Int J Colorectal Dis (2009) 24:711–723
DOI 10.1007/s00384-009-0660-z

ORIGINAL ARTICLE

The morbidity surrounding reversal of defunctioning ileostomies: a systematic review of 48 studies including 6,107 cases

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Accepted: 20 January 2009 / Published online: 17 February 2009

Abstract
Background and aims Loop ileostomies are used currently in surgical practice to reduce the consequences of distal anastomotic failure following colorectal resection. It is often assumed that reversal of a loop ileostomy is a simple and safe procedure. However, many studies have demonstrated high morbidity rates following loop ileostomy closure. The aims of this systematic review were to examine all the existing evidence in the literature on morbidity and mortality following closure of loop ileostomy.
Method A literature search of Ovid, Embase, the Cochrane database, Google Scholar™ and Medline using Pubmed as the search engine was used to identify studies reporting on the morbidity of loop ileostomy closure (latest at June 15th 2008), was performed. Outcomes of interest included demographics, the details regarding the original indication for operation, operative and hospital-related outcomes, post-operative bowel-related complications, and other surgical and medical complications.
Results Forty-eight studies from 18 countries satisfied the inclusion criteria. Outcomes of a total of 6,107 patients were analysed. Overall morbidity following closure of loop ileostomy was found to be 17.3% with a mortality rate of 0.4%. 3.7% of patients required a laparotomy at the time of ileostomy closure. The most common post-operative complications included small bowel obstruction (7.2%) and wound sepsis (5.0%).
Conclusion The consequences of anastomotic leakage following colorectal resection are severe. However, the consequences of stoma reversal are often underestimated. Surgeons should adopt a selective strategy regarding the use of defunctioning ileostomy, and counsel patients further prior to the original surgery. In this way, patients at low risk may be spared the morbidity of stoma reversal.

Keywords Defunctioning ileostomy · Loop ileostomy · Closure · Reversal · Complications · Morbidity

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Introduction

Turnbull and Weakly were the first to describe the loop ileostomy in 1971 [1], using it in combination with two colostomies to decompress patients with toxic megacolon. Currently, defunctioning or loop stomas are often used in colorectal surgery to protect a distal colonic anastomosis, particularly after low anterior resection and restorative proctocolectomy. Anastomotic leaks have been reported to occur in up to 17% of patients following left sided colonic resection [2] and are associated with considerable morbidity and mortality including localised abscess formation, sepsis, frank peritonitis, poor subsequent neorectal function and increased cancer recurrence rates [3–5]. Although the presence of a diverting loop stoma does not reduce the total incidence of anastomotic leakage, they may reduce the disastrous clinical consequences of leakage [6, 7].

Loop ileostomies are often favoured over colostomies for defunctioning distal anastomoses as they are less bulky,

better sited for the patient, less odorous and less prone to prolapse [8]. One recent meta-analysis [2] has suggested that the advantages of loop ileostomies include fewer wound infections following stoma reversal while another demonstrated that temporary colostomy was significantly more likely to cause stoma-related complications in patients undergoing elective resection for colorectal cancer [9].

Loop ileostomy closure is typically undertaken 8 to 12 weeks after construction allowing sufficient time for recovery from the initial resection, softening of intra-abdominal adhesions and resolution of inflammation and oedema within the abdomen and around the stomal orifice [8, 10]. Ileostomy closure can be performed using either a stapled or a sutured technique and although opinion differs as to the optimal closure technique the meta-analysis of Leung et al. revealed no statistically significant differences in short-term outcome between the two approaches [11].

Although loop ileostomy closure is often thought of as a simple and minor procedure, it can have significant impact on the patient, with morbidity rates of up to 33% reported [12]. Kaidar-Person et al. reviewed 26 studies evaluating the complications of loop ileostomy closure [10] and reported rates of small bowel obstruction following ileostomy closure ranging from 0% to 15%, wound infections from 0% to 18.3% and anastomotic leak rates of 0% to 8%. Enterocutaneous fistulae occurred in 0.5% to 7% of patients, and stoma site hernias occurred in up to 12% of patients. In addition to these risks exists the possible need for a further laparotomy to facilitate ileostomy reversal, and the potential for operative mortality. These risks are often underestimated by surgical teams, especially trainees, and thus not brought to the proper attention of the patient, bringing into question the issue of informed consent.

The aims of the present systematic review were to examine the available literature concerning morbidity and mortality following closure of a defunctioning ileostomy.

Methods

This systematic review was carried out with reference to the AMSTAR measurement tool [13]. The AMSTAR tool is an 11-item measurement scale that was developed in 2007 by an international panel of experts in the field of methodology and systematic reviews. Its aim was to assess the methodological quality of systematic reviews. Although the authors agree that further work needs to be performed to fully assess the reproducibility and construct validity of AMSTAR, preliminary investigations have demonstrated good face and content validity for measuring the methodological quality of systematic reviews. Thus, the tool was felt appropriate for reference during this work.

Literature search

A literature search was performed using multiple electronic search engines including the Cochrane Database, Google Scholar™, Ovid, Embase, and Medline using PubMed. No restrictions were made to the year of publication. Studies reporting on the morbidity of loop ileostomy closure (last search date at June 15th 2008) were identified. The following keywords were used for the search: "defunctioning ileostomy", "loop ileostomy", "closure", "reversal", "complications", and "morbidity". The "related articles" function in PubMed was also used to identify additional studies. References of the articles identified were also searched for by title and then subsequent abstract review.

Eligibility criteria and data extraction

All published studies reporting the results of reversal of defunctioning ileostomy were considered. No restrictions on type of study were made. Studies where defunctioning colostomy or other types of small bowel stoma were included with the results were excluded.

Data were extracted on author, date of publication, study design, and technical aspects of the studies. All data were extracted independently by two reviewers (AC and SP), and discrepancy was resolved by consensus. Restrictions to papers published in the English language were made.

Inclusion and exclusion criteria

To be included in the analysis, studies had to (1) include patients undergoing reversal of defunctioning ileostomy; (2) report on at least one of the outcome measures mentioned in the next section. When two studies were reported by the same institution and/or authors, the more recent publication was included in the analysis.

Studies were excluded from the analysis if (1) the outcomes of interest were not reported; (2) it was impossible to extract or calculate the necessary data from the published results; or (3) results from reversal of defunctioning ileostomy were not separated from reversal of other types of stoma.

Outcomes of interest and definitions

The following outcomes were of interest

1. Patient-related data included demographics, time from creation of ileostomy to stoma closure, as well as original operation and underlying pathology.
2. Operative and hospital-related outcomes included operative time excluding that for subsequent procedures to close the ileostomy, the need to perform a laparot-

omy at the time of reversal and length of postoperative hospital stay.
3. Post-operative bowel-related complications included small bowel obstruction, anastomotic leak, fistula, perforation and ileus
4. Post-operative non-bowel-related complications included wound sepsis, bleeding, hernia, cardiorespiratory complications and overall subsequent in hospital mortality.

Data analysis

Raw data on outcomes of interest was collected and tabulated. Numbers of patients were converted into percentages for analysis. Where studies published percentages instead of giving the number of patients, the number of patients affected was calculated. Overall averages were weighted according to the size of the study.

Results

We identified 596 articles using the above keywords. Title and abstract review resulted in exclusion of 518 studies which did not primarily address reversal of loop ileostomy. Seventy-eight references were searched in full, and a further 30 studies were excluded (see Fig. 1). Fifteen studies were excluded as they did not report data following reversal of ileostomy. Four studies were excluded as they were meta-analyses, or systematic review articles that did not report original data [2, 9–11]. Three studies were excluded as they did not report data following reversal of ileostomy separately from the outcomes of reversal for other types of stoma. Three studies were excluded due to overlap with previous publications. Four studies reported on outcomes other than those of interest, and one publication was a letter without original data. This left 48 studies from 18 different countries for evaluation in full [12, 14–60].

Study characteristics

Of the 48 included studies, 25 collected data retrospectively [14–18, 20, 21, 24, 25, 28, 30, 35, 36, 41–43, 45–47, 51, 53, 54, 56, 57, 60]. There were 23 studies that collected data prospectively [12, 19, 22, 23, 26, 27, 29, 31–34, 37–40, 44, 48–50, 52, 55, 58, 61], with seven of these being randomised trials [22, 27, 29, 32, 38, 39, 44]. The average number of patients undergoing ileostomy reversal was 127, with an average of 75.4 days (10.8 weeks) between stoma creation and closure. The majority of ileostomies were created following anterior resection, restorative proctocolectomy, or reversal of Hartmann's procedure. The major underlying pathologies included malignancy (34 papers containing 3,618 patients) [12, 14, 16, 18, 20–22, 26, 27, 29–31, 35, 37–39, 41–49, 51–58, 61], inflammatory bowel disease (28 papers containing 3,277 patients) [12, 14–17, 20, 21, 24, 25, 28–31, 34, 36–38, 40, 43, 45–48, 50, 53, 54, 56, 58] and familial adenomatous polyposis (18 papers containing 2,168

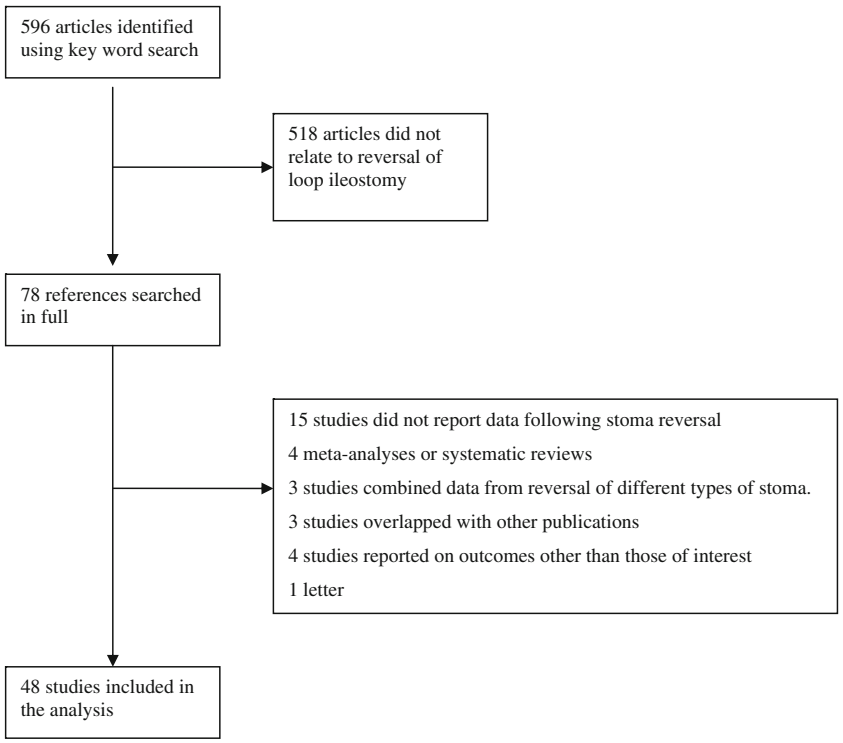

Fig. 1 Flow diagram describing the selection of studies included in this review

patients) [12, 15, 17, 20, 24, 28, 30, 31, 36–38, 43, 45, 50, 53, 54, 56, 58] (see Table 1).

Operative and hospital statistics

Eighteen studies reported on operative time for stoma closure, with an average of 63.5 min. Patients remained in hospital an average of 5.1 days following stoma closure (see Table 2).

Bowel-related morbidity

The studies demonstrated 339 patients out of 4,735 (7.2%) suffered from small bowel obstruction following ileostomy closure. Approximately one third of these patients (107 patients, 2.5%) required re-laparotomy for this problem. There were 60 patients out of 4,439 (1.4%) that suffered an anastomotic leak at the stoma closure site, with intraoperative bowel perforation and peritonitis occurring in 13 out of 1,119 patients (1.2%) from the few studies that reported these figures. Thirty-seven of 2,885 patients (1.3%) suffered from a postoperative enterocutaneous fistula (see Table 3).

Other morbidity

Wound infection was the most common non-bowel-related complication, being reported in 228 patients out of a total of 4,574 (5.0%). Sixty-eight of 3,697 patients (1.8%) developed an incisional hernia through the stoma site. Few studies reported on other complications such as cardiac, respiratory or renal dysfunction (see Tables 4 and 5).

Need for laparotomy at stoma closure, overall morbidity and mortality

Nine studies reported on the need for a midline laparotomy incision at the time of closure, with an average rate of 3.7%. The reasons given for laparotomy at closure included the presence of dense adhesions making stoma mobilisation difficult, obstructive symptoms prior to closure, and the need to repair a midline hernia. Complications occurred in 823 out of 4,765 patients giving an overall morbidity rate of 17.3%. In the papers that reported mortality, there were 19 deaths out of 4,319 patients giving a mortality rate of 0.4% (see Table 6).

Discussion

Loop ileostomies are created to protect a distal colonic anastomosis, and are most frequently used following low anastomoses such as following low anterior resection, or restorative proctocolectomy. The consequences of anastomotic leak are well known, with mortality rates between 6% and 22% following leakage being reported in the literature [62]. Anastomotic leak is associated with significant short- and long-term morbidity, a reduced quality of life, poor subsequent bowel function, and increased risk of cancer recurrence [63–65]. Although anastomotic leak rates have been reported as being as high as 17%, some centres report leak rates to be much lower between 1.8 and 5% [66]. The current guidelines for the management of colorectal cancer, issued by the Association of Coloproctology of Great Britain and Ireland, have stated that surgeons should expect to achieve an overall leak rate of less than 8% following anterior resection [67]. A recent meta-analysis by Huser et al. examined the effects of a defunctioning stoma following low rectal cancer surgery [68]. They demonstrated no significant difference in mortality between the group with a defunctioning stoma compared to the group without a stoma. However, they did demonstrate an increased risk of anastomotic leakage in the group without a protective stoma (OR=0.32), along with an increased need for reoperation (OR=0.27).

The proponents of a defunctioning ileostomy argue that it is safer to use a defunctioning ileostomy as (1) closure of a loop ileostomy has minimal morbidity; and (2) the consequences of distal anastomotic leakage are reduced, thereby minimising the risk of pelvic sepsis [69].

The arguments for omitting an ileostomy are that (1) only a single hospital admission is required; (2) immediate use of the anal sphincter may avoid disuse atrophy; and (3) the complications of ileostomy closure are avoided [69].

In the case of ileal pouch surgery, the presence of a defunctioning ileostomy may allow the function of the anal sphincter and ileal mucosa to recover before intestinal continuity is restored. However, a defunctioning ileostomy may compromise the blood flow to the distal small bowel thus increasing the risk of pouch ischaemia, and be associated with diversion ileitis which could impair ileal transport mechanisms [69].

This review of the literature has demonstrated that in general, reversal of loop ileostomy is relatively safe, with a low mortality rate of 0.4%. However, morbidity is significant, with 17.3% of patients suffering from some form of postoperative complication. The review has demonstrated a 7.2% occurrence of small bowel obstruction requiring repeat hospital admission. Overall, one third (2.5%) of these patients will require a repeat laparotomy to resolve the issue, again with all the associated risks of re-operation. It should be noted that there will be a proportion of patients who suffer bowel obstruction as a result of their original laparotomy. It was not possible to quantify this amount from our data. However, the incidence of small bowel obstruction and need for operation must be explained to patients prior to reversal of their stoma. Risks of anastomotic leak following reversal or intraoperative bowel perforation are reported as 1.4% and 1.2%, respectively.

Table 1 Study characteristics

References	Author	Study type	Number pts	Reversal	Days to closure (range)		Original op	Underlying pathology
[14]	Amin	R	67	Stapled	140	(10–790)	AR, RP, RH, CR	IBD, Ca, CF, MR,
[15]	Bain	R	20[a]	Stapled	–	–	RP	IBD, FAP
			20[b]	Sutured	–	–		
[86]	Bakx	R	60	–	168	(14–868)	AR, CR, RP, RH, Ex	Ca, DD, IBD, TVA,
[17]	Barry	R	33	Sutured	95	(86–104)	RP	IBD, FAP
[18]	Bell	R	20	–	–	–	CR	DD, Ca
[19]	Berry	P	16	Stapled	98	–	AR, IP	–
[20]	Carlsen	R	92	–	217	–	RP	IBD, FAP, Ca, CF, Ab, Pf
[21]	Chen	R	72	–	–	–		Ca, IBD, DD, Pf, TVA, Ps, RP
[22]	Edwards	P, Rn	32	–	62	(17–120)	AR	Ca
[23]	Fasth	P	21	–	63	(42–84)	–	–
[24]	Feinberg	R	110	–	122	(30–763)	RP, IP	FAP, IBD
[25]	Fonkalsrud	R	39	–	113	(37–435)	RP	IBD
[12]	Garcia-Botello	P	109	–	278	–	AR, RP	Ca, IBD, DD, FAP, Pf
[26]	Gastinger	P	407	–	–	–	AR	Ca
[27]	Gooszen	P, Rn	29	–	–	–	–	Ca, DD, Pf, In, Ab
[28]	Gunnarsson	R	143	Sutured	98	–	RP	IBD, FAP
[29]	Haase	P Rn	80	Stapled	–	–	TME, RP, CR	Ca, Pf, IBD, CF
[30]	Hainsworth	R	72	–	–	–	RP	IBD, FAP, Con, Ca, Hir, AD
[31]	Hallbook	P	213	–	91	(42–490)	RP, AR	Ca, IBD FAP
[32]	Hasegawa	P, Rn	71[a]	Stapled	183	(30–336)	AR, IP, CR, RH, SR, RV	–
			70[b]	Sutured	153	(31–275)		
[33]	Hull	P	31[a]	Stapled	31	(65–141)	RP, IP	–
			30[b]	Sutured	30	(63–168)		
[34]	Ikeuchi	P	92	–	–	–	RP	IBD
[35]	Kaiser	R	56	–	336	(61–610)	–	Ca, Pf
[36]	Khoo	R	201	Stapled	70	(21–350)	RP	IBD, FAP
[37]	Krand	P	25[c]	Sutured	12	(10–14)	AP, RP	Ca, IBD, FAP, Hir
			25[d]	Sutured	84	(49–231)		
[38]	Lahat	P, Rn	20[e]	Stapled	93	(65–180)	RP, AR, CR	IBD, Ca, FAP, DD
			20[f]	Stapled	91	(67–103)		
[39]	Law	P, Rn	35	–	183	–	AR	Ca
[40]	Lewis	P	40	Sutured	63	(35–371)	RP	IBD
[41]	Mala	R	62	–	–	–	AR	Ca
[42]	Mann	R	50	Sutured	115	(63–440)	CR	CF, DD, Ca, Pf
[43]	Mansfield	R	123	–	–	–	AR, RP, CR, RH	Ca, DD, IBD, CF, FAP, TVA
[44]	Matthiessen	P, Rn	111	–	–	–	AR	Ca
[45]	O'Toole	R	84		120	–	RP, AR	IBD, Ca, Con, Vo, FAP, SU, CF, TVA
[46]	Perez	R	89	–	100	(7–1,092)	–	Ca, IBD, CF, DD
[47]	Phang	R	339	–	–	–	–	IBD, Ca, DD, CF
[48]	Platell	P	231	Stapled	–	–	AR, IP, CR, RH	Ca, DD, IBD, TVA
[49]	Poon	P	46	–	–	–	CR, TME	Ca
[50]	Rathnayake	P	115	–	91	(7–420)	–	Ca, FAP, IBD, Pf, Hir
[51]	Rullier	R	96	Sutured	104	(25–199)	AR	Ca
[52]	Sakai	P	48	Sutured	97	–	–	–
[53]	Senapati	R	263	–	–	–	RP, IP	FAP, IBD, Ca
[54]	Thalheimer	R	120	Sutured	143	–	AR, RP, CR	FAP, IBD, Ca
[55]	Tsunoda	P	22	–	–	–	AR	Ca
[56]	v.d. Pavoordt	R	293	Sutured	90	(14–1,830)	IP, RP, CR	IBD, FAP, DD, Ca
[57]	Welten	R	23	Sutured	107	(30–214)	AR, CR	Ca, Pf
[58]	Wexner	P	67	–	70	(14–182)	IP, AR	IBD, FAP, Ca
[61]	Williams	P	50	–	203	–	AR, RP	Ca, DD, Pf
[60]	Wong	R	1,504	–	98	–	RP	–
Totals	–	–	6,107	–	–	–	–	–
Mean	–	–	127	–	75.4		–	–

AR anterior resection, *IP* ileal pouch, *CR* colonic resection, *RH* reversal of Hartmanns, *SR* sphincter repair, *RV* repair of rectovaginal fistula, *TME* total mesorectal excision, *RP* restorative proctocolectomy, *Ex* posterior exenteration, *IBD* inflammatory bowel disease, *Ca* cancer, *Con* constipation, *Vo* volvulus, *FAP* familial adenomatous polyposis, *SU* solitary rectal ulcer syndrome, *DD* diverticular disease, *CF* colonic fistula, *TVA* tubulovillous adenoma, *Pf* perforation, *In* faecal incontinence, *Ab* perianal abscess, *Hir* Hirschsprungs disease, *AD* angiodysplasia, *MR* megarectum, *Ps* pseudomembranous colitis, *RP* radiation proctitis, *R* retrospective, *P* prospective, *Rn* randomised

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

Table 2 Operative and hospital statistics

References	Author	Operating time (min)	Days to flatus	Days to defecation	Days to fluid diet	Days to solid diet	Mean Hospital LOS (days)
[14]	Amin	63	–	–	1.6	2.5	7
[15]	Bain	37[a]	–	–	–	–	7[a]
		34[b]	–	–	–	–	8[b]
[86]	Bakx	59	–	–	–	–	7
[17]	Barry	–	–	–	–	–	–
[18]	Bell	–	–	–	–	–	–
[19]	Berry	32	3	–	–	–	6
[20]	Carlsen	–	–	–	–	–	8
[21]	Chen	–	–	–	–	–	–
[22]	Edwards	48	2	3	–	–	6
[23]	Fasth	–	–	–	–	–	–
[24]	Feinberg	–	–	–	2.7	–	8
[25]	Fonkalsrud	103	–	–	–	4.3	7.1
[12]	Garcia-Botello	–	–	–	–	–	–
[26]	Gastinger	–	–	–	–	–	–
[27]	Gooszen	–	–	–	–	–	–
[28]	Gunnarsson	–	–	–	–	–	–
[29]	Haase	–	–	–	–	–	–
[30]	Hainsworth	–	–	–	–	–	–
[31]	Hallbook	–	–	–	–	–	–
[32]	Hasegawa	38[a]	–	–	–	–	8[a]
		42[b]	–	–	–	–	10[b]
[33]	Hull	60.0[a]	–	1.7[a]	1.6[a]	1.9[a]	–
		74.7[b]	–	2.2[b]	1.7[b]	–	–
[34]	Ikeuchi	–	–	–	–	–	–
[35]	Kaiser	77	–	–	–	–	6
[36]	Khoo	–	–	–	–	–	–
[37]	Krand	35[c]	–	–	–	–	–
		47[d]	–	–	–	–	5
[38]	Lahat	–	–	–	–	–	5.9[e]
		–	–	–	–	–	6.5[f]
[39]	Law	61	2	–	2	3	5
[40]	Lewis	–	–	–	–	–	5
[41]	Mala	–	–	–	–	–	5
[42]	Mann	–	–	–	–	–	–
[43]	Mansfield	–	–	–	–	–	–
[44]	Matthiessen	–	–	–	–	–	–
[45]	O'Toole	–	–		–	–	8
[46]	Perez	100	–	–	–	–	6.8
[47]	Phang	–	–	–	–	–	–
[48]	Platell	–	–	–	–	–	6.6
[49]	Poon	–	–		–	–	–
[50]	Rathnayake	–	–	–	–	–	–
[51]	Rullier	–	–	–	–	–	–
[52]	Sakai	98.5	–	–	–	–	7
[53]	Senapati	–	–	–	–	–	–
[54]	Thalheimer	–	–	2.3	–	–	10.3
[55]	Tsunoda	–	–	–	–	–	6
[56]	v.d. Pavoordt	–	–	–	–	–	–
[57]	Welten	–	–	–	–	–	–
[58]	Wexner	56	–	–	3	4	5
[61]	Williams	–	2	2	–	–	8
[60]	Wong	–	–	–	–	–	3
Mean		63.5	2.1	2.2	2.3	3.2	5.1

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

Table 3 Bowel-related morbidity

References	Author	Number pts	Bowel Obstruction		Laparotomy for SBO		Anastomotic leak		Perforation		Prolonged ileus		Fistula	
			n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
[14]	Amin	67	2	(3)	1	(1.5)	–	–	–	–	1	(1.5)	–	–
[15]	Bain	20[a]	4	(20)[a]	2	(10)[a]	–	–	–	–	–	–	0	(0)[a]
		20[b]	5	(25)[b]	3	(15)[b]	–	–	–	–	–	–	1	(5)[b]
[86]	Bakx	60	5	(8.3)	1	(1.7)	–	–	–	–	–	–	1	(1.7)
[17]	Barry	33	–	–	–	–	–	–	1	(3)	–	–	1	(3.0)
[18]	Bell	20	–	–	–	–	0	(0)	–	–	1	(5)	1	(5)
[19]	Berry	16	0	(0)	–	–	0	(0)	–	–	–	–	–	–
[20]	Carlsen	92	–	–	5	(5.3)	–	–	–	–	–	–	–	–
[21]	Chen	72	6	(8.3)	2	(2.8)	–	–	–	–	–	–	1	(1.4)
[22]	Edwards	32	0	(0)	–	–	–	–	–	–	–	–	–	–
[23]	Fasth	21	–	–	–	–	–	–	–	–	–	–	0	(0)
[24]	Feinberg	110	16	(14.5)	3	(2.7)	4	(3.6)	1	(0.9)	–	–	1	(0.9)
[25]	Fonkalsrud	39	–	–	3	(7.7)	–	–	–	–	–	–	–	–
[12]	Garcia-Botello	109	5	(4.6)	1	(0.9)	9	(8.3)	–	–	2	(1.8)	6	(5.5)
[26]	Gastinger	407	–	–	–	–	9	(2.2)	–	–	17	(4.2)	–	–
[27]	Gooszen	29	–	–	–	–	1	(3.4)	–	–	2	(6.9)	2	(8.6)
[28]	Gunnarsson	143	22	(15.3)	10	(7.0)	1	(0.7)	–	–	–	–	–	–
[29]	Haase	80	–	–	1	(1.3)	1	(1.3)	1	(1.3)	11	(13.8)	1	(1.3)
[30]	Hainsworth	72	–	–	–	–	–	–	1	(1.4)	–	–	–	–
[31]	Hallbook	213	7	(3.3)	5	(2.3)	–	–	–	–	4	(1.9)	–	–
[32]	Hasegawa	71[a]	10	(14)[a]	–		0	(0)[a]	–	–	–	–	–	–
		70[b]	2	(3)[b]	–		2	(2.9)[b]	–	–	–	–	–	–
[33]	Hull	31[a]	1	(3.2)[a]	0	(0)[a]	0	(0)[a]	1	(3.2)[a]	–	–	–	–
		30[b]	4	(13.3)[b]	2	(6.7)[b]	0	(0)[b]	0	(0)[b]	–	–	–	–
[34]	Ikeuchi	92	15	(16.3)	–	–	1	(1.1)	–	–	–	–	–	–
[35]	Kaiser	56	2	(3.6)	–	–	0	(0)	–	–	2	(3.6)	1	(1.8)
[36]	Khoo	201	–	–	1	(0.5)	3	(1.5)	–	–	–	–	–	–
[37]	Krand	25[c]	0	(0)[c]	0	(0)[c]	–	–	–	–	–	–	–	–
		25[d]	1	(4.0)[d]	0	(0)[d]	–	–	–	–	–	–	–	–
[38]	Lahat	20[e]	–	–	–	–	1	(5.0)[e]	–	–	–	–	–	–
		20[f]	–	–	–	–	1	(5.0)[f]	–	–	–	–	–	–
[39]	Law	35	3	(8.6)	1	(2.9)	–	–	–	–	–	–	1	(3.1)
[40]	Lewis	40	3	(7.5)	2	(5.0)	–	–	–	–	–	–	0	(0)
[41]	Mala	62	–	–	–	–	–	–	–	–	–	–	–	–
[42]	Mann	50	6	(12)	0	(0)	–	–	–	–	–	–	–	–
[43]	Mansfield	123	8	(6.5)	1	(0.8)	1	(0.8)	1	(0.8)	6	(4.9)	–	–
[44]	Matthiessen	111	–	–	–	–	1	(0.9)	–	–	–	–	–	–
[45]	O'Toole	84	2	(2.4)	2	(2.4)	–	–	1	(1.2)	–	–	–	–
[46]	Perez	89	11	(12.4)	3	(3.4)	–	–	–	–	–	–	1	(1.1)
[47]	Phang	339	17	(5.0)	–	–	10	(2.9)	–	–	–	–	–	–
[48]	Platell	231	3	(1.3)	2	(0.9)	1	(0.4)	–	–	–	–	–	–
[49]	Poon	46	2	(4.3)	2	(4.3)	–	–	–	–	–	–	1	(2.2)
[50]	Rathnayake	115	5	(4.4)	–	–	1	(0.9)	–	–	–	–	5	(4.3)
[51]	Rullier	96	5	(5.2)	1	(1.0)	–	–	–	–	–	–	0	(0)
[52]	Sakai	48	0	(0)	–	–	0	(0)	–	–	–	–	–	–
[53]	Senapati	263	30	(11.4)	11	(4.2)	–	–	3	(1.1)	2	(0.8)	2	(0.8)
[54]	Thalheimer	120	–	–	–	–	3	(2.5)	–	–	8	(6.7)	–	–
[55]	Tsunoda	22	–	–	–	–	–	–	–	–	–	–	–	–
[56]	v.d. Pavoordt	293	33	(11.3)	16	(5.5)	3	(1.0)	3	(1.0)	–	–	–	–
[57]	Welten	23	–	–	–	–	–	–	–	–	–	–	–	–
[58]	Wexner	67	1	(1.5)	0	(0)	–	–	–	–	–	–	2	(3.0)
[61]	Williams	50	6	(12.0)	1	(2.0)	1	(2.0)	–	–	–	–	–	–
[60]	Wong	1,504	97	(6.4)	25	(1.7)	6	(0.4)	–	–	–	–	9	(0.6)
Total (%)		–	339	(7.2)	107	(2.5)	60	(1.4)	13	(1.2)	56	(3.8)	37	(1.3)

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

Table 4 Other surgical morbidity

References	Author	Number pts	Wound sepsis		Bleeding		Hernia		Intra-abdominal abscess	
			n	(%)	*n*	(%)	*n*	(%)	*n*	(%)
[14]	Amin	67	2	(3)	–	–	1	(1.5)	–	–
[15]	Bain	20[a]	1	(5)[a]	–	–	0	(0)[a]	–	–
		20[b]	2	(10)[b]	–	–	1	(5)[b]	–	–
[86]	Bakx	60	4	(6.7)	–	–	5	(8.3)	–	–
[17]	Barry	33	–	–	–	–	–	–	–	–
[18]	Bell	20	1	(5)	–	–	–	–	–	–
[19]	Berry	16	1	(6.3)	–	–	–	–	–	–
[20]	Carlsen	92	–	–	–	–	–	–	–	–
[21]	Chen	72	5	(6.9)	–	–	1	(1.4)	–	–
[22]	Edwards	32	1	(3.1)	–	–	–	–	–	–
[23]	Fasth	21	1	(4.8)	–	–	–	–	–	–
[24]	Feinberg	110	3	(3.0)	–	–	–	–	–	–
[25]	Fonkalsrud	39	4	(10.3)	–	–	–	–	0	(0)
[12]	Garcia-Botello	109	20	(18.3)	–	–	13	(11.9)	–	–
[26]	Gastinger	407	–	–	–	–	–	–	–	–
[27]	Gooszen	29	2	(8.6)	–	–	–	–	–	–
[28]	Gunnarsson	143	5	(3.5)	–	–	–	–	2	(1.4)
[29]	Haase	80	8	(10)	0	(0)	–	–	–	–
[30]	Hainsworth	72	1	(1.4)	–	–	1	(1.4)	–	–
[31]	Hallbook	213	–	–	–	–	5	(2.3)	2	(0.9)
[32]	Hasegawa	71[a]	6	(8.5)[a]	1	(1.4)[a]	–	–	–	–
		70[b]	7	(10)[b]	0	(0)[b]	–	–	–	–
[33]	Hull	31[a]	0	(0)[a]	–	–	–	–	–	–
		30[b]	0	(0)[b]	–	–	–	–	–	–
[34]	Ikeuchi	92	3	(3.3)	–	–	–	–	–	–
[35]	Kaiser	56	4	(7.1)	0	(0)	0	(0)	0	(0)
[36]	Khoo	201	–	–	1	(1.5)	0	(0)	–	–
[37]	Krand	25[c]	2	(8.0)[c]	–	–	0	(0)[c]	–	–
		25[d]	2	(8.0)[d]	–	–	1	(4.0)[d]	–	–
[38]	Lahat	20[e]	2	(10)[e]	–	–	–	–	–	–
		20[f]	4	(20)[f]	–	–	–	–	–	–
[39]	Law	35	1	(3.1)	–	–	–	–	–	–
[40]	Lewis	40	1	(2.5)	–	–	0	(0)	–	–
[41]	Mala	62	2	(3.2)	–	–	4	(6.5)	–	–
[42]	Mann	50	7	(14.0)	–	–	–	–	–	–
[43]	Mansfield	123	8	(6.5)	1	(0.8)	3	(2.4)	–	–
[44]	Matthiessen	111	–	–	–	–	–	–	–	–
[45]	O'Toole	84	–	–	–	–	–	–	–	–
[46]	Perez	89	2	(2.2)	1	(1.1)	–	–	–	–
[47]	Phang	339	48	(14.2)	1	(0.3)	3	(0.9)	–	–
[48]	Platell	231	–	–	–	–	2	(0.9)	1	(0.4)
[49]	Poon	46	–	–	–	–	1	(2.2)	–	–
[50]	Rathnayake	115	–	–	–	–	–	–	–	–
[51]	Rullier	96	3	(3.1)	–	–	4	(4.2)	–	–
[52]	Sakai	48	2	(4.2)	0	(0)	–	–	–	–
[53]	Senapati	263	14	(5.3)	1	(0.4)	–	–	–	–
[54]	Thalheimer	120	10	(8.3)	–	–	–	–	–	–
[55]	Tsunoda	22	1	(4.5)	–	–	–	–	–	–
[56]	v.d. Pavoordt	293	8	(2.7)	–	–	5	(1.7)	1	(0.3)
[57]	Welten	23	2	(8.7)	–	–	1	(4.3)	–	–
[58]	Wexner	67	1	(1.5)	–	–	–	–	–	–
[61]	Williams	50	4	(8.0)	2	(4.0)	–	–	–	–
[60]	Wong	1,504	23	(1.5)	2	(0.1)	17	(1.1)	5	(0.3)
Total (%)		–	228	(5.0)	10	(0.3)	68	(1.8)	11	(0.4)

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

Table 5 Medical morbidity

Ref	Author	Number pts	DVT		PE		Chest Morbidity		Cardiac Morbidity	
			n	(%)	n	(%)	n	(%)	n	(%)
[14]	Amin	67	–	–	–	–	–	–	–	–
[15]	Bain	20[a]	–	–	–	–	–	–	–	–
		20[b]	–	–	–	–	–	–	–	–
[86]	Bakx	60	–	–	–	–	–	–	–	–
[17]	Barry	33	–	–	–	–	–	–	–	–
[18]	Bell	20	–	–	–	–	1	(5)	–	–
[19]	Berry	16	–	–	–	–	–	–	–	–
[20]	Carlsen	92	–	–	–	–	–	–	–	–
[21]	Chen	72	–	–	–	–	1	(1.4)	–	–
[22]	Edwards	32	1	(3.1)	1	(3.1)	–	–	–	–
[23]	Fasth	21	–	–	–	–	–	–	–	–
[24]	Feinberg	110	–	–	–	–	–	–	–	–
[25]	Fonkalsrud	39	–	–	–	–	–	–	–	–
[12]	Garcia-Botello	109	–	–	1	(0.9)	–	–	–	–
[26]	Gastinger	407	–	–	–	–	–	–	–	–
[27]	Gooszen	29	–	–	–	–	1	(3.4)	–	–
[28]	Gunnarsson	143	–	–	–	–	–	–	–	–
[29]	Haase	80	–	–	–	–	–	–	–	–
[30]	Hainsworth	72	–	–	–	–	–	–	–	–
[31]	Hallbook	213	2	(0.9)	–	–	–	–	1	(0.5)
[32]	Hasegawa	71[a]	–	–	–	–	–	–	–	–
		70[b]	–	–	–	–	–	–	–	–
[33]	Hull	31[a]	–	–	–	–	–	–	–	–
		30[b]	–	–	–	–	–	–	–	–
[34]	Ikeuchi	92	–	–	–	–	–	–	–	–
[35]	Kaiser	56	–	–	–	–	–	–	–	–
[36]	Khoo	201	–	–	–	–	–	–	–	–
[37]	Krand	25[c]	–	–	–	–	–	–	–	–
		25[d]	–	–	–	–	–	–	–	–
[38]	Lahat	20[e]	–	–	–	–	–	–	–	–
		20[f]	–	–	–	–	–	–	–	–
[39]	Law	35	–	–	–	–	0	(0)	0	(0)
[40]	Lewis	40	–	–	–	–	–	–	–	–
[41]	Mala	62	–	–	–	–	–	–	–	–
[42]	Mann	50	–	–	–	–	4	(8.0)	1	(2.0)
[43]	Mansfield	123	–	–	–	–	6	(4.9)	2	(1.6)
[44]	Matthiessen	111	–	–	–	–	–	–	–	–
[45]	O'Toole	84	–	–	–	–	–	–	–	–
[46]	Perez	89	1	(1.1)	–	–	–	–	–	–
[47]	Phang	339	2	(0.6)	–	–	–	–	–	–
[48]	Platell	231	–	–	–	–	–	–	–	–
[49]	Poon	46	–	–	–	–	–	–	–	–
[50]	Rathnayake	115	–	–	–	–	–	–	–	–
[51]	Rullier	96	–	–	–	–	–	–	–	–
[52]	Sakai	48	–	–	–	–	1	(2.1)	–	–
[53]	Senapati	263	2	(0.8)	–	–	2	(0.8)	–	–
[54]	Thalheimer	120	–	–	–	–	–	–	–	–
[55]	Tsunoda	22	–	–	–	–	–	–	–	–
[56]	v.d. Pavoordt	293	–	–	–	–	–	–	–	–
[57]	Welten	23	–	–	–	–	–	–	–	–
[58]	Wexner	67	–	–	–	–	–	–	–	–
[61]	Williams	50	–	–	–	–	–	–	1	(2.0)
[60]	Wong	1,504	–	–	–	–	6	(0.4)	1	(0.06)
Total (%)		–	8	(0.9)	2	(1.4)	22	(1.0)	6	(0.3)

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

Table 6 Need for laparotomy, overall morbidity and mortality rates

References	Author	Number pts	Laparotomy at closure		Overall morbidity		Mortality	
			n	(%)	*n*	(%)	*n*	(%)
[14]	Amin	67	–	–	6	(9.0)	0	(0)
[15]	Bain	20[a]	–	–	6	(30)[a]	–	–
		20[b]	–	–	7	(35)[b]	–	–
[86]	Bakx	60	–	–	11	(18.3)	0	(0)
[17]	Barry	33	–	–	–	–	–	–
[18]	Bell	20	–	–	4	(20)	0	(0)
[19]	Berry	16	–	–	–	–	–	–
[20]	Carlsen	92	–	–	–	–	–	–
[21]	Chen	72	–	–	22	(30.6)	–	–
[22]	Edwards	32	–	–	–	–	0	(0)
[23]	Fasth	21	–	–	–	–	–	–
[24]	Feinberg	110	0	(0)	22	(20.0)	–	–
[25]	Fonkalsrud	39	–	–	–	–	–	–
[12]	Garcia–Botello	109	–	–	42	(38.5)	1	(0.9)
[26]	Gastinger	407	–	–	91	(22.4)	2	(0.5)
[27]	Gooszen	29	–	–	8	(27.6)	2	(6.9)
[28]	Gunnarsson	143	–	–	28	(19.6)	0	(0)
[29]	Haase	80	–	–	19	(23.8)	0	(0)
[30]	Hainsworth	72	–	–	–	–	–	–
[31]	Hallbook	213	4	(1.9)	27	(12.7)	1	(0.5)
[32]	Hasegawa	71[a]	–	–	–	–	–	–
		70[b]	–	–	–	–	–	–
[33]	Hull	31[a]	0	(0)[a]	–	–	0	(0)
		30[b]	0	(0)[b]	–	–	0	(0)
[34]	Ikeuchi	92	–	–	17	(18.4)	–	–
[35]	Kaiser	56	–	–	–	–	–	–
[36]	Khoo	201	–	–	–	–	–	–
[37]	Krand	25[c]	–	–	2	(8.0)[c]	0	(0)[c]
		25[d]	–	–	4	(16.0)[d]	0	(0)[c]
[38]	Lahat	20[e]	–	–	–	–	–	–
		20[f]	–	–	–	–	–	–
[39]	Law	35	–	–	–	–	–	–
[40]	Lewis	40	–	–	–	–	–	–
[41]	Mala	62	–	–	–	–	2	(3.2)
[42]	Mann	50	–	–	18	(36)	0	(0)
[43]	Mansfield	123	–	–	41	(33.3)	4	(3.3)
[44]	Matthiessen	111	–	–	–	–	1	(0.9)
[45]	O'Toole	84	–	–	–	–	–	–
[46]	Perez	89	–	–	16	(18.0)	–	–
[47]	Phang	339	–	–	83	(24.5)	1	(0.3)
[48]	Platell	231	3	(1.3)	7	(3)	0	(0)
[49]	Poon	46	–	–	–	–	0	(0)
[50]	Rathnayake	115	–	–	–	–	–	–
[51]	Rullier	96	1	(0.9)	12	(12.5)	0	(0)
[52]	Sakai	48	–	–	3	(6.3)	–	–
[53]	Senapati	263	5	(1.9)	59	(22.4)	–	–
[54]	Thalheimer	120	–	–	24	(20.0)	2	(1.7)
[55]	Tsunoda	22	–	–	–	–	–	–
[56]	v.d. Pavoordt	293	9	(3.1)	50	(17.1)	0	(0)
[57]	Welten	23	–	–	–	–	0	(0)
[58]	Wexner	67	–	–	9	(13.4)	–	–
[61]	Williams	50	–	–	13	(26.0)	2	(4.0)
[60]	Wong	1,504	80	(5.3)	172	(11.4)	1	(0.1)
Total (%)		–	102	(3.7)	823	(17.3)	19	(0.4)

[a] Stapled group
[b] Sutured group
[c] Early reversal
[d] Late reversal
[e] Primary skin closure
[f] Secondary skin closure

These conditions too are likely to result in the need for a repeat laparotomy and possible further bowel resection and anastomosis. This review has shown a 3.7% rate of laparotomy for stoma reversal. This will of course prolong length of stay and recovery time. According to HES (Hospital Episode Statistics) data, in the financial year 2005–2006, there were 3,941 reversal of ileostomies performed in the UK, using a total of 34,577 bed days nationwide [70]. Thus, the morbidity arising from reversal of the ileostomy may have significant impact upon healthcare resources.

The major limitation to this study is the fact that it is a review of primarily observational, non-comparative studies, the majority of which were retrospective in nature. Definitions of complications such as bowel obstruction, ileus and wound sepsis varied between papers. Similarly, not all papers reported on all the desired outcome measures, meaning that some results are based upon the data of only a few studies. Thus, figures should be interpreted with these caveats in mind.

Even with these limitations, there is undoubtedly a significant rate of morbidity associated with loop ileostomy reversal. The presence of a temporary stoma also significantly affects health-related quality of life factors [71, 72], and it should also be remembered that a significant number of so-called "temporary" stomas are never reversed. A prospective study performed by Kairaluoma et al. assessed patients undergoing either sigmoidostomy, transversostomy or ileostomy creation over an 8-year period [73]. Of 141 temporary stomas formed, only 67% were reversed. Studies quoting closure rates of loop ileostomy alone vary from 80% [58] to 96% [31]. Thus, considerable thought should be given before the choice to fashioning a defunctioning stoma following colorectal resection and anastomosis is made. In fact, a review by Platell et al. revealed that in their cohort of patients undergoing colorectal surgery, more than 90% derived no benefit from their defunctioning ileostomy [48]. In addition, the need to close the stoma added nearly a week to their inpatient stay. Kanellos et al. demonstrated a low clinical leak rate of 4.9% in their cohort of 82 patients following low anterior resection without defunctioning ileostomy [74]. Although they also reported a 4.9% subclinical leak rate, there were no reported deaths, and only a 13.4% non-specific complication rate. They concluded that omission of a defunctioning ileostomy was recommended following low anterior resection.

Weston-Petrides et al. [69], recently demonstrated in a meta-analysis the use of defunctioning ileostomy following restorative proctocolectomy and reported that the incidence of clinical anastomotic leak was higher in the group without protective ileostomy. However, differences in pouch-related sepsis did not reach significance, and the only randomised trial in that analysis demonstrated no significant differences in anastomotic leak or pelvic sepsis [75]. They concluded that although they still supported the use of a defunctioning ileostomy following restorative proctocolectomy, selective omission of ileostomy would be justified in a subset of low-risk patients including those in whom the ileal pouch may be technically easier to construct, such as young women not taking corticosteroids, without serious additional comorbidity and for non-inflammatory conditions such as polyposis.

Known factors that may increase the risk of anastomotic leakage include male gender, malnutrition, preoperative weight loss, cardiovascular disease, steroid use, preoperative alcohol abuse, perioperative blood transfusions, advanced age of the patient, obesity and previous irradiation [7, 62, 76–82]. Many studies have also demonstrated increased leak rates with anastomoses that are closer to the anus [7, 62, 78, 80, 83]. Thus, an appropriate low-risk patient who has few of these risk factors may be appropriate for colorectal resection without defunctioning. Of course, aside from these risk factors, good anastomotic healing requires excellent surgical technique to ensure sufficient microvascularization and a tension-free anastomosis [68].

The results of this review indicate that care should be taken to ensure that patients are counselled appropriately prior to reversal of loop ileostomy. In the same way that the Surgical and Clinical Adhesions Research studies have led to increased awareness regarding the need to appropriately counsel patients about the possibility of adhesional small bowel obstruction following surgery [84, 85], the authors feel that surgeons should be increasingly aware of the need to appropriately counsel patients regarding the morbidity of reversing a defunctioning ileostomy. In particular, the risk of the need for repeat laparotomy, as well as the possibility of prolonged or repeated hospital admission must be made clear in order to fulfil the requirements of informed consent. Ideally, this should be done prior to the initial surgery as well as prior to reversal. At the same time, surgeons, especially surgical trainees, must be aware of the significant morbidity that can occur following what is often thought to be a simple and straightforward procedure. As an extension to this, more senior colorectal surgeons should perhaps adopt a more selective approach to the use of a defunctioning ileostomy to protect a distal anastomosis. For a select group of low-risk patients, the risks of having a defunctioning stoma may well outweigh any potential benefit.

Conclusions

The consequences of anastomotic leakage following colorectal surgery are severe. These complications can be reduced by the use of a defunctioning ileostomy. However, the consequences of stoma reversal are often underestimated by clinicians and their patients. A selective approach to the use of defunctioning ileostomy may be of help to

reduce the morbidity associated with stomas and their reversal in patients with a lower risk profile. Patients should also be counselled in detail regarding the complications of stoma reversal as part of the informed consent process of the initial resection.

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