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# ROBOTIC COLORECTAL SURGERY USING SENHANCE® ROBOTIC PLATFORM: REPORT OF 81 CASE

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**Keywords*:*** colorectal surgery; minimally invasive surgery; robotic surgery; Senhance® robotic platform.

**Summary**

Purpose: the aim of the study was to prospectively evaluate patients who underwent colorectal surgery using Senhance® robotic platform in our center.

Methods: over a period of from November 2018 to August 2021 and since the adoption of Senhance® robotic surgery, 81 robotic colorectal procedures were performed. We performed the analysis of prospectively collected data. Perioperative, intraoperative and short-term postoperative data was assessed.

Results: From 81 patient who underwent colorectal resection using Senhance® robotic platform, 41 were female and 40 male, age range 23-92 years, on an average 62 years. Length of hospital stay as 3 to 48 days, on an average 7,4 days. Sixty-eight patients (83,9%) patients underwent operations for colorectal cancer (29 colon and 39 rectal), and the remaining thirteen patients were operated for benign diseases. The average operating time during the first 25 procedures was 3 hours and 38 minutes, ranging from 2 hours and 5 minutes to 6 hours and 20 minutes. During the last 25 procedures it was on an average 2 hours and 45 minutes, ranging from 1 hour and 20 minutes to 5 hours and 10 minutes. Amongst 68 patients with colorectal cancer, 16 (19,7%) were stage I, 16 (19,7%) stage II, 34 (41,9%) stage III and two (2,5%) were stage IV colorectal cancers. 39 (48,2%) operations were performed on the colon and 42 (51,8%) were different type of rectal surgeries. There were three (3.7%) conversions to open surgery, one of which was due to intraoperative complication – bleeding. 9 (11.1%) postoperative complications were recorded, of which three (3,7%) had to undergo interventions under general anaesthetic. No postoperative deaths occurred.

Conclusions: Our experience allows to conclude that colorectal surgery using the new Senhance® robotic platform is safe and feasible. Additional studies are mandatory to delineate the exact role of this type of robotic surgery in surgery of the colon and rectum.

## Introduction

Robotic surgery was introduced in 2020, when Food and Drug Administration (FDA) approved the Intuitive's da Vinci® robotic system in the United States, shortly followed by first colorectal resections performed in early 2001 (1). However, the analysis of true benefits of this surgery on an evidence based level is still ongoing. Furthermore, today, the Da Vinci® is no longer the only existing robotic system: case series in colorectal cancer surgery, although small, are already published, using the FDA and European CE mark approved Senhance® robotic system (2,3), the European CE mark approved Versius® robotic system (4,5,6) and other systems having approval for clinical use on a single country level like Microhand S® in China (7,8). In the near future, a number of new robotic systems are also to be introduced.

In our center, robotic surgery program using the Senhance® robotic system was implemented in 2018 in a multidisciplinary fashion (9) and was developed universally in general and colorectal surgery, gynecology and urology. Up to date, more then 500 robotic surgeries were performed using the Senhance® robotic system. We have published a number of video-vignettes on different colorectal procedures (10-14), describing the technical steps on how to perform this type of robotic surgery and to fill the existing gap, as reports

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using this robotic system in colorectal surgery are scarce.

In this article, we included prospectively collected data on 81 colorectal robotic surgeries. The aim of the study was to evaluate initial single robotic center experience in Senhance® robotic colorectal surgery.

**Patients and methods**

The study was approved by Klaipeda University Hospital Review board. All patients gave informed written consent.

The retrospective analysis of prospectively collected data was performed. From November 2018 to August 2021, 81 colorectal procedures were performed at the Klaipeda University Hospital in Klaipeda, Lithuania, using the Senhance® robotic system.

*Surgical technique*

Patient was put in a supine position under general anesthesia. Through a 1 cm skin incision either supra-umbilical or infra-umbilical, a 10 mm trocar was introduced under direct vision and a 10 mm 30 degree camera inserted. After inspection of the abdominal cavity for possible metastatic spread, primary tumor and adhesions, other trocars and robotic instruments were inserted and robot docked. Performing a right hemicolectomy, we used two 5 mm trocars for robotic instruments. No assistant trocar was necessary (10) identical to our laparoscopic technique. Vascular ligation and anastomosis were performed extracorporeal through a 5-6 cm trans-umbilical incision. For sigmoid colectomy and rectal procedures, after inserting the camera, two 10 and 12 mm trocars were used on the right, and one 5 mm (or 10 mm if use of articulating 10 mm instrument Radia® was planned) on the left (11-14). The patient was put into a reverse Trendelenburg position. We did not perform splenic flexure mobilization as a routine. After mobilizing the descending and sigmoid colon and, in some cases, the rectum, vascular ligation, stapling of the rectum and anastomosis were performed using laparoscopic assistance. In sigmoid and rectal cancer surgery, 5-6 cm trans-umbilical, infra-umbilical or Pfannenstiel incision were used for specimen extraction. For bowel transection, we used ECHELON (Ethicon, Somerville, NJ, USA) with a 60 mm blue cartridge. ECHELON was always introduced through the 12 mm troacar, which was inserted 2 cm medial and 2 cm below right anterior superior iliac spine. Straight ileorectal anastomosis after subtotal colectomy, straight colorectal anastomosis after sigmoid resection and partial mesorectal excision, and side-to-end coloanal anastomosis after total mesorectal excision was performed using circular 29 or 31 mm stapler (Ethicon, Somerville, NJ, USA). When performing TaTME, the procedure

**Figure 1**. Right hemicolectomy being performed using Senhance® robotic platform.

was started with the patient in a prone-jackknife position and the transanal part of the operation was performed in an open fashion similar as described by a French group (15). For the robotic part the patient was put in a reverse Trendelenburg position. While performing abdominoperineal resection and after the abdominal robotic part and creation of the stoma was completed, the perineal part was performed in a prone-jackknife position (11). For right hemicolectomy, only straight robotic instruments were used (Figure 1). In the sigmoid colon and rectal surgery, we selectively used articulating 10 mm Radia® instrument. In most of our cases, we used three robotic arms; in all cases we used Senhance® ultrasonic Lotus® for dissection. If the tumor was small and in the transverse colon or the left side, we used endoscopic tattooing. For rectal cancer cases we assessed the quality of the specimen, distal, proximal and circular margins and lymph node harvest.

Complications were prospectively recorded up to 30-days post operatively using the Clavien-Dindo classification (16).

Simple descriptive tests for statistical analysis were used. For the Gaussian quantitative variable, Student's t-test was used. For the non-Gaussian variable, we used the Mann–Whitney U test. $P < 0.05$ were considered statistically significant.

**Results**

From 81 patient who underwent colorectal resection using Senhance® robotic platform, 41 were female and 40 male, age range 23-92 years, on an average 62 years. Length of hospital stay as 3 to 48 days, on an average 7,4 days. Sixty-eight patients (83,9%) patients underwent operations for colorectal cancer (29 colon and 39 rectal), and in the remaining thirteen patients, the reasons for surgery were large endoscopically not-removable colorectal adenomas (including two carcinoma in situ) in ten patients, familial adenomatous polyposis in one and diverticular disease in two patient. The average operating time during the first 25 procedures was 3 hours and 38 minutes, ranging from 2 hours and 5 minutes to 6 hours and 20 minutes. During the last 25 procedures it was on an average 2 hours and 45 minutes, ranging from 1 hour and 20 minutes to 5 hours and 10 minutes.

After sigmoid colectomy or subtotal colectomy, rectal stump just below promontory was closed using ECHELON 60 mm stapler with one cartridge in all cases. After partial total mesorectal excision (including one Hartman type procedure) and total mesorectal excision (30 operations), rectal stump was closed using one cartridge in 26 cases and two cartridges in 4 cases. When performing TaTME, rectal stump was routinely closed using a purse-string suture.

Amongst those 68 patients with colorectal cancer, 16 (19,7%) were stage I, 16 (19,7%) stage II, 34 (41,9%) stage III and two (2,5%) were stage IV colorectal cancers. Robotic colorectal operations are listed in Table 1.

As listed in Table 1, 39 (48,2%) operations were performed on the colon and 42 (51,8%) were different type of rectal surgeries.

Patients with upper rectal cancer did not receive any neoadjuvant treatment. From the remaining 27 patients with mid and low rectal cancers, 20 (74.1%) received long courses of chemoradiotherapy and 1 (3,7%) short course radiotherapy (this patient after short course radiotherapy was Covid positive prior surgery, surgery was not postponed but performed within one week after completion of neoadjuvant treatment using all necessary precautions). Nineteen patients were operated on 8 to12 weeks after completion of the long course radiotherapy, and one with endoluminal recurrence of a lower third rectal cancer was operated on after 18 months after complete clinical response (he underwent a 'watch and wait' strategy).

There were three (3.7%) conversions to open surgery. One case was due to an unexpected localization of the tumor: after mobilization of the right colon and hepatic flexure and performance of a transumbilical incision for specimen extraction, a small colon tumor was found in the mid transverse colon (preoperatively assessed as being close to hepatic flexure) and, after extending the incision upwards, an extended right hemicolectomy was performed. In the other case, a spread into the anterior wall of the pre-pyloric part of the stomach from the proximal transverse colon tumor was detected, and a subtotal gastrectomy was necessary in addition to the right hemicoletomy. Third one was due presacral bleeding performing TME 10 weeks after long course chemoradiotherapy for mid rectal cancer. All of these patients had uneventful postoperative courses.

**Table 1.** Type of 81 robotic colorectal operations performed with Senhance® robotic platform

| Type of operation | Number |
|---|---|
| Right hemicolectomy | 24 |
| Anterior resection with partial mesorectal excision (PME) | 14 |
| Sigmoid colectomy | 14 |
| Anterior resection with total mesorectal excision (TME) | 15 |
| Abdominoperineal resection (APR) | 7 |
| Transanal total mesorectal excision (TaTME) | 5 |
| Subtotal colectomy with ileorectal anastomosis | 1 |
| Anterior resection with partial mesorectal excision (PME) and end colostomy (Hartmann type) | 1 |
| Total | 81 |

A total of 9 (11,1%) complications were recorded and three cases (3.7%) required intervention under general anesthesia. All patients recovered. No postoperative deaths occurred. Complications, their management and severity according to the Clavien-Dindo classification is listed in Table 2.

In 68 patients operated for colorectal cancer, the average lymph-node harvest was 19±8,9 (range 7 to 38 lymph nodes). In the rectal cancer group of 38 patients, the distal resection margin was 1 to 7 cm, on an average 3.3±1.7 cm. Circumferential margin was positive in one case, in all other the closest distance from the tumor to the circumferential resection margin in this patient population was 0.3 cm.

**Discussion**

Spinelli A et al published the first report on Senhance® robotic colorectal surgery series in 2017 (5). Over the period of 1.5 year, they performed 45 colorectal resections, 66% of them for colorectal malignancies. Of those 45 patients, 12 underwent rectal resections and 33 were colonic resections. Despite this relatively small group of rectal surgery, they demonstrated safety and feasibility of the Senhance® robotic system both in colon and rectal surgery. A large volume Senhance® robotic surgery center in Siegen, Germany, presented their initial experience with various abdominal procedures, but amongst them were just a few colonic resections for benign reasons (17). After this system was approved by FDA in the United States in 2018, only one paper reported two cases of colonic resections with this system (18) in USA. A very important paper was published by a group in Siegen on 12 Senhance® robotic sigmoid colectomies for diverticular disease (19). They had to convert 2 of 12 operations to laparoscopy, these conversions did not change their described procedure steps of the robotic intervention, exact position of robotic arms and instruments and camera during each docking step. We did use part of their experience in our practice, but our approach did not involve routine splenic flexure mobilization. It therefore made one step of their procedure not necessary. It would be of use in the future to have published series suggesting such a roadmap for other standard colorectal operations, especially in rectal cancer surgery which is, in general, technically more demanding. We tried to perform all colorectal operations with the Senhance® system just to ensure that using this system has no limitations as we do not see many limitations in our laparoscopic practice. Right hemicolectomy (10), sigmoid colectomy (14), anterior resection with TME (12), abdominoperineal resection (11) and TaTME (13) were successfully performed. The video-vignettes included description of our standardized approach to each surgical procedure. A Japanese group suggested interesting techniques for seemingly well described Senhance® procedures. A 4 robotic arm D3 right hemicolectomy for right sided transverse colon cancer was successfully performed, and all operational steps were performed intracorporeally including lymph-node dissection (21). They even implemented single-port access surgery (plus two additional ports) to perform a sigmoid colectomy for cancer (22). For ileocaecal resection, an original port placement was used (23), in the same article 'ideal' port

**Table 2.** Surgical complications (9 – 11,1%) after 81 robotic colorectal operations with Senhance® robotic platform
*TME – total mesorectal excision*
*i/v – intravenous*

| Sex | Age | Type of operation | Complication | Management | Clavien-Dindo classification |
|---|---|---|---|---|---|
| F | 52 | Abdominoperineal resection | Bleeding from perineal wound | Suturing of the bleeding vessel | Grade IIIb |
| M | 66 | Sigmoid resection | Anastomotic leakage | Resection of anastomosis, end colostomy | Grade IIIb |
| F | 57 | Right hemicolectomy | Anastomotic leakage | Resection of anastomosis, end ileostomy | Grade IIIb |
| M | 64 | Anterior resection with partial TME | Bleeding from the anastomotic staple line | Endoscopic clipping | Grade IIIa |
| F | 75 | Abdominoperineal resection | Bowel obstruction | Conservative (i/v fluids) | Grade II |
| M | 73 | Abdominoperineal resection | Bowel obstruction | Conservative (i/v fluids) | Grade II |
| M | 23 | Anterior resection with TME (with covering ileostomy) | Anastomotic leakage | Conservative (antibiotics) | Grade II |
| M | 50 | Anterior resection with TME (with covering ileostomy) | Anastomotic leakage | Conservative (antibiotics) | Grade II |
| M | 64 | Anterior resection with TME (with covering ileostomy) | Wound infection (specimen extraction site) | Wound opened | Grade I |

placement which is in fact the same as we used for all our right hemicolectomies was suggested, not demanding an additional port for assistant. The last and largest series prior to our data from Taiwan were published recently (6) on 46 colorectal resections (39 (84.8%) for colorectal cancer) using Senhance® robotic system. 30 (65.2%) patients underwent rectal procedures. Despite that, some authors conclude that rectal cancer surgery with this robotic system does not seem to be promising. It is necessary to emphasize that they used only straight robotic instruments. That may be the cause for their conclusions, but at the same time, it should be noted that a great number of rectal surgery worldwide is performed successfully laparoscopically up to date, where only straight instruments are used.

We selectively implemented the use of the articulating Senhance® 10 mm instrument Radia® and found it advantageous. Especially with the 5 mm version on the market today (23), it is a way to overcome the shortcomings of straight instrument robotic Senhance® surgery in rectal cancer. Our experience starting from the operating time, including blood loss and ending with quality of surgery (surgical complications, lymph node harvest, distal and circumferential resection margins) should not allow us to limit this type of robotic surgery to the colon alone.

The small numbers and retrospective analysis of our prospectively arranged database limits our study. Furthermore, we did not compare the results with other techniques (open or laparoscopy) or other robotic systems.

In our center with high volume experience in laparoscopic colorectal surgery, we demonstrated a reduction of total operation time from on an average of 3 hours and 38 minutes during the first 25 procedures to on an average of 2 hours and 45 minutes during the last 25 procedures. This simply demonstrates that with reasonable previous experience in laparoscopic colorectal surgery, adoption of robotic Senhance® colorectal surgery is not difficult.

## Conclusions

Our experience allows to conclude that colorectal surgery using the new Senhance® robotic system is safe and feasible. Additional studies are mandatory to delineate the exact role of this type of robotic surgery in surgery of the colon and rectum.

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## ROBOTINĖ KOLOREKTINĖ CHIRURGIJA, NAUDOJANT SENHANCE® ROBOTINĘ PLATFORMĄ: 81 ATVEJO ANALIZĖ

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Raktažodžiai: kolorektinė chirurgija, mažai invazinė chirurgija, robotinė chirurgija, Senhance® robotinė platforma.

Santrauka

Darbo tikslas: prospektyviai įvertinti pacientus, kuriems buvo atliktos robotinės kolorektinės operacijos, naudojant Senhance® robotinę platformą mūsų centre.

Metodai. Nuo 2018 metų lapkričio mėnesio (robotinės chirurgijos įdiegimo) iki 2021 metų rugpjūčio atlikta 81 robotinė kolorektinė operacija, naudojant Senhance robotinę platformą. Buvo išanalizuoti prospektyviai surinkti duomenys. Buvo vertinami perioperaciniai reiškiniai, operacijos duomenys bei ankstyvasis pooperacinis laikotarpis.

Rezultatai. Kolorektinės operacijos naudojant Senhance® robotinę platformą buvo atliktos 81 pacientui. Iš to skaičiaus: 41 moteris ir 40 vyrų, amžius 23-92 metai, amžiaus vidurkis 62 metai. Hospitalizacijos trukmė nuo 3 iki 48 dienų, vidutiniškai 7,4 dienos. 68 (83,9%) pacientams operacijos buvo atliktos dėl kolorektinio vėžio (29 dėl gaubtinės žarnos vėžio ir 39 dėl tiesiosios), 13 pacientų buvo operuoti dėl kitos patologijos. Pirmųjų 25 operacijų trukmė buvo vidutiniškai 3 valandos ir 38 minutės, nuo 2 valandų ir 5 minučių iki 6 valandų ir 20 minučių. Paskutiniųjų 25 operacijų trukmė vidutiniškai buvo 2 valandos ir 45 minutės, nuo 1 valandos ir 20 minučių iki 5 valandų ir 10 minučių. Iš 68 pacientų, sirgusių kolorektiniu vėžiu, 16 (19,7%) buvo I stadija, 16 (19,7%) - II, 34 (41,9%) – III ir 2 (2,5%) - IVstadija. Gaubtinės žanos operacijos buvo 39 (48,2%), tiesiosios − 42 (51,8%). Trimis atvejais (3,7%) operacijos buvo konvertuotos į atvirą chirurgiją, 1 iš jų dėl intraoperacinės komplikacijos – kraujavimo. 9 (11.1%) pacientams po operacijos išsivystė įvairios komplikacijos, iš kurių 3 (3,7%) reikėjo operuoti iš naujo, naudojant bendrinę nejautrą. Po operacijos nei vienas ligonis nemirė.

Išvados. Mūsų tyrimo duomenys leidžia daryti išvadą, kad kolorektinė chirurgija naudojant Senhance® robotinę platformą yra galima ir saugi. Reikalingi papildomi tyrimai, kurie padėtų aiškiai apibrėžti šios robotinės chirurgijos vaidmenį atliekant operacijas dėl gaubtinės ir tiesiosios žarnos chirurginių susirgimų.

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