Updates Surg
DOI 10.1007/s13304-017-0474-4

ORIGINAL ARTICLE

Enhanced recovery pathway in elderly patients undergoing colorectal surgery: is there an effect of increasing ages? Results from the perioperative Italian Society Registry

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Received: 18 January 2017 / Accepted: 6 June 2017

Abstract Previous studies reported that enhanced recovery pathway (ERP) is safe in elderly who did not require a specifically tailored protocol. In previous studies, elderly have been considered as a homogeneous cohort and the cut-off value to identify them was different. The aim of the present study is to assess the compliance to ERP and its impact on postoperative outcome in three subgroups of elderly patients with increasing ages. Prospectively collected data entered in an electronic Italian registry specifically designed for ERP were reviewed. 315 elderly patients undergoing elective colorectal resection were divided into three groups. Group 1: 71–75 years ($n = 105$), Group 2: 76–80 years ($n = 117$), Group 3: over 80 years ($n = 93$). Primary endpoints of the study were adherence to ERP and time to readiness for discharge (TRD). Compliance to ERP was similar in the three groups. No difference among groups was found for mortality, overall morbidity, major complications, reoperation rate and readmission rate. Median TRD and length of hospital stay (LOS) were progressively longer with increasing age ($p = 0.018$ and $p = 0.078$, respectively). Increasing age did not impact on adherence to ERP and postoperative morbidity, but delayed both TRD and LOS.

Keywords Enhanced recovery after surgery · Colorectal surgery · Elderly · Postoperative morbidity · Length of stay

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Published online: 15 June 2017

Introduction

Advanced age has traditionally been associated with increased mortality and morbidity, and longer recovery following colorectal surgery [1–3]. Elderly should benefit from enhanced recovery pathway (ERP) which has been shown to reduce perioperative stress, minimize postoperative organ dysfunction, and improve short-term outcomes following elective colorectal surgery [4–9].

Recent studies reported that elderly patients did not require a specifically tailored enhanced recovery protocol [10–12]. Within ERP, a small difference in time to readiness for discharge and length of hospital stay was found comparing younger vs. elderly, even when patients were stratified according to ASA grade [12]. A limitation of previous studies is that elderly have been considered as a homogeneous cohort, moreover, the cut-off value to identify elderly was different [10–14].

The aim of the present study is to assess the compliance to ERP and its impact on postoperative outcome in subgroups of elderly patients with increasing ages undergoing elective colorectal surgery.

Methods

This study is reported according to the STROBE guidelines for the conducting and reporting of observational cohort studies [15].

The present study is a review of the prospectively collected PeriOperative Italian Society database. Elderly (>70 yrs.) patients undergoing elective colorectal surgery between June 2014 and December 2015 were treated according to a comprehensive ERP which was defined with the active contribution of the ERAS® Society (Table 1). The cohort of elderly patients was divided into three groups according to age. Group 1: 71–75 years; Group 2: 76–80 years; Group 3: over 80 years. Demographics, patient comorbidities, preoperative and intraoperative parameters, adherence to ERP items, early recovery variables, and short-term postoperative outcomes were collected in all patients.

Primary endpoints of the study were adherence to ERP and time to readiness for discharge (TRD). According to a previous study, adherence to ERP was a priori defined [12]. TRD is defined as the time to achieve standardized discharge criteria [16]. Discharge criteria were the following: no clinical or laboratory evidence of postoperative complications or untreated medical problems; good pain control by oral analgesics; adequate oral food intake with no need for intravenous infusion support; recovered mobilization; and recovery of bowel function defined as passage of flatus. Secondary endpoints were overall postoperative morbidity and primary length of hospital stay (LOS). Postoperative pain was assessed according to the VAS scale. According to a previous study, criteria to identify postoperative complications were a priori defined [17]. Postoperative complications were graded according to Clavien–Dindo classification [18]. Complications graded as III to V were considered as major. Follow-up for postoperative outcomes was carried out for 30 days after hospital discharge. Hospital readmissions for any postoperative complication occurring within 30 days after discharge were also recorded.

Statistical analysis

Descriptive data are reported as mean (±standard deviation), or median (25th–75th percentile), otherwise specified. Normality was assessed by inspection of frequency histograms.

The three groups were compared using Chi-square test for categorical data, and Mann–Whitney *U* test, ANOVA and Kruskal–Wallis tests for continuous data, as appropriate.

Statistical analyses were performed using STATA® version 13.1 software (StataCorp, College Station, TX, USA). All statistical tests were two-sided, a "p" value <0.05 was considered to indicate statistical significance.

Results

A total of 315 elderly patients were included in the analysis and were divided into three groups according to age. Group 1: 71–75 years ($n = 105$), Group 2: 76–80 years ($n = 117$), Group 3: over 80 years ($n = 93$).

Table 2 reports preoperative and operative variables in the three groups. Preoperative hemoglobin levels were higher in the Group 1 and operative time was shorter in the Group 3. No significant difference for other variables including ASA grade, obesity, diabetes, cancer, and laparoscopic approach was found among groups.

Table 3 shows that the ERP compliance was similar in the three groups. All patients received antibiotic and antithrombotic prophylaxis. The vast majority of patients had multidisciplinary counselling and did not receive oral bowel preparation. In all groups the most relevant deviations from ERP was the abdominal drain placement. Epidural analgesia was given in about 50% of patients in all groups, the others receiving morphine either as scheduled or patient-controlled administration. The vast majority of patients had the naso-gastric tube removed at the end of surgery with a low repositioning rate. On postoperative day

Table 1 Perioperative care ERP interventions and definition of compliance

ERAS intervention	Definition of compliance
Preoperative	
Preadmission education	Patient received preoperative multidisciplinary counseling including information on recovery goals and expectation about hospital stay
No mechanical bowel preparation	No preoperative oral solution for bowel cleansing
Carbohydrate loading	Intake of a preoperative maltodextrin-based drink
No long-acting sedation	No long acting sedating medication used before surgery
Intraoperative	
Antibiotic prophylaxis	Antibiotic prophylaxis completed prior to surgical incision
Epidural analgesia	Thoracic epidural analgesia started before surgery and prolonged until POD 3
Avoid fluid overload	Intraoperative fluid infusion rate <6 mL/kg/hour
PONV prophylaxis	Multimodal pharmacologic prophylaxis administered
No abdominal or pelvic drainage	No resection-site drainage used
Active warming	Active patient warming during surgery
Thromboembolic prophylaxis	Thromboembolic disease prophylaxis with low-molecular-weight heparin
Avoidance of nasogastric tube	Nasogastric tube removed at the end of surgery
Postoperative	
Opioid-sparing multimodal analgesia	Use of opioid-sparing analgesic strategies
Oral liquids on POD 0	Patient receives oral liquids on the day of surgery postoperatively
Solid diet on POD 1	Patient receives solid food starting on POD 1
Early mobilization out of bed	Patient mobilized out of bed within the first 24 h after surgery
Early termination of IV fluid infusion	Termination of intravenous fluid infusion by POD 2
Early removal of urinary drainage	Removal of urinary drainage by POD 1

POD postoperative day, *PONV* postoperative nausea and vomiting, *IV* intravenous

1, the majority of patients had the urinary catheter removed and recovered mobilization out of bed. On postoperative day 2, 80% of patients received oral feeding and 70% had no intravenous fluid infusion. Compliance to ERP was similar by comparing patients who underwent colonic or rectal resection. Cancer stage and type of anastomosis did not impact on protocol compliance.

In the overall series, no mortality was observed, major complications occurred in 16 (5.1%) patients and overall morbidity in 72 (22.9%) patients. No difference among the three groups was found for major complications, anastomotic leak, respiratory complications, urinary tract infections, and reoperation rate (Table 4).

Table 5 shows that no difference was found in the time to reach standardized discharge criteria, except for bowel function which recovered earlier in the Group 1. Both TRD and LOS were progressively longer with increasing age ($p = 0.078$ and $p = 0.018$, respectively).

Discussion

The present study showed that elderly had a good adherence to enhanced recovery pathway. Increasing age did not reduce ERP compliance and did not impact on postoperative morbidity rate. However, both time to readiness for discharge and length of hospital stay were delayed in octogenarians.

In a large cohort of patients from the International Registry of ERAS Society, the increasing compliance to the enhanced recovery program was independently associated with a better short-term outcome following elective colorectal surgery [19]. In a systematic review, Bagnall reported that enhanced recovery pathway improved short-term postoperative outcome in elderly when compared to conventional perioperative care [11]. However, the included studies only partially reported the compliance to ERP elements. In a previous study [12], elderly patients did not

Table 2 Demographics, preoperative, and operative variables

	71–75 years ($n = 105$)	76–80 years ($n = 117$)	>80 years ($n = 93$)	p value
Age (years)	73 (1)	77 (2)	84 (3)	
Men/women	42/63	64/53	42/51	0.410
ASA[†] score	I–II 58 (55%)	I–II 63 (54%)	I–II 40 (43%)	0.499
	III–IV 47 (45%)	III–IV 54 (46%)	III–IV 53 (57%)	
Haemoglobin (g/L)	13 (2)	12 (2)	12 (2)	<0.001
Diabetes	21 (20%)	18 (15%)	14 (15%)	0.670
Cancer	93 (89%)	99 (85%)	89 (96%)	0.828
Neoadjuvant CT-RT	4 (4%)	11 (9%)	3 (3%)	0.125
Obesity (BMI >30)	7 (7%)	13 (11%)	5 (5%)	0.322
Preoperative stay (days)	0.8 (0.9)	0.9 (1.5)	1.1 (1.7)	0.313
Laparoscopy	81 (77%)	92 (79%)	54 (58%)	0.332
Operative time (min)	200 (69)	208 (78)	178 (72)	0.012
Operative blood loss (mL)	96 (111)	86 (104)	74 (100)	0.545
Transfusion	15 (14%)	9 (8%)	10 (11%)	0.367
Right colectomy	37 (35%)	45 (39%)	44 (48%)	
Left colectomy	39 (37%)	40 (34%)	26 (28%)	
LAR/miles	27 (26%)	26 (22%)	23 (25%)	
Total colectomy	2 (2%)	6 (5%)	0	
New stoma	14 (13%)	15 (10%)	14 (15%)	0.916

Data are number of patients (%) or mean (standard deviation)

[†] American Society of Anesthesiologist

show a worse compliance to an enhanced recovery protocol when compared to younger. Elderly did not require a specifically tailored protocol and had only a 1-day longer TRD and LOS when compared to younger. Within enhanced recovery protocol, no significant increase in postoperative mortality and major complications was found in the subgroup of elderly with ASA III-IV [12].

In previous studies patients over 70 years were considered as a homogeneous cohort and no data are available in subgroups of elderly with increasing ages [10–14]. In the present study, adherence to each ERP item has been prospectively registered in all patients. The three groups were comparable for ASA score, obesity, diabetes, blood transfusions, and rate of minimally invasive surgery which per sé can increase the adherence to postoperative ERP elements and can modify surgical risk factors [20–22].

No difference in the compliance to preoperative and intraoperative ERP elements was found among the three groups. In particular, all groups had a very high adherence for preadmission counselling, no oral bowel preparation, preoperative carbohydrates loading, and active intraoperative warming. The main deviation from ERP occurred for the abdominal drain placement. Although the abdominal drain did not reduce both rate and severity of anastomotic leak [23, 24], a number of surgeons are still reluctant to change their habits. The low adherence to epidural analgesia in all groups could be partially explained by the high rate of minimally invasive surgery in our series. In fact, loco-regional analgesia has been recently proposed in patients undergoing laparoscopic surgery as a possible alternative to epidural analgesia [25, 26].

In the present study, elderly patients recovered oral feeding as early as in previous studies carried out in the general population. The majority of patients had i.v. fluids stopped on postoperative day 2 with a low rate of nasogastric tube replacement and i.v. fluids restart. This confirms that elderly do not require a specifically tailored postoperative pathway. Postoperative complication rate was similar in the three groups and was not substantially different from values previously reported in the general population [12]. This suggests that reducing the surgical stress by enhanced recovery protocol is effective in elderly patients, who can specifically benefit from a minimally invasive perioperative care pathway. In the elderly, the improved postoperative recovery due to ERP might translate in a substantial reduction of hospital and social costs.

Both urinary tract and respiratory infection rates were very low reflecting the beneficial effects of fluid restriction, adequate pain control, early postoperative mobilization, and early removal of bladder catheter [7, 27, 28].

Table 3 Adherence to ERP elements

	71–75 years ($n = 105$)	76–80 years ($n = 117$)	>80 years ($n = 93$)	p value
Preadmission Counselling	105 (100%)	116 (99%)	90 (97%)	0.986
No oral bowel prep.	94 (90%)	100 (86%)	83 (90%)	0.966
Preop. oral carbohydrate	84 (80%)	95 (81%)	76 (82%)	0.994
Epidural analgesia	52 (50%)	60 (51%)	54 (58%)	0.784
No premedication	42 (40.0%)	51 (43.6%)	37 (39.8%)	0.816
PONV prophylaxis	77 (73%)	77 (66%)	82 (88%)	0.375
Active warming	104 (99%)	114 (97%)	88 (95%)	0.975
Intraop. fluids (mL/kg/h)	9.7 (4.1)	8.5 (4.0)	10.3 (5.9)	0.817
No abdominal drain	32 (30%)	39 (33%)	41 (44%)	0.602
No NGT	95 (91%)	109 (93%)	84 (90%)	0.986
Need for NGT repositioning	10 (9%)	14 (12%)	11 (12%)	0.850
Oral liquids on POD 0	62 (59%)	69 (59%)	46 (49%)	0.705
Oral liquids on POD 1	95 (90%)	108 (92%)	84 (90%)	0.992
Solid food on POD 1	56 (53%)	67 (57%)	48 (52%)	0.898
Solid food on POD 2	81 (77%)	101 (86%)	76 (82%)	0.854
Stop i.v. fluids on POD 2	78 (74%)	79 (67%)	56 (60%)	0.648
Restart i.v. fluids	13 (12%)	15 (13%)	11 (12%)	0.982
Urinary catheter removal on POD 1	74 (70%)	79 (67%)	64 (69%)	0.979
Epidural catheter removal on POD 3	38 (36%)	44 (38%)	44 (47%)	0.536
Mobilization out of bed on POD 1	98 (93%)	106 (91%)	83 (89%)	0.975

Data are number of patients (%) or mean (standard deviation)

NGT naso-gastric tube, *POD* postoperative day

Table 4 Postoperative outcome parameters

	71–75 years ($n = 105$)	76–80 years ($n = 117$)	>80 years ($n = 93$)	p value
Overall complications	22 (21%)	22 (19%)	28 (30%)	0.288
Major complications (Dindo III–V)	6 (6%)	5 (4%)	5 (5%)	0.888
Anastomotic leak	5 (4.8%)	2 (1.7%)	1 (1.1%)	0.219
Respiratory complications	1 (1%)	2 (2%)	2 (2%)	0.796
Urinary tract infection	1 (1%)	1 (1%)	1 (1%)	0.367
Reoperation	5 (5%)	6 (5%)	4 (4%)	0.965
30-day Mortality	0	0	0	

Data are number of patients (%)

Anastomotic leak rate was not increased in comparison with previous series not receiving ERP, thus confirming that both oral bowel preparation and prolonged postoperative fasting are not protective factors for the occurrence of anastomotic dehiscence. Elderly patients early recovered self-care and other criteria for discharge, however, TRD was reached one-day later in octogenarians.

A possible limitation of the study is that participating hospitals could differ for the level of ERP implementation and this might explain the different levels of compliance to some elements of the protocol. Strengths of the present study include a specifically designed database to capture adherence to ERP elements and the use of a validated indicator of short-term recovery, such as time to readiness for discharge [16].

In conclusion, the present study showed that increasing age had no impact on adherence to enhanced recovery pathway and occurrence of postoperative complications. A small increase in time to readiness for discharge and length of hospital stay was found in octogenarians.

Table 5 Time to reach discharge criteria, time to readiness for discharge, and hospital discharge (postoperative days)

	71–75 years ($n = 105$)	76–80 years ($n = 117$)	>80 years ($n = 93$)	p value
Adequate oral food intake	2.8 (2.3)	3.1 (2.7)	3.0 (2.0)	0.648
Recovery of bowel function	2.7 (1.3)	3.4 (1.9)	3.3 (1.6)	0.004
Pain control (oral drugs)	3.0 (1.3)	3.2 (1.8)	3.4 (1.3)	0.177
Ability to mobilize and self-care	3.0 (2.2)	3.6 (3.0)	3.5 (1.6)	0.146
No morbidity evidence	5.5 (2.6)	5.9 (3.1)	6.2 (3.0)	0.153
Length of hospital stay	6.2 (3.1)	6.7 (3.5)	7.3 (3.6)	0.078
Time readiness for discharge	5.7 (2.8)	6.4 (3.4)	7.0 (3.4)	0.018
Readmission	6 (6%)	2 (2%)	1 (1%)	0.111

Data are reported as mean (standard deviation) or number of patients (%)

Compliance with ethical standards

Funding None.

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

Research involving human participants and/or animals This research involves only human participants. This retrospective study is in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent All patients signed an informed consent form before surgery.

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