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## Minimally invasive multivisceral resection in rectal cancer: Preparation or Precipitation?

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### Abstract

Rectal cancer is a malignant neoplasm that constitutes a significant public health challenge due to its high incidence and associated mortality. In this editorial, we comment on the article by Chan *et al.* In recent years, there has been progress in the development of new treatments for initial and metastatic rectal cancer due to introduction of techniques of innovative and minimally-invasive surgery (MIS) such as laparoscopy and robotic surgery. However, only a few studies have analyzed the feasibility, safety, and results of MIS in relation to open surgery, thereby highlighting the promising and superior results of MIS in functional and oncological terms. The findings were corroborated by the comparative study of Chan *et al* which evaluated the feasibility and safety of minimally invasive multivisceral resection (miMVR). A comparison of postoperative outcomes between open MVR and miMVR showed that miMVR presented less blood loss, fewer postoperative complications, and less morbidity. This editorial article is focused specifically on analysis of the characteristics of new minimally-invasive surgical techniques in rectal cancer, particularly in advanced stages. The importance of future research is emphasized by progress in knowledge, training, and clinical practice in the application of these surgical procedures for the treatment of advanced colorectal cancer.

**Key Words:** Minimally invasive surgical procedures; Multivisceral resection; Rectal neoplasms; Robotic surgical procedures

**Core Tip:** In this editorial, we commented on the observational study by Chan *et al.* The study analyzed the feasibility and safety of minimally invasive multivisceral resection (miMVR) for stage T4b rectal cancer by comparing postoperative outcomes between miMVR and open MVR, and it also compared postoperative outcomes between robotic and laparoscopic approaches. We complemented this by discussing some of the most notable studies, with emphasis on the development of new treatments for initial and metastatic rectal cancer, and introduction of innovative and minimally-invasive surgery techniques such as laparoscopy and robotic surgery. The importance of future research is emphasized by progress in knowledge, training, and clinical practice in the application of these surgical procedures for the treatment of advanced colorectal cancer.

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## INTRODUCTION

Rectal cancer, a malignant neoplasm that originates in the rectum, represents a significant fraction of cases of colorectal cancer which is one of the most prevalent types of cancer worldwide. It has been estimated that there will be 152810 new cases of colorectal cancer in the United States in 2024, out of which 46220 will be specifically cases of rectal cancer. This type of cancer is responsible for a significant portion of the estimated 53010 deaths from colorectal cancer in the United States[1]. In recent decades, there have been significant changes in the incidence of colorectal cancer which was hitherto thought to be low, and currently, notable increases in cases of this disease have been identified[2]. The World Health Organization (WHO) states that colorectal cancer accounts for approximately 10% of all cancer cases, and it is the second most important cause of cancer-related mortality worldwide[2]. In 2020, more than 1.9 million new cases of colorectal cancer were diagnosed, and more than 930000 deaths due to this condition were reported worldwide by WHO in 2023. At initial diagnosis, 36% of patients present colorectal cancer in an advanced stage which is characterized by invasion of surrounding tissues and/or regional lymph nodes, with 22% of the patients developing distant metastases. Data from the National Cancer Institute of the United States show that the five-year overall survival for colon cancer patients is 64%, while that for rectal cancer patients is 67%[3].

Genetic and environmental factors play critical roles in the etiology of rectal cancer[2]. However, most of these cancers are sporadic. Indeed, three-quarters of rectal cancer patients report a negative family history. The notable increase in the incidence of this disease has been linked to a variety of largely modifiable environmental factors such as unhealthy modern dietary patterns (high intake of processed meats and low intake of fruits and vegetables), and the prevalence of risk factors such as smoking, alcoholism, lack of physical activity, and obesity[2,4].

Early detection and identification of rectal cancer are crucial for improving survival rates and reducing mortality associated with the disease[4,5]. By diagnosing cancer in its early stages, treatment options become more effective and less invasive, thereby offering a better post-treatment quality of life. In contrast, identification of rectal cancer in advanced stages presents significant challenges, as treatment options become more complex, with attendant decline in survival rate. Therefore, early identification and treatment are fundamental pillars for a favorable prognosis in rectal cancer.

## SURGICAL TREATMENT FOR RECTAL CANCER

Medicine has evolved in the development of treatments for rectal cancer, both in the initial and metastatic phases, through introduction of innovative surgical techniques for combating the primary disease, and the application of more aggressive surgical strategies for metastases such as liver and lung metastases[6-13]. Additionally, specific radiotherapy, chemotherapeutic therapies (neoadjuvant and palliative) and immunotherapies for rectal cancer have been incorporated [3,8,14]. Despite these advances, the impact of treatment strategies on cure rates and long-term survival has been rather modest[6].

Surgical treatments for rectal cancer have progressed significantly, with availability of various modalities ranging from traditional open procedures to minimally-invasive surgery (MIS) techniques such as laparoscopy and robotic surgery[3,6,7,10,13]. The choice of treatment depends on several factors, *e.g.*, the stage of cancer, tumor location, patient's systemic health, and the expertise of the surgical team. Open surgery has been the gold standard for many years. This treatment modality allows direct access to the tumor, as well as a wide surgical field, and it facilitates resection in cases of large, complex, and/or complicated tumors, thereby enhancing complete tumor resection with negative margins. However, this technique may be associated with increased morbidity, longer recovery time, increased postoperative pain, and a higher risk of postoperative complications such as surgical site infections[6]. On the other hand, MIS which comprises laparoscopy and robotic surgery, has been widely accepted due to its perceived benefits such as lower postoperative morbi-

dity, reduced hospitalization time, and faster recovery without compromising oncological outcomes[6,7,10]. Laparoscopy, in addition to the previously mentioned benefits, offers oncological results comparable to those of open surgery, for certain patients. However, laparoscopy requires considerable technical skill, and it is not always suitable for all cases of rectal cancer, especially in situations of advanced cancer, or when the tumor is located in a difficult-to-access area[6,11]. Robotic surgery, a variant of laparoscopy, offers greater precision and greater flexibility, in addition to a three-dimensional view with depth perception, high-resolution images, dexterity and other benefits such as applicability of artificial intelligence, truly objective metrics for evaluation, augmented reality, and ergonomic advantages for the surgeon (*e.g.*, elimination of tremors and surgeon comfort)[11,13,15-17]. Although preliminary studies showed promising results in terms of functional and oncological outcomes, the significantly higher cost and limited availability constitute considerable disadvantages[6,9,13]. Despite the fact that open surgery is the gold standard for cancer, recent studies have indicated that MIS may offer significant advantages in terms of postoperative recovery, with comparable survival and recurrence rates[6,9,11]. However, only a few studies have analyzed the feasibility, safety, and outcomes of MIS, in relation to a more invasive method such as open surgery, for treating advanced rectal cancer.

In the recent issue of the *World Journal of Gastrointestinal Surgery* by Chan *et al*[18] published an interesting paper titled Feasibility and safety of minimally invasive multivisceral resection for T4b rectal cancer: A 9-year review. The study analyzes the feasibility and safety of minimally invasive multivisceral resection (miMVR) for stage T4b rectal cancer, and compared postoperative outcomes between miMVR and open MVR (oMVR), as well as postoperative outcomes between robotic and laparoscopic approaches. In the study which included 46 patients, it was observed that, when compared with oMVR, miMVR was associated with less blood loss (median 450 *vs* 1200 mL,  $P = 0.008$ ); lower major morbidity (14.7% *vs* 50.0%,  $P = 0.014$ ); fewer postoperative intra-abdominal collections (11.8% *vs* 50.0%,  $P = 0.006$ ); lower cases of postoperative ileus (32.4% *vs* 66.7%,  $P = 0.04$ ), and fewer surgical site infections (11.8% *vs* 50.0%,  $P = 0.006$ ). Moreover, the length of hospital stay for patients treated with miMVR was shorter than that for patients treated with oMVR (median: 10 *vs* 30 days,  $P = 0.001$ ). Additionally, more patients underwent robotic MVR than laparoscopic MVR for complex cases (robotic *vs* laparoscopic: 57.1% *vs* 7.7%,  $P = 0.004$ ). Operation time was significantly longer for robotic MVR than for laparoscopic MVR [robotic: 602 (400-900) minutes; laparoscopic: Median 455 (275-675) minutes,  $P < 0.001$ ]. The 3-year overall survival and recurrence-free survival were markedly superior in robotic minimally invasive MVR, when compared with laparoscopic MVR (3-year overall survival: Robotic *vs* laparoscopic: 83.1% *vs* 58.6%,  $P = 0.008$ ; recurrence-free survival: Robotic *vs* laparoscopic: 72.9% *vs* 34.3%,  $P = 0.002$ ). The superiority of robotic minimally invasive MVR in both 3-year overall and recurrence-free survival, relative to laparoscopic MVR, may suggest that the robotic approach may be preferable in complex cases. Some of these findings are at variance with those obtained in the studies by Kazi *et al*[6] and Bonjer *et al*[19]. In the study by Kazi *et al*[6], 158 patients were participants, and the objective was to compare the perioperative and short-term oncological results of pelvic exenterations performed using MIS methods in primary locally-advanced rectal cancers, with those obtained using open surgery. In this retrospective analysis, it was observed that operation time was significantly longer for MIS than for open surgery (640 minutes for MIS *vs* 450 minutes for open surgery,  $P < 0.001$ ), and MIS resulted in less blood loss than open surgery (900 mL for MIS *vs* 1600 mL for open surgery,  $P < 0.001$ ). Moreover, MIS was associated with lower abdominal wound infections than open surgery (8.2% for MIS *vs* 17.5% for open surgery,  $P = 0.020$ ). However, there were no significant differences in 3-year overall survival and recurrence-free survival between MIS and open surgery. In addition, in both studies, the duration of hospital stay, R0 resection rates, and 3-year oncological outcomes were similar in the MIS and open surgery groups. The study by Bonjer *et al*[19] was a multicenter, international, randomized trial involving 1044 rectal cancer patients, in which the 3-year rates of cancer recurrence in the pelvic or perineal area (locoregional recurrence) and survival after resection, were compared between laparoscopic MVR and open surgery. In this multicenter study, locoregional recurrence rate of 5.0% was reported for each surgical approach, with greater disease-free survival for laparoscopy (74.8%) than for open surgery (70.8%), and also greater overall survival for laparoscopy (86.7%) than for open surgery (83.6%). However, there was no indication that laparoscopic surgery was inferior to open surgery. Interestingly, in the study by Bonjer *et al*[19], patients with lesions in stages T4 and T3 Less than 2 mm from the endopelvic fascia were excluded because the researcher considered laparoscopic resection of these large tumors very difficult, in addition to the likelihood of incomplete resection and higher rates of locoregional recurrence. Therefore, Bonjer *et al*[19] did not recommend laparoscopic surgery in patients with T4 or T3 rectal cancers with threatened circumferential margins. This opinion highlights the significance of the study by Chan *et al*[18], which showed evolution in recent years in terms of increases in surgical training in miMVR techniques, as well as development of advanced surgical technologies that favor the execution of complex procedures more safely and efficiently in the most advanced stage of colorectal cancer. Despite differences in sample size, selection criteria, and reported results amongst the studies by Chan *et al*[18], Kazi *et al*[6] and Bonjer *et al*[19], the three groups of authors agree on the feasibility of MIS in relation to open surgery, for the treatment of rectal cancer through highlighting its potential to reduce postoperative morbidity without negatively affecting long-term oncological results.

In the surgical treatment of advanced rectal cancer, particularly in cases of T4b cancer, it is essential to note that advances in minimally invasive surgical technique such as laparoscopic surgery and robotic surgery, have produced promising results. However, early adoption of these methods in clinical practice, especially for complex cases, remains limited due to several factors. The decision on when and how to implement these techniques is influenced by paucity of robust, standardized studies that directly compare the short- and long-term outcomes of open surgery and MIS in this specific context. The choice of surgical modality in the treatment of rectal cancer must be personalized, based on a detailed evaluation of each case while taking into account the specific characteristics of the tumor, the patient's preferences, and the benefits and risks associated with each method.

The selection of miMVR should be based on a careful evaluation of each patient, always considering factors such as tumor stage, cancer location, and medical conditions. An individualized treatment plan should be developed within a multidisciplinary approach that includes oncologists, radiologists, and other specialists[18,19]. Detailed planning is essen-



tial to ensure complete tumor resection and reduce the risk of recurrence. To achieve this, advanced imaging tools and the assessment of resection margins are indispensable[18]. Adequate preoperative preparation should also include discussing patient expectations and possible outcomes, as well as planning for complication management. MiMVR surgery for advanced rectal cancer involves several critical points that must be addressed precisely, including the proper management of surgical margins, the preservation of pelvic nerves to avoid urinary and sexual dysfunctions, and intestinal reconstruction to ensure optimal functional recovery[19]. Handling and preserving the inferior mesenteric artery (IMA) is a crucial consideration in rectal cancer resection, requiring special attention. Surgical techniques for managing the IMA, including high and low ligation and the hemodynamic implications of each approach, have been considered. The decision to preserve or locate the IMA is conditioned by various factors, including the location and extent of the tumor, as well as the patient's vascular anatomy. Therefore, preoperative evaluation using angiography or advanced imaging techniques would be most appropriate for planning the intervention. For the standardization of miMVR surgical procedures, we reiterate the need to implement detailed protocols that address each stage of the surgical procedure; this includes proper patient selection, preoperative planning, resection techniques, and postoperative management. These protocols will demonstrate significant benefits in terms of reducing complications and improving long-term oncological outcomes[19].

Although technological advances have improved the precision and capabilities of MIS, its impact on cure rates and long-term survival is still the subject of research[6,18,19]. The effective implementation of miMVR for the treatment of rectal cancer requires a high level of expertise and specialized training. Surgeons must be well-trained and certified in the use of advanced technology and in managing potential complications. First, implementing structured training programs that include theoretical and practical modules; this training should cover surgical anatomy, laparoscopic and robotic techniques, complication management, and postoperative care. Using surgical simulators and skill labs to allow surgeons to practice and perfect miMVR techniques; particularly, robotic simulators can be useful for developing skills in using robotic systems. Second, establishing mentoring and apprenticeship programs where experienced surgeons guide trainees through live surgical procedures; observation and gradual participation under supervision are crucial for developing confidence and competence. Third, organizing workshops focusing on specific techniques, such as IMA preservation, T4b tumor management, and reconstruction techniques; these courses should include both practical and theoretical components[9,16]. To ensure surgeons maintain and improve their skills, it would be beneficial to implement a continuous evaluation system; certification in miMVR, particularly in the use of robotic technology, can standardize competencies and ensure a minimum skill level[9,16]. Additionally, access to cutting-edge technology, including robotic surgery platforms and advanced visualization systems, would involve training in the use of emerging tools like artificial intelligence and augmented reality, which are becoming important for such procedures. International exchange and collaboration of experiences can also accelerate the learning curve and improve global outcomes in rectal cancer treatment. Enhancing competencies in miMVR techniques will ensure that patients receive high-quality treatment with optimal outcomes[9,16].

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## FUTURE PERSPECTIVES

The findings obtained from the article by Chan *et al*[18] open the door to several important directions for future research in the treatment of advanced rectal cancer using miMVR. There is need to design prospective studies and randomized controlled trials in order to carry out more robust comparisons of short- and long-term outcomes between robotic surgery and laparoscopic MVR[5]. These studies should focus on the evaluation of the quality of oncologic resection and functional outcomes such as patients' quality of life, recurrence rates, and overall and disease-free survival, in order to provide a stronger evidence base to guide future research. The choice of surgical technique guides the analysis of the efficacy of miMVR in different subgroups of patients, in view of variables such as tumor stage, presence of comorbidities and demographic characteristics.

Given that economic feasibility is an important factor in the adoption of new medical technologies, an important aspect to evaluate is the cost-effectiveness of robotic MVR, when compared to laparoscopic surgery and open surgery[9,11,12]. This analysis will contribute to understanding the relative value of these technologies in the management of T4b rectal cancer. Additionally, there is need to develop, validate, and implement risk prediction and stratification tools that help personalize the therapeutic approach for each patient, in order to maximize benefits while minimizing risks and costs.

It is essential to analyze strategies for implementation of continuous increases in surgical training and training in miMVR techniques, as well as the development of advanced surgical technologies that favor the execution of complex procedures in a safer and more efficient manner[17]. These strategies include innovation in surgical instrumentation, visualization systems, and robotic platforms.

Finally, to determine the long-term effectiveness of miMVR in the treatment of T4b rectal cancer, long-term follow-up of patients is essential to evaluate cancer recurrence, overall survival, and disease-free survival[6].

These future perspectives are essential for advancing knowledge, training, and clinical practice in the management of T4b rectal cancer. The goal is to improve patient outcomes from both clinical and economic perspectives, through technological innovation and rigorous clinical research.

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## CONCLUSION

The surgical management of rectal cancer has evolved significantly, with increasing focus on minimally invasive surgery (MIS) techniques that offer oncologic outcomes comparable to those of open surgery, along with the added benefit of

faster recovery, reduced postoperative pain, and decreased risk of postoperative complications. Future research is crucial for advancing understanding, training, and clinical application of MIS techniques in the treatment of rectal cancer, with the aim of optimizing results for patients, in both clinical and financial terms, through the utilization of cutting-edge technology and thorough clinical investigations.

## FOOTNOTES

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