

ORIGINAL ARTICLE

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## Laparoscopic rectal resection versus conventional open approach for rectal cancer – a 4-year experience of a single center

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### Summary

**Purpose:** This study was carried out to compare the therapeutic outcomes and complications of the laparoscopic and the conventional open surgery technique used for treating rectal cancer. Another goal was to find the fastest and most accurate method of treatment for rectal cancer, along with establishing the advantages and disadvantages of the two surgical techniques, depending on cancer location and its stage.

**Methods:** A total of 172 patients diagnosed with rectal cancer and hospitalized in the Department of Surgery III between January 1st 2008 and December 31st 2011 were studied. The laparoscopic approach was performed on 29 (16.8%) patients, and the remaining 143 (83.2%) underwent the conventional Miles/Lloyd-Davies abdominoperineal resection. A longitudinal study was conducted on patients with rectal resection, the used data being obtained from the database of the Department of Surgery III, hospital records, protocols and clinical charts of rectal cancer cases.

**Results:** There were no statistically significant differences

regarding symptoms, gender, age, body mass index (BMI), tumor site, TNM stage, intraoperative accidents, operative time, and postoperative mortality between the two groups. The laparoscopic group presented advantages regarding antibiotic and analgesic therapy, early mobilization, hospital stay, intraoperative blood loss, resuming oral nutrition, bowel transit resumption, postoperative complications and wound complications.

**Conclusion:** Laparoscopic abdominoperineal resection for rectal cancer is feasible, safe and effective. It can be safely performed by an experienced team, reducing the rate of postoperative complications, the need for blood transfusions, the administration of antibiotics and painkillers, allowing faster bowel transit resumption, shortening hospital stay and providing superior aesthetic results.

**Key words:** complications, laparoscopic resection, rectal cancer, safety

### Introduction

The third most common cancer in both females and males is rectal cancer. The American Cancer Society has estimated 39,610 new cases in 2015. The incidence, as well as mortality rates, have been decreasing in the last several decades, from 66.3 per 100,000 population in 1985 to 45.5 in 2006 because of implementation of screening

programs [1].

A multidisciplinary approach that includes rectal surgery, systemic therapy, and radiation therapy is required for optimal outcome of patients with rectal cancer. The timing of surgical resection is dependent on the size, location, extent, and grade of the rectal carcinoma.

**Table 1.** Symptom distribution in the two groups

Symptoms	Conventional group N=143		Laprosopic group N=27		p value
	N	%	N	%	
Alternating diarrhea - constipation	25	17.5	9	31.03	0.095
Tumor formation	7	4.9	1	3.45	1.000
Weight loss	18	12.58	4	13.8	0.769
Occlusion	7	4.9	1	3.45	1.000
Asthenia	15	10.48	2	6.9	0.741
Loss of appetite	16	11.18	2	6.9	0.741
Blood in the stool	22	15.38	5	17.25	0.802
Tenesmus	18	12.58	2	6.9	0.533
Pain	15	10.48	3	10.35	1.000

Although radical resection of the rectum is the mainstay of therapy, surgery alone has high recurrence rates (30-50%). Preoperative radiation therapy has many potential advantages, including tumor downstaging, increase in resectability and decreased tumor viability, which may decrease the risk of local recurrence. In a study of patients with locally advanced rectal cancer, a higher dose of radiation delivered using an endorectal boost achieved a major response in T3 tumors by 50% without increasing surgical complications or toxicity [2]. High-risk patients, including those with poorly differentiated tumors and those with lymphovascular invasion, should be considered for adjuvant chemotherapy. The National Comprehensive Cancer Network (NCCN) guidelines recommend combination therapy with infusional fluorouracil, folinic acid and oxaliplatin or with capecitabine and oxaliplatin as a reasonable treatment approach for patients with high- or intermediate-risk stage II disease [3].

The purpose of this study was to analyze both the laparoscopic and the conventional surgical technique used for treating rectal cancer and to evaluate the frequency of possible complications of the two surgical approaches. More importantly, this study aimed at finding the fastest and most beneficial method of treatment for rectal cancer, along with the advantages and disadvantages of the previously mentioned surgical techniques, depending on cancer location and its stage.

## Methods

A total of 172 patients diagnosed with rectal cancer and hospitalized in the Third Surgical Clinic, between January 1<sup>st</sup> 2008 and December 31<sup>st</sup> 2011 were studied. The laparoscopic approach was performed on

29 of these patients, and the remaining 143 underwent the conventional Miles / Lloyd-Davies abdominoperineal resection.

A longitudinal study was conducted on patients with rectal resection, the used data being obtained from the database of the Department of Surgery III, hospital records, protocols and clinical charts of rectal cancer cases.

The following parameters we assessed:

Gender, age and BMI;

Clinical symptoms and symptom onset (in months);

Tumor properties, such as location, diameter and distance from the anal verge (AV);

TNM stage;

Perineural invasion and inflammatory infiltrates;

Intraoperative accidents;

Postoperative complications;

Medication (antibiotics and analgesics administration);

Serum CEA levels;

Resumption of bowel transit and food ingestion, duration of operative time, blood loss and transfusion requirements, early mobilization, and length of hospital stay.

The 172 cases were divided into two groups:

Group A: 143 patients who underwent conventional abdominoperineal resection (96 males and 47 females).

Group B: 29 patients who underwent laparoscopic resection (21 males and 8 females).

Stage definition was based on preoperative clinical examination, imaging results, intraoperative macroscopic findings and intraoperative histopathological findings.

The surgical treatment consisted of rectal resection, either via conventional abdominoperineal approach or via laparoscopy, and the postoperative

evolution of the cases was assessed according to the occurrence of complications, early mobilization, feeding resumption and hospital stay.

### Statistics

The Epi Info computer package, version 3.3.2, was used for statistical analyses. Comparative analyses of continuous variables were performed by means of ANOVA test, Wilcoxon test, and  $\chi^2$  test was used for categorical type data. Student's t-test and Fisher's exact test were also used for analyzing nominal data. The chosen statistical significance level was  $p < 0.05$ .

## Results

The incidence of rectal cancer was highest in the 60-70 years age group (36.36% in the conventional approach, 27.58% in the laparoscopic approach) and lowest in the under 40 years age group (5.6 vs 10.35%, respectively). There was a decreasing incidence after 80 years, without reaching statistical significance ( $p = 0.091$ ).

Clinical symptoms were: alternating diarrhea-constipation (17.5 vs 31.03%), weight loss (12.58 vs 13.8%), and rectal bleeding (15.38 vs 17.25%) in the conventional and laparoscopic groups (Table 1).

Gender distribution was homogeneous between the two groups ( $p = 0.66$ ). The majority of patients were men (conventional group 67.13%, laparoscopic group 72.41%).

Symptom onset was similar in the 2 groups

( $p = 0.844$ ). However, we noticed a higher frequency for 1-3 months symptom onset in the conventional group (Table 2).

Regarding tumor location, in a high number of cases it was in the lower third of the rectum (113 cases/79.5% for the conventional group vs 22 cases/75.8% for the laparoscopic group), followed by the middle third (19 cases/13.2% vs 4 cases/13.7%). Also, in 6 cases the tumor was located in the anal canal in the conventional group and in 3 cases in the laparoscopic group (Table 3).

Most intraoperative accidents occurred during the conventional approach, with 7 cases of intra-peritoneal hemorrhage (important vascular trunks lesions) and 2 right ureteral injuries that required stitches. During the laparoscopic approach, only one case required conversion to conventional approach due to bleeding from the middle rectal artery (Table 3).

Regarding TNM stage the groups were highly similar ( $p = 0.769$ ). Stage III had the highest incidence in both groups (38.46% for the conventional group vs 41.37% for the laparoscopic group), followed by stage I (30 vs 20.68%), stage II (25.17 vs 31%) and stage IV (6.29 vs 6.89%) in the conventional and the laparoscopic groups respectively.

The presence of inflammatory infiltrates was similar in the two groups ( $p = 0.096$ ). Perineural invasion was higher in the conventional group reaching almost statistical significance ( $p = 0.055$ ; Table 3).

**Table 2.** Comparison of clinical characteristics between the two groups

Characteristics	Conventional group		Laprosopic group		p value
	N	%	N	%	
Gender					
Male	96	67.1	21	72.4	0.666
Female	47	32.9	8	27.6	
Age (years)					
<50	34	23.78	9	31.04	0.091
50 – 70	91	63.63	15	51.72	
>70	18	12.58	5	17.24	
Symptom onset (months)					
Uncertain	35	24.4	7	20.3	0.844
0 – 6	79	55.2	15	51.7	
7 – 12	21	14.6	6	20.6	
>12	8	5.6	1	3.4	
Body mass index					
Normal weight	87	60.8	14	48.2	0.017
Overweight	33	23.07	11	37.9	
Obesity grade I – III	23	16.08	4	13.8	

**Table 3.** Comparison of tumor characteristics, histopathological findings, and postoperative findings between the two groups

Characteristics	Conventional group		Laparoscopic group		p value
	N	%	N	%	
Tumor site					
Anal canal	6	4.2	3	10.3	0.425
Rectum – lower third	113	79.02	22	75.8	
Rectum – middle third	19	13.2	4	13.7	
Rectum – upper third	5	3.5	0		
Intraoperative accidents	9	6.3	2	6.9	1.000
TNM stage					
I	43	30	6	20.68	0.769
II	36	25.1	9	31.03	
III	55	38.4	12	41.37	
IV	9	6.29	2	6.9	
Presence of inflammatory infiltrates	34	23.8	6	15.4	0.096
Presence of perineural invasion	29	20.3	6	15.4	0.055
Patients requiring intraoperative transfusion	18	12.6	2	3.45	0.057
Postoperative complications	48	33.6	5	12.8	0.0004
Wound complications	29	20.3	0	0	0.00026
Postoperative deaths	5	3.5	0	0	0.527
Antibiotic therapy > 3 days	86	60.84	6	20.7	<0.001
Analgesic therapy > 3 doses	89	62.43	6	20.68	<0.001
Early mobilization	28	19.58	20	68.9	0.017
Hospital stay > 6 days	61	42.65	7	24.1	<0.001

Tumor diameter was lower in the laparoscopic group ( $4.00\pm 1.93$  vs  $5.00\pm 1.61$ ), but without reaching statistical significance ( $p=0.052$ ).

The distance of the tumor from the anal verge was also smaller in the laparoscopic group ( $4.90\pm 3.44$  vs  $5.00\pm 2.64$ ), but again without statistical significance ( $p=0.062$ ).

The preoperative levels of serum CEA were higher in the conventional surgery group ( $2.05\pm 3.62$  vs  $1.45\pm 0.07$ ), still without statistical significance ( $p=0.074$ ).

Intraoperative blood loss was much lower in the laparoscopic group ( $220\pm 104.38$  vs  $364.85\pm 223.78$  mL), the difference between the two groups being statistically significant ( $p<0.001$ ).

Also, the number of patients who required intraoperative transfusion was lower in the laparoscopic group (3.45 vs 12.6% ;  $p=0.128$ ).

Both types of surgery required an operating

time of about 3 hours ( $179.20\pm 46.32$  min for the laparoscopic group, and  $176.00\pm 56.14$  min for the conventional group), the duration of the laparoscopic approach depending exclusively on the surgeon's abilities and experience.

Postoperative complications were significantly higher in the group of patients undergoing conventional surgery (33.56 vs 12.8%;  $p=0.0004$ ). In these cases, the most common complications were wound suppuration/seroma (26 cases) and cardiorespiratory failure (11 cases). In the laparoscopic group, there were only 5 early postoperative complications: 2 cases of urinary retention, 1 case of cardiorespiratory failure, 1 pelvic abscess which was drained laparoscopically, and 1 case of repeat postoperative bowel obstruction (postoperative adhesions, surgical drain volvulus), which required other conventional surgical procedure for restoration.

Wound complications (wound suppuration/seroma, eviscerations) were much higher and statistically significant ( $p=0.00026$ ) in the conventional surgery group (20.3 vs 0%).

Resuming normal food ingestion was another important parameter. The number of days until this was possible was significantly higher in the conventional surgery group ( $2.63\pm 0.96$  days for the conventional approach vs  $2.00\pm 0.65$  days for the laparoscopic approach;  $p<0.001$ ). The time until bowel transit was resumed was significantly shorter in the laparoscopic group ( $1.92\pm 0.38$  days vs  $2.45\pm 0.16$  days;  $p<0.001$ ).

When referring to medication, antibiotics were administered to most patients after both types of surgery. When assessing the administration of antibiotics for more than 3 days the results proved that the conventional surgery group had significantly higher need for a longer duration of therapy (60.84 vs 20.7%;  $p<0.001$ ).

Postoperative pain relief was accomplished by using nonsteroidal anti-inflammatory drugs (NSAIDs). NSAIDs were initially administered every 8 hrs (3 doses/24 hrs) and afterwards only by request. The number of patients who required more than 3 analgesic doses was significantly lower in the laparoscopic group (20.68 vs 62.43%;  $p<0.001$ ).

The time interval for early patient mobilization (first day after surgery) was significantly lower in the laparoscopic group (68.9 vs 19.58;  $p=0.0002$ ).

The total length of hospital stay was significantly lower in the laparoscopic group ( $8.05\pm 0.91$  days vs  $6.32\pm 0.45$  days;  $p<0.001$ ). The number of patients who required more than 6 days of hospital stay was also significantly lower in this group (24.1 vs 42.65%;  $p<0.001$ ; Table 4).

Finally, 5 deaths (3.5%) were reported during hospital stay, all within the conventional group and with no statistically significant difference between the two groups ( $p=0.591$ ).

## Discussion

Even though it eliminates the risk of postoperative anastomotic fistula, the conventional open approach used in abdominoperineal rectal resection is followed by a high morbidity rate. The presence of complications, especially their high frequency of occurrence, is the reason why both patients and surgeons are willing to try new techniques and treatment methods, hoping they would attain the most promising results. The technical development and the surgeons' increasing experience in laparoscopy and oncology have allowed the successful use of the laparoscopic approach in treating digestive disorders, particularly in the last decade. Since tumor is manipulated by the surgeon only during perineal dissection, some authors have suggested that perineal time should be the predominant time used during abdominoperineal resection and laparoscopic dissection to be used to a minimum. Further proof overcame these concepts, clearly demonstrating that the laparoscopic approach allows an adequate, thorough and safe pelvic dissection [1-3].

Abdominoperineal resection of the rectum by means of laparoscopy provides a pelvic dissection, a total mesorectal excision (TME) with safety radial margins, a locoregional lymph node dissection at high standards which are at least as good as the open surgery [2,4]. Decanini et al. [5] have described rectal resection by means of laparoscopic "no-touch" oncological approach on a ghastly pattern since 1994.

Simon and colleagues [6] published the first randomized trial in 2008, including 99 patients with lower rectal cancer, and proved the superiority of the laparoscopic approach regarding the quicker bowel transit resumption, the faster social integration and the need of less postoperative analgesics; 5-year overall and disease-free survival were similar in both groups. The same results

**Table 4.** Comparison of intraoperative data and postoperative evolution between the two groups

Parameters	Conventional group (mean $\pm$ SD)	Laparoscopic group (mean group $\pm$ SD)	p value
Tumor diameter (cm)	5.00 $\pm$ 1.61	4.00 $\pm$ 1.93	0.052
Distance from anal verge (cm)	5.00 $\pm$ 2.64	4.90 $\pm$ 3.44	0.062
Serum CEA levels (ng/ml)	2.05 $\pm$ 3.62	1.45 $\pm$ 0.07	0.074
Intraoperative blood loss (ml)	364.85 $\pm$ 223.78	220 $\pm$ 104.38	<0.001
Resuming nutrition by mouth (days)	2.63 $\pm$ 0.96	2.00 $\pm$ 0.65	<0.001
Bowel transit resumption (days)	2.45 $\pm$ 0.16	1.92 $\pm$ 0.38	<0.001
Hospital stay (days)	8.05 $\pm$ 0.91	6.32 $\pm$ 0.45	<0.001
Intraoperative accidents	9	1	1.000

were obtained by other authors in randomized but small-sized trials [7].

Since the screen image is transmitted in high-definition and, moreover, it is magnified 2-3 times, the ability to identify and protect any noble element from the surgical field grows exponentially; thus, the risk of surgical incidents or accidents of this kind is small [2-4,8]. In this study, the laparoscopic approach did not report intraoperative incidents / accidents.

Laparoscopic surgery in rectal cancer has some disadvantages. The main drawbacks are the relatively difficult learning curve and the lack of tactile sensation when examining the mesorectum and the pelvic organs; both could be overcome through persistence [3,4]. Comparing the two techniques in a randomized clinical trial on 40 patients, Gonzales et al. [9] reported postoperative results inferior to those obtained by the conventional technique after the first 20 laparoscopic surgical interventions, and some authors consider 11-15 operations as being enough to comfortably perform this procedure [2].

The critics of the laparoscopic approach blamed the method for the presence of recurrent tumors in the trocars' implantation sites. Multi-center randomized studies, with a follow-up of at least three years, have shown that the occurrence of metastases at the trocars' implantation site is a sporadic accident occurring with similar frequency as relapse in laparotomy for conventional approaches, and long-term results obtained by laparoscopy are similar to those obtained by the open technique [3,4,6,9-12].

Despite the undeniable advantages, the laparoscopic approach in abdominoperineal rectal resection is not widely used as a routine practice, due to both the higher cost and the technical difficulties resulting in an increased intervention time. In institutions where the minimally invasive approach in rectal resection is widely practised it has long been observed that the operating time has significantly decreased as the surgeons got more experienced [13].

There are also many authors who note that the operating time of the surgery is similar for both approaches [14] or even shorter during the laparoscopic approach [15]. The fact that the laparoscopic approach can be performed by a mixed team must also be considered (Lloyd-Davies method). In this study, the average operating time was about 180 min, largely depending on the surgeon's experience (first interventions lasted longer); increased experience resulted in a shorter

operating time.

Intraoperative blood loss is an inevitable occurrence, especially for serious or technically difficult interventions. As demonstrated in our study, rectal resection by means of laparoscopy was associated with lower intraoperative blood loss which generated less blood or red blood cell transfusion requirements, decreasing the risk of postoperative complications and postoperative mortality. This ensures (at least theoretically) a better immune response for patients undergoing the minimally invasive approach, making them less susceptible to tumor recurrence or dissemination [15,16]. Similar results have been reported by other studies (3,17-19), although other studies could not prove statistically significant differences between the two types of approach used in abdominoperineal rectal resection [6].

Early bowel transit resumption and decreased pain medication requirements are among the proven advantages of the laparoscopic approach. Our results showed that patients undergoing abdominoperineal rectal resection by means of laparoscopy resumed bowel transit and peristalsis faster and the need for analgesics was lower compared with the conventional approach. Similar results were reported by other authors [20,21].

All literature data published in the last decade confirm that the laparoscopic approach is safe and effective for most of the patients [9,10]. Most studies published in Western literature show that the laparoscopic approach reduces overall morbidity [22,23], although there are studies noting no significant difference between the two types of surgical approach [13]. There are studies aiming at identifying risk factors for developing postoperative complications in patients who underwent laparoscopic rectal resection. Stewart et al. [14] have shown, through multivariate analysis, that smoking, personal history of cerebrovascular accident and loss >10% of body weight are risk factors associated with postoperative complications for conventional rectal resection, while for the laparoscopic approach, the only risk factor associated with postoperative complications was high blood pressure and neoadjuvant radiation therapy.

Perineal wound management, neoadjuvant radiotherapy, presence of colorectal inflammatory diseases, intraoperative blood loss, obesity, diabetes and smoking influence perineal wound healing, being considered by some authors as risk factors for the occurrence of perineal complications [24-28], while other studies did not consider smoking, diabetes or advanced age as risk factors [29].

In this study, the incidence of wound suppurations for the two types of approaches was similar, which is somewhat logical, as perineal wound management was similar in both groups. Most patients from the minimally invasive approach group who had long hospital stay accused perineal wound complications, also noted by other authors [6,14]. On the other hand, there are studies considering that the laparoscopic approach reduces the incidence of perineal abscesses [15], and there are authors believing that minimally invasive approach increases the incidence of these complications [30].

Rectal surgery involves an increased risk of lower urinary tract infections [31-33]. Generally, these are secondary to incomplete bladder evacuation during micturition with the occurrence of stasis and infection. The sympathetic denervation, secondary to hypogastric plexus injuries, causes urinary incontinence, the patient becoming a chronic bearer of catheter. From this point of view, the laparoscopic approach should provide a significant advantage by reducing these complications as it provides a secure pelvic dissection, avoiding nerve damage and ensuring a faster catheter removal. Most studies show a slight decrease in the frequency of urinary infections, but without reaching the statistical threshold [6,14,15].

Sexual dysfunctions secondary to abdominoperineal rectal resection are a thorny problem for the surgeon, but especially for the patient. Maintaining the integrity of the autonomous nerve plexus is a prerequisite for the integrity of the sexual function [34,35]. This paper could not determine the frequency of postoperative sexual dysfunctions and retrograde ejaculation or impotence, although most studies cite ranges between 33 and 95% [36,37], depending on the surgical technique used, the thoroughness of nerve dissection and the association with radiotherapy. However, recent data are more optimistic. Most sexual dysfunctions decrease in intensity postoperatively and then, the downward trend to recovery stagnates. Patients receiving adjuvant chemotherapy have a 1.8-fold higher risk of developing sexual dysfunctions as compared with those without adjuvant treatment [38]. External pelvic irradiation reduces sexual activity from 71% before the procedure to 56% after radiotherapy [39]. Laparoscopic surgery allows a better preservation of nerve structures and, consequently, a higher postoperative sexual function. In a recent study, Liang et al. [40] showed that the laparoscopic approach allows

high nerve preservation even in patients who had undergone neoadjuvant radiotherapy, with sexual function remaining good in 65% of the cases and retrograde ejaculation being present in only 25% of the patients.

Most studies do not report deaths in patients operated by means of laparoscopic approach [30,41,42] or they don't reveal significant mortality differences between the two surgical approaches [6,43].

Since the laparoscopic results in faster resumption of bowel transit and nutrition and an early active mobilization, most authors indicate a lower average length of hospital stay for patients undergoing the minimally invasive approach. Stewart and colleagues [14] reported an average hospitalization of  $10.3 \pm 7.7$  days for the conventional approach group, and  $8.1 \pm 10.9$  days for the minimally invasive approach group. Fleshman and colleagues [30] reported an average length of hospital stay of 7 days for the laparoscopic approach compared with 12 days for the conventional surgery. In our study, the average length of hospital stay was significantly lower in the group of patients undergoing the minimally invasive approach.

## Conclusions

Laparoscopic-assisted abdominoperineal resection in rectal cancer is feasible, safe and effective. It can safely be performed by an experienced team, reducing the rate of postoperative complications, the need for blood transfusions, the administration of antibiotics and painkillers, allowing faster bowel transit resumption, shortening hospital stay and providing superior aesthetic results.

In addition to patient benefits (reduced morbidity and mortality), the laparoscopic approach also provides advantages for the surgeon: easy to view the pudendal plexus, easy dissection in the pelvic area, absence of parietal complications and low postoperative adhesions.

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