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ORIGINAL ARTICLES

Emergency surgery for complicated colorectal cancer – What we choose: a retrospective cohort study

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Abstract: *Introduction: Despite the progress that has been made regarding the diagnosis, a worrying percentage of patients are still admitted in an emergency, with complicated colorectal tumors, which often require interventions without a curative visa. The study aims to analyze the factors involved in choosing the type of surgical treatment.*

Patients and methods: We included in the study a group of 431 patients admitted and operated in an emergency for complicated colorectal cancer in the Surgery II Clinic of the Clinical Emergency County Hospital "Sf. Ap. Andrei" from Galați, between 2008-2017. We retrospectively analyzed the patients' data and we made statistical correlations between the type of emergency surgery and epidemiological, clinical, paraclinical, and intraoperative factors.

Results: Colostomy was mainly practiced in older patients (p<0.01), from rural areas (p<0.01), with associated cardiac diseases (p<0.01), with hydro electrolytic disorders (p<0.03), rectal tumors (p<0.01), peritoneal carcinomatosis (p<0.02), frozen pelvis (p<0.01). Hartmann's operations were associated with patients with: leukocytosis (p<0.01), intestinal perforation (p<0.01), sigmoid tumors (p<0.01). Internal derivations were associated with patients with: liver metastases (p<0.01), splenic angle tumors (p<0.01), tumors invading other organs (p<0.01), and stage IV of the disease (p<0.01). Resections with anastomosis were associated with transverse colon tumors (p<0.01), well-differentiated tumors (p<0.01).

Conclusions: The type of emergency surgery performed correlated well with the age of patients, the area, the comorbidities, the history of the disease, cachexia, anemia, oligoanuria, hydroelectrolyte disorders, tumor complication, and location of the tumor, hepatic metastases, and tumors' invasion in other organs, tumor grading and stage of the disease.

Keywords: *surgical treatment, colorectal cancer, emergency, correlations*

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INTRODUCTION

In Romania, according to the GLOBOCAN 2012 analysis, colorectal cancer was the second [1]. According to the data provided by the GLOBOCAN 2018 statistics, colorectal cancer ranks third in incidence globally (after lung and breast

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cancer) and at the 2nd place as cancer mortality (after lung cancer) [2].

The incidence is increasing both in developed countries and in those where until a few decades ago, the colorectal cancer was not a major concern [1].

Both sexes are affected in approximately equal proportions and the most affected decades of age are the sixth and the seventh [1].

Despite the improvements that have been made regarding the diagnosis and the possibilities of screening, a worrying percentage of patients are still admitted in an emergency, with complicated colorectal tumors, which often require interventions without a curative visa [3].

Of all the complications of colorectal cancer, the intestinal occlusion is the most frequent and it occurs especially in the case of tumors located in the left colon and rectum [4].

There are no clearly established protocols regarding the choice of the type of emergency surgery for colorectal cancer. Various standardizations have been tried, but no consensus has yet been reached [5]. The most debated issue is the choice of the optimal intervention for occlusive left colon cancers [6].

The choice of the surgical treatment method in an emergency is made according to several factors, such as the biological status of the patients, the duration of the complication, comorbidities, age, local invasion of the tumors, the presence of metastases, the appearance of the affected colon. Whenever possible, it is ideal to choose a method that involves the tumor resection or allows it in a second time [7].

The most recent recommendations of the WSES Scientific Committee indicate in the case of occlusive or perforated colon tumors to practice a right hemicolectomy with a terminal ileostomy. The right hemicolectomy with ileocolic anastomosis can be performed if there is no significant increase in operative time and good bowel vascularization. For left colon occlusive tumors, the Hartmann operation is considered the procedure of choice. In patients with severe instability, a colostomy should be performed. For perforations on the left colon, Hartmann's procedure is recommended, with the mention of considering the open abdomen [8].

PATIENTS AND METHODS

We included in the study a group of 431 patients admitted and operated in an emergency for complicated colorectal cancer in the Surgery II Clinic of the Clinical Emergency County Hospital “Sf. Ap. Andrei” from Galați, between 2008-2017.

The patients’ data were collected from observation sheets, operating protocols, and pathological exams. The following epidemiological and clinical factors were analyzed: age, sex, provenance area, hereditary-collateral history, abdominal surgical history, comorbidities, preoperative diagnosis, and clinical status at admission (weight, height, diuresis).

We analyzed the following paraclinical factors: the values of hemoglobin, hematocrit, leukocytes, platelets, and ionograms at admission. Among the therapeutic factors, we analyzed the tumor location, the invasion in other organs, the intraoperative appearance of the frozen pelvis, the presence of hepatic metastases and peritoneal carcinomatosis, the type of surgery performed in an emergency, lymph node dissection, liver biopsy, stoma reversal after Hartmann procedure.

The inclusion criteria were patients with colorectal malignancies hospitalized and surgically treated in the Surgery II clinic of the Clinical Emergency County Hospital “Sf. Ap. Andrei" from Galați, between 2008-2017, patients over 18 years old.

The exclusion criteria were patients with benign colorectal pathology, patients with malignant colorectal tumors operated electively, patients whose observation sheets no pathological reports were attesting the type of tumor, grading, and classification in the pTNM system were not found.

Study design

Epidemiological, clinical, paraclinical, and therapeutic factors were retrospectively analyzed, to correlate them with the four types of surgery (external derivations, Hartmann procedure, internal derivations, and resections with anastomosis).

Statistical analysis

Using the SPSS version 23.0, statistical correlations were obtained, indicating the p-value with the Pearson, Chi-Square, and Likelihood Ratio tests. Statistical conclusions were formulated using a statistically significant difference threshold the value $p < 0.05$ for all calculations performed.

RESULTS

In each of the 10 years included in the observation period of this study, an average of 43 patients was hospitalized and operated in an emergency.

There have been practiced 179 (41.5%) external derivatives

(of which 158 colostomies and 21 Pezzer cecostomies), 134 (31.1%) Hartmann operations, 29 internal derivatives (of which 16 ileo-transverse, 9 transverse-descending, 2 ileo-sigmoid, 1 ileo-descending, and 1 transverse-sigmoid anastomosis) and 89 (20.9%) resections with anastomosis (of which 47 right hemicolectomies, 13 left hemicolectomies, 26 transverse/sigmoid/descending segmental colectomies, 1 subtotal colectomy, 1 ileo-transverse anastomotic resection for a relapsed tumor and 1 rectal tumor resection with mechanical anastomosis).

The sex distribution of patients in the study reveals the predominance of men, with a ratio M/F = 256/175. Comparing the types of surgery performed (1 - colostomy/ cecostomy, 2 - Hartmann, 3 - internal derivations, 4 - resections with anastomosis), no association with the sex of the patients is obtained.

In the studied group, the patients from the urban area predominated. Patients in rural areas were associated with a colostomy ($p<0.01$) (Table 1).

Most patients (55.92%, n = 241) included were in the 5th and 6th decades of age. An association of the advanced age of the patients with the colostomy is noted ($p<0.01$) (Table 1).

43 (9.97%) of the patients had a significant hereditary-collateral history, as follows: 19 had a brother/sister with colorectal cancer, another 18 patients had a father diagnosed with colon or rectal cancer, and six patients had a son with colorectal cancer. Patients with a significant heredocolateral history for colorectal cancer were associated with colostomy and with Hartmann's procedure ($p<0.02$) (Table 1).

174 patients (40.37%) had a personal history of abdominal surgery, as follows: appendectomy - 72 patients, hysterectomy - 31 patients, cholecystectomy - 29, gastric resections (for gastroduodenal ulcer disease) – 12, caesarean section - 8, splenectomy (post-traumatic spleen rupture) -6, nephrectomy (renal lithiasis) - 6, segmental colectomy (descending colon cancers) - 4, right hemicolectomy - 2, adnexectomy - 2, hepatic hydatic cyst operated - 1 patient and colon esophagoplasty (for accidental ingestion of sodium hydroxide in adolescence) -1 patient. Comparing the patients with or without a surgical history, no statistical associations are found with the type of surgery.

Most patients (51.04%) included in the study had comorbidities. 148 of the patients (34.33%) had associated cardiac pathology, of which 77 (17.86%) with high blood pressure, 38 (8.81%) with atrial fibrillation with chronic anticoagulant treatment, 8(1.85%) with a history of myocardial infarction, 13 (3.01%) with varying degrees of heart failure, 12 (2.78%) with ischemic stroke; 42 (9.74%) patients were diabetic; 9 (2.08%) patients were diagnosed with liver cirrhosis, with thrombocytopenia; 9 other patients had colonoscopically diagnosed colon pathology, 5 of whom had colonic polyposis, 3 with Crohn's disease and one with diverticulosis. 2 of the patients had active pulmonary tuberculosis at the time of admission (transferred from another hospital). We also found statistical association by correlating the type of surgery with the presence of heart disease and atrial fibrillation, but not with liver cirrhosis. Thus, in patients with cardiac disease or atrial fibrillation, type 1 surgery (colostomy) was performed ($p<0.01$), respectively ($p<0.01$) (Table 1).

The majority of patients (87.94%, n = 379) had as main symptoms at admission the abdominal pain and the disorders of intestinal transit, and the rest (12.06%, n = 52) presented with rectal bleeding. Regarding the beginning of the symptomatology, the majority of patients (58%, n = 250) had symptoms (intestinal transit disorders and rectal bleeding) that they neglected. In patients with neglected symptomatology, it was performed a Hartmann procedure or colostomies ($p<0.01$). Patients with abdominal pain and intestinal transit disorders were associated with colostomy/ Hartmann ($p<0.01$) (Table 1).

Figure 1: Perforated sigmoid tumor (Surgery Clinic II of the County Hospital of Emergency Clinic „Sf. Ap. Andrei „Galati)

The preoperative diagnosis was intestinal obstruction in 332 patients (77.03%); 36 patients (8.35%) had intestinal perforation (tumor/diastatic) (Figure 1), 14 (3.25%) with imminent diastatic perforation (Figure 2) and 49 (11.37%) had rectal bleeding. Patients with hemorrhage or with imminent intestinal perforation (tumor/diastatic) at admission were associated with a colostomy; patients with intestinal occlusion were associated with internal derivations and resections with anastomosis. Patients with intestinal perforation were associated with the Hartmann

procedure (p<0.01) (Table 1).

Table 1: Statistical correlations of the main types of surgery

	Type 1 (N=179 – 41.5%)	Type 2 (N=134 – 31.1%)	Type 3 (N=29 – 6.7%)	Type 4 (N=89 – 20.9%)	p_value (test)
Sex					
F	74/179	47/134	12/29	42/89	0.341089 (1)
M	105/179	87/134	17/29	47/89	
Age	72.35±12.5117	67.88±12.3811	62.72±10.2396	64.89±11.2426	0.000001 (2)
Area					
R	98/179	52/134	7/29	20/89	0.000001 (1)
U	81/179	82/134	22/29	69/89	
Number of days of hospitalization	10.0 [7.0, 15.0]	13.0 [10.0, 16.2]	14.0 [12.0, 16.5]	15.0 [12.0, 17.0]	0.000000 (3)
Abdominal pain=yes	135/179	133/134	29/29	83/89	0.000000 (1)
Intestinal transit disorders=yes	135/179	133/134	28/29	81/89	0.000000 (1)
HCA=yes	10/179	20/134	1/29	12/89	0.017821 (1)
Surgical abdominal antec.=yes	81/179	50/134	13/29	30/89	0.243466 (1)
History=yes	118/179	87/134	11/29	31/89	0.000001 (1)
Anemia=yes	134/179	76/134	22/29	67/89	0.002115 (1)
Anemia transfusions=yes	55/179	27/134	2/29	23/89	0.018961 (1)
Leukocytosis=yes	13/179	33/134	4/29	13/89	0.000342 (1)
Trombocytosis=yes	4/179	5/134	0/29	0/89	0.092185 (4)
Cachexia=yes	80/179	36/134	4/29	8/89	0.000000 (1)
HE disorders=yes	82/179	54/134	7/29	27/89	0.029122 (1)
Oligoanuria=yes	72/179	35/134	2/29	5/89	0.000000 (1)
Preop. diagnosis					
H	42/179	1/134	0/29	6/89	0.000000 (4)
I	11/179	3/134	0/29	0/89	
O	120/179	106/134	29/29	77/89	
P	6/179	24/134	0/29	6/89	
Tumor location					
Ascendant	1/179	0/134	14/29	45/89	0.000000 (4)
Descendant	6/179	23/134	12/29	16/89	
Rectum	149/179	0/134	0/29	2/89	
Sigmoid	19/179	102/134	0/29	12/89	
Transverse	4/179	9/134	3/29	14/89	
Tumor invasion=yes	69/179	26/134	22/29	9/89	0.000000 (1)
Synchronous tumors=yes	1/179	0/134	0/29	2/89	0.232949 (4)
Frozen pelvis=yes	38/179	5/134	0/29	2/89	0.000000 (1)
Hepatic MTS=yes	37/179	23/134	16/29	5/89	0.000000 (1)
Carcinomatosis=yes	9/179	2/134	2/29	0/89	0.019195 (4)
Cardiac diseases=yes	83/179	38/134	7/29	20/89	0.000133 (1)
FiA=yes	26/179	7/134	2/29	3/89	0.005035 (1)
HC=yes	4/179	5/134	0/29	0/89	0.092185 (4)
HP					
ADK	179/179	134/134	28/29	89/89	0.142874 (4)
GIST	0/179	0/134	1/29	0/89	

Grading					
1	60/179	26/134	1/29	28/89	0.002476 ([1])
2	104/179	97/134	22/29	52/89	
3	15/179	11/134	6/29	9/89	
Mucoid=yes	6/179	3/134	1/29	6/89	0.411940 ([4])
pTNM					
2	20/179	51/134	0/29	35/89	0.000000 ([1])
3	120/179	59/134	12/29	50/89	
4	39/179	24/134	17/29	4/89	

Figure 2: Rectosigmoid tumor with necrosis and imminence of diastatic perforation (Surgery Clinic II of the County Hospital of Emergency Clinic „Sf. Ap. Andrei „Galati)

All patients benefited from preoperative imaging investigations, such as empty abdominal radiography and for those with a clinical diagnosis other than intestinal obstruction, abdominal ultrasonography was performed.

128 patients (29.69%) presented with cachexia when admitted (BMI <18.5). 114 patients (26.45%) had oliguria at admission (diuresis <= 500 ml). We found statistically significant differences in the cases of cachectic and oliguric patients at admission. In these patients, the colostomies were mainly practiced and only in very few cases the internal derivations/resections with anastomosis were chosen (p<0.01) (Table 1).

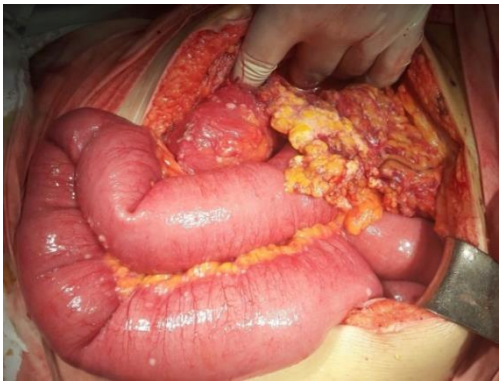
299 (69.37%) of all patients had anemia at admission. Of these, 107 required full blood transfusions or erythrocyte mass. According to the reference interval of our laboratory, we considered anemia values of hemoglobin less than 11g/dl and hematocrit less than 35%. Statistical analysis revealed the association of patients with anemia with a colostomy, and Hartmann's operations (p<0.01); as well as patients with anemia with blood transfusion with a colostomy, or internal derivations (p<0.02) (Table 1).

63 patients (14.61%) had leukocytosis at admission (a number of leukocytes> 10,000/µl). Thus, patients with leukocytosis were associated with Hartmann's interventions (p<0.01) (Table 1).

170 patients (39.44%) had hydro electrolytic disorders at admission (especially hypopotassemia). We considered that the patients with hydro electrolytic disorders were those whose ionograms on admission showed values of Na <136 mmol/l and potassium values <3.5 mmol/l. Patients with hydro electrolytic disorders were associated with a colostomy (p<0.03) (Table 1).

During the emergency surgery, in 13 cases (3.01%) the presence of peritoneal carcinomatosis was found (Figure 3). Peritoneal carcinomatosis has been associated with a colostomy (p<0.02). 81 (18.79%) patients had liver metastases, found either on preoperative ultrasound examination or the occasion of laparotomy (in most cases). Patients with liver metastases were associated with internal derivations (p<0.01) (Table 1).

Figure 3: Ascendant colon tumor, peritoneal carcinomatosis (II Surgery Clinic, Sf. Ap. Andrei Clinic Emergency County Hospital Galati)



45 (10.44%) of the patients had "frozen pelvis" (tumor block comprising other pelvic organs, to which there is firm adherence, with very difficult or non-existent cleavage planes, to which small bowel loops adhere). Patients with frozen pelvis were associated with a colostomy (p<0.01) (Table 1).

Regarding the location of tumors, 60 (13.92%) were located at the level of the ascendant and hepatic angle of the colon, 30 (6.98%) at the level of the transverse colon, 57 (13.22%) at the level of the descending and splenic angle of the colon, 133 (30.85%) in the sigmoid colon and recto-sigmoid junction and 151 (35.03%) were rectal tumors.

For the tumors of the ascending colon and hepatic angle, in most cases, resections with anastomosis (right hemicolectomies) were practiced, followed by internal derivations and cecostomies ($p<0.01$), the patients with tumors located on the descending colon and the splenic angle mainly benefited from internal derivations or Hartmann's interventions ($p<0.01$), for patients with tumor location in the rectum, colostomies were practiced ($p<0.01$) and for the transverse colon locations, resections with anastomosis ($p<0.01$) were performed (Table 1).

In 126 cases (29.23%) we encountered tumors invading other organs: 27 invasive tumors in the prostate, 26 cases with tumors that invaded the small intestine, 18 invasive tumors in the gastrocolic ligament/large epiploon, 13 in the vagina, 11 in the abdominal wall, 10 in the sacrum bone, 6 tumors were invasive in the bladder, 4 in the duodenum (+/- head of the pancreas) and spleen, 3 invasive tumors in the right/left annexes, 2 in the left renal capsule and 2 tumors that invaded the pelvic ureter. The subset of patients with invasive tumors in other organs was associated with internal derivations ($p<0.01$) (Table 1).

Data from the histological reports revealed the predominance of adenocarcinomas (99.76% of cases) and only one GIST tumor. 16 (3.71%) of the patients had tumors with a mucoid component.

Regarding tumor grading, 115 (26.68%) were well-differentiated adenocarcinomas (grade 1), 275 (63.8%) medium differentiated tumors (grade 2) and 41 (9.52%) weak tumors differentiate (grade 3). Well, and medium differentiated tumors were associated with colostomies or with resections with anastomosis ($p<0.01$).

For postoperative staging, we used the classification recommended by The Union for International Cancer Control (UICC). Thus, according to pTNM staging, tumors in stages II and III predominated - 106 (24.59%), tumors in stage II, 241 (55.91%) in stage III, and 84 (19.5%) in stage IV. The patients in stage II were associated with resections with anastomosis or Hartmann operations ($p<0.01$), patients with tumors in stage III were associated with colostomies ($p<0.01$), and patients in stage IV were associated with internal derivations and colostomies ($p<0.01$) (Table 1).

DISCUSSIONS

According to literature data, up to 30% of colorectal cancer patients present with complicated tumors in emergency [9]. Despite many standardization attempts, the best surgical option for patients with complicated colorectal tumors is still under debate. [5, 10]

We have shown in this study that the type of surgery in patients with complicated colorectal cancer correlates with: age, provenance area, associated cardiac diseases, history of the disease, cachexia at admission, oliguria and hydro electrolytic disorders, diagnosis, presence of liver metastases, and frozen pelvis appearance, tumor location, tumor invasion in other organs and staging.

There is no consensus regarding the surgical treatment of the elderly affected by colorectal cancer, but it is generally accepted that patients over 80, who present in an emergency, compared to the younger ones, have a higher risk of postoperative complications and mortality, despite the progress made in preoperative care, surgical techniques, and intensive care.[11] Most authors reported significant correlations between the type of intervention and the age of the patients [6, 12], as we found in our study, but different from the data obtained by other authors.[13]

Several authors found significant correlations between the type of operation and the patients coming from the rural area [14], as we found in our study. Most authors agree that patients in rural areas have lower addressability due to more difficult access to medical services and therefore tend to show up later, with more advanced tumors.[15, 16]

The comorbidities, especially the cardiac ones, are associated in many studies with the practice of non-curative interventions in patients with complicated colorectal cancer.[17, 18] We also found this correlation in our study.

The pathophysiology of cachexia syndrome is characterized by negative energy and protein balance. In neoplastic patients, it is a major cause of morbidity and mortality [19-22]. A recent study, which included 235 patients with advanced colorectal cancer, reaffirms the negative impact of cachexia on the evolution of the patients with complicated colorectal cancer.

Oliguria is considered a specific and sensitive biomarker of renal dysfunction and a good predictor of mortality risk in critically ill patients, including complicated colorectal tumors.[24, 25] For patients with complicated colorectal cancer, with oligoanuria at admission, colostomies are performed, according to several reports [26, 27], as we found in our study.

Neoplastic patients frequently present with hydroelectrolyte balance disorders. These occur during tumor growth, because of inadequate absorption of electrolytes or because of the secretion of metabolically active substances by the tumor [28]. The hydroelectrolyte disorders present at admission are associated with the type of surgery performed in patients with complicated colorectal cancer [29], as we have shown in our study.

The liver is the most common location of secondary dissemination of primary colorectal tumors. Between 10% and 25% of colorectal cancer patients have liver metastases at the time of surgery [30]. Despite all the therapeutic progress made in recent years, the presence of liver metastases remains a negative prognostic factor.[31] Most of the time, these patients have advanced tumors and the only viable option in an emergency is a colostomy, which will allow them to survive for several months.[32] We made the same finding in our study.

The type of surgery is associated with the preoperative diagnosis, which, most commonly, is the intestinal obstruction. The therapeutic attitude in these cases depends on the location of the primary tumor, the stage, the general state of the patient, and the local changes (tumor resectability, colic distention, ischemic lesions of the colic wall, integrity of the ileocecal valve).[33, 34]

For perforated tumors, Hartmann's intervention is the recommended option in most published works [35-37], as we have shown in our study. For hemorrhagic tumors, the options are different depending on the location of the tumor.

In our study, most hemorrhagic tumors were rectal, and the emergency surgical option was most often a colostomy, after a local bleeding control. In the literature, there is also mentioned the practice of arteriographic embolization in these situations [38], a technical possibility that we did not have.

Patients with locally advanced colorectal tumors, with invasion in other organs, can be a therapeutic challenge [39-41].In most cases, in these situations, a terminal colostomy is practiced [42], which also happened in our study group. Other authors have considered the practice of plurivisceral resections in these situations.

The first such series was reported by Sugarbaker in 1946.[43] Croner et al. performed a study on 174 patients who underwent plurivisceral resections during the period 1978-2002 [44]. Most of the patients had sigmoid colon cancers and the most commonly invaded organs were the small intestine, the bladder, and the abdominal wall.

The type of emergency surgery performed for complicated colorectal cancer is significantly statistically correlated with the colorectal tumor location in all the analyzed studies. Most authors consider, as in our study, that single-phase procedures for left colon tumors are not indicated in emergency and that in these situations the Hartmann procedure is preferable.[45, 46] But some authors believe that, including for occlusive left colon tumors, the first option should be a resection with anastomosis [7, 13, 47, 48]. For the complicated tumors located on the right colon, there seems to be unanimity regarding the surgical option, in these cases the right hemicolectomy being the option.[8, 49]

The TNM staging proposed by the AJCC has remained a universal model since its first edition in 1977 [50]. Since then, the guides have been revised several times and the last update was proposed in 2018 [51]. In our study, stage II of disease correlated with Hartmann's operation and stage IV with a colostomy, as we found in other works.[52, 53]

CONCLUSIONS

1) The colostomy was associated with: older age, rural area, associated cardiac diseases, especially atrial fibrillation, neglected symptomatology, cachexia, oliguria, anemia, and hydro electrolytic disorders at admission, tumors complicated with hemorrhage or with imminent diastatic perforation, the intraoperative aspect of the frozen pelvis, rectal tumors, well or medium differentiated tumors, advanced stages of disease (III or IV pTNM).

2) Hartmann's operations were associated with the significant hereditary-collateral history, neglected symptomatology, intestinal transit disorders and abdominal pain upon admission, leukocytosis, intestinal perforation, sigmoid, and recto-sigmoid junction tumors, and stage II TNM.

3) Internal derivations were associated with the presence of intestinal occlusion at admission, liver metastases, and invasion in other organs, with tumors of splenic angle or descending colon and with stage IV disease.

4) Resections with anastomosis per primam were associated with the absence of comorbidities, tumors located at the level of the ascendant colon, hepatic angle, or transverse colon and well-differentiated tumors.

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