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MINIREVIEWS

Surgical management of rectal prolapse: The role of robotic surgery

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Abstract

The robotic technique as a safe approach in treatment of rectal prolapse has been widely reported during the last decade. Although there is limited clinical data regarding the benefits of robotic surgery, the safety of robotic surgery in rectal prolapse treatment has been cited by several authors. Also, the robotic approach helps overcome some of the laparoscopic approach challenges with purported advantages including improved visualization, more precise dissection, easier suturing, accurate identification of anatomic structures and fewer conversions to open surgery which can facilitate the conduct of technically challenging cases. These advantages can make robotic surgery ideally suited for minimally invasive ventral rectopexy. Currently, with greater surgeon experience in robotic surgery, the length of the procedure and the recurrence rate with the robotic approach are decreasing and short term outcomes for robotic rectal prolapse seem on par with laparoscopic and open techniques in recent studies. However, the high cost of robotic procedures is still an important issue. The benefits of a robotic approach must be weighed against the higher cost. More research is needed to better understand if the increased cost is justified by an improvement in outcomes. Also, published articles comparing long term outcomes of the robotic approach with other approaches are very limited at this time and further clinical trials are indicated to affirm the role of robotic surgery in the treatment of rectal prolapse.

Key words: Rectal prolapse; Robotic surgery

Core tip: Robotic rectopexy is a safe and feasible technique for the treatment of rectal prolapse with improved visualization and ease of suturing. The robotic approach can provide functional results and short term outcomes similar to laparoscopic surgery. However, increased operative time and higher cost are challenges. Further prospective clinical trials assessing the role of robotic surgery in the treatment of rectal prolapse are needed.

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INTRODUCTION

Rectal prolapse was first described in the Ebers Papyrus around 1500 BC. In 1899, Edmond Delorme reported the first successful surgical treatment of rectal prolapse[1,2]. Since 1899, more than 100 procedures have been described for the treatment of rectal prolapse[3]. However, there has been ongoing controversy regarding the ideal procedure for the treatment of prolapse with the lowest rates of recurrence, complications, and mortality.

Practically speaking, the numerous rectal prolapse procedures are categorized into trans-abdominal and perineal approaches. Trans-abdominal operations can be performed with open, laparoscopic, and robotic techniques. The perineal and abdominal approaches each have their own advantages and disadvantages. While the trans-abdominal approaches are reported to have longer operative times, higher costs, and lower recurrence rates, perineal approaches tends to be safer but with a greater recurrence rate[4]. The trans-abdominal approach is more commonly performed, and is a popular choice for patients without significant comorbidities[5] fit for a major abdominal operation. Also, trans-abdominal approaches can be combined with other abdominal/pelvic procedures such as uteropexy, colpopexy, or sigmoidectomy[6,7], whereas, the perineal approach can be done under regional anesthesia and is often favored for elderly and/or high-risk patients[2,5]. Treatment should be individualized for each patient with the aim of achieving the better outcome[2].

MINIMALLY INVASIVE APPROACHES IN TRANS-ABDOMINAL RECTAL PROLAPSE REPAIR

Trans-abdominal operations can be performed with open, laparoscopic, and robotic techniques. Since the introduction of minimally invasive techniques for rectal prolapse in 1993[7], the use of laparoscopy in the treatment of rectal prolapse has expanded. Lower morbidity, faster recovery time, shorter hospital stay, and less blood loss have been reported as the advantages of laparoscopic surgery over the open approach[8-10]. The laparoscopic approach as the preferred approach in the treatment of rectal prolapse has been recommended by several studies[8,9,11].

Since the introduction of robotic surgery in 1998, it has been widely applied in a variety of procedures across many surgical specialties[12]. The aims of robotic surgery are to facilitate minimally invasive surgery and overcome some of the challenges of laparoscopic surgery[13]. Features such as high-quality, three-dimensional vision, restoration of the eye-hand-target axis, better depth perception, tremor elimination, more precise dissection, and a better definition of tissue planes lead to precise dissection, especially in the pelvis[13]. Published articles have reported advantages of robotic surgery (*e.g.*, faster recovery time, and less postoperative pain compared to open surgery) including less blood loss and a lower conversion rate (compared to laparoscopic surgery)[13-15]. However, the high cost and prolonged operative time of robotic procedures are disadvantages of this approach[16]. As surgeons become more experienced in robotic techniques, the length of the procedure decreases significantly; however, the higher cost of robotic procedures is still an important issue[17]. More research is needed to better understand if the increased cost is justified by an improvement in outcomes.

OPERATIVE INDICATIONS AND PATIENT SELECTION

The first step in choosing the appropriate approach to treat rectal prolapse is to evaluate the patient's operative and anesthesia risk as well as their baseline bowel function and continence. It is commonly accepted that patients with low operative and anesthesia risk should be offered an abdominal approach. A robotic approach also has the additional advantage of allowing easier technical access to other pelvic pathologies including enterocele, rectocele and vaginal vault prolapse, should they exist. In patients who have failed a prior repair and have a recurrence of their rectal prolapse a laparoscopic or robotic-assisted abdominal repair is a good choice[18].

Contraindications to a laparoscopic or robotic approach are similar and can be subdivided into physiologic contraindications and anatomic/technical contraindications. Physiologic contraindications precluding laparoscopic/robotic surgery include: pregnancy, coagulopathy, increased intracranial pressure, low cardiac output, severe pulmonary disease and chronic liver disease. The above mentioned conditions are not an absolute contraindication for surgery and the risk of a laparoscopic/robotic surgery should be assessed for each case separately. Anatomic contraindications to robotic surgery are rare but mostly pertain to patients with an extensive prior history of abdominal operations with a hostile abdomen and thick adhesions which preclude good visualization and safe dissection with the surgical robot. These patients rarely suffer from rectal prolapse, but when they do, they are usually best served with an open surgical approach.

PREOPERATIVE WORKUP

Evaluation of patients always starts with a thorough and complete history and physical examination. The most common presentation of rectal prolapse is that of a large prolapsing rectal mass and patients usually provide a history of a mass protruding from the anus on defecation or with walking. However it is also not uncommon for patients to present with chief complaints of fecal incontinence or hemorrhoids as opposed to a large prolapsing rectal mass. Other less common presenting symptoms of rectal prolapse include: soiling of the undergarments, mucus discharge, feeling of incomplete evacuation, constipation, fecal urgency, change in bowel habits, and poor anal control. This constellation of symptoms underscores why a comprehensive history of anal function and bowel habits should be recorded as a baseline reference for future evaluations.

Physical examination of rectal prolapse requires a specific approach. In the lateral or prone position, it is sometimes very hard for patients to reproduce rectal prolapse. Frequently, the only abnormality identified in these positions is a patulous anus. To reproduce the prolapse in the office, it is sometimes required that the patient sits on a toilet and perform a Valsalva maneuver. If the examiner is unable to replicate the prolapse on examination then a defecography may be helpful. Defecography may also be helpful in patients suspected of internal prolapse or intussusception as a cause of obstructive defecation syndrome.

Once the diagnosis of rectal prolapse is established, the examiner is required to differentiate between mucosal prolapse and full-thickness rectal prolapse. This usually can be achieved during gross evaluation and digital rectal examination. Furthermore the patient's anal sphincter function and integrity may be evaluated subjectively with digital exam, or objectively with anorectal manometry. Patients with a concurrent history of constipation may also require a motility (Sitzmarks®) study to evaluate their symptoms. Finally, there exists a slightly increased risk for cancer in patients with rectal prolapse and thus all patients with prolapse should undergo colorectal cancer screening *via* a recent colonoscopy, barium enema, or alternative.

In terms of preoperative preparation, patients are commonly instructed to adhere to a clear liquid diet on the day prior to their surgery. Moreover, some surgeons advocate a limited bowel preparation and evacuation of the rectum with an enema before surgery. Single dose broad spectrum antibiotic should be administrated within an hour before the incision. Thrombosis prophylaxis should start prior to the operation and should be continued during hospitalization.

POSTOPERATIVE CARE

Patients ideally are treated in a clinical pathway (such as an enhanced recovery after surgery pathway) to expedite and optimize their recovery. These usually include prompt mobilization of the patient the day of or the first day after operation. The patient's diet should be advanced as tolerated and their urinary catheter removed as soon as the patient is adequately mobile. Patient's length of stay after laparoscopic/robotic rectal rectopexy repair is usually short, with most patients being discharged on the second or third post-operative day. In the first 6 wk of recovery, patients are reminded to abstain from any heavy lifting greater than 15lbs that might strain their fresh repair. Patients are also prescribed stool softeners liberally to try and limit any postoperative constipation or straining.

OPERATIVE DETAILS

Place the patient in modified lithotomy position with Allen stirrups. Soft foam or egg crates should be fixed to the surgical table and placed directly under the patient to prevent slipping during the steep Trendelenberg positioning required for the safe conduct of the operation. The arms are tucked at the sides with adequate padding to minimize injuries along pressure points. Place a padded strap across the patient's chest to prevent lateral movement. Intraoperative hypothermia can be minimized with Bair Hugger® blanket. The abdomen and perineum are prepped and draped in the usual sterile fashion.

Port placement and robotic docking

The robotic camera should be placed first, as placement of all other ports depends on the location of this particular port. A Veress needle is placed at Palmer's point and the abdomen is insufflated. The 12 mm camera port is placed about 15 cm cephalad to the pubis. Placing this port too far superiorly will result in difficulty in reaching the deep pelvis during the procedure. A line is drawn from the camera port to the anterior superior iliac spine on each side. Two additional robotic ports are placed about 8-10 cm from the camera port along this line. A third robotic port is placed 6 cm lateral to the left lower quadrant port (designated robotic arm number 3). Assistant ports consist of a 12 mm port in the right upper quadrant and 5 mm port in the epigastric area. The patient is then placed in steep Trendelenberg position. The small bowel is swept superiorly out of the pelvis.

Next, the robot is docked, with the robot cart positioned along the patient's left side. Arm 1 is placed in the right lower quadrant, Arm 2 in the left quadrant, and Arm 3 in left lateral abdomen. Instrument placement is as follows: Arm 1 with monopolar scissors, Arm 2 with fenestrated bipolar grasper, Arm 3 with atraumatic graspers. The beginning of the case proceeds with use of the 0-degree robotic camera.

Rectal mobilization

Inspect the abdomen and pelvis for any abnormalities.

Consideration may be given to lysis of adhesions if involved organs have adhesions. For female patients with an intact uterus, a 0-Prolene suture is inserted into the abdominal cavity on a straight Keith needle, passed once through the uterus and back through the abdominal wall to elevate the uterus during the surgery and provide gentle traction. The rectosigmoid is grasped and elevated anteriorly by the assistant using the epigastric port. Sharp dissection is used to open the peritoneum along the base of the rectosigmoid mesentery. Dissection along the sacral promontory is developed along the avascular areolar plane. While dissecting along the sacral promontory, care should be taken to identify and preserve the hypogastric nerve plexus and ureters. The peritoneum along the right side of the rectum is opened up to the rectovaginal septum, in females. A vaginal manipulator can be used to elevate the posterior vagina and aid dissection along the anterior rectum. While the vagina is elevated, the assistant uses an atraumatic grasper to lift the rectum up and out of the pelvis. Electrocautery is used to incise the peritoneum to enter the rectovaginal plane at this level. The dissection along this plane may be difficult in patients with chronic rectal prolapse as this layer may be especially thinned out. Dissection is carried along the right side of the sacral promontory towards the left lower rectum. Next, separate the rectum and vagina in females, and prostate in males, all the way down almost to the perineal body. Continue the dissection down laterally until the pelvic floor is visualized. Fully mobilize the rectum anteriorly and posteriorly, while leaving the lateral stalks intact. Perform a digital rectal exam during the dissection.

Mesh placement

Guidelines on appropriate choice of mesh are limited in the literature. In our practice, we routinely use lightweight, macroporous polypropylene mesh. Biologic mesh may also be considered in cases of gross fecal contamination or if the surgeon has high concern for infection. For the purposes of this review, we will discuss use of synthetic mesh. A slightly tapered mesh is used. The mesh is trimmed to 18 cm long, 3 cm wide along the portion that will be fixed to the anterior rectum, and tapered to 2 cm on the side that will attach to the sacral promontory. The mesh can be rolled up and introduced into the abdominal cavity through the 12 mm assistant port. Using a 2-0 Ethibond suture, about 6 sutures are used to fix the mesh along the anterior extraperitoneal surface of the rectum. The mesh is positioned along the right side of the rectum and brought to the sacral promontory. Care must be taken to ensure that both the rectal and vaginal walls are spared. The overlying presacral fascia is opened to expose the bare periosteum of the sacral promontory. Two 0-Ethibond sutures are placed in a mattress fashion to anchor the mesh to the sacral promontory. Before suture placement, care should be taken to avoid presacral veins, the right ureter, and iliac vessels. The peritoneum is then closed over the mesh with 3-0 absorbable sutures and Lapra-Ty suture clips. Check for hemostasis.

POSSIBLE COMPLICATIONS

Recurrent prolapse

Long term recurrence of rectal prolapse after robotic surgery is about 11%-13%[19,20] and is similar to recurrence rates after laparoscopic surgery[10,21]. Recurrent rectal prolapse after standard perineal surgery is reported around 25%[22]. Should the patient develop recurrent prolapse after robotic surgery, the surgeon may again consider reattempting robotic rectopexy. Intraoperatively, the surgeon can assess why the prolapse recurred (detachment of mesh from the sacrum or rectum) and take a tailored approach in correcting it.

Mesh complications

Use of mesh rectopexy has been shown to decrease recurrence of rectal prolapse[23]. However, as with use of any foreign body, use of mesh is not completely without consequence. The literature reports an increase in mesh-related complications when synthetic mesh is used in the presence of a rectal anastomosis[24,25]. Rates of pelvic sepsis have been reported in 2%-16% cases, however these rates were observed with use of polyvinyl alcohol sponge - a type of mesh that is no longer used[26,27]. Other mesh-associated complications include mesh erosion observed in 0%-1%[27-31], fistulas, and dyspareunia[32,33].

Management of mesh complications can be difficult. Mesh erosion involving the vagina or rectum have been successfully treated with simple transvaginal or transanal excision[28,29]. Other case reports also describe laparoscopic excision and primary repair for mesh erosion involving the rectum, vagina and bladder.

Several studies have analyzed the used of biologic mesh for pelvic organ prolapse. However, there is no strong evidence favoring the use of biologic mesh *vs* synthetic mesh. Indeed, some limited reports describe higher rates of recurrence with biologic mesh[34]. When comparing synthetic *vs* biologic mesh, mesh-related complications are similar. The use of mesh rectopexy in the absence of colon resection is associated with an acceptable rate of morbidity and mortality.

Constipation

Constipation is a very common pre-existing condition among patients with rectal prolapse[35]. Constipation after rectopexy surgery can be due to kinking of the redundant rectosigmoid in patients with suture rectopexy[36] or denervation of the rectum if the lateral stalks are divided[37]. Several studies have shown decreased rates of postoperative constipation with limited rectal dissection and preservation of the lateral rectal ligaments[28,38]. Other studies have reported decreased rates of constipation with limited posterior rectal mobilization[39]. These maneuvers may be considered for patients with a history of constipation.

Fecal incontinence

Fecal incontinence is extremely common in patients with rectal prolapse[26,40]. This may be due to sphincter injury, pudendal neuropathy, or impaired rectal adaptation to distention in patients with chronic rectal prolapse[26,41]. In patients with fecal incontinence, the abdominal approach has been shown to be more effective than the perineal approach, and has been reported to improve incontinence in more than 62% of patients in short-term follow up[42,43].

OUTCOMES OF ROBOTIC SURGERY FOR RECTAL PROLAPSE

There are limited published articles regarding robotic rectal prolapse surgery. However, in this section the available literature is reviewed.

Although published studies are consistently small, available published case-series, case-control studies, and a recently published clinical trial study reveal that robotic-assisted rectal prolapse surgery has equivalent safety compared to laparoscopic surgery[12,13,44].

The safety of the robotic approach in the treatment of rectal prolapse has been cited numerous times in the literature, even in elderly patients. Munz *et al*[15] in 2002 reported treatment of six rectal prolapse patients with robotic assisted suture rectopexy. The study reported mean procedure time of 127 min with no major complications and without any recurrence in six months[15]. In 2007, a larger case control study with 14 consecutive patients who underwent robotic treatment of pelvic organ prolapse was published[17]. The authors noted that postoperative complication rates were similar in the robotic and laparoscopic groups. However, they reported longer operative time and greater hospitalization cost for the robotic group[17]. Both studies reported robotic surgery as a feasible, safe and effective technique in the treatment of rectal prolapse[15,17]. Later Germain *et al*[19], in a study of 77 rectal prolapse patients, reported robotic-assisted rectopexy as a safe approach in patients aged over 75 years with similar results in younger patients. The authors reported a morbidity rate of 1.7% for patients older than 75 years of age[19]. A published systematic review by Rondelli and a recently published clinical trial by Mehmood *et al*[44] confirmed safety of the robotic approach in treatment of rectal prolapse[44,45].

Short term outcomes for robotic rectal prolapse seem on par with the laparoscopic and open technique. Ayav *et al*[13], with one year follow up of eighteen female patients operated on by the robotic assisted technique, reported they all remained free of rectal prolapse. Zero short term recurrence rate was also reported by Munz *et al*[15] and Germain *et al*[19]. In a recently published systematic review of 340 patients in six observed studies by Rondelli a meta-analysis showed that the robotic approach does not influence the recurrence rate of rectal prolapse[45]. However, the only available clinical trial with 12 mo follow-up reported a better functional outcome and quality of life in patients undergoing robotic surgery compared to laparoscopic surgery[44].

Although published studies are low volume studies, some major postoperative complications have been reported. Overall, a 10.4% morbidity rate has been reported for rectal prolapse patients undergoing robotic surgery[20]. Heemskerk, with a case control study, reported similar rates of postoperative constipation and incontinence in robotic and laparoscopic techniques[17]. However, the complications of urinary tract infections, pre-sacral fluid collections, rectal injuries, and post-operative hemorrhage have been reported for robotic surgery[19,20,46]. Rondelli, in a systematic review, reported a decrease in intra-operative blood loss and post-operative complications in patients who underwent robotic surgery compared to laparoscopic surgery[45]. However, Mehmood *et al*[44], in a recent clinical trial did not find any significant difference in blood loss between robotic and laparoscopic approaches[44]. Further randomized clinical trials are needed to evaluate if the robotic approach will decrease complications compared to the laparoscopic approach.

Functional outcomes for robotic rectal prolapse seem on par with laparoscopic and open techniques. de Hoog *et al*[21], with a case control study comparing the functional results among three patient groups of robotic, laparoscopic, and open approaches, found no differences in either Wexner incontinence score or IDL score (impact on daily life-score as judged by patients) between the three operation types. Similar results were reported previously by Ayav *et al*[13], Munz *et al*[15], and Heemskerk *et al*[17]. However, a recent clinical trial by Mehmood *et al*[44] reported that postoperative Wexner fecal incontinence severity index scoring were significantly lower in the robotic approach compared to the laparoscopic approach[44]. Also, they reported the SF-36 questionnaires regarding physical and emotional component had better scoring with the robotic approach compared to the laparoscopic approach[44]. Considering the limited number of published studies regarding functional outcomes, further studies should be planned to evaluate functional outcomes of patients undergoing robotic treatment of rectal prolapse.

The long-term outcomes of robotic rectal prolapse repair remain relatively unknown and there is limited published data on this topic. The only published clinical trial did not find any relapse in 12 mo follow-up of patients[44]. Other case-control and case series studies reported equal long-term rate of recurrence of rectal prolapse in robotic technique compared to laparoscopic surgery[21,47]. de Hoog *et al*[21] with a study on long-term outcomes of 20 patients who underwent robotic and laparoscopic rectal prolapse procedures reported respectively 20% and 27% recurrence rates for robotic and laparoscopic approaches, which were significantly higher than open abdominal procedure recurrence rate in his study (2%)[21]. However, in more recent studies relapse rates of 12.8% and 11% have been reported for robotic approach[20,47]. Further studies are indicated to discover long term outcomes of robotic approach rectal prolapse surgery compared to laparoscopic and open approaches.

Robotic surgery is associated with higher hospital costs compared to laparoscopic and open techniques. Higher cost of robotic rectal prolapse surgery has been reported by multiple studies[17,20]. However, a recent study shows that after adjusting the cost with hospitalization length, the cost of robotic technique is lower than laparoscopic or open surgeries in general surgery procedures except for cholecystectomy and esophagogastric procedures[48]. Further studies comparing robotic and laparoscopic approaches regarding cost-effectiveness in rectal prolapse surgery are needed.

The length of the robotic rectopexy procedure decreases with increased experience of surgeons. Increased operative time for robot rectopexy has been reported multiple times[15,17,21,44]. A portion of this increase in time is caused by robotic instruments set-up[15]. de Hoog *et al*[21] reported the mean operation time of 157 min for robotic rectopexy, which was more than two times longer than open rectopexy. However, in a more recent study, a significant decrease in operative time with improving experience of surgeons was reported[19].

CONCLUSION

Robotic surgery is a safe, effective, and feasible approach for the treatment of rectal prolapse that does not result in any difference in recurrence and function compared to laparoscopic rectopexy. However, the benefits of a robotic approach must be weighed against its higher cost and longer operative time. Further randomized clinical trials are needed to report functional outcomes and long term outcomes of robotic surgical treatment of rectal prolapse.

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