ACTA MÉDICA PORTUGUESA
A Revista Científica da Ordem dos Médicos

Robotic Colorectal Surgery: Analysis of the First Three Years of Activity in a Hospital of the Portuguese National Health Service

Cirurgia Robótica em Patologia Colorretal: Análise dos Primeiros Três Anos de Atividade num Hospital do Serviço Nacional de Saúde em Portugal

Diogo CARROLA GOMES✉[1], Rodrigo ATHAYDE NEMÉSIO[1], Susana RODRIGUES[1], Jorge PENEDO[1], Isabel PAIXÃO[1]
Acta Med Port 2024 Jul-Aug;37(7-8):535-540 ▪ https://doi.org/10.20344/amp.20204

ABSTRACT

Introduction: Minimally invasive surgery has been increasingly accepted and used in colorectal surgery. Several studies report that robotic surgery may provide advantages over 'conventional' laparoscopy, namely in rectal surgery. This paper provides an account of the first three years of experience with robotic surgery in the Unidade de Patologia Colorretal of the Unidade Local de Saúde S. José.

Methods: Variables were defined to develop a prospective database containing the data of consecutive patients operated by three internationally certified colorectal surgeons using the Da Vinci Xi® system between November 2019 and October 2022. The database was converted into an anonymized version that was used for this study. The analysis was performed on the data of all the patients operated during this period.

Results: Eighty patients were included, 47 male, median age 70 years, and median BMI 26 kg/m^2. ASA score was II in 53.7% and III in 41.3% of patients. Of the total, 97.6% had malignant or potentially malignant disease. Operative procedures consisted of 34 colectomies proximal to the splenic flexure, 20 distal colectomies and 26 anterior resections. There were two synchronous resections of liver metastases. Early perioperative outcomes and histopathological results were analyzed: median operative time: 300 minutes; median estimated blood loss: 50 mL; conversion rate: 2.5%; median days until first bowel movement: three days; median length of hospital stay: six days; complication rate: 20%, of which 5% were Clavien III and 0% Clavien IV/V; anastomotic leak rate: 2.5%; 30-day readmission rate: 1.3%; median lymph nodes resected: 20; R0 resection rate: 100%; mesorectal integrity rate: 95,8% complete/near complete.

Conclusion: Our results show that the adoption of robotic colorectal surgery in our center was safe and resulted in similar or improved short-term clinical outcomes and histopathological results when compared to those described in the literature.

Keywords: Colorectal Surgery; Intraoperative Complications; Postoperative Complications; Robotic Surgical Procedures

RESUMO

Introdução: A utilização da cirurgia minimamente invasiva no tratamento da patologia colorretal é hoje cientificamente aceite e o seu uso na prática clínica diária tem vindo a aumentar de forma sustentada. Diversos estudos indicam que a abordagem robótica pode trazer vantagens sobre a laparoscopia 'convencional', especialmente na cirurgia do reto. Este trabalho descreve e analisa os resultados dos primeiros três anos de cirurgia robótica na Unidade de Patologia Colorretal da Unidade Local de Saúde S. José.

Métodos: Foram definidas as variáveis a analisar e construída uma base de dados prospetiva com os dados referentes aos doentes operados consecutivamente por três cirurgiões colorretais, acreditados internacionalmente na utilização do sistema Da Vinci Xi®, entre novembro de 2019 e outubro de 2022. A base de dados foi convertida numa versão anonimizada e foi sobre essa mesma que se procedeu à análise de dados. Foram analisados os dados de todos doentes operados nesse período.

Resultados: Foram incluídos 80 doentes, 47 homens, mediana de idade de 70 anos e de IMC de 26 kg/m^2. O *score* ASA era II em 53,7% e III em 41,3% dos doentes. Do total, 97,6% apresentavam doença maligna ou potencialmente maligna. Realizaram-se 34 colectomias proximais ao ângulo esplénico, 20 distais e 26 ressecções anteriores do reto. Houve ressecção síncrona de metástases hepáticas em dois casos. Foram analisados os resultados peri-operatórios a curto prazo e histopatológicos: duração (mediana): 300 minutos; perda hemática estimada (mediana): 50 mL; taxa de conversão: 2,5%; dias até retomar trânsito intestinal (mediana): três dias; dias de internamento (mediana): seis dias; taxa de complicações pós-operatórias: 20%, das quais 5% Clavien III e 0% Clavien IV/V; taxa de deiscência anastomótica: 2,5%; taxa de reintervenção: 2,5%; taxa de readmissão pós-alta: 1,3%; gânglios linfáticos ressecados (mediana): 20; taxa de ressecção R0: 100%; taxa de integridade mesorretal: 95,8% completo/quase completo.

Conclusão: Os nossos resultados mostram que a introdução da cirurgia colorretal robótica no nosso centro foi segura e garantiu resultados clínicos a curto prazo e histopatológicos semelhantes ou favoráveis face aos descritos na literatura.

Palavras-chave: Cirurgia Colorretal; Complicações Intraoperatórias; Complicações Pós-Operatórias; Procedimentos Cirúrgicos Robóticos

INTRODUCTION

Minimally invasive surgery has been progressively accepted worldwide since it was first described in 1991[1] and has been used as an alternative to the laparotomic approach for the treatment of colorectal pathology. Since then, several studies have shown that the laparoscopic approach is associated with shorter hospital stays, less morbidity and post-operative pain and a lower rate of long-term complications including incisional hernia and adhesions, without affecting oncological outcomes.[2,3] Therefore, this approach has become the first choice in many institutions.

However, its adoption in Western countries is still not widespread, estimated at around 30 to 50%.[4] Its use is even more limited in rectal surgery due to the restricted movement of the instruments in confined spaces, such as the pelvic cavity, and due to the demanding learning curve.

Since the first report by Weber in 2002,[5] there has been an increasing interest in robotic colorectal surgery, as shown by the increasing number of publications.

1. Unidade de Patologia Colorretal. Unidade Local de Saúde S. José. Lisboa. Portugal.
✉ **Autor correspondente:** Diogo Carrola Gomes. diogo.gomes@ulssjose.min-saude.pt
Recebido/*Received*: 23/05/2023 - **Aceite/*Accepted*:** 10/05/2024 - **Publicado/*Published*:** 01/07/2024

Robotic surgery brings some advances over the 'traditional' laparoscopic route, with significant advantages in terms of visualisation and intra-abdominal mobility of surgical instruments. The Da Vinci® systems (Intuitive Surgical Inc.) are currently the most widely used surgical robots, providing the surgeon with a stable platform, three-dimensional visualisation controlled by the surgeon and articulated instruments with seven degrees of freedom of movement.[4] These characteristics allow for more precise gestures than straight laparoscopic instruments, representing an advantage in restricted spaces. The benefits associated with the use of fluorescence-guided techniques, ergonomics and reduced musculoskeletal injuries for the surgical team are also worth considering.

The biggest disadvantage of the robotic approach are the costs of the initial purchase, consumables and equipment maintenance. To overcome this limitation, the advantages offered by the technology will have to be translated into validated and significant clinical gains.

In Portugal, the first platform has emerged in 2010 and was only available in private hospitals for around 10 years. By October 2019, a Da Vinci XI® system went into operation at the S. José Local Health Unit (ULS S. José), becoming the first surgical robot within the National Health Service. Since then, 850 patients have been treated with this platform in urology, general surgery, thoracic surgery and gynaecology.

This study was aimed at describing the initial experience with the surgical robot of the Colorectal Pathology Unit of the General Surgery department at ULS S. José, assessing the perioperative and histopathological outcomes and their comparison with literature.

METHODS

Study design

This was a descriptive observational study, based on a prospective database where data regarding the selected variables were systematically entered for patients aged 18 and older who underwent robotic laparoscopic colorectal surgery at the Colorectal Pathology Unit of ULS S. José.

ULS S. José is a tertiary hospital accredited by the Directorate-General for Health as a reference centre for the treatment of adult rectal cancer.

The three participating surgeons were experienced in minimally invasive surgery and were internationally certified to perform robotic surgery. They worked full-time in the treatment of colorectal pathology. Patient discharge criteria were defined, namely recovery of gastrointestinal transit, diet tolerance, mobilisation, pain control and no evidence of infectious or other complications.

Following the identification of all consecutive patients operated between November 2019 and October 2022, the database was converted into an anonymised version, and this was used to carry out the analysis.

Variables

The database was built in October 2019 using Microsoft® Access software version 2019. Data were obtained from the patients' electronic medical record, including:

1. Demographic data: patient's gender, age, body mass index (BMI) and preoperative American Society of Anesthesiologists (ASA) score
2. Operative variables: intraoperative blood loss, surgery duration (excluding the duration of anaesthesia), conversion to laparotomy and intraoperative complications
3. Postoperative variables: time to first postoperative stool, length of hospital stay, 30-day complications according to the Clavien-Dindo classification, rate of anastomotic dehiscence and 30-day readmission and reintervention rate
4. Histopathological characteristics of the surgical specimen: histological type, staging, degree of resection (R), number of resected lymph nodes, mesorectum integrity.

Technical approach

A Da Vinci XI® surgical robot (Intuitive Surgical, Inc) was used. All the surgeries were performed using single docking, except for the two operations involving synchronous liver resection, where double docking was required. Fluorescence angiography was obtained in all procedures for the assessment of the perfusion of the intestinal tops before their sectioning.

Intracorporeal anastomoses were completed, and colorectal anastomoses were performed laparoscopically after undocking the robot and proximal sectioning of the operative specimen.

Conversion was defined as any laparotomy or extension of the excision for any reason other than the extraction of the operative specimen.

Postoperative approach

Although there is no formal Enhanced Recovery After Surgery (ERAS) program at ULS S. José, all patients were treated according to the same postoperative management protocol. Clear fluid intake was started on postoperative day 1 and diet progressed daily according to the patient's tolerance.

Discharge criteria included: re-established bowel pattern, urine passage after catheter removal, body temperature < 38ºC, similar tolerance to oral diet as pre-admission, pain control with oral analgesics and adequate social support for convalescence and postoperative care.

Postoperative complications were ranked according to the Clavien-Dindo scale.

Statistical analysis

Microsoft® Excel software for Mac version 16 was used. Non-parametric variables were expressed as median (minimum-maximum).

Ethical considerations

The study's design was presented and approved by the Ethics Committee of the ULS S. José.

RESULTS

A total of 80 patients underwent surgery during the study period (Table 1) [47 male patients (59%)]. The median age was 70 (35 - 90) years and BMI 26 (18 - 45) kg/m^2. Most patients were ranked as ASA score II (53.7%) and III (41.3%).

Surgical indications included malignant or potentially malignant diseases in 97.6% of the patients, including 34 patients submitted to colectomy proximal to the splenic angle, 20 to distal colectomy and 26 to anterior resection of the rectum. The five patients presenting with adenocarcinoma of the rectum who underwent neoadjuvant chemoradiotherapy underwent simultaneous derivative ileostomy.

Table 1 – Patient characteristics and surgical indication (n = 80)

	n	%
Gender		
Male	47	58.8
Female	33	41.2
Age (median; years)	70 (35 - 90)	
BMI (median; kg/m^2)	26 (18 - 45)	
ASA score		
I	3	3.8
II	43	53.7
III	33	41.3
IV	1	1.3
Indication		
Unresectable adenoma	11	13.8
Adenocarcinoma	65	81.3
Neuroendocrine tumour	2	2.5
Diverticular disease	1	1.2
Crohn disease	1	1.2
Surgical procedure		
Right hemicolectomy	34	42.5
Left hemicolectomy	20	25.0
Anterior resection	26	32.5
Without derivative ileostomy	21	(26.3)
With derivative ileostomy	5	(6.2)

Two patients underwent synchronous resection of liver metastases, in collaboration with surgeons from the Hepato-Biliary-Pancreatic Surgery Unit at ULS S. José.

The perioperative outcomes are shown in Table 2. A median surgery duration of 300 (190 - 600) minutes has been found: right colectomy, 275 (210 - 390) minutes; left colectomy, 250 (190 - 360) minutes; anterior resection, 317 (220 - 420) minutes. The median estimated blood loss was 50 mL (50 - 300) and conversion to laparotomy was required in two patients (2.5% rate): the first due to suspected duodenal invasion and the second due to difficult progression during pelvic dissection. No intraoperative complications were found.

A median 3 (0 - 7) days to re-established bowel pattern has been found in all surgeries performed without a derivative stoma. Discharge criteria were met by most (75%) patients at postoperative D7.

Postoperative complications (< 30 days) have been found in 18.8% of the patients, 80% of low severity (Clavien I/II). A 2.5% overall rate of anastomotic dehiscence was found (both cases were Grade B). A 2.5% 30-day reoperation rate (incarcerated incisional hernia at the extraction incision and haemostasis revision) and a 1.3% post-discharge readmission rate (the case of incisional hernia) were found. There were no mortality cases.

Eleven patients (13.8%) presented with adenoma with low-grade or high-grade dysplasia. As regards the 67 patients who underwent surgery for adenocarcinoma and neuroendocrine tumour (83.8%), stage I/II was found in 65.7% of cases, stage III in 31.3% and stage IV in 3.0% (Table 3). The median number of resected lymph nodes was 20 (6 - 48) and the R0 resection rate was 100%. The mesorectum was ranked as complete/almost complete in 95.8% of anterior rectal resection specimens.

DISCUSSION

Similar short-term outcomes with robotic surgery to those of conventional laparoscopic surgery have been found in literature. The most significant benefits seem to exist in terms of conversion rate and functional outcomes (rate of urinary incontinence and impotence after rectal surgery).[6-10]

Different studies regarding laparoscopic surgery, including randomised studies such as COST and CLASSIC, have shown that conversion is associated with poorer oncological outcomes and more postoperative complications.[3,11-13] The conversion rate found in our study is in line with literature (0% - 12%), confirming a potential advantage of the robotic platform.[7,9-11]

A longer surgery duration than that described for the laparoscopic route has been found in our study, in line with literature.[7,10,11,14] These results should be integrated into the

learning curve of three surgeons at different stages of their training in robotic surgery. In addition, this increased duration did not translate into increased morbidity or poor postoperative outcomes.

The robotic platform makes surgical suture easier due to the greater mobility and articulation of the instruments. Intracorporeal anastomoses were always feasible in resections close to the splenic angle, leading to less postoperative ileus and smaller incisions for the extraction of the surgical specimen, with less postoperative pain and risk of incisional hernia.[15]

There were no intraoperative complications. The 2.5% overall anastomotic dehiscence rate was slightly better than the rates of 2.8% - 11.1% described in literature,[7,8,11,14] which

Table 2 – Perioperative and short-term clinical outcomes (n = 80)

	n	%
Surgery duration (median, minutes)	300 (190 - 600)	
Right hemicolectomy	275 (210 - 390)	
Left hemicolectomy/sigmoidectomy	250 (190 - 360)	
Anterior resection	317 (220 - 420)	
Estimated blood loss (median, mL)	50 (50 - 300)	
Conversion to laparotomy	2	2.5
Suspected duodenal invasion	1	
Difficulty in progression during pelvic dissection	1	
Intraoperative complications	0	0.0
Time to first bowel movement (median, days)	3 (0 - 7)	
Right hemicolectomy	3 (1 - 7)	
Left hemicolectomy/sigmoidectomy	3 (1 - 6)	
Anterior resection (without derivative procedure)	3 (1 - 7)	
Length of stay (median, days)	6 (4 - 37)	
Right hemicolectomy	6 (5 - 18)	
Left hemicolectomy/sigmoidectomy	6 (4 - 26)	
Anterior resection	7 (5 - 37)	
Length of stay ≤ 7 days	60	75.0
30-day mortality	0	0.0
30-day readmission	1	1.3
30-day reoperation	2	2.5
Hemoperitoneum	1	1.3
Incarcerated incisional hernia	1	1.3
Morbidity (Clavien-Dindo)	15	20.0
Grade I	4	5.0
Grade II	8	10.0
Grade III	3	5.0
Grade IV	0	0.0
Anastomotic dehiscence	2	2.5

Table 3 – Histology (n = 78)

	n	%
Histological type		
Colon adenoma	9	11.5
Rectum adenoma	2	2.6
Colon adenocarcinoma	42	52.6
Rectum adenocarcinoma	24	30.8
Neuroendocrine tumour (ileocecal valve)	2	2.6
p/TNM (AJCC 8th ed) **– Colon** (n = 43)		
T1	10	23.3
T2	10	23.3
T3	17	39.5
T4	6	14.0
N0	32	74.4
N1	11	25.6
N2	0	0.0
M0	42	97.7
M1	1	2.3
Stage I	20	46.5
Stage II	11	25.6
Stage III	11	25.6
Stage IV	1	2.3
R0 resection rate	43	100.0
Resected lymph nodes (median)	22 (12 - 49)	
p/ypTNM (AJCC 8th ed) **– Rectum** (n = 24)		
T0	1	4.2
T1	5	20.8
T2	3	12.5
T3	13	54.2
T4	2	8.3
N0	12	50.0
N1	8	33.3
N2	4	16.7
M0	23	95.8
M1	1	4.2
Stage I	7	29.2
Stage II	4	16.7
Stage III	12	50.0
Stage IV	1	4.2
R0 resection rate	24	100.0
Resected lymph nodes (median)	21 (6 - 35)	
Mesorectum integrity		
Complete/almost complete	23	95.8
Incomplete	1	4.2

may be related to the systematic use of fluorescence angiography with indocyanine green, with real-time visualisation of tissue perfusion and greater objectivity in the selection of the bowel resection sites.[16]

No dehiscence occurred following right or left hemicolectomy. Two patients presented with dehiscence of colorectal anastomosis after anterior resection, a rate of 7.7% compared to the 8% - 11% described for this type of anastomosis. Both were grade B: one was treated with a diet break, parenteral nutritional support, and antibiotic therapy, without the need for bypass surgery; in the other case, a derivative ileostomy had been performed, so it was delt using transanal vacuum dressings.

Similar lengths of stay, readmission rates and reintervention rates to those described in literature have been found.[7,10,11,14] The morbidity rate was low and there was no mortality, showing the safety and efficacy of this approach.

As regards histopathology, the quality of the surgical specimens and the number of resected nodes is crucial to ensure good long-term oncological outcomes. Most studies have shown no significant differences in the number of resected nodes and the R0 resection rate.[7,10,11,14] Our results showed a similar number of resected nodes and a favourable R0 resection rate and mesorectum integrity when compared to literature.

The limitations of our study are mainly related to the observational and descriptive design of short-term outcomes, and the small number and heterogeneity of our group of patients. The follow-up time for patients diagnosed with adenocarcinoma is, in most cases, less than two years, which is why the analysis of survival and disease-free interval was not carried out.

Subsequent studies should be focused on long-term clinical outcomes and the comparison between laparotomy and laparoscopic approaches.

CONCLUSION

The introduction of the robotic approach in colorectal surgery was safe and led to favourable clinical and histopathological outcomes.

ACKNOWLEDGMENTS

The authors wish to acknowledge Maria José Pinheiro, Maria Manuel Botelho and Mário Mendes for their collaboration in the recruitment of the participants in the study, as well as in patients' care.

AUTHOR CONTRIBUTION

DCG, IP: Conception, writing and critical revision of the final version of the manuscript.

RAN, SR, JP: Critical revision and approval of the final version of the manuscript.

HUMAN AND ANIMAL PROTECTION

The authors declare that this project complied with the regulations that were established by the Ethics and Clinical Research Committee, according to the 2013 update of the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

DCG has received support from Excellence Robotics for the participation in the Da Vinci Technology Training Pathway in November 2020. The other authors declare that they have no conflicts of interest related to this work.

FINANCIAL SUPPORT

The authors declare that there was no financial support in writing this manuscript.

REFERENCES

1. Blackmore AE, Wong MT, Tang CL. Evolution of laparoscopy in colorectal surgery: an evidence based review. World J Gastroenterol. 2014;20:4926-33.
2. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, et al. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. Lancet. 2005;365:1718-26.
3. Green BL, Marshall HC, Collinson F, Quirke P, Guillou P, Jayne DG, et al. Long-term follow-up of the Medical Research Council CLASICC trial of conventional versus laparoscopically assisted resection in colorectal cancer. Br J Surg. 2013;100:75-82.
4. Gazala MA, Wexner SD. Re-appraisal and consideration of minimally invasive surgery in colorectal cancer. Gastroenterol Rep. 2017;5:1-10.
5. Weber PA, Merola S, Wasielewski A, Ballantyne GH. Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. Dis Colon Rectum. 2002;45:1689-96.
6. Tschann P, Szeverinski P, Weigl MP, Rauch S, Lechner D, Adler S, et al. Short-and long-term outcome of laparoscopic-versus robotic-assisted right colectomy: a systematic review and meta-analysis. J Clin Med. 2022;11:238.
7. Jayne D, Pigazzi A, Marshall H, Croft J, Corrigan N, Copeland J, et al. Effect of Robotic-Assisted vs Conventional Laparoscopic Surgery on Risk of Conversion to Open Laparotomy Among Patients Undergoing Resection for Rectal Cancer: The ROLARR Randomized Clinical Trial. JAMA. 2017;318:1569-80.
8. 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. 2018;97:e11817.
9. Phan K, Kahlaee HR, Kim SH, Toh JW. Laparoscopic vs. robotic rectal cancer surgery and the effect on conversion rates: a meta-analysis of randomized controlled trials and propensity-score-matched studies. Tech Coloproctol. 2019;23:221-30.
10. Gómez Ruiz M, Lainez Escribano M, Cagigas Fernández C, Cristobal Poch L, Santarrufina Martínez S. Robotic surgery for colorectal cancer. Ann Gastroenterol Surg. 2020;4:646-51.
11. Ramji KM, Cleghorn MC, Josse JM, MacNeill A, O'Brien C, Urbach D, et al. Comparison of clinical and economic outcomes between robotic, laparoscopic, and open rectal cancer surgery: early experience at a

tertiary care center. Surg Endosc. 2016;30:1337-43.
12. Fleshman J, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW, et al. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. Ann Surg. 2007;246:655-62.
13. Jayne DG, Thorpe HC, Copeland J, Quirke P, Brown JM, Guillou PJ. Five-year follow-up of the Medical Research Council CLASICC trial of laparoscopically assisted versus open surgery for colorectal cancer. Br J Surg. 2010;97:1638-45.
14. Park JS, Choi GS, Park SY, Kim HJ, Ryuk JP. Randomized clinical trial of robot-assisted versus standard laparoscopic right colectomy. Br J Surg. 2012;99:1219-26.
15. Creavin B, Balasubramanian I, Common M, McCarrick C, el Masry S, Carton E, et al. Intracorporeal vs extracorporeal anastomosis following neoplastic right hemicolectomy resection: a systematic review and meta-analysis of randomized control trials. Int J Colorectal Dis. 2021;36:645-56.
16. Martínez-López E, Martínez-Pérez A, Navarro-Martínez S, Sebastián-Tomás JC, de'Angelis N, García-Granero E. Real-time fluorescence image-guided gastrointestinal oncologic surgery: towards a new era. World J Gastrointest Oncol. 2021;13:1029-42.