

Multivisceral Resection for Locally Advanced Colon Cancer: Clinical and Treatment Characteristics Based on Final Pathological Evaluation. A Retrospective Study

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Rezumat

Rezeție multiviscerală în cancerul de colon local avansat: caracteristici clinice și tratament în corelație cu evaluarea anatomo-patologică finală. Studiu retrospectiv

Introducere: Rezeția radicală reprezintă cel mai important element care influențează prognosticul oncologic al pacienților cu cancer de colon. Pentru a obține o rezeție R0 în cazurile unor tumori local avansate de cancer de colon este necesară efectuarea unei rezeții multiorgan. Scopul acestui studiu a fost de a oferi elemente privind caracteristicile tumorale, tipul de tratament chirurgical și evaluarea histopatologică finală.

Metode: Am efectuat un studiu retrospectiv analizând documentele medicale ale pacienților diagnosticați cu cancer de colon internați în clinica noastră, în intervalul Ianuarie 2018 - Ianuarie 2025 la care s-a efectuat o rezeție multiviscerală. Am evaluat caracteristicile clinice ale acestora, tipul de intervenție chirurgicală, complicațiile postoperatorii și buletinul anatomopatologic al specimenului chirurgical. Pacienții au fost grupați în funcție de stadializarea anatomopatologică în pT3, pT4a, respectiv pT4b.

Rezultate: În perioada analizată au fost operați 968 de pacienți cu cancer de colon, iar în 82 de cazuri (8.47%) s-a efectuat o rezeție multiorgan. După evaluarea finală anatomopatologică a pieselor de rezeție 21 pacienți (25.6%) au avut tumori pT3, 74.4% au fost tumori T4, marea majoritate fiind tumori pT4b (43 cazuri, 52.4%). Organele cel mai frecvent rezecate în bloc au fost: intestin subțire în 26 cazuri (31.7%), vezică urinară în 29 cazuri (34.1%), organe genitale interne în 24 cazuri (28.2%) și perete abdominal în 22 cazuri (25.9%). Tumorile pT4b au fost cel mai frecvent moderat diferențiate (55.8%) și respectiv slab diferențiate (7%), cu invazie limfatică (67.4%), vasculară (39.5%) și perineurală (27.9%) comparativ cu tumorile pT3 sau pT4a. Complicații postoperatorii severe au apărut în 7.31% din cazuri.

Concluzii: Rezeția multiviscerală reprezintă o opțiune sigură în tratamentul radical al cancerului de colon local avansat. Acest studiu demonstrează că dacă această procedură este efectuată într-un centru terțiar, de către o

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echipă chirurgicală cu experiență în tratarea malignităților abdominale avansate, tratamentul chirurgical radical implicând rezecție multiorgan reprezintă o opțiune fezabilă.

Cuvinte cheie: cancer de colon local avansat, rezecție multiviscerală, morbiditate

Abstract

Background: Radical resection remains the most important factor that influences long term survival for patients with colon cancer. In order to achieve R0 resections in cases of locally advanced colon cancer a multivisceral resection is required. The aim of this study is to give insights regarding tumour characteristics, surgical treatment, early results, and final evaluation of surgical specimen.

Methods: This retrospective study includes all consecutive patients positively diagnosed with colon cancer between January 2018 and January 2025 in whom multivisceral resection was performed. We evaluated the clinical characteristics of the patients, the type of surgery, postoperative complications, and the final pathological staging. We grouped the patients based on pathological evaluation and TNM staging system into pT3, pT4a, and pT4b.

Results: During this period, there were 968 patients diagnosed with colon cancer in whom surgery was performed, of these, multivisceral resection was performed in 82 cases (8.47%). Based on final pathological evaluation, 21 patients (25.6%) presented pT3 tumours and the rest, 74.4% were pT4 tumours, the vast majority were patients with pT4b tumours (43 cases, 52.4%). The most common organs resected were small bowel 26 patients (31.7%), bladder 29 cases (34.1%), genital organs in 24 cases (28.2%), and abdominal wall in 22 cases (25.9%). Based on pathological evaluation, pT4b tumours were more frequent moderate (55.8%) and poorly (7%) differentiated with lymphatic (67.4%), vascular (39.5%) and perineural invasion (27.9%) by comparison with pT3 or pT4a tumours. Severe complication occurred in 7.31%.

Conclusions: Multivisceral resection represents a relatively safe procedure in the radical treatment of patients with advanced colonic cancer. Our study demonstrates that if this procedure is done in a tertiary centre by a surgical team with high expertise and experience in treatment of advanced abdominal malignancies, it can provide a safe solution for these patients.

Keywords: advanced colon cancer, multivisceral resection, morbidity

Introduction

One of the most frequent cancers worldwide is colorectal cancer, being the third most common cancer in males and the second most frequent in females (1). The highest incidence of colorectal cancer is observed in Europe, Australia, and North America (2). Although screening and early detection of colon cancer is the most important factor in order to improve the prognosis of patients with colon cancer, quite often, there are patients who are diagnosed with advanced stage tumours (3). The mainstream of treatment for colon cancer is represented by surgical resection, which gives the best chances for cure. En bloc multivisceral resection of colon cancer with curative intent has been established as a standard of care for locally advanced colorectal cancer (4), the aim of the surgical treatment is to obtain a R0 resection specimen. Due to the anatomic particularities of the colon, multivisceral resections for colon cancer

represent a heterogeneous group of surgical procedures that can include small bowel resection, partial cystectomy, gastric resection, spleen or pancreatic resection, and, in a limited number of cases, even a Whipple procedure (5). Previous studies reported a relatively high percentage of severe complications following multivisceral resection for colon cancer (over 30%) with a 5-year survival rate around 50% (6). It seems that even the type of multivisceral resection can influence the prognosis of the patient, gastrointestinal resection is correlated with the occurrence of surgical complications, and involvement of abdominal wall, omentum, ovaries was related to an increased intra-abdominal recurrence rate (5). Although the local extension to adjacent organs is suggested by preoperative imaging studies, mainly CT scan, the decision to perform a multivisceral resection is ultimately taken during the surgical evaluation of the tumour. Based on previous studies, a true tumoral infiltration of the surrounding organs was

proven histopathologically in 30 to 70 % of cases (7,8), for the rest of the cases, an inflammatory reaction was observed histopathologically. Three patterns of pT4 tumours were described: one that perforates the visceral peritoneum, another is a tumour that perforates the visceral peritoneum and directly invades other organs by ways of malignant invasion, and the latter perforates the visceral peritoneum and invades the organs by ways of inflammatory adhesions (9). Due to the fact that a multivisceral resection can be associated with severe postoperative complications that can prolong hospital stay, increase costs and delay of the adjuvant treatment, this type of surgery must be performed in a specialised centre with a highly trained surgical team.

The aim of this study is to offer an insight into a relatively large group of patients regarding the clinical and pathological characteristics, the type of surgery and the outcomes by comparing these parameters across subgroups of patients with pT3, pT4a, and pT4b tumours.

Materials and Methods

We performed a retrospective analysis on a prospectively conducted database that includes all consecutive patients diagnosed with colon cancer in whom surgery was performed from January 2018 until January 2025 in the 1st Surgical Clinic of the Regional Institute of Oncology Iasi. In this database, we identified all the patients who underwent a colectomy with a multiorgan resection for a locally advanced tumour that invaded the surrounding organs. Removal of other organs, not in contact with the tumour (such as splenectomy for an intraoperative injury) or organs which were removed due to a synchronous condition were not considered to be a multiorgan resection and, thus, were not included in the study. Prior to surgical resection, all patients were staged using a CT-scan of the chest, abdomen, and pelvis, and in selected cases, an abdominal MRI was performed. All cases were reviewed in a multidisciplinary meeting and treatment was performed according to their recommendations. Radical colon resection with D2 lymphadenectomy was performed routinely. All anastomoses were performed using a hand-sewn suture technique. All surgeries were performed by 4 senior surgeons with extensive experience in colorectal and major surgery.

We reviewed the clinicopathological data of the patients including: age, sex, tumour localisation, haemoglobin and white blood cells count, plasma

levels of tumoral markers, type of surgery, final pathological assessment of surgical specimen, histological type, depth of tumour invasion, resection margins. Postoperative complications were stratified according to the Clavien-Dindo classification (10), and we selected only grade 3 and above as major complications. We analysed the clinical, tumour characteristics type of surgery based on final pathological evaluation. Tumours were staged according to the TNM classification (11).

Statistical Analysis

For statistical analysis, we used descriptive statistics using SPSS in order to evaluate the patient, tumour, surgery and outcomes data of the selected patients. Continuous variables were expressed as mean, standard deviation and median. Categorical variables were presented as absolute and frequencies. One-Way ANOVA was used for analysis of variance, and the Mann-Whitney U test was used for medians. The Chi-square test or Fisher's exact test were used to compare the categorical data. P-value < 0.05 was considered statistically significant.

Results

During the 5-year study period, there were 968 patients diagnosed with colon cancer in whom surgery was performed, of these, tumour localisation was in 450 cases (46.48%) at the level of sigmoid colon, in 297 cases (30.68%) on the right colon, 102 cases (10.53%) on transverse colon, and in 119 cases (12.29%) on the descending part of the colon. Multiorgan resection was performed in 82 cases (8.47%). Patients and tumour characteristics are summarised in *Table 1*. Based on final pathological evaluation, 21 patients (25.6%) presented pT3 tumours and the rest, 74.4% were pT4 tumours, the vast majority were patients with pT4b tumours (43 cases, 52.4%). The mean age of all the patients was 63.76±12.62 years, although the age of patients with stages pT3 and pT4 was relatively lower, was not statistically significant ($p=0.06$). We also found that in males extended resection was performed more often (62.4%), this tendency was maintained also for pT4b cases (76.7%) and less frequent for pT4a cases (44.4%). The most common localisation of the tumour was at the level of sigmoid colon 44 cases (51.8%), and the least frequent at the level of transverse colon 8 patients (9.4%).

We primarily evaluated and grouped patients based on anatomopathological findings, but

Table 1. Patients' characteristics

	cT4 (n=82)	pT3 (n=21)	pT4a (n=18)	pT4b (n=43)	P-value
Age (yr)	63.76 (SD=12.62)	69.19 (SD=7.69)	60.55 (SD=15.47)	62.44 (SD=12.7)	0.062
Sex					
Male	53 (62.4%)	12 (57.1%)	8 (44.4%)	33 (76.7%)	0.039
Female	29 (34.1%)	9 (42.9%)	10 (55.6%)	10 (23.3%)	0.039
Lesion					
Right colon	17(20%)	7 (33.3%)	4 (22.2%)	6 (14%)	0.196
Transverse	8 (9.4%)	0	4 (22.2%)	4 (9.3%)	0.065
Left colon	13 (15.3%)	3 (14.3%)	3 (16.7%)	7 (16.3%)	0.974
Sigmoid	44(51.8%)	11 (52.4%)	7 (38.9%)	26 (60.5%)	0.302
Hb 10.3(± 2.12)	10.49 (±1.7)	10.56 (±2.36)	10.22 (±2.24)	0.813	
WBC	9700(± 3500)	9070 (±3730)	10280 (±4000)	9810 (±3270)	0.557
Albumin	4.02 (± 0.58)	4.17 (±0.46)	3.84 (±0.75)	3.95 (±0.53)	0.422
CEA	21.2(± 10.5)	17.39 (±26)	17.78 (±28.24)	25.2 (±43.1)	0.655
CA 19-9	41.8(± 12.44)	82.01 (±219)	36.43 (±43.79)	22.16 (±51.56)	0.196
Bowel invasion	26 (31.7%)	3 (14.3%)	5 (27.8%)	18 (41.9%)	0.077
Abdominal wall	22(25.9%)	7 (33.3%)	7 (38.9%)	8 (18.6%)	0.195
Bladder	29(34.1%)	5 (23.8%)	4 (22.2%)	20 (46.5%)	0.085
Duodenum	6(7.1%)	2 (9.5%)	1 (5.6%)	3 (7%)	0.887
Genital (uterus/ovaries)	24(28.2%)	3 (14.3%)	2 (11.1%)	7 (16.3%)	0.872
Stomach	7(8.2%)	0	1 (5.6%)	6 (14%)	0.151
Retroperitoneum (including pancreas)	15 (17.6%)	6 (28.6%)	6 (33.3%)	5 (11.6%)	0.096
Peritumoral abscess	12 (5.3%)	1 (4.8%)	5 (27.8%)	6 (14%)	0.126
Metastatic disease	13 (15.85%)	5 (23.8%)	2 (11.11%)	6 (13.95%)	0.259

considering the systemic disease status, 13 patients (15.85%) presented with hepatic secondary lesions, of whom 11 patients had multiple liver metastases and 2 patients had single metastases. In one case there were also multiple pulmonary metastases on thoracic CT scan; and in 2 cases there were limited pelvic peritoneal lesions. Surgical treatment was performed of first intention, with one exception in a patient presenting in a different centre with intestinal occlusion where intraoperative findings revealed localised primary sigmoid tumour with bladder invasion and a complex fistula involving the abdominal wall where a colostomy was initially performed and after chemotherapy radical resection was implied. Six patients had synchronous colorectal primary tumours that were both resected at the same operative time. One patient had metachronous colon cancer and there were one case each of synchronous prostate neoplasm, endometrial cancer, and granulocytic lymphocytic lymphoma. In all of those patients the decision to perform surgery was taken based on the patient's symptoms or on the imaging findings, for example in 8 cases an abscess was described.

Regarding the surgical procedure for the colon tumour, the most frequent technique was

Hartman's procedure in 21 cases (25.6%), as seen in *Table 2*. Tumours located at the level of the transverse colon were not resected by performing a transverse colectomy; instead, an extended right colectomy or a left colectomy was performed depending on tumour localisation and local invasion. In 4 cases (4.87%), a right colectomy with Whipple procedure was performed for tumours located at the level of the ascending colon with invasion of the duodenum, and in 3 cases (3.65%), a right colectomy with a limited resection of duodenal wall was performed. For tumours on the right side of the colon, in all cases primary anastomosis was performed, for tumours on the left side primary anastomosis was performed in 65% of cases (39 of 60 patients). In 3 cases (3.65%), a total colectomy was performed mainly due to the occlusive tumour with severe colon distension.

The most common organs resected were small bowel 26 patients (31.7%), bladder 29 cases (34.1%), internal genital organs in 24 cases (28.2%), and abdominal wall in 22 cases (25.9%). The number of organs resected, besides the colectomy, varied between 5 organs (uterus, small bowel, partial cystectomy, ureter resection, and abdominal wall) in one case, 4 organs in 5 cases,

Table 2. Type of surgery, early postoperative outcomes, and final pathological evaluation of resection specimen

	pT3	pT4a	pT4b	P-value
Right colectomy	7 (33.3%)	5 (27.8%)	7 (16.3%)	0.275
Total colectomy	0	0	3 (6.7%)	0.243
Left colectomy	12 (57.2%)	11 (61.2%)	16 (37.2%)	0.257
Hartmann procedure	2 (9.5%)	2 (11.1%)	17 (39.5%)	0.009
Fistula	0	0	4 (9.3%)	-
Bleeding	0	0	1 (2.3%)	-
Other major complication	0	0	1 (2.3%)	-
No. of resected lymphnodes	32.42 ($\pm$ 13.27)	37.5 ($\pm$ 17.2)	39.2 ($\pm$ 15.6)	0.261
Positive lymphnodes	2.85 ($\pm$ 8.83)	1.66 ($\pm$ 3)	1.35 ($\pm$ 3)	0.546
G1	4 (19%)	2 (11.1%)	5 (11.6%)	0.679
G2	7 (33.3%)	11 (61.1%)	24 (55.8%)	0.153
G3	4 (19%)	0	3 (7%)	0.091
L1	14 (66.7%)	10 (55.6%)	29 (67.4%)	0.659
V1	13 (61.9%)	7 (38.9%)	17 (39.5%)	0.220
Pn1	4 (19%)	4 (22.2%)	26 (60.5%)	0.002
Mucinous type	6 (28.6%)	9 (50%)	12 (27.9%)	0.218
NO	10 (47.61%)	10 (55.55%)	20 (46.51%)	0.806

3 organs in 8 cases, 2 organs in 12 cases. For the rest of the patients, surgical treatment consisted of colectomy and resection of either one of the mentioned organs in *Table 1*. The peritumoral abscess was diagnosed intraoperatively based on macroscopical findings in 12 cases (5.3%) and it was more frequent in pT3 (27.8%) and especially pT4 (14%) cases; but, for the majority of patients, the anatomopathological microscopic findings described inflammatory modifications with micro-foci of abscess. In terms of radicality of resection, proximal and distal sections were without tumour infiltration, but the circumferential resection margin was located up to 1 mm from the tumour front. In 2 cases of small bowel resection, there were ileal sections with tumour invasion, therefore all the cases were R0 resections.

All major complications, such as bleeding, fistula, abscess formation, were encountered in patients with pT4b tumours, as seen in *Table 2*. There were no cases of death in our group. The one patient with postoperative bleeding was managed conservatively. Also, patients with anastomotic fistula did not necessitate surgical reintervention, they were administered antibiotics, nutritional support, hydroelectrolytic rebalance, and they were closely monitored according to current recommendations. One patient had superficial surgical site infection. General postoperative complications such as urinary tract infection, hepatocytolysis syndrome, a degree of acute kidney injury or fever were isolated and transient cases.

Based on pathological evaluation, pT4 tumours were more frequently moderate (55.8%) and poorly (7%) differentiated with lymphatic (67.4%), vascular (39.5%), and perineural invasion (27.9%) by comparison with pT3 or pT4a tumours. Moreover, pT4b tumours were more frequently mucinous type tumours (27.9%). There was no difference in the number of positive lymphnodes in between T3 and T4 tumours ($p=0.546$).

Discussions

Completeness of resection remains the most important factor for the general prognosis of patients with solid tumours, and, thus, for colon cancer. According to previous published studies, multivisceral resection for colon cancer is performed in percentages that vary from 1.2 up to 19.2% of cases. (7, 12-14). This also depends on the experience of the centre involved in the treatment of colorectal cancers, more experienced centres with highly experienced surgical teams are more often involved in the treatment of complex cases. We represent a tertiary centre with a high experience in the treatment of colorectal cancer, and, based on these data, we performed multivisceral resection on 8.47% of colon cancer patients surgically treated during the past 8 years. Another possible explanation is that a large proportion of patients are diagnosed at an advanced stage of the disease due to a lack of awareness of the symptoms.

A detailed assessment of colon cancer at the

moment of positive diagnosis is crucial in order to plan the best treatment aiming to cure the patient (15). CT scanning with intravenous contrast or, in selected cases, MRI, are commonly used for preoperative assessment of colon cancer, as demonstrated in our series. There still are difficulties in obtaining an accurate clinical assessment of the TNM stage for colon cancer, a Dutch study shows that the overall clinical-pathological agreement for T stage was 59% and for N stage 57% and the sensitivity and specificity of CT to detect T3-4 tumours were 80% and 92%, with a positive predicted value of 92% (16). A more recent study that included 125,473 patients showed a moderate concordance between clinical and final pathological stage, for T stage Kappa=0.606, with lower values for right sided colon cancers (Kappa=0.594), but with a higher concordance for left sided tumours (Kappa=0.624), a sensitivity of clinical assessment for T stage ranged from 64.3 to 77.2%, and specificity ranged from 96.7 to 97.7% (17).

In our study, surgical treatment was performed of first intention in order to control local symptoms and it was discussed within a multidisciplinary team. The final decision to perform a multivisceral resection, although it was suggested in some cases based on preoperative assessment, was taken during the surgical exploration of the peritoneal cavity.

The most common structures invaded by T4b colon tumours are small bowel, urinary bladder, and abdominal wall. (5, 14, 18). The results of this study conclude with published data, but, interestingly, we found in female patients a high number of cases with invasion of gynaecological organs (28.2%), we did not separate the hysterectomy from the resection of the ovaries. The most practical aspect is that ovariectomy is less prone to developing a surgical complication, instead hysterectomy can increase the risk of fistula formation in cases of bowel anastomosis. Complication rates following multivisceral resection for colon cancer vary between 28 and 48% (7,19,20). Moreover, it was shown that gastro-intestinal multivisceral resection was independently associated with surgical complications (HR 3.9, 95% CI 1.4–10.6) (5). In our series, we presented only major complications rates, if we include the minor complications (class 1-2 Clavien-Dindo), the actual rate is higher. A possible explanation for the low percentage of fistula is that we prefer a more conservative approach, anastomosis is performed during the

surgery for right sided tumours, for left sided tumours especially for locally advanced sigmoid tumours we prefer stoma formation with a delayed anastomosis after completion of chemotherapy.

Based on the results of our study, actual pT4 tumours were 52.43%, this result is similar to previous data from retrospective studies (8,9,18, 21). Intraperitoneal inflammation and a locally advanced tumour even more complicated with peritumoral abscess represent an important cause of morbidity, but we did not register any cases of death. The adhesion found during surgical exploration cannot be distinguished between inflammatory or malignant adhesions. Moreover, the inflammatory reaction surrounding the tumour precedes subsequent tumour infiltration. In some cases, these inflammatory adhesions could play a protective role against tumour perforation with formation of abscess or peritonitis or by inducing intraperitoneal tumour seeding. The circumferential resection margins and the ileal sections with tumour invasion suggest the necessity of adjuvant therapy for local disease control.

Postoperative morbidity was similar in terms of major postoperative complications related to surgical procedure to the ones described in literature in major colorectal surgeries: we had a rate of anastomotic leak of 9.3% compared to 8.5% identified in the study of Huisman et al. published in 2022 where risk factors such as contamination of the operative field, duration of surgery of more than 3 hours, inadequate timing of preoperative antibiotic prophylaxis were considered, and found to be associated with colorectal anastomotic leakage (22).

Our study has several limitations, one of them is the retrospective design, we did not include all the minor complications, and this limits the information regarding postoperative complications rate. We did not perform neoadjuvant chemotherapy, the decision for surgical treatment was based on the ability to resect the tumour and the surrounding structures either on initial diagnosis or on surgical exploration. We did not present data regarding survival; this aspect will be the topic of a future study. The advantage of our study is that it represents a consecutive series of patients, with a similar staging and decision treatment protocol, in whom surgery was performed by a limited number of surgeons, thus reducing the bias of surgery induced different outcomes.

Conclusions

Locally advanced colon cancer is not a rare clinical setting, and radical colectomy, including multivisceral resection is a valid and safe procedure with acceptable rates of postoperative complications. Due to the complexity of the intervention and the need for a multidisciplinary team involved in the decision, treatment and postoperative care of the patient, this procedure should be reserved to a tertiary centre.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Informed Consent Statement

This study was conducted following the ethical principles of the latest version of the Declaration of Helsinki. Patient confidentiality was ensured.

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