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The influence of bowel preparation on postoperative complications in the surgical treatment of colorectal cancer

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
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ABSTRACT:

Introduction: Colorectal cancer is the most common gastrointestinal cancer treated by departments and surgical clinics in Poland. Currently, the biggest challenge of surgery is to reduce the number of leaks in the bowel anastomoses and postoperative wound infections to a minimum.

Objective : Whether bowel preparation before surgery affects the early results of treatment?

Methods: The study was retrospective and included patients operated electively on one surgical center due to colorectal and rectal cancer in years 2013–2018. Patients who underwent surgery were divided into two groups in the study. The first was 109 patients with mechanical bowel irrigation. The second group of 118 patients, in addition to mechanical bowel preparation, received an oral antibiotic.

Results: The studied groups did not differ significantly in terms of traits that could affect the results of treatment within 30 days of surgery. Postoperative mortality was 0,9% and 0,85%. Complications: leakage of the bowel anastomosis 1,8% and 1,7%, postoperative obstruction 3,7% and 5,0%, wound dehiscence 2,75% and 0,85%, infection of the surgical site 13,8% and 3,4% respectively in the first and second group of patients.

Conclusion: Mechanical bowel preparation in combination with the oral supply of antibiotic significantly reduces the frequency of surgical site infection compared to the mechanical rinsing itself. Type of preparation of the intestine before the surgery does not significantly affect postoperative mortality and other complications, including anastomotic leak, but may be important for the frequency of postoperative wound dehiscence.

KEYWORDS: colorectal cancer, postoperative complications, mechanical bowel preparation

INTRODUCTION

Colorectal cancer is one of the most common malignancies reported in Central Europe and the United States. Similarly in Poland, where around 15.000 new cases are noted each year and this rate has been growing for several years. The assessment of treatment effectiveness of the disease in Poland revealed that a 5-year survival rate improved in the years 1999-2010 from 43.2 to 51.0% in women and from 40.4 to 47.0% in men [1]. However, our results of colorectal cancer treatment are still among the worst in Europe [2]. An anticipated increase in the number of cases, as a consequence of aging of the population and growing exposure to risk factors force the search for new directions to cope with this problem, including widespread screening. In the last decade, in the US and other countries, this method allowed to reduce the incidence of colorectal cancer and the number of related deaths by about 3% per year [3].

MATERIAL AND METHODS

The retrospective study included a group of patients subsequently operated on an elective basis due to colorectal cancer at the Department of General Surgery with the Subunit of Surgical Endoscopy of the MSWiA Hospital in Rzeszow in the years 2013–2018. The data was taken from hospital medical records. The first group consisted of patients treated in the period from 2013 to 2016, subjected to mechanical bowel irrigation. The control group included patients hospitalized in the period 2016–2018 who, in addition to mechanical bowel irrigation, were given an oral antibiotic – neomycin 2x500 mg – in the evening, at the end of bowel irrigation. A change in the method of bowel preparation before colorectal operations i.e. the addition of an oral antibiotic coincided with the change of perioperative antibiotic intravenous prophylaxis at the beginning of 2016. In both groups, the same intravenous antibiotic prophylaxis was applied before surgery – metronidazole 500 mg and the 1st generation cephalosporin 1.0 g (Cefazolin). The study excluded patients operated on an emergency basis and those who due to significant stenosis could not be subjected to mechanical irrigation. Mechanical irrigation with macrogol 2x100 g in 2 litres of water was initiated in the afternoon, before the elective treatment. The majority of patients were admitted on the day before surgery, except for those requiring imaging examinations /CT, MRI/, who were hospitalized the day before. The patients from both groups were qualified for neoadjuvant and complementary treatment in accordance with the accepted standards. Most surgeries were performed by the same surgeon experienced in colorectal surgeries. Demographic data from medical records was as follows: sex, age and other information, such as: ASA /American Society of Anaesthesiologists/ classification, BMI /Body Mass Index/, type of surgery, the TNM stage of disease according to AJCC /American Joined Committee on Cancer/ and postoperative complications. The results obtained in both groups were compared in terms of individual parameters using the mean value /+ | - deviation/ and percentages in which quantitative parameters were expressed. Statistical analysis was carried out using the Statistica 13.1 statistical package (StatSoft, Inc., United States). For continuous vari-

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Tab. I. The results of comparative analysis of patients with colorectal cancer – sex.

GENDER	GROUP I N = 109	GROUP II N = 118	P
Men	58 (53,2%)	70 (59,3%)	<0,1788
Women	51 (46,8%)	48 (40,7%)	<0,1788

Tab. II. The results of comparative analysis of patients with colorectal cancer – age.

WIEK	GROUP I N = 109	GROUP II N = 118	P
Median	68,5	69,3	p = 0,4899
Range	49-89	42-89	

Tab. III. The results of comparative analysis of patients with colorectal cancer – ASA classification.

ASA CLASSIFICATION	GROUP I N = 109	GROUP II N = 118	P
I	14 (12,1%)	18 (15,3%)	<0,2946
II	67 (61,5)	66 (55,9%)	<0,1975
III/IV	28 (25,7%)	34 (28,8)	<0,3015

Tab. IV. The results of comparative analysis of patients with colorectal cancer – BMI > 30 kg/m².

BMI > 30 KG/M²	GROUP I N = 109	GROUP II N = 118	P
Men	14 (24,1%)	20 (28,6%)	<0,2877
Women	11 (21,6%)	12 (25,0%)	<0,3446

Tab. V. The results of comparative analysis of the type of surgery and the TNM stage of cancer.

TYPE OF OPERATION	GRUPA I N = 109	GRUPA II N = 118	P
Right-sided hemicolectomy	33 (30,0%)	33 (28,0%)	<0,3707
Resection of the transverse colon	0 (0%)	1 (0,8%)	<0,1814
Left-sided hemicolectomy	10 (9,2%)	9 (7,6%)	<0,3472
Sigmoid resection	19 (17,4%)	17 (14,4%)	<0,2666
Anterior resection of the rectum	29 (26,6%)	28 (23,7%)	<0,3085
Anterior resection of the rectum with ileostomy	9 (8,3%)	14 (11,9%)	<0,1841
Ventral-perineal removal of the rectum	8 (7,3%)	11 (9,3%)	<0,2946
Subtotal colectomy	1 (0,9%)	3 (2,5%)	<0,3085
Reconstructive proctocolectomy	0 (0%)	2 (1,7%)	<0,0869

ables, the results were expressed as means and ranges of values, while for categorical variables they were presented as numbers and percentages. The normality of quantitative parameter distribution was evaluated using the Shapiro-Wilk test. The individual groups were compared in terms of continuous variables using the Student's t-test and in terms of categorical variables using the $\chi 2$ test (or an exact Fischer test). In all the analyses, the P value <0.05 was considered statistically significant.

RESULTS

In the period under study, 227 patients with colorectal cancer were subjected to elective surgery. In the material presented, the first group contained 58 men and 51 women; the age of the subjects ranged from 49 to 89 years /mean age 68.5/, in the second group there were 70 men and 48 women, aged 42 to 89 years /mean age 69.3/. The comparison of both groups also included anaesthetic qualification focused on the risk of anaesthesia during surgery, according to the ASA scale. Also, the presence of obesity was evaluated (over 30 kg/m² according to the BMI definition). Given this data, no statistically significant differences were found between the groups (Tab. I.–IV.). The type of surgery and the TNM stage according to AJCC were also subject to comparative analysis. The characteristics of patients from both groups are presented in Tab. V. and VI. The groups did not differ in terms of the above parameters either. In some cases, neoadjuvant radiotherapy was used in the treatment of rectal cancer; several patients from each group underwent radiotherapy for the pelvis minor due to prostate cancer. Because radiotherapy can have an effect on postoperative complications, Tab. VII. presents the results of comparative analysis of the frequency of this factor in the material in both groups. There were no statistically significant differences between the groups. Tab. VIII. shows the results of comparative analysis for postoperative complications. It indicates that the surgical site infection was statistically more frequent in the group in which the large intestine was prepared using irrigation i.e. without added antibiotic. This complication could have an effect on the incidence of wound dehiscence in this group of patients. There were no significant differences between groups in the incidence of other complications and in the percentage of deaths.

DISCUSSION

Because the treatment of choice in patients with colorectal cancer is radical oncological operation, the role of surgery is unquestionable. In some cases, in rectal cancer /lower and middle part/ the procedure is preceded by preoperative radiotherapy and in patients with colon cancer by adjuvant chemotherapy. The quality of surgical treatment is demonstrated by the percentage of post-operative complications, including anastomotic leakage, wound dehiscence, the number of reoperations, the cases of surgical site infection and post-operative mortality within 30 days of surgery. Both groups of patients included more men than women; however, in the second group this difference was greater. A similar distribution of sex and age was reported by other authors [4]. In old age and ripe old age i.e. over 75 years, the differences are reversed with more cases registered in women [5]. The mechanical preparation of the large intestine before resection of the colon and rectum is an issue that has raised discussions and controversies for years. The analysis of research papers describing the procedures with and without the mechanical preparation of the intestine conducted by some authors revealed no significant differences between the groups of patients in terms of the overall number of complications, including intestinal anastomotic leakage and wound infections [6]. Others found that the lack of mechanical preparation of the intestine increases the rate of leakage after resection of the left part of the colon [7]. Moghadamyeghaneh et al. analysed the groups of patients who were differently prepared for surgery in the left part of the colon. Only the simultaneous mechanical preparation of the large intestine and the oral administration of an antibiotic gave a statistically significant reduction in the value of total mortality, the number of leaks and surgical wound infections [8]. Similar results were presented by Shwaartz et al. in patients undergoing surgery for inflammatory bowel disease [9]. The patients prepared to the procedure by mechanical irrigation and oral antibiotic were the only group with lower rates of wound

infection, intestinal anastomotic leakage, a lower number of postoperative obstructions and wound dehiscence. The study material also showed in these patients a statistically significantly lower percentage of postoperative wound infections and a lower rate of wound dehiscence – no statistical significance compared to the group where the intestines were only mechanically prepared. There were no differences in terms of perioperative mortality and intestinal anastomotic leakage. Obesity is a significant factor affecting mortality and the number of postoperative complications [10, 11]. In Poland, the value of over 30 kg/m2, which according to the BMI definition indicates obesity, is reported in 13.1% of women and in 13.7% of men. In the US population, this percentage ranges from 32 to 35% [12]. In the study material, the incidence of obesity was higher in individual groups of patients and was 21.5 and 25% in women, and 24 and 28% in men, respectively. This is in accordance with the fact that obesity is a risk factor for colorectal cancer, and this applies to this population. A similar or even higher percentage of obesity was noted by other authors [4]. Another notable observation is the relationship between obesity and an increased risk of postoperative cardiovascular, pulmonary and thromboembolic complications as well as surgical site infection /SSI/. While the former can be limited by quick mobilization of patients, active respiratory and general physiotherapy, initiated already on the zero and first postoperative day, and anticoagulant prophylaxis, the prevention of SSI requires actions to be taken before surgery – skin preparation, antibiotic prophylaxis at the beginning of the procedure, minimization of surgical field contamination; oxygen therapy after the procedure, in the first hours, while awakening the patient. In addition to all the above elements having an impact on the postoperative course, as well as the importance of surgical technique, close attention should be paid to the value of blood pressure in the early postoperative period. When the value drops below 100 mmHg, pressure agents should be applied to prevent ischemia, not only within the anastomosis, but also within the post-operative wound. SSI increases the rate of nosocomial infections and correlates well with the quality of surgical treatment. It can prolong the duration of patient's stay and increase the cost of treatment. The incidence of this complication varies from 1 to 27% [13, 14, 15, 16]. In the material presented, the incidence of SSI was statistically significantly lower in the group prepared using mechanical intestine irrigation combined with the oral supply of antibiotics and it amounted to 3.4% compared to patients subjected to intestinal irrigation alone – 13.8%. Other factors that may affect the frequency of this complication were similar in both groups: preparation of the operating field, intravenous antibiotic prophylaxis, protection of the intestinal ends after cutting and anastomosis, rinsing of the peritoneal cavity and coatings. While SSI was the most common postoperative complication in the group prepared for the surgery by bowel irrigation alone. On the contrary, this was not observed in the group additionally receiving an oral antibiotic. A beneficial effect of oral administration of antibiotics on the prevention of post-operative wound infection was also reported by other authors [17]. Atkinson found the advantages of oral antibiotic administration in the preparation of patients not subjected to mechanical bowel irrigation [18]. The percentage of reoperations is another factor having an influence on a 30-day post-operative mortality. Reoperations were performed due to complications such as anastomotic leakage, wound dehiscence and obstruction due to adhesions. In our material, only wound dehiscence was more frequent, but not in the group of patients with significantly more frequent SSI. Other - anastomotic leakage and obstruction due to adhesions occurred with the same frequency in both groups. The frequency of anastomotic leakage at the level below 2%, which was reported in both groups, is a very good result. According to literature, this complication occurs in 3.1 to 32% [19, 20, 21]. Some authors suggest a beneficial effect of oral administration of antibiotics on the reduction of the frequency of anastomotic leakage [22]. The comparison of both groups in terms of the factors that may have an impact on the presence of anastomotic leakage did not show significant differences. However, no influence of oral antibiotic administration on the incidence of this complication was reported. Early obstruction due to adhesions i.e. up to 30 days after surgery, which in our material required relaparotomy, was most often caused by bending of the small intestine due to clumps and adhesions in the peritoneum in the period between 5 and 15 days, most often on the 7-8th day after surgery. According to literature, the percentage of this complication varies from 3.6 to 12%; a higher percentage reaching 18% may be associated with postoperative abdominal drainage [23]. In both groups, the incidence of postoperative obstruction was similar and occurred in 3.7 and 5% of patients, respectively. A similar, but slightly higher percentage of obstruction due to adhesions reaching 8% was reported in a meta-analysis of a large group of patients [25]. Wound dehiscence is a serious postoperative complication with high mortality of up to 45%. According to literature, the incidence of this complication ranges from 0.4 to 3.5% and may be

Tab. VI. Progression according to the American Joint Committee on Cancer (AJCC).

TNM CLASSIFICATION	GROUP I N = 109	GROUP II N = 118	P
0 – Tis	4 (3,7%)	6 (5,1%)	<0,3015
I T1N0M0 T2N0M0	21 (19,3%)	20 (17,0%)	<0,3264
II T3N0M0 T4N0M0	29 (26,6%)	40 (33,9%0	<0,1170
III each T N1M0 each T N2N3M0	39 (35,8%)	35 (29,7%)	<0,2546
IV each T each N M1	15 (13,8%)	12 (10,2%)	<0,2005

Tab. VII. Comparative analysis of preoperative radiotherapy applied in cancer of the middle and lower rectum.

TYPE OF OPERATION	GROUP I N = 109	GROUP II N = 118	P
Anterior resection of the rectum with ileostomy	9 (52,9%)	14 (56,0%)	<0,4207
Ventral-perineal removal of the rectum	8 (47,1%)	11 (44,0%)	<0,4207
Preoperative radiotherapy	7 (41,2%)	8 (32,0%)	<0,2611
Past radiotherapy (prostate cancer)	3	4	

Tab. VIII. The results of comparative analysis of postoperative complications.

POSTOPERATIVE COMPLICATIONS:	GROUP I N = 109	GROUP II N = 118	P
Anastomotic leakage	2 (1,8%)	2 (1,7%)	p = 0,4681
Wound dehiscence	3 (2,75%)	1 (0,85%)	p = 0,1401
Obstruction due to adhesions	4 (3,7%)	6 (5,0%)	p = 0,2843
Reoperations - altogether	9 (8,25%)	9 (7,6%)	p = 0,2843
Urinary tract infection	3 (2,75%)	2 (1,7%)	p = 0,2946
Surgical site infection	15 (13,8%)	4 (3,4%)	p = 0,0037
Death	1 (0,9%)	1 (0,85%)	p = 0,4761

even higher. Colorectal surgeries are highly risky, especially when the wound is infected [26, 27]. In our material, the percentage of wound dehiscence was 2.75% in the first group and 0.85% in the second group, which, in addition to the mechanical irrigation, was given an oral antibiotic. In this group, this complication, which is less frequent, correlates well with a lower percentage of SSI and is not statistically significant. In a large population study, conducted in 92 hospitals in the Netherlands and covering 25 591 patients subjected to colorectal resection, the post-operative mortality rate ranged from 0 to 8.8% [28]. According to literature, 30-day mortality after colorectal surgery is between 3 and 10%, depending on the hospital referral level and the percentage of emergency interventions with the higher risk of death [4, 5, 29]. In our material which included patients with colorectal cancer operated on an elective basis, mortality was low and in individual groups amounted to 0.9 and 0.85%. The period that has elapsed from the treatment of patients is too short and does not yet allow for a thorough oncological assessment, that is, the evaluation of a 5-year survival. We intend to continue monitoring of these patients so that the assessment of therapeutic results is complete.

CONCLUSIONS

1. The preparation of the large intestine by irrigation with oral antibiotic allows for a significant reduction of the incidence of surgical site infections compared to mechanical irrigation alone.

2. The method of preparation of the intestine before surgery does not have a significant impact on other complications, including anastomotic leakage, but it may be important for the incidence of postoperative wound dehiscence.

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