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Robotic Surgery in Rectal Cancer*

Cirurgia robótica no cancro do reto

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Abstract

Rectal cancer is an important cause of morbidity and mortality worldwide. The most effective and curative treatment is surgery, and the standard procedure is total mesorectal excision, initially performed by open surgery and posteriorly by minimally invasive techniques. Robotic surgery is an emerging technology that is expected to overcome the limitations of the laparoscopic approach. It has several advantages, including a stable camera platform with high definition three-dimensional image, flexible instruments with seven degrees of freedom, a third arm for fixed retraction, fine motion scaling, excellent dexterity, ambidextrous capability, elimination of physiological tremors and better ergonomics, that facilitate a steady and precise tissue dissection. The main technical disadvantages are the loss of tactile sensation and tensile feedback and the complex installation process. The aim of the present study is to review the importance and benefits of robotic surgery in rectal cancer, particularly in comparison with the laparoscopic approach. Intraoperative estimated blood loss, short and long-term outcomes as well as pathological outcomes were similar between robotic and laparoscopic surgery. The operative time is usually longer in robotic surgery and the high costs are still its major drawback. Robotic surgery for rectal cancer demonstrated lower conversion rate to open surgery and benefits in urinary and sexual functions and has been established as a safe and feasible technique.

Keywords
- rectal cancer
- minimally invasive surgery
- robotic surgery

Resumo

O cancro do reto é uma importante causa de morbidade e mortalidade em todo o mundo. O único tratamento curativo e mais eficaz é a cirurgia, sendo que o procedimento padrão é a excisão total do mesoreto, inicialmente realizada por cirurgia aberta e mais tarde por técnicas minimamente invasivas. A cirurgia robótica é uma tecnologia emergente que pretende ultrapassar as limitações da laparoscopia. As vantagens incluem plataforma de câmera estável, imagem tridimensional com alta definição, instrumentos flexíveis com sete graus de liberdade, terceiro braço para retração fixa, movimentos finos, excelente destreza, ambidestria, eliminação do

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tremor fisiológico e maior conforto ergonômico, que facilitam uma disseção firme e precisa dos tecidos. As principais desvantagens técnicas são a perda da sensação táctil e *feedback* tensional e o complexo processo de instalação. O objetivo deste estudo é fazer uma revisão bibliográfica da importância e dos benefícios da cirurgia robótica no cancro do reto, particularmente em comparação com a cirurgia laparoscópica. A perda estimada de sangue intraoperatória, os *outcomes* a curto e longo-prazo e os *outcomes* patológicos foram equivalentes entre a cirurgia robótica e laparoscópica. O tempo operatório é geralmente mais longo na cirurgia robótica e os elevados custos são a sua principal desvantagem. A cirurgia robótica no cancro do reto demonstrou menor taxa de conversão para cirurgia aberta e benefícios nas funções urinária e sexual e está estabelecida como uma técnica segura e viável.

Palavras-chave
- cancro do recto
- cirurgia minimamente invasiva
- cirurgia robótica

Introduction

According to data from The Global Cancer Incidence, Mortality and Prevalence (GLOBOCAN) 2018,[1] colorectal cancer is the 3rd most common cancer worldwide, with an annual global incidence of 1,849,518 cases per year (10.2%), and the 2nd most deadly cancer in the world, with 880,792 deaths per year (9.2%). Rectal cancer represents 38% of all colorectal cancers, being a significant cause of morbidity and mortality worldwide. In Portugal, rectal cancer is the fifth most common cancer and the eighth deadliest.[1]

The most effective and only curative treatment for the majority of patients with rectal cancer is surgery, and the standard procedure is total mesorectal excision (TME), introduced by Heald et al.[2] in 1982.[3–6] Total mesorectal excision involves complete and sharp circumferential dissection and en bloc resection of the mesorectum, from the sacral promontory to the pelvic floor, to ensure negative circumferential and distal margins and complete removal of the local lymph nodes.[7–10] Therefore, TME is associated with reduced local recurrence rate, increased survival rates, and high sphincter-saving rate. As the pelvic autonomic nerves are outside the mesorectum, this technique also allows better preservation of the urinary and sexual functions.[10–13]

Initially, during the 1980s, TME was performed by open surgery, which is still acceptable and commonly used in the treatment of rectal cancer. Currently, minimally invasive surgery techniques, such as laparoscopy and robotic surgery, are gaining popularity.[14,15]

In 2004, the first laparoscopic TME (LaTME) for rectal cancer was reported, and, since then, it has been widely used.[16] Laparoscopic TME is a safe and effective approach with oncological outcomes, such as TME quality and resection margins, number of lymph nodes removed, local recurrence, and overall survival, comparable to those of open surgery.[17–20] Additionally, it is consistently associated to improved short-term outcomes, including less tissue trauma, better cosmetic results, reduced analgesia, reduced intraoperative blood loss, less wound complications, less postoperative pain, faster recovery of oral intake and return to normal activities, faster recovery time and shorter hospital stay.[6,13,19–24] Nonetheless, laparoscopy has limitations and is technically challenging in rectal cancer surgery, with a long learning curve, particularly due to the narrow and deep pelvic cavity and anatomical complexity.[16,24,25] Unstable, assistant-dependent two-dimensional camera, straight and rigid instruments, poor dexterity, limited range of motion, poor ergonomics, reduction of tactile sensation and tremor amplification contribute to the difficulty of LaTME. Moreover, the conversion rate to open surgery is still considerably high.[20,23,26–28]

Robotic surgery is an emerging technology that is expected to overcome the limitations of the laparoscopic approach.[23,29] The first robotic TME (RoTME) for rectal cancer was performed in 2006.[15,17] Robotic systems provide a stable camera platform with high-definition three-dimensional image, flexible instruments with seven degrees of freedom that mimic and enhance human wrist movements and a third arm for fixed retraction. These features enable fine motion scaling, excellent dexterity, ambidextrous capability, elimination of physiological tremors, greater ergonomic comfort, and less fatigue for the surgeon, which facilitates a steady and precise dissection in deep and narrow spaces, such as the pelvic cavity, and ultimately may result in better clinical, oncological, and functional outcomes in rectal cancer treatment.[17,20,21,23,27,30–32] Nevertheless, the robotic approach has disadvantages, particularly the loss of tactile sensation and tensile feedback, the complex installation process, and the high cost and maintenance fees.[9,18,20,23]

More recently, a new technique has been performed and studied for the treatment of rectal cancer. Transanal TME (TaTME), first described in 2010, overcomes the difficulty of operating in a narrow pelvis and allows excellent access to the distal rectum and, consequently, a more accurate distal dissection with wider margins.[4,5,7,17] However, it is a technically difficult procedure and, therefore, several authors proposed a transanal approach surgery using a robotic platform, with all its inherent advantages, which is proving to be a safe, feasible, and promising technique.[3,33,34]

The aim of this study is to review the importance and benefits of robotic surgery in rectal cancer, particularly in comparison with the laparoscopic approach.

Methods

A literature search was performed in PubMed between October and November 2019, for articles in English and Portuguese, published after 2014, using the terms *robotic surgery* and *rectal cancer*. In total, 69 articles were selected, including cross-referenced studies from the chosen articles.

Results and Discussion

Intraoperative Parameters

Operative Time

Robotic surgery is generally associated with longer operative time compared with laparoscopic and open approaches.[9,27,29,35–40] Nevertheless, there is some variability, with some studies and meta-analysis reporting comparable results between robotic and laparoscopic surgery.[13,28,35,41–45] A study by Crolla et al. showed that the mean operative time in the robotic group was significantly 40 minutes longer than in the laparoscopic group.[36] The Robotic vs Laparoscopic Resection for Rectal Cancer (ROLARR) randomized clinical trial, a well-designed phase-III study with clear objectives and rigorous methodology, also demonstrated a significantly longer operative time in the robotic-assisted group, which was performed by surgeons with varying experience.[38,46] In contrast, Rouanet et al. reported no significant difference between RoTME and LaTME in terms of operative time in a retrospective study in which RoTME and LaTME were performed by the same senior surgeon.[46] In fact, surgeon and team experience seems to be one of the factors that improves operative time.[9,25,39,45] Mégevand et al. compared the operative time between the first 17 patients and the last 18 patients in both robotic and laparoscopic groups. Statistically significant difference in operative time was found between the two subpopulations of the robotic group. Additionally, considering only the last group of patients, no difference was found between laparoscopy and robotic surgery. These results show not only that the operative time decreases with experience but also that robotic and laparoscopic approaches are comparable once the learning curve is stabilized.[27] Alfieri et al. made a similar comparison and also concluded that the operative time significantly decreases as the number of robotic surgeries performed increases.[26] Kim et al. also reported shorter operative time as the experience in robotic surgery increases.[16] The longer operative time of RoTME may also be related to the complexity of the technique itself, the set-up time and the robotic system.[26,36,42] However, the latest version of the da Vinci system, with narrower arms and easier docking process, may contribute to decrease the operative time.[3,39,44]

With improvement of robotic systems and increased surgeon experience, the operative time of robotic surgery is expected to decrease in the future.

Estimated Blood Loss

Since robotic systems warrant better visualization and a more precise dissection, a lower estimated blood loss (EBL) in RoTME could be expected, in comparison with LaTME. In fact, some studies reported lower EBL as an advantage of robotic surgery.[29,47,48] Tang et al. inclusively reported no blood vessels injury nor intraoperative bleeding in a series of 392 patients who underwent RoTME.[30] Contrariwise, several studies and meta-analysis failed to find any significant differences in EBL between RoTME and LaTME.[6,15,23,28,35,39,42] Nevertheless, low EBL is a clear advantage of minimally invasive techniques over open surgery.[29,35,40] Although the results are variable, rectal surgery is considered a relatively bloodless procedure, regardless of the approach.[44]

Conversion to Open Procedure

In general, conversion rate to open procedure is associated with higher intraoperative and postoperative complication rates, longer hospital stay, higher costs, and worse oncological outcome with increased postoperative mortality, higher long-term disease recurrence, and poorer survival.[25,27–29,36,45,49] Amongst the reasons for conversion to open surgery, the more frequently reported are obesity, difficulty in dissection, narrow pelvis, intraoperative hemorrhage and tumor invasion.[9,25]

Most studies demonstrate that RoTME has a significantly lower conversion rate than LaTME.[6,21,25,27,29,36,39,41,46,50] Kim et al. reported no need for conversion in the 60 RoTME performed.[16] Tang et al. reported only 7 conversions in 392 RoTME (1.8%), all within the first 50 cases.[30] The ROLARR trial, however, found no statistically significant differences. Once again, it is important to note that robotic procedures were performed by surgeons with varying experience, some still in their learning curve. The authors analyzed the potential learning effects and concluded that lower conversion rate is a significant advantage of robotic surgery over laparoscopy when performed by experienced surgeons.[36,38,46] Moreover, this study reported a lower conversion rate when using robotic surgery in the subgroups of male patients, with typically narrower pelvis, and obese patients.[38]

The better conversion rate achieved by robotic surgery in rectal cancer may result from the characteristics of the robotic systems, namely high exposure, high three-dimensional definition, stable camera platform, ergonomic instruments and freedom of movements that enable a better visualization and dissection in the narrow pelvis.[19,29,36,41]

Notwithstanding the lower conversion rate of RoTME, the expected advantage over LaTME in terms of postoperative courses and oncological outcomes, discussed ahead, is yet to be established.[25,29,45]

Ergonomic Comfort

The ergonomic comfort of the surgeon during surgery is an important parameter with impact on the quality of the surgical performance, surgical errors, and surgeon's well-being but seldom assessed in studies comparing robotic and laparoscopic rectal surgery.[36,51,52]

Laparoscopic surgery certainly has advantages over open surgery, particularly in patient-related short-term outcomes.

Nevertheless, the ergonomic conditions for surgeons are not especially favorable, due to the instability of the assistant-dependent camera, monitor positioning, rigid instruments with limited degrees of freedom and maintenance of awkward or uncomfortable positions for long periods of time, and, thus, require more physical and mental effort.[51,53,54] Studies indicate that around 73 to 88% of laparoscopic surgeons report musculoskeletal pain or discomfort related with laparoscopy.[53,54]

In robotic surgery, the work environment is quite different. The surgeon sits at a remote-control console in a stable position, with forehead and arm-rests, and manipulates the camera and the lightweight masters that control the instruments with great range of motion, while observing the procedure through a stable three-dimensional image.[51–53,55,56] These features contribute to a healthier and more ergonomic work environment. Actually, most studies report less physical and mental strain in robotic surgery than in laparoscopic surgery, with fewer occupational injuries, particularly musculoskeletal.[36,51–56] These assessments were based on both objective parameters, such as muscle activation and heart rate, as well as subjective questionnaires, and the results were consistent. The surgeon's perception is that robotic system improves comfort and mental and physical efforts. Consistently, surgeon's monitoring revealed higher levels of muscle activation, namely in the back and shoulders, and increased heart rate during laparoscopy when compared with robotic surgery.[52,53,55] Furthermore, ergonomic improvements of robotic systems appear to be more beneficial to surgeons with greater experience in robotic surgery, underlining the importance of well-trained surgeons.[51]

The improved ergonomic comfort of robotic surgery ensures better surgical performance and work satisfaction and may contribute to its acceptance amongst surgeons.[36,52,55]

Short-term Postoperative Parameters

Length of Hospital Stay

Although some studies[46,50] found significant shorter length of hospital stay following RoTME compared with LaTME, most meta-analysis demonstrated that there are no statistically significant differences between the two techniques in terms of hospital stay.[13,15,25,41,44] Despite the technical advantages of robotic systems, the degree of surgical stress caused by RoTME and LaTME and recovery time appear to be similar.[13]

First Passing Flatus

Return to bowel function measurement is variable between studies, with some considering the first passing flatus and others first bowel movement.[44] Prete et al. found a significant earlier recovery of bowel function after robotic surgery but stated that this is supported by very low quality evidence.[25] Other studies also found a shorter time to first flatus following RoTME, yet only marginally significant and with little clinical significance at the moment.[6,27,49] RoTME appears to be comparable to LaTME in terms of first passing flatus.[18,42–44,47,48]

Time of Return to Normal Diet

No significant difference was demonstrated in terms of time of return to normal diet between patients who underwent RoTME and LaTME.[13,15,47,48]

Some studies applied, to all patients, fast-track/enhanced recovery after surgery (ERAS) protocols, that consist of a set of perioperative recommendations and aim to reduce surgical stress and improve surgical outcomes. These protocols include, amongst others, recommendations for early optimized nutrition, and, therefore, in these cases, time of return to normal diet was not considered as an outcome.[12,27,36,37,57,58] Additionally, Asklid et al. compared compliance to the ERAS protocol between laparoscopic and robotic rectal cancer surgery, and the difference was not statistically significant.[57]

Complications

Rectal cancer surgery is a procedure with a relatively high morbidity, averaging 39% in large trials.[44] Postoperative complications include anastomotic leakage, surgical wound infection, intraabdominal abscess, ileus, postoperative bleeding, and cardiac and pulmonary complications. In general, no statistically significant difference was found between RoTME and LaTME neither in overall complication rate nor in each complication separately.[10,15,27,39,41,44,45,59] Moreover, there are no significant differences in complication rate between minimally invasive techniques and open surgery.[29,40,60]

The ROLARR trial demonstrated similar complication rate following robotic and laparoscopic surgery and stated that there were no safety issues attributable to the robotic system.[38] Chang et al. analyzed information from a prospectively designed database with 1,145 consecutive cases of robotic rectal surgery and reported an overall complication rate of 16.3%, of which 2.4% corresponded to severe complications. These results are lower than those reported for laparoscopic rectal surgery in previous studies. The authors identified the male gender, mid-low rectum tumors, combined organ resection, and clinical T category (cT3–4) as independent risk factors for robotic surgery complications. Other risk factors previously associated with laparoscopic or open surgery, such as body mass index ≥ 28, age ≥ 75, comorbidities, preoperative radio or chemoradiotherapy, and tumor size ≥ 5 cm, were not significant in this study.[61] Tsukamoto et al., in a multi-center pilot phase II study with 50 cases, reported similar overall and severe complication rates (16% and 4%, respectively) with anastomotic leakage being the most common complication. The authors suggest that the low complication rate may be associated, among others, with the robotic system characteristics that allow better visualization and mobilization, precise dissection and safe reconstruction.[31] Tang et al. also reported anastomotic leakage as the most frequent complication (4.1%) out of an overall complication rate of 10.2%.[30]

Additionally, no difference was found between the robotic and laparoscopic surgery in terms of reoperation rate.[9,21,29,39]

Pathological Outcomes

Pathological outcomes are important to assess the quality of surgery and its oncological safety.[62] The main objective of

TME is to achieve a good quality mesorectal excision with negative resection margins and an acceptable number of harvested lymph nodes.[62,63]

Positive Circumferential Resection Margin/Radial Margin

Circumferential resection margin (CRM) is a well-known prognostic factor associated with local recurrence, distant metastasis and worse survival outcomes.[9,25,41,62] Positive CRM is usually defined as margin distance $\leq$ 1 mm.[18,29,41,44,62,63]

Considering the better image, improved mobility and control and consequent more precise dissection provided by the robotic system, an improvement in pathological outcomes such as CRM would be expected. However, most studies failed to demonstrate a statistically significant superiority of robotic surgery over laparoscopy regarding CRM.[6,10,21,25,37–39,45,46,64] The ROLARR trial reported positive CRM in 5.1% and 6.2% of cases in the robotic and laparoscopic groups, respectively, which was not statistically significant.[38] A meta-analysis by Prete et al. reported a CRM involvement of $<$ 5%, similar between the two techniques.[25] A study by Chang et al. including 1,145 cases of robotic rectal cancer surgery reported a positive CRM rate of 1.3%, and Tang et al., in a series of 392 cases, reported 2.5% of CRM involvement, which supports the safety and feasibility of RoTME.[30,61] Moreover, no significant difference was found between these minimally invasive techniques and open surgery.[29,35,60,64]

Lymph Nodes Harvested

Another important parameter with impact on the patient's prognosis is the number of harvested lymph nodes (HLN).[18,25] For TME, it is recommended to harvest a minimum of 12 lymph nodes and a lower number may be associated with increased risk of recurrence and worse survival.[41,62,63]

Although some results regarding HLN are contradictory, the average number of HLN in RoTME is usually similar to that in LaTME and both are beyond the minimum recommended.[6,13,15,21,25,27,39,41,45,64] Chang et al., Tang et al. and Kim et al., in their series of cases of robotic rectal surgery, reported a mean number of HLN of 17, 14.6 and 20.1, respectively, all greater than 12 HLN, ensuring the safety of RoTME.[16,30,61] When comparing robotic and laparoscopic approaches with open surgery, no significant difference was found.[29,35,60,64]

Distal and Proximal Resection Margins

The length of distal and proximal resection margins (DRMs and PRMs, respectively) are also important parameters to assess surgical quality and may affect long-term oncological outcomes.[41,45]

In most studies, the length of the DRM or DRM involvement (usually $\leq$ 1 mm) achieved by RoTME was comparable to that obtained with LaTME and open surgery.[6,21,29,35,39,41,44–46] The average DRM length of robotic surgery reported by Tang et al. and Kim et al. was 3.5 cm and 3.1 cm, respectively, which is considered a safe margin.[16,30]

Although few studies evaluated PRM, no statistically significant difference was found between RoTME and LaTME.[19,41,62]

Quality of the Mesorectum

Macroscopic TME completeness has been reported to reflect the quality of the surgery more precisely than CRM.[25,41,45] Incomplete TME may result in worse long-term oncological outcomes with increased risk of local recurrence and worse survival.[9,45]

Robotic systems provide improved image, flexibility, freedom of movement, and control of instruments that enable a better grasping and traction, consequently causing less tissue shearing, which would likely translate into better TME completeness. In fact, some studies demonstrated a statistically significant superiority of robotic surgery in terms of TME quality, although there is no evidence that this affects long-term outcomes such as survival rate, as will be further discussed.[44,45,65] Contrarily, several studies found no significant difference in TME quality between robotic and laparoscopic techniques.[19,21,25,46,62] Rouanet et al. found that 98% and 99% of cases were graded as complete or nearly complete in the RoTME and LaTME groups, respectively.[46] Chang et al. reported no cases of incomplete mesorectum in their study of 1,145 cases of robotic rectal surgery, and Alfieri et al. reported 98.3% of complete or near complete mesorectum.[26,61] These results, although comparable with those of LaTME, are very satisfactory and validate the safety of TME.[19,45]

Functional Outcomes

Urinary and sexual dysfunction are well-known sequelae, whether temporary or definitive, of rectal cancer surgery, due to unintentional injury or excision of pelvic autonomic nerves.[44,45,66]

The robotic systems' features, namely stable high definition three-dimensional image, flexible-wristed tremor-free instruments and steady counter-traction by the third arm that enable precise dissection even in confined spaces such as the pelvic cavity, are expected to translate into greater preservation of autonomic nerves and consequently of the urinary and sexual functions.[45,66,67] In fact, several studies suggest that robotic surgery is advantageous in terms of these functional outcomes.[12,44,49,66–68]

Kim et al. concluded that robotic surgery in male patients resulted in less urinary and sexual function deterioration and faster recovery, compared with laparoscopic surgery. The authors analyzed urinary and sexual functions at baseline, 3, 6, and 12 months after surgery. The urogenital function was impaired at 3 months after surgery in both robotic and laparoscopic groups and then progressively improved, which is consistent with the expected resolution of postoperative tissue inflammation and nerve repair. In male patients, urinary function at 6 months, although different from baseline in both groups, was significantly better in the robotic group. At 12 months, urinary function was similar between the groups but only comparable to baseline in the robotic group. In female patients, no significant difference was found regarding urinary function, which may be justified by the more difficult approach to the male pelvic cavity that is usually narrower and deeper. Therefore, male patients may benefit more from robotic rectal cancer surgery. In terms of sexual function, no differences were found between the groups, but male patients in the robotic group recovered to baseline function at 6 months, faster than the ones from the laparoscopic group, that recovered at 12 months.[66] A study by Tang et al. suggested that robotic surgery may result in faster recovery of urogenital function.[67] Wang et al. compared urinary and sexual functions at baseline and 12 months after surgery and demonstrated that robotic surgery significantly preserves urinary and sexual functions.[12] A meta-analysis by Broholm et al. showed an inconsistent tendency toward improved urinary and sexual functions following robotic surgery suggesting that further investigation is necessary to assess functional outcomes.[68] The ROLARR trial compared urinary and sexual functions between the robotic and laparoscopic groups at 6 months after surgery and found no statistically significant differences. Furthermore, the authors state that, given the small differences between baseline and 6 months evaluation, autonomic nerve preservation was accomplished, and urinary and sexual dysfunctions were infrequent events in both robotic and laparoscopic groups.[38]

In conclusion, robotic surgery appears to have some benefits in terms of urinary and sexual functions.

Long-term Parameters

Long-term outcomes are also important to evaluate the oncologic safety of the robotic approach in rectal cancer surgery and include overall survival, disease-free survival and local recurrences.

Overall survival and disease-free survival at 3 and 5 years are comparable between RoTME and LaTME.[10,13,15,37,39,44–46,50] In a study by Feroci et al., the 3-year overall and disease-free survival rates were 90.2% and 79.2% in RoTME and 90.0% and 83.4% in LaTME, differences not statistically significant.[37] Rouanet et al. reported lower 3-year overall survival rates of 84.1% and 88.4% in RoTME and LaTME, respectively, also non-statistically significant.[46] Additionally, no statistically significant difference was found in 5-year overall and disease-free survival rates between the minimally invasive techniques and open surgery.[29,40]

No significant difference was found in 3-year local recurrence between RoTME and LaTME and between these minimally invasive techniques and open surgery.[9,10,13,15,29,37,44,48]

In conclusion, despite the above-mentioned features and advantages of robotic systems and short-term benefits reported by some studies, there is still no evidence of robotic surgery superiority in terms of the prognosis of patients with rectal cancer.

Cost

The major drawback and main limitation to widespread use of robotic surgery is the high costs.[29,39,44] Most studies found that robotic surgery has statistically significant higher overall costs than laparoscopic surgery, even excluding the acquisition and maintenance costs.[29,38,39,44] According to Quero et al., the mean operating room costs and the mean costs of surgical equipment of robotic surgery are higher, to which the longer operative time may contribute, but no difference was found regarding hospital stay costs between robotic and laparoscopic surgery, which may be related to similar length of hospital stay and complication rate.[29]

Nevertheless, the development of new robotic platforms is expected to result in a reduction of costs associated with robotic surgery and ultimately in its widespread use.[29,45]

High-risk Patients

High-risk patients are those in which pelvic surgery is significantly more challenging and include the following characteristics: male gender, obesity, preoperative chemoradiotherapy, tumors < 8 cm from the anus, and previous abdominal surgery.[20,64] In high-risk patients, robotic surgery appears to have additional benefits compared with laparoscopic surgery, namely higher sphincter preservation rate, reduced blood loss, reduced conversion rate and shorter length of stay.[20,63]

In elderly and very elderly patients ($>$ 65 years old and $\geq$ 80 years old, respectively), who have a significantly higher American Society of Anesthesiologists (ASA) score and comorbidity index, the conversion rate to open surgery and the complication rate following robotic surgery were similar to those of the younger population ($\leq$ 65 years old). Thus, robotic surgery is also safe and feasible in elderly and very elderly patients and should be an option in these populations, although a multidisciplinary case-to-case selection is advisable.[69]

Conclusion

Robotic surgery, with its high definition three-dimensional image and flexible instruments with high freedom of movements, has a major importance in rectal cancer, given the technical difficulty of operating in a confined and deep space such as the pelvic cavity. In terms of intraoperative EBL, short and long-term outcomes, and pathological outcomes, RoTME is similar to LaTME. The operative time is usually longer in robotic surgery, but there is a tendency to improve with surgeon experience and improvement of robotic systems. The high costs are still its major drawback, and it is essential to understand in which cases robotic surgery is more beneficial, with special attention to high-risk patients. Notwithstanding, robotic surgery for rectal cancer demonstrated lower conversion rate to open surgery, benefits in the functional outcomes and in the urinary and sexual functions, and it has been established as a safe and feasible technique with improved ergonomic comfort for surgeons.

Conflicts of Interests
The authors declare no conflict of interests.

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