

## Robotic technology: Optimizing the outcomes in rectal cancer?

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### Abstract

Minimally invasive rectal resection remains a challenging procedure, even in experienced hands. Technical limitations explain at least in part the reasons of a relatively poor adoption of laparoscopy for rectal resection, in particular for low tumors in a deep and narrow pelvis. Robotics is intended to overcome these limitations. Potentially better short-term outcomes have been

published: reduced conversion rates, better functional outcomes, shorter learning curve, reduction of positive margins, better specimen... However, robotic surgery has not yet taken over as the gold standard approach for low anterior resection. Several drawbacks might indeed discourage the most fervent surgeon: the size of the robot, the lack of tactile feedback, the risk and difficulties during multiquadrant surgery, and, of course, costs. Whilst new systems might overcome most of these drawbacks, it seems obvious that the development of robotic surgery is underway. Robotics is not just another interesting technical tool, but more a new concept, which should play a role in the future.

**Key words:** Robot; Laparoscopy; Total mesorectal excision; Transanal total mesorectal excision; Transanal endoscopic microsurgery; Outcomes; Rectal cancer

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**Core tip:** The current evidences of robotic rectal resection are presented, as its potential limitations. While several better short-term outcomes have been reported (notably reduced conversion rates, better functional outcomes, shorter learning curve, reduction of positive margins, and better specimen), robotics has not yet taken over as the gold standard for low anterior resection. The reasons for this are analyzed, as the future developments in the robotic rectal field.

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### TEXT

Rectal resection for cancer remains a difficult operation

especially when using a minimally invasive approach. This explains at least in part the reasons for the limited diffusion of laparoscopy in the colorectal field. The technical explanations for this relatively low adoption are well known: unstable instrumentations, two-dimensional vision, narrow space, and poor ergonomics. These limitations are particularly relevant during low rectal dissection in the confines of the pelvis.

On the other hand, the recently published Colorectal cancer Laparoscopic or Open Resection (COLOR) II study has confirmed that in selected patients with rectal cancer treated by skilled surgeons, laparoscopic surgery resulted in similar safety, resection margins, and completeness of resection to that of open surgery, while recovery was improved after laparoscopic surgery. However, even in highly experienced hands, the authors still reported a conversion rate of 17%<sup>[1]</sup>.

The use of robotic technology is intended to overcome these limitations. The initial reports were encouraging with promising outcomes, although a clear advantage has not yet been demonstrated. More than 10 years after the initial experience, robotic surgery has not (yet?) taken over as the gold standard approach for low anterior resection (LAR), and the main question is why?

Focusing on the published evidences, there are yet potentially better short-term outcomes, as shown in several systematic reviews<sup>[2-6]</sup>, notably better functional outcomes<sup>[7]</sup> and a shorter learning curve<sup>[8]</sup>. This is particularly true when applied in selected patients such as obese and/or male patients, especially those with preoperative radiotherapy, and tumors in the lower two thirds of the rectum<sup>[3]</sup>. Indeed, robotics may overcome the challenges associated with difficult pelvic anatomy and might reduce the risk of conversion (ranging from 1% to 7.3% for robotics vs 3% to 34% for laparoscopy)<sup>[3,9]</sup>. An open conversion in these difficult cases can be still technically challenging, leading to potentially worse short-term or oncological outcomes<sup>[9,10]</sup>. On the other hand, it is not clear why robotics might prevent conversion. There are some hypothetical explanations: (1) better vision that could allow better dissection; (2) a more stable platform; (3) a self-controllable camera; (4) instruments with more degrees of freedom and without tremor; (5) improved opportunity to control unexpected bleeding; and (6) better ergonomics.

According to the CLASICC trial (up to 34% of conversion!), the main reasons for conversion from laparoscopy were: tumor fixity or uncertainty of tumor clearance, obesity, anatomic problems, and tumor inaccessibility<sup>[9]</sup>. All these parameters are crucial from an oncological point of view when performing a LAR or an ultra-LAR. The risk of positive margins for low rectal tumor is indeed still high (9% with a laparoscopic approach, but up to 22% with an open approach)<sup>[1]</sup>. The corollary of these relatively poor outcomes has been the introduction and the development of different technical options to reduce the risk of positive margins.

Firstly, robotics might reduce the rate of positive circumferential resection margins (CRM)<sup>[5]</sup>. In addition,

it might improve the quality of the specimen, with more complete total mesorectal excision (TME)<sup>[11]</sup>, which might reduce the risk of local recurrence<sup>[12]</sup>. However, this advantage of the robotic approach remains hypothetical, and so far oncological outcomes seem to be comparable between robotic and laparoscopic approaches<sup>[13]</sup>.

Secondly, transanal TME has been developed, based on the concept to start first the distal dissection from the anus (so called "bottom-up technique"), allowing to define precisely the distal margin. The early data are encouraging, with a reduced positive margins rate in comparison to standard approach<sup>[14]</sup>. However, this technique, still in its infancy, remains technically challenging, and again the robot could be applied to overcome the difficulties associated with this new technique<sup>[15]</sup>. Interestingly, the same advantages and drawbacks were seen when using robotics for transanal endoscopic microsurgery<sup>[16]</sup>.

Looking at the published experience, it would seem obvious that robotic surgery is a valid option for low rectal cancer. However, the enthusiasm has been dampened by several drawbacks, which could discourage the most fervent surgeon: the size of the robot, the lack of tactile feedback, the risk and difficulties during multiquadrant surgery, and, of course, costs. While part of these disadvantages might be overcome with the new Xi system (Intuitive Surgical Inc., Sunnyvale, CA), the global economic impact of robotic surgery remains unclear and the increase in overall costs is probably the most limiting factor for a wide diffusion of robotic technology. The real benefits for the institution remain to be scrutinized (marketing impact, increased referral, reduced global costs), and beyond this local economic problem, the risk that this technology will be restricted to rich countries is real.

So far, the best indications for this technology are not yet clear. However, it seems obvious that the development of robotic surgery is underway. The number of series to date is significant and the safety and feasibility of the robotic approach have been proven, along with its oncological outcomes (at least the short-term outcomes). However, comparison between robotics and laparoscopy did not give the expected results in favor of robotics. While still in its youth, it should be noted that the perioperative outcomes associated with robotic LAR are at least as good as laparoscopy, and could be achieved with a shorter learning curve and better functional results, in particular in difficult patients. Regarding the learning curve, it is not clear if open colorectal surgeons (who probably did not embark on laparoscopy) would be interested by robotics (as were the urologists in those days). The learning curve might be then slightly different for an open surgeon starting robotic surgery than an already experienced laparoscopic colorectal surgeon embarking on robotics. The evidences concerning the learning curve are indeed mainly based on skilled minimally invasive surgeons.

So far, the main difference remains the reduction in conversion rate after a robotic LAR. The clinical

corollary of this fact is still hypothetical, but might give some benefits to robotic patients. From an oncological point of view, similar outcomes have been reported. However, better TME and a reduction in positive CRM were reported in selected robotic series, especially when applied for low tumors.

To conclude, the main question is not whether robotic surgery will take over from laparoscopy, but when and how. However, technical challenges and barriers (such as costs, size of the robot, and lack of tactile feedback) still need to be overcome. Looking at the history of surgery, it seems obvious that robotics is not just another interesting technical tool, but more a new concept, creating a computer interface between the patient and the surgeon. The possibilities appear really interesting, notably in terms of planning, teaching, automation, and telemedicine. However, this technology has a cost, and it is not yet clear whether the surgical community, or even the overall community, is ready to pay for this.

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