Impact of chronic steroid use on outcomes of colorectal surgery

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Abstract
BACKGROUND: Steroid use has been recognized as a factor which has various effects on multiple organs. We aim to investigate the association between chronic steroid use and postoperative complications after colorectal surgery.

METHODS: The National Surgical Quality Improvement Program database was used to examine the clinical data of patients undergoing colorectal resection during 2005 to 2013. Multivariate regression analysis was performed to investigate outcomes of patients with chronic steroid use.

RESULTS: We sampled a total of 147,121 patients who underwent colorectal resection. Of these, 11,195 (7.6%) had a history of chronic steroid use. Patients who had chronic steroid use had a higher risk of preoperative sepsis (adjusted odds ratio [AOR]: 1.41, $P < .01$), hypoalbuminemia (AOR: 1.49, $P < .01$), bleeding disorders (AOR: 1.54, $P < .01$), and diabetes (AOR: 1.11, $P = .01$). Chronic steroid use was associated with a significant increase in the mortality and morbidity of patients (AOR: 1.56 and 1.25, respectively, $P < .01$).

CONCLUSIONS: Patients with a chronic steroid use have a high risk of preoperative malnutrition, diabetes, bleeding disorders, and sepsis. A history of chronic steroid use was associated with a significant increase in the mortality and morbidity of patients.

Corticosteroids are used for the treatment of a wide variety of autoimmune and inflammatory diseases and are one of the most commonly prescribed classes of drugs in the United States.[1] However, their use is not without consequences. Chronic corticosteroid use is associated with an increased risk of cardiovascular diseases such as myocardial infarction and stroke and acute arterial thrombotic events.[2,3] Patients on corticosteroid therapy frequently need surgical treatment due to related or unrelated comorbid medical conditions. There is a general belief that patients receiving long-term corticosteroid therapy have higher postoperative complications, especially wound complications. [4–7] The effects of corticosteroids on surgical outcomes have long been a topic of interest among surgeons.

A number of previous studies have illustrated the risk of postoperative complications of surgical patients when they are on corticosteroid therapy. A higher risk of anastomosis leakage, wound infection, and intra-abdominal infection of patients with

chronic steroid use has been reported in the literature.[4–6] However, the solution to decrease mortality and morbidity of such patients is still unclear. Discontinuation of the corticosteroid drugs before an operation usually is not an option, and increasing the dosage before operation may be needed in some patients. This study aims to investigate the outcomes of colorectal surgery patients with chronic steroid use, and compare outcomes of such patients in emergent and/or urgent operations with elective operations, and evaluate if minimally invasive approaches and/or use of a stoma decrease postoperative complications.

Methods

This study was designed according to the National Surgical Quality Improvement Program (NSQIP) database of the American College of Surgeons during 2005 to 2013. The NSQIP of the American College of Surgeons is a nationwide outcomes-based database which provides preoperative to 30-day postoperative information of surgical patients based on clinical data in the United States.[8] We analyzed the available data on patients aged 18 years and older who underwent colorectal resection using the appropriate procedure codes as specified by the Current Procedural Terminology codes. Patients who underwent colorectal resection were defined based on the following Current Procedural Terminology codes: 44140–44160, 44204–44213, 45110, 45111, 45113, 45126, and 45395. We excluded patients who did not undergo colorectal resection and younger than 18 years. Patient diagnoses were defined based on the International Classification of Diseases, 9th Revision, Clinical Modifications codes of malignant neoplasm of colon and rectum (153.0–153.9, 154.0, 154.1, 230.3, and 230.4), benign neoplasm of colon and rectum (211.3, 211.4), diverticulosis (562.10 and 562.12), diverticulitis (562.11 and 562.13), Crohn disease (555.1, 555.2), and ulcerative colitis (556.0–556.9). Chronic steroid use was defined as the administration of oral or parenteral corticosteroid medications in the 30 days before surgery for a duration of more than 10 days.

Variables that were analyzed were provided by the NSQIP database and include patient demographics (age, sex, and race) and comorbid conditions including the following: history of ischemic heart disease (history of congestive heart failure, chest pain, cardiac surgery, percutaneous coronary intervention, and myocardial infarction), renal failure with need for dialysis, history of dyspnea within the 30 days before surgery, bleeding disorder, steroid use, disseminated cancer, diabetes mellitus, preoperative sepsis (systemic inflammatory response syndrome, sepsis, or septic shock within 48 hours before surgery), weight loss (more than 10% in the last 6 months), history of peripheral vascular disorders (rest pain, history of revascularization, or amputation of lower extremities), history of severe chronic obstructive pulmonary disease, current smoker within 1 year, hypertension requiring medication, American Society of Anesthesiologists (ASA) class, and history of central vascular disorders (central vascular accident and transient ischemic attack). Body mass index was calculated based on the available data points of weight and height, and hypoalbuminemia was calculated according to the most recent serum albumin level of patients before operation. Operative variables analyzed included surgical approach (open vs laparoscopic), operative time, type of the surgery (emergent and/or urgent vs elective), type of the procedure (primary

anastomosis vs creating a stoma), and wound classification (clean, clean and/or contaminated, contaminated, and dirty and/or infected). The primary end points investigated included mortality, overall morbidity, anastomosis leakage, postoperative superficial surgical site infection (SSI), organ space SSI, wound disruption, deep vein thrombosis (DVT), pneumonia, unplanned intubation, ventilator dependency more than 48 hours, pulmonary embolism, cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, progressive renal insufficiency, sepsis, septic shock, hemorrhagic complications, urinary tract infections, and prolonged hospitalization (longer than 30 days). Patients were identified for chronic steroid use, preoperative and operative factors, and postoperative complications. Risk-adjusted analysis was performed to compare the outcomes of patients with or without chronic steroid use in different operative conditions.

Statistical analysis

Statistical analysis was conducted using the SPSS software, version 22 (SPSS Inc., Chicago, IL). Multivariate statistical analyses using logistic regression were conducted to eliminate confounding variables and estimate the association between chronic steroid use and binary end points which include each postoperative complication. Also, logistic regression analysis was used to compare postoperative complications of patients with chronic steroid use in different surgical situations. Linear regression was used for the comparison of continuous end points (eg, length of stay) in patients with or without chronic steroid use. For each outcome, the adjusted odds ratio (AOR) with a 95% confidence interval (CI) was calculated, and P values less than .05 were considered statistically significant. Independent variables used for risk adjustment included hypertension, smoking, diabetes mellitus, chronic obstructive pulmonary disease , ischemic heart disease, central vascular disorders, peripheral vascular disorders, body mass index, disseminated cancer, weight loss, preoperative sepsis, dyspnea, renal failure need dialysis, steroid use, ASA score, bleeding disorders, type of the operation, creating a stoma, surgical approach (open vs laparoscopic), wound classification, age, sex, and race. Missing data were less than 2% for all variables of the study except for the serum albumin level variable which had 29% missing data.

Results

The study population consisted of 147,121 patients who underwent colorectal resection during 2005 to 2013. Of these, 11,195 patients (7.6%) had the comorbidity of chronic steroid use. The median age of patients was 63 years; most patients were Caucasian (86.2%) and female (50.4%). The summary of patient characteristics is shown in Table 1.

Patients with chronic steroid use had significantly higher need for emergent and/or urgent operations compared with patients who did not (13.1% vs 7.4%, AOR: 1.25, CI: 1.14 to 1.38, $P < .01$). Also, patients with chronic steroid use had higher rates of bleeding disorders (AOR: 1.54, CI: 1.38 to 1.72, $P < .01$), hypoalbuminemia (AOR: 1.49, CI: 1.41 to 1.58, $P < .01$), preoperative sepsis (AOR: 1.41, CI: 1.30 to 1.53, $P < .01$), and diabetes (AOR: 1.11, CI: 1.02 to 1.21, $P = .01$).

The median lengths of hospitalization for patients with and without chronic steroid use were 7 and 6 days, respectively. Patients with chronic steroid use had significant longer hospitalization (AOR: 1.002, P = .04).

Risk-adjusted analysis of outcomes of patients with chronic steroid use is reported in Table 2. Chronic steroid use had significant associations with mortality (AOR: 1.56, P < .01) and morbidity (AOR: 1.25, P < .01).

Mortality and morbidity predictors of patients on chronic steroids who underwent colorectal resection are reported in Table 3. Factors such as emergent/urgent admission and open surgery increased mortality and morbidity of patients. Creating a stoma did not decrease mortality (AOR: .99, P =.98) or morbidity (AOR: .90, P =.17) of patients significantly.

In a subset analysis of data for emergently admitted patients, those with chronic steroid use had modestly higher mortality (AOR: 1.04, CI: 1.03 to 1.04, P < .01) and significantly higher morbidity risks (AOR: 1.49, CI: 1.37 to 1.62, P < .01). Surprisingly, among patients who were admitted electively, those with chronic steroid use had markedly higher mortality (AOR: 1.82, CI: 1.56 to 2.12, P < .01) and significantly higher morbidity risk (AOR: 1.36, CI: 1.28 to 1.44, P < .01). When evaluating outcomes of chronic steroid use in a subset analysis of open and laparoscopic colectomies, chronic steroid use increases mortality of patients in both laparoscopic (AOR: 1.66, CI: 1.20 to2.29, P < .01) and open colectomy (AOR: 1.88, CI: 1.72 to 2.06, P < .01). Also, morbidity of patients increases in the presence of chronic steroid use in both open (AOR: 1.35, CI: 1.28 to 1.43, P < .01) and laparoscopic approaches (AOR: 1.48, CI: 1.38 to 1.63, P < .01) to colectomy. Patients who had chronic steroid use due to inflammatory bowel disease had lower mortality (AOR: .38, P < .01) and morbidity (AOR: .87, P = .02) compared with patients who had chronic steroid use for other reasons.

Comments

Chronic steroid use has significant effects on colorectal surgery outcomes. Chronic steroid use is associated with a worse prognosis, increased rates of mortality and morbidity, as well as an observed increase in hospitalization length of stay after colorectal operations. Our study results show in all subgroups of patients including emergent admission, elective admission, open surgery, and laparoscopic surgery, patients with chronic steroid use had significantly higher mortality and morbidity. In addition, we found that patients who had chronic steroid use due to inflammatory bowel disease had better outcomes compared with patients who had steroid use for other reasons.

Our study results highlight the impact of chronic steroid use on 11 postoperative complications. We confirm the previous report of increased risks of organ infection, dehiscence, reintubation, prolonged intubation, and pulmonary embolism in patients with chronic steroid use by Ismael et al.[6] Among surgical complications, wound disruption has the strongest association with chronic steroid use in our study. Adverse effects of steroid use on wound healing and a significant increase in the rate of wound disruption in association with chronic steroid use have been cited multiple times.[5,6,9,10] The decrease in collagen synthesis and activation of inflammatory cells are 2 important effects of glucocorticoid drugs on wound healing that impair the process of healing.[4,11] Discontinuation of the corticosteroid drugs before operation usually is not an option.

However, recently introduced selective glucocorticoid receptor modulators may have less adverse effects on wound healing compared to nonselective glucocorticoid drugs.[10,12,13] The data to support this practice are still sparse to truly affect the clinical practice.

This study found higher rates of preoperative coagulation disorders and postoperative hemorrhagic complications and thrombotic events (DVT) in patients with chronic steroid use. Similar results were reported previously.[2,11,14–17] The effect of glucocorticoids agents on changes of procoagulant, anticoagulant, and fibrinolytic factors have been noted.[2] These findings suggest that more aggressive DVT prophylaxis and/or more active surveillance of the efficacy of DVT prophylaxis and anticoagulation treatment might be necessary in patients on chronic steroids. Also, we found a significant number of patients with steroid use have malnutrition. However, hypoalbuminemia and malnutrition in patients with steroid use are often due to their primary disease rather than just chronic steroid use. Further studies should evaluate and look for ways to optimize nutritional status in patients with chronic steroid use.

Table 1 Demographics of patients who have undergone colon and rectal surgery, NSQIP 2005–2013

Variables	Patients with chronic steroid use (n = 11,195)	Patients without chronic steroid use (n = 135,926)	*P* value
Age, y			
Mean ± SD	52 ± 19	63 ± 15	<.01
Median	53	63	—
Sex, n (%)			
Male	5,398 (48.3)	67,411 (49.7)	<.01
Body mass index			
Mean ± SD	26.6 ± 6.7	28.4 ± 6.6	<.01
Median	25.6	27.4	—
Race, n (%)			
White	9,333 (90.2)	106,491 (85.9)	<.01
Black or African American	807 (7.8)	12,346 (10)	<.01
Asian	150 (1.4)	3,853 (3.1)	<.01
Other	65 (.6)	1,341 (1.1)	<.01
Comorbidity, n (%)			
Hypertension	4,154 (37.1)	69,338 (51)	<.01
Diabetes mellitus	1,328 (11.9)	20,506 (15.1)	<.01
Dyspnea	1,235 (11)	12,446 (9.2)	<.01
Weight loss	1,180 (10.5)	6,306 (4.6)	<.01
Chronic obstructive pulmonary disease	986 (8.8)	6,670 (4.9)	<.01
Bleeding disorders	765 (6.8)	5,136 (3.8)	<.01
Ischemic heart disease	635 (5.7)	9,142 (6.7)	<.01
Disseminated cancer	376 (3.4)	6,457 (4.8)	<.01
Central vascular disease	290 (2.6)	4,913 (3.6)	<.01
Peripheral vascular disease	76 (.7)	1,010 (.7)	.44
Dialysis	120 (1.1)	789 (.6)	<.01
Surgical approach, n (%)			
Laparoscopic	4,768 (42.6)	63,482 (46.7)	<.01
Open	6,427 (57.4)	72,444 (53.3)	<.01
Type of operation, n (%)			
Elective	9,730 (86.9)	125,831 (92.6)	<.01
Urgent/emergent	1,465 (13.1)	10,095 (7.4)	<.01
Procedure, n (%)			
Creating a stoma	4,539 (40.5)	24,681 (18.2)	<.01
Partial colectomy	6,279 (56.1)	89,844 (66.1)	<.01
Total colectomy	2,836 (25.3)	5,022 (3.7)	<.01
Anterior resection	1,025 (9.2)	33,737 (24.8)	<.01
Proctectomy	821 (7.3)	2,362 (1.7)	<.01
Abdominoperineal resection	225 (2)	4,670 (3.4)	<.01
Pelvic exenteration	9 (.1)	291 (.2)	<.01
Pathology, n (%)			
Crohn	3,550 (31.7)	4,532 (3.3)	<.01
Ulcerative colitis	3,124 (27.9)	3,193 (2.3)	<.01
Diverticulitis of colon	1,842 (16.5)	34,092 (25.1)	<.01
Colon cancer	1,508 (13.5)	51,266 (37.7)	<.01
Rectal cancer	468 (4.2)	20,616 (15.2)	<.01
Benign colorectal tumor	471 (4.2)	18,075 (13.1)	<.01
Diverticulosis of colon	232 (2.1)	4,152 (3.1)	<.01
Other factors, n (%)			
ASA score >2	6,235 (55.7)	66,306 (48.8)	<.01
Hypoalbuminemia*	4,142 (47.9)	24,106 (26.1)	<.01
Smoking	1,775 (15.9)	23,971 (17.6)	<.01
Preoperative sepsis†	1,638 (14.7)	8,787 (6.5)	<.01

ASA = American Society of Anesthesiologists; NSQIP = National Surgical Quality Improvement Program; SD = standard deviation.

*Serum albumin level lower than 3.5 g/dL.

†Preoperative sepsis, septic shock, and systemic inflammatory response syndrome.

Table 2 Risk-adjusted analysis of outcomes associated with chronic steroid use in colon and rectal surgery patients

Complications	Patients with chronic steroid use (n = 11,195) n (%)	Patients without chronic steroid use (n = 135,926) n (%)	Adjusted odds ratio	95% confidence interval	*P* value
Mortality	392 (3.5)	2,436 (1.8)	1.56	1.35–1.81	<.01
Overall morbidity	4,042 (36.1)	33,983 (25)	1.25	1.18–1.33	<.01
Hemorrhagic complications	1,211 (10.8)	9,088 (6.7)	1.20	1.10–1.31	<.01
Superficial SSI	893 (8)	9,921 (7.3)	1.02	.93–1.13	.57
Sepsis	861 (7.7)	5,216 (3.8)	1.40	1.27–1.56	<.01
Organ space SSI	809 (7.2)	5,147 (3.8)	1.25	1.12–1.39	<.01
Hospitalization >30 d	480 (4.3)	2,393 (1.8)	1.37	1.20–1.57	<.01
Urinary tract infection	453 (4)	4,074 (3)	1.22	1.07–1.40	<.01
Ventilator dependency	436 (3.9)	3,019 (2.2)	1.03	.90–1.18	.66
Pneumonia	423 (3.8)	3,106 (2.3)	1.34	1.17–1.53	<.01
Septic shock	383 (3.4)	2,423 (1.8)	1.39	1.21–1.61	<.01
Deep vein thrombosis	339 (3)	1,685 (1.2)	1.63	1.38–1.91	<.01
Unplanned intubation	350 (3.1)	2,624 (1.9)	1.34	1.16–1.55	<.01
Wound disruption	294 (2.6)	1,776 (1.3)	1.82	1.54–2.15	<.01
Deep incisional SSI	220 (2)	1,883 (1.4)	1.10	.91–1.33	.29
Pulmonary embolism	125 (1.1)	921 (.7)	1.38	1.07–1.76	.01
Acute renal failure	96 (.9)	794 (.6)	1.19	.91–1.55	.19
Progressive renal insufficiency	92 (.8)	1,020 (.8)	.99	.76–1.29	.97
Cardiac arrest	77 (.7)	671 (.5)	1.25	.93–1.67	.13
Myocardial infarction	60 (.5)	791 (.6)	1.01	.73–1.39	.93
Central vascular accident	26 (.2)	403 (.3)	.74	.45–1.21	.23

SSI = surgical site infection.

Our results show that a laparoscopic approach is associated with a decrease in mortality and morbidity. Lower rates of postoperative complications of laparoscopic colorectal surgery compared to open surgery have been reported previously.[16] However, the inherent selection bias of laparoscopic surgery compared to open surgery makes comparison difficult. Patients who undergo open surgery commonly are sicker and more complicated. Further clinical trials are needed to compare outcomes of patients with chronic steroid use in laparoscopic and open surgery in 2 homogeneous groups of patients.

This study found numerous mortality and morbidity predictors, and it is not surprising that emergent and/or urgent operations had a worse prognosis compared with elective operations. Also, major colorectal procedures such as pelvic exenteration significantly increase morbidity of patients. Greater adoption of minimally invasive approaches as well as controlling the identified reducible predictors such as preoperative sepsis, coagulation disorders, and hypoalbuminemia may improve outcomes in patients with chronic steroid use. Of course, these factors may be secondary to the disease process being treated. We found significantly higher rates of preoperative sepsis, septic shock, and systemic inflammatory response syndrome in patients with chronic steroid use. In addition, patients with chronic steroid use had a significantly higher rate of emergent and/or urgent operations compared to other colorectal patients. During the postoperative period, such patients had higher risk of sepsis, septic shock, pneumonia, urinary tract infection, and intra-abdominal infections. Impaired immune function may be responsible for the high rates of preoperative and postoperative infections in such patients. [11] More intensive perioperative care including more aggressive treatment of infections may be warranted and may improve outcomes of patients with chronic steroid use.

Our results show that creating a stoma does not decrease the mortality and morbidity risk of patients. It appears surgeons use a stoma for patients with chronic

steroid use more frequently, as 40.5% of patients with chronic steroid use who underwent colorectal resection had a stoma as part of the colorectal procedure, compared with 18.2% for patients without chronic steroid use (P < .01). A previous study on patients with chronic steroid use recommended construction of a diverting stoma or Hartmann procedure in such patients.[4] However, we did not find any significant decrease in mortality and morbidity of patients with chronic steroid use with creating a stoma. Because patients with and without stoma may have different disease stages in our study, further studies are indicated to investigate benefits of creating a stoma in patients with chronic steroid use in 2 homogeneous groups of patients.

Table 3 Risk-adjusted analysis of mortality and morbidity predictors of patients with chronic steroid use underwent colorectal resection

	Mortality		Morbidity	
Variables	AOR (95% CI)	*P* value	AOR (95% CI)	*P* value
Age	1.04 (1.03–1.06)	<.01	1.005 (1.002–1.009)	<.01
Sex				
Male	.97 (.75–1.26)	.83	1 (.91–1.10)	.89
Comorbidity				
Preoperative sepsis*	2.20 (1.61–3.02)	<.01	1.82 (1.57–2.11)	<.01
Dyspnea	1.79 (1.33–2.40)	<.01	1.22 (1.04–1.43)	.01
Dialysis	2.77 (1.52–5.05)	<.01	1.60 (1.02–2.52)	.03
Disseminated cancer	4.16 (2.90–5.99)	<.01	1.24 (.96–1.59)	.08
Diabetes mellitus	1.39 (1.02–1.88)	.03	1.14 (.98–1.32)	.07
Ischemic heart disease	1.59 (1.12–2.25)	<.01	1.14 (.92–1.41)	.21
Bleeding disorders	.96 (.69–1.35)	.84	1.72 (1.43–2.07)	<.01
Chronic obstructive pulmonary disease	1.31 (.96–1.79)	.08	1.05 (.87–1.26)	.57
Weight loss	1.19 (.79–1.80)	.38	1.12 (.96–1.30)	.13
Smoke	1.25 (.87–1.79)	.21	1.10 (.96–1.26)	.14
Central vascular disease	1.14 (.69–1.89)	.60	1.14 (.85–1.54)	.36
Hypertension	.78 (.58–1.05)	.11	1.06 (.94–1.20)	.30
Surgical approach				
Open	Reference	—	Reference	—
Laparoscopic	.67 (.44–.99)	.04	.76 (.67–.85)	<.01
Type of surgery				
Elective	Reference	—	Reference	—
Emergent/urgent	2.85 (2–4.06)	<.01	1.25 (1.05–1.49)	<.01
Type of operation				
Operation without a stoma	Reference	—	Reference	—
Creating a stoma	.99 (.66–1.48)	.98	.90 (.78–1.04)	.17
Procedure				
Partial colectomy	Reference	—	Reference	—
Total colectomy	078 (.41–1.48)	.45	1.51 (1.26–1.80)	<.01
Proctectomy	.62 (.24–1.59)	.32	1.41 (1.10–1.80)	<.01
Abdominoperineal resection	1.87 (.61–5.76)	.27	1.76 (1.18–2.61)	<.01
Anterior resection	.90 (.55–1.50)	.71	.97 (.80–1.18)	.80
Pelvic exenteration	.99 (.98–1)	.50	4.57 (1.01–25.32)	.04
Other factors				
ASA score >2	4.95 (2.37–10.32)	<.01	1.54 (1.37–1.72)	<.01
Hypoalbuminemia†	2.82 (2.01–3.96)	<.01	1.58 (1.42–1.75)	<.01
Body mass index	.98 (.96–1)	.10	1.01 (1.008–1.02)	<.01

AOR = adjusted odds ratio; ASA = American Society of Anesthesiologists; CI = confidence interval.
*Preoperative sepsis, septic shock, and systemic inflammatory response syndrome.
†Serum albumin level lower than 3.5 g/dL.

Study limitations

The main limitation is the retrospective nature of our study that makes firm conclusions difficult. Because this study is not a randomized study, it is subject to selection bias. Also, coding errors may exist because of the use of discharge data in the collection of

data.17 The wide variation in hospital setting, hospital quality, surgical strategy, and surgeons' expertise in a nationwide database can confound the study. Also, NSQIP does not collect any details regarding corticosteroid dosing regimens, duration of use, and indications for steroid use which may impact the risk of complications. Despite these limitations, this study provides a large sample size to report outcomes in patients with chronic steroid use in colorectal surgery and compare outcomes of such patients by surgical indications.

Conclusion

Patients with chronic steroid use have a worse outcome in colorectal surgery. Death and postoperative infections are higher in such patients. Wound disruption due to impaired wound healing has the strongest association with glucocorticoid use in colorectal surgery. Creating a stoma in such patients does not decrease the mortality and morbidity of patients. Malnutrition and coagulation disorders are significantly higher in such patients. More aggressive DVT prophylaxis and/or more active surveillance of the efficacy of DVT prophylaxis and anticoagulation treatment might be necessary in patients on chronic steroids.

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Discussion

Discussant

Dr. Gary Dunn (Oklahoma City, OK): Operating on a patient on chronic steroids is often like having to tee off from the rough without a tee. I do have a couple of questions.

First, isn't the use of chronic steroids in your study merely a marker for a group of sicker patients that we would expect to have higher morbidity rather than a direct steroid effect? The patients in the steroid group had a higher ASA class score overall. Although you would expect them to have an increased deep SSI infection rate, they did not. In short, how much of the morbidity can you blame on the steroid use?

Second, you comment that patients who had laparoscopic procedures fared better than those that had open procedures. Isn't it more likely that within the steroid group those that had laparoscopic procedures were the healthier patients in the group, whereas the more moribund had open interventions? Can we really say that laparoscopic surgery is protective, or is this just another reflection of a sick vs less sick group of patients?

Dr. John Potts, III (Chicago, IL): This information is obviously important when you're counseling a patient preoperatively about their risk of complications postoperatively, but my question to you is, has this study changed your practice or your group's practice in patients who are chronic steroid users?

Dr. Zhobin Moghadamyeghaneh: Discontinuing corticosteroid drugs before operation is not an option in most cases. We have a limited number of options in the prevention of complications. First of all, we need to evaluate the possibility of laparoscopic surgery in such patients. Also, patients with chronic steroid use have a significantly higher risk of

thromboembolic events. Such patients may benefit from longer prophylactic thromboembolic treatment even after discharge. Third, there are some recent published articles that have reported that vitamin A can decrease significantly postoperative wound complications of these patients, but it needs more investigation.

Also, we may ask patients with chronic steroid use to have limited activity after operation for a longer period of time, or we may leave the stitches in for a longer time after operation in such patients. Some high-risk patients may benefit from wearing garments or using retention sutures, or we might consider early elective treatment of patients with chronic steroid use.

Patients with chronic steroid use may benefit from early treatment of diverticulitis after their 1st episode of the disease, but these recommendations need more investigation.

Dr. Lillian Liao (San Antonio, TX): In your patient group selection, it seems like there's a significant number of patients with hypoalbuminemia. Have you considered doing subgroup analysis to separate out those patients with steroid use with and without hypoalbuminemia because a lot of the complications that are reported in this group seem like they are similar to steroid use?

Dr. Zhobin Moghadamyeghaneh: Actually, we adjusted our result with serum albumin level for all patients. Patients with chronic steroid use had significantly lower level of serum albumin. This may be related to a nutritional problem in these patients or extra risks of the surgery on the stage of the disease. We cannot state correcting the serum albumin level with albumin can decrease postoperative complications of such patients.

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