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## Minimally invasive surgery for rectal cancer: Are we there yet?

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### Abstract

Laparoscopic colon surgery for select cancers is slowly evolving as the standard of care but minimally invasive approaches for rectal cancer have been viewed with significant skepticism. This procedure has been performed by select surgeons at specialized centers and concerns over local recurrence, sexual dysfunction and appropriate training measures have further hindered widespread acceptance. Data for laparoscopic rectal resection now supports its continued implementation and widespread usage by experienced surgeons for select patients. The current controversies regarding technical approaches have created ambiguity amongst opinion leaders and are also addressed in this review.

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### INTRODUCTION

The benefits of laparoscopic colon surgery compared to the open approach are well established<sup>[1-4]</sup>. Furthermore, laparotomy has been associated with an increased morbidity when compared to minimally invasive techniques for colorectal disease<sup>[5]</sup>. More recently, the implementation of enhanced care programs coupled to laparoscopic resection has also resulted in a significant reduction in length of stay after both colon and rectal resection<sup>[6,7]</sup>. Laparoscopic colon surgery for select cancers is slowly evolving as the standard of care but minimally invasive approaches for rectal cancer have been viewed with significant skepticism.

Laparoscopic rectal resection for cancer is performed by select surgeons at specialized centers. The variability in anatomic definitions of the rectum, technique, selection criteria, and need for neoadjuvant therapy amongst this group of surgeons have made parallel comparisons difficult and ambiguous. Concern over local recurrence, sexual dysfunction and appropriate training measures have further hindered widespread acceptance of this approach. This opinion addresses short-term and oncological outcomes for laparoscopic resection of rectal cancer, the aforementioned obstacles, and current controversies regarding technical approaches.

### ONCOLOGICAL OUTCOMES

There are many potential endpoints for determining success for laparoscopic rectal resection. Undoubtedly, the

most significant is ensuring oncologic equivalence when compared to the open technique. This variable can primarily be measured by the adequacy of circumferential radial margins, recurrence rates, and both disease free and overall survival. Furthermore, the incidence of sexual dysfunction and other complications after laparoscopic pelvic dissection should approximate that with the open approach.

**Circumferential radial margin**

A positive circumferential resection margin (CRM) is a known marker for increased risk of future recurrence<sup>[8]</sup>. Strict adherence to the principles of “total mesorectal excision” is essential to preserve the mesorectal envelope, obtain an adequate circumferential margin and therefore reduce local recurrence rates. The first randomized trial for laparoscopic rectal resection showed a trend towards increased CRM positivity (6% open *vs* 12% laparoscopic, *P* = 0.19) for anterior resection<sup>[3]</sup>. Although this was initially alarming, several surgeons involved were on their learning curve, and preoperative chemoradiotherapy (CRT) was not standardized. Fortunately, three year outcomes showed that the difference in CRM positivity between laparoscopic and open approaches for anterior resection did not influence local recurrence rates. More recently, five year outcomes revealed no difference between groups in survival, disease-free survival, and local and distant recurrence<sup>[9,10]</sup>. Wound/port-site recurrence rates in the laparoscopic arm were 2.4% and also unchanged<sup>[10]</sup>. Conversion was associated with significantly worse outcomes overall but not disease-free survival.

In the largest retrospective review to date, Ng *et al*<sup>[11]</sup> reported 579 laparoscopic rectal resections for cancer with a CRM positivity of 2.14%. These encouraging results were further substantiated by two recent randomized controlled trials that reported CRM positivity rates of 2.9% (open) *vs* 4% (laparoscopic)<sup>[12]</sup> and 1.4% (open) and 2.6% (laparoscopic)<sup>[13]</sup>.

In 2006, the Spanish Association of Surgeons started an audited teaching program to both make known the results of rectal cancer treatment and improve the outcomes by the teaching process. The quality of the pathologic specimens for laparoscopic and open rectal resection patients was scored and the circumferential radial margin was positive if tumor was located 1 mm or less from the surface of the specimen. No differences between groups for the completeness of the mesorectum or distance of the tumor from the CRM were observed<sup>[14]</sup>. Although laparoscopic TME amongst this experienced group approximates that for their open resection for select tumors, the results may not be as favorable for low bulky lesions or those in an obese male or narrow pelvis.

**Local recurrence**

As highlighted above, the five year results of the MRC CLASSIC trial reported similar regional recurrence for laparoscopic *vs* open resection of rectal cancer. Several other studies have also shown acceptable regional recurrence rates. In their retrospective review, Ng and colleagues reported two port site recurrences and a pelvic recurrence rate of 7.4%<sup>[11]</sup>. Similarly, ten year outcomes from a pro-

Table 1 Overall survival for laparoscopic rectal resection with minimal 5 yr follow-up

Authors	Survival (laparoscopic)	Survival (open)	Follow-up (yr)
MRC CLASSIC (Jayne <i>et al</i> )	57.9%	58.1%	5
Sartori <i>et al</i>	75.4%	NA	5
Ng <i>et al</i>	63.9%	55.0%	10
Lam <i>et al</i>	64.0%		5
Laurent <i>et al</i>	82.0%	79.0%	5
Ng <i>et al</i>	70.0%	NA	5
Siami <i>et al</i>	80.2%	NA	5
Bianchi <i>et al</i>	81.4%	NA	5
Tsang <i>et al</i>	81.3%	NA	5

NA: Not applicable.

spective randomized trial for the laparoscopic resection of upper rectal cancers demonstrated a regional recurrence rate of 7.1% with no port-site recurrences<sup>[13]</sup>. Laurent and colleagues aimed to assess long-term oncologic outcomes after laparoscopic versus open surgery for rectal cancer from in a retrospective comparative study<sup>[15]</sup>. 471 patients had rectal excision for invasive rectal carcinoma during the trial period: 238 were treated by laparoscopy and 233 by open procedure. At 5 years, there was no difference of local recurrence (3.9% *vs* 5.5%, *P* = 0.371) between laparoscopic and open surgery<sup>[15]</sup>.

The multi-institutional series from Japan reported 1057 selected patients with rectal cancer that underwent laparoscopic surgery<sup>[16]</sup>. All the data regarding the patient details and operative and postoperative outcome were collected retrospectively. At thirty months recurrence was found in 6.6% of the 1011 curatively treated patients. Specifically, local recurrence occurred in 11 patients (1.0%) and there was no port-site metastasis (Table 1)<sup>[15]</sup>.

**FUNCTIONAL OUTCOMES**

Laparoscopic rectal surgery proponents argue that the view in the pelvis is superior compared to the open approach. This magnification theoretically provides better visualization of the pelvic nerves. However, in the first randomized trial for laparoscopic rectal cancer male sexual function, erection and ejaculation were all significantly reduced with laparoscopic surgery. This should be interpreted with caution considering the aforementioned learning curve and that more patients in the laparoscopic group underwent a full TME, as compared to the open group. Bladder function remained similar between groups.

In a prospective evaluation of sexual function Stamopoulos and colleagues<sup>[17]</sup> used the international index of erectile function (IIEF) for 56 patients who underwent rectal cancer surgery (38 open *vs* 18 laparoscopic procedures, 38 low anterior *vs* 18 abdominoperineal resections). Rectal cancer resections were associated with a significant reduction in IIEF scores and high rates of sexual dysfunction at 3 and 6 mo. The IIEF and domain scores at different assessment points were comparable between the laparoscopic and open surgery groups<sup>[17]</sup>.

Morino *et al*<sup>[18]</sup> also analyzed male sexual and urinary function after laparoscopic total mesorectal excision. They found that sexual desire was maintained by 55.6%, ability to engage in intercourse by 57.8%, and ability to achieve orgasm and ejaculation by 37.8% of the patients. The distance of the tumor from the anal verge and adjuvant or neoadjuvant treatments were the significant predictors of poor postoperative sexual function. Seven patients (14%) presented transitory postoperative urinary dysfunction, all of whom were medically treated. Tumor stage and distance from the anal verge were independently associated with the postoperative global international prostatic symptom score (IPSS). No differences were observed in urinary quality of life. The authors concluded that laparoscopic resection did not reproduce or improve on sexual and urinary dysfunction outcomes obtained in the best open TME series<sup>[18]</sup>.

In another series with investigators well beyond their learning curve, urinary dysfunction was reported by 6 (6%) patients and 6 (6%) patients had sexual dysfunction, manifesting as retrograde ejaculation in four patients and erectile dysfunction in a further two patients. The low rates of sexual dysfunction in this unit may be attributable to pelvic dissection only being undertaken by experienced, dedicated laparoscopic colorectal surgeons. Previous studies reporting poorer functional outcomes have probably included a significant number of patients on the surgeons' learning curve.

## CONVERSION

The conversion rate for laparoscopic rectal resection is variable between centers and levels of expertise. The MRC CLASSIC randomized trial had a conversion rate of 32% for rectal cancer<sup>[3]</sup>, yet a previous experience of only 20 laparoscopic colon and rectal cases was sufficient to participate. A similar conversion rate (30%) was realized by Ng *et al*<sup>[11]</sup> in their ten year experience with laparoscopic rectal resection. After the inception of this trial significant improvements in energy devices, ports, cameras, and stapling devices have occurred that, combined with their experience, would likely decrease their current conversion rate.

Further analysis has shown that factors associated with conversion are BMI, male sex, and locally advanced tumors<sup>[19]</sup>.

More recently, conversion rates reflect the beneficial impact of extensive experience. Three large retrospective series (2008-2010) have reported conversion rates as low as 5.4%<sup>[11]</sup>, 15%<sup>[15]</sup>, and 4.9%<sup>[20]</sup>. The multi-center retrospective series from Japan also demonstrated a reasonable conversion rate of 7.3%<sup>[16]</sup>.

Conversion rates are as dependent on a reasonable inclusion or selection criteria as surgeon experience. Very low bulky tumors, anterior lesions in men with previous intervention for prostate cancer, T4 lesions, reoperative pelvic dissections and morbidly obese patients should be reserved for the open approach in most cases.

## DEFINING THE RECTUM

There has been considerable debate as to the exact length

of the rectum, the site of transition from sigmoid to rectum and most importantly the point of reference from where measurements are made. Within the surgical literature, numerous series have reported rectal cancer as being within 15, 16 and even 18 cm from the verge, although several other series use the dentate line as the reference point. Currently, the variability of these definitions not only impacts surgical decision making between centers but also the timing and need for neoadjuvant therapy, which in turn impacts oncologic outcomes and morbidity rates.

There are also significant differences in practice internationally with respect to the selection criteria used for CRT. In the United States, most practitioners adhere to the NCCN guidelines that recommend neoadjuvant CRT for patients with T3 or N1 disease with tumors within 10 cm of the dentate line<sup>[21]</sup>. The Mercury study group<sup>[22]</sup> has provided evidence that pre-operative MRI can accurately predict surgical resection margins. This report has led to a paradigm shift in the preoperative investigation and treatment of rectal cancer in the UK. With this approach, CRT is predominantly used when the tumor threatens or involves the mesorectal fascia and in all low rectal cancer where there is an inherent increased risk of involving the CRM.

Despite these apparent discrepancies most surgeons and oncologists generally agree that rectal cancer consists of extraperitoneal and intraperitoneal lesions. Tumors at or below the anterior reflection should be grouped together in investigations and are the real subject of this and other discussions surrounding laparoscopic rectal cancer.

## TECHNICAL ISSUES

The most important variable being assessed with laparoscopic vs open rectal resection for cancer is the pelvic dissection. Surgeons must analyze their own ability to perform a laparoscopic total mesorectal excision with the same precision achieved by their open technique. Although this fact seems obvious it cannot be understated. Several studies continue to populate the literature describing a "hybrid" technique. With this approach the mobilization of the left colon is performed laparoscopically and the pelvic dissection and transection of the rectum are performed through a Pfannenstiel or lower midline incision. Outcomes with this technique have been favorable and it certainly has inherent advantages but unquestionably it is not laparoscopic rectal surgery. Therefore, although published results substantiate its role, ideally it should not be included in trials or case series for laparoscopic rectal resection and should not be billed or coded as such. If this procedure continues to demonstrate favorable outcomes and has a shorter learning curve it may require its own procedure code in the future.

Internationally, the straight laparoscopic approach with three or four abdominal trocar sites and a left lower quadrant or periumbilical extraction incision is preferred. Outcomes with this approach (outlined in previous section) were initially concerning but have now more consistently been favorable. As discussed above, the protracted opera-



tive times and concerns over both local recurrence and sexual function have been diminished with increased operative experience. This may be the most technically demanding method and surgeons preferring this technique recognize its limitations. Dividing the lower rectum, providing adequate traction low in the pelvis, and teaching trainees how to perform an appropriate total mesorectal excision are the current challenges. This procedure is less daunting for patients requiring an abdominal perineal resection. They are left without the morbidity of an abdominal wound as the specimen is routinely removed through the perineum.

Proponents of hand-assisted laparoscopy in the United States continuously have demonstrated equivalent outcomes for laparoscopic colon resection with reduced operative times. More recently results with hand-assisted methods for rectal cancer have also been reported with success<sup>[23,24]</sup>. When the hand-assisted device is left in place and the pelvic dissection is performed laparoscopically these cases should be included with other minimally invasive approaches to rectal cancer. This approach may be favorable in patients with a bulky mesorectum or when additional tension is required to facilitate accurate transection of the low rectum.

Dividing the rectum laparoscopically is not always technically feasible. The limited angulation of the stapler and physical limitations of working in the bony confines of the pelvis are common deterrents<sup>[25]</sup>. In this situation, having an assistant apply perineal pressure may elevate the pelvic floor enough to allow the first cartridge of the stapler to reach the anorectal junction. Furthermore, utilizing a suprapubic port or medicalizing the right lower quadrant port may help. Lastly, if these techniques are unsuccessful a limited lower midline or Pfannenstiel incision can be made and a 30 mm open stapler can be introduced. If an appropriate distal margin is not obtainable with these methods a mucosectomy with partial inter-sphincteric resection and hand-sewn coloanal anastomosis is performed.

In addition to the difficulty with transection, very low anteriorly based and bulky lesions are often challenging. Entering the appropriate plane anterior to Denonvillier's fascia laparoscopically, respecting the need for an adequate radial margin, and maintaining meticulous hemostasis is essential. In this location, tissue planes can be more ambiguous and any bleeding further obscures the appropriate anatomy. If there is considerable doubt that the correct tissue plane is being violated, immediate conversion is warranted. Ideally these tumors are approached by surgeons who are well past their learning curve for laparoscopic pelvic dissection.

The recognition of these technical limitations and the ongoing development of advanced technology led to the introduction of robotic applications for low pelvic dissection. Data for robotic approaches to rectal cancer have recently been published and presented in national and international forums. The advantage of operating with more degrees of freedom for low rectal cancer is apparent and is of particular benefit in a narrow male pelvis. However, concerns over significantly increased cost, operative times, and training have limited its widespread adoption. Furthermore, proponents seem to be employing this

approach *carte blanche* and looking for opportunities to expand its indications rather than using it as a tool. In the era of economic constraints and limited resident exposure to cases a costly technique with ill defined training methods should be used for select cases only.

## CONCLUSION

Technical advances in the field of coloproctology have unquestionably improved patient outcomes. However, it is essential that we continue to strive to define the appropriate inclusion criteria for new approaches in regards to patient, disease, and surgeon experience. Historically, new technology, such as the PPH stapler, robotics, and laparoscopy, has become more than an optional approach or "tool". Surgeons inherently develop extraordinary comfort with the technology and tend to expand its indications, often illogically. Creativity and "pushing the envelope" should not be discouraged but when it becomes apparent that new approaches become simply a "means to an end" patients outcomes may be less than ideal.

The abundance of data for laparoscopic rectal resection for cancer supports its continued implantation and widespread usage by experienced surgeons for select patients. Until we become more adept at operating in the low narrow pelvis and transecting the rectum we must recognize that this approach is complementary to our open technique. To ensure the best outcomes we must continue to recognize the difference between the questions, "can you?" and "should you?" in regards to minimally invasive surgery.

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