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Original Article

Robotic-Assisted Colorectal Surgery - Initial Results

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Abstract

Introduction: The mini invasive procedure in colorectal surgery is gaining ground as an alternative to conventional surgery. Colorectal surgery has significantly evolved since the advent of the automatic stapler devices and subsequently with the minimally invasive approach. The next logical step - the robotic assisted surgery was developed to satisfy surgeons' needs to the area of colorectal surgery and to offer a new and safer method to patients. The evidence for benefits of its use in this area appears to be promising.

Aim: The aim of this study was to analyse and share our initial results in robotic colorectal surgery and compare them with literature data.

Materials and methods: A retrospective study was conducted in order to review seven patients with colorectal cancers operated by the robotic-assisted technique over three months in the initial phase of the learning curve. Gender, age, diagnosis, and surgical indication, type of surgery performed, surgical time, conversion, bleeding, post-operative complications, and hospital stay, were analysed and described. A literature review was performed on the role of robotic surgery in colorectal cancer.

Results: Seven patients were operated, 5 males and 2 females with a mean age of 68.2 years. The following procedures were performed: left hemicolectomy with primary anastomosis, low anterior resection, left hemicolectomy, sigmoid resection. The mean surgery time for the seven patients was 4 h 06 min, with a time on the console of 2 h and 50 min, and mean bleeding of 192 cc. None of the patients required conversion and the hospital stay was 7 days.

Conclusions: Despite the reduced case series, the initial results of our learning curve in colorectal robotic surgery are among the parameters imposed by the medical literature.

INTRODUCTION

The history of colorectal surgery is an exciting journey of innovations that emphasises the significant advances made in the field. The last century was the era of minimally invasive surgery and colorectal surgery was also affected.[1]

The mini invasive procedure in colorectal surgery increased as an alternative to conventional surgery despite its oncological safety and efficiency. The evidence that it is superior to an open surgery is indisputable. It is now understood that laparoscopic surgery is equal, or even superior, to the open surgery in colorectal procedures.[2]

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Colorectal surgery has significantly evolved since the advent of the automatic stapler devices and subsequently with the minimally invasive approach. The next logical step - robotic surgery - was developed to satisfy the surgeons' needs to the area of colorectal surgery and to offer a new and safer method to patients. The evidence for the benefits of its use in this area appears to be promising.[3,4]

The beginnings of robotic surgery marked a new era in the history of minimally invasive surgery. The National Aeronautics and Space Administration (NASA) developed the first remotely controlled robot in 1985 at the request of the United States Department of Defense with the objective of reducing the number of deaths in the Vietnam War. The initial model of the DaVinci system was launched in 1999. Since then, it has undergone a series of improvements until the development of the better performing da Vinci X/Xi version. The Da Vinci system consists of a console **(Fig. 1)** and a robot with 4 interactive robotic arms **(Fig. 2)** connected to the console and controlled by the surgeon.[5,6]

AIM

The aim of this study was to analyse and share our initial results in robotic colorectal surgery and compare them with literature data.

MATERIAL AND METHODS

A retrospective study was conducted in order to review our first seven patients with colorectal cancers operated by a robot-assisted technique. Gender, age, diagnosis and surgical indications, type of surgery, surgical time, conversion, bleeding, post-operative complications, and hospital stay were analysed and described. A literature review was performed on the role of robotic surgery in colorectal cancer.

Figure 1. Robotic arms connected to the console.

Figure 2. Robotic arms connected to the console.

RESULTS

Seven patients were operated during the study period (5 men and 2 women, mean age 68.2 years). The procedures we performed were as follows:

1. Left hemicolectomy (LHC) with primary anastomosis due to malignancy, with a surgery time of 3 h and 30 min, 2 h and 20 min of which were on the console, and haemorrhage of 150 cc with no complications;

2. Low anterior resection (LAR) with colorectal anastomosis for mid rectal cancer after radiation therapy, with a duration of 4 h and 30 min, 3 hours of which were on the console, and bleeding of 200 cc;

3. Low anterior resection with colorectal anastomosis for mid-rectal cancer after chemo/radiation therapy, with a duration of 4 hours, 2 h and 15 min of which were on the console, and bleeding of 200 cc;

4. Left hemicolectomy due to adenocarcinoma at the sigmoid colon with a duration of 4 h and 15 min, with 2 h and 45 min on the console, and bleeding of 175 cc;

5. Low anterior resection in a patient with high BMI lasting 4 h and 40 min, with 3 h 20 min on the console, bleeding of 350 cc, and anastomotic leakage in postoperative period requiring re-surgery;

6. Sigmoid resection (SR) with mechanical colorectal anastomosis for cancer taking 4 h and 30 min, 2 h and 45 min of which were on the console, and bleeding of 100 cc;

7. Left colectomy for left flexure colon cancer lasting 4 h and 10 min, with 2 h and 10 min of this time spent on the console, and bleeding of 175 cc.

The surgery time for these seven patients was 4 hours and 6 minutes, with time spent on the console of 2 hours and 50 minutes, and bleeding of 192 cc. None of the patients required conversion and the mean hospital stay was 7 days **(Table 1)**.

DISCUSSION

The present study describes the short-term outcomes of seven consecutive colorectal cancer cases performed at the Kaspela University Hospital, Plovdiv for the first month of our robotic colorectal procedures.

Most authors reported a very low conversion rate for robotic colorectal surgeries.[7] This is in accordance with our study which did not report a case of conversion. Usually, the main reasons for conversion are bleeding, high BMI, difficult orientation, lack of progression, and adverse events. The conversion rates reported in a multiple analysis show that there was no difference in the conversion rate between obese and non-obese patients undergoing laparoscopic colorectal surgery. Although these results suggest non-inferiority for robotic surgery in the risk of conversion to a laparoscopic procedure, and indicate advantages. This is due to the enhanced ergonomics and increased degrees of freedom in a tight operative space afforded by robotic platforms, for example in obese men with a narrow pelvic inlet or when surgical planes are limited by extensive adhesions.[8,9]

Owing to the precise dissection and to the significant magnification, the blood loss in our study ranged between 350 cc and 100 cc. All surgeons reported almost the same results for blood loss not exceeding 500 cc.[10] Some authors think that this result indicates that the blood loss is significantly lower for robotic surgery than it is for laparoscopic surgery due to the better 3D visualisation of structures, the pneumo dissection that facilitates work in embryonic planes, and the wrist motion of instruments that allows gentle dissection of structures.

The anastomotic leakage is the most threatening complication in rectal surgery. This is the "price" that is paid for rectal sphincters preservation. There was an anastomotic leakage in one male patient (14.28%) with neoad-

Table 1. Patients, surgery, times, and outcomes

Patient No.	Gender/ age	Diagnosis	Surgery time (hours)	Surgery performed	Console time (hours)	Conver- sion	Complica- tions	DHS	Bleeding (ml)
1	M/68	Left colon cancer	4:30	LHC	2:20	No	No	7	150
2	M/81	Rectal cancer	4:30	LAR	3:00	No	No	6	200
3	M/57	Rectal cancer	4:00	LAR	2:15	No	No	6	200
4	F/55	Sigmoid colon cancer	4:15	SR	2:45	No	No	5	175
5	M/72	Rectal cancer	4:40	LAR	3:20	No	AL	12	350
6	F/64	Sigmoid colon cancer	4:30	SR	2:45	No	No	6	100
7	M/68	Left colon cancer	4:10		2:10	No	No	6	175
Mean	66.4		4:19		2:50	0	1	7	192

LHC: left hemicolectomy; LAR: low anterior resection; SR: sigmoid resection; AL: anastomotic leakage; DHS: days of hospital stay

juvant chemo/radiation therapy with low rectal cancer in our initial series. In this case we did not use diverting ileostomy. Our main criteria for diverting ileostomy creation are high leakage score. To evaluate it, we used a PROCOLE score (Prognostic Colorectal Leakage - weight of the factors for calculation of the prognostic index of anastomotic leak). Pigazzi et al. reported almost the same leakage rate (10.5%).[11] Unfortunately, our patient needed re-surgery due to diffuse peritonitis, which goes in agreement with the percentages (10.4%) reported by Hellan et al.[12] The post-op period after re-surgery was uneventful.

The mean hospital stay in our group was 7 days, which is comparable to that reported by Pigazzi et al.[13] and other researchers (8.3 days). Of course, this time will be rather longer than that in complicated cases. And again shorter hospital stay in uneventful cases was explained by the advantages of robotic surgery. Some of them are the same as in the laparoscopic surgery, but others are typical for the robotics surgical systems: they eliminate operator tremor, and provide a 3D view, high degrees of movement of the EndoWrist which helps to avoid injuries to major blood vessels, especially in the narrow male's pelvis and in left flexure mobilization.

The long operative time is often described as one of the major drawbacks of robotic surgery. In the present study, the mean time the operation took was 259 min and 170 min of which on the console, which is less than that time reported by Spinoglio et al.[13] and Sawada et al.[14] (383.3 min and 417 min, respectively). However there are studies reporting a shorter time of surgery. In our cases, the surgery time was less than that reported in most literature sources, mainly due to our major experience in laparoscopic colorectal surgery.

The disadvantage of Robotics in colorectal surgery is the high cost that is associated with this technique. Several studies report that the cost of a robotic colorectal surgery is higher than that for a laparoscopic surgery. This fact can account for the limitations of its widespread use in many countries.[15] Comparing laparoscopic colorectal to robotic colorectal surgery is beyond the scope of this study; however, laparoscopic surgery has a steep learning curve especially for rectal cancer, where the integrity of total mesorectal excision influences the outcomes. One of the potential benefits of robotic surgery is that it facilitates less experienced surgeons to perform minimally invasive surgery because of its advantages.[16]

CONCLUSIONS

Despite the small number of cases in this study, the initial results of our learning curve in colorectal robotic surgery are well within the range recommended by the medical literature.

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Competing Interests

The authors have declared that no competing interests exist.

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Робот-ассистированная колоректальная хирургия – первые результаты

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Резюме

Введение: Миниинвазивная процедура в колоректальной хирургии стала альтернативой традиционной хирургии. Колоректальная хирургия значительно изменилась с момента появления автоматических степлерных устройств, а затем и минимально инвазивного подхода. Следующий логический шаг – робот-ассистированная хирургия была разработана, чтобы удовлетворить потребности хирургов в области колоректальной хирургии и предложить пациентам новый и более безопасный метод. Доказательства преимуществ его использования в этой области кажутся многообещающими.

Цель: Целью этого исследования было проанализировать и поделиться нашими первоначальными результатами робот-ассистированной колоректальной хирургии и сравнить их с литературными данными.

Материалы и методы: Было проведено ретроспективное исследование семи пациентов с колоректальным раком, прооперированных с помощью роботизированной техники в течение трёх месяцев в начальной фазе процесса обучения. Были проанализированы и описаны пол, возраст, диагноз и показания к операции, тип выполненной операции, время операции, конверсия, кровотечение, послеоперационные осложнения и пребывание в больнице. Был проведён обзор литературы о роли роботизированной хирургии при колоректальном раке.

Результаты: Прооперировано 7 пациентов, 5 мужчин и 2 женщины, средний возраст которых составлял 68.2 года. Выполнены следующие операции: левосторонняя гемиколэктомия с первичным анастомозом, низкая передняя резекция, левосторонняя гемиколэктомия, резекция сигмовидной кишки. Среднее время операции у семи пациентов составило 4 часа 06 минут, время пребывания на консоли 2 часа 50 минут, средний объём кровотечения 192 мл. Ни одному из пациентов не потребовалась конверсия, а пребывание в стационаре составило 7 дней.

Заключение: Несмотря на сокращение серии случаев, первоначальные результаты нашего процесса обучения робот-ассистированной колоректальной хирургии относятся к параметрам, установленным в медицинской литературе.

Ключевые слова

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