Acta Chir Croat 2024; 21: 7-12

ROBOTIC VERSUS CONVENTIONAL LAPAROSCOPIC TECHNIQUE FOR THE TREATMENT OF COLORECTAL CANCER DISEASE

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ABSTRACT

Background: Robotic surgery addresses many of the technical and ergonomic limitations of laparoscopic surgery, but the literature regarding clinical outcomes in colorectal surgery is limited. The purpose of this study is to analyze the differences between laparoscopy and robotics for colorectal cancer in terms of oncologic and clinical outcomes in an initial experience.

Methods: In our study we analyzed and compared two group of patients operated robotically and laparoscopically. 85 patients operated robotically (49% female, 51% male). The average age was 63.5 years, 110 patients operated laparoscopic operations (64% male, 36% female), the average age was 65.5 years.

Results: In all patients radical resection has been done. The average number of isolated lymph nodes in the robotic method was 19 while in laparoscopic method was 15,5. The hospitalization was shorter in robotic operated patients (average 7,3days), on the other hand the time of the robotic operations was longer than laparoscopic operations. Intraoperative blood loss was in the robotic method smaller (50-120 ml) in comparison with laparoscopic method (100-300 ml). Conversion to open surgery was in robotic method lower (4,5%) than in laparoscopic method (7%). Laparoscopic method has more frequent complications 9 (10,3%) while robotic method 4 (9%). In 10 years follow up 9 laparoscopically operated died (10,3%), (5 due to cardiovascular disease, 4 due to progression of disease). In this period 3 robotically operated patients died (6%), one due to progression of disease, the others due to cardiovascular disease. The most common operation was right hemicolectomy (46%) by laparoscopic procedure, in the robotic method was anterior resection of rectum (54%).

Conclusion: Robotic colorectal surgery (RCS) is a promising technique and is safe and effective alternative to laparoscopic colorectal surgery. The advantages of RCS include reduced EBLs, lower conversion rates and shorter times to recovery of bowel function. Further studies are required to define the financial effects of RCS and the effects of RCS on long-term oncologic outcomes.

Keywords: robotic surgery, colorectal cancer, oncologic outcomes

INTRODUCTION

Robotic surgery for colorectal cancer has been widely accepted in recent years [1,2]. It has emerged as minimally invasive alternative to traditional laparoscopy. Robotic surgery addresses many of the technical and ergonomic limitations of laparoscopic surgery, but the literature regarding clinical outcomes in colorectal surgery is limited. The purpose of this study is to analyze the differences between laparoscopy and robotics for colorectal cancer in terms of oncologic and clinical outcomes in an initial experience We present our initial observations and results of robotic operations of the large intestine with special regard to the patient undergoing robotic surgery of the colon, rectum cancer and compare to the laparoscopic.

METHODS

The first totally robotic-assisted resection of rectum cancer in our department in Slovenia (single docking system with da Vinci SI system) was performed in May 2014. The last patient in 2020 was operated on before the outbreak of SARS-CoV-2 virus infection, and then no robotic operations were performed until September 2022. Due to the lack of staff, we only carried out emergency operations. After that, we started again and more than 100 operations of colon and rectum have been done. Retrospectively we analyzed 85 patients operated robotically, (49% female, 51 % male). The average age was 63,5 years. 62 % had ASA classification II, colorectal carcinoma was presented in 76 % patients, the others had diverticulosis and benign diseases. Carcinoma of rectum and recto-sigmoid colon was presented in 62% of patients. Retrospectively we analyzed 110 laparoscopic operations as well (64 % male, 36 % female), the average age was 65,5 years. 40 % of the patients had ASA classification III. Adenocarcinoma were presented in 75 % patients, the others had diverticulosis and benign diseases. The degree of differentiation of the tumor (gradus II) in laparoscopic method was presented in 67 % patients, while in robotic method was presented in 68 % patients. According to the TNM classification in both methods was dominated stage T3 (laparoscopic 44 %, robotic 46 %). Stage N0 for lymph nodes was in laparoscopically operated patients 54 %, in robotically operated patients

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DOI: *10.5281/zenodo.14009663*

was 40 %. T1 and T2 tumor were presented in 26 % in the robotic operated patients, and 23 % patients operated laparoscopically.

The most common localization in laparoscopic operations was cancer of cecum and ascending colon (45 %), in the robotic was rectum (22 %) and recto-sigmoid colon (40 %).

Surgery

Robotic surgery was performed according to standards which are described elsewhere [2-4]. For surgery we used the Da Vinci Si platform. The patient was positioned in the lithotomy anti-Trendelenburg position. The ports were positioned as depicted in Figure 1.

Figure 1. Port positioning for the Da Vinci Si platform

The surgery was performed by a specially trained dedicated team under the leadership of the head surgeon IC. The positioning of the DaVinci Si system is presented in figure 2.

Data sources

All data were prospectively stored in the department's database. In addition, we used the hospital's data registry to collect additional demographic data like comorbidity, previous medical history, and histology results. The data acquisition was done under strict central supervision. Only the permanent employees of the Department for abdominal and general surgery in the Teaching hospital Celje had access to these databases. The quality of data acquisition and surgical quality control was assessed externally. The acquired procedural data was sent to ABA Medica (Gragnano, Italy). ABA Medica analyzed the data and only certified robotic surgeons were allowed to send and request the data. For this study, all data has been blinded. The study was approved by a local ethics committee.

Data processing

The retrieved data is coded and analyzed by designated surgeons for robotic surgery (IC and OS). The patients were grouped by pathology and performed the surgery. The continuous data were presented as mean ± SD, while the discrete variables were presented as %. All graphs were plotted with Microsoft Excel for Windows version 2022 (Microsoft, Washington, USA)

RESULTS

Patients

The average age of operated patients was similar in both groups (63 years), however; more patients in the laparoscopic group were male compared to robotic group (64% vs 51%). Seven patients in the robotic group received preoperative radio-chemotherapy for rectal cancer. Patients in the laparoscopic group tended to have more accompanying diseases. The most prevalent pathology was adenocarcinoma in both groups. The most common operation in the laparoscopic group was the right hemicolectomy, compared to sigmoid resection in the robotic group. More patients had an anterior resection in the robotic group (54% vs 14%). The proportion of the low anterior resection was similar in both groups (7% in robotic vs. 5% in laparoscopic group). The TNM stage was similarly distributed in both groups. Stage pT3N0M0 was the most prevalent. In both groups the UICC stage III was the most prevalent. The clinicopathological characteristics are presented in Table 1.

Perioperative results

The average console time in robotic surgery was 186,6 minutes, which was comparable to the operation time in laparoscopic surgery. The range of intraoperative blood loss in the robotic group was 50 – 150 ml, which was lower compared to laparoscopic surgery (100-300ml). The average number of extracted lymph nodes was comparable in both groups (18 in the robotic vs. 16 in the laparoscopic group). Patients in the robotic group resumed oral diet faster (3.7 days vs 4.6 days) and had a significantly shorter hospital stay compared to the laparoscopic group (7.5 days vs 10.3 days). Morbidity was comparable in both groups, while the conversion rate was lower in the robotic group (4.5% vs 7%).

RESULTS

Robotic surgery for colorectal cancer has been widely accepted and embraced in recent years [2, 13, 14]. It offers many decisive advantages to laparoscopic surgery and makes difficult cases safer to operate. The department for abdominal and general surgery in the Teaching hospital Celje introduced robotic colorectal surgery in Slovenia in 2014. At that time this was a novel surgical procedure in Slovenia and opened the region for a wider acceptance of robotic surgery in other centers. In the present paper, we present the initial experience of robotic colorectal surgery at the Department for abdominal and general surgery in Celje and compare the results to laparoscopic colorectal operations.

Patients in the robotic group although of comparable age to the laparoscopic group were in better general shape. This might be due to the initial period of the robotic surgery introduction, where the patient selection might have been present. Even so, the distribution of presenting pathology and the stage distribution of tumors were similar. We could therefore argue that, although patients might have been in a better general condition in the robotic group, we did not select easier patients with early cancer for robotic surgery. Therefore we feel both groups were comparable. This is also true for the patients who received anterior and low anterior resections. In both groups, these operations were

similarly distributed and hence comparable.

Regarding the perioperative results, we could confirm that the morbidity of the robotic surgery was comparable to the laparoscopic procedures. Despite that these results present the initial period of the introduction of the robotic platform for colorectal patients, we could show that this method is safe and feasible and the procedure takes comparable time to perform. Similar results were obtained in other pioneer studies [2-4]. Spinoglio et al. showed that robotic surgery is comparable to laparoscopy in regard to safety [5]. We agree with Yasir et al. who stated that the use of the robotic platform is intuitive and has a short learning curve for an experienced laparoscopist [6]. Our results are in line with this observations since we could bring down the perioperative morbidity rates despite this being the initial period.

Robotic platforms not only have articulated instruments allowing better surgical dexterity, but the decisive advantage is also that surgery is easier in small operative fields like the pelvis. As the male pelvis can be narrow the visibility, especially in obese patients can be difficult. These are even more so challenging to overcome in laparoscopic surgery. Robotic surgery has decisive advantages with superior 3D visibility, motion scaling, and angulation. This was possibly the reason for smaller blood loss and smaller conversion rates in the robotic group. Similar results were observed in other studies [5, 7-12].

We believe that less intraoperative bleeding and a more precise dissection in the robotic group were the main factors influencing the faster postoperative regaining of digestive functions. Patients in the robotic group passed stool and restarted oral diet earlier, which eventually lead to shorter hospital stay compared to laparoscopic group. Similarly Spinoglio et al observed significantly shorter hospital stay in the robotic group compared to laparoscopic surgery [5].

This study presents only the initial experience of robotic surgery, therefore there might be some bias in respect to patient selection. We still believe that our results firmly support the further use of robotic surgery in colorectal cancer patients. Robotic surgery allows surgeons to perform complex surgical tasks in confined surgical fields, which brings decisive advantages to demanding patients, reducing the need for conversions, blood loss, and other intraoperative complications. Additionally, shorter hospital stays could also reduce the total costs of treatment justifying the higher costs of the robotic platforms compared to laparoscopy. Perhaps it is important to recognize the limitations and benefits of both laparoscopic and robotic surgery, determine a suitable minimally invasive surgical approach and ultimately choose the ideal surgical technique most appropriate for the specific surgical indication.

DECLARATIONS

Competing Interests: Not applicable.

Funding: Not applicable.

Acknowledgments: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Written informed consent has been obtained from the patient(s) to publish this paper

Ethics approval: The study was approved by the local ethics committee.

Conflicts of Interest: None declared.

Consent for publication: Not applicable.

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FIGURES

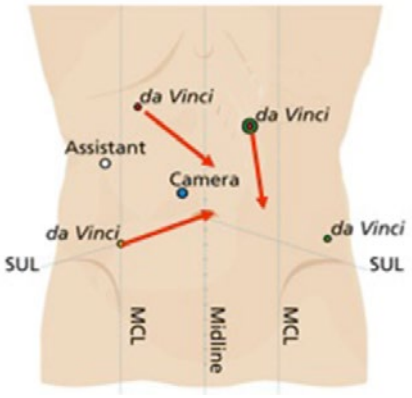

Figure 1. Port positioning for the Da Vinci Si platform

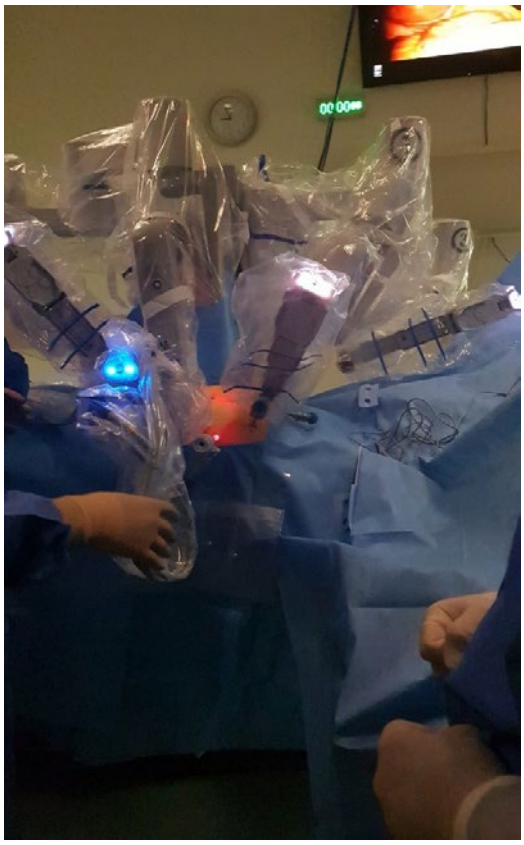

Figure 2a

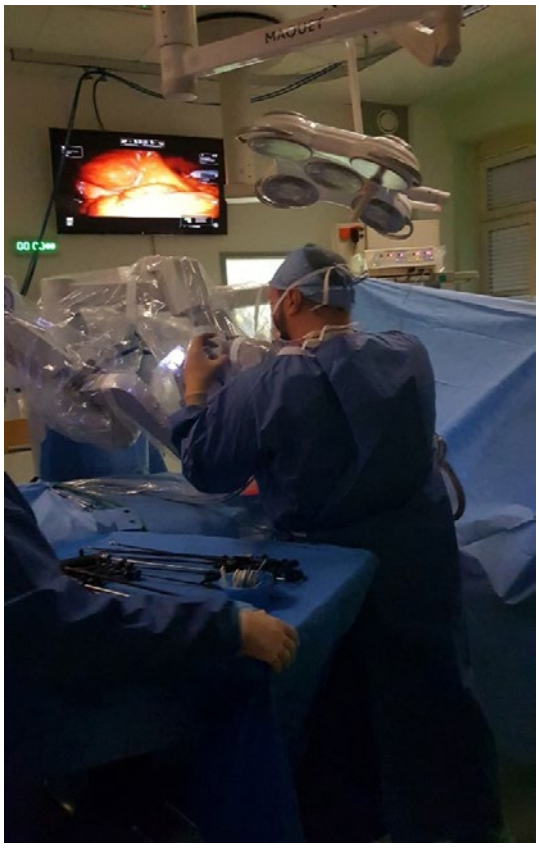

Figure 2b

Figure 2 a, b. The positioning of the DaVinci Si platform for the left hemicolectomy

Figure 3 a, b. Port placement for robotic right hemicolectomy

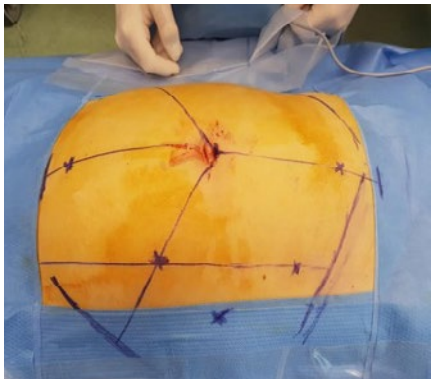

Figure 3a

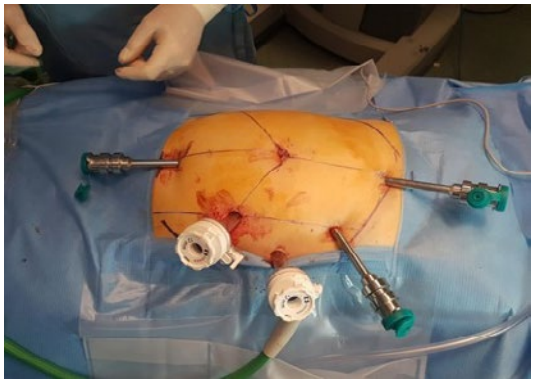

Figure 3b

Figure 4. Rectosigma resection

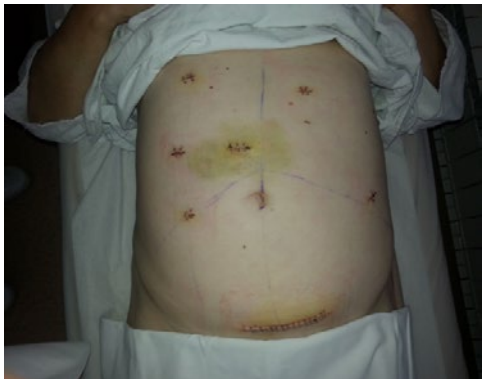

Figure 5. Postoperative view of the patient

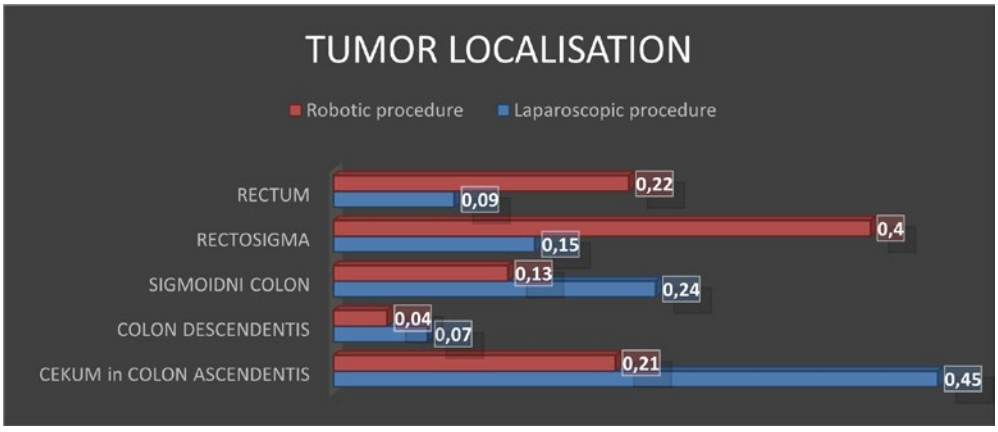

Fig:6 Localisation of tumor: Robotic/ laparoscopic procedure

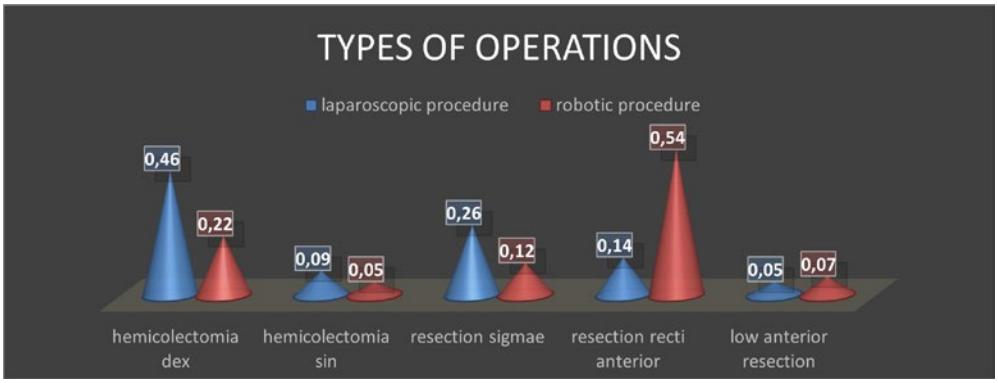

Fig. 7: Types of operations (robotic/ laparoscopic procedure)

TABLES

	Robotic surgery	Laparoscopic surgery
ASA		
I	37%	7%
II	62%	51%
III	1%	40%
	0%	2%
Sex		
M	51%	36%
F	49%	64%
Indication for surgery		
Adenocarcinoma	76.6%	74.1%
Adenoma	11.6%	15.2%
Polipectomia	10%	7.1%
Diverticulitis	1.7%	3.5%
Tumor location		
Right colon	21%	45%
Left colon	4%	7%
Sigmoid colon	13%	24%
Rectosigmoid junction	40%	15%
Rectum	22%	9%
Types of operations		
Right hemicolectomy	22%	46%
Left hemicolectomy	5%	9%
Sigmoid resections	12%	26%
Anterior rectal resection	54%	14%
Low anterior resection	7%	5%
T stage		
1	9%	17%
2	39%	35%
3	46%	44%
4	6%	4%
N stage		
0	40%	54%
1	36%	37%
2	24%	9%
UICC stage		
I	51%	30%
II	15%	33%
III	34%	37%
IV	0%	0%
Tumor Grade		
I	15.8%	7.8%
I-II	11.5%	17.9%
II	67.6%	67.2%
III	5%	6.2%
Operation time	186.6 min	187.6 min
Blood loss (range)	50-150 ml	100-300 ml
Number of extracted LNs	18.5	16.5
Oral diet	3.7 days	4.6 days
First stool	4.5 days	4.6 days
Morbidity	9%	10.3%
Conversion	4.5%	7%
Hospital stay	7.5 days	10.3 days

Table 1. Patients' characteristics, pathology and operative results.

	Laparoscopic procedure	Robotic procedure
Duration of operation (min)	187,6 min.	186,6 min (operation on conzole)
Intraoperative blood loss (ml) average	100-300 ml	50-150 ml
Average number of lymph-nodes	16,5	18,5
Time to resume regular diet(days)	4,6	3,7 days
Time to passage of stool(-days)	4,1 days	4,5 days
Lenght of stay in hospital (days)	10,3 days	7,5 days
Complication(n%)	(10,3%)	(9,0%)
Conversion to open surgery (n(%)	(7%)	(4.5%)

Table 2. Laparoscopic/ Robotic procedure (statistic analyze)