# The circumferential resection margins status: A comparison of robotic, laparoscopic and open total mesorectal excision for mid and low rectal cancer

J.P. de Jesus [a], M. Valadão [a,*], R.O. de Castro Araujo [a], D. Cesar [a], E. Linhares [a], A.C. Iglesias [b]

[a] Department of Abdominal and Pelvic Surgery, National Cancer Institute (INCA), Rio de Janeiro, Brazil
[b] Department of General and Digestive Surgery, Federal University of the State of Rio de Janeiro (UNIRIO), Rio de Janeiro, Brazil

## Abstract

*Introduction*: Minimally invasive surgery for rectal cancer (RC) is now widely performed via the laparoscopic approach, but robotic-assisted surgery may overcome some limitations of laparoscopy in RC treatment. We compared the rate of positive circumferential margins between robotic, laparoscopic and open total mesorectal excision (TME) for RC in our institution.

*Methods*: Mid and low rectal adenocarcinoma patients consecutively submitted to robotic surgery were compared to laparoscopic and open approach. From our prospective database, 59 patients underwent robotic-assisted rectal surgery from 2012 to 2015 (RTME group) were compared to our historical control group comprising 200 open TME (OTME group) and 41 laparoscopic TME (LTME group) approaches from July 2008 to February 2012. Primary endpoint was to compare the rate of involved circumferential resection margins (CRM) and the mean CRM between the three groups. Secondary endpoint was to compare the mean number of resected lymph nodes between the three groups.

*Results*: CRM involvement was demonstrated in 20 patients (15.5%) in OTME, 4 (16%) in LTME and 9 (16.4%) in the RTME ($p = 0.988$). The mean CRM in OTME, LTME and RTME were respectively 0.6 cm (0–2.7), 0.7 cm (0–2.0) and 0.6 cm (0–2.0) ($p = 0.960$). Overall mean LN harvest was 14 (0–56); 16 (0–52) in OTME, 13 (1–56) in LTME and 10 (0–45) in RTME ($p = 0.156$).

*Conclusion*: Our results suggest that robotic TME has the same oncological short-term results when compared to the open and laparoscopic technique, and it could be safely offered for the treatment of mid and low rectal cancer.

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*Keywords:* Rectal cancer; Robotic surgery; Minimally invasive surgery; Total mesorectal excision; Circumferential resection margins

## Introduction

Minimally invasive surgery for rectal cancer is now widely performed via the laparoscopic approach and has been validated in randomized controlled trials compared to open surgery.[1,2] However, there are several technical drawbacks to laparoscopic surgery, including limited range of motion of instruments in narrow pelvic cavity, 2-dimensional view, need for a skilled assistant and unstable camera view.[3] Technical advantages of the robotic-assisted surgery compared to laparoscopic surgery in rectal surgery includes improved 3-dimensional vision, enhanced ergonomics, tremor elimination, superior dexterity, surgeon's comfort[4,5] and potentially better oncological and functional outcomes.

For successful treatment of rectal cancer, the quality of the surgical technique is critical and affects both local recurrence and overall survival. The most important technical factor is to assure the integrity of the mesorectal fascia during total mesorectal excision (TME). The pathologic features of the resected specimen most widely investigated

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\* Corresponding author. Department of Abdominal and Pelvic Surgery, National Cancer Institute (INCA), Praça Cruz Vermelha, 23, Centro, Rio de Janeiro-RJ, CEP: 20230-130, Brazil. Tel.: +55 21 3207 1161.

*E-mail addresses:* drmarcusvaladao@gmail.com, mvaladao@inca.gov.br (M. Valadão).

and shown to predict local recurrence are circumferential resection margins (CRM) status and quality of mesorectal excision.[6–8] A pooled meta-analysis by Nagtegaal and Quirke comprising over 17,500 patients has demonstrated that a CRM of ≤1 mm is a strong predictor of local recurrence.[9] CRM involvement was found to be an even stronger predictor of local recurrence after neoadjuvant therapy.[10]

Some large prospective series have evaluated the safety and feasibility of robotic TME and demonstrated equivalent short-term oncological outcomes compared to open surgery regarding mesorectal fascia integrity, CRM status and lymph node resection rate.[11,12] The only published randomized data so far comparing laparoscopic and robotic TME included only 18 patients in each arm and found no difference in the quality of resected specimen.[4] On the other hand, there is a multitude of systematic reviews and case-matched series that show equivalent clinical and oncologic outcomes.[13] Currently, one large multicenter randomized controlled trial comparing robotic versus laparoscopic surgery for rectal cancer (ROLARR) is underway. The endpoints are rate of conversion to open surgery and the pathologic CRM positivity rates. Moreover, three meta-analysis comparing robotic and laparoscopic approaches revealed similar pathological outcomes.[14–16] The aim of this study was to compare pathological CRM positivity rates between robotic, laparoscopic and open TME for rectal cancer.

## Patients and methods

From our institution prospective database we selected all biopsy proven locally advanced (T3 and T4) rectal adenocarcinomas submitted to preoperative chemoradiotherapy (CRT) followed by surgical resection. Neoadjuvant CRT in our institution was delivered as fluorouracil-based chemotherapy concomitant to external bean radiation at 50.4 Gy usual dose. All tumors were located in the middle and low rectum. Rectal cancers were classified in low rectal tumors if located no more than 5 cm from the anal verge or mid rectal tumors when located between 5 and 10 cm from the anal verge, as detected by rigid proctoscopy. Exclusion criteria were the presence of distant metastasis at the time of surgical treatment, squamous cell carcinoma, recurrent tumor and upper rectal cancer (located above 10 cm from the anal verge). Between May 2012 and September 2015, 89 consecutive unselected patients underwent robotic-assisted TME (RTME) by three experienced rectal surgeons at the Instituto Nacional de Câncer (INCA, Rio de Janeiro, Brazil). Of these 89 patients, 30 were ultimately excluded: 2 patients with squamous cell carcinomas, 1 with familial adenomatous polyposis (FAP) and 27 with high rectal tumors (located above 10 cm from the anal verge). These 59 remaining patients formed the experimental group (Robotic), and were compared to patients submitted to open or laparoscopic resection (historical controls).

The historical control group was composed of unselected patients consecutively operated in our institution from July 2008 to February 2012 and were included only if they have met the same inclusion criteria applied for the robotic group. They were further divided in a former group of 200 patients submitted to open TME (OTME) and a later group of 41 laparoscopic TME (LTME). Open or laparoscopic approaches were performed according to surgeons ability (not all surgeons were familiar with the laparoscopic TME). The 7th edition of AJCC cancer staging system was used.[17]

For comparison of the quality of surgical resection between the groups the main variable studied was the CRM status. CRM was measured as the minimal distance from any residual tumor deposit to the painted resection margin, using whole-mount sections.[6] Any tumor margin measured less than 1 mm from the CRM was considered to be involved according to previous evidence.[18,19]

The primary endpoint of this study was to compare the rate of involved CRM and also the mean CRM between the three groups. The secondary endpoint was to compare the mean number of resected lymph nodes between the three groups.

### Statistical analysis

All robotic group data was registered in a prospective database and the historical control group data was retrospectively collected from medical records and electronic patient's charts. Statistical analysis was performed using SPSS 17.1 (IBM SPSS Inc., Armonk, NY, USA). Null hypotheses of no difference were rejected if *p*-values were less than 0.05, or, equivalently, if the 95% confidence intervals of risk point estimates excluded 1.

## Results

Between July 2008 and September 2015, 300 patients who met the inclusion criteria for middle and low rectal adenocarcinoma underwent TME with curative intent. Three groups were analyzed: 200 patients in the OTME (open TME), 41 in the LTME (laparoscopic TME) and 59 in the RTME (robotic TME) group. The clinical and pathological characteristics of these 300 patients are shown in Table 1. Although there was a male predominance in both laparoscopic (58% vs 42%) and robotic groups (61% vs 39%), there was no significant statistic difference between the 3 groups in gender distribution (Table 1). Moreover, no significant statistic difference was observed between the 3 groups concerning age, tumor stage or in any other clinical characteristics. The median age was 58 (18–81) years.

### Pathological outcomes

Complete pathologic response was observed in 4 (1.5%) patients, all of them were in the robotic group. The majority of patients (n = 181) were staged as ypT3 (67.3%), and this