ARAŞTIRMA MAKALESİ/ ORIGINAL ARTICLE

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Sol Kolon Kanserinin Cerrahi Tedavisinde Robotik Komplet Mezokolik Eksizyonun Kısa Dönem Sonuçları

Short-term Outcomes of Robotic Complete Mesocolic Excision for the Surgical Treatment of Colon Cancer

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ÖZ

GİRİŞ ve AMAÇ: *Komplet mezokolik eksizyon (KME) tekniğinin tanımlanması ve robotik cerrahinin uygulanması ile son yıllarda kolorektal cerrahi alanında önemli gelişmeler kaydedilmiştir. Ancak, KME tekniğinde robotik cerrahinin uygulanabilirliği hakkında veri azdır. Bu çalışmada robotik KME uyguladığımız hasta serisi üzerinden ameliyatın teknik ayrıntılarını ve postoperatif sonuçları sunmayı amaçladık.*

YÖNTEM ve GEREÇLER: *Çalışmaya Kasım 2014 ve Mayıs 2017 tarihleri arasında kolon adenokanseri nedeni ile robotik KME ameliyatı yapılan toplam 98 hasta alındı. Veriler prospektif olarak kayıt edildi ve retrospektif incelendi. Hastaların perioperatif klinik bulguları, histopatolojik verileri ve postoperatif ilk 30 gün sonuçları değerlendirildi.*

BULGULAR: *Hastaların 60'ı (%61.2) erkek ve 38'si kadın, yaş ortalaması 64.4±12.2 yıl ve vücut kitle indeksi 27.3±4.6 kg/m2 idi. Serimizde en sık sigmoid kolon tümörü mevcuttu (%48.9), bunu sağ kolon (%23.5), sol kolon (%16.3), transvers kolon (%6.1) ve senkron yerleşimli tümörler (%5.1) izledi. Ortalama ameliyat süresi 263.6±85.9 dk ve kanama miktarı 98.9±108.0 ml (ortanca=55 ml, aralık=10-800 ml) idi. Toplam beş hastada (%5.1) intraoperatif komplikasyon gelişti. İki hastada (%2) açık cerrahiye geçildi. Histopatolojik incelemede hiçbir hastada cerrahi sınırlarda tümör saptanmadı ve çıkarılan ortalama lenf nodu sayısı 34.7±15.2 idi. İlk defekasyon ve oral katı gıda alımı için geçen süre sırasıyla 3.5±1.3 ve 3.5±1.7 gün ve ortalama hastanede yatış süresi 6.3±2.6 gün idi. Ameliyat sonrası komplikasyon %19.4 hastada gelişti.*

TARTIŞMA ve SONUÇ: *Kolon kanserinin cerrahi tedavisinde KME robotun sağladığı teknik avantajlar sayesinde güvenle yapılabilir. Robotik KME daha yüksek sayıda lenf nodu çıkarılması ile daha doğru bir evreleme yapılmasını sağlayabilir ve onkolojik sonuçlara olumlu yönde katkıda bulunabilir.*

Anahtar Kelimeler: *kolon kanseri, komplet mezokolik eksizyon, robotik cerrahi*

ABSTRACT

INTRODUCTION: *Since the description of complete mesocolic excision (CME) technique and use of robotic surgery, important advances have been made in the field of colorectal surgery in recent years. However, limited data exists regarding the feasibility of robotic surgery in the CME technique. In this study, we aimed to present the details of our operative technique and evaluate postoperative clinical outcomes in a series of patients undergoing robotic CME procedure.*

METHODS: *Included in this study were 98 patients undergoing robotic CME for colon adenocarcinoma between November 2014 and May 2017. Patient data were recorded prospectively and reviewed retrospectively. Data on perioperative clinical findings, histopathologic data and postoperative 30-day outcomes were analyzed.*

RESULTS: *There were 60 male (61.2%) and 38 female patients with a mean age of 64.4±12.2 years and body mass index of 27.3±4.6 kg/m2. In this series, sigmoid colon cancer was the most common (48.9%) and this was followed by right colon (23.5%), left colon (16.3%), transverse colon (%6.1) and synchronous cancers (5.1%). The mean operative time was 263.6±85.9 min and blood loss was 98.9±108.0 ml (median, 55 ml; range, 10-800 ml). Intraoperative complication occurred in 5 patients (5.1%). Two cases were converted to open surgery (2%). On histopathologic examination, all the surgical margins were clear and the mean number of harvested lymph nodes was 34.7±15.2. The mean time to first bowel movement and receiving oral solid diet were 3.5±1.3 and 3.5±1.7 days, respectively. The mean length of hospital stay was 6.3±2.6 days. The postoperative complication rate was 19.4%.*

DISCUSSION and CONCLUSION: *For the surgical treatment of colon cancer, CME can be safely performed with the technical advantages of the robot. Robotic CME may provide accurate staging of the disease with a high number of harvested lymph nodes and this may translate into favorable oncologic outcomes.*

Keywords: *colon cancer, complete mesocolic excision, robotic surgery*

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INTRODUCTION

In the field of colon cancer surgery, since the results of complete mesocolic excision (CME) were first reported by Hohenberger et al. in 2009 (1), this technique has now been increasingly used as it has been shown to result in a wider mesocolic dissection with a higher degree of lymphadenectomy when compared to the standard colectomy procedure (2,3). The purpose of CME procedure is to remove a maximum number of lymph nodes and minimize local recurrence rates with more accurate disease staging by performing central vascular ligation, mesocolic dissection in the embryological planes and removal of the intact visceral peritoneum (4).

In its original definition, CME was first described using an open approach, and in the following years, laparoscopic approach has also been preferred because of the advantages of minimal invasive surgery in the postoperative recovery period (4,5). However, some disadvantages of classical laparoscopic surgery, including restriction of movement due to the use of rigid instruments, instability of the camera and tissue traction can make this operation cumbersome, especially during vascular dissection and intracorporeal anastomosis of the procedure (6,7).

Along with the developments in the technology, the introduction of robotic systems in colorectal surgery has provided the surgeon important advantages such as stable camera and tissue traction, a three-dimensional high-resolution stereoscopic view, a wider range of motion with angled instruments, and better ergonomics (8,9). Because of these advantages, robotic approach has become more commonly preferred for surgeries performed in a narrow space such as pelvic procedures like proctectomy. As a consequence, data on the use of robot in colon surgery and especially on the feasibility and safety of CME technique has remained limited. In this study, we aimed to present the technical details and evaluate the postoperative clinical and oncological outcomes in a series of patients undergoing robotic CME procedure.

METHODS

For this study, Ethical Committee approval was obtained from ,,,, University, School of Medicine, Ethics Committee with a decision number of 2017-8/22. A total of 98 patients who underwent robotic CME procedure for colon adenocarcinoma between November 2014 and May 2017 in the General Surgery Department of …… University hospitals were included in the study. Informed consent was obtained from all the patients. Data was collected from our prospectively maintained Research Electronic Data Capture (REDCap) (10) colorectal cancer database. Patient demographics, preoperative clinical data, intraoperative findings, histopathological results, and postoperative 30-days outcomes were analyzed retrospectively.

Colon adenocarcinoma was defined as tumors located between the ileum and rectum. Docking time was defined as the time between the moving of the robot to the surgical side and setting the robotic arms into the trocar sides. Operative time was defined as the time from the first skin incision to the closure of the last incision. Conversion was defined as completion of any part of the surgery with an open or classical laparoscopy, excluding the extraction of the specimen and placement of the stapler anvil.

Preoperative Evaluation and Preparation

After diagnosing colon cancer with colonoscopy and histopathological examination, a computed tomography scan of thorax and abdomen was performed to determine the clinical tumor stage. One day before the surgery, bowel preparation was performed with oral and rectal enema solution and venous thrombosis prophylaxis was administered. During induction anesthesia, an antibiotic prophylaxis was given and a nasogastric tube and a urinary catheter were placed.

Operative Technique

The operation was carried out using the da Vinci Xi® Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA) with a medial-to-lateral dissection technique (11).

Complete mesocolic excision for right-sided colon tumors (right CME)

Two different dissection techniques were employed depending on the location of right-sided colon tumors: 1) for tumors localized in the cecum or ascending colon, dissection was initiated at the level of ileocolic vessels and continued superiorly along the superior mesenteric vein (SMV) (caudal-to-cranial dissection technique), and 2) for distal ascending, hepatic flexure and proximal transverse colon tumors which required an extended hemicolectomy, dissection was initiated superiorly in order to identify the SMV and ligate the root of the middle colic vessels. Afterwards, mesocolic dissection was completed inferiorly (cranial-to-caudal dissection technique).

In the ‘‘caudal-to-cranial dissection technique’’, the patient was placed in a modified lithotomy position. After pneumoperitoneum was establihed, four 8-mm robotic trocars and one 5-mm assistant trocar were placed in the abdomen **(Figure 1).**

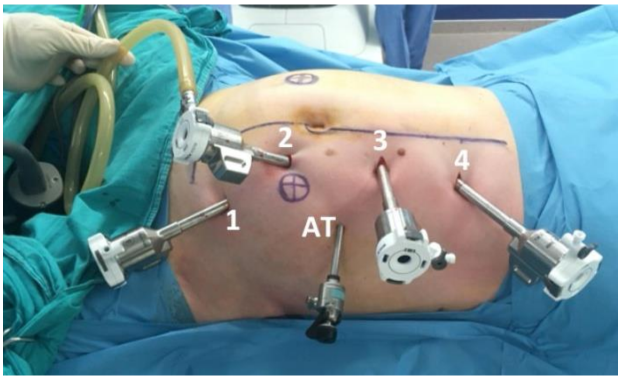

Figure 1. Trocar placement for robotic right CME. Camera was attached to the robotic arm number 3, tip-up grasper to number 1, bipolar forceps to number 2 and monopolar scissors to number 4. AT, assistant tracar

The operation table was positioned in 150 Trendelenburg and 300 left tilt position. The robot was docked from the right side of the patient. First, the ileocecal junction was retracted anterolaterally with tip-up grasper and the ileocolic pedicle was dissected with bipolar grasper and monopolar scissors. The ileocolic vein and ileocolic artery were clipped with Hem-o-lok clips (Teleflex, Morrisville, NC, ABD) at their origins from the SMV and superior mesenteric artery (SMA) **(Figure2).**

Mesocolic dissection was continued superiorly at the anterolateral side of SMV to reach the second portion of duodenum and pancreas.

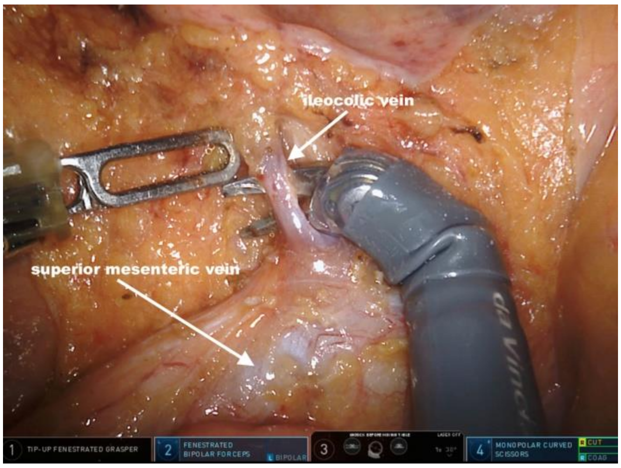

Figure 2. Dissection of the ileocolic vein

Meanwhile, the right colic vessels, if present, were clipped and divided. Then, the right branch of middle colic artery and vein were isolated, clipped and divided. Dissection was continued between the embryological planes just over Toldt’s fascia and was completed from medial to lateral side, protecting the retroperitoneal structures. Following completion of mesocolic dissection, the transverse colon was retracted inferiorly and the omental bursa was entered. The gastrocolic ligament, hepatic flexure and lateral ligaments of colon were divided along the greater curvature of stomach. At this stage, the fourth trocar was replaced with a 12-mm robotic trocar in order to insert an EndoWrist® stapler for sequential transection of the ileum and colon. For specimen extraction, the suprapubic trocar was changed to a 15-mm laparoscopic trocar and the specimen was placed in an endobag. An intracorporeal side-to-side isoperistaltic ileotransversostomy anastomosis was created using a robotic stapler **(Figure 3).** The stapler insertion sides in the bowel were closed in a two-layered suture fashion. No abdominal drain was placed routinely. The specimen was extracted from the suprapubic incision extended from the suprapubic trocar site.

In the ‘‘cranial-to-caudal dissection technique’’, different from the above-mentioned technique, the patient was first placed in a reverse Trendelenburg position and dissection was initiated with opening of the gastrocolic ligament. The omental bursa was entered and the right gastroepiploic vein (RGEV) was dissected. Using the RGEV as a landmark, the gastrocolic trunk of Henle was identified.

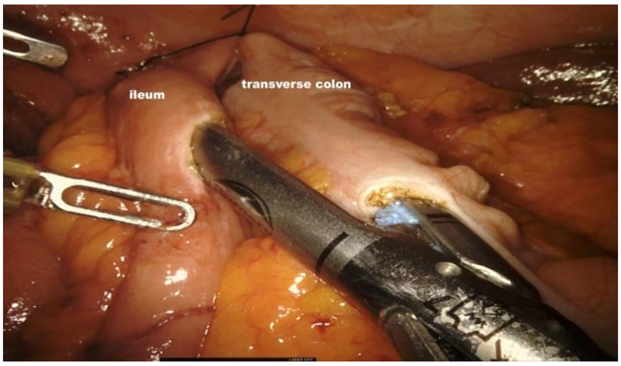

Figure 3. Creation of ileocolic anastomosis using a robotic stapler

The right gastroepiploic vessels, the branches of gastrocolic trunk, middle colic artery and vein were clipped and divided **(Figure 4).** In this step, the subpyloric lymph nodes and greater omentum at a length of 10-15 cm from the tumor was dissected off to include with the specimen. Then, the patient was positioned in a Trendelenburg position and mesocolic dissection was directed to the ileocolic junction and continued superiorly along the SMV, as described above.

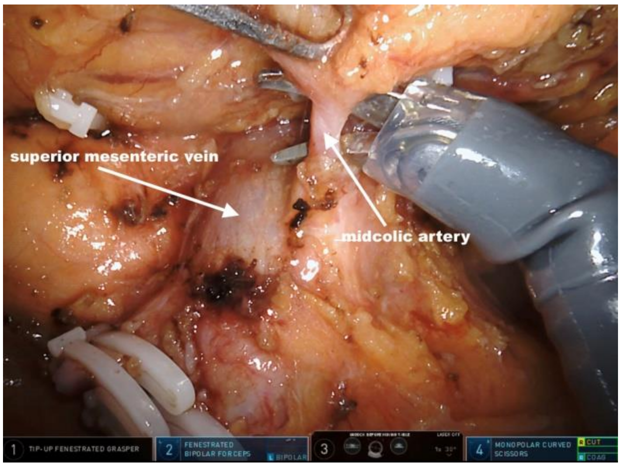

Figure 4. Dissection of the middle colic artery in the cranial-to-caudal technique

Complete mesocolic excision for sigmoid and left-sided colon tumors (left CME)

Trocar placement for sigmoid mesocolic excision is shown in **Figure 6.** The patient was placed in a modified lithotomy position and the operation table was placed in a 300 reverse Trendelenburg position with a 150 right tilt. The robot was docked from the left side of the patient. The sigmoid colon was lifted anteriorly and the peritoneum was dissected from the level of sacral promontory until inferior mesenteric artery (IMA) was reached.

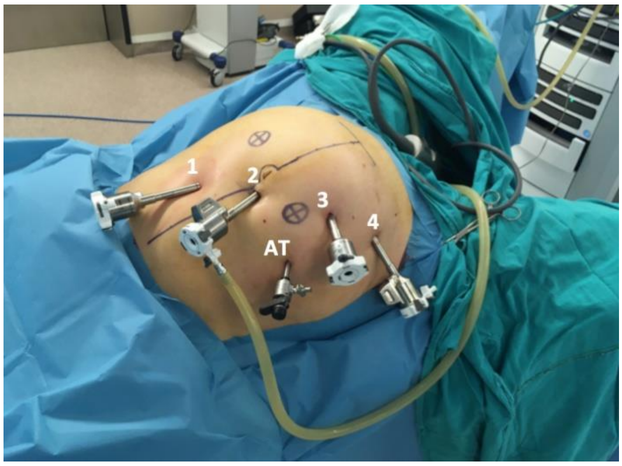

Figure 6. Trocar placement for sigmoid CME. Camera was attached to the robotic arm number 2, bipolar forceps to number 1, monopolar scissors to number 3 and tip-up grasper to number 4. AT, assistant trocar

The IMA was clipped and divided 1 cm distal to its root from the aorta in order not to injure the inferior mesenteric plexus. The inferior mesenteric vein (IMV) was divided at the level of the inferior border of pancreas **(Figure 7).**

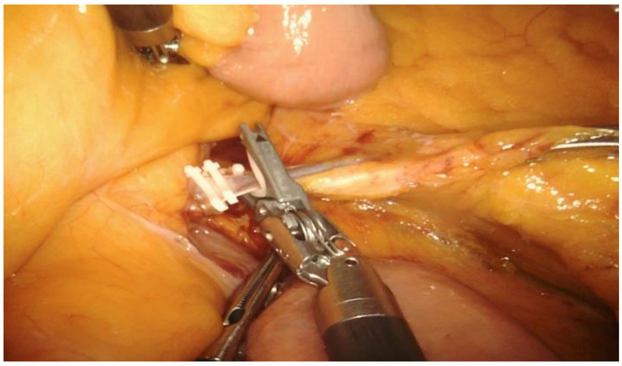

Figure 7. Division of the inferior mesenteric vein at the lower edge of the pancreas

The mesocolon was freed from the pancreas anteriorly and the omental bursa was reached. Then, the mesocolon was separated from the retroperitoneum, protecting the left ureter and gonadal vessels. Laterally, the left colon was separated from the peritoneum and the splenic flexure was mobilized partially or completely to prevent tension in the anastomosis. This was followed by transection of the colon at the upper level of rectum using robotic stapler(s). The mesocolon was extracted through a 6-8 cm suprapubic transverse incision with a wound protector **(Figure 8).** A circular stapler anvil was placed to the descending colon which was then returned to the abdominal cavity. Following closure of the suprapubic incision, an intracorporeal end-to-end colorectal anastomosis was created with a circular stapler inserted through the anus. A silicon drain was placed in the pelvis.

Figure 8. Sigmoid mesocolon spesimen

The operative steps for splenic flexure and descending colon tumors were similar to the technique mentioned above. However, for splenic flexure tumors, the left colic branch of IMA was divided preserving the IMA, and the roots of middle colic artery and vein were divided after the transverse colon was freed from the gastrocolic ligament (12). For descending colon tumors, the IMA was divided, preserving its hemorrhoidal branch.

Postoperative Period

Intravenous narcotic analgesics were given for pain management. Nasogastric tube was removed one day and urinary catheter was removed one or two days after surgery. Patients were discharged once effective pain management with oral analgesics and adequate oral intake were established.

RESULTS

Of the 98 patients, there were 60 (61.2%) men and 38 women with a mean age of 64.4 ± 12.2 years and body mass index of 27.3 ± 4.6 kg/m2. Patients' demographics and preoperative clinical characteristics are presented in Table 1. The most common tumor location in our series was sigmoid colon (48.9%), followed by right colon (23.5%), left colon (16.3%) transverse colon (6.1%), and synchronous tumors (5.1%).

Table 1. Patients' demographics and preoperative clinical characteristics

Gender, n (%)	
male	60 (61.2)
female	38 (38.8)
Age, years, mean ± SD	64.4 ± 12.2
BMI, kg/m², mean ± SD	27.3 ± 4.6
ASA score, n (%)	
I	28 (28.6)
II	51 (52.0)
III	18 (18.4)
IV	1 (1.0)
Tumor location, n (%)	
cecum	12 (12.2)
ascending colon	5 (5.1)
hepatic flexure	6 (6.1)
transverse colon	6 (6.1)
splenic flexure	8 (8.2)
descending colon	8 (8.2)
sigmoid colon	48 (48.9)
synchronous tumors	5 (5.1)

BMI, *body mass index;* ***ASA,*** *American Society of Anesthesiologists;* ***SD,*** *standard deviation*

Operative procedures, intraoperative findings and postoperative 30-day follow-up data are presented in Table 2. An extended left CME was performed in one patient with an obstructive sigmoid colon tumor. Among the five patients with synchronous tumors, a total and a subtotal colectomy were performed in two and three patients, respectively. Additional surgical procedures were performed in nine patients; cholecystectomy in five patients, small bowel resection in two, liver metastasectomy in one, and partial cystectomy in one patient. The mean operative time and estimated blood loss were 263.6 ± 85.9 min and 98.9 ± 108.0 ml (median, 55 ml; range, 10 - 800 ml), respectively. Intraoperative complications occurred in five patients (5.1%). These complications were injury of the jejunal branch of SMV in two patients during the extended right CME procedure, left renal vein injury in one patient, left gonadal vein injury in one and right inferior epigastric vein injury in the other patient during anterior resection. The jejunal vein injuries were repaired uneventfully with the robot. The left renal vein injury occurred during separation of the retroperitoneally infiltrated sigmoid colon tumor from the Gerota's fascia and the vein was repaired by converting to open approach. In the patient with gonadal vein injury, the vein was clipped. The right epigastric vein injury was discovered following a hematoma formation in the abdominal wall in the early postoperative period and this complication regressed with conservative management. In total, there were two conversions to open approach (2%) due to left renal vein injury in one patient and the requirement for a liver metastasectomy in the other.

Table 2. Intraoperative and postoperative findings

Operative procedure, n (%)	
right CME	16 (16.3)
extended right CME	11 (11.2)
left CME	6 (6.1)
extended left CME	10 (10.2)
anterior resection	47 (47.9)
subtotal colectomy	6 (6.1)
total colectomy	2 (2.0)
Stoma, n (%)	4 (4.1)
Robot docking time, min, mean ± SD	5.1 ± 1.7
Operative time, min, mean ± SD	263.6 ± 85.9
right CME	262.2 ± 69.2
extended right CME	299.0 ± 84.3
left CME	269.3 ± 85.8
extended left CME	273.0 ± 82.7
anterior resection	227.5 ± 64.5
subtotal / total colectomy	410.0 ± 158.5
Estimated blood loss, ml, mean ± SD, median (range)	98.9 ± 108.0, 55 (10 – 800)
right CME	50.3 ± 44.4
extended right CME	118.6 ± 91.2
left CME	52.2 ± 76.1, 30 (5 – 150)
extended left CME	76.0 ± 77.7, 20 (10 – 250)
anterior resection	103.1 ± 129.9, 100 (5 – 800)
subtotal / total colectomy	212.5 ± 135.6, 175 (50 – 400)
Intraoperative complication, n (%)	5 (5.1)
Conversion, n (%)	2 (2.0)
Time to first flatus, days, mean ± SD	2.7 ± 1.4
Time to first bowel movement, days, mean ± SD	3.5 ± 1.3
Time to resume diet, days, mean ± SD	3.5 ± 1.7
Length of hospital stay, days, mean ± SD	6.3 ± 2.6
30-day morbidity, n (%)	19 (19.4)
ileus	7
wound infection	6
atelectasis	2
pneumonia	2
intraabdominal abscess	1
thromboembolism	1
Overall morbidity, n (%)	24 (24.4)
Reoperation, n	0
Mortality, n	0

***CME**, complete mesocolic excision; **SD**, standard deviation*

The mean time to first bowel movement and oral intake of solid regimen was 3.5 ± 1.3 and 3.5 ± 1.7 days, respectively. The mean length of hospital stay was 6.3 ± 2.6 days. Postoperative complication occurred in 19 (19.4%) patients (Table 2). The overall morbidity rate was 24.4%, including the intraoperative complications. All the patients with ileus responded well to medical decompression therapy. Antibiotic therapy and/or local drainage were performed for surgical site infections. Percutaneous drainage was required in one patient with intraabdominal abscess. The patient with pulmonary embolism was successfully managed with heparin treatment. There were no anastomotic leak and no mortality.

Histopathological findings are shown in Table 3. The mean number of harvested lymph nodes was 34.7 ± 15.2. Lymph node metastasis was detected in 37 patients. The surgical margins were clear in all the specimens. The mean distance between the vascular ligation and tumor was 14.2 ± 4.1 cm.

Table 3. Histopathological data

Length of specimen, cm, mean ± SD	31.5 ± 17.6
Tumor size, cm, mean ± SD	5.0 ± 2.6
Number of harvested lymph nodes, mean ± SD	34.7 ± 15.2
right CME	38.4 ± 10.6
extended right CME	48.1 ± 11.7
left CME	25.8 ± 5.1
extended left CME	25.8 ± 5.9
anterior resection	29.6 ± 10.8
subtotal / total colectomy	64.6 ± 30.2
pT, n (%)	
T_0	6 (6.1)
T_1	5 (5.1)
T_2	16 (16.3)
T_3	37 (37.8)
T_4	34 (34.7)
pN, n (%)	
N_0	61 (62.2)
N_1	29 (29.6)
N_2	8 (8.2)
pTNM stage, n (%)	
0	7 (7.1)
I	12 (12.2)
II	42 (42.9)
III	32 (32.7)
IV	5 (5.1)
Proximal resection margin, cm, mean ± SD	13.4 ± 12.3
Distal resection margin, cm, mean ± SD	12.0 ± 9.3
Radial resection margin, cm, mean ± SD	4.7 ± 2.2
Surgical margin positivity, n (%)	0 (0)
Length between vascular tie and tumor, cm, mean ± SD	14.2 ± 4.1

***CME**, complete mesocolic excision; SD standard deviation*

DISCUSSION

Our findings from this retrospective patient cohort with colon cancer show that CME procedure can be safely performed with the robotic approach with low morbidity rates. Based on our experience, the three-dimensional magnified visualization provided by the robotic camera, high-articulating feature of the robotic instruments and stable tissue traction provide the surgeon a better perception of depth and range of motion, which in turn facilitate better oncological dissection.

The use of robot in colorectal surgery was first introduced by Ballantyne et al. in 2009 (13). Since then, robotic approach has been increasingly used in colorectal surgery as it has been reported to be technically advantageous when compared to classical laparoscopy (7-9). However, this increase has occurred predominantly in rectal surgery, and therefore, the role of robot in colon cancer surgery has remained somewhat unclear (14). The CME technique is based on the principle of excision of an intact mesocolon with central ligation of the colonic vessels. To perform this procedure, it is necessary to visualize the central vessels clearly and carry out a careful dissection in order not to breach the mesocolon. In comparison with laparoscopy, the easier and more effective implementation of these operative steps with robotic surgery has given rise the idea of performing the CME procedure with robotic approach but the data on this subject remained limited.

Regarding right robotic CME, there are currently two studies available in the literature (7,15). Trastulli et al. (15) reported on a series of 20 patients a mean lymph node number of 17.6 and a mean operative time of 328 min. There was no conversion and one patient had surgical site infection. In the other study in which 53 robotic CME cases were compared to its 69 laparoscopic counterparts, Formisano et al. (7) reported less anastomosis leak and conversion rates after robotic surgery. In our series which included 27 patients undergoing right CME or extended right CME hemicolectomy, the mean operative time was 270 min and there was no conversion. The two vascular injuries of the jejunal branch of SMV were repaired uneventfully. The mean number of harvested lymph node was 41.9 and this number is found be high considering the current literature data in open, classical laparoscopic and robotic CME series (1-5,7,16). The number of harvested lymph nodes is an important surrogate marker for the quality of surgical resection and prognosis of the disease (17).

The technical difficulties in the dissection of Henle's trunk are important disadvantages of classical laparoscopy in right colon cancer surgery (6). In extended right CME hemicolectomy procedure, the middle colic vessels need to be divided at their roots and this requires dissection of the Henle's trunk. Careful vascular control of this trunk is important for the prevention of potential bleeding which can occur due to its anatomical variations. This procedure can be troublesome both in classical laparoscopy and robotic surgery. In our series, the purpose of the cranial-to-caudal dissection technique was to expose the Henle's trunk and SMV in the early phase of operation, minimizing the risk of bleeding and providing a more effective nodal dissection.

The left colon has a less complicated vascular anatomy compared to the right colon. For this reason, it is recommended that surgeons who wish to gain experience in minimal invasive colorectal surgery should start first with left colon procedures, especially anterior resections (6). Nevertheless, one of the most commonly reported difficulties in laparoscopic left colon surgery is the mobilization of splenic flexure (6,18). In the presence of a deeply located splenic flexure, excessive tissue traction may result in iatrogenic splenic injuries. In our experience, better ergonomics, stable camera and tissue traction provided by the robot facilitated this phase of the surgery to a large extend that no splenic injury occurred in any case.

Difficulty of performing intracorporeal anastomosis has long been the reason why surgeons prefer extracorporeal anastomosis in classical laparoscopic surgery (6,18). However, the intracorporeal anastomotic technique provides important advantages such as less bowel traction, more certainty about the correct orientation of the bowel and reduction of incision length for specimen extraction (7,15,19-22). All the anastomoses in our series were carried out intracorporeally and there was no anastomotic leak in any patient. Compared to the rigid instruments used in classical laparoscopy, the angled arms of robot offer a great advantage of multidirectional mobility to surgeon when creating intracorporeal anastomosis. We prefer the suprapubic incision for specimen extraction since this incision is associated with better cosmetic outcomes, less pain, and hernia risk (7,21,23).

In the presented series, the mean operative time was 263.6 min, hospital stay was 6.3 days and postoperative morbidity rate was 19.4%. These findings are in accordance with the previously reported data from the right and left colectomy series (operative time, 219-271 min) (24,25), (hospital stay, 3-10 days) (24,26), (complication rates, 7.5-21.8%) (26,27).

Considering the previous da Vinci Si model, the da Vinci Xi system has new features such as thinner and longer arms, ability to mount the camera to any desired arm, and the possibility of arranging the distance between the arm and the patient (patient clearance). These features further minimize the collision of robotic arms, increase the working area of the system and enable the surgeon perform a multi-quadrant surgery without prolonging the operative time (8).

We note that the retrospective design and the non-comparative nature of this study are important limitations. Additionally, the learning curve which is necessary for the use of robotic systems in the CME technique can also influence our results. Although there is no literature data regarding the required number of surgery to complete the learning curve of robotic CME technique, this number is reported to be between 15 and 35 in general robotic colorectal series (7,14). In addition to these, the higher cost of robotic systems is another limitation of this technique (8,14).

In conclusion, the CME technique, which is now considered as the standard surgical treatment of colon cancer, can be safely performed with robotic approach with low morbidity rates. Robotic CME may provide accurate staging of the disease with a better quality resection and high number of harvested lymph nodes and these may translate into favorable oncologic outcomes.

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