Evaluation of pilot experience with robotic-assisted proctectomy and coloanal anastomosis for rectal cancer

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Background: Robotic-assisted proctectomy with coloanal anastomosis (RPCA) is an innovative technique of pelvic dissection for low rectal cancer. Our objective was to evaluate our pilot experience with this procedure compared with open proctectomy with coloanal anastomosis (OPCA).

Methods: We performed a retrospective 5-year review of all consecutive cases of RPCA and OPCA performed at our institute. We focused on tumour characteristics, quality of surgery, analgesic requirements, average length of hospital stay (LOS), complications and long-term outcomes.

Results: Three patients underwent RPCA and 25 had OPCA. The average duration of surgery was similar (288 min for RPCA v. 285 min for OPCA). Four patients in the OPCA group had positive or very close margins, and 2 had a mesorectal defect less than 5 mm. The average LOS was 6.66 and 9.29 days in the RPCA and OPCA groups, respectively, and the average duration of epidural or patient-controlled anesthesia was 2.67 and 5.16 days, respectively. We did not perform a statistical comparison because of the discordant size and sex distribution between the groups. There were no perioperative complications in the RPCA group, and all patients had negative margins and adequate lymph node retrievals with no long-term complications or recurrence recorded so far.

Conclusion: Our very early experience with RPCA is quite encouraging, suggesting that it is a safe alternative to OPCA with a similar duration and the added benefits of a minimally invasive procedure, including decreased LOS and reduced postoperative analgesic requirements.

Contexte : La proctectomie robot-assistée avec anastomose colo-anale est une technique novatrice de dissection pelvienne pour les cancers du bas rectum. Notre objectif était d'évaluer notre expérience pilote avec cette intervention, comparativement à la proctectomie ouverte avec anastomose colo-anale.

Méthodes : Nous avons procédé à une revue rétrospective sur 5 ans de tous les cas consécutifs de proctectomie robot-assistée et de proctectomie ouverte avec anastomose colo-anale effectuées dans notre établissement. Nous nous sommes concentrés sur les caractéristiques des tumeurs, la qualité de l'intervention chirurgicale, les besoins analgésiques, la durée moyenne du séjour hospitalier (DSH), les complications et l'issue à long terme.

Résultats : Trois patients ont subi une proctectomie robot-assistée et 25 une proctectomie ouverte. La durée moyenne des interventions a été similaire (288 minutes pour la proctectomie robot-assistée c. 285 minutes pour la proctectomie ouverte). Quatre patients du groupe soumis à la proctectomie ouverte présentaient des marges positives ou très étroites et 2 présentaient des anomalies mésorectales de moins de 5 mm. La DSH moyenne a été de 6,66 et de 9,29 jours dans les groupes soumis à la proctectomie robot-assistée et à la proctectomie ouverte, respectivement, et la durée moyenne de l'anesthésie péridurale ou contrôlée par les patients a été de 2,67 et 5,16 jours, respectivement. Nous n'avons pas procédé à une comparaison statistique entre les groupes en raison de la disparité de leur taille et de la distribution inégale du sexe des participants. Nous n'avons enregistré aucune complication périopératoire dans les groupes soumis à la proctectomie robot-assistée et tous les patients présentaient des marges négatives; les prélèvements ganglionnaires ont été adéquats, sans complications à long terme ni récurrences à ce jour.

Conclusion : Notre expérience très récente avec la proctectomie robot-assistée est plutôt encourageante et donne à penser qu'il s'agit d'une solution de rechange sécuritaire à la proctectomie ouverte étant d'une durée similaire et procurant les avantages supplémentaires d'une intervention minimalement effractive, assortie d'une DSH plus brève et d'une diminution des besoins en analgésie postopératoire.

Robot-assisted surgery is on the rise. In the past 3 years, the number of robotic surgeries performed in the United States has increased from 80 000 to 205 000,[1] and the number of robotic systems available in hospitals rose from 800 to 2000.[1] While the most common forms of robotic surgery performed in North America are urological and gynecological operations, the robot is being increasingly used for colorectal surgery, in particular for rectal dissection. Robotic total mesorectal excision (TME) may be advantageous in dissection of the avascular plane between the presacral fascia and fascia propria of the rectum without injury to the integrity of the mesorectum in the narrow pelvic cavity and for dissection between the rectum, seminal vesicles and prostate.

Increasing evidence is pointing toward the effectiveness of robotic pelvic dissection for rectal cancer with oncological outcomes comparable to conventional rectal surgery as well as shorter length of stay in hospital (LOS) and analgesic requirements.[2–5] Some cadaveric evidence also points toward shorter task performance times, a faster learning curve and fewer complications when performing complex tasks with robotic compared with laparoscopic surgery.[6] There is also some evidence suggesting that robotic techniques are easier to perform ergonomically than laparoscopic surgery.[7]

Robotic-assisted proctectomy and coloanal anastomosis (RPCA) is a unique, innovative technique that, to our knowledge, has not been directly compared with conventional open proctectomy with coloanal anastomoses (OPCA).[8,9] The RCPA technique combines the benefits of a minimally invasive procedure with the addition of the robot to provide better ergonomics, better views of tissue dissection plane and potentially improved outcomes. The purpose of our study was to report the first 3 cases of RPCA performed at our institute and compare them with a concurrent series of OPCA.

Methods

Study design

We performed a retrospective chart review of all consecutive cases of proctectomy with coloanal anastomoses performed either via the open or robotic-assisted (da Vinci Surgical System, Intuitive Surgical) approach at a university-based, teaching hospital between 2006 and 2011. All OPCA procedures were open proctectomies with a coloanal pull-through, a hand-sewn anastomosis and a diverting loop ileostomy. These procedures were performed by 4 surgeons at the London Health Sciences Centre who are trained and experienced at treating rectal cancer. The robotic procedures were performed as collaborative cases. The abdominal and pelvic component of the surgeries were performed robotically by a surgeon trained and experienced in the use of the robotic surgical system and who had served as a proctor for robotic rectal cancer surgery. The perineal component and coloanal anastomosis were performed by 1 of the 4 colorectal surgeons also contributing to the open surgery case series.

In our institution ethics approval for robotic surgery is not required; however, all surgeons using da Vinci are required to meet rigorous requirements for credentialing of robotic surgery privileges, including mentorship, simulation-based training and certification by Intuitive. All patients consented to surgery after a specific discussion and disclosure regarding the use of the robot, available evidence and the surgeons' experience.

Following a protocol approved by the institution's research ethics board, we obtained patient information from electronic charts through the hospital's electronic patient records system. Data extracted from medical records included patient demographics, comorbid status, surgical history, biology and quality of pathology specimens, the role of adjuvant or neoadjuvant therapy, short and long-term complications, analgesic requirements, LOS, recurrence and survival. No enhanced recovery protocols were implemented on any of these patients, and the postoperative protocol for analgesia reduction, diet advancement and discharge was the same for robot and open procedures.

Tumour height from the anal verge was measured using a rigid sigmoidoscope preoperatively and prior to neoadjuvant treatment. For the purpose of this study the tumours were classified according to distance from the anal verge as follows: distal (< 6 cm), mid (6–12 cm), and proximal (> 12 cm). In some instances the recorded tumour height was not described from the anal verge, but anatomic landmarks like the anorectal ring or the dentate line were used to describe tumour location at the time of sigmoidoscopy. In those cases we used average distances of those landmarks from the verge to get an estimated tumour height based on distances calculated by Nivatvongs and colleagues[10] in their study on human anorectal anatomy.

Technique for RPCA

The basic principles of da Vinci-assisted proctectomy with coloanal anastomoses were the same as for the standard open procedure. A hybrid approach was used, beginning the procedure with standard laparoscopic mobilization of the sigmoid colon and ligation of the inferior mesenteric pedicle. Splenic flexure was then mobilized, if deemed necessary, based on an intraoperative assessment of the ability to create a tension-free anastomosis. The robotic surgical cart was then docked to perform a TME to the pelvic floor. Then the perineal component of the procedure was performed with a standard transanal mucosectomy and hand-sewn coloanal anastomosis. This was followed by a diverting loop ileostomy performed laparoscopically.

Outcome measures

Intraoperative outcomes included skin-to-skin procedure length and preprocedure time (defined as time from the patient entering the operating room to the time of first incision). We could not measure the exact time required for docking and undocking the da Vinci when switching between da Vinci, standard laparoscopy and perineal dissection because these times were not specifically recorded. However, docking and undocking were included in the procedure duration.

Statistical analysis

Owing to the small number of patients in the RPCA group, a direct statistical comparison between the groups was not deemed appropriate.

Results

Patient and tumour characteristics

We compared 25 consecutive cases of OPCA with our first 3 cases of RPCA. The 3 patients selected for RPCA were women, and their age and American Society of Anesthesiologists (ASA) status were comparable to that of patients in the OPCA group. Two-thirds of the patients in both groups had early-stage tumours (I-II), but the patients in the RPCA group had a lower incidence of neoadjuvant chemoradiotherapy. They also had more distally located lesions. Most patients in the OPCA group were men (Table 1).

Specimen quality

Four specimens from patients in the OPCA group had fewer than 12 lymph nodes. All patients had received neoadjuvant chemoradiotherapy. Two OPCA specimens had positive circumferential radial margins, and 2 had close distal margins (< 1 cm). Two OPCA specimens had defects greater than 5 mm in the mesorectum. None of these quality concerns occurred in the RPCA group (Table 2).

Outcome measures

Outcomes are summarized in Table 3. The OPCA and RPCA groups had very similar preprocedure times. The duration of RPCA was on average 23 minutes shorter than that of OPCA. The mean LOS was reduced in the RPCA group by 2.6 days (6.7 v. 9.3 d). The average duration of epidural or patient-controlled analgesia use in the OPCA group was almost double that in the RPCA group (5.16 v. 2.67 d). The average dimenhydrinate (50 mg v. 103 mg) and metoclopramide (6.7 mg v. 11.0 mg) use was also lower in the RPCA group.

Complications

Complications are reported in Table 4. Eleven (44%) patients in the OPCA group experienced wound infections. Postoperative leak was identified in only 1 patient. At a median follow-up of 3 years, 8 (32%) patients in the OPCA group had long-term incontinence, and hernias developed in 8 (32%) patients. Seven (28%) patients in the OPCA group experienced a recurrence, and 2 (8%) died from the consequences of recurrent disease. Postoperative ileus was observed in 1 patient in the RPCA group. At a median follow-up of 3 years, no recurrences had been detected in the RPCA group.

Table 1. Comparison of patient demographics in RPCA and OPCA groups

	Group; mean ± SD*	
Characteristic	RPCA, *n* = 3	OPCA, *n* = 25
Age, yr	58 ± 4	54 ± 5
ASA score	2.33 ± 0.53	2.64 ± 0.64
Sex, M:F	0:3	17:8
Stage, early:late†	2:1	16:9
Distance from the anal verge, cm	3.96 ± 2.1	6.40 ± 3.4
Neoadjuvant treatment, no.	2	18

ASA = American Society of Anesthesiologists; F = female; M = male; OCPA = open proctectomy with coloanal anastomosis; RCPA = robotic-assisted proctectomy with coloanal anastomosis; SD = standard deviation.
*Unless otherwise indicated.
†Early stage: up to stage 2b; late stage: 3a and above.

Table 2. Comparison of the quality of surgery in RPCA and OPCA groups

	Group; no. of patients	
Quality marker	RPCA	OPCA
Positive margins	0	4
> 5 mm defects in the mesorectum	0	2

OCPA = open proctectomy with coloanal anastomosis; RCPA = robotic-assisted proctectomy with coloanal anastomosis.

Table 3. Comparison of outcome measures in RPCA and OPCA groups

	Group; mean ± SD	
Outcome measures	RPCA, *n* = 3	OPCA, *n* = 25
Procedure duration, min	288 ± 19.4	311 ± 16.4
Preprocedure length, min	38.3 ± 5.6	33.4 ± 6.2
Mean LOS, d	6.66 ± 1.15	9.29 ± 3.00
Duration of epidural or patient-controlled analgesia, d	2.6 ± 1.52	5.36 ± 1.45
Metoclopramide used in hospital, mg	6.67 ± 11.54	11.02 ± 20.06
Dimenhydrinate used in hospital, mg	50 ± 50	103 ± 107

LOS = length of stay in hospital; OCPA = open proctectomy with coloanal anastomosis; RCPA = robotic-assisted proctectomy with coloanal anastomosis; SD = standard deviation.

Discussion

When introducing a new surgical technique or technology it is important to be vigilant for patient safety concerns from the outset. With the rapid growth of robot-assisted rectal cancer surgery in recent years, it is only natural to expect increased application of robotic surgery for progressively more challenging procedures. Our study highlights that in this specific subset of rectal cancer surgery robotic surgery shows promise in delivering the commonly observed benefits of minimally invasive surgery, including decreased LOS and postoperative analgesic/antiemetic requirements, with a duration comparable to open surgery when performed by experienced robotic trained colorectal surgeons. We also found that oncological outcomes are at least as good with robotic surgery as with conventional surgery. We have encountered no reasons yet to preclude a larger case experience.

The proven benefits of laparoscopic colorectal surgery include less postoperative pain, earlier return of normal bowel function and shorter LOS.[11] Total mesorectal excision often involves meticulous and precise dissection of the mesorectum in a previously irradiated rectum down to the pelvic floor within the confines of a narrow pelvis. The laparoscopic approach is demanding even for experienced surgeons. The preservation of anal sphincter function while obtaining an oncological clearance in rectal cancers can be very challenging.[11] The robotic surgical system was developed to overcome the shortcomings of conventional laparoscopic surgery. Compared with conventional laparoscopic surgery, the robot has several potential advantages. These include 3-dimensional imaging, better visualization of surgical tissue dissection planes, a stable camera and operating platform, articulating instruments with 7 degrees of freedom, enhanced ergonomics, motion scaling and tremor-free movements.[12] The robotic approach to low rectal tumours may be the ideal minimally invasive approach for such dissections.

Robotic colorectal surgery, particularly for very low rectal tumours that involve complete TME with sphincteric protectomy and coloanal anastomoses, is an innovative technique compared with conventional open surgery. The major limitations in applying this technology are a lack of data supporting cost-effectiveness, utility in actual clinical settings and comparison to conventional open and laparoscopic TME. Our study is an attempt to address some of these factors.

Table 4. Comparison of surgical complications in RPCA and OPCA groups

Complication	Group; no. of patients	
	RPCA	OPCA
Early		
Wound infection	0	11
Intraoperative bleeding	0	2
Postoperative ileus	1	3
Pulmonary embolism	0	2
High ileostomy output	0	3
Urinary tract infection	0	3
Pelvic abscess	0	1
Anastomotic leak	0	1
Late		
Incontinence	0	8
Ventral hernia	0	8
Erectile dysfunction	0	1
Recurrence	0	7
Death	0	2

OCPA = open proctectomy with coloanal anastomosis; RCPA = robotic-assisted proctectomy with coloanal anastomosis.

Limitations

Our study limitations are the small sample size in the robotic group and the clear selection bias for these early cases. A straight comparison between outcomes of RPCA and OPCA is not entirely fair, other than to demonstrate that outcomes were no worse with the RPCA approach and that promising advantages may be obtained using this technique. Ours is clearly an early experience. The quality of surgery using the RPCA technique appears to be no worse than OPCA. The patients in the RPCA group, so far, have had a median follow-up of 3 years; this is a short period from which to comment on long-term outcomes. The possible clinical superiority of RPCA and an evaluation of cost-effectiveness will depend on outcomes of larger trials. We cannot afford to draw strong conclusions from the results of the present study.

Conclusion

Despite limitations of our initial experience, RPCA may be a promising alternative to conventional OPCA with very encouraging initial results. Some might argue that the correct comparison group for RPCA should be a laparoscopic control. However, penetration of laparoscopic rectal cancer surgery in Canada has been slow.[13,14] As we have seen with prostate surgery, because of the ergonomic advantages[7] and the attenuated learning curve for complex MIS procedures,[6] the more facile approach to a minimally invasive proctectomy may be via the robotic approach. As more evidence emerges from other centres, the picture will become clearer. In addition, any potential benefits of the robotic approach will need to be justified in the context of perceived higher equipment costs.

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Contributors: S. Ali and C. Schlachta designed the study and analyzed the data, which S. Ali and B. Taylor acquired. S. Ali wrote the article, which all authors reviewed and approved for publication.

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