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LAPAROSCOPIC AND ROBOTIC-ASSISTED SURGERY FOR COMPLICATED DIVERTICULITIS

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ABSTRACT — The article presents the results of a longtime experience with the effects of perioperative intestinal decontamination in patients with complicated diverticulitis on the incidence of postoperative complications following delayed minimally invasive sigmoid colectomy and colorectal anastomosis creation.
PURPOSE. This work aims to evaluate the prophylactic potential of selective perioperative intestinal decontamination in patients with sigmoid diverticulitis due to perforation of the inflamed diverticula, as a form of diverticular disease; to study the incidence of postoperative complications in patients with complicated diverticulitis following laparoscopic and robotic-assisted surgery.
MATERIALS AND METHODS. We studied the short-term postoperative outcomes of 179 patients with sigmoid diverticulitis associated with perforation of the inflamed diverticula using both prospective and retrospective methods. The study participants were divided into two groups: Group A (n=91) (50.8%)), of which 65 patients (36.3%) underwent laparoscopic and 26 patients (14.5%) — robotic-assisted surgery and received intestinal decontamination peri-operatively, and Group B, consisting of 88 patients (49.2%), who underwent laparoscopy but did not receive intestinal decontamination. In all cases, sigmoid colectomy was performed and a primary colorectal anastomosis was formed.
RESULTS. Of 179 patients included in the study, 136 (76%) did not develop postoperative complications. In Group A, 11 (12%) of 91 patients and in Group B, 17 (19.3%) of 88 patients developed postoperative complications specific to the type of surgery undertaken. The most common complications included colorectal anastomotic leakage, adhesive intestinal obstruction, anastomotic bleeding, intra-abdominal hemorrhage and localized peritonitis. A statistical comparison revealed no statistically significant differences between the groups studied. 8 (8.8%) of 91 patients in Group A and in 7 (8.0%) of 88 patients in Group B were diagnosed with extra-abdominal (non-surgical) complications. Thus, the total postoperative complication rate was lower in Group A (n=19 (20.9%) than in Group B (n=24 (27.3%)) (X^2=1.002, p=0.316). Colorectal anastomotic leakage rates were lower in Group A (n=1 (1.1.%)) than in Group B (n=4 (4.6%)) (F=0.205, p>0.05). Wound infection rates in Group A were 6.6% (n=6) patients and in Group B – 11.3% (n=10) patients (X^{2*}=6.483, p=0.01). No deaths were reported.
CONCLUSION. Selective intestinal decontamination combined with oral decontaminating solutions has been shown to reduce the occurrence of colorectal anastomotic leaks, wound infection, surgical and general postoperative complications.

KEYWORDS — selective intestinal decontamination (SID), diverticular disease, robotic-assisted and laparoscopic sigmoid colon resection, colorectal anastomotic leakage (AL), postoperative complications.

INTRODUCTION

Diverticular disease is a prevalent inflammatory disorder that affects the digestive tract. The prevalence of diverticular disease is estimated to be as low as 2% in those 30 years or younger, 5% in those 40 years of age and it is estimated to be as high as 70% by 80 years of age [1, 2]. Although 80% of patients tend to have uncomplicated presentations, 20% develop various types of diverticulitis [3, 4].

The current Hansen and Stock classification of colonic diverticular disease is used as the standard for clinical practice in the guidelines for the treatment of diverticular disease in Germany [5]. Complicated diverticulitis associated with perforation of the intestinal wall and pericolic abscesses have been a subject of increasing interest for surgeons. Patients with complicated diverticulitis often require numerous hospitalizations and/or surgery [6, 13].

Approximately 15% of patients develop perforated diverticulitis associated with pericolic abscesses measuring 5 cm in size or larger. In such cases, ultrasound or CT imaging can be used to guide abscess drainage [7, 8]. Patients with complicated diverticulitis often require sigmoid resection down to the rectosigmoid junction to avoid diverticulitis relapses and complications. However, potential risks of bowel resection are mainly those of any major complications including anastomotic leakage (AL), which is the most common cause of prolonged hospital stays and may even lead to death in 5.0–20.0% of cases [9, 12].

Recent studies with *Pseudomonas aeruginosa* and *Enterococcus faecalis* have shown that various concentrations of these bacteria, which are capable of activating intestinal tissue matrix metalloproteinase-9 (MMP9) and degrading collagen, lead to the development of AL [10]. The negative impacts of the gut

Pseudomonas aeruginosa and *Enterococcus faecalis* can be significantly reduced with the use of perioperative selective decontamination [11].

The purpose of our study was to evaluate the prophylactic potential of perioperative SID in patients with sigmoid diverticulitis associated with perforation of the inflamed diverticula and to study the occurrence of general and specific to the type of surgery undertaken postoperative complications in patients following laparoscopic colorectal resection.

MATERIALS AND METHODS

Between January 2015 and October 2020, in the Department of General, Oncologic and Thoracic Surgery of Sana Klinikum Hof GmBH, University Hospital of Erlangen, Friedrich-Alexander University of Erlangen-Nürnberg (Bavaria, Germany) 191 patients were operated on for acute complicated diverticulitis (Type IIa, IIb) using conventional and robotic-assisted laparoscopy. The patients were eligible for the study if they had been diagnosed of having sigmoid diverticulitis, provided informed consent for surgery and anesthesia, and were good candidates for a primary anastomosis. The exclusion criteria included high risk of anesthesia-related complications (ASA class IV), immunosuppression, severe diabetes mellitus, and end-stage renal disease (ESRD).

A total of 179 patients who consented were enrolled in the study. 91 patients who received oral decontamination perioperatively were attributed to Group A, while 88 patients, comprising Group B, underwent major surgery without receiving perioperative oral decontamination.

The conservative treatment involving administration of intravenous antibiotics and analgesics as well as high-calorie parenteral nutrition solutions was followed by sigmoid resection, of which 153 resections (65 (71.4%) in Group A) and 88 (100%) in Group B) were performed laparoscopically, and 26 ((28.6%) in Group A) resections — using a robotic-assisted technique.

Primary colorectal anastomoses were formed using a circular stapling instrument ~10–12 cm above the anal sphincter. The mean age of patients in Group A was 58±12.5 year, while in Group B — 55.6±13.2 (Student's t test =1.368, p=0.086). Females accounted for 50.5% (n=46) of the total sample size in Group A, and 42 (47.7%) in Group B. The study population comprised 45 (49.5%) males in Group A and 46 (52.3%) males in Group B, respectively. There were no statistically significant gender differences in the study groups (X^2=0.142, p=0.705).

The majority of patients in the study groups were classified as ASA class II (X^2=0.05, p=0.82) or ASA class III (X^2=0.01, p=0.903). No statistically significant differences between ASA III and ASA II patients in Group A and Group B were found. Baseline CRP level (110±75.4 mg/L) was statistically lower in Group B (Mann-Whitney U test =2.733, p=0.006) than in Group A (130.7±59.2 mg/L). For WBC counts, we found no statistically significant differences in the study groups (Student's t test =2.005, p=0.88).

In all cases, the diagnosis of complicated diverticulitis was confirmed with CT imaging with intravenous contrast. If a pericolic abscess measuring > 5 cm in size was available, CT imaging was used to guide abscess drainage. Pericolic abscesses were identified in 35 (38.5%) of 91 patients in Group A and in 21 (23.7%) of 88 patients in Group B (X^2=5.05, p=0.02). In Group A, external drainage prior to surgical resection was performed in 7/35 (7.7%) of 35 cases, in Group B – in 3/21(3.4%) of 21 cases. No statistically significant differences in the frequency of use of this treatment approach were found in the study groups (F=0.72, p>0.05).

In Group A, patients received intestinal decontamination in the conventional manner: one day before surgery and after mechanical bowel preparation the patients received the first dose of neomycin (1 g) and 800 mg of metronidazole at 7 and 11 pm. The patients received a second dose of neomycin (500 mg) at 6 am on the day of surgery. Postoperatively, the patients received metronidazole at a dose of 400 mg orally twice a day for 5 days.

RESULTS AND DISCUSSION

The general and postoperative length of hospital stay was significantly shorter in Group A and amounted to 13.9±4.1, while in Group B — 16.1±6.1 days (Student's t test =-2.721, p=0.003). Postoperative hospital stay for Group A patients was 8.1±3.6 and for Group B patients — 9.3+5.5 days (Student's t test = -1.883, p=0.036). The duration of laparoscopic surgery in Group A was significantly shorter (173±45.6 minutes) than in Group B (190.1±50.1 minutes) (*z=2.1758, p=0.02926).

Two (1.1%) of 179 patients developed intraoperative complications. Ureteral trauma occurred in one patient in Group A during the surgery. The repair of ureteral trauma involved creating a reanastomosis between the bladder and the proximal ureter. Moreover, one patient in Group B developed bleeding from the staple line (anastomosis) which was arrested with endoscopic clipping.

The number of conversions from laparoscopic surgery to an open approach was greater in Group B —

10 (11.4%) of 88 patients than in Group A — 5 (5.5%) of 91 patients (X^2 with Yates's correction =1.316, p=0.252). The reasons for conversion to an open approach included large pelvic abscesses (3 cases) which for some technical reasons had not been drained prior to surgery; internal fistulas (5 cases) which required additional resection of the urinary bladder, uterus or the small intestine; extensive peritoneal adhesions arising due to inflammation (7 cases) whose separation with a minimally invasive approach was impossible.

In Group A, anastomotic leakage occurred in 1 patient (1.1%) and it was treated with re-laparoscopy, pelvic lavage, formation of a double-barrel ileostoma and placement of a transrectal endoscopic vacuum-assisted system. On day 21 postoperatively, the patient had resolution of the anastomotic defect which had been covered with granulation tissue. The protective double barrel ileostoma was closed 42 days following the initial surgery. In Group B, AL occurred in 4 patients (4.55%). In 3 patients AL was treated with a minimally invasive approach, which involved laparoscopic lavage, abdominal drainage, formation of a distal ileostoma and placement of a transrectal endoscopic vacuum-assisted system.

One patient underwent Hartman's procedure by laparotomy due to colorectal anastomotic failure related to a large size of the AL, intestinal ischemia and severe fecal peritonitis. A comprehensive intensive treatment program helped to stabilize the patient and plan rehabilitation and follow-up for him. The period of time from the patient's discharge from hospital to the closure of the single-barrel colostoma was 6 months. The recovery period was uneventful.

An overview of general and specific to the type of surgery undertaken postoperative complications which occurred in the study groups is presented in Table 1.

CONCLUSION

Our findings show that SID holds great potential as a treatment approach to patients with diverticulitis associated with perforation of the inflamed diverticula (Type IIa, IIb). It decreases not only the number of postoperative wound infections but also general postoperative complications, including colorectal AL. The study provides evidence of the beneficial effects of intestinal decontamination in preventing complications following laparoscopic or robotic-assisted colorectal resections which are commonly undertaken in complicated diverticulitis.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

Concept and design of the study — O.F. Vorontsov, C. Graeb;

Data collection and processing — O.F. Vorontsov, V.V. Tolochyk, A.V. Kitaeva;

Text writing — O.F. Vorontsov;

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Table 1. *Postoperative complications in the study groups*

Complication	Study groups		Statistically significant difference
	A (n=91)	B (n=88)	
Extra-abdominal	8 (8.79%)	7 (7.95%)	X^{2*}=0.004, p=0.945
Wound infection	6 (6.6%)	10 (11.3%)	X^{2*}=6.483, p=0.01
Intra-abdominal complications	5 (5.49%)	7 (7.95%)	X^{2*}=0.649, p=0.420
Adhesive intestinal obstruction	1 (1.1%)	1 (1.14%)	F=1, p>0.05
Peritonitis	2 (2.2%)	0 (0%)	F=0.497, p>0.05
Anastomotic bleeding	0 (0%)	1 (1.14%)	F=0.491, p>0.05
Intra-abdominal hemorrhage	1 (1.1%)	1 (1.14%)	F=1, p>0.05
Anastomotic leak	1 (1.1%)	4 (4.55%)	F=0.205, p>0.05
Total	19 (20.88%)	24 (27.27%)	X^2=1.002, p=0.316

X^2 — the chi-square test, X^{2*} — the chi-square test with Yates's correction, F — Fisher's exact test.

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