



Robotic Complete Mesocolic Excision: A Systematic Review of the Literature

Ilektra Kyrochristou^{1,2*}, Eleftherios Spartalis^{2,3}, Georgios Anagnostopoulos¹, Georgios Lampropoulos¹, Gerasimos Tsourouflis^{2,3}, Dimitrios Dimitroulis^{2,3} and Nikolaos I Nikiteas^{2,3}

¹2nd Department of Surgery and Vascular Surgery Unit, General Hospital of Nikaia and Piraeus "Agios Panteleimon", Athens, Greece

²Hellenic Minimally Invasive Surgery Study Group (MIRS), Greece

³2nd Department of Propedeutic Surgery, National and Kapodistrian University of Athens, Medical School, Athens, Greece

Abstract

Aim: Complete Mesocolic Excision (CME) consists of the complete removal of tumor-bearing soft tissues enveloped by the mesocolic fascia and radical lymphadenectomy at the origin of feeding vessels. We conducted a systematic review, evaluating the efficacy of the Robotic CME (RCME) in patients with right-sided colon cancer and we attempted a comparison it to the gold standard procedure, the open RC with CME.

Method: MEDLINE-PubMed, Cochrane Library, UpToDate, and Trip databases were searched for published and unpublished material.

Results: Twenty articles were found to refer in CME, 9 of which met the selection criteria following the PRISMA Guidelines. All researchers presented short-term outcomes and agreed on the oncologic safety of CME.

Conclusion: Since current studies on the RCME do not provide long-term oncologic results, more data are needed to establish it as a standard of care in the surgical treatment of right sided colon cancer.

Keywords: Complete mesocolic excision; Robotic right colectomy; Colon cancer

Introduction

Through the past years, robots have altered the landscape of general surgery in various matters, achieving satisfying oncologic outcomes with less surgery-related morbidities. However, several decades after the dawn of minimally invasive surgery, robotic colectomies remain a matter of controversy. Complete Mesocolic Excision (CME) consists of the complete removal of tumor-bearing soft tissues enveloped by the mesocolic fascia and radical lymphadenectomy at the origin of feeding vessels. Technical advances, including a reliable lymph node dissection along the central vascular trunk, are being studied.

Due to the limited research data upon the matter, CME has not yet been a standardized procedure during right colectomy, although it has so far demonstrated better outcomes in terms of OS (Overall Survival) and DFS (Disease-Free Survival).

During the thriving of minimal invasive and the robotic era the need of changing our everyday practice from the standard open procedures to the new robotic ones seems mandatory. Unfortunately, few data is published supporting a trend to robotic surgery.

Our goal was to conduct a systematic review, evaluating the efficacy of the robotic CME in patients with right-sided colon cancer. More specifically, based on the current data, we attempted to compare the RRC with RCME, to the gold standard procedure, the open RC with CME.

Materials and Methods

Search methods

The purpose of the study was to collect all data regarding the Robotic Complete Mesocolic Excision (RCME) in the context of Robotic Right Colectomy (RRC) for colon cancer. MEDLINE-PubMed, Cochrane Library, UpToDate and Trip were searched for published and unpublished

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*Correspondence:

Ilektra Kyrochristou, 2nd Department of Surgery and Vascular Surgery Unit, General Hospital of Nikaia and Piraeus "Agios Panteleimon", Sofokli Venizelou 26A, Agioi Anargyroi, Attiki, Athens, Greece, Tel: 00302102619642/00306989290934; E-mail: electra.cyro@gmail.com

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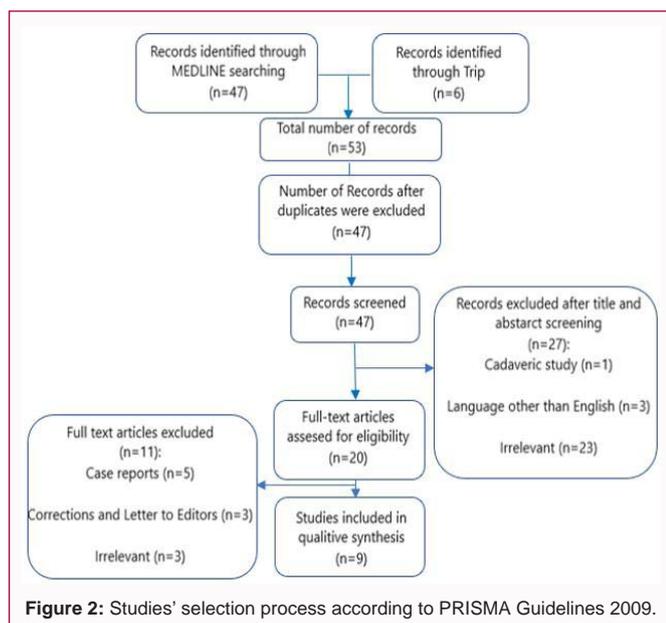
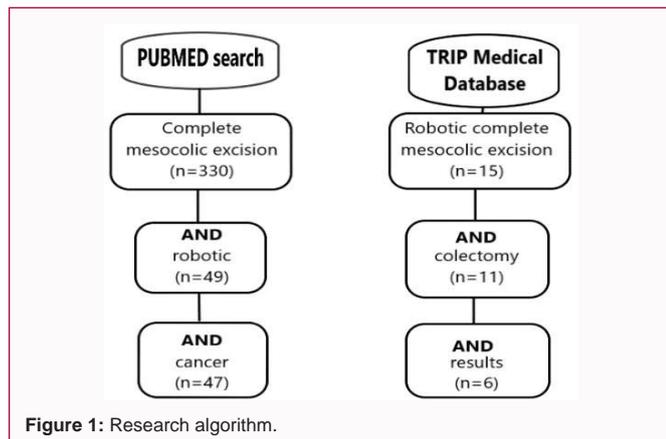
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material. The research algorithm is presented in Figure 1.

The total number of references for complete mesocolic excision was 53, with 9 of them being included in the qualitative synthesis of the review (Figure 2). The search took place in February of 2020.

Study selection

All studies that presented a series of patients who underwent RRC and CME for colon cancer were evaluated ($n=47$) following the PRISMA guidelines. Articles only mentioning the method or quoting individual results in the context of different studies were excluded ($n=23$). Finally, 22 articles were found to describe RCME. Articles in other languages and case reports were ruled out ($n=3$). No reviews or metaanalysis were found concerning the topic of RCME in RRC.

Ten articles were finally selected [1-10]. Two of them were considered as possible duplicates as they were written by the same leading author and described almost identical series of patients within the same period. Therefore, the most recent one was selected and included in the review [6]. One article presented two groups of patients that both underwent RRC with CME, although through different surgical approaches [8]. Those groups were considered separately in the review, as independent series. One of the articles compared the RCME to the LCME [6] (Laparoscopic Complete Mesocolic Excision) (Figure 2).

Results

Overall, 9 articles contained series of patients who underwent RRC with RCME (Table 1).

All authors provided common demographics of their patients including sex, age, BMI and ASA Score (8/10 studies). In total 365 patients were included in the studies, with a mean age of 68.7 (± 2.746) years old and a mean BMI of 26.04 (± 1.211).

Most patients demonstrated an ASA Score of 2, while for two of the studies no data were given (Table 2). All writers apart from Shulte am Esch et al. [8] provided information about the specimen length and tumor site (Table 3). Most common site was the ascending colon, while the patients included in the studies were mostly stage III, although in some cases only the clinical T stage was provided [1,7]. Clinical information such as hospital stay, time to first flatus and to consumption of light diet were similar in all studies (Table 4).

The exclusion criteria were not mentioned in all studies, however most researchers excluded all cases of urgent surgery (bowel perforation or obstruction), as well as synchronous primary cancer or hereditary cancerous conditions (familial adenomatosis, hereditary non polyposis colon cancer). It is worth mentioning that Trastulli et al. [2]. Although choosing to exclude patients with “locally invasive neoplasm” or “a tumor diameter greater than 7 cm”, included Stage IV patients, implying that they proceeded to surgery, even of patients with lymph node of distal metastasis. The three articles which presented a different surgical approach other than the mainstream CME [8,9,10] did not provide their exclusion criteria, probably because the authors wished to highlight the feasibility, safety and efficacy of the new approach, rather than present an oncological clinical series.

Oncologic safety

In the matters of oncologic safety of the procedure all authors agreed that an R0 resection was feasible and a safe oncological result could be accomplished, regardless the surgical approach. With median specimen lengths ranging from 21 cm to 40 cm, the range of the dissected piece mostly represented the radical approach of the individual surgeon. However, differences in the proximal and distal margin selection were not justified among writers (Table 3).

Lymph node yield

The median number of lymph nodes ranged from 12 to 43, thus implying that CME has not yet been standardized as a procedure. As Ozben et al. [4] proposed, in elective series of patients undergoing an extended right colectomy, one can identify the surgery itself as a probable contributing factor to the significantly higher lymph node count, in comparison to the rest of the studies. To assess the adequacy of the harvested lymph nodes though, long term oncological results are needed, therefore further investigation is necessary (Table 3).

Postoperative complications

Postoperative complications were classified using the Clavien Dindo System (Appendix), and most of them concerned low grade (I & II) complications. Occasionally more severe complications were identified including intestinal bleeding requiring blood transfusion, cirrhotic ascites, chyle leakage, anastomotic leakage and pleural effusion (Table 5,6).

Overall, 78 (21.4%) complications occurred, most of them were Clavien Dindo II ($n=46$, 12.6%), while only one death was reported.

Table 1: Studies included in the review.

Author	Type of study	Study Period	Study's goal	Number of Patients
Peutz et al. [1]	prospective	2016-2017	Suprapubic RRC and CME: oncologic safety, short-term outcomes	20
Trastulli et al. [2]	prospective	2011-2012	RRC with CME: short-term outcomes	20
Bae et al. [3]	retrospective	2008-2016	Robotic mCME and CVL: feasibility, mid-term oncologic outcomes	43
Ozben et al. [4]	retrospective	2015-2017	RCME short term outcomes	37
Yozgatli et al. [5]	prospective	2015-2017	RCME vs Conventional LH: short term outcomes' comparison	35
Spignolio et al. [6]	prospective	2005-2015	RRC with CME Long-Term Oncologic Outcomes	101
Schulte am Esch et al. BTU group [8]	retrospective	2016-2018	Suprapubic bottom up approach CME Short term outcomes	24
Schulte am Esch et al. MTL group [8]	retrospective	2016-2018	Suprapubic bottom up approach CME Short term outcomes	7
Hamzaoglu et al. [9]	prospective	2015-2017	RCME short-term outcomes	12
Yang et al. [10]	prospective	2016-2018	Superior Mesenteric Vein first approach to RCME: technique and preliminary outcomes	66
Total Number of Patients				365

*RRC: Robotic Right Colectomy; CME: Complete Mesocolic Excision; mCME: modified Complete Mesocolic Excision; CVL: Central Vascular Ligation; BTU group: Bottom to Up approach group; MTL group: Medial to Lateral approach group

Table 2: Patient Demographics.

Researcher	No. of patients (M/F)	Median Age (years)	Median BMI (kg/m ²)	ASA Score
Petz et al. [1]	20 (10/10)	69 (59-89)	27 (19-40)	NOT PROVIDED
Trastulli et al. [2]	20 (7/13)	66,7 (55-83)	23,3 (16,5- 28,1)	I (8) - II (8) III (4) - IV 0
Bae et al. [3]	43 (20/23)	66 (32-85)	22,9 (17,1 - 32)	I 35 - II 5 III 3 - IV 0
Ozben et al. [4]	37 (20/17)	64,4 (50,9 - 77,9)	26,8 (21,1 - 32,5)	I 8 - II 24 III 5 - IV 0
Yozgatli et al. [5]	35 (20/15)	65 (52-78)	29 (24-34)	median of 2
Spignolio et al. [6]	101 (57/44)	71,2 (60 - 83)	25,1 (21,1-29,1)	I 13 - II 40 III 38 - IV 10
Schulte am Esch et al. [7] BTU group	24 (7/17)	72,5 (64,6-83,4)	24,7 (21,1-28,3)	I 3 - II 11 III 10 - IV 0
Schulte am Esch et al. [8] MTL group	7 (2/5)	78,1 (69,3-86,9)	28 (23,6-32,4)	I 0 - II 3 III 4 - IV 0
Hamzaoglu et al. [9]	12 (8/4)	64,8 (49,9-79,7)	25,6 (21,9-29,3)	I 2 - II 8 III 2 - IV 0
Yang et al. [10]	66 (35/31)	63(54-73)	28 (24,5-31,5)	NOT PROVIDED

Table 3: Oncologic details of patients.

Researcher	No. of patients	Tumor site			Median Specimen length (cm)	Median Number of harvested lymph nodes	Stage				
		Cecum	Ascending colon	Hepatic flexure			0	I	II	III	IV
Petz et al. [1]	20	6	7	7	40 (26-66)	40 (19-67)	cT1 (3) – cT2 (6) – cT3 (11)				
Trastulli et al. [2]	20	6	9	5	32,7 (26-44)	17,6 (14-21)	-	3	5	10	2
Bae et al. [3]	43	12	29	2	35 (9-113)	29 (6 -157)	1	9	15	15	3
Ozben et al. [4]	37	15	11	11	34,1 (24,4 - 43,8)	41,8 (29,9-53,7)	-	6	16	11	3
Yozgatli et al. [5]	35	24		11	34,1 (17,8-52,4)	41 (29-53)	2	5	13	12	3
Spignolio et al. [6]	101	29	49	23	35,2 (21-70)	28,2 (13-66)	-	21	38	37	4
Schulte am Esch et al. [7] BTU group	24	NO INFORMATION PROVIDED			NO INFORMATION PROVIDED	38 (14-86)	T1(2) -T2(2) -T3(12) -T4(1)				
Schulte am Esch et al. [8] MTL group	7	NO INFORMATION PROVIDED			NO INFORMATION PROVIDED	12 (9-30)	T1(1)- T2(2) - T3(2) - T4(2)				
Hamzaoglu et al. [9]	12	0	6	6	37,8 (27,9 - 47,7)	43 (31-62)	-	2	6	4	-
Yang et al. [10]	66	38	12	10	31 (23-40)	32 (25-40)	-	10	21	27	8

Most common complications were ileus, surgical site infection and post-operative bleeding which not required transfusion (Table 6).

In one of the less biased studies presenting a series of 66 patients, Yang et al. [10] proposed that as most complications arise from injuries in the SMV or its branches, if the surgeon was to begin the

dissection from the SMV he would ideally create a better surgical field (SMV-first approach). Patients were mainly of stage II (21/66, 31.8%) and III (27/66, 40.9%). Utterly though the blood loss was in average 33 ml, comparable to that referred in literature, where 50 ml is the average rate. Only one patient required conversion, as quoted due to “advanced nature of his tumor”. Median number of harvested lymph

Table 4: Clinical features of post-operative period.

Researcher	No. of patients	Mean time to peristalsis (days)	Mean time to resume liquid diet (days)	Mean length of hospital stay (days)
Petz et al. [1]	20	NO INFORMATION	2 (1-4)	6 (4-9)
Trastulli et al. [2]	20	1,5 (1-3)	1,7 (1-3)	4,5 (3,5-7)
Bae et al. [3]	43	3 (1 - 16)	4 (1 - 16)	8 (4-48)
Ozben et al. [4]	37	2,9 (1-4,8)	3,4 (1,1-5,7)	6,6 (2,9 - 10,3)
Yozgatli et al. [5]	35	3 (2-4)		6 (3-9)
Spignolio et al. [6]	101	1,9 (1-7)	1,3 (1-9)	7,9 (4-37)
Schulte am Esch et al. [7] BTU group	24	1,4 (0,3-2,5)	NO INFORMATION	10,7 (8,4-13,3)
Schulte am Esch et al. [8] MTL group	7	0,6 (+/-1) ?	NO INFORMATION	11,6 (7,9-15,3)
Hamzaoglu et al. [9]	12	3,8 (1,6-6)	3,7 (1,5-5,9)	7,6 (2,9-12,3)
Yang et al. [10]	66	NO INFORMATION	NO INFORMATION	2 (2-3)

Table 5: Operation times and complications.

Researcher	No. of patients	Mean overall operative time (min)	Intra-operative blood loss	Intra-operative morbidity	Post-operative 30day complications	Conversion	Mortality
Petz et al. [1]	20	249 (194-330)*	Negligible (median 50 ml)	0	2 Grade IIIa	0	0
Trastulli et al. [2]	20	327,5 (255-485)	Negligible (median 50 ml)	0	1 Grade I	0	0
Bae et al. [3]	43	293 (180 - 644)*	Negligible (median 50 ml)	0	3 Grade I 5 Grade II 2 Grade IIIA 1 Grade IIIB 6 Grade II	0	9
Ozben et al. [4]	37	289,8 (204,5 - 375,1)	negligible (median 77 ml)	2	1 Grade III 1 Grade IV 5 Grade I	1	0
Yozgatli et al. [5]	35	NO INFORMATION	negligible (median 77 ml)	2	4 Grade II 1 Grade V	0	0
Spignolio et al. [6]	101	279 (135-540)	negligible (median 77 ml)	0	24 Grade II 4 Grade IV	0	1
Schulte am Esch et al. [7] BTU group	24	283 (195,1-370,9)	NO INFORMATION	0	7 Grade I 1 Grade II	0	0
Schulte am Esch et al. [8] MTL group	7	287,5 (242,5-332,5)	NO INFORMATION	0	2 Grade I 1 Grade II	0	0
Hamzaoglu et al. [9]	12	312.1 (218,2-406)	100 ml (50-300)	2	1 Grade II 1 Grade IV	0	0
Yang et al. [10]	66	196 (172-240)*	Negligible (median 33 ml)	0	1 Grade I 2 Grade II 2 Grade III	1	0
	Total 365		Total number of complications 78		19 Grade I 46 Grade II 6 Grade III 6 Grade IV 1 Grade V	2	10

*these data refer to MEDIAN not mean operating time

nodes was 32, and all resections were R0. Reoperation was conducted in two patients, the first one to resolve a bowel obstruction and the second to control postoperative bleeding.

Overall survival & disease-free survival

Modified Complete Mesocolic Excision (mCME) as described by Bae et al. [3] refers to a lymphadenectomy following the basic principles of CME, as to dissect the feeding vessels at its origins – standard D3 lymphadenectomy-, although depending on tumor location. More specifically Bae et al. [3] routinely preserved the middle colic vessel, unless the tumor was located in the hepatic flexure or beyond. They presented a series of 43 patients most of them suffering by ascending colon cancer (29/43).

Oncologic short-term outcomes were like others with R0 resections and eight tumors (18.6%) showing lymphovascular invasion. Bae et al. presented, by exception to the rest, also a follow-

up of the patients for 55 months, during which mean OS rate was 93.6%, the median DFS was 38 months, and the DFS was 81.1%. Seven patients (16.3%) had recurrence after surgery. Five systemic recurrences (11.6%) developed in the liver, left ovary, paraaortic lymph node, and peritoneum, respectively, and two local recurrences (4.7%) developed in upper boarder and anterior surface of pancreas, respectively.

Oncologic outcomes of LRC VS RRC with CME

The biggest series of patients studied after RCME so far was presented by Spinoglio et al. [6,7], in a prospective research that took place since 2005 until 2015. 202 patients were included in the study, half of whom underwent RRC with CME. The aim was to compare oncologic outcomes of RRC to those of LRC. The robotic group included 21 patients of stage I, 38 of stage II, 37 of stage III and 4 of stage IV. In average 28.2 (13 to 66) lymph nodes were harvested,

Table 6: Post-operative complications.

Researcher	Approach	Overall Complications number n(%)	Post-operative hemorrhage	Surgical site infection	Ileus	Pulmonary complications	Urinary Tract Infections	Other
Petz et al. [1]	Suprapubic RRC and CME	2 (10%)	2 (10%)	-	-	-	-	-
Trastulli et al. [2]	RRC with CME	1 (5%)	-	1 (5%)	-	-	-	-
Bae et al. [3]	Robotic mCME and CVL	11 (2.6%)	-	-	2 (4.7%)	2 (4.7%)	-	2 complications Calvien Dindo I NR Cirrhotic ascities 1 (2.3%) Chyle leakage 2 (4.7%) Intra-abdominal abscess 1 (2.3%) Anastomotic Leakage 1 (2.3%)
Ozben et al. [4]	RCME	8 (2.16%)	1 (2.7%)	2 (5.4%)	1 (2.7%)	2 (5.4%)	-	Pulmonary Embolism 1 (2.7%) Intra-abdominal abscess 1 (2.7%)
Yozgatli et al. [5]	RCME	10 (2.9%)	1 (3%)	4 (11%)	2 (5%)	2 (5%)	-	Pulmonary Embolism 1 (3%) Wound dehiscence 1 (3%)
Spignolio et al. [6]	RRC with CME	28 (27.7%)	5 (17.9%)	5 (17.9%)	0 (35.8%)	4 (14.3%)	1 (3.6%)	Arrythmia 2 (7.2%) Anastomotic Leakage 1 (3.6%)
Schulte am Esch et al. [7]	Suprapubic BTU CME	9 (37.5%)	-	2 (8.3%)	-	3 (12.5%)	1 (4.4%)	Anemia 1 (4.4%) Lymphatic fistula 1 (4.4%) Incisional hernia 1 (4.4%)
Schulte am Esch et al. [8]	Suprapubic MTL CME	2 (28.6%)	-	-	-	-	-	Anemia 1 (4.3%) Incisional hernia 1 (4.3%)
Hamzaoglu et al. [9]	RCME short-term outcomes	2 (16.6%)	-	-	1 (8.3%)	-	-	Pulmonary Embolism 1 (8.3%)
Yang et al. [10]	SMV-First RRC and CME	5 (7.6%)	1 (1.5%)	-	2 (3%)	-	-	Cardiac complications 2 (3%)
Total number of patients (356)		Total 78 (21.4%)	10 (2.7%)	14 (3.8%)	18 (4.9%)	13 (3.56%)	2 (0.55%)	22 (6.03%)

*NR: Not required

although there was no reference regarding the resection margins. In the early post-operative period 24 patients (23.8%) presented a complication of Dindo grade I-II, with most common the prolonged postoperative ileus, while 4 (3.9%) Dindo grade III-IV, with two of them requiring reoperation, one due to anastomotic leakage and the second due to massive hemoperitoneum because of injury of the right branch of middle colic artery. One patient died within the first 30 post-operative days.

As this is one of the three studies in the entire literature to compare robotic to laparoscopic right colectomy with CME, we quote the results of the five year follow up; the OS was 77% and the DFS 85%, but not statistically significant difference was found between the robotic and the laparoscopic group (5-year OS of laparoscopic group 73%, p-value 0.64 and DFS 83%, p-value 0.58).

As the utility and safety of CME was being established by various writers, researchers began to wonder if the surgical approach was significant to the oncologic result of the patient's morbidity. Herein, Schulte am Esch et al. [8] conducted a study of 31 patients undergoing RRC with CME, and in 24 of them a Bottom-To-Up (BTU) approach was carried out in contrast to the rest 7, where the "classical" Medial-To-Lateral (MTL) was performed. We present the results of the two series separately in all given tables. Type I and II complications and surgical characteristics including OR-time were comparable between

the two groups. However, the lymph node yield was superior in the BTU-group (mean 40.2 ± 17.1) when compared with the MTL-group ($16.3 \text{ nodes} \pm 8.5$; $p < 0.001$).

A different approach was presented by Hamzaoglu et al. [9] in 2018. Researchers proposed a top-down-no touch technique of RRC and CME, in a series of 66 patients. His team despite the excessive operating time (345 min, range of 180 min to 420 min) managed to harvest in average 43 (median rate) lymph nodes (range of 23 to 66), comparable to the rest researchers, and all surgical margins clear of malignant cells. No conversions occurred and postoperative complications occurred in 2 patients (17%), one ileus and another case of pulmonary embolism.

In conclusion, all authors agree that RCME is a feasible and oncologically safe procedure in the treatment of right sided colon cancer. The number of harvested lymph nodes although causally linked with the extend of the colectomy, cannot be considered a reliable index of the oncological safety. As expected, more radical excisions provide a wider node yield of up to 60 or even more nodes. Conversions are not a common complication, in contrast to post-operative bleeding, which in most cases is a result of the right branch of middle colic artery of branches of the SMV. Operating time varies, depending the surgeon's education and experience, and postoperative complications are mainly minor (Clavien Dindo I or II).

Appendix: Clavien Dindo Classification of post-operative complications²²

Grades	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic or radiological intervention
- IIIa	Intervention not under general anesthesia
- IIIb	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications) requiring IC/ICU-management
- IVa	single organ dysfunction (including dialysis)
- IVb	Multiorgan dysfunction
Grade V	Death of a patient

Discussion

As minimally invasive surgery techniques have permeated in everyday practice, the aims for better aesthetic results, less complications and post-operative morbidity and safer oncologic outcomes are getting higher. Herein robotics has gained their place among first-line treatments and in some cases even standardized procedures.

Despite this intrusion of robotics in surgery, robotic assisted colectomies remain unpopular mainly due to the lack of evidence based in large series of patients and, as authors imply, due to inability of the so far used robotic system dVSi to perform multiquadrant procedures. The lack of benefit, in addition to the increased operating times and cost remain the Achilles' heel of robotic colon surgery. Researchers have settled their hopes to the new dVXi as the new asset in the field of robotic colectomies within the next decades [11].

Main concern in the evolution from open to minimally invasive colectomies remains the oncological safety. This parameter is reflected on the negative resection margins, as well as in the number of lymph nodes that accompany the specimen. A lymphadenectomy is considered adequate when the specimen is accompanied by at least 12 nodes. This minimum number ensures an accurate pathological staging and has proved to result in better OS and DFS [12].

Complete Mesocolic Excision (CME) with Central Vascular Ligation (CVL) was first described by Hohenberg et al. [13] in 2009 as the procedure ensuring a more standardized radical resection for colon cancer. In strict terms CME is the resection of the tumor by sharp dissection of the visceral plane from the parietal fascia layer, along with the entire regional mesocolon in an intact package [14]. This more radical approach has led to higher degrees of lymphadenectomy, resulting in fewer local recurrences and better long-term survival rates [15,16].

Several studies have proven the superiority of RC (Right Colectomy) with CME over the classical RC with a D2 lymphadenectomy. However, in terms of open, laparoscopic or robotic surgery, there are no clear data determining the prevailing one. A recent meta-analysis compared LRC (Laparoscopic Right

Colectomy) to ORC (Open Right Colectomy) in which no difference in short-term mortality was shown (Odds Ratio (OR) =2.16 (0.73, 6.41); p=0.16), with no statistically significant difference in overall survival [HR=0.85 (0.69, 1.06); p=0.15], disease free survival, local recurrence and distant metastases. Therefore, researchers established the non-inferiority of the laparoscopic method, thus not altering the gold standard, which remains the open procedure [17].

Taking under consideration the fact that all robotic excisions were characterized as R0 resections, as well as the superabundant number of harvested lymph nodes – always more than 12- it is safe to comment that RRC with CME is oncologically equivalent to the open and the laparoscopic procedure. As far as the complications rate although, apart from the undoubted better cosmetic outcome of the minimally invasive surgery, there are no current studies comparing open to robotic RC. The only comparisons made, concern the laparoscopic equivalent. In a meta-analysis by Ma et al. depicted the rate of overall complications in the RRC group appeared significantly lower than that in the LRC group (OR=0.73; 95% CI: 0.52 to 1.01; P=0.05), suggesting a prompt superiority of the robotics' safety [18].

Furthermore, a matter not to be overlooked is that all robotic procedures, demonstrate a significantly higher learning curve than the previous open and laparoscopic ones. Cost-effectiveness studies are yet to take place, as we currently lack of long-term follow ups for the robotic group.

As described above, several approaches have been proposed, each in the purpose of diminishing the intra-operative complications and enhance surgeon's ability to more radically extract the specimen as quickly as possible.

In the "classical" medial to lateral approach the extent of dissection has been modified, to involve not only the colon and its mesocolon, but also the entire mesenteric root and the duodenum with the pancreatic head to facilitate safe access to the origin of the vascular supply [13]. In an alternative version, the superior mesenteric vein first approach was proposed by Yang et al. [10] where a transverse curvilinear incision is made along the inferior aspect of the ileocolic vessels to identify the SMV. Then, the surgeon performs the dissection along the anterior SMV plane in full accordance to the

CME principles.

New versions of CME include the bottom to up suprapubic approach, in which as described by Petz et al. [1] the mesenteric root is detached with a bottom-to-up approach from Gerota's fascia and the visceral peritoneum is incised along the axis of the superior mesenteric vessels.

Another proposal is the top down no-touch approach in which the omental bursa is entered to identify the right gastroepiploic vein. Exposing the vessel and using it as a landmark, the gastrocolic trunk is identified and prepared, branches of this trunk and the middle colic vessels are divided. Following, the surgeon proceeds to the ileocolic region and begins dissection in an inferior-to-superior direction along the superior mesenteric vein to divide the ileocolic and right colic vessels consecutively [9].

Utterly, the target of every approach is to eliminate peri-operative complications, especially bleeding. As mentioned above, most cases of bleeding occur due to handling of the SMV and its branches especially the jejunal one. Each surgical approach presented claims to offer an advantage over the identification or safer exposure of this vessel. To this direction, researchers also proposed the ultrasound-guided identification of SMV, using an intraoperative Doppler ultrasound device [19].

All these different treating options demonstrate various advantages and disadvantages. In the regard of similar complication rates of all approaches, authors of the current paper suggest that each surgeon proceeds in the approach they feel most familiar with, until further data are collected.

Point of conflict

Due to the encouraging oncologic outcomes resulting from various studies, the concept of CME has gained several grounds within the surgical community, although its necessity and efficacy remain open to interpretation.

More specifically in a pooled analysis conducted by Alhassan et al. in 2018, data of 14 studies that compared the traditional right colectomy to the CME were processed. As reported by the authors only three studies reported statistically significant higher disease-free or overall survival in favor of CME [20]. To add hurt to the insult, in an authors' reply in *Lancet Oncology* called: "The incomplete story or Complete Mesocolic Excision", Bertelsen et al. [21] questioned openly the metanalysis quoting that "The review cited by Dossa et al. included the same patients twice in the analysis, which questions the validity of its findings. In many studies, complete mesocolic excision is either not undertaken according to the definition by Hohenberger et al. or described at all."

Conclusion

To conclude, data concerning the CME remain controversial. Even more in the case of robotic CME, the published studies are seldom, and the number of patients studied limited. Therefore the need for larger scale studies and presentation of long-term outcomes is highlighted, in the direction of turning RCME into a standardized procedure for colon cancer.

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