

Comparison of robotic-assisted resection alone and with natural orifice specimen extraction for rectal cancer by using Da Vinci Xi

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Abstract. – OBJECTIVE: The aim of our study is to compare the results of robotic surgery-assisted Low Anterior Resection (LAR) and Natural Orifice Specimen Extraction (NOSE) for Rectal Cancer (RC).

PATIENTS AND METHODS: From November 2015 to June 2021, patients receiving robotic NOS-ES and robotic surgery assisted resection (RSAR) were retrospectively enrolled in the study. All robotic-assisted LAR of the rectum, NOSE, colorectal anastomosis and loop ileostomies were performed using the Da Vinci Xi system.

RESULTS: A total of 57 patients with robotic NOSES and 93 with robotic RC resection were enrolled. Total mesorectal excision of the rectum, trans-anal or transvaginal specimen extraction (TVSE), anastomoses and protective ileostomy were conducted in all patients. ASA, BMI, tumor histology, stage, nodal stage, mean operative time, estimated blood loss, tumor size, lymph nodes removal, hospital stay morbidity and mortality were evaluated. No patient required conversion to conventional surgery. NOSE has less morbidity and significantly reduces postoperative pain and hospital stay (5.0 vs. 5.5). The two groups were similar in long-term survival.

CONCLUSIONS: According to our literature search, this is the first study to compare RSAR and NOSE for RC using the Da Vinci Xi system. NOSE can be performed safely and successfully on selected patients, providing excellent good results.

Key Words:

Robotic surgery, Da Vinci Xi, Rectum cancer, Low anterior resection, Natural orifice specimen extraction.

Introduction

Minimally invasive surgery has been developed rapidly in the field of colorectal surgery since the first description of laparoscopic colectomy for colon cancer by Jacobs et al¹ in 1991.

While colorectal resections can be performed with total laparoscopic techniques, an additional incision is required for specimen extraction from the abdominal cavity. Each additional skin incision can increase the risk of postoperative complications, such as pain, infection, hematoma, and incisional hernia. Removing the specimen *via* natural openings, such as the vagina or rectum, may decrease the risks associated with a skin incision. In recent years, natural orifice transluminal endoscopic surgery^{2,3} has come to the fore. New techniques have been applied to reduce incision sizes⁴. Most colorectal surgeons are unfamiliar with surgical access *via* the vaginal or anal route and TVSE or TASE. The purpose of this study is to present the first experience on comparing the specimen extraction from the vagina or *anus* after performing robotic RC surgery with traditional RARC surgery. We concluded that robotic LAR or VLAR with lymphadenectomy for RC and TVSE or TASE was both safe and feasible and gave us good cosmesis in experienced hands but not justified for routine use due to its higher cost and lack of clinical benefits. Here, we describe our new technique with an assessment of short-term results in a series of the first 57 patients to whom this surgical approach was applied at our institution.

Patients and Methods

This study was designed as a retrospective single-center cohort study and conducted at the University of Health Sciences Antalya Education and Research Hospital, Antalya, Turkey. All patients gave informed consent. The Ethics Committee of the University of Health Sciences Antalya Training and Research Hospital approved the study (EC reference: 2015/2021). From November 2015 to

June 2021, 150 patients with resectable RC without distant metastasis underwent surgery using the Da Vinci Xi system by experienced surgeons. Robotic RC resection with NOSE was performed in 57 patients, and conventional robotic-assisted RC resection was performed in 93 patients.

All data were collected retrospectively. Variables were age, sex, American Society of Anesthesiologists score (ASA), variables about tumor (histology, stage, tumor size, lymph node status, metastases even if they exist,) and variables about the operation itself (approximate operation time, estimated blood lost), together with variables about the postoperative outcome (mean hospital stay, morbidity, mortality) collected and analyzed.

Patients aged between 20 and 80, who had tumor in the rectosigmoid region, no intestinal obstruction symptoms, and no previous abdominal operation were included in the study. Patients with a synchronous and metachronous malignancy within five years, previous chemo or radiotherapy for any malignancy, severe mental disorder, history of myocardial infarction, uncontrolled hypertension, diabetes, and pulmonary disorder, and who were pregnant, or breastfeeding were excluded from the study.

We proposed robotic resection and specimen extraction from the abdominal incision, vagina or *anus*. After explaining the procedure details to all patients, informed consent was obtained from the patients.

Surgical Technique

Mechanical bowel preparation and antithrombotic prophylaxis with low molecular weight heparin were applied to the patients in the evening before the operation. Prophylactic antibiotic (Cefuroxime axetil 1 g) was administered 1 hour before the surgical incision and 16 Fr urinary catheter was inserted.

The Da Vinci Surgical System Xi (Intuitive Surgical, Sunnyvale, CA, USA) was used. Maryland fenestrated bipolar forceps, tip-up double fenestrated grasper and monopolar scissors were used from the arms of robotic system. The surgery was divided into abdominal and pelvic phases. The first is the abdominal phase, after general anesthesia, the dorsolithotomic position was given with a 26° Trendelenburg position. 10 cm lateral the umbilical level Veress needle was inserted to insufflate the abdomen. After the insufflation, an 8 mm incision was made, and the first trocar was placed in the first port; then, three more ports were placed under direct visualization. Assistant

10 mm trocar was placed at the right upper quadrant. Docking with four arms were performed. After the induction of pneumoperitoneum at 8-12 mmHg and the insertion of 30° angled camera and placing all the arms, the abdominal cavity was explored. Medial-to-lateral dissection, ligation of the root of the inferior mesenteric artery, splenic flexure, sigmoid colon and descending colon were medially mobilized. To achieve TME rectal mobilization down to the pelvic floor was performed. In LAR, two laparoscopic Endo GIA linear staplers (green cartridge, 60 mm, Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA) were used to divide the distal rectum. At the NOSE for RC, in the pelvic phase for women, the vaginal speculum was placed, the ovarian clamp was also placed on the posterior fornix of the vagina. The vagina was opened intracorporeally with the electrocautery scissors. The specimen was captured and taken outside the vagina. 15 cm proximal of the tumor, the specimen was divided with electrocautery and the circular stapler anvil was put and fixed with purse string 2/0 prolene suture inside the colon. Then, the sigmoid colon returns to the abdomen. A sponge was pushed through the posterior fornix of the vagina. NOSE for RC, in the pelvic phase for men, the specimen was extracted through the anus using oval forceps through the inserted sterile plastic sheath. The distal rectal opening was then closed using a linear stapler. Digital rectal examination was performed, and 31 mm circular stapler was placed in the rectum. The anvil and the stapler were put together, colon was squeezed, and stapler was fired. At the RSAR, the specimen was extracted through a 5 cm incision in the hypogastrium. Finally, the abdominal cavity was thoroughly cleaned and washed to prevent the tumor cells from remaining. Then, diverting ileostomy was established at the right lower side of the abdomen for all patients. Following placement of an abdominal drain to the pelvis, and a vaginal tamponade at women on NOSE for RC, abdominal trocar site incisions and specimen extracted incisions were all closed with 3/0 prolene sutures.

Statistical Analysis

Statistical analyses were carried out using the statistical software SPSS version 15.0 for Windows (SPSS Inc., Chicago, IL, USA). Student's *t*-test was used to analyze the data that were normally distributed, and Mann-Whitney U test was used for data that were not normally distributed. Chi-square test was used for categorical data. *p*-values of <0.05 were accepted as significant.

Results

The baseline characteristics and parameters are summarized in Table I. All surgeries were performed successfully. The mean patient age was 64.8 ± 6.46 (58-72) years at the NOSE group and 58.2 ± 5.83 (48-70) years at the RARC group, and the mean BMI was 28.4 ± 2.32 kg/m² and 25.8 ± 2.58 , respectively. LAR and VLAR were performed in 42 and 15 patients in NOSE group, while 68 and 25 patients in RARC group. NOSE was performed to 18 male and 39 female patients. The frequencies of T stage in the NOSE group were 38 and 19 for I, and II, while that in the RARC group were 65 and 28. The composition of T stage in the two groups had similar numbers. Histological differentiation showed no significant

differences in both groups, the mean operation time was fundamentally identical in both groups (NOSE group 275 ± 30.50 min RARC group 225 ± 22.50 min). In all 150 cases, no patient required conversion to open surgery. Moreover, the NOSE group and RARC group had similar estimated intraoperative blood loss (50 ± 10.50 ml; 40 ± 8.20 ml). According to the pathology report, the mean tumor size was 15 ± 2.40 mm and 16 ± 3.30 , and the mean number of lymph nodes harvested was similar in both groups (20 ± 5.50 vs. 18 ± 5.30), respectively. In terms of morbidity, patients in the NOSE group have less morbidity than those in the RARC group. No other complications or mortality occurred during surgery and early postoperative follow-up. Patients were followed up for 6 months or longer postoperatively.

Table I. Baseline characteristics and parameters of the patients.

Baseline characteristics and parameters of the patients	NOSE group (N=57)	Robotic-Assisted RC group (N=93)	<i>p</i>
Age (years)	64.8±6.46 (58-72)	58.2±5.83 (48-70)	0.252
Gender			
Male	18	37	
Female	39	56	0.402
ASA score: I	2	4	
II	21	39	
III	16	38	
IV	8	12	0.572
BMI (kg/m ²)	28.4±2.32 (25.2-30.0)	25.8±2.58 (24.7-31.2)	0.108
Tumor histology: Adenocarcinoma	57	93	
Tumor stage:			
T1	38	65	0.275
T2	19	28	
Node stage:			
N0	12	25	0.341
N1	27	44	
N2	18	24	
Metastases	None	None	
Stage:			
I	28	43	
II	29	50	0.014
Surgery:			
LAR	42	68	
VLAR	15	25	0.01
Mean operation time (min)	275±30.50 (180-360)	225±22.50 (120-330)	0.252
Mean estimated blood loss (mL)	50±10.50 (25-150)	40±8.20 (25-125)	0.158
Mean tumor size (mm)	15±2.40 (7-20)	16±3.30 (5-22)	0.687
Mean lymph nodes removed	20±5.50 (12-26)	18±5.30 (10-28)	0.341
Mean positive lymph nodes removed	6±1.50 (0-8)	6.5±1.60 (0-10)	0.226
Mean hospital stay (days)	5±0.50 (5-7)	5.5±0.70 (5-10)	0.743
Morbidity	2	4	
Mortality	None	None	

p-values of <0.05 were accepted as significant. NOSE Natural Orifice Specimen Extraction, RC Rectal Cancer, ASA score American Society of Anesthesiologists score, BMI Body Mass Index, LAR Low Anterior Resection, VLAR Very Low Anterior Resection.

Discussion

In this retrospective study, the surgical procedure of RARC resection with or without NOSE was introduced by comparing the clinical outcomes. As the concept of TME has become a standard of care for low RC surgery⁵, there has been an increasing interest in new minimally invasive techniques. In this study, we propose that RARC with NOSE through the vagina or *anus* is a safe and effective surgical model that benefits from better short-term outcomes with significant survival outcomes compared to conventional RARC resection. To our knowledge, this is the first study that compares the clinical outcomes of robotic RC surgery with or without NOSE. Although extraction specimen site infections and hernias have been described in the literature, reducing the size of abdominal incisions to the minimum required for abdominal specimen extraction⁶⁻⁸. NOSE has aroused great interest among colorectal surgeons as a way to further reduce abdominal incision. Indications for NOSE procedures are strict and include T2-T3 tumors, with a maximum circumferential diameter of 3 cm and BMI less than 30 kg/m² for trans anal extraction and 3-5 cm and a BMI less than 35 kg/m² for transvaginal extraction^{9,10}. Previous studies^{11,12} have mostly focused on laparoscopic surgery with NOSE, and their results have mostly demonstrated that RARC resection with NOSE provides greater benefits than short-term outcomes. NOSE surgery has advantages in reducing the risk of intra-abdominal contamination and accurately identifying the line of rectal resection. NOSE surgery of the sigmoid colon and rectal tumors has had fewer postoperative complications¹². The minimally invasive operative approach for rectal surgery has advanced significantly in recent years. Reducing trocar size and number of ports are sensible solutions for less invasive and achieving scar-free surgery¹³. However, their applicability and overall value in clinical practice are questionable. Reduced wound size is associated with fewer wound-related complications, and less pain and improved cosmesis^{14,15}. Specimen extraction is the final step in any laparoscopic or robotic surgery. The incision can be made by enlarging a trocar site incision or creating a new incision. An additional incision increases pain, risk of wound infection and hernia formation¹⁶. The transvaginal approach has been used for several years for sampling in minimally invasive gynecologic procedures^{17,18} and RC^{19,20} to avoid abdominal wall incisions. With NOSE,

reduction of abdominal wall trauma, shortening of the length of the skin incision, less or no wound-related complications such as evisceration, infection, incisional hernia, less pain, representing a faster healing process, and less intraabdominal adhesions can be achieved with NOSE²¹. No postoperative wound infection, mortality or other complications were observed in our series. No patient in this series required conversion to conventional laparoscopic or open surgery. In addition, there were no short-term intraoperative, postoperative complications or mortality in this series. In addition, there have been complications of TVSE which may include dyspareunia, infection, infertility, bleeding, rectovaginal fistula, trauma to pelvic structures, and risk of pelvic adhesion¹¹. We did not encounter these complications in our study. The number of lymph nodes removed in the samples was acceptable and comparable to other scholars⁵. Although our study had some limitations due to its retrospective nature, small number of cases and short follow-up period, all patients were satisfied with their wounds and postoperative recovery. Clearly, to better understand the safety and feasibility of robotic RC resection with NOSE, comparative and prospective randomized trials with larger population are needed to figure out the role of using transvaginal or anal way for specimen extraction in RARC surgery.

Conclusions

RARC surgery and NOSE is a safe and feasible minimally invasive surgery that can be performed successfully with satisfying short-term outcomes in selected patients with considerable advantages, such as better cosmetic body image, decreased pain, quicker recovery of intestinal function, and less complication related with additional skin incisions. Further comparative studies are needed to confirm the clinical advantages of our technique. Thanks to unique advantages of the Da Vinci system, robotic LAR plus NOSE for RC patients can be an effective approach as opposed to open, conventional laparoscopic or robotic surgery.

Conflict of Interest

The Authors declare that they have no conflicts of interest.

Funding

None.

Ethics Approval

This study was conducted in accordance with the Declaration of Helsinki principles and was approved by the Ethics Review Committees of the University of Health Science Antalya Training and Research Hospital.

Informed Consent

The patients were informed, and consent was obtained.

Availability of Data and Materials

The datasets are available from the corresponding author upon request.

Authors' Contributions

Arif Aslaner: Conceptualization, Supervision, Methodology, Writing – Review & Editing. Tuğrul Çakır: Data curation, Writing – Original draft preparation, Supervision. Kemal Eyvaz: Resources, Visualization, Investigation. Murat Kazım Kazan: Investigation. Remzi Can Çakır: Software, Data curation. Uğur Doğan: Formal analysis. Umut Rıza Gündüz: Investigation.

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