Research Article

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Urgent Right Hemicolectomy

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ABSTRACT Right hemicolectomy with the formation of primary ileotransverse anastomosis is the method of choice in emergency surgery as well.

AIM OF THE STUDY Comparative evaluation of the results of urgent right hemicolectomy with the formation of a primary anastomosis and without the formation of a primary anastomosis at the first stage of surgical intervention.

MATERIAL AND METHODS A retrospective cohort study included patients who underwent emergency right hemicolectomy. The database includes: demographic indicators, comorbidity, data on the general condition of the patient, the time of the surgical intervention, the time from the onset of the disease to hospitalization, laboratory parameters. The patients were divided into two groups. Group 1 included patients in whom the operation was performed with the formation of a primary anastomosis, which was applied manually; group 2 consisted of patients who underwent surgery with the formation of a separate double-barrel stoma and the 2nd stage of surgical intervention was planned. The Clavien–Dindo classification was used to assess postoperative complications.

RESULTS The results of 112 right hemicolectomies performed according to emergency indications were analyzed. Group 1 (operations with the formation of a primary anastomosis) included 87 patients (77.7%); group 2 (n=25) included 18 patients (16.1%) who underwent two-stage operations: stage 1 — right hemicolectomy without primary anastomosis formation, stage 2 — restorative intervention, anastomosis formation; and 7 patients (6.2%), in whom the operation ended with the formation of a separate double-barreled intestinal stoma. In the 1st group, the patients were younger: the average age was 61 years versus 73 years in the 2nd group (p=0.021). Patients of the 2nd group were in a more serious condition upon admission (ASA III–IV) and had a higher comorbidity.

The average duration of surgical intervention was 162±10.2 minutes in group 1 and 110±9.5 minutes in group 2 (p=0.038). Group 2 had more serious complications (IIIB–IVB according to Clavien–Dindo) compared to group 1 (p=0.001). The main factors that had a statistically significant impact on the risk of postoperative complications were: severe degree of comorbidity (odds ratio — OR 3.1; 95% confidence interval — CI 1.4–6.3; p=0.002), severe general condition upon admission — ASA III–IV (OR 2.7; 95% CI 1.2–7.4; p=0.01), anemia — Hb<90 g/l (OR 1.7; 95% CI 1.5– 6.1; Odd=0.004), time between the onset of the disease and admission more than 12 hours (OR 2.1; 95% CI 0.9–6.8; p=0.03), time to perform the operation (OR 2 .05, 95% CI 1.38–8.1, p=0.033).

CONCLUSION The presence of chronic diseases characterized by systemic lesions and comorbidity determines the choice of a primary treatment strategy for perforation, bleeding, acute mesenteric ischemia, where it is advisable to perform a right hemicolectomy without primary anastomosis, followed by recovery stage.

Keywords: urgent right hemicolectomy with and without primary anastomosis, postoperative complications, comorbidity

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AF – anastomotic failure
ASA – American Society of Anesthesiologists
CI – confidence interval
MOF – multiple organ failure
OSH – odds ratio
PA – primary anastomosis
PE – pulmonary embolism
RH – right hemicolectomy

INTRODUCTION

Right hemicolectomy (RH) entails a risk of postoperative complications of up to 22% and mortality of about 1% [1, 2]. In emergency surgery, these figures increase: postoperative complications up to 50%, mortality up to 10%, especially in the presence of risk factors [3–5].

Patient-related risk factors are age over 70, male gender, protein deficiency, American Society of Anesthesiologists (*ASA*) physical status greater than 3, diabetes mellitus, tobacco smoking, and immunocompromised states. The risk factors associated with surgery, in addition to the risk of emergency surgery, are intraoperative blood transfusion, surgeon's skills, the duration of the operation as a cumulative indicator reflecting the severity of the underlying disease and the traumatic effect of the operation, and the time of the operation is nighttime [6–8].

Therefore, when performing emergency operations, when surgeons have to take into account the influence of several risk factors, it is of first importance to choose a strategy in which the maximum reduction in surgical risk and prevention of postoperative complications is possible.

In emergency situations associated with a complicated course of pathological processes in the left half of the colon and rectum (obstruction of tumor genesis, perforation, bleeding), standardized approaches to staged surgical treatment have been developed depending on the severity of the complication [9–13].

In accordance with the results of the studies, approaches to the treatment of emergency complications of diseases of the right half of the colon today differ somewhat. Of the surgical operations aimed at eliminating emergency complications, the following can be used: RH with the formation of a primary anastomosis (PA), RH with PA with the creation of a proximal stoma, RH without the formation of PA, stoma formation, bypass ileotransverse anastomosis, endoscopic stent placement which may be palliative or as "bridge" to surgery. Today, the least safe surgical methods of treatment for emergency situations have not been determined in the pathology of the right half of the colon. Stenting of the right colon is considered a technically challenging task, so further comparative studies are needed to develop recommendations [14].

Right hemicolectomy with the formation of a primary ileotransverse anastomosis is also the method of choice in emergency surgery [11, 14]. However, overall postoperative morbidity and mortality rates raise the question of the need for safer surgical approaches.

Based on this, **the aim of this study** is the comparative assessment of the results of emergency right hemicolectomies with the formation of a primary anastomosis and without the formation of a primary anastomosis at the first stage of surgical intervention.

MATERIAL AND METHODS

A retrospective cohort study was conducted, which included all patients who underwent emergency RH from January 2014 to January 2020 in two surgical hospitals in Smolensk. Emergency right hemicolectomy included a standard RH with resection of up to 20 cm of the small (ileal) intestine. Surgical intervention was assessed as emergency if it was performed within 3±1.5 hours from the moment of admission to the hospital.

When included in the database, demographic indicators, comorbidity (cardiomyopathy after myocardial infarction, cirrhosis, diabetes mellitus, obesity, chronic renal failure) were taken into account. The Charlson comorbidity index and *ASA* grade were used to assess the patient's condition and physical status.

We entered data on the time of the surgical intervention (day, evening, night); time from the onset of the disease (appearance of the first symptoms) to hospitalization: ⩽12 hours >12 hours from the onset of the disease; laboratory parameters (level of WBC, hemoglobin parameters). The patients are divided into two groups. Emergency RH in patients of both groups was performed by open access. Group 1 included patients who underwent RH with PA formation and included all types of anastomosis formation — end-to-end, end-to-side, side-to-side. All patients underwent manual anastomosis. The 2nd group included patients who underwent RH without the formation of a primary anastomosis, but with the formation of a separate double-barreled intestinal stoma. If the obturation is at the level of the right half of the colon, then the distal part of the intestine, as a rule, is collapsed and does not require decompression through the intestinal stoma. In decompensated AIO, it may be necessary to decompress through the intestinal stoma. These patients were scheduled for the 2nd stage of surgical intervention. The inclusion criteria for the retrospective study are shown in the figure.

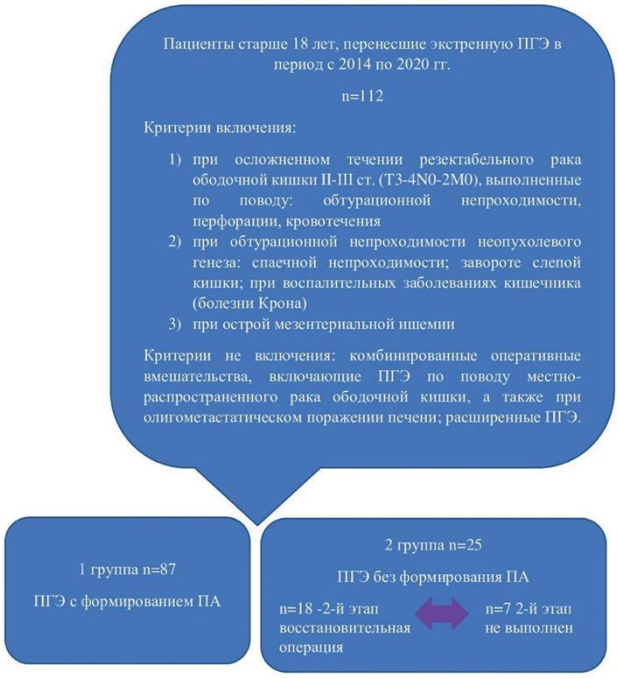

Figure. Scheme of inclusion in the study of patients who underwent emergency right hemicolectomy
Notes: PA — primary anastomosis; RH — right hemicolectomy

Surgical interventions performed for malignant tumors were performed in compliance with the established criteria for radicalness in accordance with the prevalence of the oncological process. Resection of the transverse colon and extended RH were not included in the study. The operations were performed by experienced oncological surgeons with at least 10 years of surgical experience. The study was approved by the ethics committee of the Federal State Budgetary Educational Institution of Higher Education of the SSMU of the Ministry of Health of the Russian Federation, protocol No. 1 dated May 20, 2020.

Postoperative complications were assessed 30 days after surgery using the Clavien-Dindo classification. The analysis took into account the complication with the highest severity for each patient. In the 2nd group, the time to the second stage of the surgical intervention, the reconstructive operation, was analyzed.

For statistical processing, the data were combined into a Microsoft Excel table. Statistical analysis was performed using *SPSS* 20 software for *Windows v.* 10. Most of the collected variables were qualitative. Epidemiological and clinical characteristics before, during and after surgery were compared using the χ^2 test or Fisher's exact test. Quantitative variables were compared using the Mann–Whitney U test. Multivariate analysis was performed using binary logistic regression. The inclusion criterion for variables from univariate to multivariate analysis was their statistical significance in univariate analysis. A p value <0.05 was considered significant.

RESULTS

The results of 112 right hemicolectomies performed according to emergency indications were analyzed. Group 1 — RH with PA formation included 87 patients (77.7%); Group 2 (n = 25) included 18 patients (16.1%) who underwent two-stage operations: stage 1 — RH without PA formation, stage 2 — restorative intervention — anastomosis formation, and 7 patients (6, 2%), in which RH ended with the formation of a separate double-barreled intestinal stoma, the 2nd (recovery) stage was not performed. Main characteristics are represented in Table 1.

Table 1

Main characteristics of patients undergoing urgent right hemicolectomy

Factors	Group 1 (RH with PA), *n* = 87	2nd group (RH without PA), *n* = 25	*p*
Gender (male/female)	46/41	12/13	0.064
Age	61 (29–78)	73 (41–89)	0.021
Body mass index			
<30	78 (89.7%)	23 (92%)	0.073
>30	9 (10.3%)	2 (8%)	
ASA			
II	26 (29.9%)	0	<0.0001
III	53 (60.9%)	16 (64%)	
IV	8 (9.2%)	9 (36%)	
Comorbidity			
Diabetes mellitus type II	14 (16.2%)	4 (16%)	<0.0001
Diseases of the cardiovascular system (ischemic heart disease, postinfarction cardiosclerosis)	61 (70.1%)	5 (20%)	
Multimorbidity (the presence of competing comorbidities: diseases of the cardiovascular system, diabetes mellitus, peptic ulcer)	0	16 (64%)	
Comorbidity index Charlson >3	52 (59.8%)	24 (96%)	0.011
Time from the onset of the disease (appearance of the first symptoms) to hospitalization			
≤12 hours	69 (79.3%)	18 (20.7%)	0.007
>12 hours since the onset of the disease	9 (36%)	16 (64%)	
Leukocytosis in the preoperative period			
Moderate ($9–20×10^9$)	79 (90.8%)	8 (32%)	<0.0001
Severe ($>20×10^9$)	8 (9.2%)	17 (68%)	
Hemoglobin values in the preoperative period			
110–90 g/l	49 (56.3%)	5 (20%)	0.004
90–70 g/l	38 (43.7%)	18 (72%)	
<70 g/l	0	2 (8%)	
Indications for emergency surgery			
Intestinal obstruction, cause:			<0.0001
- malignant tumor	66 (75.9%)	6 (24%)	
- adhesive obstruction	13 (14.9%)	0	
- cecal volvulus	2 (2.3%)	0	
- obstructive obstruction due to Crohn's disease	3 (3.4%)	0	
- perforation due to a malignant tumor	0	9 (36%)	
- bleeding, the cause is a malignant tumor	1 (1.1%)	2 (8%)	
- acute mesenteric ischemia	2 (2.3%)	8 (32%)	

Operation time			
daytime	58 (66.7%)	6 (24%)	<0.0001
from 4 pm to 8 pm	29 (33.3%)	7 (28%)	
after 8 pm	0	12 (48%)	
Average operation time (minutes)	162±10.2 (105–248)	110±9.5 (59–212)	0.038

Notes: PA — primary anastomosis; RH - right hemicolectomy

Patients of the 1st group (with the formation of PA) were younger in age: in the 1st group, the average age was 61 years versus 73 years in the 2nd ($p = 0.021$). In addition, patients of the 2nd group were initially in a more severe condition upon admission to *ASA* III–IV and had a higher comorbidity.

Statistically significant differences were found between the groups in terms of indications for surgery. In most cases, the main indication for emergency right hemicolectomy in group 1 was obturation, and more often the cause of obturation was a malignant tumor ($n = 66$; 75.9%) located in the ascending colon ($n = 39$), ileocecal junction ($n = 27$). In other cases, obturation intestinal obstruction was caused by adhesions ($n = 13$; 14.9%), cecal volvulus ($n = 2$; 2.3%), inflammatory diseases (Crohn's disease) ($n = 3$; 3.4%) .

In group 2, the main indications for RH without PA formation were malignant tumor perforation ($n = 9$; 36%) and acute mesenteric ischemia ($n = 8$; 32%). In a smaller number of cases, RH without PA formation was performed for tumor obstruction ($n = 6$; 24%) and bleeding from a malignant tumor ($n = 2$; 8%).

A statistically significant difference was obtained between the groups in terms of the time of the operation: daytime, evening or night. In the 2nd group, more surgical interventions were performed after 8 pm (p <0.0001). All 87 patients of the 1st group underwent manual anastomosis; in most cases, end-to-side ($n = 3944$; 8%) and side-to-side anastomoses ($n = 31$; 35.6%) were performed and in a smaller percentage of cases — end-to-end ($n = 17$; 19.5%). The average duration of surgical intervention in the 1st group was 162±10.2 minutes (105–248), in the 2nd group — 110±9.5 minutes (59–212) ($p = 0.038$), Table 1.

In the 2nd group (without the formation of PA), there was a greater number of serious complications (III *B* – IV *B* according to *Clavien – Dindo*) compared with the 1st group ($p = 0.001$ and $p = 0.025$, respectively), Table 2. In both groups, the most common postoperative complication was wound infection.

Table 2

Postoperative complications according to Clavien – Dindo

View after surgical complication	Severity of complications according to *Clavien - Dindo*	Number of patients with - postoperative complications in group 1, *n* (%)	Number of patients with - postoperative complications in group 2, *n* (%)	*p*
Wound infection	I	25 (28.7)	9 (36)	0.061
Postoperative paresis of the gastrointestinal tract	II	1 (1.1)	0	0.023
Postoperative pneumonia (focal)	II	2 (2.3)	4 (16)	
Parastomal abscess	IIIa	0	3 (12)	0.0014
Exudative pleurisy	IIIa	2 (2.3)	3 (12)	
Bladder atony	IIIa	1 (1.1)	1 (4)	
Eventration	IIIb	1 (1.1)	0	<0.0001
Necroscolostomy	IIIb	0	2 (8)	
Early adhesive intestinal obstruction	IIIb	1 (1.1)	0	
Postoperative bleeding	IIIb	1 (1.1)	1 (4)	
Anastomotic failure	IIIb	4 (4.6)	0	<0.0001
Atrial fibrillation complicated by heart failure	IVa	3 (3.4)	1 (4)	0.037

Polysegmental pneumonia	IVa	5 (5.7)	2 (8)	
Renal failure due to diabetic nephropathy	IVb	3 (3.4)	2 (8)	0.025
Progressive peritonitis	IVb	1 (1.1)	1 (4)	
Fatal outcome	V	4 (4.6)	2 (8)	0.044

Anastomotic failure (AF), requiring repeated surgical intervention, was observed in 4 patients (4.6%) of the 1st group. In all patients with AF, repeated laparotomies were performed, with separation of the anastomosis and removal of a separate double-barrel colonostomy.

In the 2nd group, 18 out of 25 patients (72%) underwent subsequent operations aimed at restoring intestinal continuity - the formation of an interintestinal anastomosis as the second stage. In 16 patients (64%), end-to-side anastomosis was formed at the second stage, and side-to-side anastomosis was formed in 9 (36%) patients.

Fatal outcome was observed in 4 patients of the 1st group and in 2 patients of the 2nd group (p = 0.044). In the RH group with the formation of PA, the causes of death were: one multiple organ failure (MOF) due to progressive peritonitis and sepsis caused by AF; 3 patients had pulmonary embolism (PE), the cause of obstruction was a malignant tumor. In the RH group without PA formation, the causes of death were: progressive peritonitis, which developed due to tumor perforation (n = 1), with MOF; PE (n =1).

Eighteen patients of the 2nd group, who underwent a reconstructive operation at the second stage, required repeated hospitalization for the implementation of the 2nd stage. Out of 18, 8 patients of the 2nd group had a separate double-barrel the colonostomy was brought out through one opening on the anterior abdominal wall, which did not require laparotomy during the second stage. In the remaining 10 patients of the 2nd group, the second stage was performed by laparotomy. The median readmission time was 14 days (11–37). After the recovery phase, AF was not observed. In seven patients of the 2nd group, the recovery stage was not performed for the following reasons: 2 patients died within 30 days after the operation, 5 had contraindications: 3 cases due to the progression of the malignant process and 2 cases due decompensated cardiovascular pathology. It should be noted that these patients were over 75.

Based on the results of multivariate analysis, we were able to identify the main factors that had a statistically significant effect on the risk of postoperative complications — Clavien-Dindo III B-*V* in both compared groups were: severe comorbidity, including diseases of the cardiovascular system, diabetes mellitus — Charlson index >3 (OR 3.1; 95% CI 1.4-6.3; p = 0.002), severe general condition at admission *ASA* III-IV (OR 2.7; 95% CI 1.2-7, 4; p = 0.01), anemia — Hb <90 g/l (OR 1.7; 95% CI 1.5–6.1; p = 0.004), time from the onset of the disease (appearance of the first symptoms) to hospitalization to hospital >12 hours (OR 2.1; 95% CI 0.9–6.8; p = 0.03).

When comparing the time of the operation: a) in the daytime; b) performed from 4 pm to 8 pm; c) performed after 8 pm — differences were established in the presence of postoperative complications in both groups (p = 0.014 and p = 0.032, respectively). When conducting a subgroup analysis in the two main groups after combining the subgroups by the time of the operation: in the daytime, performed from 4 pm to 8 pm, significant differences were found between the combined subgroups and subgroups in which operations were performed after 8 pm (p = 0.021 and p = 0.009, respectively). This was also confirmed by multivariate analysis: the time of surgical intervention had a statistically significant effect in this study on the development of postoperative complications (OR 2.05; 95% CI 1.38–8.1, p = 0.033).

When conducting a subgroup analysis in the 1st group on the risk of AF requiring relaparotomy, the technique of creating a manual anastomosis ("end-to-end", "end-to-side") did not have a statistically significant effect on AF (OR 0.91; 95% CI 0.76–1.04, p = 0.13).

DISCUSSION

According to the study, the primary anastomosis was formed in 87 patients out of 112 who underwent RH (77.7%), respectively, 25 underwent RH without the formation of PA (22.3%). According to the conducted studies, the indications for emergency RH without primary anastomosis are such complications from the primary tumor as perforation, abscess formation, bleeding [11, 15–17]. In this study, RHs without PA were performed precisely for these complications.

Anastomotic failure in group 1 was observed in 4 patients (4.6%), which corresponds to the data of published studies (4–6%) [4, 18, 19]. This complication was observed in patients with the presence of risk factors: general condition corresponding to III–IV *ASA*, high comorbidity (cardiovascular disease). One case of AF complicated

by widespread peritonitis resulted in a fatal outcome. This complication was in a 76-year-old patient with stage IIIb adenocarcinoma of the ascending colon, with type II diabetes mellitus, stage II obesity, with severe cardiovascular disease (postinfarction cardiosclerosis).

In the study, patients of the 2nd group (emergency RH without the formation of PA) were older than patients of the 1st group (emergency RH with the formation of PA) (p <0.001). There were statistically significant differences in these groups in terms of the etiology of the disease, intraoperative data, see Table 1. This retrospective study includes operations performed by experienced surgeons with a specialization in oncology. Based on the multivariate analysis, it was found that the following factors had a decisive role in the choice of surgical tactics: general condition III-IV *ASA*; high comorbidity; the presence of such complications from the underlying disease as perforation, abscess formation, bleeding and the presence of such an underlying disease as an acute violation of the mesenteric blood supply with necrosis of the intestinal area. In the presence of these factors, two-stage interventions were performed: the 1st stage of RH without the formation of PA, the 2nd stage — restorative surgery. These circumstances are consistent with the literature data [11, 16, 17]. It should be noted that good results were observed in situations during the formation of the primary anastomosis in case of obstruction of tumor genesis with proximal dilatation of the intestine.

All surgical interventions in group 1 were performed in the daytime and in the evening. Surgical interventions in group 2 were predominantly performed at night. Thus, the factor under consideration is the time of the operation (daytime, evening, night) and it had a statistically significant impact in the present study on the decision. According to other studies, the time factor did not have a significant impact on the development of serious postoperative complications. They emphasize the impact of the complicated course of the disease on the exacerbation and decompensation of the existing comorbidity, the adverse effect of the surgical intervention itself, performed according to emergency indications [20].

Surgical interventions performed with these clinical features should be the safest for the patient and aimed at reducing the risk of postoperative complications. Thus, based on a substantiated concept, in patients with the presence of risk factors that statistically significantly affect the development of postoperative complications, it is advisable to perform RH without the formation of PA, with a planned second stage.

In the case of diffuse peritonitis or abdominal sepsis, surgical intervention should be of a minimum volume aimed at eliminating the source of peritonitis, which can be carried out by performing primary resection, using open abdomen technologies, laparostomy and planned repeated surgical interventions after stabilization of the patient's condition (second-look operations) [19, 21]. However, in such a severe contingent of patients, the results of surgical treatment remain unsatisfactory, and advanced resuscitation in the intensive care unit is important for treatment outcomes [18, 22]. The surgical strategy with the formation of a primary anastomosis was used for patients who did not have such risk factors, the rates of postoperative complications were comparable with the data of the studies [1, 23].

With clinical features associated with acute intestinal obstruction of tumor genesis, perforation caused by a malignant tumor, bleeding from a tumor, acute mesenteric ischemia from the stage of laparotomy, the surgeon often deals with technical and tactical difficulties that cannot be resolved at once. In such circumstances, an exclusively individual approach is important in each specific clinical situation in order to eliminate errors due to inadequate analysis of the general condition of the patient, intraoperative data. The experience of the operating surgeon has a great influence on the rates of postoperative complications, which has been confirmed by a number of authors [20, 22–24].

The study included patients operated on by experienced surgeons with a specialization in oncology (at least 10 years of experience). However, two-stage surgery — RH without PA formation — followed by a reconstructive step is the best surgical option for high-risk patients.

This study has certain limitations as it is retrospective. However, it is important that this analysis allows in certain difficult situations to decide on the tactics of surgical treatment: to form a primary anastomosis or not.

CONCLUSION

In the study, in patients who underwent emergency right hemicolectomy, primary anastomosis was formed in 78% of patients, the rest underwent two-stage interventions.

Thus, for patients with high comorbidity: cardiovascular diseases, diabetes mellitus, with such complications of the main pathology as perforation, bleeding, as well as in the main disease, acute impairment of the mesenteric blood supply with necrosis of the intestinal area, the most appropriate is right hemicolectomy without the formation of a primary anastomosis followed by a planned recovery phase.

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