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Original Article

Predictive factors of acute kidney injury in patients undergoing rectal surgery

Sung Yoon Lim, Joon Yong Lee, Ji Hyun Yang, Young Joo Na, Myung-Gyu Kim, Sang-Kyung Jo, Won Yong Cho*

Division of Nephrology, Department of Internal Medicine, Korea University Medical College, Seoul, Korea

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Abstract

Background: Despite major advance in surgical techniques from open surgery to robot-assisted surgery, acute kidney injury (AKI) is still major postoperative complication in rectal surgery. The purpose of this study is to compare the incidence of postoperative AKI according to different surgical techniques and also the risk factors, outcomes of AKI in patients undergoing rectal cancer surgery.

Methods: A retrospective medical chart review was done in a total of 288 patients who received proctectomy because of rectal cancer from 2011 to 2013.

Results: The mean patient age was 62 ± 12 years, and male was 64.2%. Preoperative creatinine was 0.91 ± 0.18 mg/dL. Open surgery was performed in 9%, and laparoscopy assisted surgery or robot assisted surgery were performed in 54.8% or 36.1% of patients, respectively. AKI developed in 11 patients (3.82%), 2 (18%) of them received acute hemodialysis. Incidence of AKI was not different according to the surgical technique, however, the presence of diabetes, intraoperative shock, and postoperative ileus was associated with the development of AKI. In addition, AKI patients showed significantly longer hospital stay and higher mortality than non-AKI patients.

Conclusion: Our study demonstrated that despite advances in surgical techniques, incidence of postoperative AKI remains unchanged and also that postoperative AKI is associated with poor outcome. We also found that presence of diabetes, intraoperative shock and postoperative ileus are strongly associated with the development of AKI. More careful attention should be paid on high risk patients for the development of postoperative AKI regardless of surgical techniques.

Introduction

Acute kidney injury (AKI) is commonly seen in the postoperative period and is consistently associated with increased rates of mortality and morbidity [1,2]. Postoperative AKI frequently occurs after cardiac surgery (frequency, 48–94%) or liver transplantation (frequency, 25%), thus clinical characteristics, risk factors, or outcomes of AKI in these clinical situations have been extensively studied. However, only a few studies addressed AKI after colorectal surgery, which has different pathophysiology with cardiac surgeries or transplantation.

In regard to colorectal surgery, laparoscopic surgery is now considered as the approach of choice for the surgical treatment

* Corresponding author. Division of Nephrology, Department of Internal Medicine, Korea University Anam Hospital, 5ka, Anam-dong, Sungbuk-gu, Seoul, 136-705, Korea.
E-mail address: wonyong@korea.ac.kr (WY Cho).

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of colon and rectal diseases. In contrast, robotic-assisted laparoscopic surgery is gaining more acceptance recently and showed comparable short-term outcomes as compared with conventional laparoscopic surgery. Although the routine use of the robotic platform for colorectal surgery is not supported because of longer operative time and higher expenses than laparoscopic surgery, robotic surgery is the main indication in cases of rectal or pelvic surgeries.

To our knowledge, it is the first study that assessed the incidence of postoperative AKI in patients who underwent robotic assisted rectal surgery compared with conventional laparoscopic surgery. We compared the clinical characteristics between the AKI and the non AKI groups, and identified perioperative factors that predispose patients to AKI in this population as well as prognosis.

Methods

Ethics statement

The Institutional Review Board of Korea University Anam Hospital approved this study (ED10066-001).

Patients and study design

Patients aged 18 years or older who underwent elective rectal resection admitted to the division of the colo-rectal surgery of the Korea University Anam Hospital (Seoul, Korea) between July 2011 and January 2013 were included.

Exclusion criteria were baseline estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m^2, end stage renal disease on maintenance renal replacement therapy (RRT) or AKI developed in the week before surgery. Preoperative baseline serum creatinine (SCr) values were defined as the most recent SCr (mg/dL) measured within 30 days of the surgery.

The primary outcome was the development of postoperative AKI within 7 days after surgery, and postoperative AKI was diagnosed according to the Acute Kidney Injury Network criteria (i.e., $\geq$ 0.3 mg/dL or a $\geq$ 50% increase in the SCr level from the baseline value within 48 hours or a urine output < 0.5 mL/kg/h for $\geq$ 6 hours). The eGFR was calculated using the Modification of Diet in Renal Disease equation.

Patient electronic hospital database were reviewed to collect the following variables: patients' demographics (age and sex), preoperative patient characteristics (comorbidity, namely, diabetes mellitus, hypertension, CKD, heart failure and stage of malignancy; albumin, total cholesterol, and SCr), surgical procedure (open, laparoscopy, robotic), intraoperative patient characteristics (operation time, intraoperative shock, and bleeding), and postoperative data need for RRT, total hospital stay, and in-hospital mortality.

An ejection fraction of less than 50% in echocardiography was the criteria for diagnosing heart failure. Postoperative ileus was diagnosed if both passage of flatus or stool and tolerance of oral diet did not occur before day 4 combined with gaseous dilatation of intestine more than 3 cm in simple postoperative abdominal x-rays taken postoperatively [3]. The diagnosis of postoperative infection was made when fever higher than 38°C on more than one occasion and elevated serum C-reactive protein within one week were present.

Statistical analysis

SPSS software, version 19.0 (SPSS Inc., Chicago, IL, USA), was used for statistical analyses. Comparisons between the 2 groups were performed using the Student *t* test or the Mann–Whitney *U* test for numerical data and the chi-square test or Fisher exact test for categorical data.

To identify the risk factors for the development of AKI, we initially conducted univariate analysis, and variables that were statistically significant ($P < 0.05$) in the univariate analyses were then included in the multivariate analysis with forward conditional elimination of data. Data are presented as odds ratios (ORs) with 95% confidence intervals. A 2-tailed *P* value < 0.05 was considered significant.

Table 1. Preoperative characteristics, type of surgery, and intraoperative characteristics

Characteristics	All ($N = 288$)	Non-AKI ($N = 277$)	AKI ($N = 11$)	*P*
Age (y)	62 ± 12	62 ± 12	59 ± 17	0.535
Sex (male)	185 (64.2)	176 (63.5)	9 (81.8)	0.215
Baseline Cr (mg/dL)	0.9 ± 0.2	0.9 ± 0.2	1.0 ± 0.2	0.044
Hypertension	101 (35.1)	95 (34.3)	6 (54.5)	0.060
Diabetes mellitus	44 (15.3)	41 (14.9)	3 (27.3)	0.020
Heart failure (EF < 50%)	11 (3.8)	10 (3.6)	1 (9.1)	0.765
Albumin (g/dL)	4.0 ± 0.4	4.1 ± 0.4	3.9 ± 0.7	0.351
Total cholesterol (mg/dL)	172.3 ± 39.9	172.0 ± 40.0	181.5 ± 39.9	0.568
Operation time (min)	275 ± 99	274 ± 100	293 ± 59	0.132
Intraoperative bleeding (mL)	198 ± 318	193 ± 311	323 ± 471	0.179
Intraoperative shock	49 (17.0)	45 (16.2)	4 (36.4)	0.050
Laparoscopy-assisted surgery	156 (54.2)	150 (54.2)	6 (54.5)	0.979
Robot-assisted surgery	107 (37.2)	102 (36.8)	5 (45.5)	0.561
Concurrent CRTx	22 (7.3)	21 (7.7)	1 (6.3)	1.000
Preoperative CTx	2 (0.9)	2 (0.9)	0	1.000
Adjuvant CTx	110 (38.2)	108 (39.1)	2 (18.2)	0.244
Postoperative infection	13 (4.5)	10 (3.6)	3 (27.3)	0.010
Postoperative bowel ileus	75 (27.4)	67 (25.5)	8 (72.2)	0.002

Data are presented as *n* (%) or mean ± SD.
AKI, acute kidney injury; Cr, creatinine; CRTx, chemoradiotherapy; CTx, chemotherapy; EF, ejection fraction.