The Implementation of a Standardized Approach to Laparoscopic Rectal Surgery: A Paradigm Shift

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1 Background

Colorectal cancer is the fourth most common cancer in men and third most common in women worldwide, accounting for approximately 436,000 incident cases and 212,000 deaths in 2008. This cancer has an important economic impact, estimating that in the initial, continuing and last year of life phases of care a total of more than $7 billion were spent (American Cancer Society Website Cancer Facts and Figures, 2004). Colorectal cancer accounts for 11% of cancers diagnosed. The worldwide incidence of colorectal cancer is increasing: in 1975 the worldwide incidence of colorectal cancer was only 500,000 (Boyle & Langman, 2000). In western countries, some of the increase is attributable to the aging of the population and perhaps better diagnostic abilities; however, in countries with a low baseline rate of colorectal cancer, an increase in incidence after adjustment of age has been found. There is substantial geographic variation in the incidence of colorectal cancer with relatively high rates in North America, Western Europe, and Australia and relatively low rates in Africa and Asia (Lagiou P, 2002). Interestingly, there is less variation in the incidence of rectal cancer between countries as compared with the incidence of colon cancer (Parkin DM et al., 1999; Wingo PA et al., 2003).

There have been great improvements of surgical and medical treatment over the last 20 years. This means that the patients that previously had metastatic disease and those patients that were not previously assessed for surgery can now be considered for surgical treatment. Hence, the increasing number of patients that need not only surgery but also radiological examinations and oncological treatment is a challenge for the workload in healthcare institutions worldwide.

2 Introduction

In recent years laparoscopic surgery has become increasingly popular in several fields of general surgery. In 1987 laparoscopic cholecystectomy was introduced by the French gynecologist Mouret and it quickly became the golden standard for treatment of symptomatic gall stone disease due to less postoperative pain and faster recovery. Similarly, laparoscopic appendectomy has become the standard choice of operation for treatment of acute appendicitis since the
method was introduced by K Semm in 1983. Also in colorectal surgery several studies have analyzed benefits of laparoscopic surgery – especially during the last decade. However, the laparoscopic technique was not rapidly adapted by colorectal surgeons – partly due to the technically difficulty of the laparoscopic procedure but also due to uncertainty of the oncological safety. In 1995 Fodera (Fodera et al., 1995) raised concern of risk of port site metastasis after laparoscopic assisted colectomy. It took several years and studies to conclude, that this risk was minimal and that the oncological outcomes (short- and long-term results) were equal to the outcomes after laparoscopic surgery. Not until 2005 two large scale randomized clinical trials (Guillou et al., 2005; Van der Pas et al., 2005) concluded that laparoscopic surgery for colon cancer is safe with satisfying oncological results. Further the authors concluded that laparoscopic surgery lead to smaller peroperative blood-loss, earlier recovery of bowel function, less postoperative pain and shorter hospital stay. Morbidity and mortality was equal to open surgery. However, the duration of laparoscopic surgery was significantly longer and furthermore, laparoscopic colorectal surgery is technically challenging with a steep learning curve for even experienced surgeons, and finally it is economically straining for any surgical department to invest in laparoscopic equipment. Hence, the implementation of laparoscopic colorectal surgery can be described as a challenging “bottle neck” when looked upon in a global as well as in a local perspective.

Recently a large American review (Kang CY et al., 2012) of the Nationwide Inpatient Sample (NIS) data from 2007 and 2009, including data from more than 200,000 patients undergoing colorectal surgery, described how laparoscopic surgery has evolved. In 2007 13.8% of the registered patients underwent laparoscopic surgery for colorectal diseases (colon and rectal cancers and diverticulitis) but two years later a dramatic increase was registered with 42.6% of the patients now being laparoscopically operated. The in-hospital mortality was significantly lower for patients undergoing laparoscopic surgery (0.6 vs. 1.2 respectively) and the length of hospital stay was shorter (5 vs. 6 days). In 2007 the cost of laparoscopic surgery per patient was more expensive than open surgery, but in 2009 laparoscopic surgery had become the cheaper choice of surgical treatment. The study illustrates how a new method of surgery begins as a minor experimental, expensive treatment for few patients, but over time the method becomes more popular and established.

The evolution of laparoscopic surgery for rectal cancer is similar to that of colon cancer. Many studies have found good results with shorter hospital stay, less postoperative pain, morbidity and oncological results similar to results after open surgery (Miyajima N et al., 2008; Lujan J et al., 2009; Ströhlein et al., 2008). However, most studies were not properly randomized and all were of too small sample sizes. In 2013 a large multicenter prospective randomized study (van der Pas MH et al., 2013) including 1103 patients from eight different countries was finally published. The patients were randomized to either laparoscopic or open surgery for rectal cancer. The authors found more extensive use of epidural analgesia in the open group, shorter hospital stay in the laparoscopic group and equal results of mortality (30 days), morbidity and oncological short-term outcomes (histopathologic evaluation of specimen) between groups. The long-term oncological follow-up still remains to be published.

In Denmark 1200-1400 patients are diagnosed with rectal cancer every year. National guidelines (Danish Colorectal cancer Database, 2011) ensure that every patient-case is discussed on a multidisciplinary colorectal cancer team conference (MDT). Here individual plans for treatment are made for the patients after evaluation of computed tomography (CT) scan of the abdomen and thorax, magnetic resonance imaging (MR) of the rectum, histology after biopsy taken during colonoscopy or sigmoideoscopy, and if indicated ultrasound of the liver.
The patients are staged according to international guidelines (UICC – Union for International Cancer Control). Patients with ≥T3 tumors and with threatening of the circumferential resection margin are referred to preoperative neoadjuvant radiochemotherapy. Approximately 20% of the patients receive preoperative oncological treatment in order to down-stage tumor. In 2011 62.2% of the patients referred to surgery underwent laparoscopic surgery for rectal cancer.

The operative methods are chosen according to the location of the rectal tumor and after evaluation of the patient’s general health status. Very brief, the low anterior resection (LAR) is chosen for patients with tumors in the upper two thirds of the rectum. After resection of the tumor-carrying part of the rectum (at least 2 cm free resection margin distal of the tumor (measured by the length of the free bowel wall) is recommended) a primary anastomosis is performed between the sigmoid colon and the low rectum. Depending on the height of the anastomosis and comorbidities of the patient it is often advisable to supply with a temporary loop-ileostomy in order to protect the patient from severe infection in case of anastomotic leak. The abdominoperineal resection (APR) is chosen for patients with low rectal cancers, where primary anastomosis is not possible. In these cases the rectum and anus is removed “en bloc” and the sigmoid colon is used to construct a stoma in the left fossa. The perineal defect can if chosen be reconstructed with a gluteus maximus flap – the so called “ad modum Holm” procedure (Holm T et al., 2007). If the tumor is extended with severe invasion of neighboring organs or the patient is suffering from severe comorbidity it may be proper to offer a Hartmann’s operation (HO) with resection of the rectal tumor and construction of a left colostomy. The anal part of the rectum that remains after resection is left in situ.

Our institution has been a pioneer of fast track surgery programs ever since it was introduced in 2000 (Basse L et al., 2000). The program was originally designed for open surgery for colon cancer and included early mobilization, early oral feeding, optimal analgesia (epidural catheter) and early removal of urinary catheter. Hence, most patients can be discharged 2 days after open colon resection. Our rectal cancer surgery patients are likewise, after modification of the above mentioned fast track program, scheduled for discharge on the third postoperative day. When laparoscopic surgery for rectal cancer was implemented in our department the operative approach was standardized into a stepwise procedure in order to ensure equal and optimal treatment for all patients.

The purpose of this chapter is to audit the clinical and oncological results of an observational retrospective study in our institution during the implementation of laparoscopic surgery for rectal cancer within a fast track recovery setting as an alternative to traditional open surgery. Until 2009 all patients with colorectal cancer underwent open surgery. The decision to introduce laparoscopic surgery was primarily made for highly selected patients. Hence, at the beginning of our experience only benign rectal resections and highly selected rectal cancer patients went through laparoscopic surgery. As the surgeons gained more experience during the study-period the criteria for laparoscopic surgery got wider.

3 Materials and Methods

3.1 Patient Selection
From January 2009 to February 2011, 100 consecutive patients underwent laparoscopic surgery on an intention to treat basis for rectal cancer in our department. The clinical, operative and
pathological data of these patients were retrospectively reviewed from a prospectively collected database. Every patient who was operated laparoscopically for rectal cancer in an elective setting in the period was included. There were no exclusion criteria. Hence, some patients had previously gone through abdominal surgery, mainly smaller operations like appendectomy, laparoscopic cholecystectomy and hysterectomy.

3.2 Preoperative Work-Up

The preoperative work-up included biopsy, endoscopy, CT, liver ultrasound, chest x-ray and MR. All patients were staged according to national guidelines. Each patient was reviewed at our MDT meetings before and after surgery. Tumors staged as ≥ T3, and those with a threatened circumferential resection margin (CRM) underwent neoadjuvant chemoradiotherapy. Surgery was carried out 6-8 weeks after completion of treatment. Patient characteristics, tumor size and location as well as perioperative data, pathological results, morbidity, length of hospital stay (LOS), readmission rate, 30 days mortality and follow-up were recorded prospectively. All procedures were performed by the same surgical team.

Tumors were considered rectal cancers if located below 15 cm from the anal verge measured with a rigid rectoscope. Rectal cancer suitable for surgery was defined as a biopsy-proven adenocarcinoma. Patients were considered suitable for laparoscopic surgery if they had no serious health conditions precluding a laparoscopic procedure. Patients with CT or MR evidence of tumor infiltration of adjacent organs and T4 cancers were considered as unsuitable for laparoscopic surgery in this implementation period. All patients were informed about possible risks and benefits of laparoscopic surgery and informed written consent was obtained. A phosphate enema was given as bowel preparation prior to surgery. Stoma sites were marked preoperatively. All patients received epidural anesthesia (bupivacaine/fentanyl) or intravenous morphine as postoperative pain relief. Perioperative care was previously described and primarily developed for open colonic surgery in fast track settings (Basse L et al., 2000). The fast track settings included initiation of mobilization and full oral feeding (minimal oral intake of 1500 ml of fluid, but full diet was allowed) on the evening of surgery, removal of epidural catheter and urinary or suprapubic catheter on the third day of surgery and planning of discharge as soon as possible hereafter. During hospital stay all patients received thromboembolic prophylaxis. Nasogastric tubes and drains were not used routinely.

3.3 Surgical Method

Our surgical approach is based on the steps primarily described by Dr. J Leroy of France who is one of the pioneers in laparoscopic rectal surgery (http://www.websurg.com). We used 5 port sites. The standardized operative steps for laparoscopic rectal resection are: 1) open insertion of the umbilical port for establishment of pneumoperitoneum and peritoneal inspection. The patient was then placed in steep Trendelenburg’s position and the operating table was rotated towards the right side. 2) Placement of three or four ports at variable sites. 3) Mesocolic dissection and inferior mesenteric pedicle isolation was achieved with medial approach and the inferior mesenteric artery was ligated close to its origin with clips or Endo-GIA. The superior rectal artery was divided just below the inferior mesenteric artery after application of 5 mm clips in the cases of APR and Hartmann’s operation (HO). 4) The left ureter was recognized and subsequently, with the patient placed supine and rotated left side up medial-to-
lateral dissection was continued cranially up until the left colon was mobilized. 5) The patient was returned to the Trendelenburg’s position, and the small bowel was reflected cranially after the completion of mobilization of the left colon. A grasper was used to elevate the rectosigmoid colon out of pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. 6) The posterior aspect of the mesorectum was easily identified and the mesorectal plane dissected with harmonic scalpel, preserving the hypogastric nerves. Dissection was continued down to the presacral space in this avascular plane toward the pelvic floor. 7) Dissection proceeded laterally on both sides of rectum until circumferential mobilization of lower rectum was accomplished. 8) Digital examination was performed to verify the distance between the inferior margin of the tumor and the line of resection and the adequacy of distal margin was marked with a clip. 9) An EndoGIA roticulator stapler (Covidien Ltd., Norwalk, Conn. USA) 45-mm was fired twice to divide the lower rectum safely. The abdomen was then deflated and a suprapubic incision of 4-6 cm performed to extract the left colon and resect the specimen. A wound protector (Alexis OTM, Applied Medical Rancho Santo Margarita, CA) was placed at the incision. 10) Extracorporal preparation of the proximate colon was completed with placement of the anvil of a 29-mm circular stapler (Proximate ILS circular stapler, Ethicon, Endo-surgery, Cincinnati, OH, USA) in position to perform a side-to-end or end-to-end colorectal anastomosis in the cases of low anterior resection (LAR). Bowel anastomosis was performed intracorporally by double staple technique. The splenic flexure was not routinely mobilized. For tension-free anastomosis, full splenic flexure mobilization was performed in case of lack of redundancy of the sigmoid colon during surgery. The low pelvic dissection in APR was performed first posteriorly, then anteriorly, and finally with lateral dissection. The remainder of deep pelvic dissection was performed through perineal approach including removal of the tip of os coccyx together with the specimen ad modum T. Holm (Holm T et al., 2007). In cases of HO and APR a stoma was placed in the lower left quadrant according to the pre-operatively marked stoma-site. A standardized perioperative care protocol was used.

Conversion to an open procedure was defined as any abdominal incision larger than the above mentioned to extract the specimen. A protective loop ileostomy was performed for the patients needing anastomosis within 5 cm of the anal verge. Intestinal continuity was re-established 3 months later or after completion of postoperative adjuvant therapy.

3.4 Follow-Up
Postoperative complications were defined as any morbidity, including wound-infection, in the postoperative period in hospital or in the outpatient clinic up to 30 days after the operation. Perioperative death was defined as death occurring within 30 days after surgery. Anastomotic leaks were defined as any dehiscence of the anastomosis observed by endoscopy, digital examination, CT scan or gastrograffin enema. All patients were referred to colonoscopy and CT-scan after the first and third year of surgery.

3.5 Pathologic Method
All specimens were examined by local pathologists with special attention to the number of harvested lymph nodes, CRM, distal resection margin (DRM) and completeness of the mesorectal fascia (MRF).
3.6 Statistical Analysis

Data was collected in a SPSS work-sheet (SPSS version 19; SPSS INC. Chicago, IL). All values are presented as median (range). When appropriate, Fisher’s Exact Test (Chi-square test) was used for nonparametric data. P <.05 was considered statistically significant.

4 Results

Patients’ characteristics are summarized in Table 1 and Perioperative data are shown in Table 2.

<table>
<thead>
<tr>
<th>Gender, m/f (n)</th>
<th>61 / 39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (years)</td>
<td>66 (range 30-88)</td>
</tr>
<tr>
<td>Body mass index, median (kg/m²)</td>
<td>24 (range 17-40)</td>
</tr>
<tr>
<td>ASA-score, median*</td>
<td>2 (range 1-3)</td>
</tr>
<tr>
<td>Tumor location, median (cm from anal verge)</td>
<td>10 (range 2-15)</td>
</tr>
<tr>
<td>Previous intraabdominal surgery (n)</td>
<td>31</td>
</tr>
<tr>
<td>Preoperative chemoradiotherapy:</td>
<td></td>
</tr>
<tr>
<td>• None</td>
<td>76</td>
</tr>
<tr>
<td>• Chemo- and radiotherapy</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 1: Patients demographics. * ASA = American Society of Anesthesiologists.
Surgical procedure (n)  
• Low anterior resection  26  
• Low anterior resection with loop-ileostomy  39  
• Hartmann’s operation  14  
• Abdominoperineal resection  21  
Operative time, median (min)  250 (range 51-397)  
• Low anterior resection  181 (range 51-353)  
• Low anterior resection with loop-ileostomy  261 (range 100-376)  
• Hartmann’s operation  186 (range 114-345)  
• Abdominoperineal resection  280 (range 131-397)  
Loss of blood, median (ml)  100 (range 0-1145)  
Hospital stay, median (days)  7 (range 3-80)  
Re-admission (n)  9  

Table 2: Perioperative data.

Nine patients (9%) were readmitted for a median of 3 days (range 1-13). There were 9 operations where conversion to open surgery were necessary. Indication for conversion included fixation of the tumor to the surrounding organs (n=6), dense adherences (n=1), tumor-growth into the bladder (n=1) and progressive respiratory insufficiency related to establishment of pneumoperitoneum (n=1).

Intraoperative complications occurred in 3 cases. One bladder injury and one superficial laceration of the rectum occurred during laparoscopic resections. These injuries were repaired laparoscopically without conversion. Finally one perforation of the anal canal occurred during perineal dissection in an APR-procedure.

In the postoperative period we registered 11 cases of anastomotic leaks in accordance to our previously mentioned criteria among the 65 patients who underwent low anterior resection. Amongst those, 6 patients (9%) required reoperation. The remaining 5 patients (8%) were treated conservatively or with endoscopic vacuum assisted closure. Table 3 outlines all postoperative complications encountered. Two patients developed compartment syndrome of one leg, probably as a result of improper positioning during the surgical procedure. We found a 30-days mortality-rate of 5% (5 patients). Mean follow-up was 9 months (range 1-27). The oncologic outcomes are shown in Table 4.

Twenty-four patients underwent neoadjuvant treatment prior to surgical procedure. Five of these (20.8%) had a complete pathological response with no residual tumor detectable in the resected specimen. The median length of the specimen was 17 cm (range 10-35), the median distal resection margin (DRM) was 30 mm (range 2.5-35), the median CRM was 10 mm (range 0-55) and CRM were positive in 6 patients. The overall median number of harvested lymph nodes was 15 (range 2-48). The median lymph node harvest in patients who underwent preoperative neoadjuvant treatments (n=24) were 12 (range 4-35) and in patients who underwent primary resection without neoadjuvant treatment (n=76) the median lymph node harvest was 16 (range 2-28). The mesorectal fascia (MRF) was complete or near-complete in 84 cases and not complete in 14 cases. The MRF was not described in the histopathological reports in two cases. One patient with disseminated cancer developed port-site metastasis.
### Table 3: Postoperative complications. *Endo-VAC = Endoscopic Vacuum-assisted closure.

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. of patients (n)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine tract infection</td>
<td>5</td>
<td>Antibiotics</td>
</tr>
<tr>
<td>Gastrointestinal bleeding</td>
<td>1</td>
<td>Self-resolved</td>
</tr>
<tr>
<td>Superficial wound-infection</td>
<td>2</td>
<td>Drainage</td>
</tr>
<tr>
<td>Leakage of the rectal “stump”</td>
<td>3</td>
<td>Ultrasound-guided drainage</td>
</tr>
<tr>
<td>Compartment syndrome</td>
<td>2</td>
<td>Fasciotomy</td>
</tr>
<tr>
<td>Necrosis of stoma</td>
<td>2</td>
<td>Stoma refashioned</td>
</tr>
<tr>
<td>Ileus (adhesions)</td>
<td>1</td>
<td>Lysis of adhesions</td>
</tr>
<tr>
<td>Early port-site hernia</td>
<td>1</td>
<td>Repaired</td>
</tr>
<tr>
<td>Peritonitis</td>
<td>2</td>
<td>Laparotomy</td>
</tr>
<tr>
<td>Parastomal hernia</td>
<td>2</td>
<td>Repaired</td>
</tr>
<tr>
<td>Presacral abscess</td>
<td>3</td>
<td>Ultrasound-guided drainage</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>5</td>
<td>Conservative treatment/Endo-VAC*</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>6</td>
<td>Reoperation</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>35</strong></td>
<td></td>
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</tbody>
</table>

### Table 4: Oncologic results.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Median (range)</th>
</tr>
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<tbody>
<tr>
<td>Circumferential resection margin</td>
<td>10 (range 0-55)</td>
</tr>
<tr>
<td>Distal resection margin</td>
<td>30 (range 2.5-70)</td>
</tr>
<tr>
<td>Length of specimen</td>
<td>17 (range 10-35)</td>
</tr>
<tr>
<td>Harvested lymph-nodes</td>
<td>15 (range 2-48)</td>
</tr>
<tr>
<td>Mesorectal fascia (n)</td>
<td></td>
</tr>
<tr>
<td>• Complete</td>
<td>68</td>
</tr>
<tr>
<td>• Near-complete</td>
<td>16</td>
</tr>
<tr>
<td>• Incomplete</td>
<td>14</td>
</tr>
<tr>
<td>Radical resection</td>
<td>94</td>
</tr>
</tbody>
</table>

#### 5 Discussion

The results of this study reflect the circumstances that are present when an operating team adapts to a new surgical set-up. The surgeon and assisting surgeon is obviously challenged with the new laparoscopic technique, but also surgical nurses and the staff on the surgical ward must adapt to the new method and solve unforeseen problems as they occur. The results therefore may differ from other studies. For instance the operative time in this study was relatively long. Lindsetmo and Delaney (Lindsetmo RO & Delaney CP 2009) described a standard, stepwise laparoscopic procedure for rectal resections. As described earlier we have adapted this technique, which makes the operation predictable and reproducible for the whole surgical team. The process of adapting this standardized technique is however most likely one of the causes for the median operative time of 250 minutes, which is longer than comparable studies (Guillou PJ *et al.*, 2005; Ströhlein MA *et al.*, 2008). Other causes could be that two new surgeons in our team were trained to perform laparoscopic rectal surgery during the study-period. Furthermore there were a high number of patients with a history of previous abdominal surgeries...
in our series (31%). This may lead to intraabdominal adhesions which may prolong the phase of dissection during surgery.

There have been reports about increasing complication rates in patients converted from laparoscopic to open surgery (Lujan J et al., 2009). Our rate of conversion was 9% which is lower than other studies (Guillou PJ et al., 2005; Ströhlein MA et al., 2008). This may reflect some degree of bias as our patients were selected candidates for laparoscopic surgery and not randomized to either open or laparoscopic surgery. Morbidity and length of hospital stay for converted patients were however similar to those who completed laparoscopic surgery. Our data therefore confirm that careful selection of patients for laparoscopic surgery makes the procedure practicable and the need to convert small. This study also confirms that our strategy to convert whenever there was failure to progress in the very difficult operative field was safe.

At present, our approach is to initially plan laparoscopic method for almost all patients, only exclusions being T4 tumors or local growth into neighboring organs.

A median postoperative hospital stay of only 7 days in this series is short when compared to other studies with a median hospital stay of 8 to 15 days (Guillou PJ et al., 2005; Lujan J et al., 2009; Good DW et al., 2011; Kang S-B et al., 2010; Sartori CA et al., 2010). This great variety of results is probably due to cultural and economic differences in health care systems between countries. In Denmark all expenses for surgery and postoperative care lay with the state. The national welfare-system also include possibility for nursing assistance in the home, for instance in case of need for help with stoma- or wound care. These conditions perhaps facilitate early discharge. In our department there are very well established routines in our fast-track surgery program. As before mentioned it was originally evolved for postoperative care after colon surgery (Basse L et al., 2000). It has over the years been adjusted for rectal surgery. Hence, all patients were prepared for stoma self-care already prior to surgery by one of the specialist nurses from our ward. Furthermore all patients, if possible, received epidural analgesia up to 3 days after surgery, all patients were encouraged to early oral feeding and mobilization as soon as possible after surgery - at latest the first day after surgery, and drains and catheters were withdrawn the third postoperative day. Our readmission rate of 9% with a median secondary hospital stay of 3 days is comparable to similar studies where up to 23% of the patients were readmitted after fast-track rectal cancer surgery (Schwenk et al., 2006).

Table 3 shows that the majority of complications were surgical. There is no difference in complication-rates between the first and the last 50 patients in this series. Our overall complication rate of 35% matches results of other studies (Guillou PJ et al., 2005; Lujan J et al., 2009). There is a small tendency towards increased risk of complications, if the patient had received preoperative radio therapy as 40.9% of the radiated patients experienced complications versus 35.9% of the non-radiated patients. The tendency is however not statistically significant (p=0,803). Although a total of 15 reoperations seem to be a high figure, it is comparable to other reported series of laparoscopic rectal surgery (Bärlechner E et al., 2005; Morino M et al., 2003).

Much depends on the author’s definition of anastomotic leakage when it comes to calculating leakage rates. We have used wide spanning criteria for our definition of anastomotic leaks. Our rate of leakages that required reoperation (9%) is acceptable in comparison of other series (Guillou PJ et al., 2005; Lujan J et al., 2009; Sartori CA et al., 2010). Neither conversion nor neoadjuvant therapy resulted in higher risk of development of anastomotic leakage in this series. However Figure 2 shows that there is a decreasing tendency in the leakage rate in the latter part of the study period (study period B), where the standardized surgical approach had
Our 30-days mortality was 5% which is relatively high when compared to other studies (Ströhlein MA et al., 2008; Kang S-B et al., 2010). The postoperative morbidity and mortality in fast track settings remain challenging and controversial due to mainly a non-selected, high risk elderly population with co-existing illness (Stottmeier S et al., 2012; Vlug MS et al., 2011). In the present series the 5 patients who died were 78 to 88 years of age at the time of operation. They all preoperatively suffered from severe degrees of ischemic heart failure. Moreover one of the patients suffered from severe chronic obstructive lung-disease and non-insulin dependent diabetes mellitus, one patient suffered from renal failure and obesity (BMI=33) and one patient had recently been hospitalized due to lung embolia. After primary surgery all five patients experienced surgical complications and underwent re-operations. In two cases reoperation was needed because of fecal peritonitis (anastomotic leak and small bowel perforation), in two cases because of severe ischemia of the stoma and in one case because of non-fecal peritonitis of unknown origin. All five patients died due to sepsis and failure of multiple organs.

Large randomized trials comparing laparoscopic versus open resection for colorectal cancer have shown an equivalent oncological outcome (The COlon cancer Laparoscopic or Open Resection Study Group, 2005; The Clinical Outcomes of Surgical Therapy Study Group, 2004). Adequate surgical margin clearance remains crucial for local recurrence rates. The results of the CLASICC trial (Guillou PJ et al, 2005) with a trend towards increased rate of involved CRM (6% open vs. 12% laparoscopic) for anterior resection were initially alarming. However, a recent meta-analysis suggests that there are no differences between laparoscopic and open surgery for rectal cancer in terms of number of harvested lymph nodes, involvement of CRM and local recurrence (Huang M-J et al., 2010). The rate of positive CRM was 6% in our study. All positive margins occurred in patients with T4 tumors or node positive (N2) disease. This rate is comparable with other reports (Guillou PJ et al., 2005; Lujan J et al., 2009). The number of lymph nodes harvested from the mesorectum during surgery is also an important predictor of prognosis (Nagtegaal ID et al., 2002). In our study there was a median harvest of 15 lymph nodes and 80% of the specimens contained 12 lymph nodes or more which is equal to results of several studies (Ströhlein MA et al., 2008; Lujan J et al., 2009; Kang S-B et al., 2010; Miyajima N et al., 2008) and in accordance with international and national guidelines for lymph node harvest.

**Figure 2:** Anastomotic leakage rates. In study period A, patients no. 1-50 underwent surgery and 9 had anastomotic leakage (25%). In study period B, patients no. 51-100 underwent surgery, and 2 had anastomotic leakage (6.9%) (p=.094)

been fully implemented. The difference between these rates of leakages is however not significant (p=0.094).
The mesorectal fascia was not complete in 16% of our patients. Macroscopic evaluation of the mesorectal fasciae is considered an important quality measure in rectal cancer surgery. Tears and shallow breaks in the mesorectum, however, are difficult to avoid, particularly when dealing with large bulky tumors in laparoscopic colorectal cancer surgery. Other factors such as a narrow pelvis and a fatty mesorectum increase the risk of damaging the mesorectal fascia with the laparoscopic instruments as well. For that reason, the grading of the mesorectal fasciae was characterized as only nearly complete in some cases, even though dissection was carried out in the correct surgical plane. Nagtegaal (Nagtegaal ID et al., 2002) have shown that a complete or nearly complete mesorectal fascia is prognostic for good long-term oncological outcomes whereas an incomplete fascia is prognostic for unfortunate oncological long-term outcomes. Because of the short follow-up period it is not possible to conclude, if our oncologic result influences the long term oncologic outcome. Only one patient with disseminated cancer developed a port-site metastasis.

Amongst limitations of this study are furthermore that this retrospective series with prospectively registered data does not include a large number of patients. More data are needed from ongoing large randomized controlled trials regarding long-term oncological outcome.

6 Conclusions

Our results which included a small number of patients support the literature that finds advantages of lesser pain, faster recovery, lower postoperative morbidity and shorter length of hospital stay in comparison to open surgery. At present we need to confirm this evidence with the long term results of ongoing randomized studies (van der Pas MH et al., 2013; Kang S-B et al., 2010).

We believe that it is important to continuously evaluate the daily routines, such as choice of operative technique, and we found the given epidemiologic method, a prospective cohort study, efficient and conclusive. After finishing the study, laparoscopic surgery for rectal cancer continued to be “first choice” in our surgical treatment of patients with rectal cancer. In 2009 when this study took its beginning only few carefully selected patients underwent laparoscopic surgery for rectal cancer. At the beginning of our experience only benign rectal resections and highly selected rectal cancer patients were selected for laparoscopic surgery. Before 2009 all patients were operated by open approach.

The fraction of laparoscopic surgery increased during the study-period to 87.8% in 2011 and today more than 90% of the patients with rectal cancer undergo laparoscopic surgery. It seems logical that minimizing the surgical trauma leads to less pain and discomfort for the patient and therefore we keep straining ourselves to refine the laparoscopic technique without compromising the oncological and surgical safety. In the near future we find it likely that new techniques, for instance single port surgery and use of the robotic platform, will gain access to the surgical everyday life.
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References


