

Reviewing the Comparison of Robotic Colectomy with the Laparoscopic Ones of All the Procedures based on Determined Parameters

¹Michail A Kirmanidis, ²Christodoulos Keskinis

ABSTRACT

Aim: The purpose of our systematic review is to clarify the current data in the domain of colorectal surgery regarding minimally invasive surgery (MIS).

Introduction: Two new methods have been recently introduced in the MIS arena. Most of the studies are in favor of robotic surgery (RS), whereas the literature lacks statistically significant results.

Results: Totally, only 19 articles fulfilled the prerequisites and our research was mainly based on meta-analyses. Some parameters were established, in order to investigate the oncologic and clinical outcomes. Heterogeneity is the existing condition, which means that robotics is more beneficial than laparoscopic surgery in some parameters in a specific procedure and the opposite.

Conclusion: There is no clear conclusion in the literature whether RS is indeed more advantageous than laparoscopic ones, so it is recommended that long-term meta-analyses and reviews be conducted, in order to specify the effectiveness of each method in every surgical procedure.

Clinical significance: It would be really beneficial for the patients to be informed in detail of the clinical and oncologic outcomes for each method.

Keywords: Colorectal malignancies, Comparison, Laparoscopic, Robotic, Surgery, Systematic review.

How to cite this article: Kirmanidis MA, Keskinis C. Reviewing the Comparison of Robotic Colectomy with the Laparoscopic Ones of All the Procedures based on Determined Parameters. *World J Lap Surg* 2017;10(2):61-65.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Two different main surgical methods are emerging in the field of minimally invasive surgery (MIS) over the past 20 years and they are being applied in colorectal

domain.¹⁻⁸ Laparoscopic surgery (LS) for colon cancer has a wide use due to its beneficial properties and has prevailed compared with open surgery.⁹⁻¹⁵ However, robotic surgery (RS) has been recently introduced as a new contemporary alternative because of its obvious advantages, including the three-dimensional view, the ability to use multidegree-of-freedom forceps, the elimination of physiological tremors, and the stable camera control, in order to broaden the horizons of MIS.^{3-5,16-19} Initially, it was expected that RS would dominate the field of MIS related to colorectal surgery because of its obvious structural advantages and due to the limited space in the pelvis for the laparoscopic instruments and the restricted potential of movements even for an experienced surgeon to perform rectal dissection.³ However, it seems that there is no clear-cut answer in the literature determining the beneficial use of RS over LS in the field of colorectal cancer.^{20,21} In our review, we present the data regarding the use of both methods in the domain of colorectal surgery regarding all the surgical techniques. According to the New York Statewide Planning and Research Cooperative System administrative data, colectomy is one of the five most common laparoscopic procedures between 2008 and 2012, so a comparison between the laparoscopic and robotic colectomy is a matter of big significance and has to be clearly underscored.²² The first robotic colectomy was reported in 2002, and the use of robotic procedures has been increasing since then, while it has a more extensive use in the field of urology.^{3,17,23,24} This is a retrospective comprehensive review of various publications comparing these two methods of surgical procedures separately and taking into consideration plenty of parameters, such as the clinical and the oncologic outcomes and how they can be affected, the body mass index (BMI), the total mean hospital costs for each procedure, and postoperative complications. Only studies that had classified their patients with similar criteria were taken into consideration (gender, BMI, American Society of Anesthesiologists [ASA] score, tumor location, previous abdominal surgery).

RESULTS

The review was built-up by downloading various articles regarding laparoscopic and robotic colectomy from

¹Surgeon, ²Intern

^{1,2}Department of General Surgery, General Hospital of Drama Drama, Greece

Corresponding Author: Michail A Kirmanidis, Surgeon Department of General Surgery, General Hospital of Drama, Drama, Greece, Phone: +00302521350412, e-mail: mihaliskirmanidis@yahoo.gr

search engines like PubMed, MEDLINE, and so forth. “Laparoscopic vs robotic colectomy” and “comparing laparoscopic with robotic colectomy” were the search keywords that were used to find the publications that would conduct our research, and publications until March of 2016 were included. Our review contains retrospective studies, comparative studies, and meta-analyses. Only papers relevant to the laparoscopic and robotic colectomy have been taken into consideration in this review, focusing on the parameters mentioned above and also on the learning curve of young novice surgeons. Articles which compared the two methods with a separate specific surgical procedure, such as right colectomy are included, and reviewed and articles which do not classify the procedures separately are reviewed as well. Totally, 19 studies were reviewed.

At first, there were 56 articles related to our scientific interest identified after a long database search, but 10 of them were excluded after reading the abstract. Twenty-one of the remaining 46 records were excluded due to lack of full texts. Six more papers were excluded because they mentioned the comparison between hybrid robotic-assisted laparoscopy colectomy and conventional colectomy. The rest 19 papers were assessed for eligibility, screened in detail, and included in our review. Retrospective comparative studies and meta-analyses are the majority of the articles in our review. More importance is given to the findings of the meta-analyses due to their reliability. Heterogeneity can be found in the literature whether or not RS is indeed superior to LS in the colorectal field.²¹ Total operative time, estimated blood loss (EBL), conversion to open procedure, length of hospital stay (LOS), readmission rate, number of lymph nodes harvested, time to return of bowel function, time of initiation of soft diet, and perioperative complications are the main clinicopathologic and oncologic parameters that have been extensively assessed in our review (Flow Chart 1).

Ferrara et al² mention that there are no differences between right, left, and rectal robotic colectomy and respective laparoscopic procedures in terms of mentioned parameters. In fact, RS shows larger number of harvested lymph nodes, while LS seems to have lower conversion rate (7.1% for robotics and 3.4% for laparoscopy) and operative time, but the results are not statistically significant.²

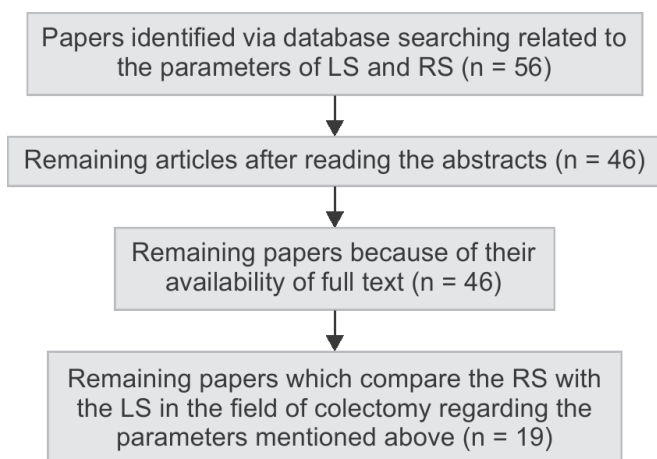
Comparison between RS and LS in the Field of Left Colon and/or Rectal Resections

A matched case–control study indicates that there are no different short-term outcomes between the two methods regarding left-sided and rectal resections.³ The EBL, the need for open conversion, complications (anastomotic leakage, ileus, and wound infections), flatus passage, LOS, and the number of retrieved lymph nodes presented no significant difference, except for the operative time which was significantly longer in the RS colectomy.³ On the contrary, a recent meta-analysis conducted by Sun et al²⁵ shows that robotic low anterior resection (R-LAR) for rectal cancer is proven to be more beneficial for LOS, the conversion to open surgery, the circumferential margin involvement, and the overall complications than the laparoscopic low anterior resection (L-LAR), whereas there was no difference regarding the operative time, the number of lymph nodes removed, and the return of bowel function.²⁵

Comparison of RS with the LS in the Field of Right Colon Resections

Because robotic right colectomy (RRC) and laparoscopic right colectomy (LRC) are less complicated as a surgical procedure than rectal resection due to the anatomy of the human body, there are fewer studies comparing these two methods with right colectomy.¹⁷ We included three meta-analyses in our research.^{4,7,17} Cumulatively, these three studies include 30 comparative studies, in which 1,322 patients underwent RRC and 4,185 were treated with LRC. The first one was recently conducted from the Surgery Department of Sapienza University and compared the indications, surgical and oncologic outcomes, and costs of RRC with the LRC ones.¹⁷ The EBL, the conversion to open procedure, the number of retrieved lymph nodes were similar in both of them.¹⁷ Unimportant statistical differences were presented regarding LOS and the overall complications.¹⁷ The RRC entails more expenses than LRC, although the difference is still not statistically important.¹⁷ On the contrary, the second meta-analysis which had the larger statistical sample was conducted by Trinh et al⁴ and yielded the following outcomes. No significant difference was spotted regarding the harvested lymph nodes, the bowl function, the

Flow Chart 1: Literature research



days to soft diet, the LOS, the hospital readmission, and the postoperative complications.⁴ Based on this meta-analysis, the robotic approach showed longer operating times, less EBL, and a higher rate of conversion to an open procedure compared with that of LS.⁴ Xu et al⁷ considered in their meta-analysis which showed that RRC involves longer operative times, lower EBL, shorter LOS, lower overall complications, and, importantly, faster bowel function recovery. The rest clinical and oncological results seem to not have any statistical difference.⁷

A newly comparative study by Cardinali et al²⁶ indicates that RRC appears to have some advantages over the LRC like the lower time of first flatus, but it does not offer any benefit in obese patients due to the fact that both methods perform no significant difference in the conversion rate. Another comparative study points out that the RS could also shorten the learning curve, in case the respective strict protocols are applied.¹

DISCUSSION

In the field of colorectal cancer, LS and RS are both considered almost equally safe and effective methods, proving that radical prostatectomy was only the beginning of consolidation of RS and the use of RS can be more widespread.^{3,7,17,24,26} Our research focuses on the conventional laparoscopy and the RS as separate surgical methods and does not include their hybrid use. The confirmation of the existing heterogeneity between these two new surgical methods involves our reviewed parameters along with the clinicopathological, oncological, and financial ones. The accurate choice of these criteria was accomplished after a careful, long research via recent meta-analyses, control and statistically reliable comparative studies.^{1,3,7,16,17,20,25} Mainly, meta-analyses were reviewed due to their credibility compared with other studies, which are reviewed and included in our manuscript. More specifically, the criteria are presented in Table 1, but the research contains the rectal and left-sided colon resections as well.

Pelvis is the anatomical section of the human body where RS can be applied with its maximum benefits according to its adopters, but controversial studies' results came up through our research. Studies which did not end up with this conclusion were reviewed, but the most statistically reliable meta-analysis, the one by Sun et al,²⁵ clarifies the advantages of R-LAR over L-LAR for the LOS as mentioned earlier. Another randomized controlled study is in favor of the adoption of RS in rectal surgery, but tempers the encouraging conclusion from the former meta-analysis.³ The main reason why RS seems to be a more promising tool in the pelvis is because of the absence of the tremor, which implies less EBL and makes

Table 1: Presentation of each one of the three meta-analyses for every parameter

Parameters	1st Meta-analysis	2nd Meta-analysis	3rd Meta-analysis
Operative time	Yes	Yes	Yes
EBL	No	Yes	Yes
Conversion to open procedure	No	Yes	No
Number of retrieved lymph nodes	No	No	NA
LOS	No	No	Yes
Overall complications	No	No	Yes
Financial expenses	No	NA	NA
Bowel function	NA	No	Yes
Days of soft diet	NA	No	NA
Hospital readmission	NA	No	NA
Circumferential margin involvement	NA	NA	NA

The meta-analyses are numbered according to their order in the text; NA: Not applicable

it easier to avoid the trauma to the nerves related to the sexual and urinary functions.²⁷ Fabrizio Luca presented a paper in the 5th Congress of the Clinical Robotic Surgery Association (CRSA) and mentioned that RS can enhance the nerve-sparing results of total mesorectal excision related to LS method regardless of the gender.²⁸ However, during the paper's discussion some doubts were posed about the preoperative reliability of the evaluation of these specific functions (urinary and sexual), so that they become more standardized in the future.

Undoubtedly, right colectomy is a less complicated procedure than rectal resection, but the use of both RS and LS has also been reviewed thoroughly. Two of the three recent meta-analyses concluded that there are some statistical differences between the RRC and the LRC in some of our parameters. Both studies agree that RRC is a longer procedure than LRC and that the EBL is less in the RRC. Huirong Xu et al⁷ deem that LOS, the overall complications, and the bowel function differ between the two methods in an important way, whereas the other respective meta-analysis' results are considered controversial. The results of these three meta-analyses are summarized in Table 1 and the "YES" and "NO" are used as the answers to the question: "Is there a statistically significant result between the RRC and LRC regarding to a specific parameter each time?" while the choice "not available (NA)" is used for whether or not in this particular meta-analysis the mentioned appearing parameter is included.

In the CRSA Fifth Worldwide Congress in Washington DC from 3 to 5 October 2013, a controlled randomized trial ended up with the conclusion that RRC has no significant difference with the LRC and due to its expenses it should not be frequently used.²⁸

The intro of a learner in the MIS can be easier for the RRC than LRC in a specific center with rigorous protocols,

which can be explained once more due to some of the structural advantages of the RS like the three-dimensional view, for instance.²⁹ But, acceptable outcomes can be fulfilled with simultaneously practical exercise.²⁹

CONCLUSION

It is common even for meta-analyses reviewing the same parameters to present contradictory results in the literature. As a result, we conclude that the benefits from the RS in all the procedures related to colorectal cancer are currently under scientific investigation. Hopefully, the benefits will be more clearly defined in the near future. We suggest for more standardized controlled studies and meta-analyses to be performed in the future, as to evaluate the current data and the long-term outcomes of our parameters. The heterogeneity was more obvious in the right colectomy procedure than in the others, but all the results should be better stabilized.

CLINICAL SIGNIFICANCE

In fact, it is very crucial to establish whether the RS is more beneficial than the LS or the opposite. Patients with morbidity factors would have to be aware of the positive aspect of each method for every procedure.

REFERENCES

1. Formisano G, Misitano P, Giuliani G, Calamati G, Salvischiani L, Bianchi PP. Laparoscopic versus robotic right colectomy: technique and outcomes. *Updates Surg* 2016 Mar;68(1):63-69.
2. Ferrara F, Piagnerelli R, Scheiterle M, Di Mare G, Gnoni P, Marrelli D, Roviello F. Laparoscopy versus robotic surgery for colorectal cancer: a single-center initial experience. *Surg Innov* 2016 Aug;23(4):374-380.
3. Sawada H, Egi H, Hattori M, Suzuki T, Shimomura M, Tanabe K, Okajima M, Ohdan H. Initial experiences of robotic versus conventional laparoscopic surgery for colorectal cancer, focusing on short-term outcomes: a matched case-control study. *World J Surg Oncol* 2015 Mar;13:103.
4. Trinh BB, Jackson NR, Hauch AT, Hu T, Kandil E. Robotic versus laparoscopic colorectal surgery. *JLS* 2014 Oct;18(4):e2014.00187.
5. Trinh BB, Hauch AT, Buell JF, Kandil E. Robot-assisted versus standard laparoscopic colorectal surgery. *JLS* 2014 Oct-Dec;18(4):e2014.00154.
6. Zeng WG, Zhou ZX. Mini-invasive surgery for colorectal cancer. *Chin J Cancer* 2014 Jun;33(6):277-284.
7. Xu H, Li J, Sun Y, Li Z, Zhen Y, Wang B, Xu Z. Robotic versus laparoscopic right colectomy: a meta-analysis. *World J Surg Oncol* 2014 Aug;12:274.
8. Baek SJ, Kim SH, Cho JS, Shin JW, Kim J. Robotic versus conventional laparoscopic surgery for rectal cancer: a cost analysis from a single institute in Korea. *World J Surg* 2012 Nov;36(11):2722-2729.
9. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. *N Engl J Med* 2004 May;350(20):2050-2059.

10. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, Heath RM, Brown JM; MRC CLASICC trial group. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. *Lancet* 2005 May;365(9472):1718-1726.
11. Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Bonjer HJ, Haglind E, Pahlman L, Cuesta MA, Msika S, et al. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. *Lancet Oncol* 2005 Jul;6(7):477-484.
12. Kang SB, Park JW, Jeong SY, Nam BH, Choi HS, Kim DW, Lim SB, Lee TG, Kim DY, Kim JS, et al. Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial): short-term outcomes of an open-label randomised controlled trial. *Lancet Oncol* 2010 Jul;11(7):637-645.
13. Leung KL, Kwok SP, Lam SC, Lee JF, Yiu RY, Ng SS, Lai PB, Lau WY. Laparoscopic resection of rectosigmoid carcinoma: prospective randomised trial. *Lancet* 2004 Apr;363(9416):1187-1192.
14. Lezoche E, Feliciotti F, Paganini AM, Guerrieri M, De Sanctis A, Minervini S, Campagnacci R. Laparoscopic vs open hemicolectomy for colon cancer. *Surg Endosc* 2002 Apr;16(4):596-602.
15. Fleshman J, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW Jr, Hellinger M, Flanagan R Jr, Peters W, Nelson H, 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 Oct;246(4):655-662.
16. Pai A, Marecik SJ, Park JJ, Melich G, Sulo S, Prasad LM. Oncologic and clinicopathologic outcomes of robot-assisted total mesorectal excision for rectal cancer. *Dis Colon Rectum* 2015 Jul;58(7):659-667.
17. Petrucciani N, Sirimarco D, Nigri GR, Magistri P, La Torre M, Aurello P, D'Angelo F, Ramacciato G. Robotic right colectomy: a worthwhile procedure? Results of a meta-analysis of trials comparing robotic versus laparoscopic right colectomy. *J Minim Access Surg* 2015 Jan-Mar;11(1):22-28.
18. Yu HY, Friedlander DF, Patel S, Hu JC. The current status of robotic oncologic surgery. *CA Cancer J Clin* 2013 Jan;63(1):45-56.
19. Wedmid A, Llukani E, Lee DI. Future perspectives in robotic surgery. *BJU Int* 2011 Sep;108(6 Pt 2):1028-1036.
20. Trastulli S, Farinella E, Cirocchi R, Cavaliere D, Avenia N, Sciannameo F, Gullà N, Noya G, Boselli C. Robotic resection compared with laparoscopic rectal resection for cancer: systematic review and meta-analysis of short-term outcome. *Colorectal Dis* 2012 Apr;14(4):e134-e156.
21. Baek SK, Carmichael JC, Pigazzi A. Robotic surgery: colon and rectum. *Cancer J* 2013 Mar-Apr;19(2):140-146.
22. Altieri MS, Yang J, Telem DA, Zhu J, Halbert C, Talamini M, Pryor AD. Robotic approaches may offer benefit in colorectal procedures, more controversial in other areas: a review of 168,248 cases. *Surg Endosc* 2016 Mar;30(3):925-933.
23. Weber PA, Merola S, Wasielewski A, Ballantyne GH. Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. *Dis Colon Rectum* 2002 Dec;45(12):1689-1694.
24. Sandoval Salinas C, González Rangel AL, Cataño Cataño JG, Fuentes Pachón JC, Castillo Londoño JS. Efficacy of robotic-assisted prostatectomy in localized prostate cancer: a systematic review of clinical trials. *Adv Urol* 2013;2013:105651.

25. Sun Y, Xu H, Li Z, Han J, Song W, Wang J, Xu Z. Robotic versus laparoscopic low anterior resection for rectal cancer: a meta-analysis. *World J Surg Oncol* 2016 Mar;14:61.
26. Cardinali L, Belfiori G, Ghiselli R, Ortenzi M, Guerrieri M. Robotic versus laparoscopic right colectomy for cancer: short-term outcomes and influence of body mass index on conversion rate. *Minerva Chir* 2016 Aug;71(4):217-222.
27. Scarpinata R, Aly EH. Does robotic rectal cancer surgery offer improved early postoperative outcomes? *Dis Colon Rectum* 2013 Feb;56(2):253-262.
28. Bianchi PP, Pigazzi A, Choi GS. Clinical Robotic Surgery Association fifth worldwide congress, Washington DC, 3 to 5 October 2013: robotic colorectal surgery. *Ecancermedicalsecience* 2014 Jan;8:385.
29. Melich G, Hong YK, Kim J, Hur H, Baik SH, Kim NK, Sender Liberman A, Min BS. Simultaneous development of laparoscopy and robotics provides acceptable perioperative outcomes and shows robotics to have a faster learning curve and to be overall faster in rectal cancer surgery: analysis of novice MIS surgeon learning curves. *Surg Endosc* 2015 Mar;29(3):558-568.