Laparoscopic versus Open Anterior Resection in Patients with Rectal Cancer: a Review of literature

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Background:
Total mesorectal excision has become the gold standard for treating rectal tumors. Controversy exists regarding laparoscopic anterior resection of rectal carcinoma.

Purpose:
To review the literature comparing laparoscopic *and* open anterior resection of rectum utilizing total mesorectal excision (TME) principles for rectal carcinoma.

Methods:
A literature search was performed on studies comparing laparoscopic and open anterior resection for rectal cancer on perioperative outcome and quality of life.

Conclusions:
Laparoscopic total mesorectal excision of rectal carcinoma is feasible and not inferior to open resection regarding oncologic outcomes. However the learning curve and technical difficulties recommends tackling this problem in specialized centers to optimize the outcome. Long term results and big randomized studies are eagerly awaited.

Key words:
Laparoscopy – open surgical outcome - Postoperative complications - Rectal cancer - Total mesorectal excision - Quality of life

INTRODUCTION:

Advocates of laparoscopic surgery in colon cancer showed a lot of growing evidence of its adequate oncological clearance [1–8], most would not agree with its use in rectal cancer. Early reports on laparoscopic rectal cancer surgery were dominated by sphincter-ablating resection [9–15]. Technical hurdles as well as skepticism on oncological clearance had once confined sphincter preservation to carcinomas located at the rectosigmoid junction or in the upper rectum [8, 16–20]. Progress in technology and skills, however, has finally led to the controversial extension of minimally invasive techniques to distal rectal cancer with sphincter preservation [21–33]. Here we present a review of the clinical outcomes of laparoscopic surgery for rectal cancer in the literature in comparison to conventional open surgery.

The TME

A successful TME starts with the proper ligation of the SHA or IMA. As one dissects down toward the sacral promontory, the sympathetic nerve trunks are identified. The dissection plane is just anterior or medial to these nerves. Using the cautery or scissors, the nerves are reflected toward the pelvic sidewall while the mesorectal fascia surrounding the mesorectal fat is kept as an intact unit. The dissection starts posteriorly and then at each level proceeds laterally and then anteriorly. In the mid rectal area along the lateral sidewalls, one can sometimes see the parasympathetic nerves tracing anteriorly toward the hypogastric plexus. The plexus is usually on the anterolateral sidewall of the pelvis, just lateral to the seminal vesicles in the man and the cardinal ligaments in the woman. There is often a tough “ligament” that traverses the mesorectum at this point. It theoretically contains the middle rectal artery. However, in a study by Jones et al.,74 this artery is only present to any significance about 20% of the time. The anterior dissection is perhaps the most difficult. In men, one should try to include the two layers of Denonvillier’s fascia. This fascia is composed of peritoneum that has been entrapped between the seminal vesicles and prostate anterior and the rectum posterior (Figure 1A&B). In woman, the peritoneum at the base of the pouch of Douglas is incised and the rectovaginal septum is then separated.

Surgical procedure:
The patients were placed in a modified lithotomy position, and a pneumoperitoneum was established with a Veress needle, maintaining intraabdominal pressure at 12–15 mm Hg. Four or five trocars were placed. the descent of the splenic flexure was first carried out after placing the patient in the anti-Trendelenburg position with inclination to the right. After the patient was placed in the Trendelenburg position, dissection was performed with ligature of the inferior mesenteric vessels at the site of origin, respecting the left colic vein whenever possible. Dissection was then made by the avascular plane, performing rectosigmoid dissection with TME in tumors of the middle and lower thirds (LAR) and mesorectal excision up to 5 cm below the lesion in tumors of the upper third (AR). After completion of the pelvic dissection, the distal end was sectioned using an EndoGIA-type mechanical suturing device. The assistance incision was made at the suprapubic level (Pfannenstiel incision) with a length of 5–7 cm, according to the size of the tumor. Intracorporal anastomosis was made in all cases under laparoscopic control, and a low-pressure aspirative drain was placed next to the anastomosis. Protective ileostomy was performed in cases with very low anastomoses and in patients who had undergone previous neoadjuvant treatment, although this was always done at the discretion of the surgeon. Conversion was defined as the need to carry out an unplanned incision or an incision of greater than normal size to complete the dissection and/or section of the distal end of the rectum. A Pfannenstiel incision or infraumbilical middle laparotomy was performed at to the discretion of the surgeon.

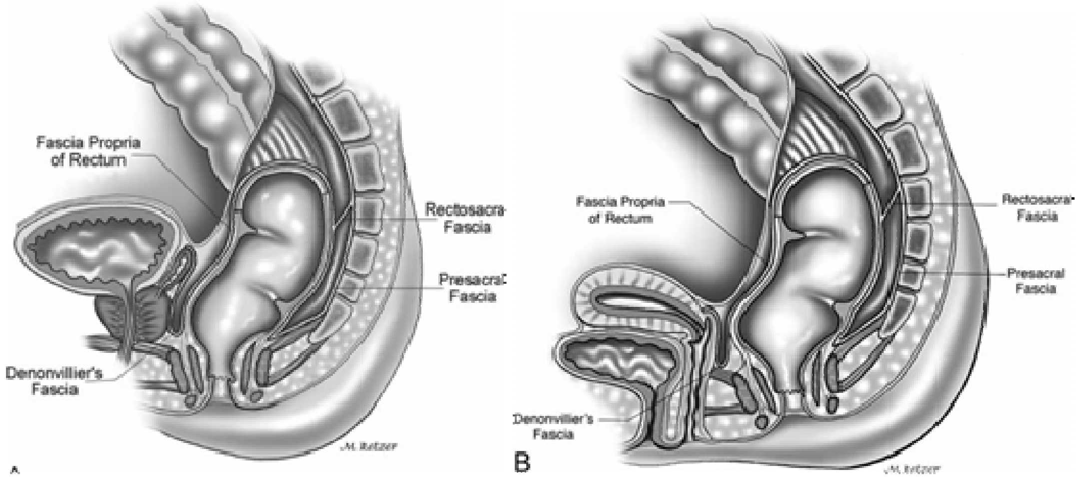

Figure 1 A&B: peritoneal reflections in male and female

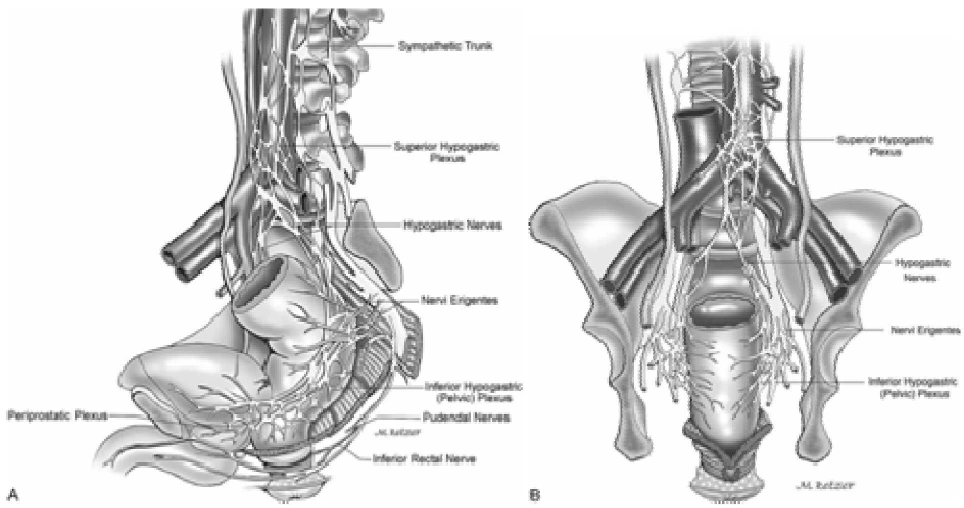

Figure 2 A&B:

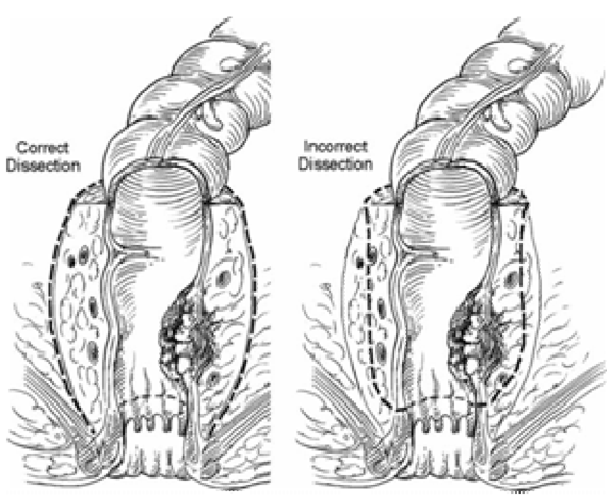

Figure 3 : Schematic representation of the correct TME dissection versus an incorrect dissection. The dissection should proceed between the mesorectal fascia and the pelvic wall fascia to ensure a complete" TME.

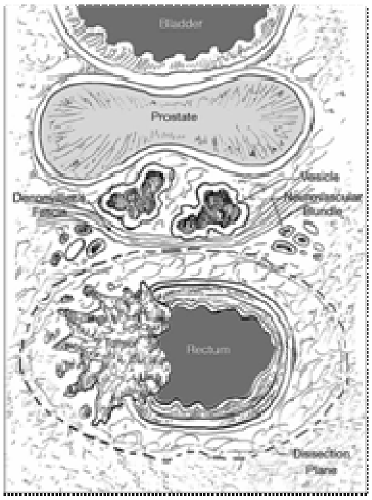

Figure 4: Transverse diagram of the structures of the mid rectum. The proper dissection proceeds just outside the mesorectal fat and fascia but with sparing of the neurovascular bundle and hypogastric plexus that is located anterolaterally along the pelvic sidewall. One or both layers of Denonvillier's fascia should be included in males and the equivalent fascial dissection along the back of the vagina in females.

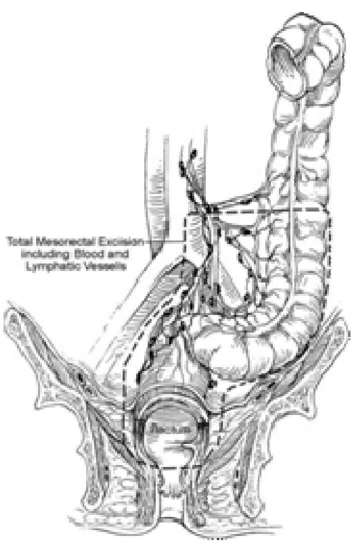

Figure 5: The vascular supply of the sigmoid and rectum. A typical ligation is performed at the junction of the SHA and left colic artery. In patients with a clinical suspicion of positive nodes at the level of the IMA or if vascular mobilization is needed for the left and transverse colon, then a ligation of the IMA is performed at the aorta.

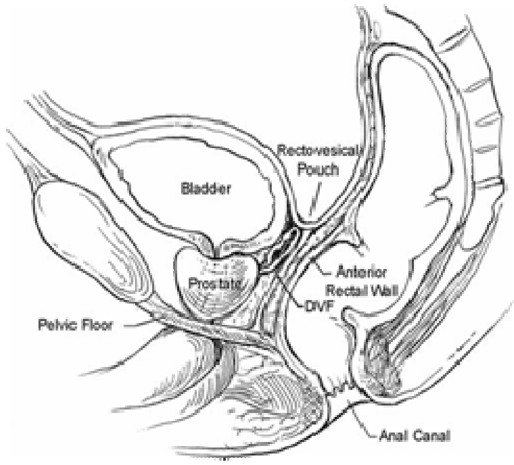

Figure 6: Sagittal view of the rectum, bladder, Denonvillier's fascia, and the prostate. The dissection should proceed anterior to one or both layers of Denonvillier's fascia.

Oncologic outcome:

Nonrandomized comparative studies shows that laparoscopic and open excision of rectal cancer were found to be equivalent in achieving distal and radial margins [9–12, 18, 24, 28, 33–35]; however, it is unclear whether sphincter preservation during laparoscopic total mesorectal excision (TME) makes the resection Margins less than sufficient.

Small comparative studies found no difference in the distal [28, 33] and radial margins [28] between open and laparoscopic sphincter-preserving TME. the reported distal margin in laparoscopic sphincter-preserving TME for mid and low rectal cancer ranged from 3 to 4.3 cm, with microscopic involvement in 1% (range 0–2) of cases was shown in four separate studies [27,29,30,33].

Another study reported a 7-mm radial margin with 10% microscopic involvement in 50 rectal tumors within 11 cm of anal verge [29]. In two other series, all 131 patients who had carcinoma within 12 cm of the anal verge had tumor-free radial margins [27, 30].Low rectal cancer, being surrounded by a thin mesorectum, is associated with an increased rate of positive radial margin [36]. Long-term local recurrence rates for laparoscopic sphincter-preserving TME are needed to evaluate the actual place of laparoscopic anterior resection of rectum compared to open surgery; however, there are limited recurrence data available [37, 38].

The adequacy of radical resection can also be measured by the ability to achieve high-ligation, specimen characteristics, and lymph node yield.

In Scheidbach series [39] successful high ligation of the inferior mesenteric artery reported in 342 (90%) of 380 laparoscopic rectal cancer resections.

Rullier found intact fasica propria in 29 (91%) of 32 laparoscopic TME specimens, and demonstrated quality of excision comparable to open surgery [28]. Laparoscopic excision of rectal cancer was found to yield the same specimen length as open surgery in all comparative studies [10, 24, 33, 35, 41], this was contradicted in one study [40]. lymph node harvest in the resected specimens varied considerably from 5.2 to 25 [9–12,18,24,25,27–29,32–35,39,40,42,43], this was found to be similar to that of open surgery in all comparative studies[9–12,18,24,33–35] except one study done by

Anthuber M and colleagues [40].
From the above mentioned data, evidence exists to support that laparoscopic excision of rectal cancer is as radical as open surgery.

Feasibility and safety:
Evidence exists in the literature confirming the safety and feasibility of laparoscopic rectal cancer surgery. Many studies show that mortality rates were similar [9-12, 24, 28, 34, 40]. Also, no increased overall morbidity when compared with open surgery in most comparative studies [10–12,18,28,33,40,41,44]. Araujo et al' reported that, there was zero mortality and no difference was observed between the two groups in terms of operative and postoperative complications [41].

1. Importance of diverting stomas:
When diverting ileostomies are only selectively created, after laparoscopic sphincter-preserving TME [24, 27, 32] the clinical leak rate was comparable to that of open TME and remained significant at 11% to 17% [45,46]. Tsang et al, practice routine protective ileostomy and have not experienced a single case of clinical leak, although 9% of their patients have had asymptomatic minor radiological leaks, as revealed by routine postoperative contrast enema [30]. Bretagnol and coworkers reported a 2% leakage rate with routine protective ileostomy [29]. Many studies clearly shown that anastomotic leaks are less frequent with proximal diversion [24, 27, 32], and when routinely employed following laparoscopic resection, comparable results with open resection can be achieved [47].

2. Case selection:
The feasibility of sphincter preservation following laparoscopic resection of distal rectal carcinoma relies not only on skills, but also on case selection. After exclusion of locally advanced tumors that invaded adjacent structures or the external anal sphincter, Tsang et al achieved sphincter preservation in 44 cases of laparoscopic TME for cancers within 10 cm of anal verge, with a stapled anastomosis at 4 cm (range 2.5–5) [30]. Other single-surgeon series of laparoscopic sphincter-preserving TME have exercised similar case selection [27,29,33].

3. Conversion rate:
Feasibility of any laparoscopic procedure is reflected by its associated conversion rates. Conversion during laparoscopic rectal cancer excision varies greatly, from 0% to 33% [9–12,15,24,25,27,29–35,39–41,43,44]. Common reasons for conversion were intraoperative bleeding, bulky or locally advanced tumors, technical difficulties, and adhesions [9–11,24,25,27,29,31,32,34,35,40]. Many authors clearly emphasized that timely conversion, wherever indicated,is of utmost importance in containing harm and should not be perceived as Failure. it also reflects surgical maturity.

4. The operative time factor:
The average operating time for laparoscopic sphincter-preserving TME was more variable, and ranged from 2 to 7 hours in different reports [21, 22, 27, 28]. Although the difference might be due to variation in the surgical technique (stapled versus transanal

intersphincteric dissection and hand-sewn anastomosis), case selection and patient body built status.
the relatively long operating time supports the clear fact that laparoscopic excision of low rectal cancer, though feasible, is technically demanding.

Postoperative comparison:
Although there is level one evidence showing that laparoscopic colectomy improves ostoperative recovery [1–3,6–8,20,48,49], there is rarity of studies addressing the same in rectal cancer resection and most of these studies are small with conflicting results.

1. Blood loss:
Compared with open surgery, laparoscopic techniques may be associated with less operative blood loss and reduced perioperative transfusions [18, 33]; others show no difference [41].

2. Hospital stay:
There is also a marginal benefit in the length of hospital stay, with studies showing either similar [18, 24, 33, 41] or shorter hospital stay [9–12, 28, 34, 40]. The absolute reduction in the mean hospital stay was quite dramatic in the latter case, ranging from 4.5 to 7 days [9–12, 28, 34, 40].

3. Postoperative analgesia:
Evidence with regard to postoperative analgesic requirement is also unclear [10,18,24,44].

4. Postoperative Morbidities:
With few exceptions [9, 24], comparative studies showed either lower [11, 33, 40, 44] or similar [10, 12, 18, 28, 41] overall morbidity rates when compared with open surgery.

A. Wound infection and pulmonary complications:
Three comparative studies on rectal cancer surgery reported a similar infection rate between the two techniques [18,24,33].
In the large series by Kockerling and coauthors on low rectal cancer [43], the incidences of abdominal wound disorders and chest infection were 5.1% and 4.3% respectively, converted cases being included. These figures are certainly significant, and suggest that, as with laparoscopic colectomy, the smaller the size of abdominal wound the less postoperative wound and pulmonary complications.
B. Port-site hernia:
Many studies addressed this complication. However, there were only three port-site hernias (0.3%) [9, 21, 30] among 1026 patients who had received laparoscopic rectal cancer surgery. Thus, port-site hernia is infrequent and should be avoidable with attention to port-site closure [51].

C. Postoperative bowel obstruction:
Small comparative studies shows that the incidence of small bowel obstruction after laparoscopic rectal cancer excision was either the same [9] or just barely lower than [12,

18, 24] after open surgery. These studies are small and lack the long-term follow-up. Available evidence does not show clear difference between both groups.

Port-site metastasis:
It was first reported in 1993 [53], and attracted much controversy against laparoscopic colectomy for malignancy. Recent series and randomized trials showed much lower incidence [1, 7, 54, 55]. The overall incidence in the literature is 0.1%. This is comparable to that of wound recurrence in open surgery [56, 57].

Local recurrence:
TME was introduced by Heald in 1982 and has set the standard for rectal cancer surgery, with a 10-year local recurrence rate of only 4% [37, 60]. This excellent result of open surgery keeps a strong challenge for laparoscopic surgery. The majority of the comparative studies found similar
local recurrence rates for laparoscopic and open rectal cancer excision [9,10,24,34,5], and most were able to achieve a local recurrence rate below 10%. Local recurrence of laparoscopic
sphincter-saving TME were in the range of 0% to 6% [24,27,29–32]. This is similar to that in open surgery [36,60,61].

Survival:
Studies on survival data in laparoscopic rectal cancer surgery are scanty in the literature with short follow-up. In a multicenter study on 288 patients with a mean follow-up of 24.8 months, Scheidbach et al [39] reported 4-year overall survival rates of 86.6% and 71.7% after curative laparoscopic APR and anterior resection respectively. Morino and colleagues [27] reported 74% 5-year overall survival following curative laparoscopic TME, with a median follow-up of 46 months. With a mean follow-up of 3 years, Leroy and coworkers [32] reported a slightly lower 5-year figure of 65%. Several small comparative studies of laparoscopic versus open rectal cancer excision demonstrated no survival difference, but follow-up time was short in all these reports [9,18,24,34,35,44].
Apparently laparoscopic TME does not show difference regarding early local disease recurrence and survival rate. Further randomized controlled trials and long-term outcomes needed to support this believe.

Cost effectiveness:
In COLOR (colon cancer open or laparoscopic resection) trial, there was no difference in the total cost by laparoscopic or open surgery group within 12 weeks of surgery[50]. In another study there was no difference in the cost for both procedures [58]. In general, laparoscopic surgery is more costly compared to open surgery even though laparoscopic surgery shows shorter hospital stay and comparable operative time in some studies. The importance of cost-effectiveness in overall assessment of laparoscopic role in rectal cancer management cannot be overemphasized; therefore cost analysis studies are needed in the future.

Genitourinary Dysfunction:
Relation between Laparoscopic rectal cancer excision and genitourinary dysfunction is shown in few reports with conflicting results. One study by Rullier reported one (3.1%) long-term bladder dysfunction in 32 patients after Laparoscopic TME and a 44% sexual dysfunction rate among male patients [28]. On the other hand, Watanabe et al [22] reported no genitourinary dysfunction in a small series of laparoscopic TME comprising only 7 patients. In Tsang'series, although no patient suffered from long-term bladder dysfunction, 2 (9.5%) male patients complained of erectile dysfunction at follow-up visits [30]. Theoretically, with the magnified view and improved visualization of deep pelvic structures under the laparoscope, laparoscopic rectal cancer excision should yield functional outcomes at least comparable to, if not better than, open surgery [7,21,33].

Quality of life:
In spite that Open surgery is considered more invasive than laparoscopic surgery; studies could not show significant difference in quality of life between both procedures. Breukink et al, in a recent prospective study evaluating quality of life and sexual dysfunction after laparoscopic TME excision concluded that one year after laparoscopic TME patients reported improvement in some quality of life outcomes [59].

Summary:
Available literature comparing laparoscopic and open rectal cancer surgery is limited, non- randomized and contains case series. Laparoscopic TME is safe in experienced hands but requires a steep learning curve and an oncological clearance comparable to that of the open counterpart. Realistic case selection and timely conversion are crucial for success and avoiding harm. Overall morbidity looks similar. Laparoscopic surgery offers less abdominal wound infection and pulmonary complications.
Regarding genitourinary dysfunction after laparoscopic rectal cancer excision data are very limited, and future studies needed to address this problem .from oncological point of view port-site metastasis is rare. Laparoscopic surgery also does not seem to confer any disadvantage in early local disease recurrence and survival figures of rectal cancer. Having no adverse influence on postoperative and early oncological outcomes, laparoscopic rectal cancer surgery therefore deserves further evaluation, in the context of large randomized studies, to determine its functional and financial outcomes as well as long-term oncological outcomes.

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