Application of an enhanced recovery pathway for ileostomy closure: a case–control trial with surprising results

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Abstract

Background Enhanced recovery after surgery (ERAS) protocols have been widely validated in colorectal surgery; however, few data exist on loop ileostomy closure. The aim of this study was to compare clinical outcomes before and after introduction of ERAS for loop ileostomy closure.

Methods Data on outcomes after loop ileostomy closure were retrospectively collected before ERAS was applied at our department (control group). These results were compared to results of patients undergoing loop ileostomy closure within the original colorectal ERAS pathway (ERAS 1 group); after analysis of these results, adaptations were made to the ERAS pathway regarding the postoperative diet, and this second category of patients was analyzed (ERAS 2 group).

Results Forty-eight patients in the control group were compared to 46 ERAS 1 and 69 ERAS 2 patients. First stool was significantly faster in ERAS 2 group versus control and ERAS 1 group [median 1 (range 1–2) days vs 2 (2–3) days p value 0.01]. The incidence of vomiting increased from 26% in the control group to 45% in ERAS 1 group, and then decreased to 29% in the ERAS 2 group (p value 0.41). Length of stay was significantly shorter during the ERAS 2 protocol: median 4 (range 3–6) days versus 5 (4–8) days in the control group (p value < 0.01).

Conclusions After application of the ‘colorectal’ ERAS pathway to loop ileostomy closure, results were initially not improved. Minor corrections were sufficient to avoid increased incidence of vomiting and to allow for reduced hospital stay. Uncritical extrapolation of an ERAS colorectal protocol to other types of surgery should be monitored and needs audit for corrections.

Keywords Enhanced recovery after surgery · Ileostomy · Postoperative ileus

Introduction

Benefits of enhanced recovery after surgery (ERAS) pathways are largely proven for colorectal resections [1]. At our institution, an ERAS protocol was first introduced for elective colorectal resections and stoma procedures including loop ileostomy closure were included at a later time. Loop ileostomy closure is often considered a minor intervention, with a short length of stay and few complications. The

benefit of an enhanced recovery pathway could therefore be questionable. However, in the literature, high readmission rates have been described for loop ileostomy closure, with non-negligible morbidity rates due to wound infections, postoperative ileus, rectal bleeding, or pseudomembranous colitis [2].

This aim of the present study was to compare clinical outcomes before and after introduction of ERAS for loop ileostomy closure and the impact of protocol adaptation to this specific type of surgery.

Materials and methods

Setting

This was a case–control trial, performed at a university hospital. All consecutive patients undergoing loop ileostomy

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closure within an ERAS pathway were compared to a control group of consecutive patients before the implementation of ERAS. The study was conducted in accordance with the STROBE criteria (<http://strobe-statement.org>), approved by the ethics committee, and registered under www.researchregistry.com (UIN1286).

ERAS protocol

ERAS was systematically introduced for colorectal surgery at our tertiary academic center in May 2011; all consecutive patients were treated within the ERAS pathway. From July 2012, patients undergoing loop ileostomy closure were also included in the ERAS pathway, following the recommendations for colonic resections [3].

Groups

Consecutive patients undergoing loop ileostomy closure before the introduction of ERAS served as a control group. Their data were retrospectively analyzed. In patients

undergoing closure of loop ileostomy between July 2012 and December 2013, the ERAS ‘colorectal’-protocol was applied without modifications (ERAS 1 group). After analysis of our data, an adapted ERAS protocol for loop ileostomy closure was applied between January 2014 and July 2015 (ERAS 2 group). The protocols of the three groups are described in Table 1. We did not make a difference between clear liquids and full liquids. In both ERAS groups, there was no limitation for quantity of liquids post-operatively. Patients had to tolerate liquids, in order to receive solid meals the first postoperative day. In ERAS 2 group, the quantity of solid food was reduced by 50% (‘half’ portion prepared by the hospital kitchen), until passage of stool. Patients were discharged after tolerating full meals.

Patients with loop ileostomy closure performed in combination with other surgery or who needed an approach through laparotomy were excluded.

The standard anastomosis was a hand-sewn end-to-end anastomosis with a running absorbable suture (PDS 4-0).

Table 1 Description of perioperative care per group

	Control (before May 2011)	ERAS 1 (July 2012–December 2013)	ERAS 2 (January 2014–July 2015)
Preoperative counseling	None	All patients	=
Preoperative carbohydrates loading	None	All patients	=
Preoperative fasting	No solids/liquids from midnight until surgery	Solids up until 6 h, clear fluids up until 2 h before anesthesia	=
Preadmission medication	Long acting sedatives on demand	No long acting sedatives	=
Perioperative fluid management	No protocol	Aim 500–1000 ml ringer lactate for surgery < 180 min. Physiogel iv filling if necessary	=
Prevention PONV	Only if history of PONV	All patients: dexamethasone 4 mg + dehydrobenzperidol 1 mg at start operation, ondansetron 4 mg iv at end operation	=
Laxatives	Discretion of surgeon	All patients: magnesium hydroxide 450 mg 2/day	=
Postoperative analgesia	No protocol	Paracetamol 1 gr 4/day + ibuprofen 400 mg 3/day. Opioids if needed	=
Postoperative i.v. fluid management	Discretion of surgeon	500 ml day of surgery, then stop	=
Mobilization	No protocol	2 h on day surgery, 8 h/day following postoperative days	=
Oral diet	Discretion of surgeon	Liquid day of operation, normal first postoperative day	Liquid day of operation. Half portion until first stool, then full portion. Patient decides quantities

In ERAS 1, the original ERAS protocol for colorectal surgery was used. In ERAS 2, this protocol was adapted for loop ileostomy closure. = equal to ERAS 1

ERAS enhanced recovery after surgery, *PONV* postoperative nausea and vomiting

Data collection and outcome measures

For the control group, all data were retrospectively documented; for the ERAS groups, all data were prospectively documented in an online database by a trained ERAS nurse. The documented data were the following: demographic and surgical details of patients; adherence to the ERAS pathway assessed by comparing preoperative, perioperative and postoperative elements (compliance) of the ERAS protocol [4]. Return of bowel function was assessed by first passage of stool, but also the incidence of vomiting and ileus. Ileus was defined as the need for insertion of a nasogastric tube during the postoperative period. Overall complications were documented during 30 days postoperatively, a severe complication being regarded as higher than grade II on the Clavien–Dindo classification of complications [5]. Length of hospital stay was the number of days from the day of surgery to discharge. Readmissions were documented from the day of discharge until 30 days postoperatively.

Statistical analysis

Descriptive statistics for discrete variables was reported as frequency and percentage, and continuous variables were reported as median and interquartile range (IQR). Chi-square or Fisher's exact test were used for comparison of discrete variables. Continuous variables were compared with the Mann–Whitney *U* test. All statistical tests were two-sided, and a level of 0.05 was considered statistically

significant. Statistical analyses were performed with SPSS® 19 (IBM, Armonk, N.Y., USA).

Results

Forty-eight patients were included in the retrospective control (pre-ERAS) group, 46 patients in the first ERAS group (July 2012–December 2013), and 69 patients in the second ERAS group (January 2014–July 2015).

Demographics and surgical details

Comparisons of baseline characteristics of patients are displayed in Table 2. In the ERAS 2 group, patients tended to be younger, with higher American Society of Anesthesiologists (ASA) scores. Patients received significantly less intravenous volume during operation within the ERAS pathway than without ERAS. Duration of surgery was shorter in the first ERAS group compared to the two other groups.

Looking at all three groups together ($n = 163$), a hand-sewn end-to-end anastomosis was performed in 91% of cases; in the remaining 9% ($n = 15$), it was a stapled side-to-side anastomosis (control group $n = 1$, ERAS 1 $n = 9$, ERAS 2 $n = 5$).

Table 2 Patient characteristics

	Control (n 48)	ERAS 1 (n 46)	ERAS 2 (n 69)	<i>p</i> value
Age, years (IQR)	64 (52.5–70.8)	66.5 (53.7–75)	59 (48.5–68.5)	0.07
Sex, M:F	32:16	28:18	39:30	0.54
BMI (IQR)	23.6 (21.4–26.5)	24 (21.2–27.3)	24 (20.9–26.7)	0.96
ASA score				
1–2	42 (87.5%)	39 (87%)	50 (72%)	0.064
3–4	6 (12.5%)	6 (13%)	19 (28%)	
Total iv volume (ml) POD0	2500 (2000–2725)	1500 (1225–1800)	1500 (1140–1750)	Pre versus ERAS1: <0.01 Pre versus ERAS2: <0.01 ERAS1 versus ERAS2: 0.54
Not mobilized on POD0	Unknown	16%	12%	0.58
Mobilization (h)				
POD1	Unknown	6 (4.5–8)	6 (4–7)	0.09
POD2		8 (6–8)	6.5 (6–8)	0.19
POD3		8 (6–8)	7 (6–8)	0.13
Duration surgery, minutes (IQR)	93 (76–110)	77 (62–99)	91 (73–117)	Pre versus ERAS1: 0.01 Pre versus ERAS2: 1.0 ERAS1 versus ERAS2: 0.01

In ERAS 1 the original ERAS protocol for colorectal surgery was used. In ERAS 2 this protocol was adapted for loop ileostomy closure
ERAS enhanced recovery after surgery, BMI Body mass index, ASA American Society of Anesthesiologists, POD postoperative day

ERAS protocol adherence

Overall adherence to the ERAS pathway was in median 78% (IQR 75–95%). Adherence to preoperative elements was 100% (IQR 95–100%), for intraoperative elements it was 75% (IQR 69–75%), and for postoperative elements it was 76% (IQR 69–75%). The percentages of adherence to the two ERAS protocols are shown separately in Table 3.

Bowel function, complications, hospital stay

Results of postoperative recovery between groups are shown in Table 4. First bowel movement was observed after a median of 2 days (IQR 2–3 days) in the control group versus 2 days (IQR 1–2 days) in the ERAS 1 group, and a median of 1 day (IQR 1–2 days) in the ERAS 2 group, respectively. The incidence of vomiting increased from 26% in the control group to 45% in the ERAS 1 group and then decreased to 29% in the ERAS 2 group. The incidence of ileus was similar in all groups. Length of stay was significantly shorter during ERAS 2 protocol: median 4 (range 3–6) days versus

5 (4–8) days in the control group and 5 (4–7) days in the ERAS 1 group.

Discussion

In the present paper, application of original colorectal ERAS protocol [3] for loop ileostomy closure led to prohibitively high rates of vomiting postoperatively. Subtle modifications (half portions until bowel recovery, patient instruction to eat according to appetite) allowed to reverse this condition and to decrease hospital stay compared to the pre-ERAS situation.

However, despite the introduction of a modified colorectal ERAS protocol, the incidence of postoperative ileus remained up to 19%. In the recent literature, the reported incidence of postoperative ileus lies between 10 and 16% with the three largest studies reporting around 16%, and an overall morbidity up to 40% [1, 6–10]. One study reported specifically on results after loop ileostomy closure within an enhanced recovery pathway [8]. They found an overall 19% complication rate, with 8% postoperative ileus. The readmission rate was 12%; half of them were for postoperative ileus. The percentages in the mentioned study [8] and our present results suggest that loop ileostomy closure cannot be considered as minor intervention, and all efforts should be made to understand and decrease the incidence of postoperative ileus.

Several hypotheses can be formulated about this high incidence of ileus. A recent meta-analysis comparing 321 hand-sutured end-to-end anastomoses to 328 stapled side-to-side anastomoses after loop ileostomy closure showed significantly less ileus in staples side-to-side anastomoses [11]. So, the configuration of the anastomosis could play a role. However, there was a lack of definition of ileus throughout these studies. In our present study, the large majority of anastomoses were hand-sewn, with only 9% stapled. No significant differences in paralytic ileus were found between

Table 3 Adherence to the ERAS elements for the two separate ERAS periods

	ERAS 1 (July 2012–December 2013)	ERAS 2 (January 2014–July 2015)	<i>p</i> value
Preoperative % (IQR)	100 (92–100)	100 (97–100)	0.14
Intraoperative % (IQR)	71 (63–75)	75 (75–75)	0.08
Postoperative % (IQR)	75 (72–81)	78 (72–83)	0.67
Overall % (IQR)	81 (78–84)	84 (81–86)	0.1

In ERAS 1, the original ERAS protocol for colorectal surgery was used. In ERAS 2, this protocol was adapted for loop ileostomy closure

ERAS enhanced recovery after surgery

Table 4 Results of postoperative recovery

	Control <i>n</i> 48	ERAS 1 <i>n</i> 46	<i>p</i> value	ERAS 2 <i>n</i> 69	Overall <i>p</i> value
First stool, days (IQR)	2 (2–3)	2 (1–2)	0.08	1 (1–2)	< 0.01
Vomiting [<i>n</i> (%)]	12 (26%)	18 (45%)	0.066	20 (29%)	0.41
Ileus [<i>n</i> (%)]	8 (17%)	11 (24%)	0.41	13 (19%)	0.77
Complications [<i>n</i> (%)]	13 (27%)	19 (41%)	0.15	21 (30%)	0.30
Grade I–II	10 (21%)	15 (32%)		14 (20%)	
Grade III–IV	3 (6%)	4 (9%)		7 (10%)	
Length of stay, days (IQR)	5 (4–8)	5 (4–7)	0.22	4 (3–6)	< 0.01

In ERAS 1, the original ERAS protocol for colorectal surgery was used. In ERAS 2, this protocol was adapted for loop ileostomy closure

ERAS enhanced recovery after surgery

both techniques of anastomosis; however, the study was not powered to analyze this and it was not the aim of the study.

The small bowel seems to play a determining role. In large studies comparing left-sided colo-colic or colorectal anastomoses to right-sided ileocolic anastomosis, there is a significant higher incidence of paralytic ileus after ileocolic anastomosis [12–14]. Radical cystectomy with ileal neobladder reconstruction is also a category of intervention with high rates of postoperative ileus reported, varying from 12 to 22% [15–21]. Enhanced recovery protocol in patients undergoing radical cystectomy has not yet showed major amelioration of ileus incidence [22]. In this study, interestingly, in patients needing a nasogastric tube, a large proportion of patients had a rapid passage of stool (the first or second day after surgery), but still presented nausea and vomiting. We hypothesize that the small bowel anastomosis is still somehow narrow in some patients in the first postoperative days, possibly due to edema or spasm, and when receiving a normal diet on the first postoperative day, this could result in the high rate of vomiting we have observed. Based on this observation, we believe the oral feeding must be adapted for ileostomy closure and cannot follow the same protocol as for colorectal resections.

Concerning the postoperative care, this should not be a reason to exclude day case ileostomy closure of current practice. If patients are well instructed, and factors for dismissing patients after ambulant surgery are fulfilled, studies have shown ambulant therapy can be applied [23, 24]. However, the hospital needs to have the resources to quickly and easily re-hospitalize these patients.

The use of alvimopan, a μ -opioid receptor antagonist, could possibly bring an amelioration of this high incidence of postoperative ileus. Recent studies using alvimopan in patients undergoing major gastro-intestinal surgery have shown a reduction in duration of postoperative ileus [25, 26]. Studies addressing specifically alvimopan and loop ileostomy closure do not exist to the best of our knowledge.

In the present study, the application of a validated ERAS protocol for colorectal surgery [3] to a different patient population (loop ileostomy closure) is described. After initial evaluation of the results, modifications were introduced to the protocol resulting in improvement in the second group of ERAS patients. These results suggest that uncritical extrapolation of colorectal ERAS protocol to other types of surgery may be problematic, emphasizing the importance of audit to allow corrections. On the other hand, once ERAS principles are embedded in the routine of medical team (surgeons, nurses, physiotherapist, nutritionist); an indirect positive effect on other non-ERAS patients of the same ward has been observed by our group [27].

Some limitations to this study need to be addressed. Despite its retrospective nature, the data of ERAS groups were collected prospectively. The groups are relatively

small, with a first aim to compare 50 patients before ERAS to 50 patients within ERAS. That number of patients could not be reached exactly, due to incomplete patient files and exclusion in the retrospective group. Moreover, patients with loop ileostomy closure combined with other surgery were excluded. Also, there are several factors involved in time to recovery after surgery, such as the amount of opiate used. In this study, no data were collected on precise amounts of opiate used per- and postoperatively. No local anesthesia was performed routinely. There was a TAP block in one patient and local infiltration with bupivacaine in another patient, based on postoperative pain management needs.

Conclusions

Application of a colorectal ERAS pathway to other procedures should be monitored closely to identify problems and allow for corrections. For loop ileostomy closure, minor corrections were sufficient to avoid increased incidence of vomiting and to allow for reduced hospital stay compared to the pre-ERAS situation.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and regional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent For this type of study formal consent was not required.

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