A			5		N/A
Dai et al. [20]	13	N/A	N/A			7	*6*	41.2
Keränen et al. [21]	10	9 FC/1 UC	40.5			10		20
Abbas [22]	2	N/A	N/A			1	1	N/A
Amrani et al. [23]	3	3 FC	N/A	1	2			N/A
Chopra et al. [24]	6	N/A	9		6			N/A
Rayhanabad and Abbas [25]	6	N/A	N/A			6		15
Small [26]	3	3 FC	N/A			3		6
Abbas and Falls [27]	2	2 FC	N/A	2				N/A
Forshaw et al. [28]	5	5 FC	N/A			5		29
Stefanidis et al. [29]	1	1 FC	N/A			1		N/A
Scileppi et al. [30]	1	N/A	10	1				N/A
Forshaw et al. [31]	4	4 FC	630			4		N/A
Guan et al. [32]	1	1 FC	N/A			1		18
Delaunay-Tardy et al. [33]	3	3 FC	N/A			3		N/A

References	*N*	Type of stent	Stent mean stay in place (day)	Indication for AF	Indication for AL	Indication for AS	Indication for AS + AL or *AS* ± *AF*	Follow-up (months)
Paul et al. [34]	8	6 FC/2 UC	N/A	3		3	2	N/A
Odurny [35]	3	3 FC	N/A			3		N/A
Repici et al. [36]	1	1 FC	91				1	N/A
Jeyarajah et al. [37]	1	1 PC	N/A				1	6

N patients treated for colorectal surgical complications, *AF* anastomotic fistula, *AL* anastomotic leak, *AS* anastomotic stricture

Type of stent: *FC* fully covered, *PC* partially covered, *UC* uncovered, *BD* biodegradable

The mean time between diagnosis of the leak and stent positioning was not reported. The mean time at which stents were removed after endoscopic placement was reported in 13 studies for a total of 110 participants and was calculated as 61.2 days (range 9–630).

Primary outcomes

The estimated rate of early success was 73.3% (95% CI 66.3–79.3%), showing neither heterogeneity ($I^2 = 4.1\%$) nor publication bias ($p = 0.914$) (Fig. 2). This outcome was reported in 32 studies ranging from 1997 to 2015, involving 223 patients. Performing a cumulative analysis (adding one study at a time by its publication date), the estimated rate raised from 25 to 68% in the time frame 1997–2007, while it was quite stable only after 2006; performing an influential analysis (leaving one study out in turn), the estimated rate was not influenced by any trial.

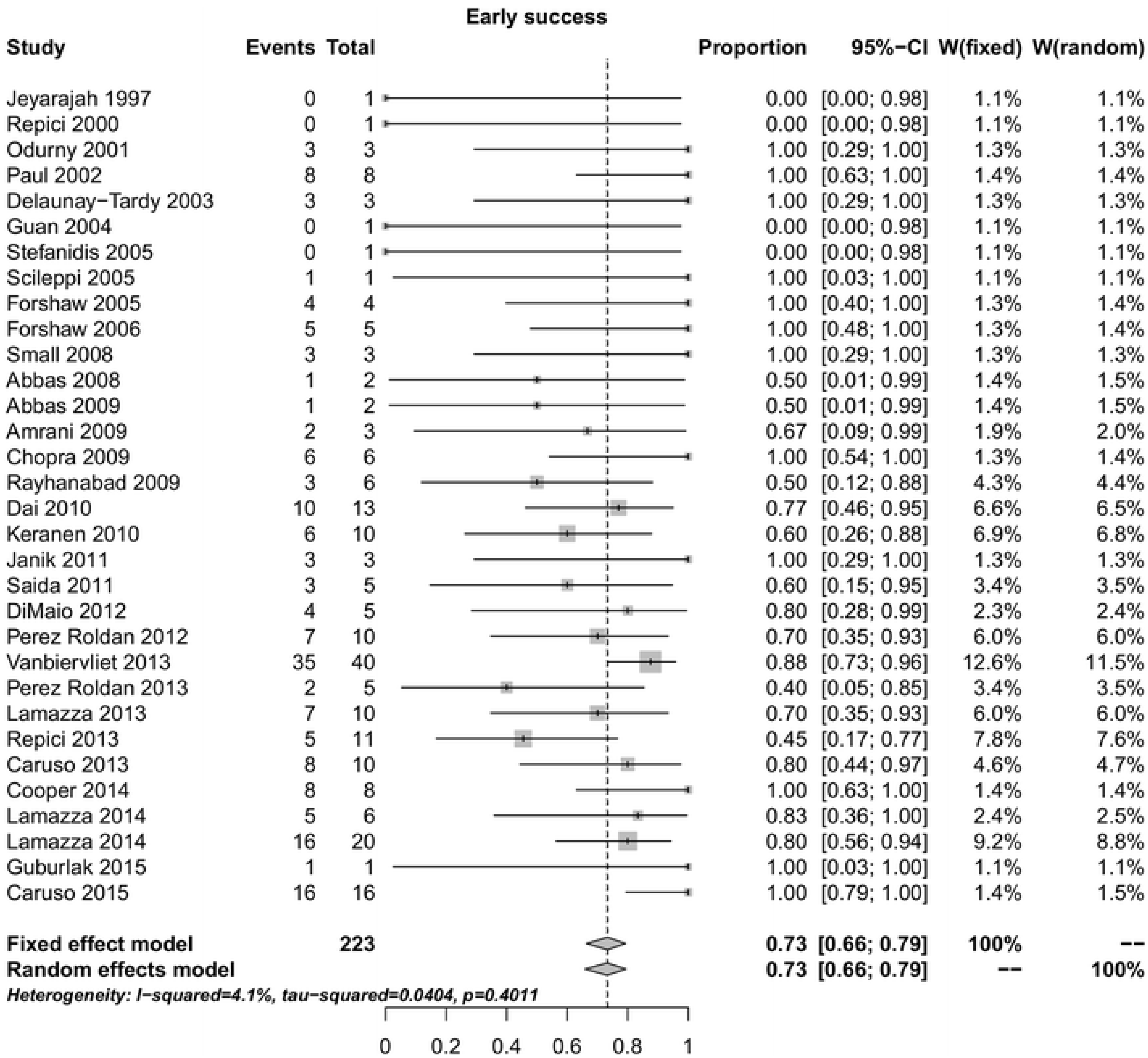

Fig. 2

Early success

The rate of early complications was 31.4% (95% CI 25.3–38.3%), showing neither heterogeneity (I^2 = 0%) nor publication bias (p = 0.779) (Fig. 3). This outcome was reported in 31 studies, involving 220 patients. Performing a cumulative analysis, the estimated rate progressively decreased from 75 to 43% up to 2009, being stable only from 2012; performing an influential analysis, the estimated rate was not influenced by any trial.

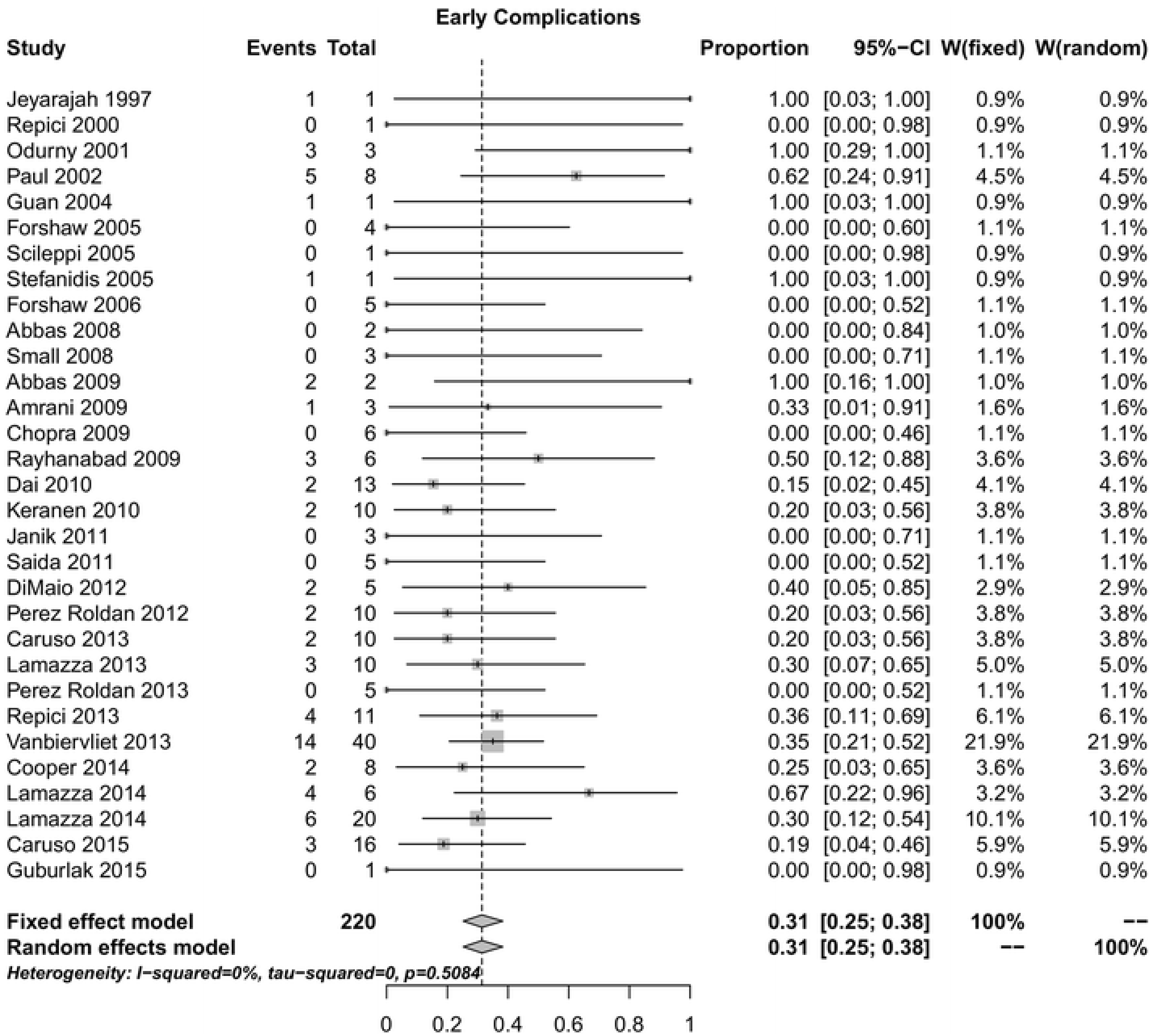

Fig. 3

Early complication

The rate of surgery for acute complication was 9.3% (95% CI 6.0–14.2%), showing neither heterogeneity ($I^2 = 0\%$) nor publication bias ($p = 0.411$) (Fig. 4). This outcome was reported in 32 studies, involving 223 patients. Performing a cumulative analysis, the estimated rate progressively reduced on time course from 25 to 9%; performing an influential analysis, the estimated rate was not influenced by any trial.

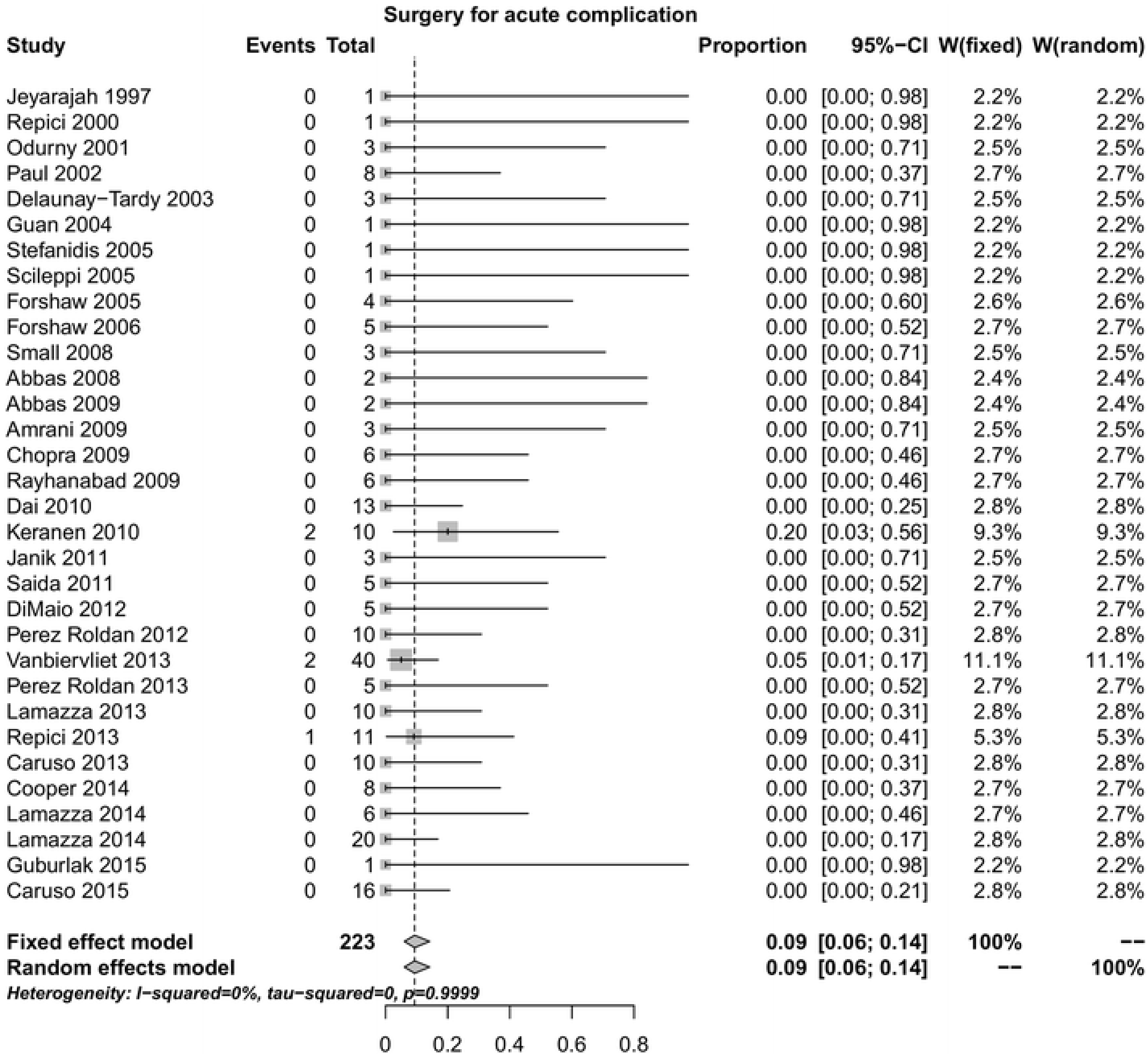

Fig. 4

Surgery for acute complication

The rate of closure of dehiscence was 74.5% (95% CI 62.8–83.5%), showing neither heterogeneity ($I^2 = 0\%$) nor publication bias ($p = 0.250$) (Fig. 5). This outcome was reported in 17 studies ranging from 1997 to 2015, involving 68 patients. No single trial showed any effect either at cumulative or influential analysis.

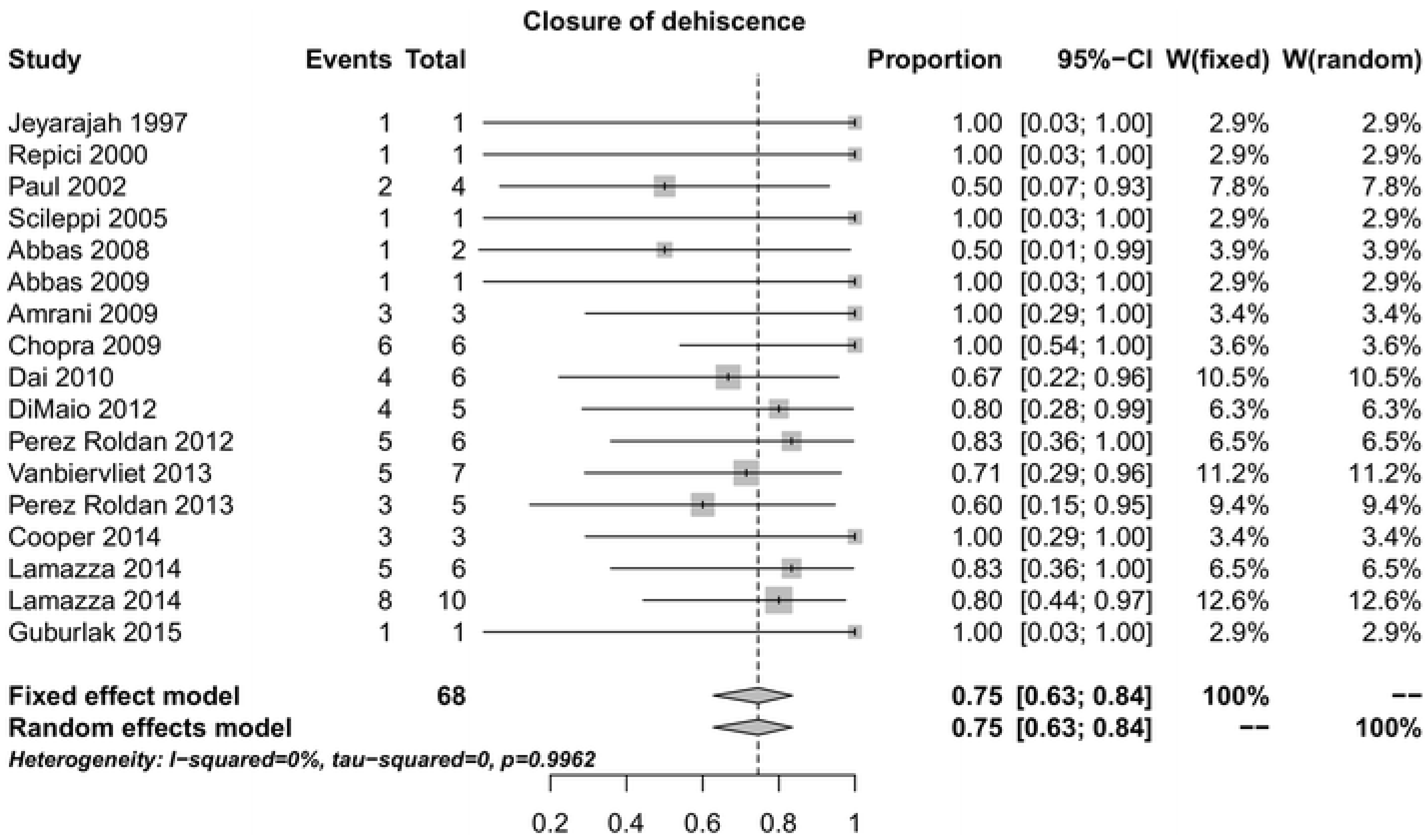

Fig. 5

Closure of dehiscence

The rate of long-lasting success was 57.3% (95% CI 50.3–64.0%), showing no heterogeneity ($I^2 = 0\%$) but a large publication bias ($p < 0.001$) (Fig. 6). This outcome was reported in 32 studies, involving 223 patients. Performing a cumulative analysis, the estimated rate progressively reduced on time course from 75 to 60% up to 2011, quite stabilizing from 2012; performing an influential analysis, the estimated rate was not influenced by any trial.

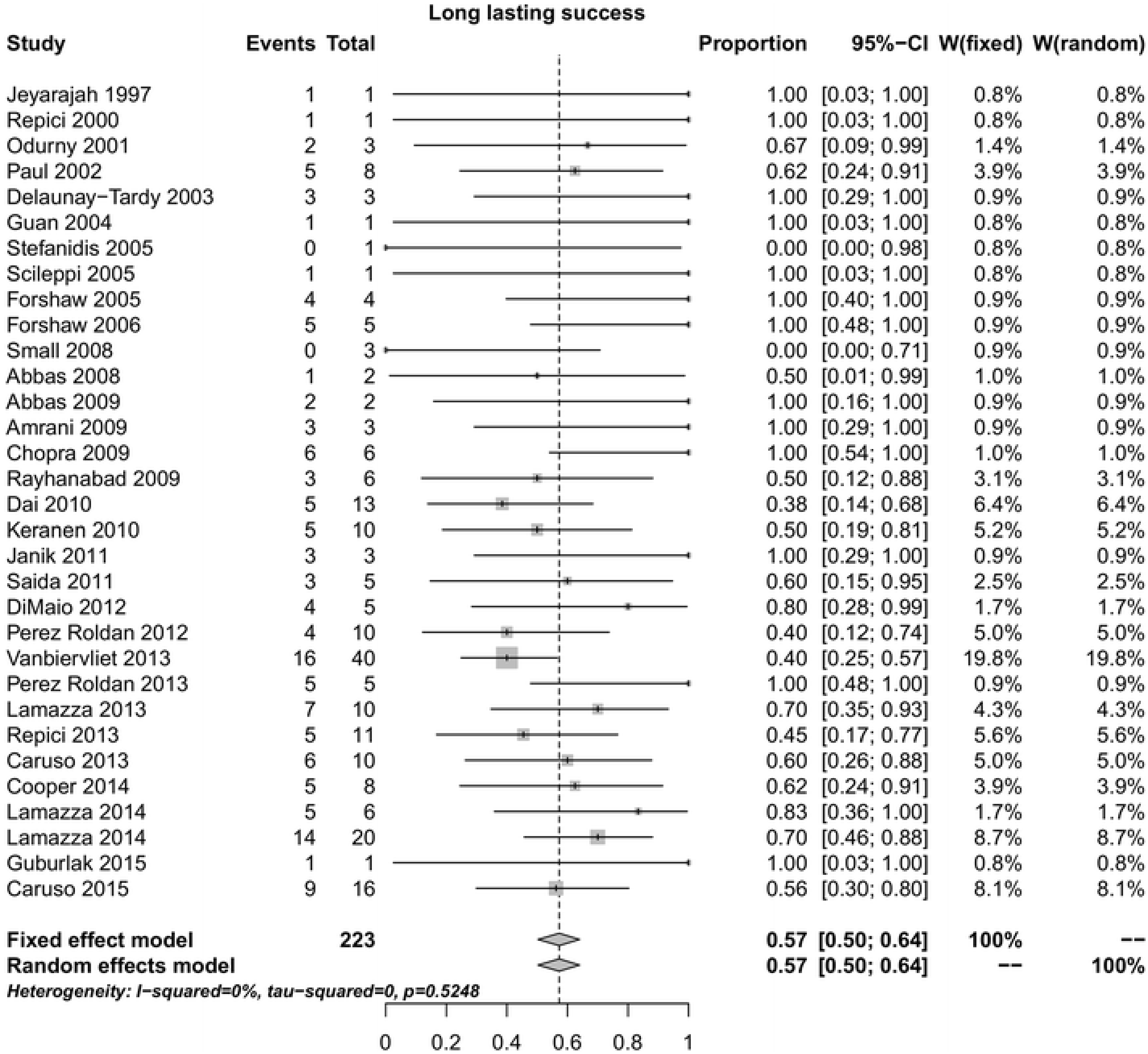

Fig. 6

Long-lasting success

As a subgroup analysis, we performed the analysis on stent-related long-lasting success including only series of 10 cases or more. Successful treatment was reported in 51.3% (95% CI 41.6–60.9%), showing neither heterogeneity (I^2 = 0%) nor publication bias (p = 0.427). This outcome was reported in 7 studies, involving 103 patients.

Secondary outcomes

The estimated rate of migration was 41.5% (95% CI 34.6–48.9%), showing a moderate heterogeneity (I^2 = 29.4%) as well as a notable publication bias (p = 0.075). This outcome was reported in 31 studies ranging from 1997 to 2015, involving 220 patients.

The rate of persisting dehiscence was 25.5% (95% CI 16.5–37.3%), showing neither heterogeneity (I^2 = 0%) nor publication bias (p = 0.250). This outcome was reported in 17 studies, involving 68 patients.

The rate of persisting stenosis was 44.0% (95% CI 35.9–52.4%), showing no heterogeneity (I^2 = 3.2%) but a notable publication bias (p = 0.004). This outcome was reported in 22 studies, involving 155 patients.

The rate of endoscopic dilatation required after stent positioning was 26.0% (95% CI 20.0–33.1%), showing neither heterogeneity (I^2 = 0%) nor publication bias (p = 0.670). This outcome was reported in 31 studies, involving 220 patients.

The need for any surgery related to unsuccessful stent positioning was 27.2% (95% CI 21.2–34.1 %), showing no heterogeneity (I^2 = 0 %) as well a notable publication bias ($p < 0.001$). This outcome was reported in 31 studies, involving 220 patients.

Discussion

Postoperative AL and AF are one of the major complications of colorectal surgery, with high mortality, to avoid which surgical treatment and abdominal drainage of liquid collections and stoma formation are often mandatory. A potential drawback of this approach is the general morbidity of diverting stomas of up to 30% and the reduced reversal rate of <50% in patients with anastomotic leakage [38, 39]. To overcome these limitations, since more than a decade, in absolutely selected patients in whom no signs of systemic sepsis are observed, the use of endoscopic means has been proposed to manage the local situation, gaining popularity in recent years.

Despite the mounting interest, only few reports in the medical literature have investigated the endoscopic approach by SEMS to the management of complications such as AL and AF after colorectal surgery. At the same time, SEMS has been proposed with growing interest for the treatment of refractory stenosis following colorectal resection and anastomosis, as a consequence of silent complication.

The present review aimed to assess the real benefit of the use of SEMS in similar condition, defining success rates and their complications. Although the population of patients reported in the literature is likely to represent a biased subgroup of patients, it is surprising that the estimated rate of early success was 73.3%, with cumulative analysis showing the estimated rate rising from 25 to 68% in the time frame 1997–2007. This matched, on the other side, with a rate of early complications higher than 30%, although progressively. In truth, less than 10% required surgery for acute complication. The most challenging clinical condition is for sure represented by the presence of an AL or AF, but this resulted healed in about ¾ of the patients treated, an absolute success, considering the potential of avoiding further surgery. This treatment is obviously proposed in patients with no systemic sepsis. In order to better assess when endoscopic treatment may represent a safe option, a disease classification according to risk would enable a reliable prognosis thus affecting decision-making. One of the scoring systems used to predict prognosis and mortality risk is the Mannheim Peritonitis Index (MPI), reported to be a reliable and accurate scoring system, with a cutoff at 21 below which the mortality risk is anecdotic. Nevertheless, similar classifications are rarely used or at least reported in the series included in this analysis.

More challenging is the treatment of postoperative stenosis, which results successfully treated in long terms, in just above 50% of cases, with about ¼ of patients requiring endoscopic dilatation, while the rest addressed for surgery, although usually not in an emergency setting. All together only about ¼ of patients required further surgery. With this indication, the latest innovation in endoscopic stent technology is represented by biodegradable stents. In fact, they have the property of not being necessary to remove. Nevertheless, their real utility at least in the colorectal tract still has to be proven.

Complications related to the positioning of SEMS consisted mainly of migration, which occurred in 41.5%. This is probably related to the fact that >80% of the stents were fully covered. This is well known so that different options to fix the stent in position have been proposed, but result more effective in the upper-GI. Mainly due to colonic peristalsis, stent migration represents an issue that is generally solved by stent removal and repositioning. Low anastomotic leaks are not suitable for stent application because of patient discomfort and a high risk of migration [40]. It is mandatory that perirectal abscesses be drained by interventional or surgical drainages because the stent prevents internal drainage. Uncovered metal stents should be avoided because they are imbedded in the rectal wall (ingrowth) and may cause perforation [41]. Vacuum-assisted therapy seems to be most suitable for leaks with large, perirectal abscess, although it often requires bowel diversion, namely ileostomy or colostomy. Fibrin injection is only able to seal very small leaks (<3 mm) and without connected cavities or abscess formation.

It must be emphasized that the presented data should be interpreted with caution. Limitations of this analysis include the retrospective nature of the majority of the study, the lack of randomization, and the small number of patients in the different series. Therefore, our results show only tendencies without a general statistical validity. Clearly, a selection bias cannot be excluded completely in a similar study. However, the clinical success was confirmed in more than 50% of cases in the subgroup analysis when only series of 10 cases or more where included, this way demonstrating only a slight reduction compared to the overall analysis and therefore substantially confirming the data.

In conclusion, we describe the use of endoscopic stenting in the early postoperative management of anastomotic complications after colorectal surgery. In patients with minimal risk for sepsis, as an alternative to traditional laparotomy, early positioning of a covered SEMS avoids further surgery in a consistent rate of patients, in a safe way, and should therefore be considered as an alternative to surgery. However, in order to establish the safety and efficacy of this technique, similar prospective studies involving a larger cohort of patients are required.

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