



Original research

# Intraoperative complications have a negative impact on postoperative outcomes after rectal cancer surgery



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## HIGHLIGHTS

- A meta-analysis showed increased intraoperative complications in laparoscopic colorectal surgery.
- The impact of intraoperative complications on the short term outcome is only poorly studied.
- Intraoperative complications increased the postoperative hospital length of stay in rectal cancer surgery.
- Intraoperative complications did not increase overall morbidity in rectal cancer surgery.

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## ABSTRACT

**Purpose:** The impact of intraoperative complications on the postoperative outcome in rectal cancer surgery is only poorly studied in literature. Thus, the aim of the present study was to assess the frequency of intraoperative complications during rectal resections for malignancies and its influence on the short term outcome.

**Material and methods:** We analyzed 605 consecutive patients, who had operations for rectal cancer at a single institution between 1995 and 2010. Retrospective data from the surgical procedure and postoperative course were obtained from the institutional colorectal database and individual chart reviews. Intraoperative complications were recorded and its influence on postoperative course was investigated. **Results:** Intraoperative complications occurred in 66 (10.9%) patients, with injury to the spleen ( $n = 35$  of 66, 53%) being the most frequent complication.

Patients with intraoperative complications had a significant longer hospital stay (median: 13 days, range 7–92) compared to patients without complications (median: 12 days, range 2–135;  $p = 0.0102$ ). In addition, intraoperative complications showed a tendency towards an increased risk for postoperative surgical complications ( $p = 0.0536$ ), whereas no impact on postoperative medical complications could be found ( $p = 0.8043$ ).

Pulmonary disorders were the only predictive marker for intraoperative complications ( $p = 0.0247$ ) by univariate analysis.

**Conclusion:** We found that intraoperative complications during rectal cancer surgery significantly prolonged hospital length stay. The overall morbidity rate was not affected.

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## 1. Introduction

Colorectal cancer represents the third most common malignancy worldwide with a median age of diagnosis of 70 years in

developed countries [1]. The treatment of patients with rectal cancer can often be challenging according to the extension and height of the tumor from the anal verge. In addition, neoadjuvant radiotherapy may be required in selected patients and can even increase the complexity of the operation. The surgeon must perform an adequate Total Mesorectal Excision (TME) while attempting to preserve the nerve supply to the pelvic organs to achieve an optimal oncological and functional outcome [2].

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Notably, rectal cancer surgery can be associated with a considerable overall postoperative morbidity rate of up to 40% [3,4]. Bennis et al. investigated risk factors to predict short-term complications after rectal resection for malignancy [5]. In a multivariate analysis, the authors reported male sex, circumferential tumor and transfusion to be independent parameters for postoperative complications.

Surprisingly, there is a considerable lack of studies that examined the impact of intraoperative complications on postoperative outcome following rectal cancer surgery. Sammour et al. performed a meta-analysis comparing intraoperative complications between open and laparoscopic colorectal resections [6]. Although, a high number of randomized controlled trials did not record complications during surgery, the laparoscopic approach was associated with significantly higher rate of intraoperative adverse events in comparison to the open procedure. However, its impact on the postoperative outcome could not be evaluated.

A recent study found an overall incidence of 8.4% of intraoperative complications during laparoscopic colorectal resections based on the prospective database of the Swiss Association of Laparoscopic and Thoracoscopic Surgery [7]. Notably, in their series, intraoperative complications significantly increased the likelihood of a postoperative eventful course.

In light of the paucity of data, the present study was designed to assess the frequency of intraoperative complications in patients undergoing open and laparoscopic rectal cancer resection and to evaluate its impact on the postoperative short-term outcome.

## 2. Methods

The investigation was approved by the local ethics committee. We included 605 patients, who were operated for rectal cancer at a single institution between 1995 and 2010. Data was retrospectively collected from the surgical operation note, from the institutional colorectal database and individual chart reviews.

We routinely conducted a TME as previously described by Heald et al. [8] The type of resection was divided into intersphincteric or complete rectal resection with coloanal anastomosis and low anterior resection with colorectal anastomosis. In selected cases a Hartmann's procedure or an abdominoperineal resection was performed.

Intraoperative complications were recorded for each case and its impact on the postoperative outcome was analyzed. The postoperative course was defined as the length of hospital stay and the occurrence of postoperative complications (medical and surgical).

In addition, we aimed to assess parameters which were considered to have potential influence on intraoperative complications: body mass index (BMI), age, type of procedure, access to the abdomen, conversion to open surgery, type of anastomosis, type of neoadjuvant radio/chemotherapy, tumor height, stoma, smoking, Union Internationale Contre le Cancer stadium (UICC), neurological disorders, diabetes, cardiovascular and pulmonary disorders.

## 3. Statistical analysis

Continuous data are shown median and minimum–maximum due to skew distribution. Differences of continuous data between patients with and without intraoperative complications are tested by Wilcoxon's rank sum test. Categorical variables are described with absolute numbers and percentages and associations between categorical variables are tested by chi-square test.

All *p*-values are two-sided and  $p \leq 0.05$  was considered significant. All calculations were performed with the statistical analysis software SAS (SAS Institute Inc., Version 9.3, Cary, NC, USA).

## 4. Results

The demographic data of all patients are outlined in Table 1.

We performed 404 (66.8%) low anterior resections, 45 (7.4%) intersphincteric resections, 52 (8.6%) complete rectal resections, 71 (11.7%) abdominoperineal resections, 27 (4.5%) Hartmann procedures and in 6 (1%) patients other procedures. We conducted 36 laparoscopic assisted resections (6%), of whom 11 patients needed conversions to open.

### 4.1. Intraoperative complications

Intraoperative complications occurred in 66 (10.9%) patients and are further described in Table 2. The most common complication was an injury to the spleen ( $n = 35/66$ , 53%), which required a splenectomy in 5 (14.3%) patients due to significant bleeding not manageable by local hemostasis. Anastomotic leaks occurred in 3 (4.5%) patients and were detected by transanal installation of air.

### 4.2. Postoperative course

In regard to the postoperative course, 222 (36.7%) patients developed early postoperative complications, of which 59 (9.8%) were medical and 185 (30.6%) surgical.

According to the Clavien–Dindo Classification of complications 82 (13.6%) patients showed grade I complications, 63 (10.4%) grade II, 16 (2.6%) grade IIIa, 55 (9.1%) grade IIIb, 2 (0.3%) grade IVa and 4 (0.7%) patients had complications grade V [9].

The hospital length of stay showed a median of 12 days (range 2–135).

### 4.3. Intraoperative complications and postoperative outcome

Patients with intraoperative complications had a significant longer hospital stay (median: 13 days, range 7–92) compared to patients without intraoperative complications (median: 12 days, range 4–135;  $p = 0.0102$ ). In contrast, intraoperative complications

**Table 1**  
Demographic characteristics of patients with rectal cancer resections.<sup>a</sup>

Demographic characteristics		Patients (%)
Sex	Female	237 (39.2)
	Male	368 (60.8)
Age		64 (range 18–92)
BMI		25.4 (range 15.2–54.9)
Smoker		100 (16.5)
Neurologic disorders		38 (6.3)
Pulmonary disorders		76 (12.6)
Diabetes mellitus		91 (15)
Cardiologic disorders		277 (45.8)
Neoadjuvant radio-(Chemo)therapy		335 (55.4)
Tumor height	High	113 (18.7)
	Middle	237 (39.2)
	Low	250 (41.3)
Protective stoma	Ileostomy	274 (45.3)
	Colostomy	139 (23.0)
Anastomosis	Stapled	414 (68.4)
	Hand-sewn	95 (15.7)
	No	96 (15.9)
Type of reconstruction	Colonpouch	63 (10.4)
	End-end	368 (60.8)
	End-side	81 (13.4)
UICC Stadium	1	179 (29.6)
	2	125 (20.7)
	3	170 (28.1)
	4	114 (18.8)

<sup>a</sup> Categorical variables are described as absolute numbers with percentages.

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