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Outcomes after ileoanal pouch surgery in frail and older adults

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ABSTRACT

Background: Evidence from single-center studies suggests that ileal pouch-anal anastomosis (IPAA) can be safely performed in selected older patients with ulcerative colitis. The impact of age and frailty on surgical outcomes and hospital length of stay after IPAA has not been examined.

Methods: We identified all patients with ulcerative colitis who underwent total proctocolectomy or completion proctectomy with IPAA in the National Surgery Quality Improvement Program database from 2005–2012. We examined the associations of age and frailty trait count with length of hospital stay and surgical complications using multivariate regression.

Results: IPAA was performed in 2493 patients with ulcerative colitis. Thirty-day mortality was 0.2% ($n = 6$). The majority of patients had no serious postoperative complications (age ≤50 y: 79.5%, age 51–60 y: 80.4%, and age >60 y: 79.1%). After multivariate risk adjustment, patients aged >60 y had a similar mean number of complications as patients aged ≤50 y (0.31 *versus* 0.35, $P = 0.47$) and a 0.8-d longer mean length of hospital stay (7.4 *versus* 8.2 d, $P = 0.035$). Compared to patients with zero frailty traits, a frailty trait count ≥1 was associated with a similar mean number of complications (0.31 *versus* 0.34, $P = 0.36$) and length of hospital stay (7.4 *versus* 7.7 d, $P = 0.25$).

Conclusions: In this analysis of patients undergoing IPAA at National Surgery Quality Improvement Program hospitals, surgical complications were not substantially increased in older patients or those with frailty traits. Older age was associated with a small increase in hospital length of stay. These findings suggest that IPAA is safe in selected older adults with ulcerative colitis.

1. Introduction

Up to a third of patients with ulcerative colitis require surgery, most commonly for dysplasia or cancer, medication intolerance, or symptoms refractory to medications [1]. Surgical treatment most commonly involves total proctocolectomy with either end ileostomy or ileal pouch-anal anastomosis (IPAA). IPAA restores intestinal continuity and is the

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most common operation performed in ulcerative colitis patients [1,2]. However, it is a major operation with an overall perioperative morbidity of 20% [3] including surgical site infection [4,5], deep space abscess [6], small bowel obstruction [5], deep venous thrombosis [5], and pelvic sepsis [7].

Historically, IPAA was not offered to patients age >50 because older age was thought to be associated with increased risk of complications and worse functional outcomes [8]. Recent single-center studies, however, have shown that functional outcomes and long-term complication rates after IPAA in selected patients age >50 are comparable with those in younger patients [9–16]. One reason age may not be an accurate predictor of surgical risk in ulcerative colitis patients is that disease severity is an important contributor to perioperative morbidity and mortality. Older patients with ulcerative colitis tend to have less severe disease [8] and more commonly require surgery for dysplasia [9]. Therefore, from the perspective of disease severity, older patients may have reduced surgical risk compared with younger patients.

Frailty is an emerging alternative to age for estimating surgical risk. Although it has many definitions, frailty describes a state of reduced physiologic reserve reflecting cognition, function, nutrition, and comorbidities [17]. Frailty is associated with increased hospital length of stay, perioperative mortality, and surgical complications across surgical specialties [18]. Although frailty is growing in popularity in the surgical literature, it is rarely discussed in the context of surgical risk for patients with ulcerative colitis. Frailty, however, may be particularly well-suited to estimate risk in individuals with ulcerative colitis given the evolving evidence that age alone should not be used to determine eligibility for IPAA.

The association between age, frailty, and morbidity after IPAA for ulcerative colitis at the population level is unknown. We hypothesized that surgical morbidity would be more strongly associated with frailty than with age. We therefore analyzed patients undergoing IPAA for ulcerative colitis using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database to examine the associations of age and frailty with surgical complications and length of hospital stay.

2. Methods

2.1. Data source

We used data from the ACS-NSQIP, a validated multicenter database that contains 30-d surgical outcomes for adult patients undergoing major surgical procedures in the United States [19]. Data are extracted from participating hospitals, which increased from 174 in 2005 to 374 in 2012 [19]. This study was performed with permission from local and national ACS-NSQIP administrators. The University of California San Francisco Committee on Human Research determined this study to be exempt from Institutional Review Board.

2.2. Cohort selection

The cohort for this analysis consisted of patients with ulcerative colitis who underwent elective total proctocolectomy or completion proctectomy with IPAA in the ACS-NSQIP Participant Use File 2005–2012. We identified ulcerative colitis patients using International Classification of Diseases, Ninth Revision diagnosis codes 556.x. The cohort was limited to those undergoing total proctocolectomy with IPAA or completion proctectomy with IPAA (current procedural terminology codes 44211, 44158, 44153, 44157, and 45113). Patients were excluded if they underwent an emergency procedure ($n = 25$), were admitted from an acute care facility or emergency department ($n = 40$), or were admitted >1 d before the operation ($n = 59$).

2.3. Outcome variables

There were two primary outcome variables for this analysis as follows: (1) number of major 30-d complications and (2) length of hospital stay. We analyzed the incidence of major (as opposed to minor) 30-d complications because we wished to make conclusions about the impact of age and frailty on complications that have a substantial impact on patients and the health care system, as has been done in other studies examining the impact of frailty on postoperative outcomes in colorectal surgery [20–22]. We considered adding models to evaluate readmission and 30-d mortality, but this was not feasible because readmission information was missing in 84% (2094 of 2493) of the observations and only six patients died.

Major complications were defined as follows: myocardial infarction, cardiac arrest, pneumonia, respiratory failure requiring intubation, need for ventilator support >48 h, coma, stroke, organ space surgical site infection, wound dehiscence, renal insufficiency, dialysis, deep venous thrombosis, pulmonary embolism, sepsis, or septic shock. The outcome variable was determined by counting the number of major complications that each patient experienced.

Length of hospital stay was defined as the number of days from the IPAA procedure to hospital discharge. Observations with length of stay <3 d were felt to be in error and were therefore excluded ($n = 26$).

2.4. Covariates

Age was categorized into clinically meaningful groups including a reference group of patients ≤50 y against which patients aged 51–60 and >60 y were compared. Frailty was analyzed as a "frailty trait count" consisting of six variables commonly used in frailty indices and present in the NSQIP database: chronic obstructive pulmonary disease (severe disease characterized by daily medication use, previous hospitalization, a forced expiratory volume in 1 s <75th percentile or functional impairment), diabetes (insulin dependent and non-insulin dependent), hypertension (requiring medication), congestive heart failure (either newly diagnosed or newly symptomatic within 30 d of surgery), dependent functional status (requiring at least some help in activities of daily living), and ≥10% weight loss in the 6 mo preceding surgery. We were unable to include other pulmonary, cardiac, neurologic, or vascular comorbidities used in a frailty index previously validated in the NSQIP database [23] because these variables were not available for 507 patients because of changes in data collection at institutions participating in procedure-specific

NSQIP programs in 2011 and 2012. The frailty trait count ranges from 0–6, with one point assigned for each variable present, and was dichotomized for use in the multivariate model into 0 and ≥1 because there were few subjects with two or more frailty traits ($n = 80$). Other covariates were predetermined by our clinical experience and included sex, smoking, body mass index, American Society of Anesthesiologists (ASA) class, wound class (clean, clean-contaminated, contaminated, and infected), perioperative blood transfusion (within 72 h of surgery), preoperative steroid use (use of corticosteroids >10 d in the month before surgery), and long operative time (≥75th percentile).

2.5. Statistical analysis

Analysis of baseline characteristics by age group for the cohort was performed using chi-squared testing for categorical variables and linear regression for continuous variables. Analyses were performed using only patients with non-missing data of interest. Our ability to analyze race and ethnicity in this cohort was limited by a significant amount of missing data ($n = 1929$ and 537, respectively). In addition, some observations were excluded from analysis because of missing data, including body mass index ($n = 10$), sex ($n = 1$), and ASA class ($n = 2$). Analyses were performed using Stata 13 (StataCorp, College Station, TX). The threshold for statistical significance was set *a priori* at $P < 0.05$.

Multivariate analysis consisted of two separate models to investigate predictors of surgical complications and length of hospital stay. The primary goal was to investigate the contributions of age and frailty after adjusting for clinically important covariates. A multivariate negative binomial regression model was used to investigate the association between age and frailty with number of major 30-d complications. The negative binomial regression model provides the multiplicative effect on the mean number of complications compared with the reference group. We used this output to calculate the number of mean complications experienced by each patient in a given risk group as well as the percentage increase in complications relative to the reference group. A separate multivariate linear regression model was designed to investigate the association between age and frailty with length of hospital stay. Length of stay data were right-skewed, which was accounted for using robust standard errors (vce [robust] option in Stata).

3. Results

Between 2005 and 2012, IPAA was performed in 2493 patients with ulcerative colitis. Seventy-three percent of patients underwent total proctocolectomy with IPAA ($n = 1818$); the remaining patients underwent completion proctectomy with IPAA. The age distribution (Figure) was as follows: 1831 patients (73.4%) ≤50 y, 408 (16.4%) aged 51–60 y, and 254 (10.2%) who were >60 y. The group ≤50 y had a median age of 34 (range 18–50). The group >60 y had a median age of 64.5 (range 61–90). There were three patients ≥80 y and 25 patients ≥70 y. Table 1 shows the distribution of preoperative and intraoperative characteristics for the cohort by age group. Patients experienced a maximum of three frailty traits (out of six possible frailty traits). There was statistically significant variation in the frailty trait count in patients by age group.

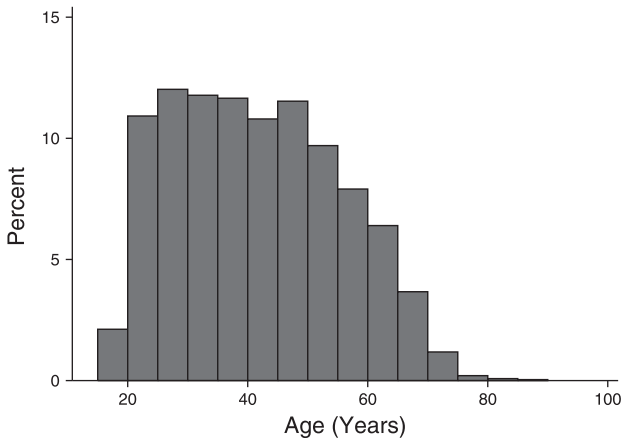

Figure – Age distribution of ulcerative colitis patients undergoing IPAA in the NSQIP database, years 2005–2012. Age range 18–90 y, median 40 years.

The 30-d mortality was 0.2% ($n = 6$), and 509 patients (20.4%) experienced at least one major complication. Table 2 shows major postoperative complications by age group. An unadjusted analysis revealed that most complications occurred at similar rates in the different age groups; statistically significant exceptions were myocardial infarction, respiratory failure requiring intubation, stroke, and wound dehiscence. The maximum number of complications was six in patients aged ≤50 y, five in patients 51–60 y, and a single patient >60 y experienced nine major complications.

The adjusted association of age with length of hospital stay and with major surgical complications is shown in Table 3. The average length of stay was 7.4 d in patients aged ≤50 y, 7.7 d in patients aged 51–60 y, and 8.2 d in patients aged >60 y. Age >60 y was associated with a 0.8-d longer mean length of stay compared with age ≤50 y ($P = 0.036$). The mean number of major complications in each age group was 0.3. The differences in mean number of complications in older groups compared with the group ≤50 y were not statistically significant (both $P > 0.47$).

The adjusted associations of frailty with hospital length of stay and with surgical complications are shown in Table 4. Patients with one or more frailty traits had a similar mean number of complications (0.31 *versus* 0.34, $P = 0.36$) and a similar mean length of stay (7.4 *versus* 7.7 d, $P = 0.25$) compared with patients with zero frailty traits.

When the same multivariate models mentioned previously were used, hospital length of stay was statistically significantly associated with male sex (0.6 -d longer, $P = 0.001$), long operative time (0.7-d longer, $P = 0.004$), and perioperative blood transfusion (1.1-d longer, $P = 0.022$). Number of major complications was statistically significantly associated with male sex (0.28 *versus* 0.34 mean complications, $P = 0.049$), steroid use (0.26 *versus* 0.40 mean complications, $P < 0.001$), and perioperative blood transfusions (0.31 *versus* 0.49 mean complications, $P = 0.021$).

Table 1 – Preoperative and intraoperative characteristics of ulcerative colitis patients undergoing IPAA, by age group.

Characteristics	Age ≤50 y ($n = 1831$)	Age 51–60 y ($n = 408$)	Age >60 y ($n = 254$)	P value*
Male sex	1021 (55.8)	268 (65.7)	160 (63.0)	<0.001
Procedure type				0.036
Total proctocolectomy with IPAA	1310 (71.6)	312 (76.5)	196 (77.2)	
Completion proctectomy with IPAA	521 (28.5)	96 (23.5)	58 (22.8)	
Wound class				0.37
2: Clean/contaminated	1555 (84.9)	364 (89.2)	217 (85.4)	
3: Contaminated	253 (13.8)	40 (9.8)	35 (13.8)	
4: Dirty/infected	21 (1.2)	3 (0.74)	2 (0.79)	
Mean body mass index (SD)	25.9 (5.4)	27.8 (5.0)	27.6 (5.4)	<0.001
Smoker	144 (7.9)	27 (6.6)	9 (3.5)	0.039
ASA class				<0.001
1: No disturbance	78 (4.3)	7 (1.7)	2 (0.79)	
2: Mild disturbance	1430 (78.2)	279 (68.4)	140 (55.1)	
3: Severe disturbance	320 (17.5)	121 (30.0)	111 (43.7)	
4: Life threatening	1 (0.05)	1 (0.25)	1 (0.39)	
Preoperative weight loss	77 (4.2)	15 (3.7)	13 (5.1)	0.67
Chronic obstructive pulmonary disease	5 (0.3)	5 (1.2)	6 (2.4)	<0.001
Diabetes	47 (2.6)	35 (8.6)	34 (13.4)	<0.001
Hypertension	147 (8.0)	100 (24.5)	118 (46.5)	<0.001
Congestive heart failure	0 (0.0)	0 (0.0)	0 (0.0)	—
Functional dependence	10 (0.6)	2 (0.5)	2 (0.8)	0.87
Frailty trait count†				<0.001
1	240 (13.1)	107 (26.2)	104 (40.9)	
2	20 (1.1)	25 (6.1)	30 (11.8)	
3	2 (0.1)	0 (0.0)	3 (1.2)	
Albumin <3 g/dL	77 (7.6)	19 (8.4)	12 (8.2)	0.90
Preoperative steroid use	756 (41.3)	150 (36.8)	81 (31.9)	0.007
Operative time >75th percentile	445 (24.3)	118 (28.9)	61 (24.0)	0.14
Perioperative blood transfusion	66 (3.6)	17 (4.2)	28 (11.0)	<0.001

SD = standard deviation.
*P value for chi-squared test.
†The maximum number of frailty traits seen in any patient was three (out of six possible). Frailty traits include chronic obstructive pulmonary disease, diabetes, hypertension, congestive heart failure, dependent functional status, and weight loss.

To address potential concerns with our covariates, we performed two sensitivity analyses. We repeated both multivariate models after (1) removing hypertension from the frailty trait count (out of concern for the large number of people who had hypertension as their sole frailty trait), and (2) removing ASA class (to ensure that the inclusion of ASA class had not masked the effect of frailty due to collinearity). In both of these analyses, the association of frailty trait count with hospital length of stay and major complications was similar (all $P > 0.10$).

4. Discussion

This study examined the associations of age and frailty with surgical complications and hospital length of stay among patients with ulcerative colitis undergoing IPAA in the NSQIP database. Our analysis produced two main findings as follows: (1) older age was associated with a small increase (0.8 d) in hospital length of stay but no substantial increase in major complications and (2) frailty trait count was not associated with a meaningful increase in hospital length of stay or major complications. These findings are in agreement with recent single-institution studies that suggest IPAA can be safely performed in selected older patients [9–16]. Before our study, however, it was not clear if this concept was generalizable in a multicenter database such as NSQIP.

Our results indicated that patients >60 y had an average hospital length of stay <1 d longer than patients ≤50 y. Although the difference was statistically significant, we believe that this small increase in hospital length of stay should not lead to the conclusion that IPAA is inappropriate in patients >60 y. From an economic perspective, the addition of a single day to hospital length of stay adds very little to the overall cost of caring for the patient. One study of surgical patients with hospital length of stay of 7–8 d showed that the final day of the hospitalization accounted for 1.8%–2.5% of the total cost of the hospitalization [24]. In addition, a meta-analysis found that the median hospital length of stay after IPAA is 10–11 d [25]. The average hospital stay in this analysis, even in the oldest group of patients, was short in comparison. Although we could not determine the reason for the small increase in hospital length of stay in older patients, it is reassuring that our findings indicated this was not due to an increase in surgical complications. We therefore believe that these results confirm the safety of this procedure in patients >60 y.

In this study, we defined the oldest age group as those aged >60 y—an age category that may seem young compared with studies evaluating the impact of age on patients undergoing

Table 2 – Postoperative complications in patients with ulcerative colitis undergoing IPAA, by age group.

Complications	Age ≤50 y ($n = 1831$)	Age 51–60 y ($n = 408$)	Age >60 y ($n = 254$)	P value*
Myocardial infarction	0 (0.0)	0 (0.0)	1 (0.4)	0.012
Cardiac arrest	1 (0.1)	1 (0.3)	0 (0.0)	0.42
Pneumonia	17 (0.9)	3 (0.7)	5 (2.0)	0.25
Respiratory failure requiring intubation	6 (0.3)	3 (0.7)	4 (1.6)	0.028
Ventilatory support >48 h	7 (0.4)	3 (0.7)	2 (0.8)	0.49
Coma	0 (0.0)	0 (0.0)	0 (0.0)	—
Stroke	0 (0.0)	0 (0.0)	1 (0.4)	0.012
Deep space surgical site infection	151 (8.3)	32 (7.8)	20 (7.9)	0.95
Wound dehiscence	13 (0.7)	7 (1.7)	6 (2.4)	0.018
Reoperation	125 (6.8)	21 (5.1)	17 (6.7)	0.46
Sepsis	130 (7.1)	34 (8.3)	13 (5.1)	0.29
Septic shock	14 (0.8)	1 (0.3)	5 (2.0)	0.51
Dialysis	5 (0.3)	0 (0.0)	2 (0.8)	0.18
Pulmonary embolism	16 (0.9)	5 (1.2)	5 (2.0)	0.25
Renal insufficiency	10 (0.6)	5 (1.2)	5 (2.0)	0.34
Deep venousthrombosis	68 (3.7)	12 (2.9)	4 (1.6)	0.18
Death	4 (0.2)	1 (0.3)	1 (0.4)	0.87
Complication count†				0.18
0	1455 (79.5)	328 (80.4)	201 (79.1)	
1	244 (13.3)	45 (11.0)	33 (13.0)	
2	92 (5.0)	25 (6.1)	10 (3.9)	
≥3	40 (2.2)	10 (2.5)	10 (3.9)	

*P value for chi-squared test.
†Major complications, including myocardial infarction, cardiac arrest, pneumonia, respiratory failure requiring intubation, need for ventilator support >48 h, coma, stroke, organ space surgical site infection, wound dehiscence, renal insufficiency, dialysis, deep venous thrombosis, pulmonary embolism, sepsis, or septic shock.

other surgical procedures. IPAA, however, is unique in that there is an alternative surgical treatment (end ileostomy) for patients considered "unfit" and IPAA is only recently being offered to older patients. In this context, defining older patients as those >60 y is appropriate for this procedure and has been done in other studies [14,15,26]. Furthermore, the ability to analyze outcomes among the oldest patients is limited by the very small numbers of patients >70 y undergoing IPAA. Previous studies that analyzed patients aged >70 [13,27] or 80 y [28] had very small sample sizes ($n = 17$, $n = 27$, and $n = 10$, respectively). Similarly, small numbers are observed in the NSQIP data set for the years 2005–2012. It must also be kept in mind that these "elderly" patients represent a highly selected population in terms of health and motivation, which likely contributed to our findings of only a small increase in hospital length of stay and essentially no increase in complication rate among the oldest patients undergoing IPAA.

Prior studies of frailty in patients undergoing colorectal operations have shown mixed results. Several indicated that frailty is associated with increased morbidity and mortality in patients undergoing colorectal surgical procedures [20,21,29–31], but one study of colon cancer patients [22] found little association. The impact of frailty on outcomes in patients undergoing IPAA has, to our knowledge, not previously been reported. The frailty trait count used in this study included six markers of functional status, nutritional status, and comorbidities, which are common components of frailty assessments. Indeed, the definition of frailty (reduced

Table 3 – Adjusted association of age with major postoperative complications and length of hospital stay.

Patient age (y)	Mean number of complications* (95% CI)	Percent difference† (95% CI)	P value	Mean length of stay (d, 95% CI)	Difference (d, 95% CI)	P value
≤50	0.31 (0.28–0.34)	Reference	Reference	7.4 (7.2–7.6)	Reference	Reference
51–60	0.31 (0.24–0.38)	0.3% (−23.0 to 30.4)	0.96	7.7 (7.2–8.1)	0.31 (−0.18 to 0.80)	0.22
>60	0.35 (0.25–0.46)	14.5% (−16.8 to 57.6)	0.47	8.2 (7.5–8.9)	0.81 (0.05–1.6)	0.035

CI = confidence interval.
Adjusted for frailty trait count, sex, smoking, body mass index, ASA class, steroid use, wound class, perioperative blood transfusion, and long-operative time.
*Major complications, including myocardial infarction, cardiac arrest, pneumonia, respiratory failure requiring intubation, need for ventilator support >48 h, coma, stroke, organ space surgical site infection, wound dehiscence, renal insufficiency, dialysis, deep venous thrombosis, pulmonary embolism, sepsis, or septic shock.
†Percent difference in mean number of complications per patient compared to the reference group.

Table 4 – Adjusted association of frailty with number of major complications and hospital length of stay.

Frailty traits	Mean number of complications* (95% CI)	Percent difference† (95% CI)	P value	Mean length of stay (d, 95% CI)	Difference (d, 95% CI)	P value
0 traits	0.31 (0.28–0.34)	Reference	Reference	7.4 (7.2–7.6)	Reference	Reference
≥1 traits	0.34 (0.27–0.41)	11.7% (−12.0 to 41.8)	0.36	7.7 (7.3–8.2)	0.30 (−0.21 to 0.82)	0.25

CI = confidence interval.
Adjusted for age category, sex, smoking, body mass index, ASA class, steroid use, wound class, perioperative blood transfusion, and long-operative time.
* Major complications, including myocardial infarction, cardiac arrest, pneumonia, respiratory failure requiring intubation, need for ventilator support >48 h, coma, stroke, organ space surgical site infection, wound dehiscence, renal insufficiency, dialysis, deep venous thrombosis, pulmonary embolism, sepsis, or septic shock.
† Percent difference in mean number of complications per patient compared to the reference group.

physiologic reserve to withstand external stressors) would indicate that frail patients should do poorly after surgery [17]. However, comparing our work with other studies is difficult owing to the lack of a universal standardized measurement for frailty. Published frailty measures used in research include as few as 5 [32] to as many as 92 items [33]. Scores can be analyzed on a continuous scale or used to categorize patients into groups. The differences in results between studies may in part relate to the disparate measures used to measure frailty.

4.1. *Limitations*

The NSQIP database includes a subset of voluntarily participating hospitals in the United States that are not necessarily representative of all hospitals in the country or abroad. For this reason, our findings may only be generalized to those institutions that participate in NSQIP or have characteristics similar to participating institutions. Despite this limitation, our analysis is likely more generalizable to older adults undergoing IPAA than studies from multiple single-center studies.

Another limitation of our study was the use of a novel frailty trait count. However, we developed what we believe to be a comprehensive definition of frailty (including domains of functional status, comorbidities, and preoperative weight loss), given the limitations of the NSQIP database and lack of a universal standard definition of frailty in the literature.

5. Conclusions

This work shows that among patients undergoing IPAA in NSQIP hospitals, neither older age nor frailty traits provided a useful prediction of surgical risk. These findings offer additional evidence that IPAA may be safely performed in selected older patients.

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Disclosure

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REFERENCES

[1] Ross H, Steele SR, Varma M, et al. Practice parameters for the surgical treatment of ulcerative colitis. Dis Colon Rectum 2014;57:5.
[2] Hulten L. Proctocolectomy and ileostomy to pouch surgery for ulcerative colitis. World J Surg 1998;22:335.
[3] Parray FQ, Wani ML, Malik AA, et al. Ulcerative colitis: a challenge to surgeons. Int J Prev Med 2012;3:749.
[4] Gainsbury ML, Chu DI, Howard LA, et al. Preoperative infliximab is not associated with an increased risk of short-term postoperative complications after restorative proctocolectomy and ileal pouch-anal anastomosis. J Gastrointest Surg 2011;15:397.
[5] Camilleri-Brennan J, Munro A, Steele RJ. Does an ileoanal pouch offer a better quality of life than a permanent ileostomy for patients with ulcerative colitis? J Gastrointest Surg 2003;7:814.
[6] Hahnloser D, Pemberton JH, Wolff BG, Larson DR, Crownhart BS, Dozois RR. Results at up to 20 years after ileal pouch-anal anastomosis for chronic ulcerative colitis. Br J Surg 2007;94:333.
[7] de Zeeuw S, Ahmed Ali U, Donders RA, Hueting WE, Keus F, van Laarhoven CJ. Update of complications and functional outcome of the ileo-pouch anal anastomosis: overview of evidence and meta-analysis of 96 observational studies. Int J Colorectal Dis 2012;27:843.
[8] Gisbert JP, Chaparro M. Systematic review with meta-analysis: inflammatory bowel disease in the elderly. Aliment Pharmacol Ther 2014;39:459.

[9] Bauer JJ, Gorfine SR, Gelernt IM, Harris MT, Kreel I. Restorative proctocolectomy in patients older than fifty years. Dis Colon Rectum 1997;40:562.
[10] Chapman JR, Larson DW, Wolff BG, et al. Ileal pouch-anal anastomosis: does age at the time of surgery affect outcome? Arch Surg 2005;140:534.
[11] Delaney CP, Fazio VW, Remzi FH, et al. Prospective, age-related analysis of surgical results, functional outcome, and quality of life after ileal pouch-anal anastomosis. Ann Surg 2003;238:221.
[12] Kiran RP, El-Gazzaz G, Remzi FH, et al. Influence of age at ileoanal pouch creation on long-term changes in functional outcomes. Colorectal Dis 2011;13:184.
[13] Pellino G, Sciaudone G, Candilio G, et al. Complications and functional outcomes of restorative proctocolectomy for ulcerative colitis in the elderly. BMC Surg 2013;13(Suppl 2):S9.
[14] Takao Y, Gilliland R, Nogueras JJ, Weiss EG, Wexner SD. Is age relevant to functional outcome after restorative proctocolectomy for ulcerative colitis?: prospective assessment of 122 cases. Ann Surg 1998;227:187.
[15] Reissman P, Teoh TA, Weiss EG, Nogueras JJ, Wexner SD. Functional outcome of the double stapled ileoanal reservoir in patients more than 60 years of age. Am Surg 1996;62:178.
[16] Tan HT, Connolly AB, Morton D, Keighley MR. Results of restorative proctocolectomy in the elderly. Int J Colorectal Dis 1997;12:319.
[17] Hubbard RE, Story DA. Patient frailty: the elephant in the operating room. Anaesthesia 2014;69(Suppl 1):26.
[18] Oresanya LB, Lyons WL, Finlayson E. Preoperative assessment of the older patient: a narrative review. JAMA 2014;311:2110.
[19] American College of Surgeons National Surgical Quality Improvement Program Participant Use Data File 2012. Am Coll Surgeons. http://site.acsnsqip.org/wp-content/uploads/2013/10/ACSNSQIP.PUF_.UserGuide.2012.pdf. Accessed November 3, 2014.
[20] Robinson TN, Wu DS, Pointer L, Dunn CL, Cleveland JC Jr, Moss M. Simple frailty score predicts postoperative complications across surgical specialties. Am J Surg 2013;206:544.
[21] Obeid NM, Azuh O, Reddy S, et al. Predictors of critical care-related complications in colectomy patients using the National Surgical Quality Improvement Program: exploring frailty and aggressive laparoscopic approaches. J Trauma Acute Care Surg 2012;72:878.
[22] Reisinger KW, van Vugt JL, Tegels JJ, et al. Functional compromise reflected by sarcopenia, frailty, and nutritional depletion predicts adverse postoperative outcome after colorectal cancer surgery. Ann Surg 2015;261:345.
[23] Velanovich V, Antoine H, Swartz A, Peters D, Rubinfeld I. Accumulating deficits model of frailty and postoperative mortality and morbidity: its application to a national database. J Surg Res 2013;183:104.
[24] Taheri PA, Butz DA, Greenfield LJ. Length of stay has minimal impact on the cost of hospital admission. J Am Coll Surg 2000;191:123.
[25] Ahmed Ali U, Keus F, Heikens JT, et al. Open versus laparoscopic (assisted) ileo pouch anal anastomosis for ulcerative colitis and familial adenomatous polyposis. Cochrane Database Syst Rev; 2009:CD006267.
[26] Page MJ, Poritz LS, Kunselman SJ, Koltun WA. Factors affecting surgical risk in elderly patients with inflammatory bowel disease. J Gastrointest Surg 2002;6:606.
[27] Delaney CP, Dadvand B, Remzi FH, Church JM, Fazio VW. Functional outcome, quality of life, and complications after ileal pouch-anal anastomosis in selected septuagenarians. Dis Colon Rectum 2002;45:890.
[28] Pellino G, Sciaudone G, Candilio G, et al. Restorative proctocolectomy with ileal pouch-anal anastomosis is safe and effective in selected very elderly patients suffering from ulcerative colitis. Int J Surg 2014;12(Suppl 2):S56.
[29] Ommundsen N, Wyller TB, Nesbakken A, et al. Frailty is an independent predictor of survival in older patients with colorectal cancer. Oncologist 2014;19:1268.
[30] Neuman HB, O'Connor ES, Weiss J, et al. Surgical treatment of colon cancer in patients aged 80 years and older : analysis of 31,574 patients in the SEER-Medicare database. Cancer 2013;119:639.
[31] Kristjansson SR, Nesbakken A, Jordhoy MS, et al. Comprehensive geriatric assessment can predict complications in elderly patients after elective surgery for colorectal cancer: a prospective observational cohort study. Crit Rev Oncol Hematol 2010;76:208.
[32] Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001;56:M146.
[33] Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of deficits as a proxy measure of aging. ScientificWorldJournal 2001;1:323.