

PROFESSIONAL PAPER

Robot-assisted colorectal operations compared to the laparoscopic approach

Igor Černi^{1,2}

Received: 1 January 2022; Accepted: 23 April 2023

ABSTRACT

Background: The minimally invasive approach has become increasingly interesting in the treatment of patients with colorectal cancer. The purpose of this study is to analyze the differences between laparoscopy and robotics used in colorectal cancer in terms of oncologic and clinical outcomes in a small general hospital.

Methods: 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 was performed. The average number of isolated lymph nodes in the robotic method was 19, while in laparoscopic method there were 155. The hospitalization was shorter in the robotic surgery patients (average 7.3 days), on the other hand the duration of the robotic operations was longer than the laparoscopic operations. Intraoperative blood loss was smaller in the robotic method (50-120 ml) in comparison with laparoscopic method (100-300 ml). Conversion to open surgery was lower when using the robotic method (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 the disease, the others due to cardiovascular disease. The most common operation was right hemicolectomy (46%) by laparoscopic procedure, and using the robotic method it was anterior resection of the rectum (54%).

Conclusion: RCS is a promising technique and is a safe and effective alternative to LCS for 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 oncological outcomes.

Keywords: robotic surgery, colorectal cancer, oncological outcomes.

¹ General and Teaching Hospital Celje, Slovenia

² Department of General and Abdominal Surgery Celje

Igor Černi

Email: igorcerni62@gmail.com

ORCID 0009-0009-9371-6932

Introduction

The minimally invasive approach has become increasingly interesting in the treatment of patients with colorectal cancer. Robotic surgery for colorectal cancer has been widely accepted in recent years^{1,2}. Reports on robotic surgery usually come from large hospitals, but it is interesting to show experiences from small general hospitals.

The purpose of this study is to analyze the differences between laparoscopy and robotics used in colorectal cancer in terms of oncologic and clinical outcomes. We present our initial the results of robotic operations of the large intestine, with special regard to the patient undergoing robotic surgery of the colon for rectum cancer and a comparison with laparoscopy.

Methods

IWe 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.

Surgery

Robotic surgery was performed according to the standards described elsewhere [2-4]. For the 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 and the operating team is presented in Figure 2.

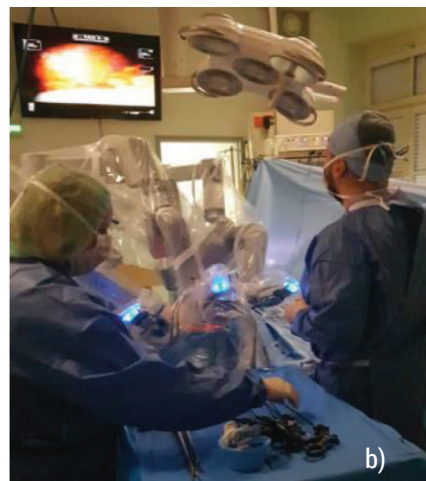


Figure 2 a,b,c. The positioning of the DaVinci Si platform.

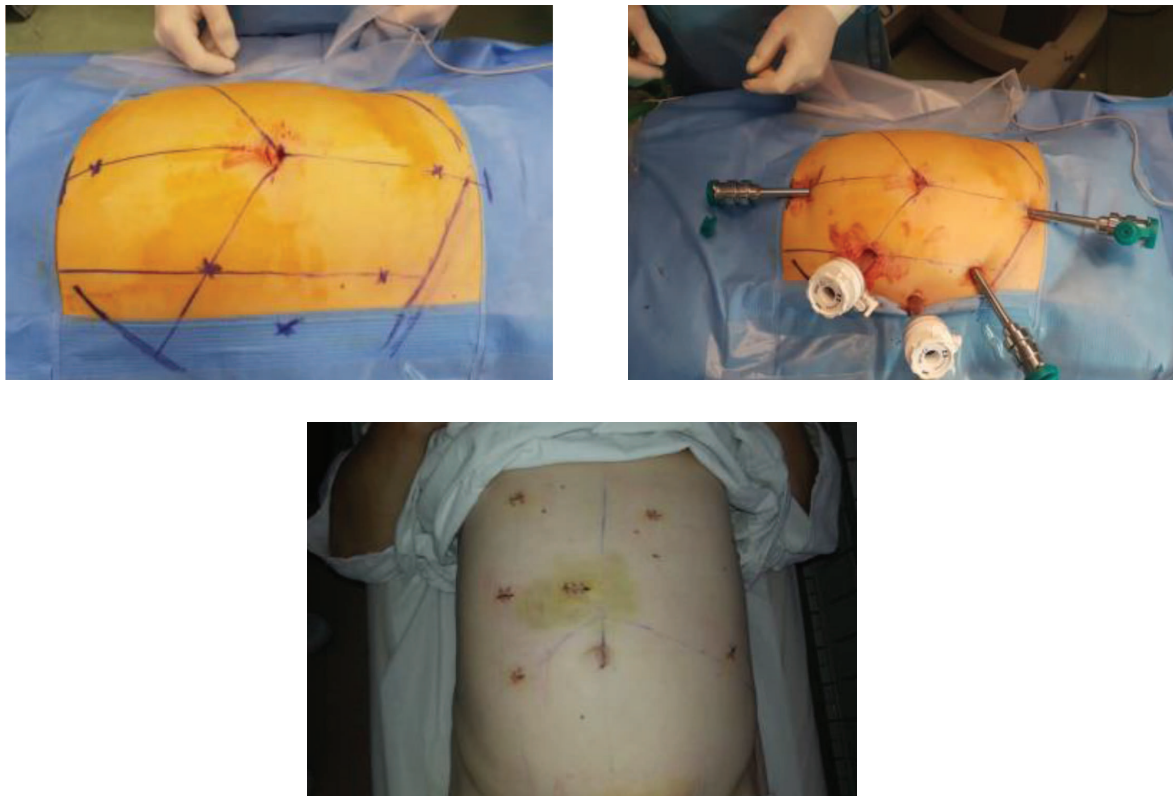


Figure 3 a,b,c. Port placement for robotic right hemicolectomy and postoperative view of the patient after robotic surgery.

Data sources

All data were stored prospectively in the department's database. In addition, we used the hospital's data registry to collect additional demographic data such as comorbidities, 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 Celje Teaching Hospital 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 (Gagnano, Italy). ABA Medica analyzed the data, and only certified robotic surgeons were allowed to send and request the data. For this study, all data were blinded. The study was approved by the local ethics committee.

Data processing

The retrieved data were coded and analyzed by designated surgeons for robotic surgery (IC and OS). The patients were grouped by pathology and how the surgery was performed. The continuous data were presented as mean $\pm$ 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 the operated patients was similar in both groups (63 years), however more patients in the laparoscopic group were male compared to the robotic

group (64% vs 51%). Seven patients in the robotic group had 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 low anterior resection was similar in both groups (7% in the robotic vs. 5% in the laparoscopic group). The TNM stage was similarly distributed in both groups. Stage pT3N0M0 was the most prevalent. In both groups, UICC stage III was the most prevalent. The clinical and pathological characteristics are presented in Table 1.

Table 1. Patients' characteristics, pathology and operative results

	Robotic surgery	Laparoscopic surgery
ASA		
I	37%	7%
II	62%	51%
III	1%	40%
	0%	2%
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%

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 than in laparoscopic surgery (100-300 ml). The average number of lymph nodes extracted 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%) (Table 2).

Discussion

Robotic surgery for colorectal cancer has been widely accepted and embraced in recent years³⁻⁵. It offers many decisive advantages over laparoscopic surgery and makes difficult cases safer to operate. The Department for Abdominal and General Surgery at Celje Teaching Hospital introduced robotic colorectal surgery to Slovenia in 2014. At that time this was a novel surgical procedure in Slovenia and opened the region for 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 with laparoscopic colorectal operations.

Patients in the robotic group, although of comparable age to the laparoscopic group, were in better general health. This might be due to the fact that in the initial period of the introduction of robotic surgery 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 that the two groups are comparable. This is also true in relation to patients who received anterior and low anterior resections. In both groups, these operations were similarly distributed and hence comparable.

Regarding the perioperative results, we can confirm that the morbidity in patients who underwent robotic surgery was comparable to the laparoscopic procedures. Although these results present the initial period of the introduction of the robotic platform for colorectal patients, we can show that this method is safe and feasible, and the procedure takes a comparable time to perform. Similar results were obtained in other pioneer studies^{3,6,7}. Spinoglio et al. showed that robotic surgery is comparable to laparoscopy in regard to safety⁸. We agree with Yasir et al. who stated that

Table 2. Laparoscopic/ Robotic procedure

	Laparoscopic procedure	Robotic procedure
Duration of operation (min)	187.6 min.	186.6 min (operation on console)
Intraoperative blood loss (ml) average	100-300 ml	50-150 ml
Average number of lymph nodes	16.5	18.5
Time to resumption of regular diet(days)	4.6	3.7 days
Time to passage of a stool (days)	4.1 days	4.5 days
Length of stay in hospital (days)	10.3 days	7.5 days
Complications(n%)	(10.3%)	(9.0%)
Conversion to open surgery (n%)	(7%)	(4.5%)

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 observation since we were able to lower 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 that surgery is also easier in small operative fields, such as the pelvis. As the male pelvis can be narrow, visibility, especially in obese patients, can be difficult. These issues are even more challenging to overcome in laparoscopic surgery. Robotic surgery has decisive advantages, with superior 3D visibility, motion scaling and angulation. This is possibly the reason for the smaller blood loss and lower conversion rates in the robotic group. Similar results were observed in other studies⁸⁻¹⁴.

We believe that less intraoperative bleeding and more precise dissection in the robotic group were the main factors that led to the faster postoperative resumption of digestive functions. Patients in the robotic group passed a stool and restarted an oral diet earlier, which eventually led to a shorter hospital stay compared to the laparoscopic group. Similarly, Spinoglio et al. observed significantly shorter hospital stays in the robotic group compared to laparoscopic surgery⁸.

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, thereby 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.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

Patient Consent Form: All participants were informed about subject of the study.

References

1. Feng Q, Yuan W, Li T, Tang B, Jia B, Zhou Y, et al. REAL Study Group. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2022;7:991-1004. doi: 10.1016/S2468-1253(22)00248-5.
2. Baek SJ, Piozzi GN, Kim SH. Optimizing outcomes of colorectal cancer surgery with robotic platforms. *Surg Oncol.* 2021;37:101559. doi: 10.1016/j.sur-
onc.2021.101559.
3. Kim CW, Baik SH. Robotic rectal surgery: what are the benefits? *Minerva Chir.* 2013;68:457-69.
4. Feng Q, Yuan W, Li T, Tang B, Jia B, Zhou Y et al. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2022;7:991-1004. doi: 10.1016/S2468-1253(22)00248-5.
5. Sheng S, Zhao T, Wang X. Comparison of robot-assisted surgery, laparoscopic-assisted surgery, and open surgery for the treatment of colorectal cancer: A network meta-analysis. *Medicine (Baltimore).* 2018;97:e11817. doi: 10.1097/MD.00000000000011817.
6. Weber PA, Merola S, Wasielewski A, Ballantyne GH. Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. *Dis Colon Rectum.* 2002;45:1689-94; discussion 1695-6. doi: 10.1007/s10350-004-7261-2.
7. D'Annibale A, Morpurgo E, Fiscon V, Trevisan P, Sovernigo G, Orsini C et al. Robotic and

- laparoscopic surgery for treatment of colorectal diseases. *Dis Colon Rectum*. 2004;47:2162-8. doi: 10.1007/s10350-004-0711-z.
8. Spinoglio G , Bianchi PP, Marano A, Priora F, Lenti LM, Ravazzoni F et al. Robotic Versus Laparoscopic Right Colectomy with Complete Mesocolic Excision for the Treatment of Colon Cancer: Perioperative Outcomes and 5-Year Survival in a Consecutive Series of 202 Patients. *Ann Surg Oncol*. 2018;25:3580-3586. doi: 10.1245/s10434-018-6752-7.
9. Rawlings AL, Woodland JH, Vegunta RK, Crawford DL. Robotic versus laparoscopic colectomy. *Surg Endosc*. 2007;21:1701-8. doi: 10.1007/s00464-007-9231-y.
10. Araujo SEA, Seid VE, Klajner S. Robotic surgery for rectal cancer: current immediate clinical and oncological outcomes. *World J Gastroenterol*. 2014;20:14359-70. doi: 10.3748/wjg.v20.i39.14359.
11. Cui Y, Li C, Xu Z, Wang Y, Sun Y 5, Xu H, Li Z et al. Robot-assisted versus conventional laparoscopic operation in anus-preserving rectal cancer: a meta-analysis. *Ther Clin Risk Manag*. 2017;13:1247-1257. doi: 10.2147/TCRM.S142758. eCollection 2017.
12. G Wilder F, Burnett A, Oliver J, Demyen MF, Chokshi RJ. A Review of the Long-Term Oncologic Outcomes of Robotic Surgery Versus Laparoscopic Surgery for Colorectal Cancer. *Indian J Surg*. 2016;78:214-9. doi: 10.1007/s12262-015-1375-8.
13. Trinh BB, Hauch AT, Buell JF, Kandil E. Robot-assisted versus standard laparoscopic colorectal surgery. *JSLs*. 2014;18:e2014.00154. doi: 10.4293/JSLs.2014.00154.
14. Young M, Pigazzi A. Total mesorectal excision: open, laparoscopic or robotic. *Recent Results Cancer Res*. 2014;203:47-55. doi: 10.1007/978-3-319-08060-4_6.